M51209P

QUAD COMPARATOR

DESCRIPTION

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

FEATURES

- Low input curret (high input resistance) ····· 20nA(typ.)
- Wide supply voltage range ····· 2.5V~28V
- Low dissipation current ····· 6.8mA(typ.)
- Capable of driving a relay or a lamp directly 200mA(max.)
- Includes voltage surge absorbing zener diodes
- High output breakdown voltage ····· 30V(max.)
- Low output voltage (I_{sink}=60mA) ····· 0.2V(typ.)
- Low input offset voltage ····· 2mV(typ.)

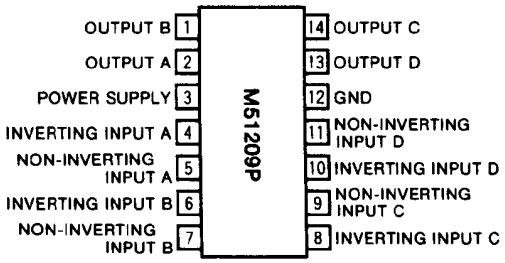
APPLICATION

Voltage comparator, sequential timer, pulse generator, analog / digital converter, time delay circuit

RECOMMENDED OPERATING CONDITIONS

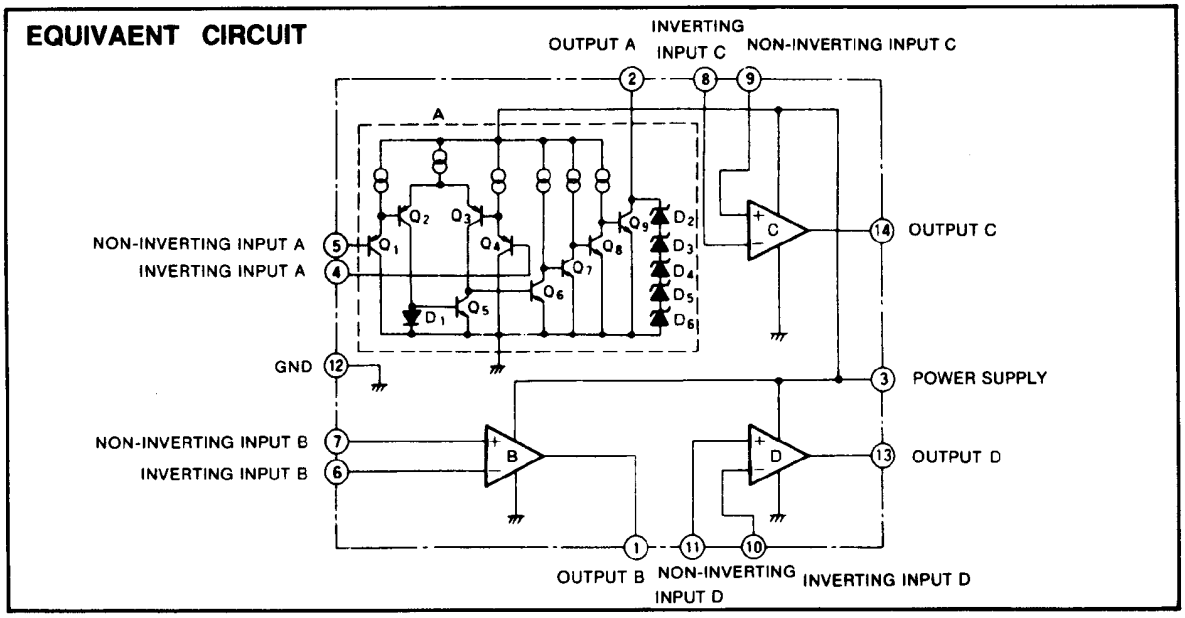
Supply voltage range ····· 2.5~28V
Rated supply voltage ····· 12V

PIN CONFIGURATION (TOP VIEW)



Outline 14P4

EQUIVAENT CIRCUIT



MITSUBISHI ELECTRIC

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

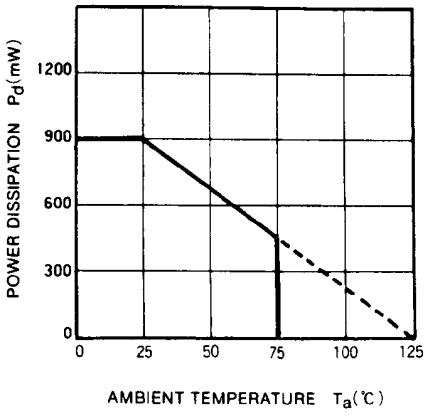
Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		28	V
V_{ID}	Differential input voltage		V_{CC}	V
V_{ICM}	Common mode input voltage range		−0.3～V_{CC}	V
Isink	Output sink current		200	mA
V_{OH}	"H" output voltage		30	V
P_d	Power dissipation		900	mW
Topr	Operating temperature		−20～+75	℃
Tstg	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=2.5～28V, unlese otherwise noted)

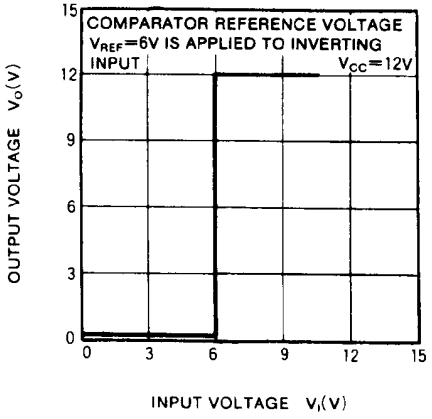
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		2.5		28	V
I_{CC}	Circuit current			6.8	9.5	mA
$V_{I\ominus}$	Inverting input voltage range		0		V_{CC}−1.5	V
$V_{I\oplus}$	Non-inverting input voltage range		0		V_{CC}−1.5	V
V_{IO}	Input offset voltage			2	7	mV
$I_{I\ominus}$	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_{sink}=60mA		0.2	0.6	V
		I_{sink}=200mA		1		
I_{LO}	Output leak 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)

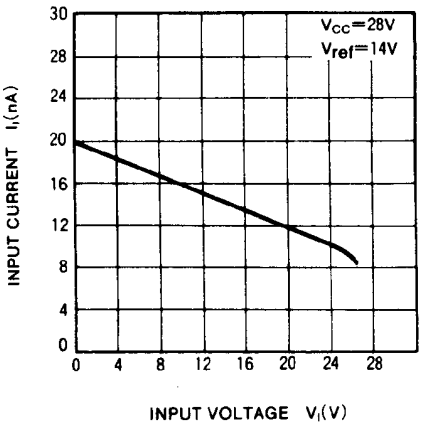
THERMAL DERATING (MAXIMUM RATING)



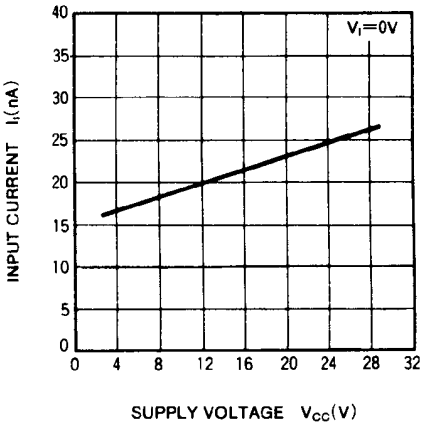
OUTPUT VOLTAGE VS. INPUT VOTAGE



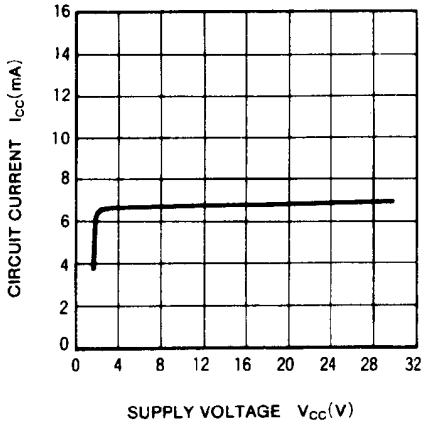
INPUT CURRENT VS. INPUT VOLTAGE



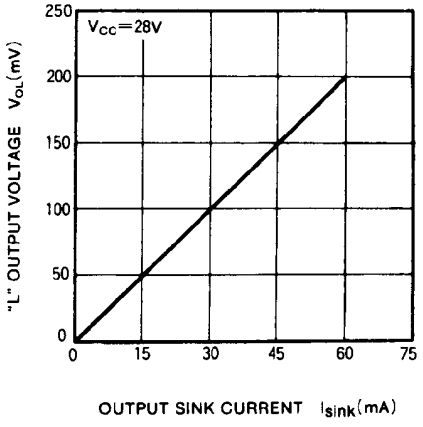
INPUT CURRENT VS. SUPPLY VOLTAGE



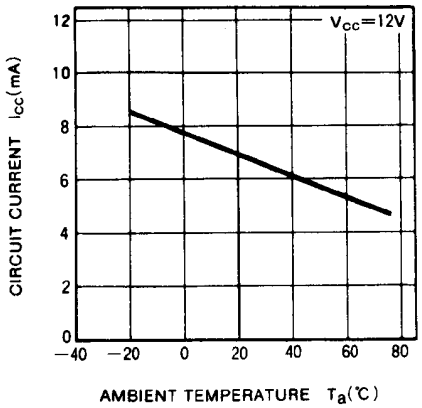
CIRCUIT CURRENT VS. SUPPLY VOLTAGE



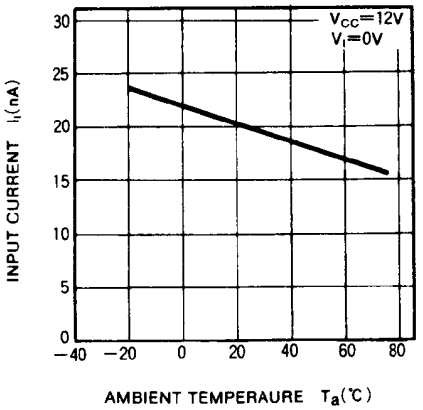
"L" OUTPUT VOLTAGE VS. OUTPUT SINK CURRENT



CIRCUIT CURRENT VS. AMBIENT TEMPERATURE



INPUT CURRENT VS. AMBIENT TEMPERATURE

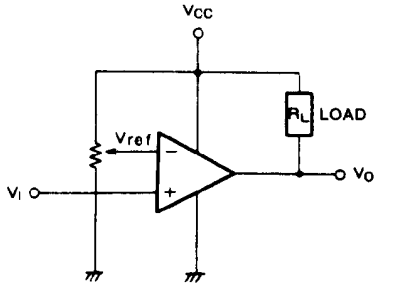


PRECAUTIONS FOU USE

1. Special care must be taken to protect the M51209P from large surges in current, such as may result from the incorrect connection of the V_{CC} and GND terminals.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, when driving another.

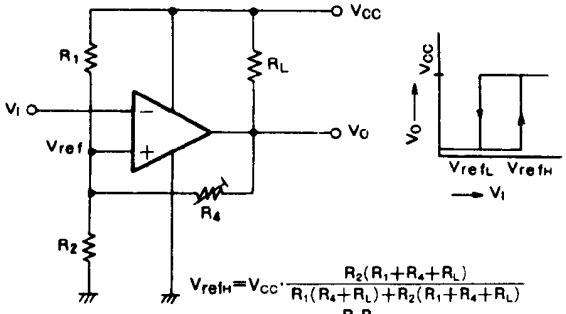
APPLICATION EXAMPLES

(1) Voltage comparator



If $V_{REF} > V_I$ V_O=Low
If $V_{REF} < V_I$ V_O=High

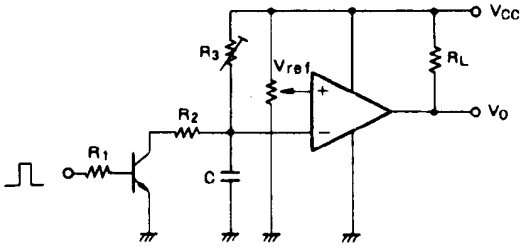
(2) Schmitt trigger circuit



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

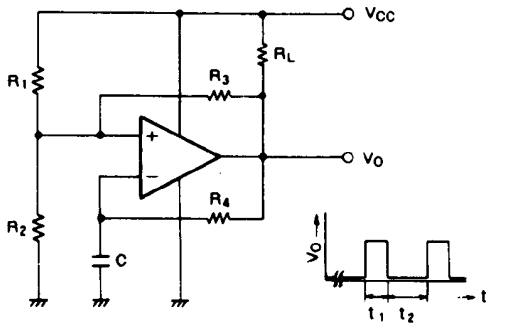
$$V_{refL} = V_{CC} \cdot \frac{R_2R_4}{R_2R_4+R_1(R_2+R_4)}$$

(3) Monostable multi-vibrator



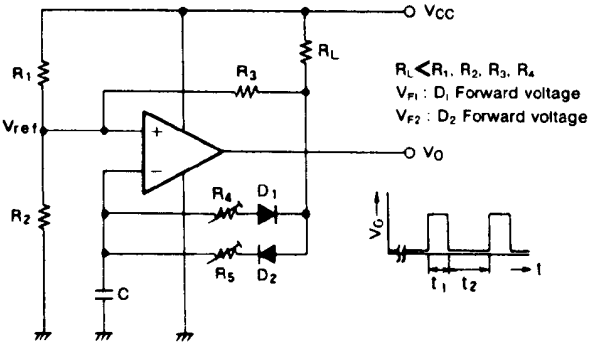
$$t = CR_3 \cdot \ell n \frac{V_{CC}}{V_{CC}-V_{ref}} \text{ (sec)}$$

(4) Unstable multi-vibrator



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

(5) Pulse generator



$R_L < R_1, R_2, R_3, R_4$
V_{F1} : D_1 Forward voltage
V_{F2} : D_2 Forward voltage

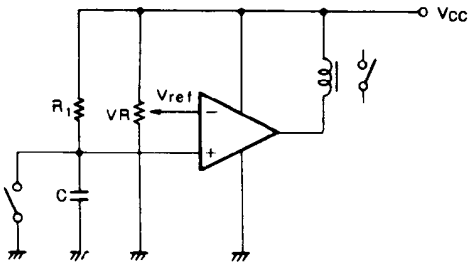
$$V_{refH} = \frac{V_{CC} \cdot R_2(R_1+R_3)}{R_1R_2+R_2R_3+R_3R_1}$$

$$V_{refL} = \frac{V_{CC} \cdot R_2R_3}{R_1R_2+R_2R_3+R_3R_1}$$

$$t_1 = CR_5 \ell n \frac{V_{CC}-V_{refL}-V_{F2}}{V_{CC}-V_{refH}}$$

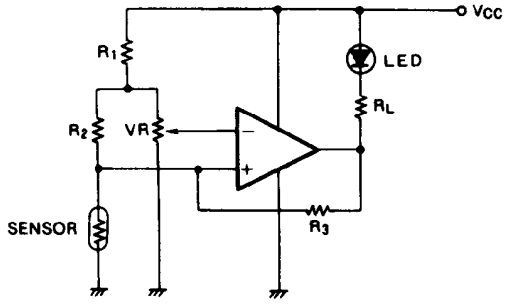
$$t_2 = CR_4 \ell n \frac{V_{refH}-V_{F1}}{V_{refL}}$$

(6) CR Timer

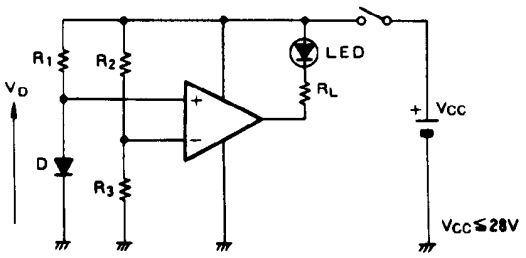


$$t = CR_1 \cdot \ell n \frac{V_{CC}}{V_{CC}-V_{ref}}$$

(7) Sensor detector



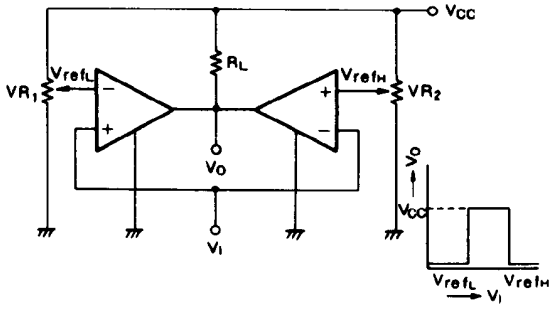
(8) Battery check circuit



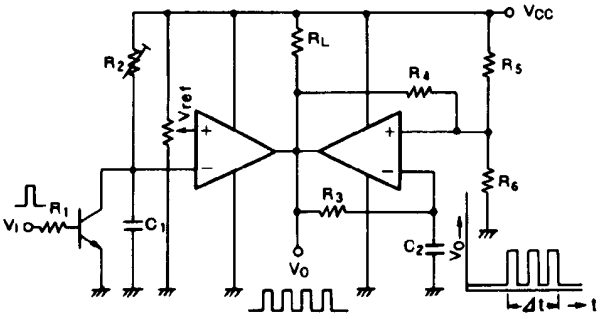
$V_D < V_{CC} \cdot \frac{R_3}{R_2+R_3}$; LED→ON

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

(9) Window comparator

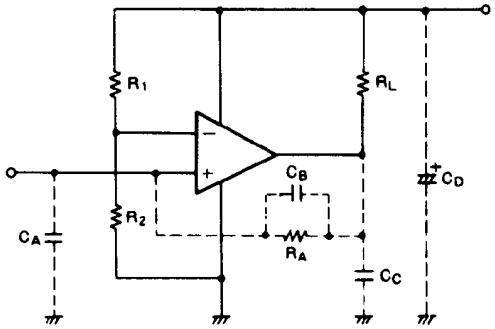


(10) Pulse train generator



$\Delta t = C_1 R_2 \cdot \ell n \frac{V_{CC}}{V_{CC}-V_{ref}}$

(11) Countermeaure against oscillation

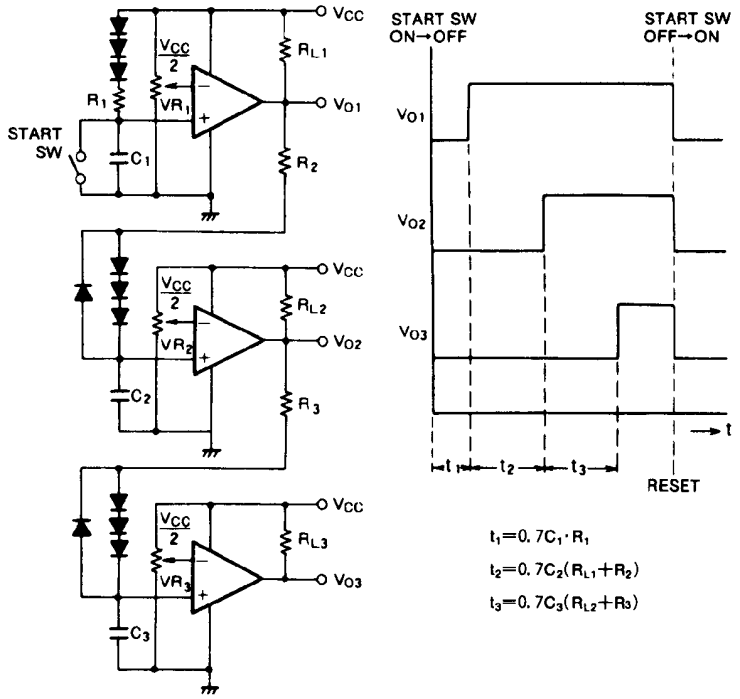


(Note) Taking steps against oscillation

The M51209P may oscillate according to input condition. If the M51209P should oscillate, the following countermeasures are applicable.

- In case of connecting input signal with chattering, connect a capcitor of small C_A. value.
- In case of oscillation with ordinary input, employ positive feedback inserting R_A (large resistor) , C_B (no polar) or connect C_C.
- When the supply voltage is not stabilized, connect C_D (a large electrolytic capacitor) to absorb the supply voltage change.

(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