

使用運算放大器及二極體來實現電流峰值偵測器

Realization of the Current Peak Detector Using an OPA and a Diode

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摘要

本文提出一個可偵測電流峰值的電路。此電路只需用一個運算放大器、一個二極體及少數被動元件所組成之電路。本電路所需之元件數目少，功率消耗低，並且可長時間維持電流之峰值。HSPICE 模擬結果也證實其理論分析。
關鍵詞：電流峰值偵測器，運算放大器

Abstract

This paper presents a prototype circuit that can detect the peak value of the current. The circuit just consists of an operational amplifier, a diode and four passive elements. The circuit is using few elements, dissipating little power and lasting the peak value for a period of time. The simulation result using HSPICE is given to verify the theoretical analysis.

Keywords: current peak detector, operational amplifier

I. INTRODUCTION

With the progress of the times, more and more electrical products have been widely used in their application field. The reason why these electrical products can be operating is due to the help of the Kirchoff's voltage and current laws. Viewing the products available in the market, they all operate in different voltage and current ranges. Besides, voltage and current values play a very important role in electrical products.

The most common damage to electrical products is when turning them on or off. That is due to the impact of surge voltage and surge current [1]. Consequently, measuring voltage signals and current signals clearly is the major things to be done. To know voltage signals and current signals well, their peak should be considered. Although peak detectors have been presented in many papers [2-3], most of them mentioned only voltage peak detectors [4]. (Fig. 1)

This paper presents a current peak detector with simple circuit architecture compared to the voltage peak detector in Fig. 1. Once input any kinds of current signals, the peaks are acquired by the circuit rapidly.

II. CIRCUIT DESCRIPTION

Operational amplifier:

The wide bandwidth dual JFET input operational am-

plifier (TL082) is used in the circuit design. The circuit symbol and its detailed characteristics are given in Fig. 2 and Table 1, respectively [5].

The detailed schematic of the wide bandwidth dual JFET input operational amplifier TL082 is shown in Fig. 3. The output impedance and open loop frequency response of TL082 are also given in Fig. 4 and Fig. 5, respectively.

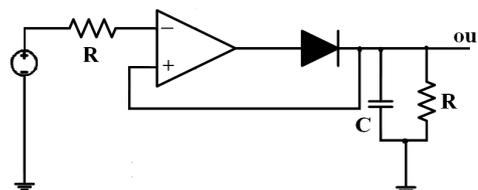


Fig. 1 Voltage peak detector

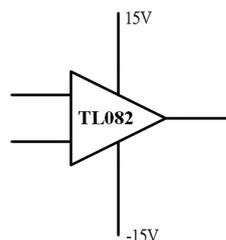


Fig. 2 TL082 symbol

Table 1 TL082 characteristics

Symbol	Parameter	Conditions	TL082			Units
			Min	Typ	Max	
	Amplifier to Amplifier Coupling	$T_A=25^\circ\text{C}$, $f=1\text{Hz}-20\text{kHz}$ (Input Referred)		-120		dB
SR	Slew Rate	$V_S=\pm 15\text{V}$, $T_A=25^\circ\text{C}$	8	13		V/ μs
GBW	Gain Bandwidth Voltage	$V_S=\pm 15\text{V}$, $T_A=25^\circ\text{C}$		4		MHz
e_n	Equivalent Input Noise Voltage	$T_A=25^\circ\text{C}$, $R_S=100\Omega$, $f=1000\text{Hz}$		25		nV/ $\sqrt{\text{Hz}}$
i_n	Equivalent Input Noise Current	$T_i=25^\circ\text{C}$, $f=1000\text{Hz}$		0.01		$\rho\text{A}/\sqrt{\text{Hz}}$
THD	Total Harmonic Distortion	$A_V=+10$, $R_L=10\text{k}$, $V_O=20\text{V}_{\text{P-P}}$, $\text{BW}=20\text{Hz}-20\text{kHz}$		<0.02		%

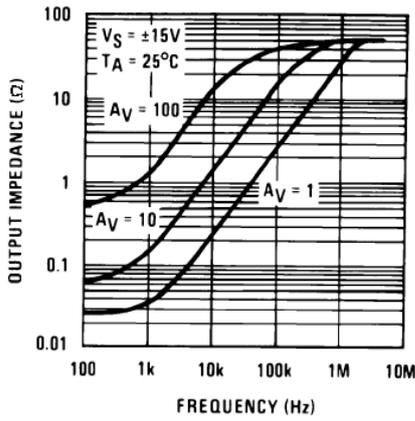


Fig. 4 Output impedance

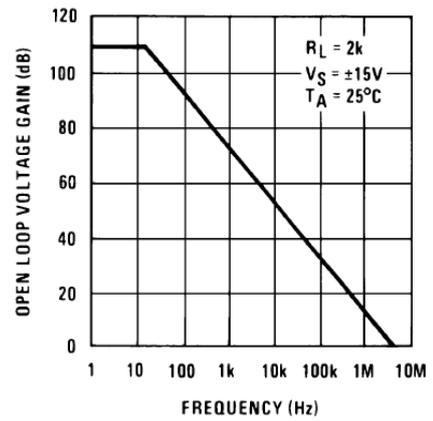


Fig. 5 Open loop frequency response

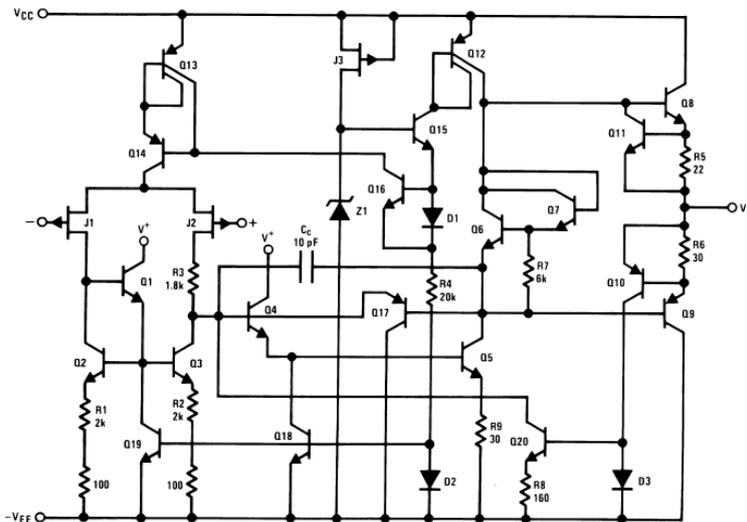


Fig. 3 Detailed schematic

Current peak detector:

The current peak detector consists of an operational amplifier, a diode and four passive elements, and the circuit is shown in Fig. 6.

In the proposed circuit, an inductance is used to hold the input peak current signal. The operational amplifier TL082 is used in the structure. If using ua741, the result of the structure will be worse than using TL082. That is due to their difference of the input DC bias currents. The maximum current of the peak detector is limited by the JFET operational amplifier TL082. The resistor r_1 should be very small to obtain the output current and the result can be distinct if using higher grade inductor.

III. SIMULATION AND EXPERIMENTAL RESULTS

The current peak detector is designed with the resistors, $r_1=50\text{ k}\Omega$, $r_2=1\text{ k}\Omega$, $r_3=2\text{ m}\Omega$ and a 10 mH inductor. The input current varies from 0s to 1ms. Fig. 7(a) shows the simulation result of the proposed current peak detector using TL082. Fig. 7(b) shows the simulation result of the proposed current peak detector using uA741.

Another simulation of current peak detector using TL082 with different input is shown in Fig. 8.

It is easy to see no matter what the input signal is, the circuit will show its current peak. There is no difference between the result of the implementation and the simulation due to the amplifier TL082.

IV. CONCLUSIONS

The current peak detector prototype is presented. It can be used on any electronic experiment. By using current peak detector, experimenter will easily know what elements should be used to meet the circuit design, so the conception of current peak detector is needed and presented in this work.

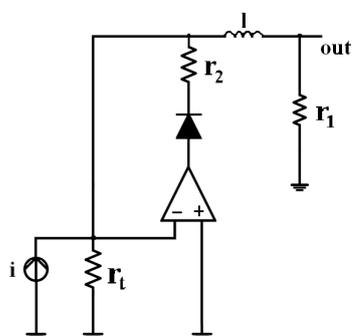
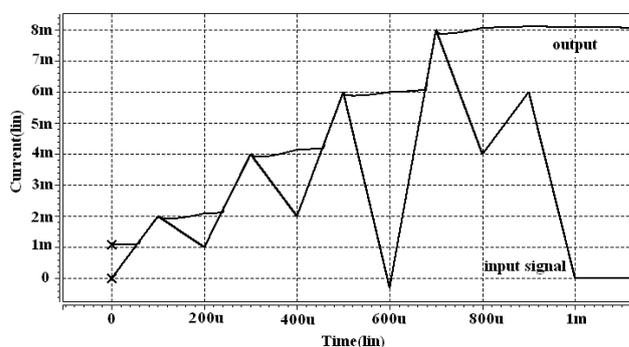


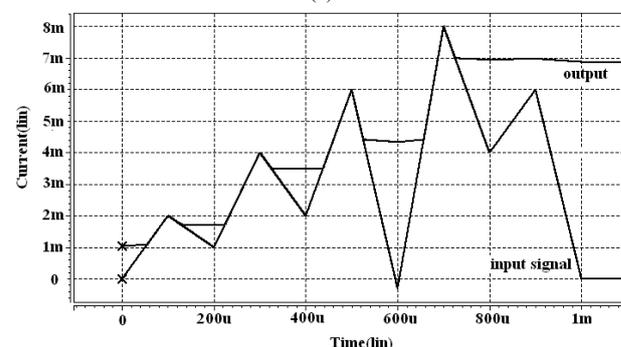
Fig. 6 Current peak detector

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(a)



(b)

Fig. 7 (a) Using TL082, (b) using uA741

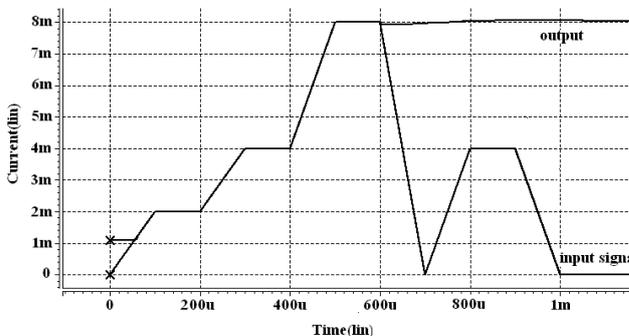


Fig. 8 Different input using TL082