# M51209P/M5N339P

## QUAD COMPARATOR

## DESCRIPTION

The M51209P/M5N339P is quad (four independent) comparator and operates over wide voltage range at single supply voltage. Especially the M51209P/M5N339P has superiority as to characteristics of input current (input resistance) and fits to wide ranged applications, for example CR Timer, oscillator and etc.

## FEATURES

- Low input current (high input resistance) ····· 20nA (typ.)
- Wide supply voltage range ····· 2.5~28V
- Low dissipation current ····· 6.8mA (typ.)
- Enable to drive a relay or a lamp directly ···· 60mA (max.)
- Including voltage surge absorbing zener diodes
- High output breakdown voltage ····· 30V (max.)
- Low output voltage ····· 0.2V (typ.)
- Low input offset voltage ····· 2mV (typ.)

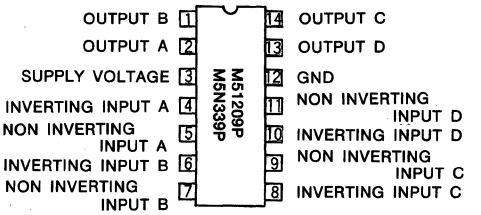
## APPLICATIONS

- Voltage comparator, sequential timer, pulse generator
- A/D converter, time delay circuit, etc.

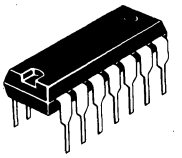
## RECOMMENDED OPERATING CONDITIONS

Supply voltage range ····· 2.5~28V
Rated supply voltage range ····· 12V

## PIN CONFIGURATION (TOP VIEW)

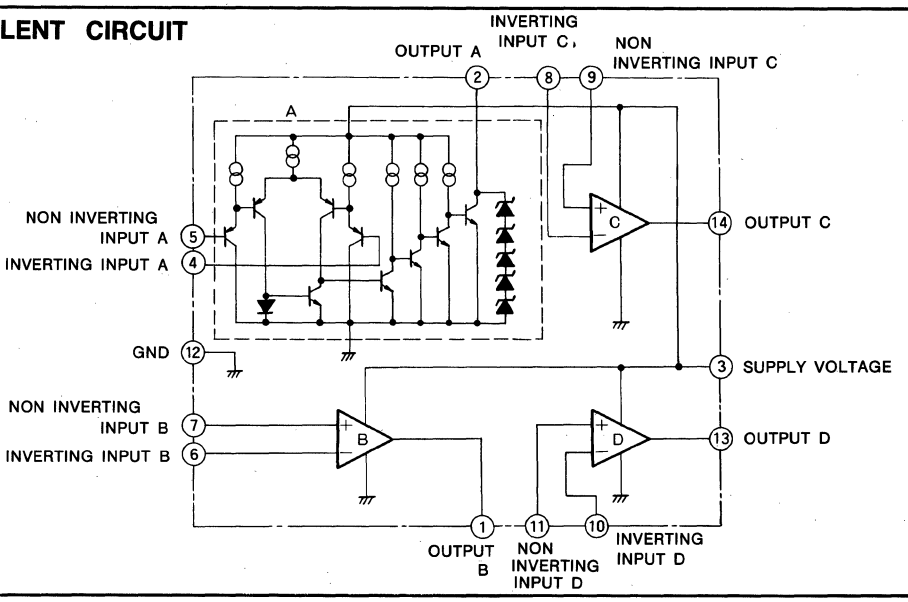



Outline 14P4



14-pin molded plastic DIL

## EQUIVALENT CIRCUIT



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

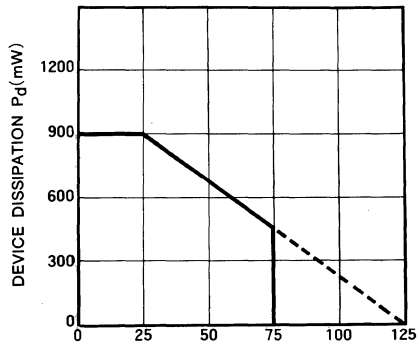
| Symbol | Parameter | Conditions | Limits | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | 28 | V |
| $V_{id}$ | Differential input voltage | | $V_{CC}$ | V |
| $V_{icm}$ | Common mode input voltage range | | −0.3～$V_{CC}$ | V |
| $I_{sink}$ | Output sink current | Output saturated | 60 | mA |
| $V_{OH}$ | "H" output voltage | | 30 | V |
| $P_d$ | Power dissipation | | 900 | mW |
| $T_{opr}$ | Operating temperature | | −20～+75 | ℃ |
| $T_{stg}$ | Storage temperature | | −40～+125 | ℃ |

## ELECTRICAL CHARACTERISTICS ($T_a$=25℃, $V_{CC}$=2.5 to 28V, unless otherwise noted)

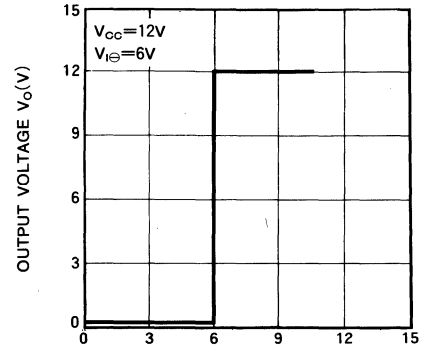
| Symbol | Parameter | Test conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $V_{CC}$ | Supply voltage range | | 2.5 | | 28 | V |
| $I_{CC}$ | Circuit current | | | 6.8 | 9.5 | mA |
| $V_{I\ominus}$ | Inverting input voltage range | | 0 | | $V_{CC}$−1.5 | V |
| $V_{I\oplus}$ | Non inverting input voltage range | | 0 | | $V_{CC}$−1.5 | V |
| $V_{IO}$ | Input offset voltage | | | 2 | 7 | mV |
| $I_{I\ominus}$ | Inverting input current | | | 20 | 100 | nA |
| $I_{I\oplus}$ | Non inverting input current | | | 20 | 100 | nA |
| $I_{IO}$ | Input offset current | | | 5 | 50 | nA |
| $V_{OL}$ | "L" output voltage | $I_{OL}$=60mA | | 0.2 | 0.4 | V |
| $I_{sink}$ | Output sink current | | | | 60 | mA |
| $I_{LO}$ | Output leakage current | | | | 0.1 | μA |
| $t_{PLH}$ | Output "L→H" propagation delay time | | | 2 | | μS |
| $t_{PHL}$ | Output "H→L" propagation delay time | | | 1 | | μS |

## TYPICAL CHARACTERISTICS ($T_a$=25℃, unless otherwise noted)

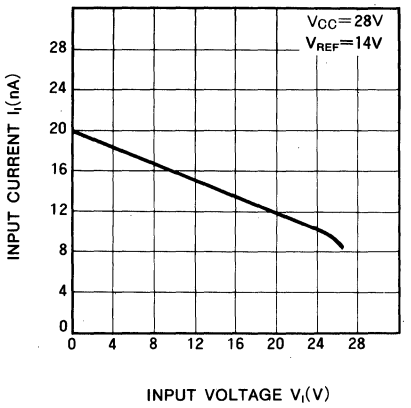
THERMAL DERATING (MAXIMUM RATING)



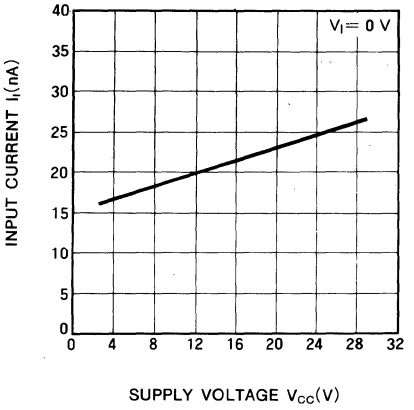

OUTPUT VOLTAGE VS INPUT VOLTAGE



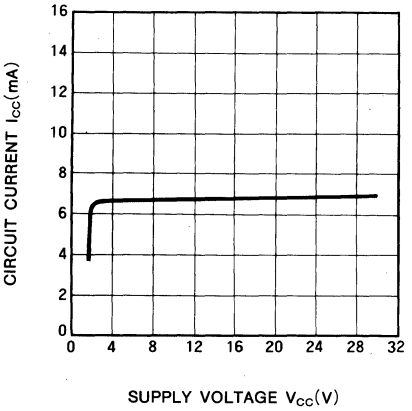
INPUT CURRENT VS INPUT VOLTAGE



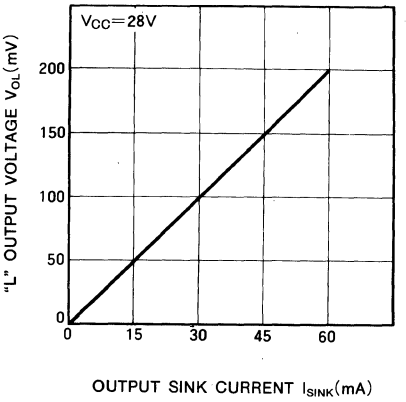

INPUT CURRENT VS SUPPLY VOLTAGE



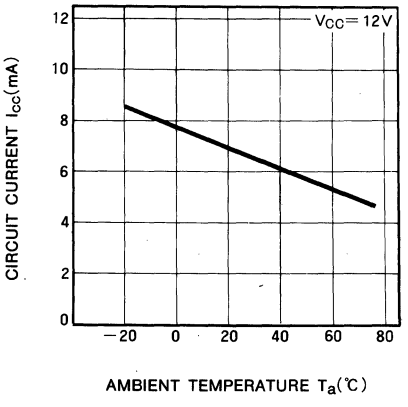

CIRCUIT CURRENT VS SUPPLY VOLTAGE



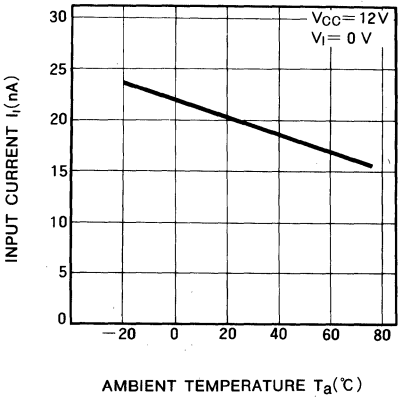

"L" OUTPUT VOLTAGE VS OUTPUT SINK CURRENT




CIRCUIT CURRENT VS AMBIENT TEMPERATURE




INPUT CURRENT VS AMBIENT TEMPERATURE

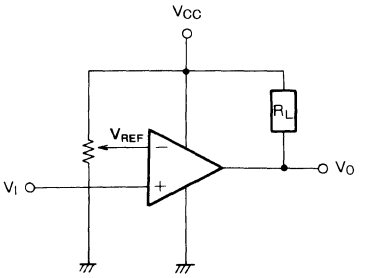


## PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51209P may flow large current and reach to destroy because of the structure when the terminals of $V_{CC}$ and GND of the M51209P is connected wrong position each other.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.

## APPLICATION

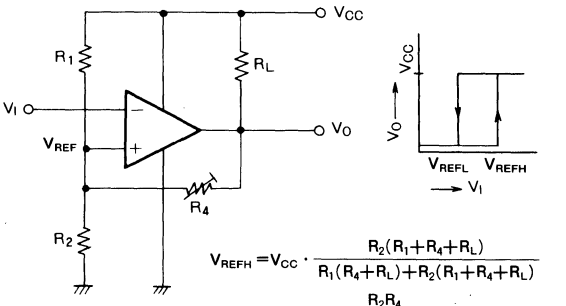
### (1) Voltage comparator




If $V_{REF} > V_I$, $V_O$=Low

If $V_{REF} < V_I$, $V_O$=High

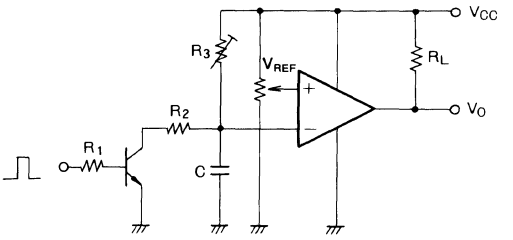
### (2) Schmit trigger circuit




$$V_{REFH} = V_{CC} \cdot \frac{R_2(R_1+R_4+R_L)}{R_1(R_4+R_L)+R_2(R_1+R_4+R_L)}$$

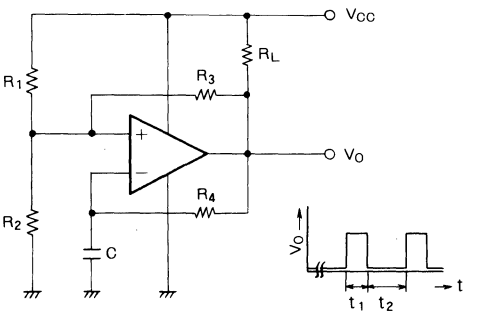
$$V_{REFL} = V_{CC} \cdot \frac{R_2R_4}{R_2R_4+R_1(R_2+R_4)}$$

### (3) Monostable multi vibrator



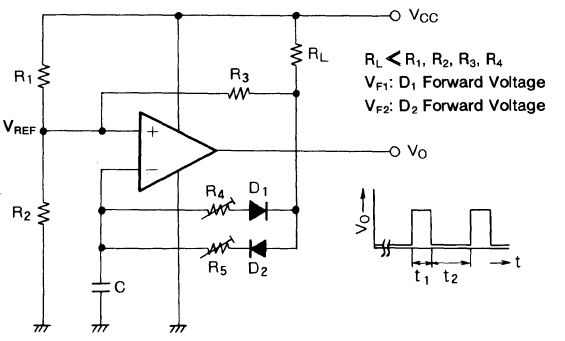

$$t = CR_3 \cdot \ell n \frac{V_{CC}}{V_{CC}-V_{REF}} \text{(sec)}$$

### (4) Astable multi vibrator




$t_1 = CR_4 \cdot \ell n \frac{R_2+R_3}{R_3}$ $t_2 = CR_4 \cdot \ell n \frac{R_1+R_3}{R_3}$ ($R_L \ll R_1, R_2, R_3, R_4$)

### (5) Pulse generator




$R_L \ll R_1, R_2, R_3, R_4$

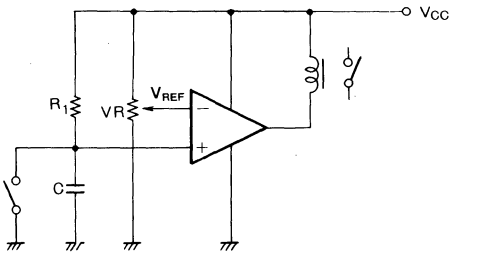
$V_{F1}$: $D_1$ Forward Voltage

$V_{F2}$: $D_2$ Forward Voltage

$$V_{REFH} = \frac{V_{CC} \cdot R_2(R_1+R_3)}{R_1R_2+R_2R_3+R_3R_1} \qquad t_1 = CR_5 \cdot \ell n \frac{V_{CC}-V_{REFL}-V_{F2}}{V_{CC}-V_{REFH}}$$

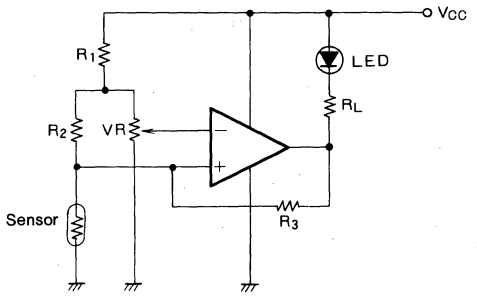
$$V_{REFL} = \frac{V_{CC} \cdot R_2R_3}{R_1R_2+R_2R_3+R_3R_1} \qquad t_2 = CR_4 \cdot \ell n \frac{V_{REFH}-V_{F1}}{V_{REFL}}$$

### (6) CR Timer

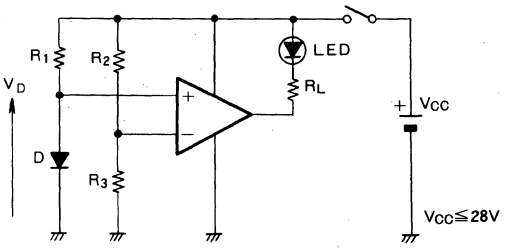



$$t = CR_1 \cdot \ell n \frac{V_{CC}}{V_{CC}-V_{REF}}$$

### (7) Sensor detector



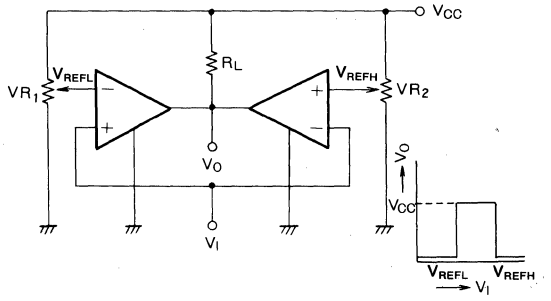

### (8) Battery check circuit



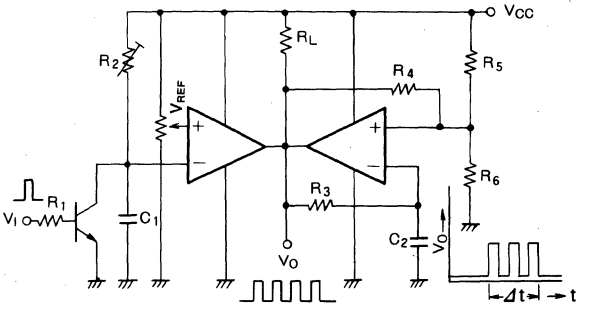

$V_D < V_{CC} \cdot \frac{R_3}{R_2+R_3}$ : LED→ON

$V_D > V_{CC} \cdot \frac{R_3}{R_2+R_3}$ : LED→OFF

### (9) Window comparator




### (10) Pulse train generator

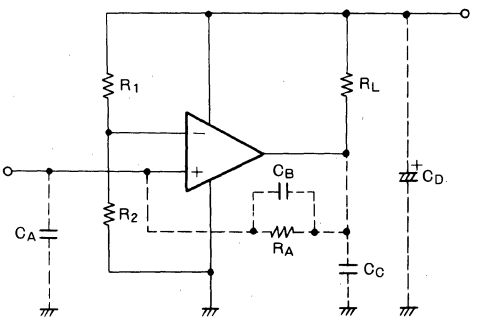



$\Delta t = C_1 C_2 \cdot \ell n \frac{V_{CC}}{V_{CC}-V_{REF}}$

### (11) Countermeasure against oscillation

(NOTE) Taking steps against oscillation
The M51209P has possibility of oscillation according to input condition. If the M51209P should oscillate, following countermeasures are applicable.

* : In case of connecting input signal with chattering connect a capacitor of small value, $C_A$.
* : In case of oscillating on the condition of ordinary input, employ positive feed back inserting $R_A$ (resistor of large value), $C_S$(no polar) or connect $C_C$.
* : In case that supply voltage is not stabilized, connect $C_D$ (electrolytic capacitor of large value) to absorb the supply voltage change.



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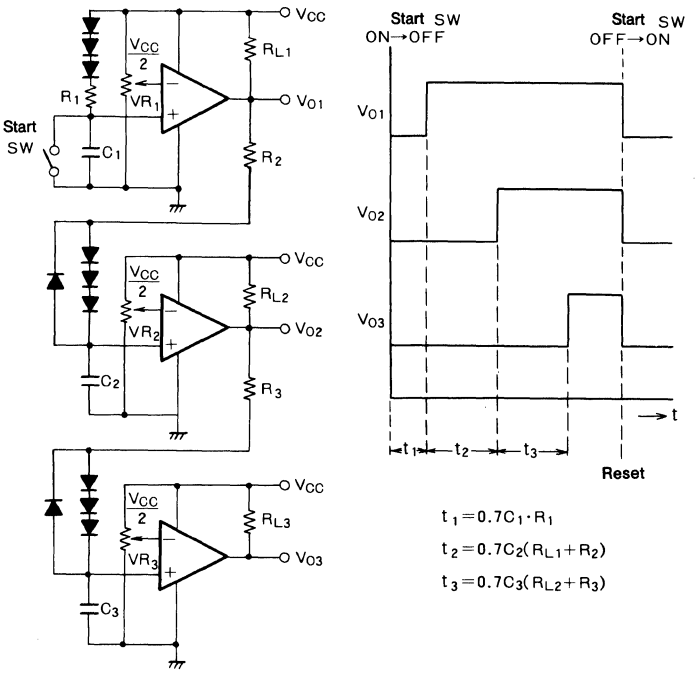
## (12) Sequential timer




$t_1 = 0.7C_1 \cdot R_1$

$t_2 = 0.7C_2(R_{L1} + R_2)$

$t_3 = 0.7C_3(R_{L2} + R_3)$

## (13) Analog/Digital converter