M51907P
M51909P

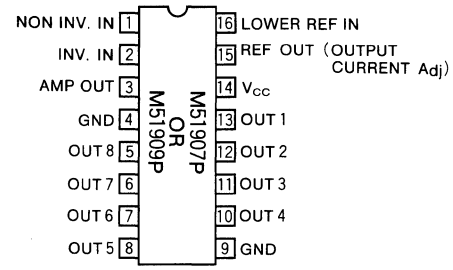
8-STEP BAR TYPE LED LEVEL INDICATOR

DESCRIPTION

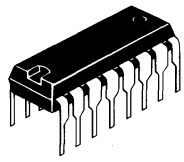
The M51907P/M51909P is a semiconductor integrated circuit consisting of a circuit designed for LED level meters. It is capable of bar type display for 8 LEDs according to a input level. AC or DC signal can be inputted because of built-in superior half-wave rectification OP Amp. Output is a cascade connection of a pair of LEDs, so current for display is half. Display level of the M51907P is logarithmical scale, +5, +2, 0, −2, −5, −8, −13, −18 dB.

The M51909P is a companion products to the M51907P, display level is linear scale, 156mV step.

PIN CONFIGURATION (TOP VIEW)



Outline 16P4



16-pin molded plastic DIL

FEATURES

- Built-in superior half-wave rectification OP Amp.
  Cut off frequency ..... 500kHz (typ.)
  Input offset voltage ..... 2 mV (typ.)
- The LED brightness can be adjusted by resistor.
  ..... 2 ~ 25mA
- Range of supply voltage is wide ..... 4 ~ 15V
- Output is a cascade connection of a pair of LEDs, so current for display is half.
- Amp gain can be varied by resistor.
- Be easily sifted on display level of LED by LOWER REF INPUT terminal.
- It is capable of cascade connection (if use more than 8 LEDs because of built-in REF OUT terminal (V_{REF} = 1.25V) correspond to full scale.

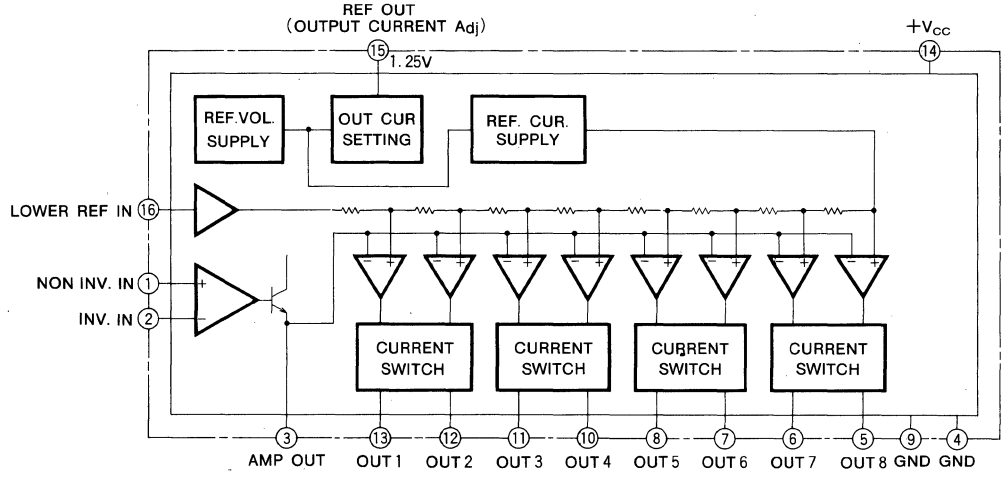
APPLICATION

Signal meters, VU meters, tuning meters, and other general display applications.

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ..... 4 ~ 15V
Rated supply voltage ..... 9 V±10%

BLOCK DIAGRAM



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8-STEP BAR TYPE LED LEVEL INDICATOR

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

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		16	V
BV_O	Output voltage		16*	V
I_O	Output sink current		25*	mA
V_{IN}	Input voltage		−3～V_{CC}	V
$1V_{①}-V_{②}1$	Difference input voltage		5	V
$V_{⑮}$	Pin⑮ voltage		V_{CC}	V
$I_{⑮}$	Pin⑮ issued current		500	μA
$I_{③}$	Pin③ issued current	Static value	1	mA
P_{dF}	Power dissipation		1600	mW
$K_{\theta F}$	Thermal derating	T_a≧25℃	12.8	mW/℃
T_{opr}	Operating temperature		−20～+75*	℃
T_{stg}	Storage temperature		−40～+125	℃

*Relations of BV_O, I_O, T_{opr} should satisfy the condition of power dissipation and derating.

M51907P
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V)

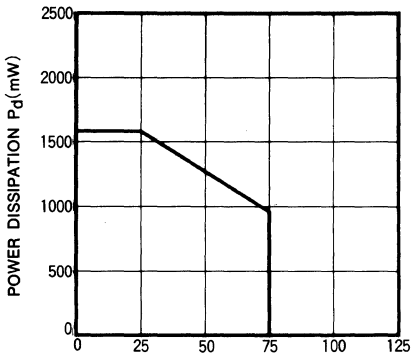
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		4		15	V
I_{CC1}	Circuit current	All outs are off. R_{ad}=2.8kΩ		5	8	mA
I_{CC2}	Circuit current	All outs are on. R_{ad}=2.8kΩ		7.0	11.2	mA
V_{IO}	Input amp offset voltage	$V_{①}$=1V		2	10	mV
I_{IB}	Input amp bias current	$V_{①}$=0V	−300	−50		nA
V_{IN}	Input voltage range		0		V_{CC}−2	V
V_{REF}	Reference voltage	R_{ad}=6.4kΩ	1.125	1.250	1.375	V
$V_{⑯}$	Pin⑯ setting voltage range		−0.2		V_{CC}−3.5	V
$I_{⑯}$	Pin⑯ issued current		−2000	−50		nA
V_{th1}	OUT 1 threshold voltage	Amp gain=1 Threshold voltage is between Pin① and Pin⑮.	70	89	111	mV
			−20	−18	−16	dB
V_{th2}	OUT 2 threshold voltage		125	157	198	mV
			−15	−13	−11	dB
V_{th3}	OUT 3 threshold voltage		235	280	333	mV
			−9.5	−8	−6.5	dB
V_{th4}	OUT 4 threshold voltage		352	395	443	mV
			−6	−5	−4	dB
V_{th5}	OUT 5 threshold voltage		498	558	627	mV
			−3	−2	−1	dB
V_{th6}	OUT 6 threshold voltage		627	703	789	mV
			−1	0	+1	dB
V_{th7}	OUT 7 threshold voltage		789	885	993	mV
			1	2	3	dB
V_{th8}	OUT 8 threshold voltage		1114	1250	1403	mV
			4	5	6	dB
I_{OL}	Output leakage current				1	μA
I_O	Output sink current	R_{ad}=6.4kΩ	9.6	12	14.4	mA
I_O	Output sink current	R_{ad}=2.8kΩ	20	25	30	mA
V_{SAT}	Output saturation voltage	R_{ad}=2.8kΩ, I_O=12.5mA			500	mV

M51909P
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V)

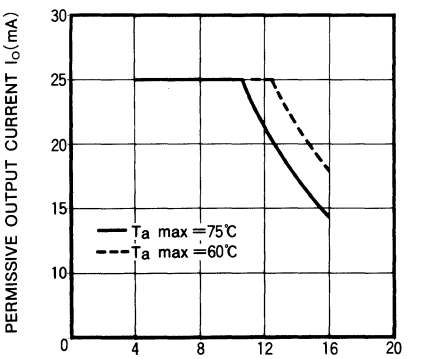
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		4		15	V
I_{CC1}	Circuit current	All outs is off, R_{ad}=2.8kΩ		5	8	mA
I_{CC2}	Circuit current	All outs is on, R_{ad}=2.8kΩ		7	11.2	mA
V_{IO}	Input amp offset voltage	$V_{①}$=1V		2	10	mV
I_{IB}	Input amp bias current	$V_{①}$=0V	−300	−50		nA
V_{IN}	Input voltage range		0		V_{CC}−2	V
V_{REF}	Reference voltage	R_{ad}=6.4kΩ	1.125	1.250	1.375	V
$V_{⑮}$	Pin⑮ setting voltage range		−0.2		V_{CC}−3.5	V
$I_{⑮}$	Pin⑮ issued current		−2000	−50		nA
V_{th1}	OUT 1 threshold voltage	Amp gain=1 Threshold voltage is between pin① and pin⑮.	136	156	177	mV
V_{th2}	OUT 2 threshold voltage		276	313	349	mV
V_{th3}	OUT 3 threshold voltage		417	469	521	mV
V_{th4}	OUT 4 threshold voltage		558	625	693	mV
V_{th5}	OUT 5 threshold voltage		698	781	864	mV
V_{th6}	OUT 6 threshold voltage		839	938	1036	mV
V_{th7}	OUT 7 threshold voltage		979	1094	1208	mV
V_{th8}	OUT 8 threshold voltage		1120	1250	1380	mV
I_{OL}	Output leakage current				1	μA
I_O	Output sink current	R_{ad}=6.4kΩ	9.6	12	14.4	mA
I_O'	Output sink current	R_{ad}=2.8kΩ	20	25	30	mA
V_{SAT}	Output saturation voltage	R_{ad}=2.8kΩ, I_O=12.5mA			500	mV

TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V, unless otherwise noted)

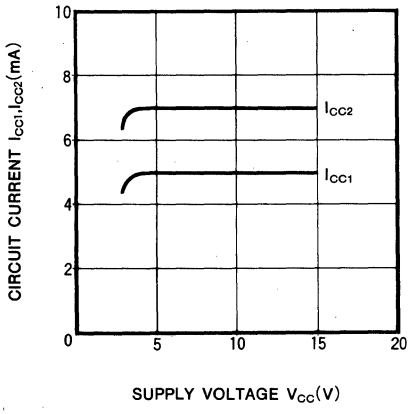
THERMAL DERATING (MAXIMUM RATING)



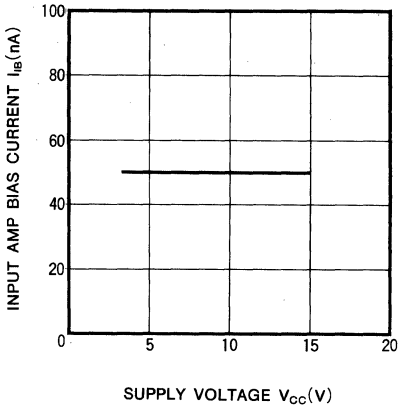
PERMISSIVE OUTPUT CURRENT VS SUPPLY VOLTAGE



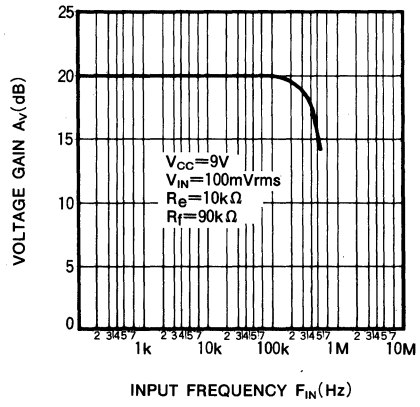
CIRCUIT CURRENT VS SUPPLY VOLTAGE



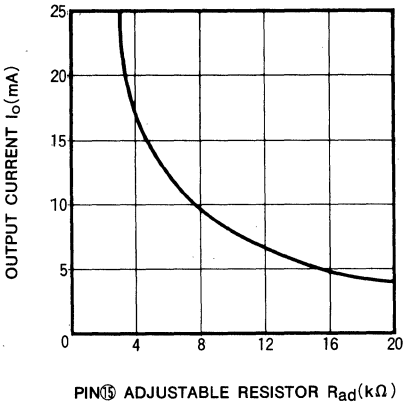
INPUT AMP BIAS CURRENT VS SUPPLY VOLTAGE



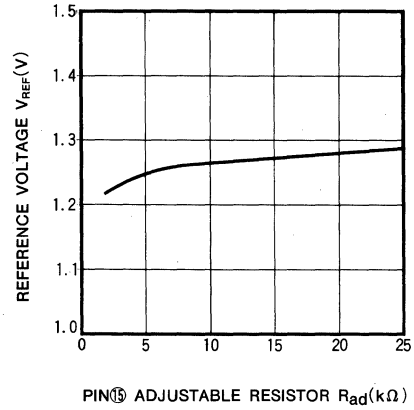
VOLTAGE GAIN VS INPUT FREQUENCY



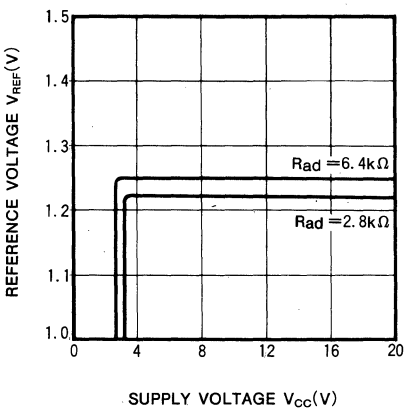
OUTPUT CURRENT VS PIN⑮ ADJUSTABLE RESISTOR



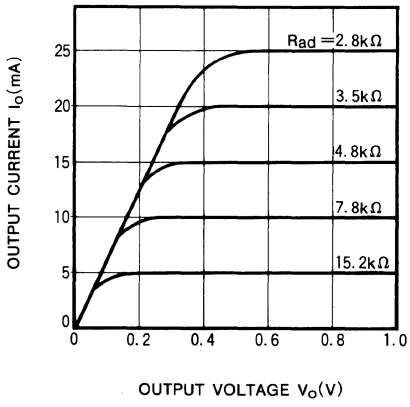
REFERENCE VOLTAGE VS PIN⑮ ADJUSTABLE RESISTOR



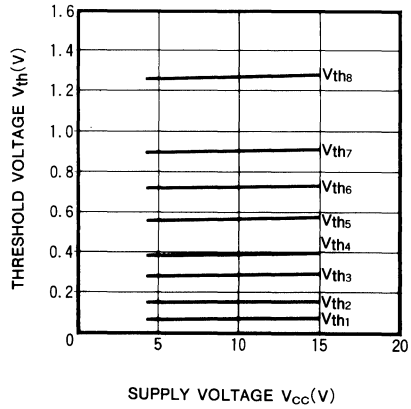
REFERENCE VOLTAGE VS SUPPLY VOLTAGE



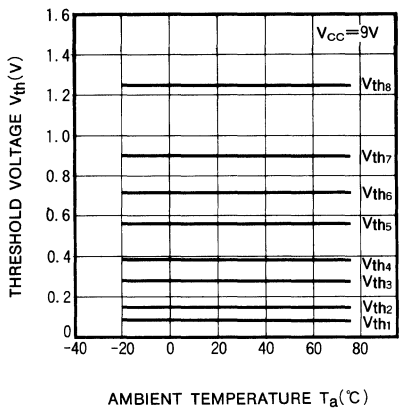
OUTPUT CURRENT VS OUTPUT VOLTAGE



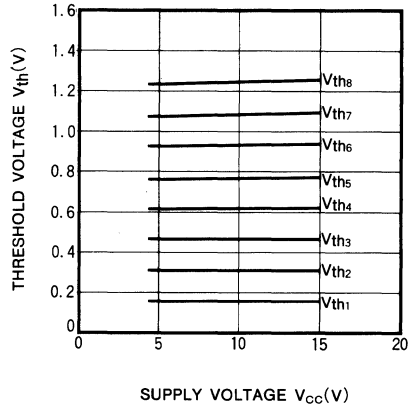
THRESHOLD VOLTAGE VS SUPPLY VOLTAGE (M51907P)



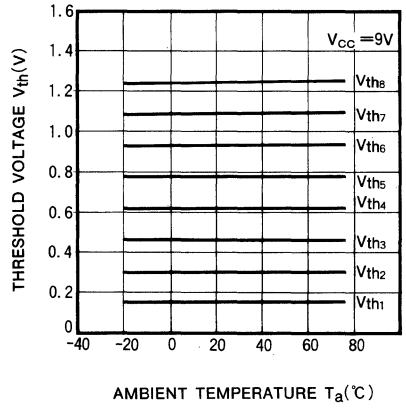
THRESHOLD VOLTAGE VS AMBIENT TEMPERATURE (M51907P)



THRESHOLD VOLTAGE VS SUPPLY VOLTAGE (M51909P)

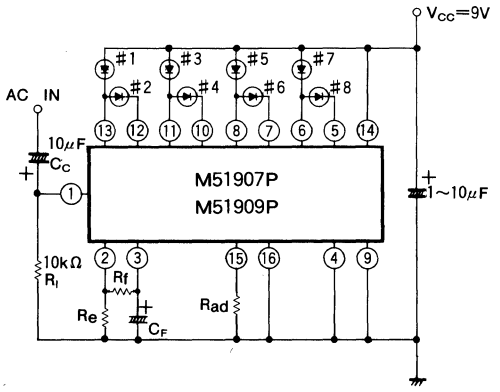


THRESHOLD VOLTAGE VS AMBIENT TEMPERATURE (M51909P)

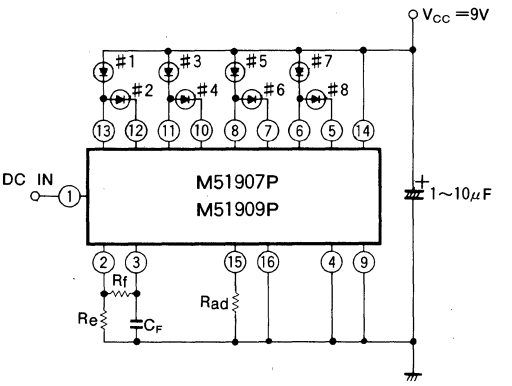


APPLICATION EXAMPLES

(1) AC input application circuit



(2) DC Input application circuit



Note : 1. Output current is decided by Rad

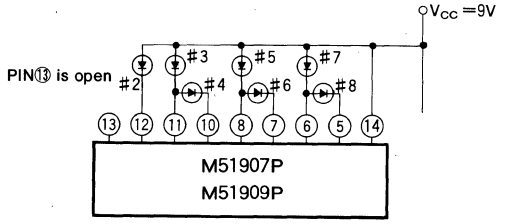
2. Amp gain $\sim \frac{R_e + R_f}{R_e}$ $(R_e + R_f \sim 30k\Omega)$

3. Recovery time : $C_F \times (R_e + R_f)$

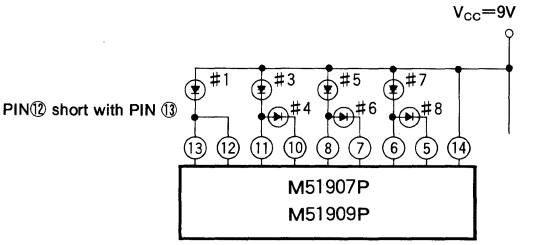
4. Attack time: $C_F \times 430\Omega$

(3) In case of use fewer than 8 pieces of LED

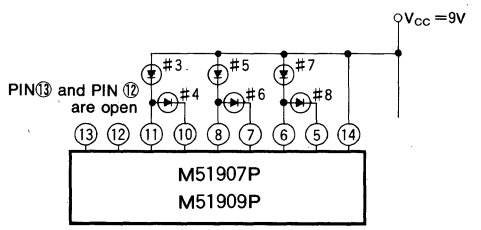
1. In case of no use of #1 LED



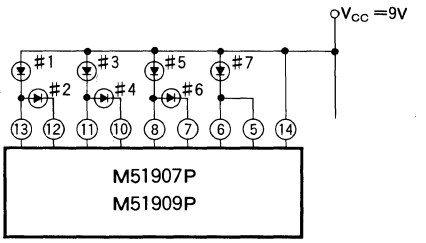
2. In case of no use of #2 LED



3. In case of no use of #1 and #2 LEDs

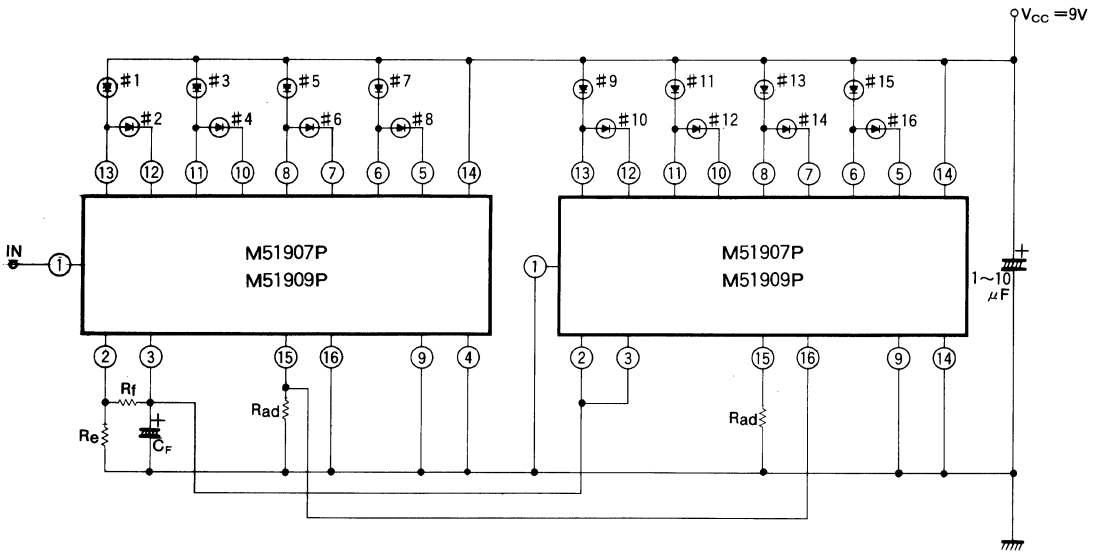


4. In case of no use of same of #3~#8 LEDs

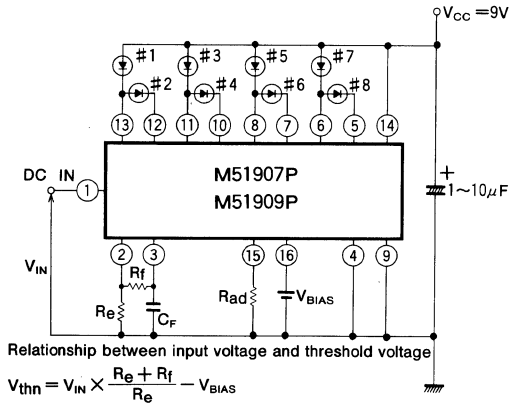


Connect similar to 1~3 according that a number of LED is odd or even. For example, in case of no use of #8 LED, connect similar to the case of no use of #2 LED.

(4) Cascade connection with 2 ICs application circuit

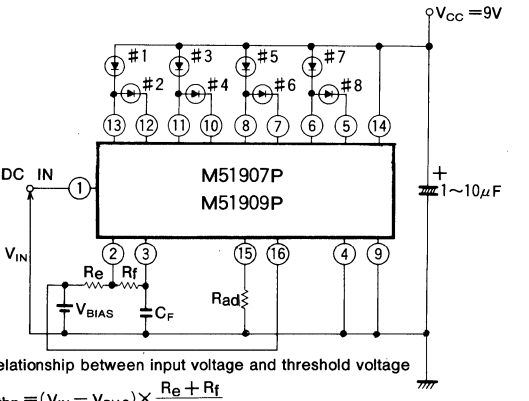


(5) In case that start point for display is not zero



Relationship between input voltage and threshold voltage

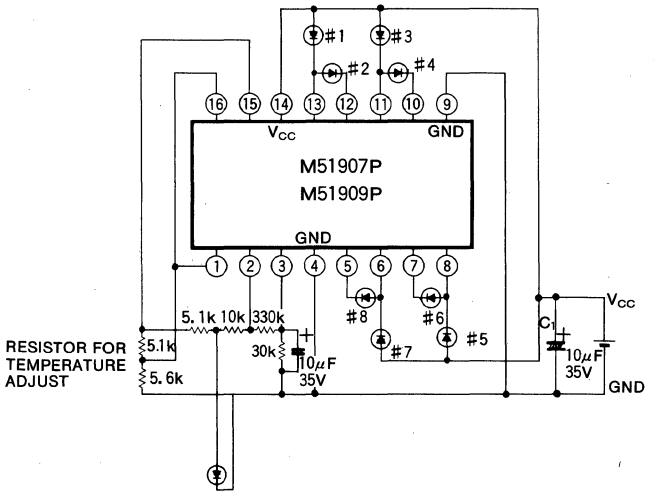
$$V_{thn} = V_{IN} \times \frac{R_e + R_f}{R_e} - V_{BIAS}$$



Relationship between input voltage and threshold voltage

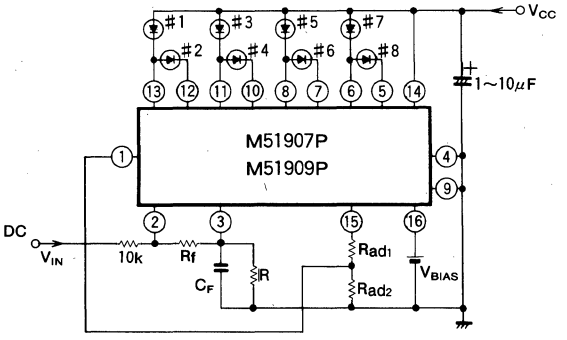
$$V_{thn} = (V_{IN} - V_{BIAS}) \times \frac{R_e + R_f}{R_e}$$

(6) Thermo indicator with diode sensor



DIODE FOR TEMPERATURE DETECTING

(7) In case that LEDs turn off by turns according to increase of input voltage.

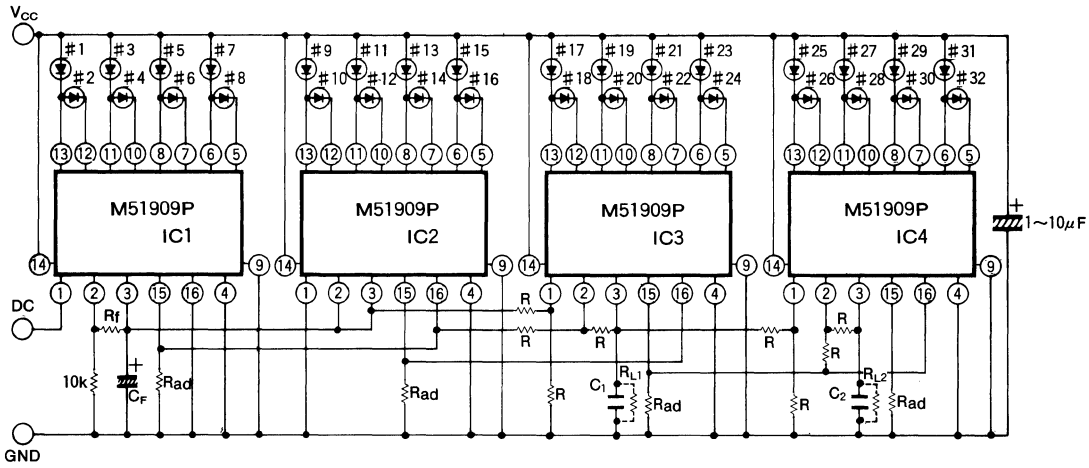


Note : 1. Relationship between input voltage

$$V_{thn} = \frac{1.25 \times R_{ad2}}{R_{ad1} + R_{ad2}} \times \left(1 + \frac{R_f}{10k}\right) - V_{IN} \times \frac{R_f}{10k} - V_{BIAS}$$

2. The LED brightness is decided by $(R_{ad1}+R_{ad2})$.

(8) 32 step bar type LED level indicator



Note : 1. Use R over 100kΩ
2. This circuit is suitable for the case V_{CC} over a 6V.
3. Recovery time $C_F \times (R_F + 10k)$
4. C_1, C_2 is a capacity for avoid oscillation.
5. Relationship between R_{L1}, R_{L2} (is resistor for discharge) and recovery time
$C_F (R_F + 10k) > C_1 R_{L1} > C_2 R_{L2}$ (C_1, $C_2 > 0.1\mu F$)