M5232L,FP

VOLTAGE DETECTOR/ON-OFF ALARM CIRCUIT

DESCRIPTION

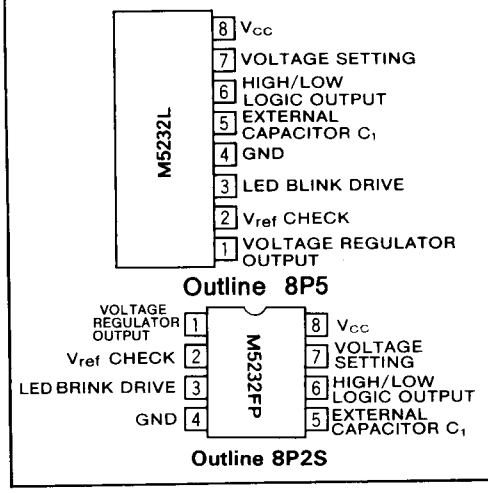
The M5232 is a unique semiconductor integrated circuit designed for use as a voltage detector/on-off alarm circuit.

Housed in a compact 8-pin SIP, the M5232L contains a comparator, reference voltage source, a vibrator circuit for turning the LED on and off, and a voltage regulation circuit. When the input voltage of the comparator at Pin ⑦ is higher than the internal reference voltage, the LED lights up, and when it is lower, the LED turns on and off. Also provided is an output pin (Pin ⑥) which does not operate intermittentlyk but permits a relay or micro buzzer to be driven while the LED is being turned on and off by Pin ③. Signals from a low voltage checker for batteries, or from optical or thermal sensors are detected at the input pin of the comparator (Pin ⑦) allowing the M5232L to be applied widely in the alarm and protection circuits of electronic equipment.

FEATURES

- Starting supply voltage at which the LED will blink can be set optionally by using external resistors R_1 and R_2 (in the case of a low voltage checker for batteries)
- LED on/off frequency can be set optionally with external capacitor C_1
- Buily-in logic output pin (Pin ⑥) causes a high-to-low level transition as soon as the blinking begins
- Hysteresis operation is possible at the blink starting voltage using Pin ⑥
- LED lights when the input voltage of the comparator at Pin ⑦ is higher than the internal reference voltage, permitting the M5232L to be used as a pilot lamp for power ON indication

PIN CONFIGURATION (TOP VIEW)



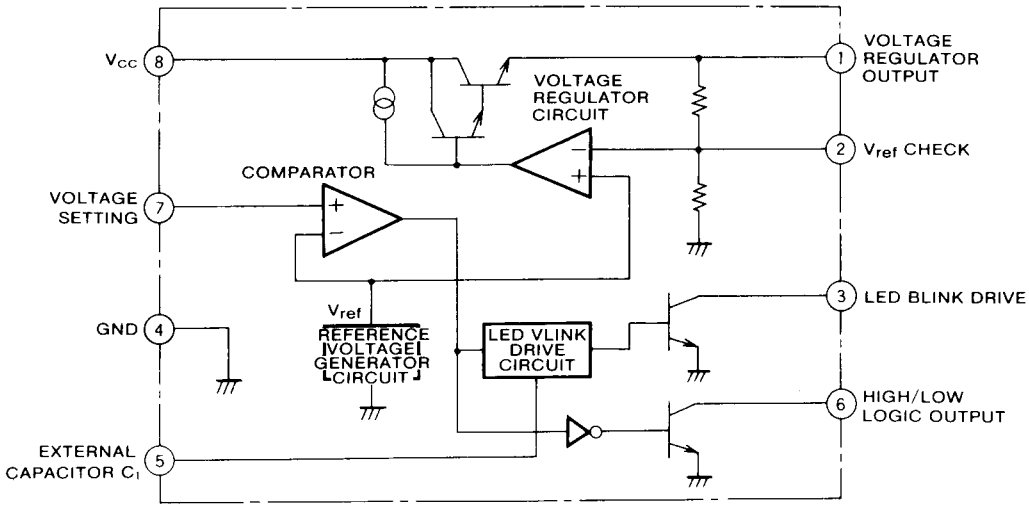
APPLICATION

Low voltage checker for batteries in equipment such as radio/cassette recorders, portable VCRs, cameras. Alarm and protection circuits of electronic equipment.

RECOMMENDED OPERATING CONDITION

Supply voltage range ····· V_{CC}=5~18V

BLOCK DIAGRAM



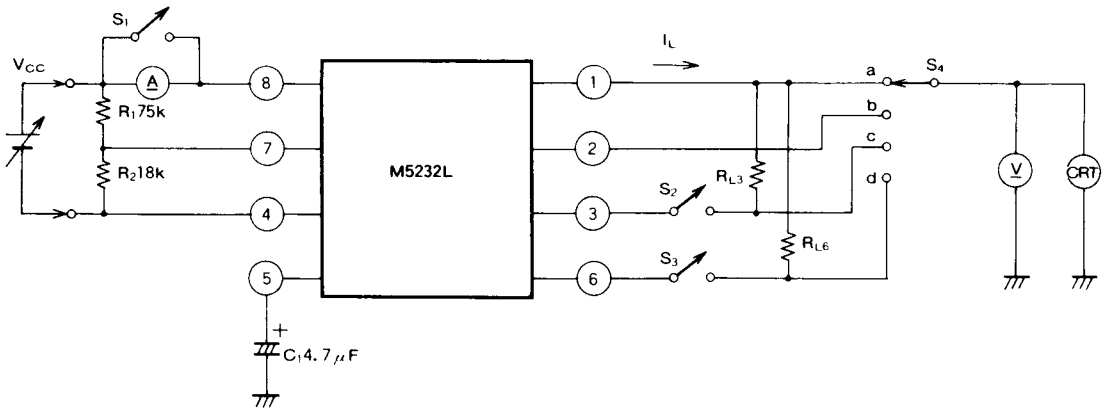
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		20	V
P_d	Power dissipation		800(L)/440(FP)	mW
I_{LP}	Load current		50	mA
K_θ	Thermal derating	$T_a \geqq 25$℃	8	mW/℃
T_{opr}	Operating temperature range		−20～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

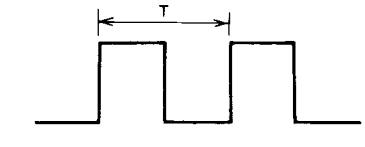
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	V_{CC}=9V, I_L=0		2.0	3.0	mA
V_2	Reference voltage	V_{CC}=9V, R_{L3}=400Ω	1.22	1.31	1.40	V
V_1	Output voltage	V_{CC}=9V, R_{L3}=400Ω	3.6	4.0	4.4	V
V_3	Saturation voltage	V_{CC}=9V, R_{L3}=400Ω		0.2	0.5	V
V_6	Saturation voltage	V_{CC}=6V, R_{L6}=400Ω		0.2	0.5	V
f	Oscillation frequency	V_{CC}=6V, C_1=4.7μF, R_{L3}=400Ω		1.8		Hz

TEST CIRCUIT



Parameter	V_{CC}	S_1	S_2	S_3	S_4
I_{CC}	9V	OFF	OFF	OFF	—
V_2	9V	ON	ON	OFF	b
V_1	9V	ON	ON	OFF	a
V_3	9V	ON	ON	OFF	c
V_6	6V	ON	OFF	ON	d
f	6V	ON	ON	OFF	c

☆ MEASUREMENT OF f ON CRT
PIN ③ WAVEFORM f=1/T (Hz)



(Duty cycle is approx. 50%)

MITSUBISHI ELECTRIC

VOLTAGE DETECTOR/ON-OFF ALARM CIRCUIT

1. Basic principle of M5232L operation

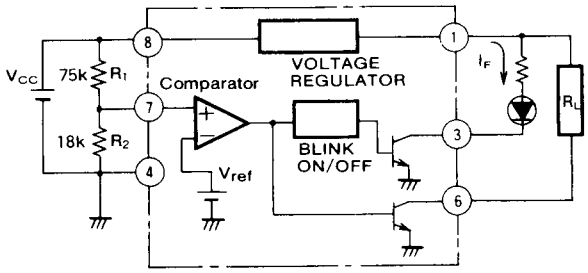
- When supply voltage V_{CC} is normal, the LED lights and functions as a pilot lamp. In this case, Pin ③ drives the LED with open-collector output.
- V_{CC} drops, becoming V_{CC1} and when the Pin ⑦ potential becomes

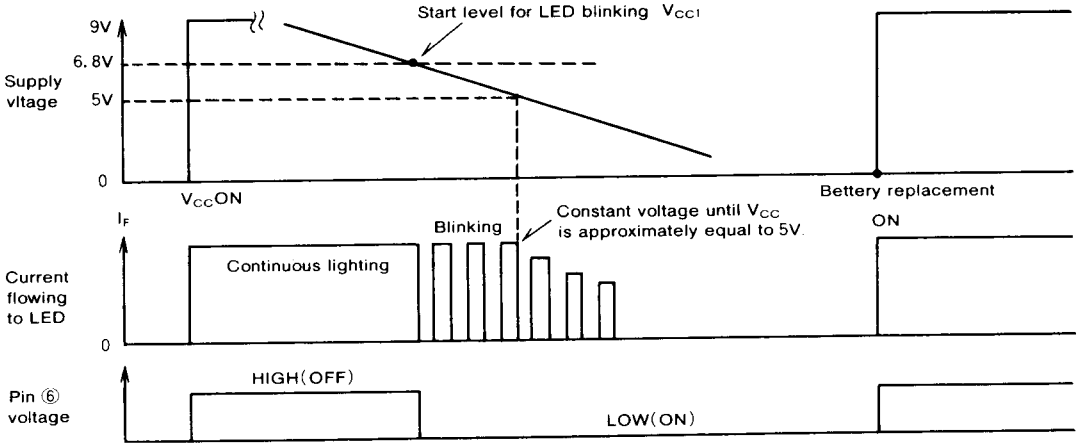
$$V_7=\frac{R}{R_1+R_2}\cdot V_{CC1}<V_{ref}$$

the comparator inverts, the blink curcuit is switched on, and the LED blinks on and off. (V_{ref}, produced by the internal reference voltage source, is 1.31V typ.)

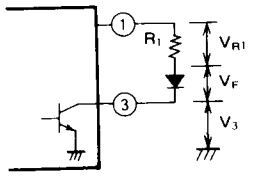
- The on/off alarm circuit shown on the right will activate when the voltage is 6.8V, which is 25% less than V_{CC}=9V (six 1.5V cells).
- Pin ⑥ is an open-collector output that causes a high-to-low level transition simulataneously with the Pin ③ on/off operation. A micro buzzer, relay or other load can be connected across this pin and Pin ① of V_{CC} (Pin ⑧) for a wide range of applications.

LOW VOLTAGE CHECKER FOR BATTERIES (SIMPLIFIED DIAGRAM)





2. LED Drive current I_F



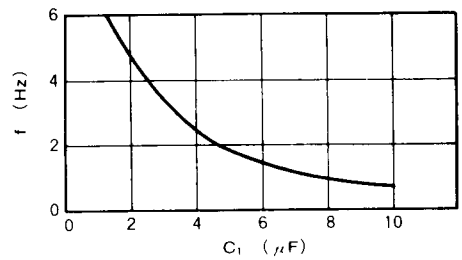
- Assuming that Pin ① output voltage is 4V, LED forward voltage is V_F, and V_3 is 0.2V, then

$$I_F=\frac{4V-0.2V-V_F}{R_1}$$

I_F is approximately equal to 4.6mA with V_F=2V, and R_1=390Ω (in a typical application circuit).

3. On/off oscillation frequency

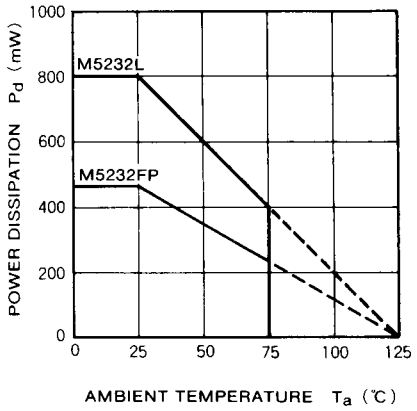
The on/off oscillation frequency can be varied by changing the value of external capacitor C_1.



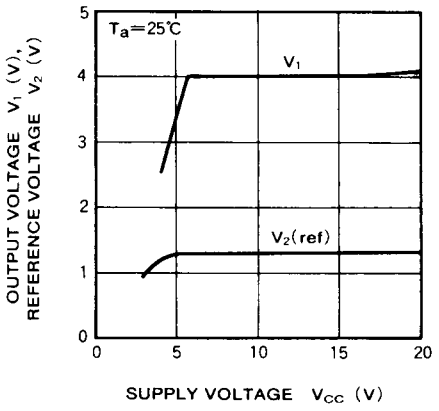
*If capacitance C_1 is even further reduced oscillation will be possible up to a frequency of about 10 kHz

TYPICAL CHARACTERISTICS

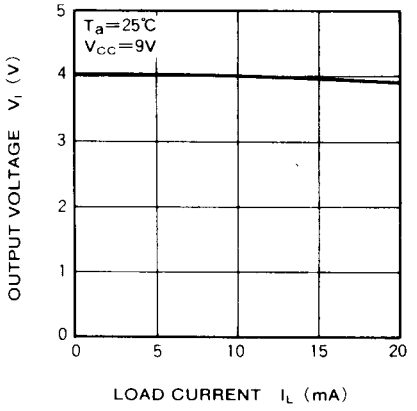
POWER DISSIPATION VS. AMBIENT TEMPERATURE



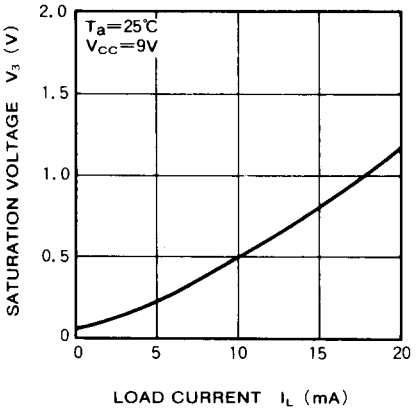
OUTPUT VOLTAGE. REFERENCE VOLTAGE VS. SUPPLY VOLTAGE



OUTPUT VOLTAGE VS. LOAD CURRENT

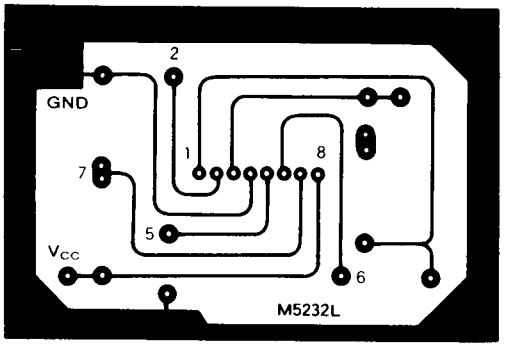


SATURATION VOLTAGE VS. LOAD CURRENT

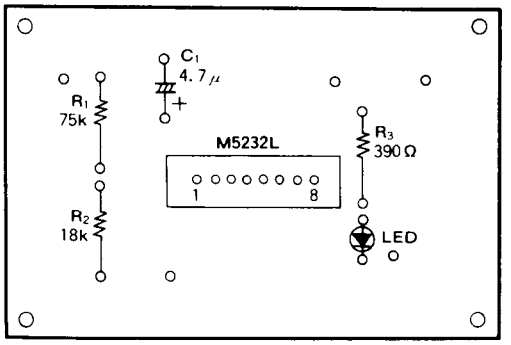


PRINTED CIRCUIT BOARD FOR CIRCUIT TESTING (TYPICAL APPLICATION EXAMPLE)

PRINTED CIRCUIT BOARD WIRING DIAGRAM (COPPER FOIL SIDE)



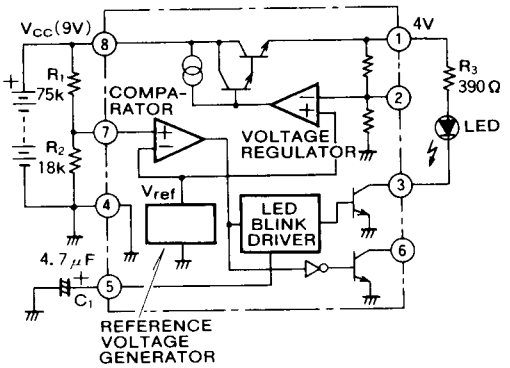
(PARTS SIDE)



MITSUBISHI ELECTRIC

APPLICATION EXAMPLES

1. Low voltage checker for batteries

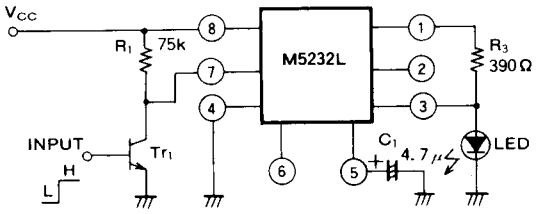


This low voltage checker for batteries is set to start the LED blinking when supply voltage $V_{CC} = 9V$ (six 1.5V cells) is reduced by 25% (to 6.8V).

$C_1 = 4.7\mu F \rightarrow f \fallingdotseq 1.8Hz$

C_2, which has a value of 100pF, prevents oscillation. It should be inserted when the input/output leads are long or when parasitic oscillation is generated by the load.

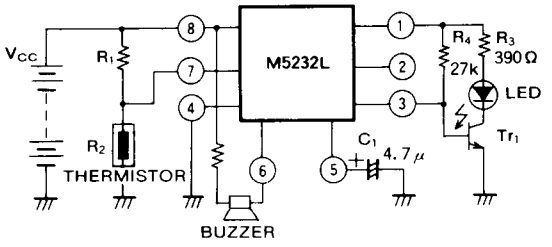
2. Trouble indicator



When the base of transistor T_{r1} is set low (the normal condition), Pin ⑦ comparator voltage is set high, Pin ③ is set low, and the LED is switched off.

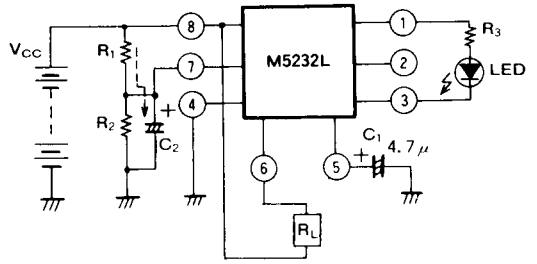
When the base of transistor T_{r1} is set high (signifying trouble), Pin ⑦ comparator input voltage is set low, the internal vibrator circuit is switched on, Pin ③ is repeatedly set high and low, and the LED blinks on and off. At the same time, an electronic buzzer can be sounded using Pin ⑥ or a relay can be driven. (An ordinary switch may be used in place of transistor T_{r1}.)

3. Abnormal temperature indicator



In normal circumstances, the LED is off and power dissipation is kept low. In abnormal circumstances, the LED blinks on and off. It is also possible to sound a buzzer or drive a relay using Pin ⑥.

4. Timer and muting indicator

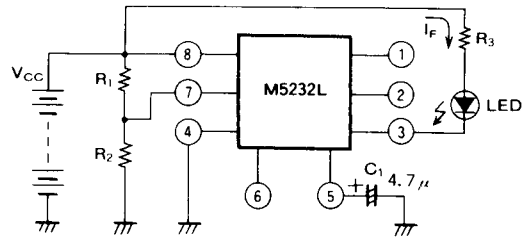


By connecting C_2 in parallel with R_2, V_{CC} is switched on, the charging current indicated by the dotted line in the figure flows, and the LED blinks on and off until the Pin ⑦ voltage reaches:

$$V_{CC} \cdot \frac{R_2}{R_1 + R_2}$$

When C_2 is charged up, the LED will light. These operations can be applied to timer and muting circuits.

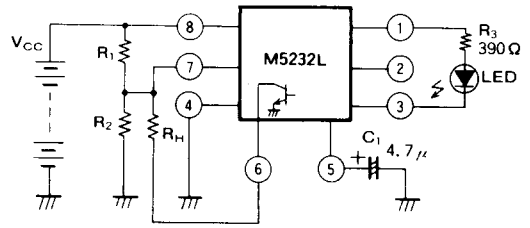
5. Low voltage checker for batteries (of 5V or less)



Since output Pin ① of the M5232L is regulated at 4V, the output is not stabilized at V_{CC} less than 5V.

When an LED is connected directly from V_{CC} as shown in the figure at left, it is possible to construct a battery checker for batteries of less than V_{CC} 5V, (for instance, $V_{CC}=3\sim5V$). Note that in this case, the I_F of the LED will fluctuate in accordance with the changes in V_{CC}.

6. Hysteresis operation of the on/off starting voltage



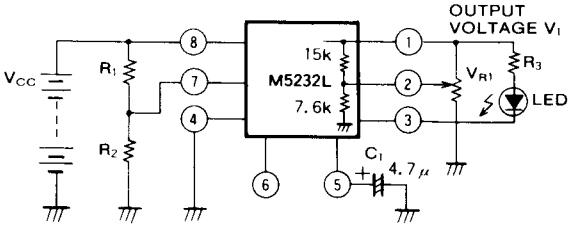
By connecting R_H across pins ⑥ and ⑦, as shown in the figure on the left, the on/off starting voltage is set at:

$$V_{2(ref)} \cdot \frac{R_1+R_2}{R_2}$$

After the start of the on/off blinking, Pin ⑥ (the open collector) goes on, and so it is possible to apply hysteresis and the voltage expressed below:

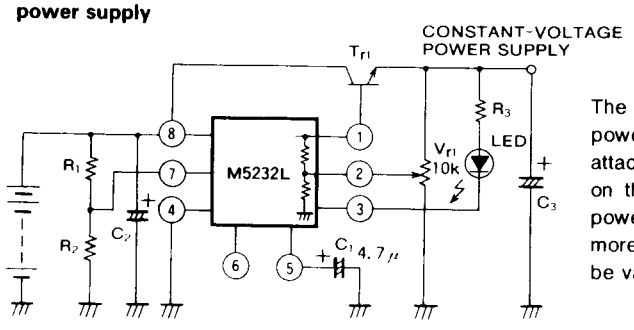
$$V_{2(ref)} \cdot \frac{R_1+R_2/\!/R_H}{R_2/\!/R_H}$$

7. Modification of output voltage V



The output voltage V_1 of the M5232L is set by the internal resistor as shown in the figure at left, but this can be changed by connecting a semi-fixed resistor across GND and pins ① and ②.

8. Increased current capacity of constant-voltage power supply



The current capacity of the built-in constant-voltage power supply is approximately 20mA. However, by attaching external transistor T_{r1} as shown in the figure on the left, it is possible to obtain a constant-voltage power supply with a large current capacity of 1A or more. The output voltage of the power supply can also be varied with variable resistor V_{r1}.

Note : Oscillation may be generated when the input or output leads are long. In cases like this, input and output capacitors C_1 and C_2 (1~ 10μF) should be inserted near the IC.