

Application Hits for Selection of Output Capacitor

1. Introduction

The voltage regulator of TH8061 is a low drop regulator (LDO) with a p-FET pass transistor.

This kind of regulator has a basic pole, which is caused from the internal frequency compensation. An additional pole is dependent from the load resistor and the load capacity. This additional pole caused in an instable behaviour of the regulator.

To compensate this pole it must be inserted a zero. This must be done via an external resistor in series with a load capacity. For this compensation it is used the equivalent series resistance (ESR) of the load capacity. This ESR resistor value is a characteristic of every real capacity and generates a zero within the loop amplification and therefore it compensates the impact of the negative phase shift.

The conclusion is that the regulator only shows stable behaviour within the defined limits for load resistance R_L and load capacity C_L including a valid ESR range. The range of load resistance is defined by the application and therefore the compensation can only be done via adjusting C_L and ESR.

2. Load Capacitor Selection

The regulator is stabilized by the output capacitor C_L . The TH8061 requires a minimum of $2.2\mu\text{F}$ capacitance on the 5V output. To insure stability, this capacitor should maintain its ESR in the stable region of the ESR curve (See Figure 1) over the full operating temperature range of the application. The output capacitor should have a good tolerance over temperature, voltage and frequency. The capacity and ESR value of some capacitor types are strong influenced from operating temperature and frequency. That means, these capacitor types decrease the capacity and increase the ESR with decreasing of the operating temperature.

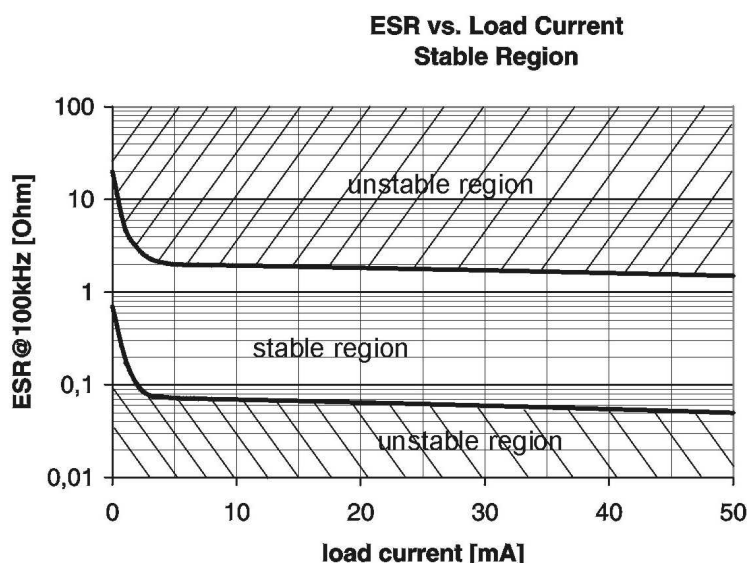


Figure 1 - ESR Curves for $6.8\mu\text{F} \leq C_L \leq 100\mu\text{F}$ and Frequency of 100kHz

The value and type of the output capacitor can be selected using the diagram shown in Figure 1.

The following two examples shows the effect of the stabilisation circuit using different values for the output capacitor.

Example 1:

The regulator is stabilized using an aluminum electrolytic capacitor of $47\mu\text{F}$ ($\text{ESR}=0.7\Omega$ @ 25°C). At $T_{\text{amb}}=-40^\circ\text{C}$ the capacitor value is decreased to $42\mu\text{F}$ and the ESR is increased to 8.9Ω . The ESR value is located in the instable region of Figure 1. The regulator will be instable at a temperature of $T_{\text{amb}}=-40^\circ\text{C}$.

Example 2:

The regulator is stabilized using a tantalum capacitor of $47\mu\text{F}$ ($\text{ESR}=0.1\Omega$ @ 25°C). At $T_{\text{amb}}=-40^\circ\text{C}$ the capacitor value is decreased to $45\mu\text{F}$ and the ESR is increased to 0.11Ω . The ESR value is located in the stable region of Figure 1. The regulator will remain stable at a temperature of $T_{\text{amb}}=-40^\circ\text{C}$.

Melexis recommends the using of tantalum capacitors as VCC load capacitor for stable behaviour of the TH8061-regulator. These types of capacitors shows a low change of the capacity and ESR value over the whole automotive temperature range and therefore it fits to the requirements for low drop regulators.

Your notes

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