M54101P

LEVEL DETECTOR

DESCRIPTION

The M54101P is a semiconductor integrated circuit containing a differential amplifier and Schmitt circuit suitable for temperature control.

FEATURES

- Suitable for high precision temperature control circuits
- High output current, high breakdown voltage (I_O=40mA, V_O=30V)
- Wide operating temperature range (T_a=−20∼+75℃)

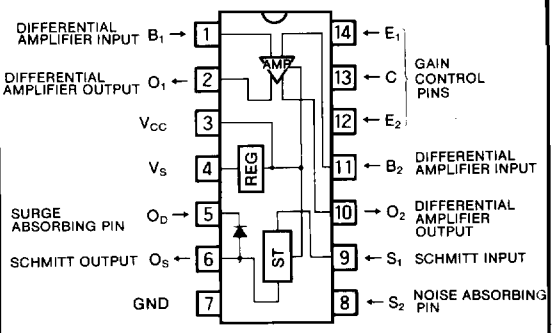
APPLICATION

General purpose, for use in industrial and consumer equipment

FUNCTIONAL DESCRIPTION

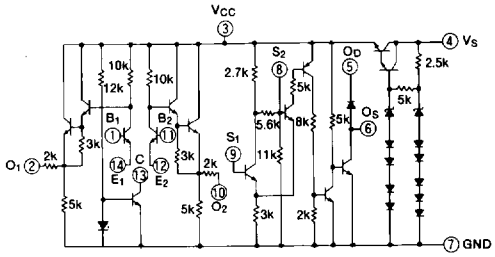
Designed for detecting minute changes in voltage and current, this IC is especially suitable for temperature control circuits using thermistors as sensors. Besides containing the differential amplifier and Schmitt circuit necessary for a control IC, it also employs a constant voltage circuit enabling usage of a 12∼16V power supply source. Being an open collector, output O_S can be used to drive a relay or a lamp. Further, in the output O_S circuit is a diode limiter which can be used in case of relay overload.

PIN CONFIGURATION (TOP VIEW)



Outline 14P4

CIRCUIT SCHEMATIC



Unit : Ω

ABSOLUTE MAXIMUM RATINGS (T_a = −20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_S	Supply voltage		20	V
V_I	Input voltage		V_{CC} (Note 1)	V
V_{ID}	Differential input voltage (Note 2)		±5	V
V_O	Output voltage	"H" level state	30	V
I_O	Output current	"L" level state	50	mA
V_R	Reverse voltage		30	V
P_d	Power dissipation		500	mW
Topr	Operating temperature		−20∼+75	℃
Tstg	Storage temperature		−55∼+125	℃

Note 1 : V_{CC} is value of voltage at pin 3.
2 : Voltage difference between inputs B_1 and B_2.

RECOMMENDED OPERATING CONDITIONS (T_a = −20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_S	Supply voltage		12	14	16	V
V_O	Output voltage	"H" level state			V_S	V
I_{OL}	"L" level output current	V_{OL} = 0.6V			40	mA
I_{AS}	Total output current (Note 3)				−4	mA

Note 3 : This is the total of all output current (excluding pins 4, 7).

ELECTRICAL CHARACTERISTICS (T_a = −20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Temp (℃)	Limits			Unit	Test circuit
					Min	Typ*	Max		
V_{CC}	Supply voltage	I_{CC} = −2mA V_{B1} = V_{B2} = 1.6V 12, 13, 14 Connected	V_S = 12V		7.8		9.6	V	1
			V_S = 16V						
Reg_1	Regulation 1 (Note 4)	I_{CC} = −2mA, V_{B1} = V_{B2} = 1.6V 12, 13, 14 Connected		425			0.22	V	1
Reg_2	Regulation 2 (Note 4)	V_S = 14V, V_{B1} = V_{B2} = 1.6V 12, 13, 14 Connected		25			0.22	V	1
I_{IN}	Input bias current	V_{B1} = V_{B2} = 1.6V 12, 13, 14 Connected	V_{CC} = 8.7V				17	μA	2
			V_{CC} = 9.6V				20		
V_{OO}	Output offset voltage (Note 5)	V_{B1} = V_{B2} = 1.6V 12, 13, 14 Connected	V_{CC} = 8.7V				0.5	V	3
			V_{CC} = 9.6V				0.55		
G_V	Voltage gain (Note 5)	V_{B1} = 1.65V V_{B2} = 1.6V 12, 13, 14 Connected	V_{CC} = 8.7V	−20	3.95		5.55	V	3
				25	3.75		5.15		
				75	3.35		4.95		
			V_{CC} = 7.8V	−20	3.25				
				25	3.15				
				75	2.85				
			V_{CC} = 9.6V	−20			6.25		
				25			5.75		
				75			5.45		
G_V	Voltage gain (Note 5)	V_{B1} = 1.6V V_{B2} = 1.65V 12, 13, 14 Connected	V_{CC} = 8.7V	−20	3.95		5.55	V	3
				25	3.75		5.15		
				75	3.35		4.95		
			V_{CC} = 7.8V	−20	3.25				
				25	3.15				
				75	2.85				
			V_{CC} = 9.6V	−20			6.25		
				25			5.75		
				75			5.45		
V_{T+}	Positive-going threshold voltage	V_{CC} = 8.7V		−20	3.75		4.45	V	4
				25	3.8		4.4		
				75	3.75		4.45		
		V_{CC} = 7.8V		−20	3.3				
				25	3.35				
				75	3.3				
		V_{CC} = 9.6V		−20			4.9		
				25			4.85		
				75			4.9		

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ELECTRICAL CHARACTERISTICS (continued)

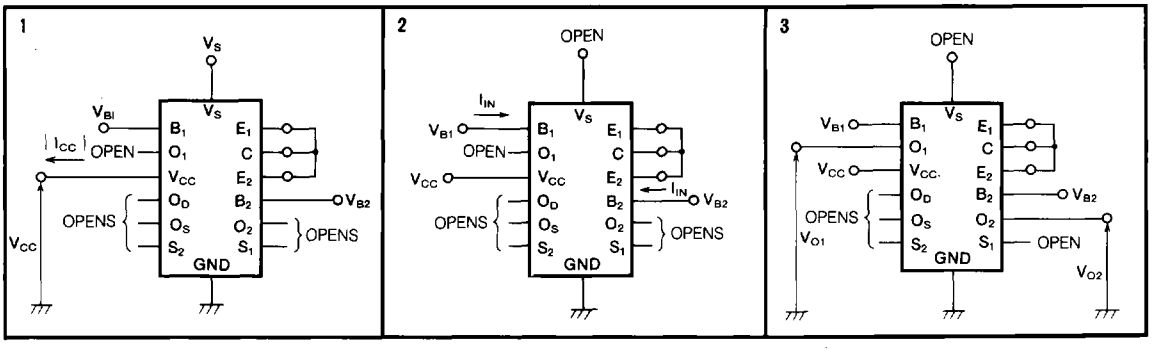
Symbol	Parameter	Test conditions	Temp (℃)	Limits			Unit	Test circuit
				Min	Typ*	Max		
V_{T-}	Negative-going threshold voltage	V_{CC} = 8.7V	−20	3.15		3.85	V	5
			25	3.2		3.8		
			75	3.15		3.85		
		V_{CC} = 7.8V	−20	2.75				
			25	2.8				
			75	2.75				
		V_{CC} = 9.6V	−20			4.25		
			25			4.2		
			75			4.25		
I_{T+}	"V_{T+}" input current	V_{CC} = 8.7V	−20	180			μA	4
			25	100				
			75	80				
		V_{CC} = 9.6V	−20	200				
			25	110				
			75	90				
I_{OH}	"H" level output current	V_{SI} = 3.2V, V_{CC} = 9.6V, V_{OH} = 16V				250	μA	5
V_{OL}	"L" level output current	V_{SI} = 4.5V, V_{CC} = 7.8V, I_{OL} = 40mA			0.3	0.6	V	4
V_O	Output voltage	V_{SI} = 3.2V, V_{CC} = 8.7V, I_O = 1mA		30			V	6
V_R	Reverse voltage	V_{OS} = 0V, I_R = 1mA		30			V	7
V_F	Forward voltage	V_{OD} = 0V, I_F = 20mA	25			1.2	V	7
I_S	Supply current	V_{B1} = V_{B2} = 1.6V, V_S = 16V 12, 13, 14 Connected	25			13	mA	8

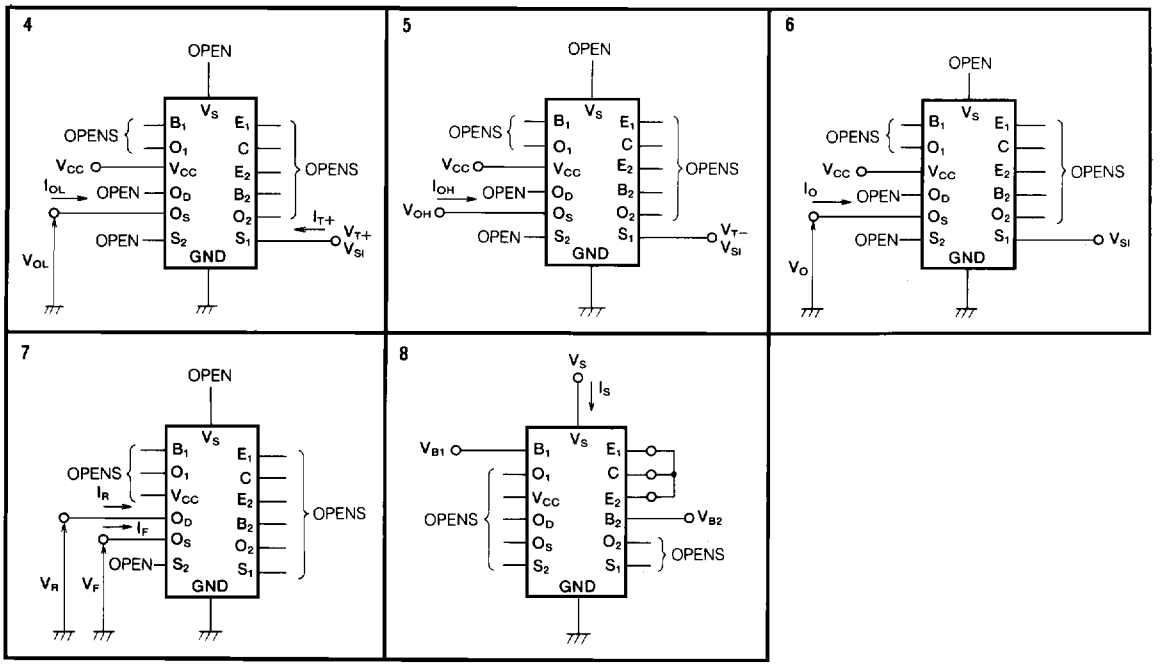
* : A typical value is at T_a=25℃.

Note 4 : Conditions of Regulation 1 and Regulation 2 are set as follows :
Reg 1 = V_{CC1} (V_{CC} when V_{CC} = 16V) − V_{CC2} (V_{CC} When V_S = 12V)
Reg 2 = V_{CC1} (V_{CC} when I_L = circuit current+2mA) − V_{CC2} (V_{CC} when I_L = circuit current+6mA)

5 : All parameters are set at $|V_{01}-V_{02}|$.

TEST CIRCUITS





APPLICATION EXAMPLES

Basic ON/OFF thermo-circuit

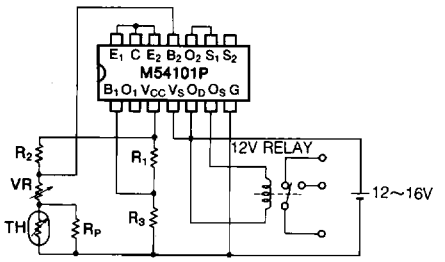


Fig.1 CIRCUIT

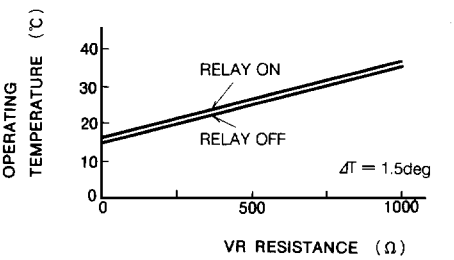


Fig.2 EXAMPLE CHARACTERISTICS

The differential amplifier connections B_1 and B_2 are biased through the bridge consisting of R_1, R_2, R_3, R_P, temperature level setting variable resistor V_R, and thermistor TH. Figure 2 shows the special characteristics of an air-conditioner room-thermal circuit employing a NTC thermistor. Hysteresis temperature ΔT varies according to value of resistance inserted between pins E_1 · C and E_2 · C.