
MCP1701 vs MCP1701A vs MCP1702

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INTRODUCTION

Since the initial release of the MCP1701 2 μ A Low Dropout Positive Voltage Regulator, Microchip Technology Inc. has been addressing customer requests for device enhancements. The customer requests for the MCP1701 enhancements were higher output currents, higher input operating voltage, and a reduction in output voltage overshoot at startup. These requests have been implemented in the newly released MCP1702 250 mA Low Quiescent Current LDO Regulator.

The original MCP1701 provided the designer with an LDO that was capable of 250 mA of output current at 5.0V with an input voltage of up to 10V. The 10V input operating voltage maximum gave designers a solution for voltages in the range of 6 to 10 volts, with the MCP1700 LDO being used for voltages up to 6.0 volts.

The MCP1701 was replaced by the MCP1701A. The MCP1701A device added another package option, the TO-92. Enhancements incorporated into the MCP1701A were improved transient response to load variations and lower dropout voltages.

The MCP1702 was developed to extend the range and performance of the MCP1701 line of regulators. The MCP1702 has several key enhancements, which make the device favorable compared to the MCP1701 and MCP1701A devices. The MCP1702 provides the following major enhancements over its predecessors:

- Thermal Protection
- Wider Input Operating Voltage 2.7V to 13.2V
- Output Current Rated Over Temperature:
 - -40°C to +125°C
- Stable with Ceramic, Tantalum, and Aluminum Electrolytic Capacitors
- Soft Start Implemented to Reduce Output Voltage Overshoot
- Added PSRR and Output Noise Parameters to Characteristics Table

OPERATION**Thermal Protection**

The MCP1702 thermal protection circuitry will shut-down the LDO if the internal junction temperature of the LDO rises above the typical threshold temperature of 150°C. The LDO will remain shutdown until the junction temperature has cooled to the typical turn-on junction temperature of 130°C. At that point, the LDO will turn back on. If the power dissipation is low enough, the device will continue to cool and operate normally. If the power dissipation remains high, the thermal shutdown protection circuitry will turn off the LDO again.

The MCP1701 and MCP1701A do not incorporate an active thermal protection circuit. Thus, the designer should limit the power dissipation of the device through good design practices.

**Wider Input Operating Voltage —
2.7V to 13.2V**

The MCP1702 device has an input operating voltage range of 2.7V to 13.2V over the entire operating temperature range. The MCP1701 and MCP1701A devices specify an upper operating voltage of 10V. The additional 3.2V of operating voltage headroom allow the MCP1702 device to be used with standard 12V supply voltages. The higher junction temperature ratings of the MCP1702 allows the device to supply more current at the higher input voltages. As an example, the MCP1702 5.0V regulator in a SOT-89 package can provide the full rated 250 mA of current with an input voltage of 12 volts at an ambient temperature of 34°C.

**Output Current Rated Overtemperature
-40°C to +125°C**

The MCP1702 now rates many of the device parameters over the extended temperature range of -40°C to +125°C. The following parameters are now rated over the entire operating temperature range:

- Input Operating Voltage (V_{IN})
- Input Quiescent Current (I_Q)
- Maximum Output Current (I_{OUT})
- Output Voltage Regulation (V_{OUT})
- Temperature Coefficient (TCV_{OUT})
- Line Regulation
- Load Regulation
- Dropout Voltage ($V_{DROPOUT}$)

Stable With Ceramic, Tantalum and Aluminum Electrolytic Capacitors

The MCP1702 allows use of Ceramic, Tantalum and Aluminum Electrolytic capacitors for the output capacitance. A minimum output capacitance of 1.0 μF is required for small signal stability in applications that have up to 250 mA output current capability. The ESR range of the capacitor may range from 0Ω to 2.0Ω .

The range and type of the input capacitor is not limited. A 1 μF ceramic input capacitor is typically sufficient to ensure circuit stability when the load is 100 mA or less.

Soft Start Implemented to Reduce Output Voltage Overshoot

A soft start was added to the MCP1702 design to reduce the output overshoot voltage seen during startup of the MCP1701 and MCP1701A devices. The soft start typically adds an additional 300 μs to 800 μs to the output delay time depending on load current. The total delay time from $V_{\text{IN}} = 6\text{V}$ to $V_{\text{OUT}} = 90\%$ of V_{R} is now represented on the data sheet as Output Delay Time. (T_{DELAY}). T_{DELAY} is the sum of the soft start delay and the output rise time delay (500 μs typical).

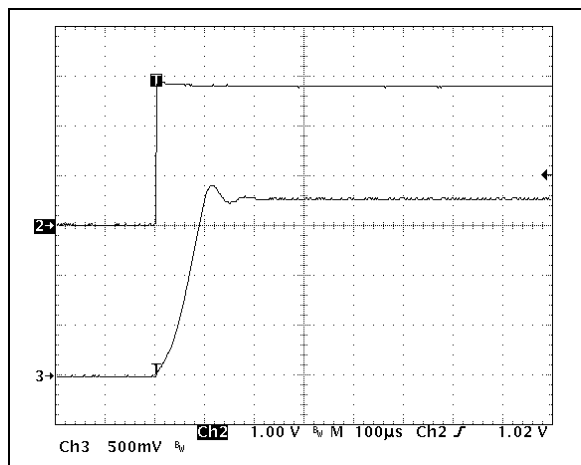


FIGURE 1: MCP1701 Power-Up Timing.

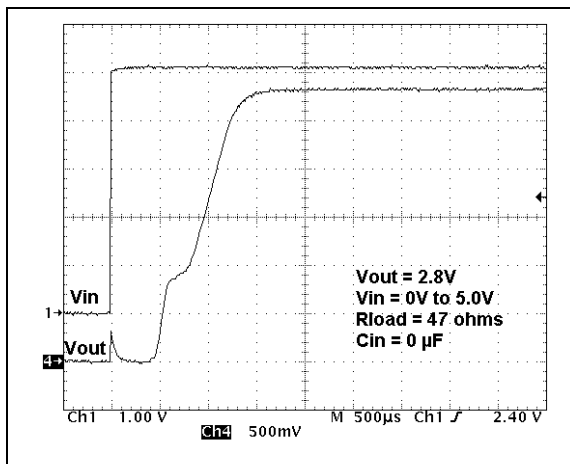


FIGURE 2: MCP1702 Power-Up Timing.

Added PSRR and Output Noise Parameters to Characteristics Table

Power Supply Ripple Rejection (PSRR) and Output Noise parameters have been added to the MCP1702 Characteristics table. These parameters give circuit designers information about the device that may help when the device is being designed into low noise circuit applications.

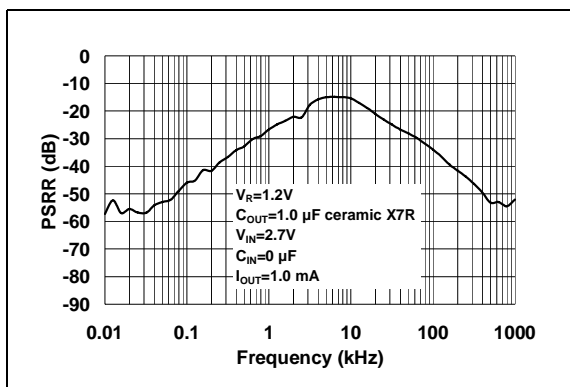


FIGURE 3: Power Supply Ripple Rejection vs Frequency.

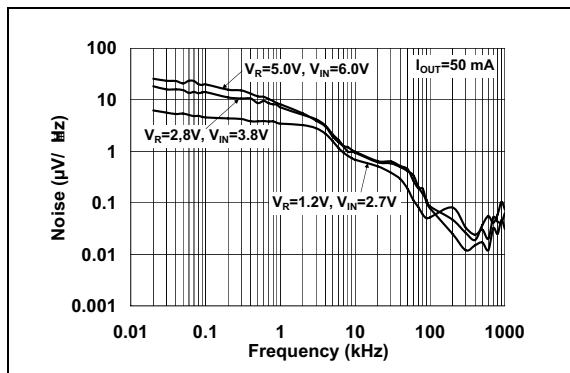


FIGURE 4: Output Noise vs Frequency.

SUMMARY

This technical brief has summarized the major enhancements of the MCP1702 over the MCP1701 and MCP1701A devices. The MCP1702 offers improved performance and thermal protection features that will allow for more robust application designs. The MCP1702 is pin for pin compatible with the MCP1701 and MCP1701A devices to allow for easy performance upgrades. The MCP1702 is also pin for pin compatible with the low voltage MCP1700 device, enabling users to upgrade to the MCP1702 device when supply voltages are between 6.0V and 13.2V.

REFERENCES

- MCP1701 data sheet, "2 μ A Low-Dropout Positive Voltage Regulator", DS21874, Microchip Technology Inc., 2005
- MCP1701A data sheet, "2 μ A Low-Dropout Positive Voltage Regulator", DS21991, Microchip Technology Inc., 2006
- MCP1702 data sheet, "250 mA Low Quiescent Current LDO Regulator", DS22008, Microchip Technology Inc., 2006

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