

Conference Paper

Reference Voltage Supply Source with Expanded Operating Temperature Range

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Abstract

The circuit of reference voltage surface with enhanced operation temperature range was developed. The operating temperature range was enlarged by a current source connected to output terminal of the regular output of LM4050 voltage regulator.

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1. Introduction

Modern integrated circuits are divided into several classes, each characterized by a specific operating temperature range. Permissible operating temperature of an apparatus is in the range from -600°N to $+1250^{\circ}\text{N}$. This temperature range is considered to be the widest at the present time. The temperature can reach to absolute zero in the conditions of space and the upper atmosphere. As a result, we observe functional and parametric failures. Heating is difficult in these conditions as it requires additional energy. Moreover, the electronic devices with an extended temperature range can be useful in the electronics of research physical installation, such as particle accelerators. The integrated circuits of reference voltage sources are widely used in analog components of electronic equipment for space and scientific applications. At present different temperature control devices and systems are developed for qualification tests of the integrated circuits in wide range of temperatures. Since electrical parameters of integrated circuits (ICs) depend on operation temperature, the devices [1, 2] for temperature control and monitoring are usually used during radiation test experiments. In our case, we didn't use the devices because the temperature dependence of electrical parameters for our devices under test is not significant.

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2. Materials and Methods

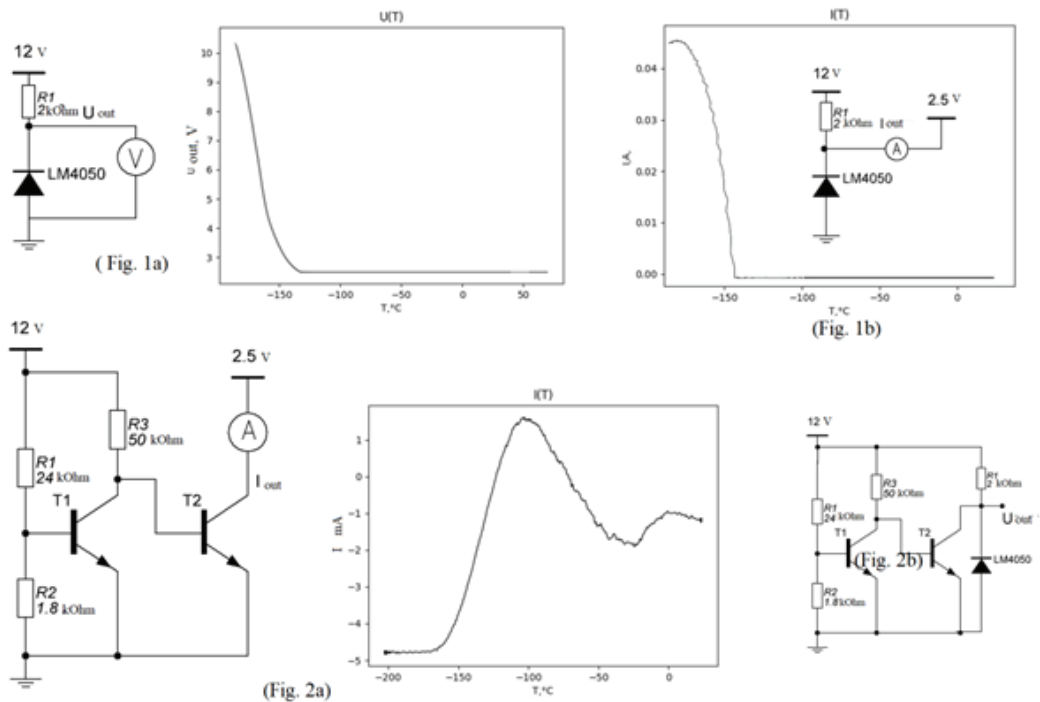
In this work, we select LM4050 reference voltage source as the object of our research. The dependence of the output voltage of LM4050 on the temperature was measured and presented in Figure 1(a) together with electrical circuit, which was used in the experiment. NI PXI-4071 digital multimeter was used for voltage measurements. The measurements and corresponding numerical processing with obtained results were performed in LabView. The output voltage rises sharply at low temperatures. The dependence of the output current at a fixed output voltage was measured to correct the obtained temperature dependence. The circuit diagram of the measuring equipment and results of the measurements are shown in Figure 1(b). The figure shows when lowering temperature below threshold value a sharp raise of an output current occurs. To hold the output voltage of the circuit (Figure 1(a)) at fixed level, it is necessary to connect a current source, which activates only at low temperatures to the output terminal of the voltage source. This compensates the output current jump and keeps the output voltage at a constant level.

3. Results

The developed circuit of the current source for connection to the output of the initial circuit is shown in Figure 2(a) together with the measured temperature dependence of the output current. The circuit of the reference voltage source obtained by connecting a compensating current source (Figure 2(a)) to the output of the initial circuit (Figure 1), which is able to operate in the extended temperature range is presented in Figure 2(b).

4. Conclusions

The prototype of the reference voltage source was developed on the basis of the integrated microcircuit LM4050. The improved reference voltage source has an extended operating temperature range and can be used in the electronic equipment for aerospace and scientific applications.



References

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