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Table of contents

EBYTE Wireless Module Power Supply Reference Design 3

Preface 3

1. Power Supply Design Using Linear Regulator (LDO) Solution 3

2. Power Supply Design Using DC-DC Solution 4

3. Power Supply Design Using DC-DC + Linear Regulator (LDO) Solution 6

4. Summary 6

About Us 7

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EBYTE Wireless Module Power Supply Reference Design

Preface

This document introduces the power supply design reference applicable to EBYTE wireless modules, which users can adjust according to actual application scenarios. It mainly covers wireless transmission modules with power less than 27dBm (0.5W), 30dBm (1W), 33dBm (2W) and 37dBm (5W). The power supply voltages of these modules involve 3.3V, 5V and 5V～12V.

1. Power Supply Design Using Linear Regulator (LDO) Solution

A linear regulator (LDO) is used as a step-down device to supply power to the module. This design is applicable to scenarios where the module power is less than 30dBm (1W) and the voltage difference between the input voltage and the output voltage is small.

The circuit design of LDO is relatively simple. When choosing an LDO with a fixed output voltage, only filter capacitors need to be added to its periphery. The circuit design schematic diagram is shown in Figure 1.

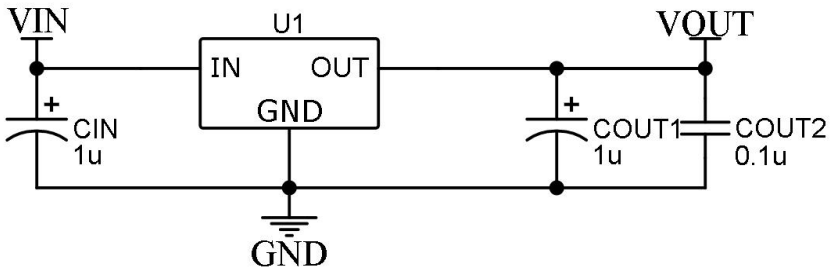


Figure 1 Schematic Diagram of LDO Circuit Design

Table 1 lists several common models.

Model	Input Voltage Range	Output Voltage	Output Current	Module Power
AMS1117-5.0	1.5V≤ (VIN - VOUT) ≤ 12V VINmax = 15V	5.0V	1A@(VIN - VOUT = 1.5V)	≤30dBm@(VIN - VOUT = 1.5V) ≤27dBm@(VIN -

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				VOUT ≥ 1.5V)
AMS1117-3.3	1.5V≤ (VIN - VOUT) ≤ 12V VINmax = 15V	3.3V	1A@(VIN - VOUT = 1.5V)	≤30dBm@(VIN - VOUT = 1.5V) ≤27dBm@(VIN - VOUT ≥ 1.5V)
LM1117IMPX-5.0	1.2V≤ (VIN - VOUT) ≤ 12V VINmax = 15V	5.0V	800mA@(VIN - VOUT = 1.2V)	≤30dBm@(VIN - VOUT = 1.2V) ≤27dBm@(VIN - VOUT ≥ 1.2V)
LM1117IMPX-3.3	1.2V≤ (VIN - VOUT) ≤ 12V VINmax = 15V	3.3V	800mA@(VIN - VOUT = 1.2V)	≤30dBm@(VIN - VOUT = 1.2V) ≤27dBm@(VIN - VOUT ≥ 1.2V)
L7805CV	7.5～35V	5.0V	1.5A	≤33dBm@(VIN ≤ 20V)
ADP151AUJZ-3.3	0.3V≤ (VIN - VOUT) ≤ 2.2V VINmax = 5.5V	3.3V	200mA	≤27dBm@(VIN - VOUT ≤ 2.2V)
LP5907MFX-3.3	0.5V≤ (VIN - VOUT) ≤ 2.2V VINmax = 5.5V	3.3V	200mA	≤27dBm@(VIN - VOUT ≤ 2.2V)

Due to the internal structural characteristics of LDO, the voltage difference between the input and output should be as small as possible when using LDO. The power consumption of LDO during operation is (Vin-Vout)×Iout. Due to the junction temperature limitation of packaging and manufacturing process, in most packages without additional heat sinks, to ensure that the LDO will not be damaged due to overheating, for applications with large voltage differences, it is recommended to use DC-DC step-down to supply power to the module.

2. Power Supply Design Using DC-DC Solution

DC-DC BUCK is a common and efficient step-down solution, which can achieve a very high input-output voltage difference. For high-power modules, using DC-DC step-down can provide a stable power supply for the module.

The figure shows a typical application diagram using the TPS54360BDDAR DC-DC chip. This DC-DC chip can provide 3.5A current for the output under the condition of a maximum 60V input.

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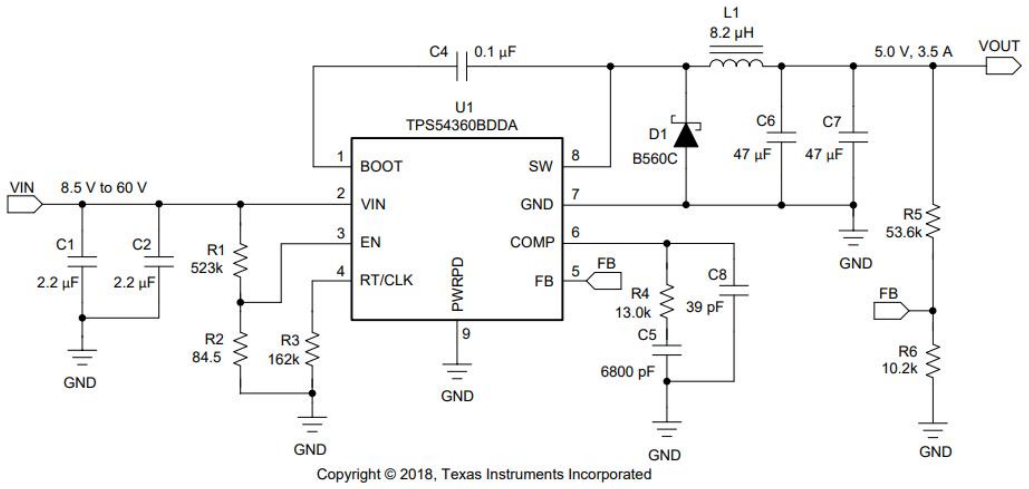


Figure 2 TPS54360 Design Reference for 5V Output

For modules with different power, different power supply voltages are required. Table 2 shows the reference values of devices under different output voltages.

Output Voltage	R5	R6	R4	C5	C8	L1	C4	Cin	Cout
3.3V	37.5K	12K	10.6K	8nF	50pF	8.2uH	0.1uF	2.2uF x2	47uF x2
5V	63K	12K	13K	6.8nF	39pF	8.2uH	0.1uF	2.2uF x2	47uF x2
8V	90K	10K	16.4K	5nF	32pF	8.2uH	0.1uF	2.2uF x2	47uF x2
12V	168K	12K	20K	5nF	25pF	8.2uH	0.1uF	2.2uF x2	47uF x2

In addition to TPS54360, there are many models available. Table 3 lists several models for selection.

Model	Input Voltage	Output Voltage	Maximum Output Current	Module Power
TPS5430DDAR	5.5V～36V	1.221V～32.04V	3A	37dBm@8～12V, ≤33dBm@5V, ≤33dBm@3.3V
TPS54331DR	3.5V～28V	0.8V～25V	3A	37dBm@8～12V, ≤33dBm@5V, ≤33dBm@3.3V
TPS563201DDCR	4.5V～17V	0.768V～7V	3A	37dBm@8～12V, ≤33dBm@5V, ≤33dBm@3.3V
TPS5450DDAR	5.5V～36V	1.221V～	5A	37dBm@8～12V, ≤33dBm@5V, ≤33dBm@3.3V

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		31.32V		
ME3103AM5G	2.5V～5.5V	0.6V～5.5V	1A	≤30dBm@3.3V
ME3104AM5G	2.5V～5.5V	0.6V～5.5V	2A	≤33dBm@3.3V
LM2576D2T-ADJR4G	7V～40V	1.23V～37V	3A	37dBm@8～12V, ≤33dBm@5V, ≤33dBm@3.3V

3. Power Supply Design Using DC-DC + Linear Regulator (LDO) Solution

For some low-power modules, if there is no external LNA inside, or the external LNA power supply does not use an independent LDO, their receiving performance is affected by the power supply, which is common in modules with a 3.3V power supply voltage.

When the system needs to use a higher voltage input, to achieve the best energy efficiency, DC-DC is usually used to step down the higher voltage to 5V or 3.3V to supply power to the module. Since the switching frequency of DC-DC will affect the radio frequency signal, to ensure that the module can achieve the best receiving performance, it is recommended to connect an LDO in series after the DC-DC output to supply power to the module.

4. Summary

① Linear regulator (LDO) is suitable for low-power modules, or can also be used for 30dBm (1W) modules under the condition of low voltage difference.

② DC-DC step-down is suitable for most modules and has high power conversion efficiency. Due to its switching characteristics, it may affect the receiving performance of some low-power modules.

③ The combination of DC-DC step-down + linear regulator (LDO) is suitable for applications where the power supply voltage is high, sensitive to power conversion efficiency, and the module used is 3.3V.

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