Product Application Note

Chengdu Ebyte Electronic Technology Co.,Ltd.

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EBYTE wireless module power supply reference design

preface

This article introduces the power supply design reference suitable for EBYTE wireless modules, which can be adjusted according to actual application scenarios. It mainly involves wireless transmission modules less than 27dBm (0.5W), 30dBm (1W), 33dBm (2W) and 37dBm (5W), and the power supply voltage of these modules involves 3.3V, 5V and 5V~12V.

1. Power supply design using a linear regulator (LDO) scheme

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

The circuit design of the LDO is relatively simple, selecting a fixed output voltage LDO with only a filter capacitor at the periphery, and the circuit design schematic is shown in Figure 1.

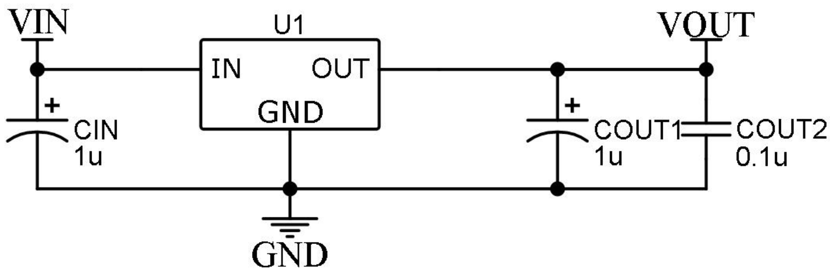

Figure 1 LDO circuit design schematic

Several common models are listed in Table 1.

Table 1 Common LDO recommendations

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 - 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 structure characteristics of the LDO, the voltage difference between input and output should be as small as possible when using the LDO, the power consumption of the LDO when working is (Vin-Vout) xIout, due to the junction temperature limitation of the package and the manufacturing process, in most of the packages without additional heat sinks, in order 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 to power the module after step-down.

2. Power supply design using a dc-to-dc scheme

DC-DC BUCK is a common and efficient step-down scheme, its input-output dropout can be high, for high-power modules, the use of DC-DC buck can provide a stable power supply to the module.

A typical application diagram using the TPS54360BDDAR DC-DC chip is shown. The DC-DC chip can deliver 3.5A to the output with an input of up to 60V.

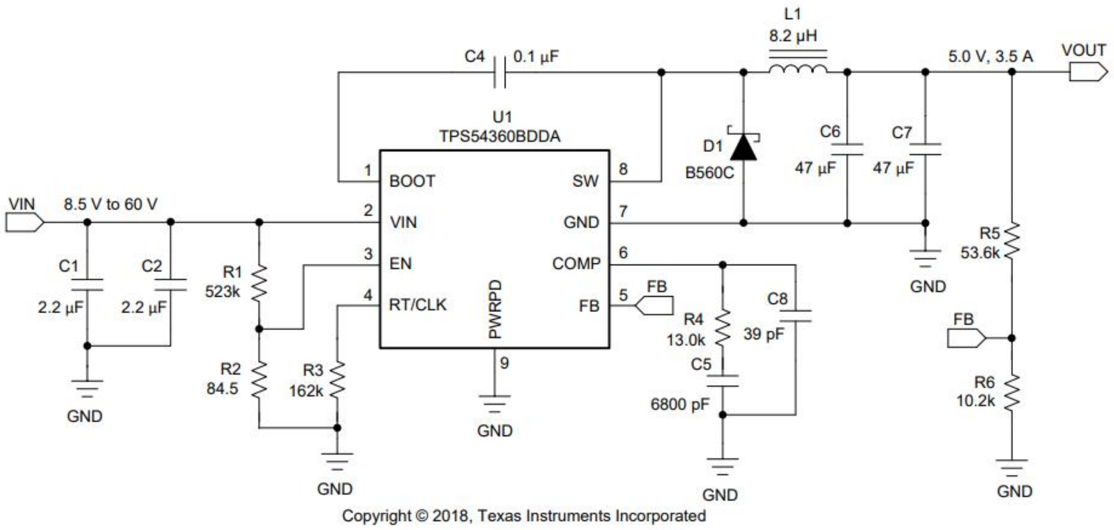

Figure 2 TPS54360 design reference for 5V output

For modules of different powers, different supply voltages are required, and Table 2 shows the large reference values for devices for different output voltages.

Table 2 Reference values for different output voltages

Output voltage	R5	R6	R4	C5	C8	L1	C4	Cin	Cost
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 the TPS54360, there are many models available, and Table 3 lists several models to choose from.

Table 3 Recommended and used power for other models

Model	Input voltage	Output voltage	Output current (max)	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~31.32V	5A	37dBm@8~12V、≤33dBm@5V、≤33dBm@3.3V
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 a DC-DC + linear regulator (LDO) scheme

For some small power modules, when there is no external LNA inside, or when the external LNA is not powered by only a separate LDO, its reception performance is affected by the power supply, which is common in modules with a supply voltage of 3.3V.

For optimal energy efficiency, DC-DC is typically used to step down higher voltages to 5V or 3.3V to power the module when the system requires increased voltage input. Since the switching frequency of the DC-DC affects the RF signal, in order to ensure that the module can achieve the best reception performance, it is recommended to connect the LDO in series after the DC-DC output to power the module.

4. summary

(1) Linear regulators (LDOs) are suitable for small power modules or 30dBm (1W) modules with low dropout voltages.

(2) DC-DC buck is used in most modules and has high power conversion efficiency, which may affect some small power mode fast reception performance due to its switching characteristics.

(3) The DC-DC buck + linear regulator (LDO) combination is suitable for applications with high supply voltages, sensitive to power conversion efficiency, and using a 3.3V module.

About us

Technical support: support@cdebyte.com
Thank you for using Ebyte products! Please contact us with any questions or suggestions: info@cdebyte.com
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Phone: +86 028-61399028
Address: B5 Mould Park, 199# Xiqu Ave, High-tech District, Sichuan, China

EBYTE Chengdu Ebyte Electronic Technology Co.,Ltd.