SSVD

Silicon photocell

PRODUCTS FEATURES

- High sensitivity
- Wide spectral response shall range
- Good linearity
- Low noise
- Simple and flexible electrical circuit design

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1. Principle and structure

Figure 1.1. is the working principle of the semiconductor p-n junction photodetector . The device is not exposed to light, and only heat is generated through the p-n junction. Tiny dark current; the p-n junction is illuminated by light, and the strong junction electric field puts The electrons generated in the space charge region are pulled towards the p region and the n region by a hole pair; The few carriers generated in the p and n regions diffuse first, Only a few carriers that have diffused to the p-n junction interface can contribute to the current.

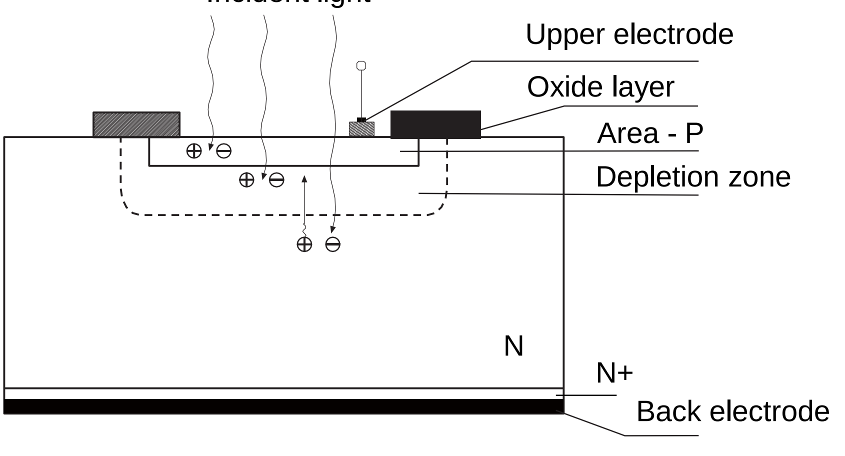

Figure 1.1. Schematic diagram of the structure of the *p-n* junction photoelectric device

We know that the penetration depth of light in silicon is inversely proportional to the absorption coefficient number relationship, that is to say, high absorption always occurs on the surface of the battery effective light as the wavelength of incident light decreases (photon energy increases). Absorption gradually moves from the inside of the silicon to the surface. The wavelength of purple blue light is shorter than the wavelength of red light, so the absorption of purple and blue light mainly occurs in the device inside the thin layer on the surface of the piece, and will never enter the depths of the battery. In order to improve the detection sensitivity of purple blue light, the knot depth must be reduced. According to this design idea, through special technological means, so that we produce SSVD series M photodetectors that can be from 200nm for digital display voltmeter, digital display ammeter, voltmeter, ammeter, power instrument The whole range of 1050nm uses each application of decentralization. Spectral response The peak wavelength of the conventional silicon photodetector has been moved from 850nm blue to 650nm. The physical shape of the device is shown in (Figure 1.2.), where (a) is a metal seal, (b)-(d) is a black ceramic package.

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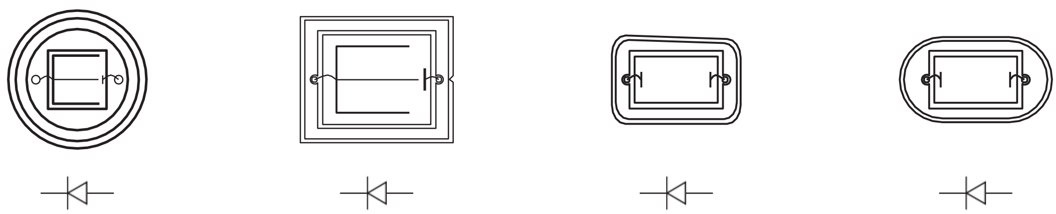

(a) (b) (c) (d)

Figure 1.2. Physical shape of the device

2. Parameters and Characteristics

Table 1 is the main parameter of the SSVD series M photoelectric controller indicators. In order to have a more in-depth understanding of the performance of the device, the following pair some of the main parameters are introduced qualitatively

Table 1.

Parameter name	Test conditions	Unit	SSVD metal shell			SSVDM100 black ceramic			SSVDM025 black ceramic			SSVDM006 black ceramic			PSD two-dimensional		
			C	D	F	C	D	E	C	D	E	C	D	F	C	D	F
Dimension		mm	Φ22			16.5x15			10.5x9			Φ8x6			Φ22		
Effective area		mm²	10x10						5x5			2x3			8x8		
Window material			G	Q	C	E	Q	E	E	Q	E	E	E	C	Glass		
Sensitivity	2856K, 100LK	uA	40		20	40			10			2		1	100		
Sensitivity	700nm	A/W	0.35		/	0.35								/	0.45		
Wavelength range	λ>10% max	nm	200-1050		380-680	380-1050	200-1050	300-1050		200-1050	300-1050			380-680	400-1100		
Peak wavelength		nm	650		550	650								550	900		
Current Shunt	E=0,VR=10 mV	MΩ	>1	>10	>0.1	>1	>10	>10	>1	>10		>10	>100	>10	0.1	1	10
Dark current	E=0, Vo=1	uA	1	0.1	10	1	0.1	0.1	1	0.1		0.1	0.01	0.1	10	1	0.1
Capacitor	E=0,V=0	nf	<10						<2.5			<0.5			1.2		
Rising time	E=1000Lx, Ri=1000	us	100		200		100		20			4			10		

*Window material: G – glass; Q – quartz; C – color film; E – epoxy.

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3. Dark current

Dark current refers to the current flowing through the photoelectric device when there is no light (that is, in the dark state). The current in the circuit is set, which consists of surface leakage and substrate leakage. Surface leakage is determined by surface state, cleanliness, bias and surface area; The leakage of the substrate depends on the effective area, the resistivity of the material and the added bias. Both leakage currents are related to temperature, and every 10C increase in temperature the dark current will increase exponentially. It can be seen that reducing the operating temperature of the device can to reduce the dark current, and the reduction of the dark current will increase the signal and noise of the device ratio. Generally speaking, the smaller the effective area, the smaller the dark current, which is conducive to the signal-to-noise ratio is improved. In turn, due to the reduction of the effective area, the output photocurrent is also reduced. It can be seen that under different requirements, you can choose photoelectric devices with different effective areas.

4. Shunt resistor

As a photodetector, not only must the influence of the series resistance Rs be considered sound, and, more importantly, the shunt resistor Rsh must also be considered influence. Most detectors are used under small signals, in order to obtain sufficient sufficient signal current (or voltage), the load resistance is generally very large, at this time, Rsh is the main classification of the SSVD series M photodetector basis.

5. Junction capacitance

The junction capacitance is related to the junction area and the thickness of the depletion layer, and the depletion layer the thickness is also related to the infiltration of the substrate and the applied voltage. At the same junction In the case of product, the smaller the impurities of the substrate (the higher the resistivity of the material), So the higher the back voltage, the smaller the junction capacitance. Alternating response for complete use, the time constant due to junction capacitance must be considered. It seriously affects the output amplitude of the signal, and the larger time constant is often It will cause the indicator meter to react too late and fail to read accurately.

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6. Spectral response

The spectral response is one of the most important parameters of the photoelectric sensor, it Determines the applicable spectral range of photoelectric devices. Figure 6.1. shows the spectral response curve of the SSVD series M curve 1 and conventional silicon the spectral response curve of the photoelectric device (curve 2), it is not difficult to see, the SSVD series has a high violet-blue light response, it can replace the photocell and detect the purple blue light, and at the same time It is also suitable for the detection of visible and near-infrared light.

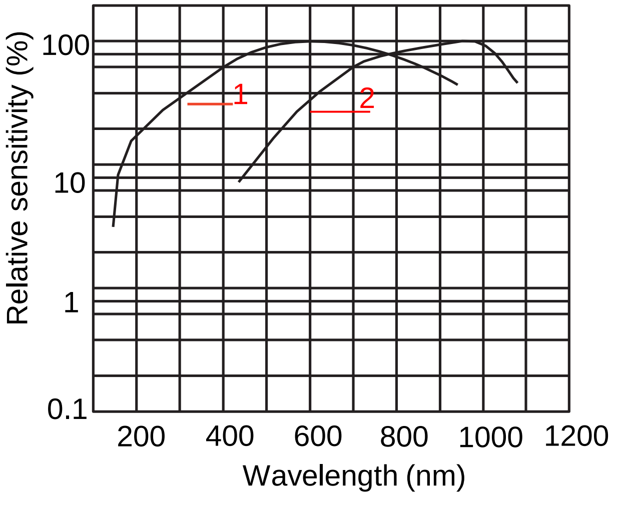

Figure 6.1. Spectral response

7. Lighting characteristics

Figure 7.1. The SSVD series measured with fluorescent lamp as the light source the lighting characteristics. The short-circuit current is linear to the light; if negative when the carrier resistance is 1KΩ, within 1000Lx, the device is still relatively Good linearity.

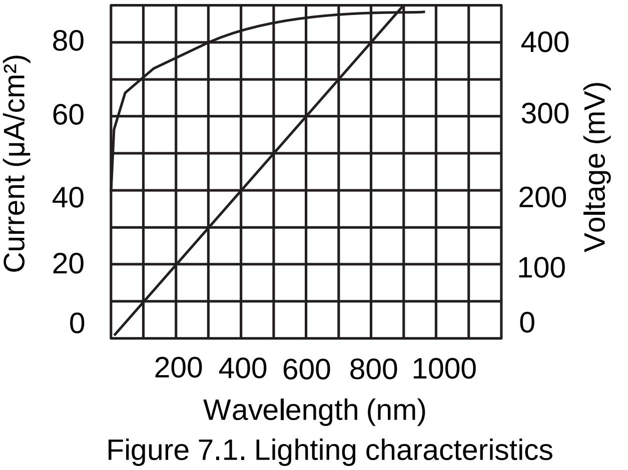

Figure 7.1. Lighting characteristics

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8. Frequency response

There is one for the generation and recombination, movement and trapping of carriers time process, therefore, various photoelectric devices based on carrier effect devices or other sensors have time to respond to this parameter. Photoelectric device the time to respond to this parameter. The time response of the photoelectric device is divided by in addition to the above-mentioned inherent factors, it is also related to the device material, structure, and several what size and conditions of use are related. Figure 8.1. is the frequency response of the SSVD series Curve, the light is 1000Lx; the load resistance is 100Ω. In the picture , Curve 1 is SSVDM100, curve 2 is SSVDM025, curve 3 Is SSVDM006.

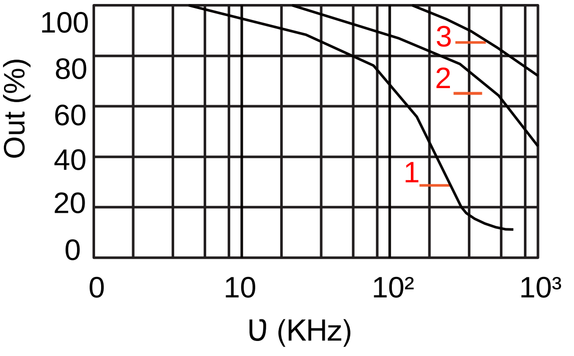

Figure 8.1. Frequency response

9. Noise

A system in thermal equilibrium, due to internal molecules or electrons It has a certain kinetic energy, so there will be some ups and downs, this kind of random The ups and downs of the machine are called noise. In short, noise is nothing more than material separation a manifestation of dispersion. Noise characteristics are the most important of all sensors one of the basic characteristics. There are two main types of noise in the sensor thermal noise and bulk noise. Thermal noise is caused by the irregularity of the carrier caused by thermal movement. A certain amount can be obtained through reasonable device design degree of control. Scattered particle noise is an inherent characteristic of photodetectors and is The average fluctuation of the number of carriers in the barrier region is caused by the production of carriers It is impossible to completely eliminate the noise caused by the compounding of life and death. Right big For most photodetectors, among the various noises, scattered particle noise dominates, especially in the interstellar state, the internal carrier of the device The thermal movement causes the electric charge inside the detector to continue to generate and compound, forming Into a nasty dark current. After the combination of the detector and the ideal amplifier The comprehensive noise mainly comes from the shunt resistor and the feedback resistor.

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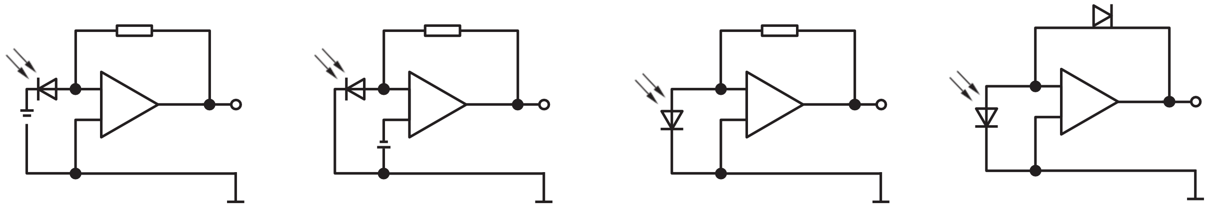
10. Reference circuit

The SSVD series is a kind of operation that can be operated under reverse bias and can be used in photoelectric devices that work at zero bias, the working state of which is called light guide mode. The latter is called the photovoltaic mode, as shown in Figure 10.1., in the figure (a) and (b) are the basic circuits in the light guide mode; (c) and (d) Is the basic circuit in photovoltaic mode; the base (c) is the current one Voltage, converter; (d) is a logarithmic converter. Working in light guide mode The working device can be a current source; it works in photovoltaic mode The device can be seen as a voltage source; this is the most photoelectric device. There are two main working modes; their advantages and disadvantages depend on the system Design and practical application. In the case of the same effective area, Using the light guide mode, a smaller junction capacitance can be obtained, resulting in Higher frequency response; higher sensitivity in the long wavelength band; in The photocurrent has good linearity over the entire irradiation range. Adopt light Volt mode can get smaller diode scattered noise, but long waves The sensitivity is low and the junction capacitance is large, resulting in poor frequency response. Under constant light, most circuit designers use light Volt mode operation; light guide mode operation is used in alternating light; no discuss which working mode to use. Currently, photodetectors are used in combination with an op amp, its outstanding advantage is that the detector output and The irradiation it receives is linearly related to the open-loop current of the amplifier the pressure gain is almost irrelevant.



(a) (b) (c) (d)

Figure 10.1. Circuit diagram

Figure 10.2 and Figure 10.3 are the typical DC and AC amplifier Type circuit. In Figure 10.2, the sensitivity is controlled by the switch K The size of the Rf is determined. As long as the input impedance of the operational amplifier Much larger than the feedback resistor (the maximum value in the figure is 10MΩ) Rf; then The circuit has good linearity and signal-to-noise ratio. If the detector is shunted If the resistance is greater than 108Ω, the above circuit should be 10-8A signal The signal current is amplified. In the AC amplifier Figure 10.3, (a) Is a field effect transistor AC preamplifier; (b) is High-speed video amplifier. In the two circuits, there is one choice for RL What we have in common is that we must take into account both the response speed and the test. Taking into account sufficient sensitivity.

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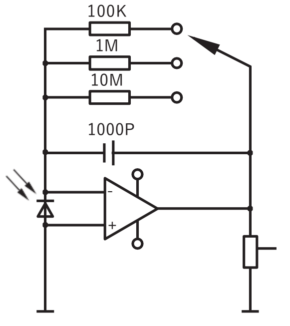
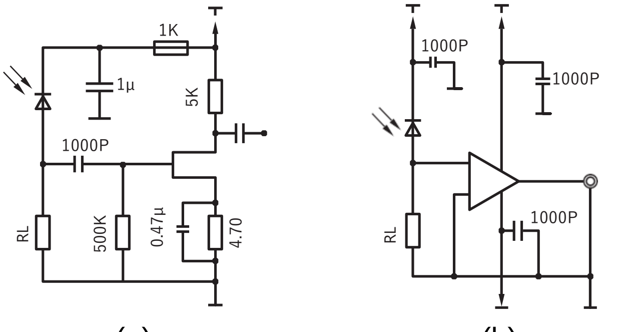


Figure 10.2.



(a) (b)

Figure 10.3.

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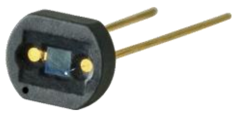
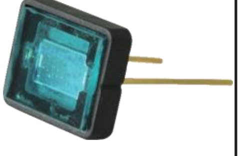
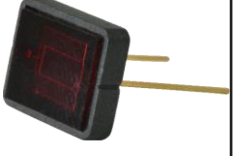
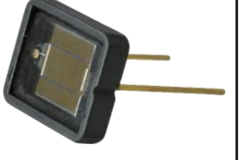
Model number	SSVDM004	SSVDM006	SSVDM025	SSVDM9018
Physical map				
Model number	SSVDM025E	SSVDM025B	SSVDM025R	SSVDM025S
Physical map				
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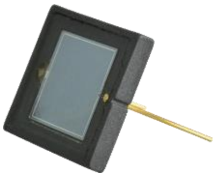
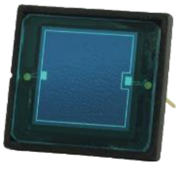
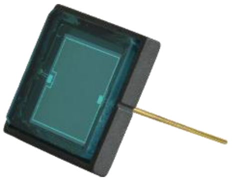
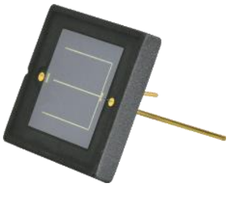
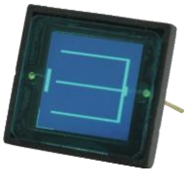
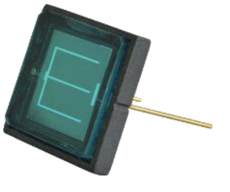
Physical map				
Model number	SSVDM100EB		SSVDM100EB1	
Physical map				

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