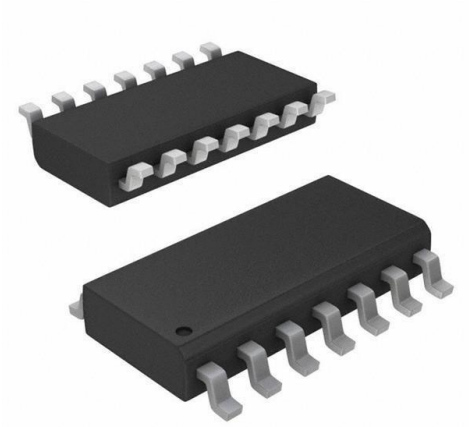
I. Overview

The integrated circuit SL2044 is applied to the automobile steering lamp circuit controlled by relays. With two independent output ports, SL2044 can control two relays separately. The left and right steering control input ends of the automobile need only very small control current, and a low power switch can be adopted as the steering control switch of the automobile. The independent failure warning signal input end simplifies the warning control switching circuit. If a bulb of the operating circuit breaks down when the steering lamp circuit works, the flicker frequency is increased doubly. Since SL2044 has extremely low quiescent current in the standby state, it can be connected directly to a battery.

II. Characteristics

- The flicker frequency has temperature and voltage compensation
- Extremely low quiescent current, ＜10uA (standby state)
- Doubled flicker for warning in condition of automobile lamp failure
- Power reverse polarity protection
- Double-relay driving output port, with great current-carrying capacity and low saturation voltage
- Three control input: left steering, right steering and failure warning
- Minimum automobile lamp bearing power: 1W
- Strong capacity in anti-electromagnetic interference
- RoHS



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III. Description in Pins

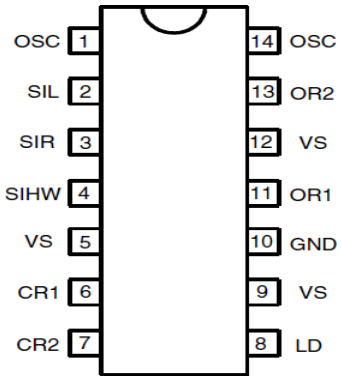


Figure 3-1 Drawing of pins of SL2044

PIN	Symbols	Description
1	OSC	Oscillator
2	SIL	Left steering lamp start-up input end
3	SIR	Right steering lamp start-up input end
4	SIHW	Alarm start-up input end
5	VS	Power input end
6	CR1	The control input end of the relay 1 of the left steering lamp
7	CR2	The control input end of the relay 2 of the right steering lamp
8	LD	Failure warning input end of the steering lamp
9	VS	Power supply end
10	GND	Reference ground end
11	OR1	The control end of the relay 1 of the left steering lamp
12	VS	Power input end
13	OR2	The control end of the relay 2 of the right steering lamp
14	OSC	Oscillator

IV. Typical Application Circuit Diagram and Internal Logic Block Diagram of SL2044

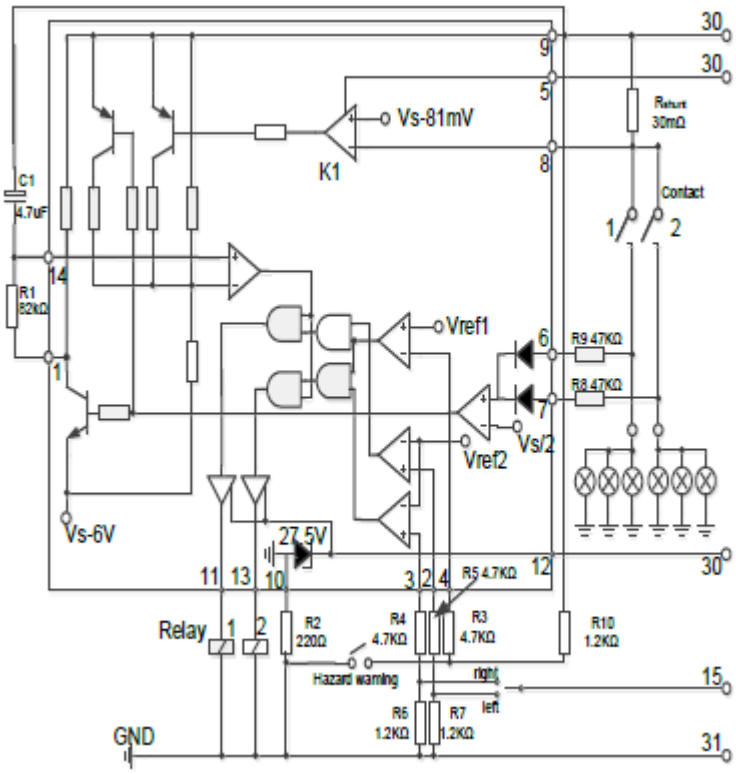


Figure 4-1 Typical application circuit and internal logic block diagram of SL2044

V. Descriptions of Pin Functions

5.1 Oscillator (pin 1 and pin 14)

The flicker frequency f_1 is determined by the oscillator composed by R_1C_1 (as shown in Figure 4-1), specifically as shown in Formula 5.1:

$$f_1 \approx \frac{1}{R_1 \times C_1 \times 1.5} Hz \qquad 5.1$$

In which $C_1 \leqslant 47\ \mu F$

$R_1 = 6.8k\ \Omega \sim 180k\ \Omega$

Where there is a failure in the bulb, the flicker frequency is doubled as f_2, $f_2 \approx 2.2 \times f_1$. In which the duty ratio of f_1 is 50%, and that of f_2 (lamp on) is 40%.

5.2The start-up input end of the left and the right steering lamps (pin 2 and pin 3)

When the input pin is grounded (the pull-down resistor R4 or resistor R5), the steering lamp does not work. When the steering switch of the steering lamp is closed, there are changes in the output state of the internal comparator of SL2044, and there is output on the output end of lead foot 11 and lead foot 13. R6 and R7 are protective resistors of the input end.

When the steering lamp switch breaks off, the quiescent current of SL2044 is only I＜15μA. If the voltage of the pull-down resistor is smaller than V≈ 6.9V, SL2044 is always in the standby state. The steering control circuit can work only when the ignition switch of the automobile turns on.

5.3Warning start-up input (pin 4)

In contrast to the steering switch input signal, the warning start-up input takes effect on the low level. When the warning switch turns on, the warning start-up input end is on the high level. When the warning switch turns off, the warning starts, and the left and right steering lamps flicker at the same time, take Formula 5.1 for reference of the flicker frequency. In which R3 is the protective resistance of the input end.

The start-up of the warning is not influenced by the state of the ignition switch.

5.4Power supply end (pin 5)

The supply input end, providing power supply for the comparator used for detecting the failure of the bulb in pin 8, which can be directly connected to an external battery.

5.5The control input end of relay 1 and relay 2 (pin 6 and pin 7)

The feedback input end of the working state of the steering lamps, which is also the enabling control end of the oscillator.

5.6The failure warning input end of the steering lamps (pin 8)

By composing a monitoring circuit with an external shunting resistance Rs and an internal comparator K1, SL2044 detects the current of the steering lamps; in which the reference voltage of the comparator K1 is 81mV, and the value of Rs can be calculated based on the following computational formula:

The rated current of a steering lamp with the power of 21W is (Vs=12V): I_{lamp1} =1.75A

The rated current of 2 steering lamps with the power of 21W is (Vs=12V): I_{lamp2} =3.5V

It is suggested to set the critical current as the median of two normal current values: I_{outage} ≈ 2.7A, and the shunting resistance is: Rs=81mV/2.7A=30mΩ.

The reference voltage value of the comparator K1 must be matched with the power of the bulb. The shunting resistance Rs and the resistance in the circuit prevent pin 8 from damages caused by high voltage in condition of bulb short circuit.

5.7Power supply end (pin 9)

The pin of the power supply end provides the oscillator, the comparator and the internal logic circuit with power supply.

5.8Reference ground end (pin 10)

The GND lead foot of SL2044 is grounded through resistance R2, to avoid damages to the internal circuit of the chip caused by jump signals. The protective circuit in the chip and the external resistances R2, R3, R4, R6, R8 and R9 work together, to prevent pulse signals from entering into the internal circuit of the chip directly. SL2044 is equipped with the reverse polarity protection function for the power supply.

5.9The control end of the relay of the steering lamps (pin 11 and pin 13)

There is a low-saturation voltage driving circuit at the control output end of the relay, which can drive a normal automobile relay with the coil resistance value of 60Ω.

5.10Power supply end (pin 12)

Power supply end The pin is connected with the power supply directly, to provide power supply for the driving circuit of the relay, and clamping is conducted internally through a 27V Zener diode.

VI. The Maximum Rated Ranges

Parameters	Symbols	Values	Units
Power voltage, 1 minute, pins 5, 9 and 12	Vs	24	V
Junction temperature	Tj	150	℃
Environment temperature	Tamb	-40 to +125	℃
Storage temperature	Tstg	-40 to +150	℃

VII. Electrical Characteristics

Table 7 Electrical characteristics of SL2044

The standard values in Table 7.1 are applicable to the typical application circuit in Figure 4-1 unless otherwise specified, in which Vs=12V, GND lead foot is connected to the ground, and Tamb=25℃.

Parameters	Testing conditions	Symbols	Min. value	Typical value	Max. value	Units
Power voltage	Pins5,9,12	Vs	8		18	V
Power current	Standby state Pins5,9,12	Is			15	uA
Relay output current	Pins11,13	Io			300	mA
Saturation voltage	RL=82Ω Vs=8V Vs=12V	Vo			1.0 1.2	V V
Reverse current of relay driving circuit	Pins 11，13	Io			0.1	mA
Relay coil resistance		R_L	60			Ω
Start-up delay	Lamp on for the first time	t_{on}			10	ms
Failure warning threshold voltage	Vs=9V Vs=13.5V Vs=16V	Vs Vs Vs		81 81 81		mV mV mV
Temperature coefficient of the failure warning threshold voltage	Vs=13.5V，pin8	Tk		10		uV/K
Clamping voltage	Tamb=-40℃ to 125℃	V_{12}	25.0	27.5	30.0	V
Threshold voltage of relay output over-voltage detection	Tamb=-40℃ to 125℃	V_{12}	18	20	22	V

VIII. Thermal Resistance

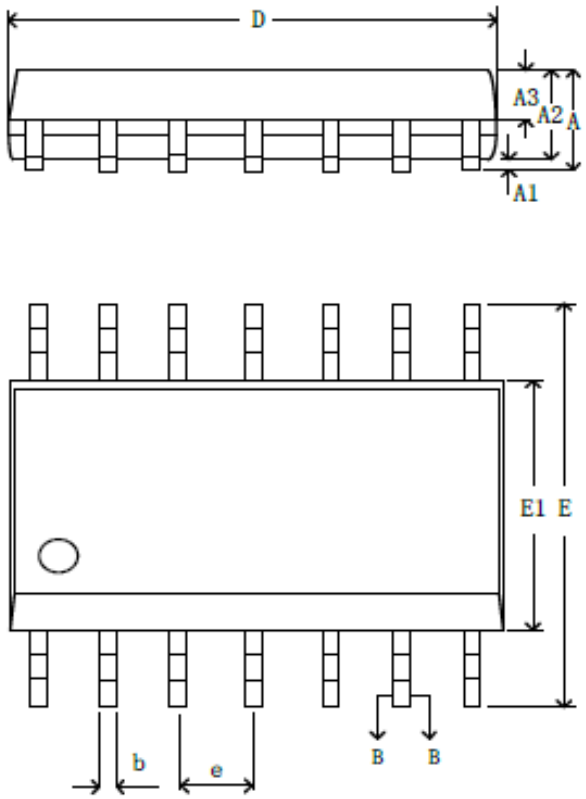
Parameters	Symbols	Values	Units
Junction temperature degree, SO14	RthJA	120	K/W

IX. Tolerance

Table 9.1 Tolerances
The tolerances shown in Table 9.1 are applicable to the typical application circuit in Figure 4-1 unless otherwise specified, in which Vs=12V, and the reference ground shall be connected to ground, and Tamb=25°C.

Parameters	Testing conditions	Symbols	Min. value	Typical value	Max. value	Units
Frequency modulation resitance		R_1	6.8		510	kΩ
Frequency modulation capacitance		C_1			47	uF
Frequency tolerance	Normal flicker frequency f_1, by taking no tolerance between R_1 and C_1 into consideration	△ f_1	-5		+5	%
Duty ratio (lamp on)	Basic frequency f_1 Doubled flicker frequency f_2	□f_1 □f_2	47 37		53 45	%
Frequency doubled	Lamp failure	f_2	2.15× f_1		2.3× f_1	Hz
Lamp load		P_L	1			W

SOP14 packaging dimension



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A			1.75
A1	0.05		0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39		0.48
b1	0.38	0.41	0.43
c	0.21		0.26
c1	0.19	0.20	0.21
D	8.45	8.65	8.85
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27 BSC		
h	0.25	—	0.50
L	0.50		0.80
L1	1.05 BSC		
θ	0	—	8°