I. Summary

TM2291 is an infrared sensing signal processor, manufactured by CMOS process, in SOP16 package form, applied to the circuit of pyroelectric infrared switch. This product has excellent performance, ultra-low power consumption, suitable for battery (dry cell, lithium battery, etc.) power supply, reliable quality, and simple peripheral circuit.

II. Characteristic description

- CMOS digital-analog hybrid special integrated circuit.
- With independent high input impedance operational amplifier, can match with a variety of sensors for signal pre-processing.
- Bidirectional amplitude discriminator can effectively suppress interference.
- Built-in delay time timer and blocking time timer, novel structure, stable and reliable, wide adjustment range.
- Built-in reference power supply
- Wide operating voltage range of +3V to +5V
- Adopt 16-pin SOP package
- Ultra-low power consumption, quiescent current 1uA~3uA

III. Pin definition.

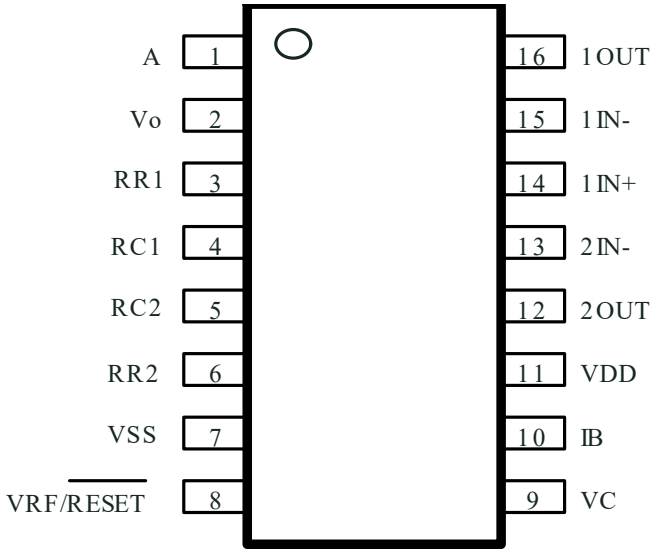


Figure 1 TM2291

IV. Pin function definition：

Symbals	Pin Name	Pin No.	Description
A	Repeatable and non-repeatable triggering control terminals	1	When A="1", repeat triggering is allowed; when A="0", no repeat triggering is allowed.
Vo	Control signal output terminal	2	Triggered by the up-jump edge of VS, Vo is triggered when it jumps from low to high level. Outside the output delay time Tx and no VS up-jump Vo is low state
RR1 RC1	Adjustment terminal for output delay time Tx	3～4	Output delay time equation: Tx≈40000R1C1
RC2 RR2	Adjustment terminal of trigger blocking time Ti	5～6	Trigger blocking time formula: Ti≈56R2C2
VSS	Negative terminal of operating power supply	7	Generally connected to 0V
VRF/ $\overline{RESET}$	Reference voltage and reset input	8	Generally connected to VDD, when connected to "0" can make the timer reset
VC	Trigger disable terminal	9	When Vc<VR, trigger is prohibited; when Vc>VR, trigger is allowed
IB	Operational amplifier bias current setting terminal	10	Connected to VSS terminal via RB, the value of RB is about 1MΩ
VDD	Positive side of operating power supply	11	The range is 3~5V
2OUT	Output of the second stage op-amp	12	Connected in parallel with 10MΩ resistor and 10nF capacitor, and then connected to the inverting input of the second stage operational amplifier
2IN-	Inverting input of the second stage op-amp	13	Connect 10MΩ resistor and 10nF capacitor in parallel, and then connect to the output of the second stage operational amplifier.
1IN+	In-phase input of the first stage op-amp	14	Connected to the S terminal of the pyroelectric receiver head
1IN-	Inverted input of the first stage op-amp	15	A 2MΩ resistor and a 10nF capacitor can be connected in parallel to the output of the first stage op-amp.
1OUT	Output of the first stage op-amp	16	2MΩ resistor and 10nF capacitor can be connected in parallel to the inverting input of the first stage operational amplifier.

V. Working Principle

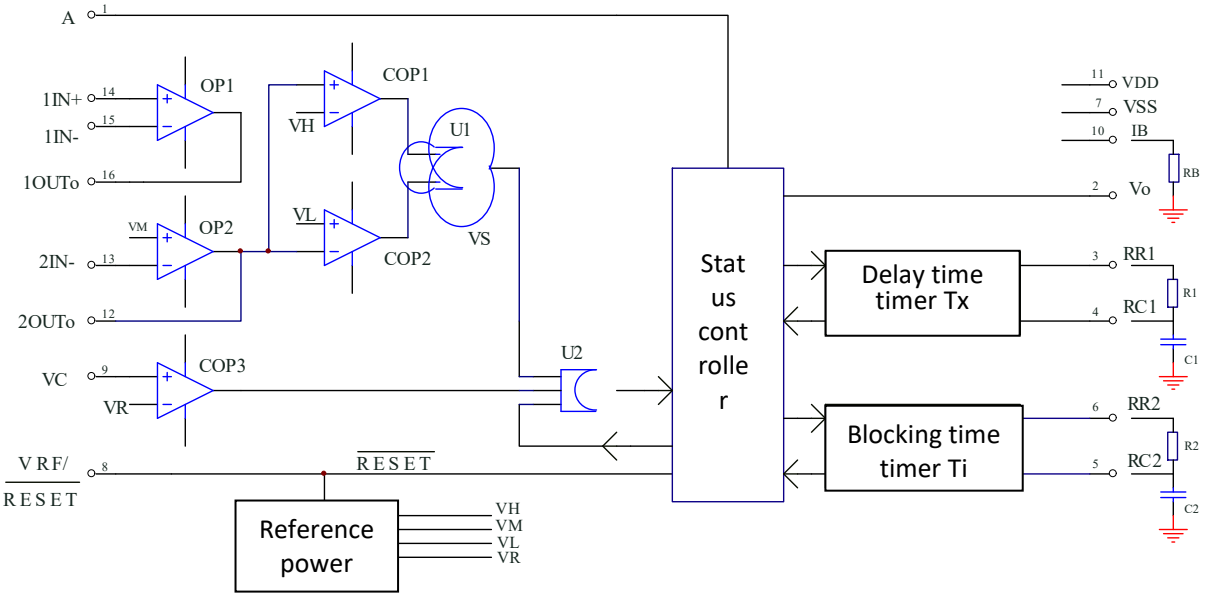


Figure 2 TM2291 Schematic block diagram

Figure 2 shows the schematic block diagram of the TM2291 infrared sensing signal processor. The external components are selected by the user according to his needs.

The TM2291 is a digital-analog hybrid IC consisting of operational amplifier, voltage comparator and state controller, delay timer, blocking time timer and reference voltage source. It can be widely used in many kinds of sensors and time delay controllers.

Let's first illustrate the operating process of TM2291 with the waveforms of each point in the non-repeatable trigger operation mode shown in Figure 3.

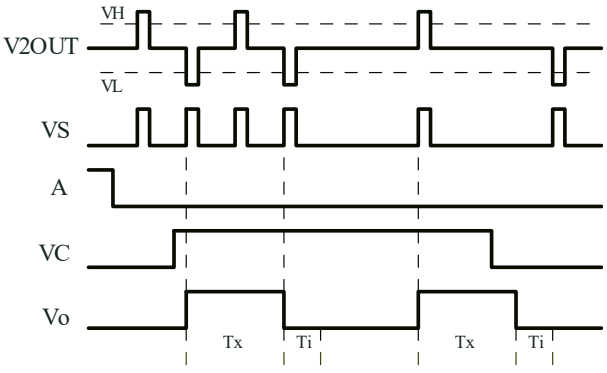


Figure 3

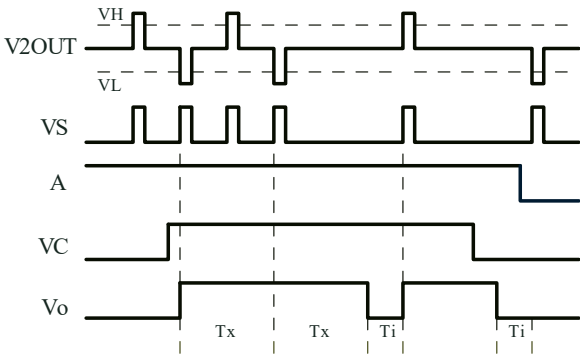


Figure 4

First, the signal is amplified by the user according to the actual needs using the sensing signal pre-processing circuit composed of operational amplifier OP1, and then coupled to operational amplifier OP2, and then the second stage amplification, while the current potential is raised to VM (≈ 0.6 VRF) and sent to the bidirectional amplitude discriminator composed of comparators COP1 and COP2 to detect the effective trigger signal VS. Since VH ≈ 0.8 VRF, VL≈0.4 VRF, so when VDD=5V, the noise interference of ±1V can be effectively suppressed. Improves the reliability of the system. COP3 is a conditional comparator. When the input voltage VC<VR(≈0.2 VRF), the output of COP3 is low to block with the gate U2, prohibit the trigger signal VS to the lower level; and when VC>VR, the output of COP3 is high to open with the gate U2, then if the upper jump edge of the trigger signal VS comes, the delay time timer can be started, and the output of Vo terminal is high to enter the delay cycle. When the A terminal is connected to "0" level, any V2 change in Tx time is ignored until the end of Tx time, that is, the so-called non-repeatable trigger mode of operation. When the Tx time is over, Vo jumps back to low level, and the blocking time timer is started to enter the blocking cycle Ti. In the Ti cycle, any V2 change cannot make VO active. This function can effectively suppress the interference generated during load switching.

The waveforms of each point in the repeatable trigger operation mode shown in Figure 4 are used to illustrate the operation process of TM2291 in this state.

During the period of VC="0" and A="0", VS cannot trigger Vo to be active. When VC="1" and A="1", VS can repeatedly trigger Vo to be active and keep it active for Tx period. During the Tx time, as long as there is an up-jump of VS, Vo will continue to extend one Tx cycle from the up-jump of VS; if VS keeps "1" state, Vo will remain valid; if VS keeps "0" state, Vo will return to "0" state at the end of Tx cycle. If VS remains "1", Vo remains valid; if VS remains "0", Vo returns to invalid state at the end of Tx period, and no change of VS can trigger Vo to be valid during the blocking time Ti time.

Through the above analysis, we have got a comprehensive understanding of the circuit structure and working process of TM2291, and it can be seen that the device has a novel structure design and strong functions, which can be applied in a wide range of fields.

VI. Applications

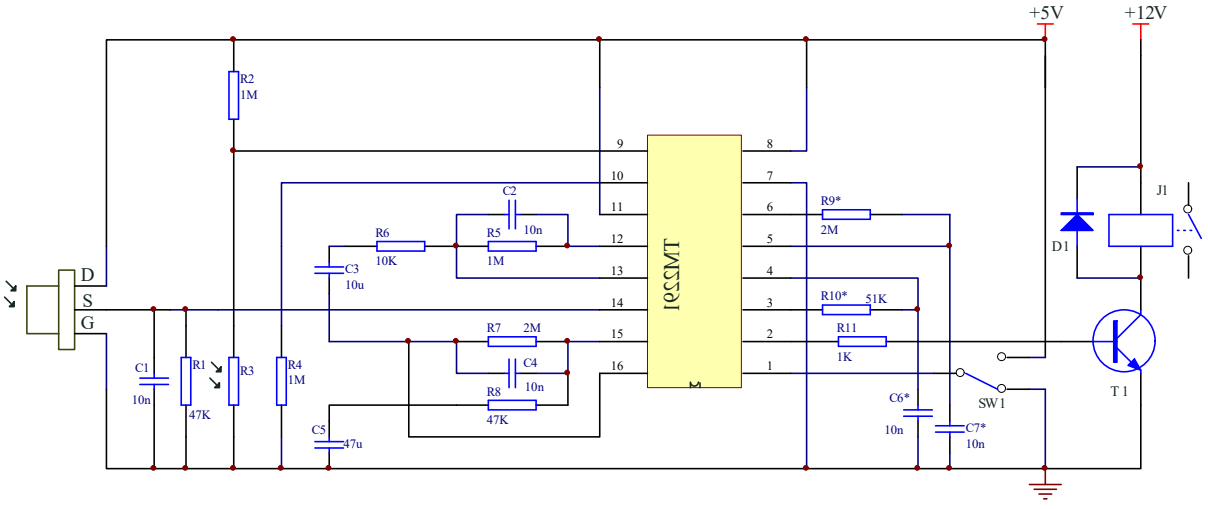


Figure 5

Figure 5 shows the circuit schematic of the TM2291 applied to a pyroelectric infrared switch. The resistors R9 and R10, and capacitors C6 and C7 are adjustable.

Pyroelectric infrared switch is a passive infrared switch composed of TM2291 with pyroelectric infrared sensor and a few external components. It can automatically and quickly turn on all kinds of incandescent lamps, fluorescent lamps, buzzers, automatic doors, electric fans, dryers and automatic hand-washing sinks, etc. It is a high-tech product. It is especially suitable for sensitive areas such as aisles and corridors in enterprises, hotels, shopping malls, warehouses and homes, or for automatic lighting, illumination and alarm systems in secure areas.

Pyroelectric infrared sensor is a new type of sensitive element, which is composed of high thermoelectric coefficient material, with filter lens and impedance matching with field effect tube. It can detect the infrared radiation emitted by human body in a non-contact way, convert it into electrical signal output, and can effectively suppress the interference radiation outside the wavelength of human radiation, such as sunlight, light and its reflected light.

In this example, the operational amplifier OP1 of TM2291 is used as the preamplifier of the pyroelectric infrared sensor. It is coupled by C3 to op-amp OP2 for amplification, and then processed by the bi-directional amplitude discriminator composed of voltage comparator COP1 and COP2 to detect the valid trigger signal to start the delay time timer. The output signal is driven by transistor T1 and relay to turn on the load, and R3 is a photoresistor to detect the ambient illumination. When used as lighting control, if the environment is brighter, the resistance value of R3 will be reduced, so that the input of pin 9 is low and the trigger signal is blocked to save electricity for lighting. If used in other applications. SW1 is the working mode selector switch, when SW1 is connected with terminal 1, the infrared switch is in repeatable trigger working mode. When SW1 is connected to end 2, the infrared switch is in non-repeatable mode.

VII. Electrical parameters.

Limit parameters (Vss = 0 V)

Parameter	Symbols	Range	Unit
Supply voltage	VDD	-0.5 ～+6.0	V
Input voltage	VI1	-0.5 ～ 6.0	V
Maximum current at each lead	IO1	±10	mA
Operating temperature	Topt	-10～+70	℃
Storage temperature	Tstg	-65 ～+150	℃

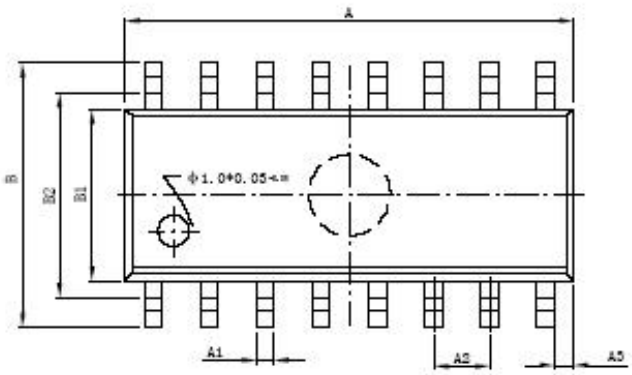
Electrical parameters（TA=25℃，Vss=0V）

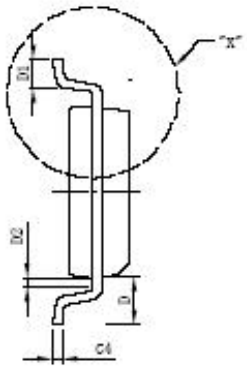
Symbols	Parameter	Test conditions		Parameter Value		Unit
				Min	Max	
V_{DD}	Operating voltage range			3	5	V
I_{DD}	Operating Current	Input Grounding	V_{DD}=3V		1	uA
			V_{DD}=5V		3	
V_{OS}	Input detuned voltage	V_{DD}=5V			1	uV
I_{OS}	Input de-regulated current	V_{DD}=5V			50	nA
A_{VO}	Open-loop voltage gain	V_{DD}=5V，R_L=1.5MΩ		60		dB
CMRR	Common Mode Rejection Ratio	V_{DD}=5V，R_L=1.5MΩ		60		dB
V_{YH}	Op-amp output high	V_{DD}=5V R_L=500KΩ接1/2V_{DD}		4.25		V
V_{YL}	Op-amp output low				0.75	V
V_{RH}	Vc input high	V_{RF}=V_{DD}=5V		1.1		V
V_{RL}	Vc input low				1.0	V
V_{OH}	Vo output high	V_{DD}=5V，I_{OH}=0.5mA		4.9		V
V_{OL}	Vo output low	V_{DD}=5V，I_{OH}=0.1mA			0.1	V
V_{AH}	Input high level at A	V_{DD}=5V		2.4		V
V_{AL}	Input low level at A	V_{DD}=5V			2.2	V

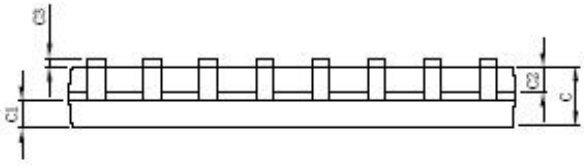
Note Size Maximal (mm)

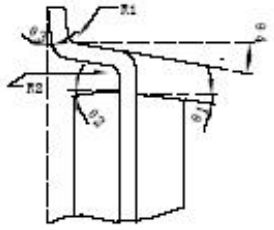
VIII. IC package diagram

Note \ Size	Minimum (mm)	Maximal (mm)	Note \ Size	Minimum (mm)	Maximal (mm)
A	9.9	10.10	C4	0.2TYP	
A1	0.356	0.456	D	1.05TYP	
A2	1.27TYP		D1	0.40	0.70
A3	0.35TYP		D2	0.22	0.42
B	5.84	6.24	R1	0.15TYP	
B1	3.84	4.04	R2	0.15TYP	
B2	5.0TYP		θ1	8° TYP	
C	1.35	1.55	θ2	8° TYP	
C1	0.61	0.71	θ3	4° TYP	
C2	0.54	0.64	θ4	15° TYP	
C3	0.10	0.30			









DETAIL "X"

All specs and applications shown above subject to change without prior notice.