

Design of the Tractor Driving Simulator Turn Signal Circuit

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Abstract. In order to improve authenticity and interactive of the tractor driving simulator system, mainly adopts double polarity 555 chip design for tractor driving simulator of turn signal circuit. Then specify bipolar 555 chip unsteady work mode setting method and principle ,and gives the tractor simulator turn signal circuit connection method.Using the method of tractor simulator turn signal circuit has simple structure, low price, etc. After the computer simulation, the result shows that output waveform of square wave signals, flicker frequency is 84 times/min, meet the design requirements.

Introduction

With the development of virtual reality technology and human-computer interaction, virtual driving simulator is more and more get the attention of people. In our cars, planes, ships and other driving simulator with high level and breakthrough[1,2,3], but development and lacking in tractor driving simulator. The respect is designed in a turn, some of the driving simulator software is adopted to simulate, authenticity is not strong. If using the same as the real car tractor turn signal circuit or photoelectric relay, flasher electronic components[4,5], such as high cost and complex circuit. So this article adopted the 555 chip and LED and other related electronic components, design the tractor driving simulator turn signal circuit, improved the tractor driving simulator authenticity, interactivity and immersion, but also to ensure the stability and reliability of the circuit.

Bipolar 555 time base circuit in time sequence features

Bipolar 555 chips in a combination of digital and analog function scale integrated device[6]. 555 chip can be in the work of 5 v to 15 v supply voltage range, output drive current is about 200 ma, good compatibility with CMOS analog circuit, TTL or level. So a lot of application in the electronic control, electronic detection, instruments and meters, household appliances, and many other aspects. 555 chip, low cost, reliable performance, just outside a few appropriate of resistance and capacitance component[7], can constitute a generator, pulse generator, delay generator, square wave generator, monostable trigger generator, bistable multivibrator, unsteady multivibrator, etc. 555 timer is a analog - digital function combining the msi timing circuit. It has simple structure, flexible use, application is very extensive, use it only need to add a small amount of peripheral devices can constitute a variety of waveform generator, multivibrator, time delay circuit, bistable trigger circuit, alarm circuit, detection circuit, frequency conversion circuit, etc. 555 chip packaging as shown in figure 1.

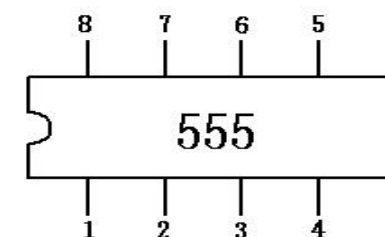


Figure 1 Package of 555 chip

Peripheral pin definition:

1. Gnd; 2.Trigger; 3.Out; 4.Reset; 5.Control; 6.Threshold; 7.Discharge; 8.Vcc

The internal equivalent circuit as shown in figure 2.

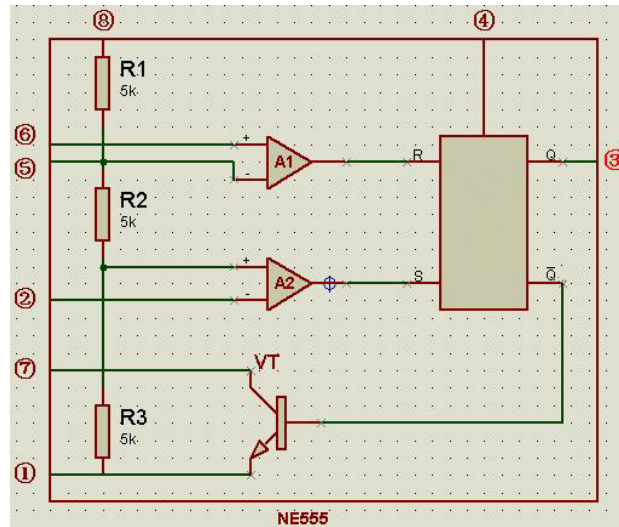


Figure 2 Equivalent circuit of 555 chip internal

The 555 chip is composed of two internal voltage comparator, 1 RS flip-flop, a discharge triode and 3 5 k ohm resistance. A1 and A2 are two high gain of the voltage comparator, their output respectively received RS flip-flop R and S. Where A1 called comparator, A2 is called the comparator, due to the resistance equal to R1, R2, R3, so potential for $2/3 V_{CC}$ pins 5, 6 pins for threshold input. Synthetic input comparator under A2, potential for a third V_{CC} , reverse the input (pin 2) as the input. The outputs of A1 and A2 are respectively connected to the RS flip-flop S setting (side), and R (reset), to control the level of the output pin 3 and discharge triode conduction and deadline.

Voltage divider is made up of three equivalent series resistance, V_{CC} is divided into three classes, the supply voltage comparator function is to provide two reference voltage U_{R1} , U_{R2} , if control end S dangling or by capacitance to ground is:

$$U_{R1} = \frac{2}{3}V_{CC} \quad U_{R2} = \frac{1}{3}V_{CC} \quad (1)$$

If S external voltage control end, then:

$$U_{R1} = U_S \quad U_{R2} = \frac{U_S}{2} \quad (2)$$

The comparator is composed of two structure of integrated operational amplifier A₁, A₂ is the same. A₁ U_{R1} used to compare the reference voltage and the voltage of the high level trigger UTH: when the $UTH > U_{R1}$, integrated operational amplifier A₁ output $U_{O1}=0$; When the $UTH < U_{R1}$, integrated op-amp output $U_{O1}=1$ A₁. A₂ to low level and the reference voltage U_{R2} trigger voltage of RTU:

When the $RTU > U_{R2}$, integrated op-amp A₂ output $U_{O2}=1$;

When the $RTU < U_{R2}$, integrated op-amp A₂ output $U_{O2}=0$.

555 chip truth table such as table 1:

Table 1 Truth table

Pin2	Pin3	Pin4	Pin6	Pin7
$\leq 1/3V_{CC}$	High	High	Any	Empty
$< 1/3V_{CC}$	Low	High	$\geq 2/3V_{CC}$	Low
$> 1/3V_{CC}$	Unchanged	High	$< 2/3V_{CC}$	Same as pin 3
Any	Low	Low	Any	Low

Simulator turn signal circuit design

This paper adopts double polarity 555 chip design for tractor simulator turn signal circuit, set 555 chip to unsteady triggers, also known as multivibrator, its output can be according to certain cycle transformation between "0" and "1", form a rectangular wave.

Working principle of the transient 555 chip

555 timer is also called time base circuit. 555 timer according to the internal components have bipolar type (TTL) and unipolar two kinds. Bipolar internal USES is the transistor; Unipolar internal is the field effect tube is used. According to the single chip 555 timer circuit includes the number of timer has single and double time base timer time base timer two kinds.

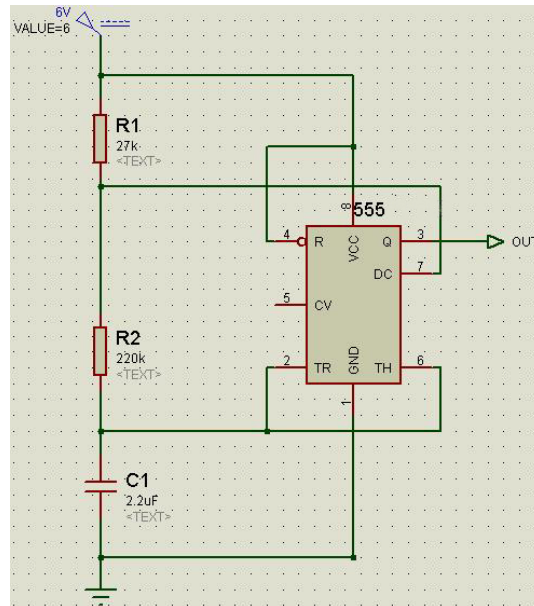


Figure 3 Unsteady connection method of 555 chip

As shown in figure 3, is a steady-state operation mode is one of the most commonly used connection mode, charge and discharge switch controlled by pin 7[8]. When the output is the logic "1", discharge tube triode VT cut-off, 1,7 pin disconnect ,pin 7 impeding, charging circuit to work, loop for Vcc, R1, R2 - C, the charging process to make potential rising, 2, 6 pin when the pin 6 potential rise to $2/3 V_{cc}$ output into a logic "0". When the output is logic "0", discharge triode VT conduction, 1, 7 pin nipple, discharge circuit to work, loop for C - R2-7 -, make the discharge process, decrease of 2, 6 pins potential when pin 2 potential drop to a third VCC, output into a logic "1".

The simulator turn signal circuit principle diagram

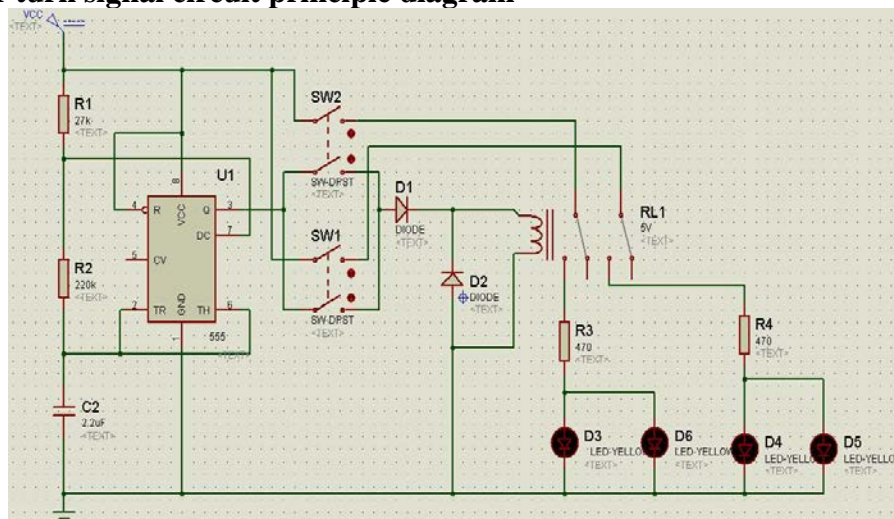


Figure 4 The tractor simulator steering circuit principle diagram

This tractor driving simulator using Proteus software for turn signal circuit principle diagram, the

simulator of the turn signal operation principle of operation is similar to that of a real car turn signal, and accompanied by steering "tick" sound. This circuit is mainly composed of 555 timer and relay, switch of two linkage. Use of two linked switch switch circuit because of this connection can work in need to relay, not to relay doesn't work, saves electricity and increase the service life of the relay. When close linkage switch SW1, because of the relay according to certain frequency or absorption, make the D4, D5 led flashing. When close linkage switch SW2, D3, D4 leds flashing. Its working principle is: the 555 timer is set to unsteady working mode, so the pin 3 form a regular pulse output, the pulse signal to activate the relay coil, and at a fixed time interval will relay is opened and closed. Is the purpose of the diode D1 to confirm only is from 555 timer output signal to the relay coil, as a flyback diodes D2, prevent the coil primary and secondary current into 555 timer, damages to the 555 timer. Calculation of 555 timer firing pulse signal and stop the launch time pulse signal by R1, R2, C1 to determine.

Transmitted pulse time T1

$$T_1 = 0.693 \times (R_1 + R_2) \times C_1 \quad (3)$$

Stop firing pulse time

$$T_2 = 0.693 \times R_1 \times C_1 \quad (4)$$

Oscillation frequency

$$f = \frac{1}{T_1 + T_2} \quad (5)$$

Square-wave cycle

$$T = T_1 + T_2 \quad (6)$$

The launch of the turn signal experimental pulse time of 0.38 s, stop sending pulse time is 0.35 s, oscillation frequency is 1.37 Hz, LED lights flashing cycle is 1.4 times per second.

System still need to multiple LED lighting so that the driver's intuitive, read the car quickly process the dynamic index. Unlike light, LED lighting power is larger, in the system USES the triode switch and function expansion flow provide the required power LED.

Drive circuit simulation

Shown in figure 4 tractor driving simulator power voltage is 12 v, 555 chip output signal frequency of 1.37 Hz, through the Proteus simulation software simulation, the oscilloscope display output voltage waveform diagram, as shown in figure 5 the oscilloscope.

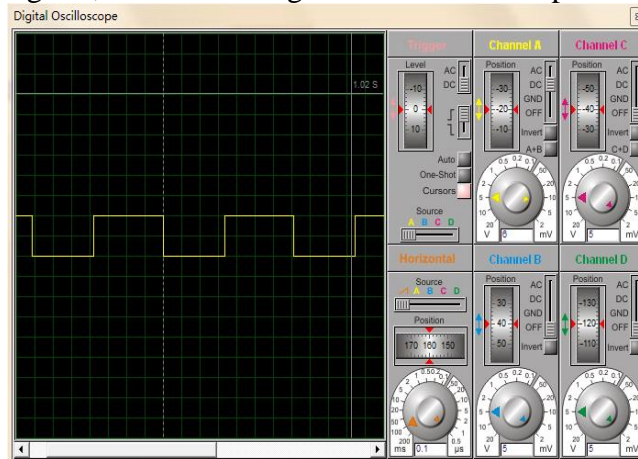


Figure 5 Oscilloscope

Can be got by figure 5, the output waveform for rectangular square wave signal, the frequency of 1.37 Hz, the output signal is stable, reliable and prove the validity of the proposed design scheme, and meets the design requirements of the tractor driving simulator turn signal.

Conclusion

Turn signal circuit, using the method of tractor simulator has simple circuit structure, low cost, long service life, good effect of the LED display, etc, and the operating tractors simulator,

accompanied by real vehicle steering "tick" sound, to improve the authenticity of the tractor driving simulator.

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