



# ***FM2044***

## ***Dual Output Flasher***

**Specification**

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**May. 2008**

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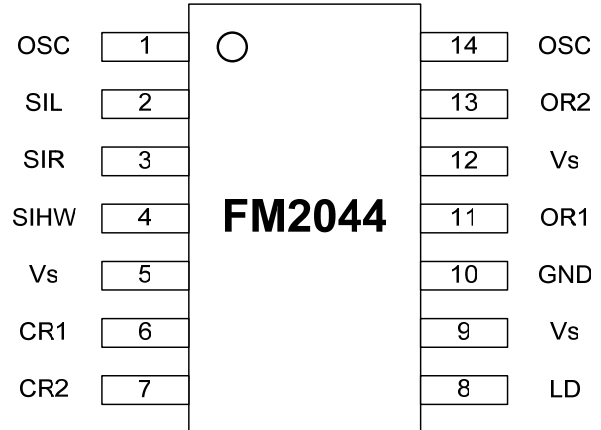
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## Description

The integrated circuit FM2044 is used in relay-controlled automotive flashers. With two output stages, each side of the vehicle is controlled separately. A left and a right direction indicator input with only a small control current makes switch contacts for small loads possible. The separate hazard warning input simplifies the construction of the hazard switch. Lamp outage is indicated by frequency doubling during direction mode. Thanks to extreme low current consumption the FM2044 can be directly connected to the battery.

## Pin Assignment



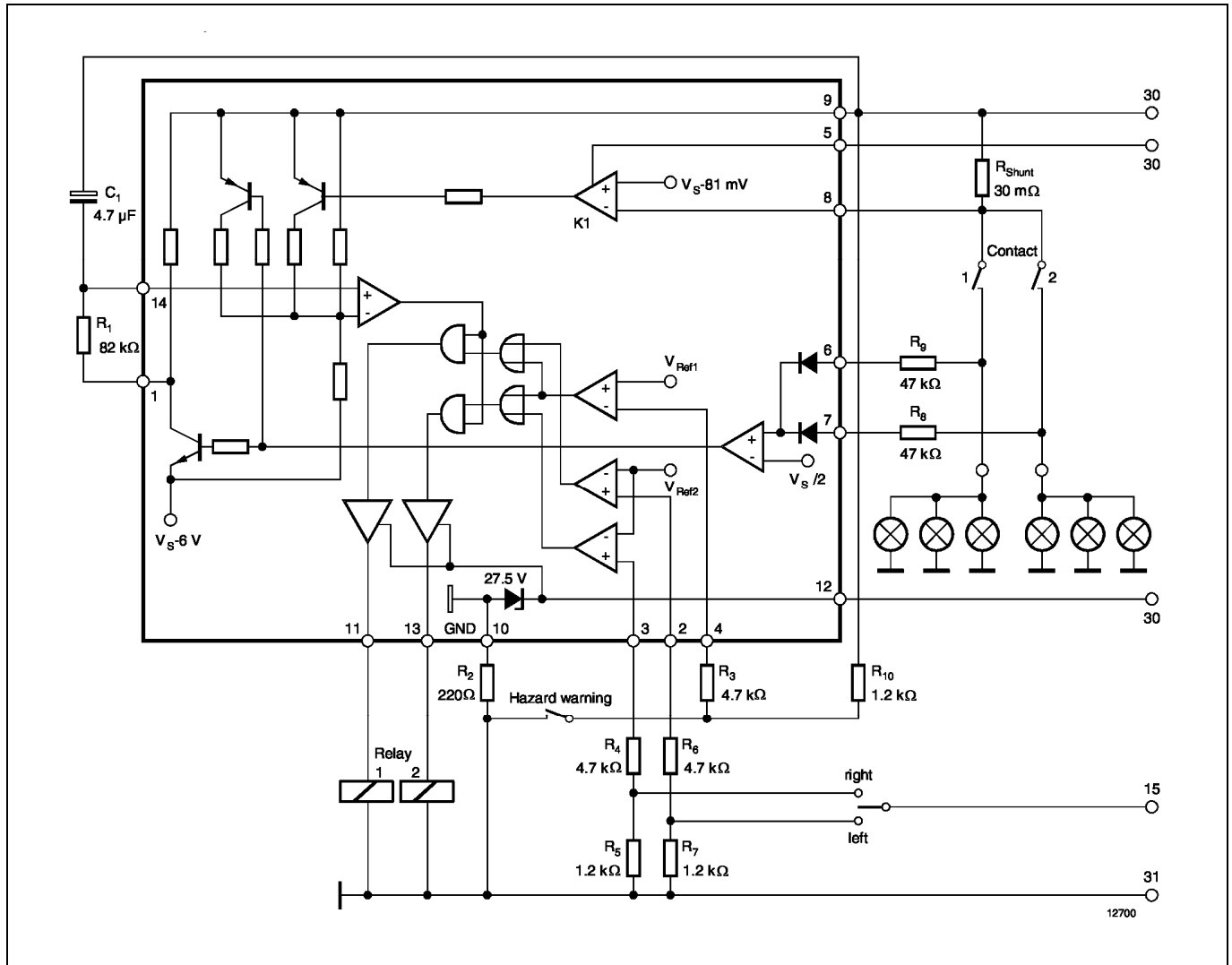
## Features

- Temperature and Supply Voltage Compensated Flashing Frequency
- Frequency Doubling Indicates Lamp Outage
- Two Relay Driver Outputs with High Current-carrying Capacity and Low Saturation Voltage
- Minimum Lamp Load for Flasher Operation:  $\geq 1\text{ W}$
- Very Low Susceptibility to EMI
- Protection According to ISO/TR7637/1 Level 4
- Extremely Low Current Consumption  $< 10\text{ }\mu\text{A}$  (with Switches Open)
- Reverse Polarity Protection
- Three Control Inputs: Left, Right and Hazard Warning

## Pin Function

Pin	Symbol	Function
1	OSC	Oscillator
2	SIL	Start input left
3	SIR	Start input right
4	SIHW	Start input hazard warning
5	V <sub>s</sub>	V <sub>s</sub>
6	CR1	Control input relay 1
7	CR2	Control input relay 2
8	LD	Lamp failure detection
9	V <sub>s</sub>	V <sub>s</sub>
10	GND	IC ground
11	OR1	Output relay 1
12	V <sub>s</sub>	V <sub>s</sub>
13	OR2	Output relay 2
14	OSC	Oscillator

Fiugre1. Block Diagram



## Function Description

### Oscillator (Pin 1 and 14)

Flashing frequency,  $f_1$ , is determined by the  $R_1C_1$  components as follows (see Figure 1):

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

Where  $C_1 \leq 47 \mu\text{F}$

$$R_1 = 6.8\text{K}\Omega \sim 180\text{K}\Omega$$

In the case of a lamp outage, the oscillator frequency is switched to the lamp outage frequency  $f_2$  with  $f_2 \approx 2.2 \times f_1$ .

Duty cycle in normal flashing mode: 50%

Duty cycle in lamp outage mode: 40% (bright phase)

### Start Input Right and Left (Pin 2 and 3)

Flashing is disabled as long as the input comparator is tied to GND (pull-down resistor  $R_7$  or  $R_5$ ). The high-side flasher switch left or right changes the comparator status and enables the output stage at pin 11 or Pin 13.  $R_6$  and  $R_4$  are protection resistors for the input stage.

With an open flasher switch the current consumption is only  $I < 10 \mu\text{A}$ . The IC is kept in stand-by mode until there is a voltage drop of  $V \approx 6.9 \text{ V}$  at the pull-down resistor.

Direction mode can only be activated when the ignition switch is in the ON-position as shown in Figure 1.

### Start Input Hazard Warning (Pin 4)

In contrast to the direction switches, the hazard input is a low-side type. The pull-up resistor  $R_{10}$  provides the off-state.  $R_3$  is a protection resistor for the input stage. Hazard warning can be activated independent of the ignition switch position.

### Supply Voltage Sense (Pin 5)

This pin supplies the lamp outage comparator at pin 8 and is externally connected to the battery (KI 30).

### Control Input Relay 1 and 2 (Pin 6 and 7)

The feedback detects the bright phase and the dark phase and enables the oscillator.

### Lamp Outage Detection (Pin 8)

The lamp current is monitored via an external shunt resistor,  $R_{\text{Shunt}}$  and an internal comparator,  $K_1$ , with its reference voltage of typically 81 mV ( $V_S = 12 \text{ V}$ ). The outage of one lamp out of two lamps is detected according to the following calculation:

Nominal current of 1 lamp:

$$21 \text{ W} / (V_S = 12 \text{ V}): I_{\text{lamp}} = 1.75 \text{ A}$$

Nominal current of 2 lamps:

$$2 \times 21 \text{ W} / (V_S = 12 \text{ V}): I_{\text{lamp}} = 3.5 \text{ A}$$

We recommend setting the detection threshold in the middle of the current range:  $I_{\text{outage}} \approx 2.7 \text{ A}$

Thus the shunt resistor is calculated as:

$$R_{\text{Shunt}} = V_T (K_1) / I_{\text{outage}}$$

$$R_{\text{Shunt}} = 81 \text{ mV} / 2.7 \text{ A} = 30 \text{ m}\Omega$$

Comparator  $K_1$ 's reference voltage is matched to the characteristics of filament lamps.

The combination of the shunt resistor and the resistance of the wire harness prevents pin 8 from a too high voltage in the case of shorted lamps.

### Supply Voltage (Pin 9)

This pin supplies the oscillator, the comparators and the logic parts of the IC.

### GND (Pin 10)

The integrated circuit is protected against transients according to ISO-TR 7637-3 level 3 via resistor  $R_2$  to ground (-31). An integrated protection circuit together with external resistors  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_6$ ,  $R_8$  and  $R_9$  limits the current pulses in the IC. The IC is also protected against reversed battery.

### Control Output Relay 1 and 2 (Pin 11 and 13)

The relay control outputs are high-side drivers with a low saturation voltage and capable of driving a typical automotive relay with a coil resistance of 60  $\Omega$ .

### Supply Voltage Power (Pin 12)

This pin supplies the relay drivers connected directly to the battery (KI 30). It is internally clamped by a 27-V Z-diode.

## Electronics characteristics

### Absolute Maximum Characteristics

Unless otherwise specified,  $T_A = 25^\circ\text{C}$

Parameter	Symbol	Value	Unit
Supply voltage	$V_S$	+24	V
Junction temperature	$T_j$	+150	$^\circ\text{C}$
Ambient temperature Range	$T_{amb}$	-40 ~ +100	$^\circ\text{C}$
Storage temperature Range	$T_{stg}$	-55 ~ +150	$^\circ\text{C}$

### DC Characteristics

Typical values under normal operation in application circuit Figure 1,  $V_S (+30) = 12\text{V}$ . Reference point ground (-31),  $T_A = 25^\circ\text{C}$ , Unless otherwise specified

Parameter	Test Condition	Symbol	Min	Typ	Max	Unit
Supply voltage range	Pin 5, 9, 12	$V_S$	8	9~15	18	V
Supply current, switches open	Pin 2,3 is tied to GND	$I_S$			10	$\mu\text{A}$
Saturation voltage	$R_2 = 82\Omega$ , $V_S = 12\text{V}$	$V_O$			1.2	V
Relay coil resistance		$R_L$	60			$\Omega$
Control signal threshold	$V_S = 12\text{V}$	$V_{cst}$	72.0	76.9	82.5	mV
Clamping voltage	$T_{amb} = -40^\circ\text{C} \sim +100^\circ\text{C}$	$V_k$	25	27.5	30	V
Relay output overvoltage detection	$T_{amb} = -40^\circ\text{C} \sim +100^\circ\text{C}$	$R_v$	18	20	23	V

### AC Characteristics

Typical values under normal operation in application circuit Figure 1,  $V_S (+30) = 12\text{V}$ . Reference point ground (-31),  $T_A = 25^\circ\text{C}$ , Unless otherwise specified

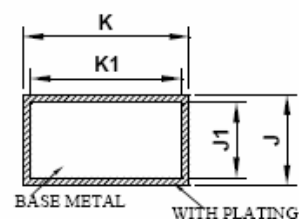
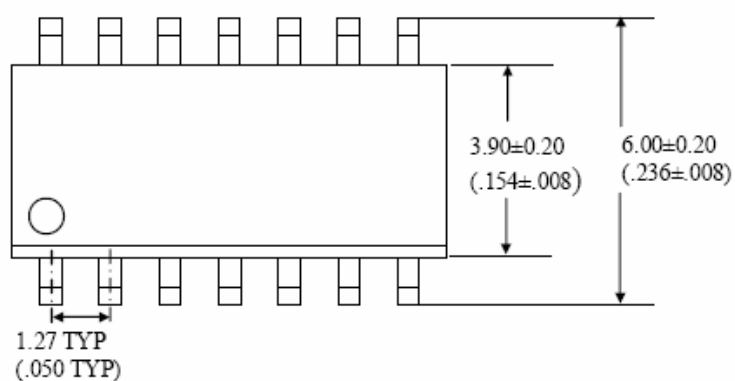
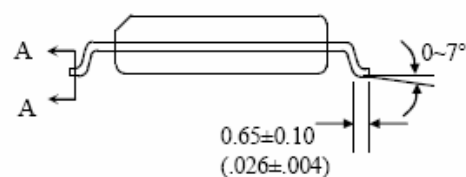
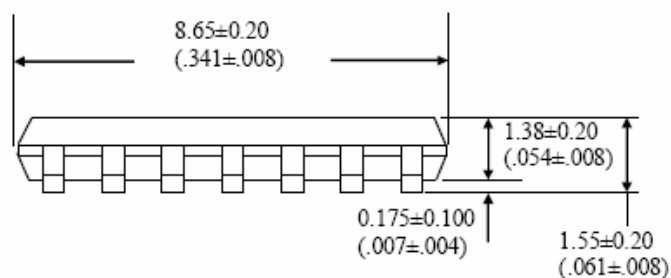
Parameter	Test Condition	Symbol	Min	Typ	Max	Unit
Frequency tolerance	Normal flashing, basic frequency $f_1$ , not including the tolerance of the external components $R_1$ and $C_1$	$\Delta f_1$	-5		+5	%
Bright period	Basic frequency $f_1$	$Df_1$	47		53	%
	Control frequency $f_2$	$Df_2$	37		45	%
Frequency increase	Lamp failure	$f_2$	$2.15 \times f_1$		$2.3 \times f_1$	Hz

## Ordering Information

Ordering Code	Package	Operation Range
FM2044-SO	SOP14	Industrial Temperature (-40℃ ~ +100℃)

## Package Information

### SOP14



SECTION A-A

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
J	0.178	0.278	.0070	.0109
J1	0.178	0.228	.0070	.0090
K	0.406	0.496	.0160	.0195
K1	0.406	0.456	.0160	.0180



## Revision History

Version	Publication date	Pages	Paragraph or Illustration	Revise Description
1.0	Oct. 2007	10		Initial Release.
1.1	May. 2008	10	Sales and service	Updated the address of HK office.



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