Acousto-Optic Tunable Filter (AOTF)

Operating Instructions and Test Report

Model: OE-AOTF-L135-400/1500-3A

(Generic Version)

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1 Product Overview

1.1 Product Description

This device is an acousto-optic tunable filter (AOTF) based on anomalous Bragg diffraction in an anisotropic medium. With the directions of the incident light and the acoustic wave fixed, only the incident light within a very narrow spectral bandwidth satisfies the momentum-matching condition for a given ultrasonic frequency and is diffracted. As the ultrasonic frequency is varied, the wavelength satisfying the momentum-matching condition changes accordingly, enabling electrically tunable spectral filtering over a wide wavelength range.

1.2 Operating Principle Schematic

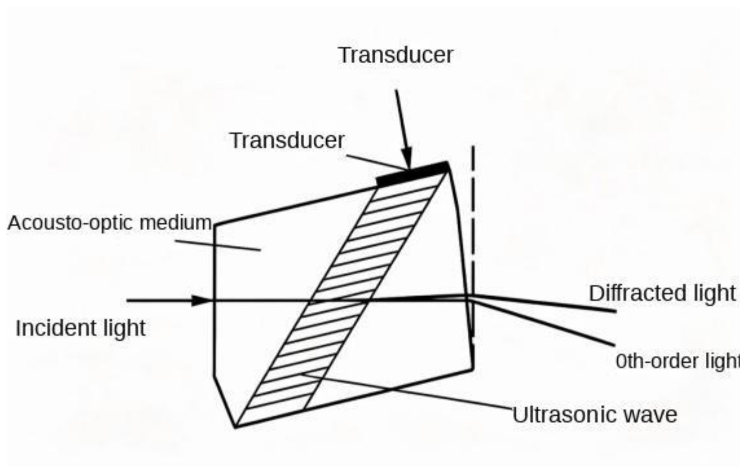

Figure 1 Operating principle of the acousto-optic tunable filter

2 Main Technical Specifications

Unless otherwise stated, the following parameters are measured at room temperature (24 °C).

Parameter	Unit	Min	Typ	Max
Optical wavelength	nm	—	400~1500	—
Input polarization	—	—	//	—
Optical aperture	mm	—	3×3	—
Diffraction efficiency	%	60	70	90
Optical transmittance	%	85 (@430~450 nm)	88	—
Optical transmittance	%	90 (@450~900 nm)	95	—
Spectral resolution	nm	—	—	12

Parameter	Unit	Min	Typ	Max
Separation angle	°	5.6	—	—
First-order deflection angle	°	—	3±0.1	—
RF drive power	W	0.5	1	2
Operating frequency	MHz	—	40~220	—
Cooling method	—	—	Conduction	—
RF connector	—	—	SMA	—

3 Device Structure and Optical Path

3.1 Dimensions and Mounting

The device adopts an LH2 package with an SMA RF connector. The overall dimensions are approximately 50 mm × 46.1 mm (subject to the actual unit). During installation, ensure the mounting base is in firm contact with a heat-dissipation plate to guarantee effective conduction cooling.

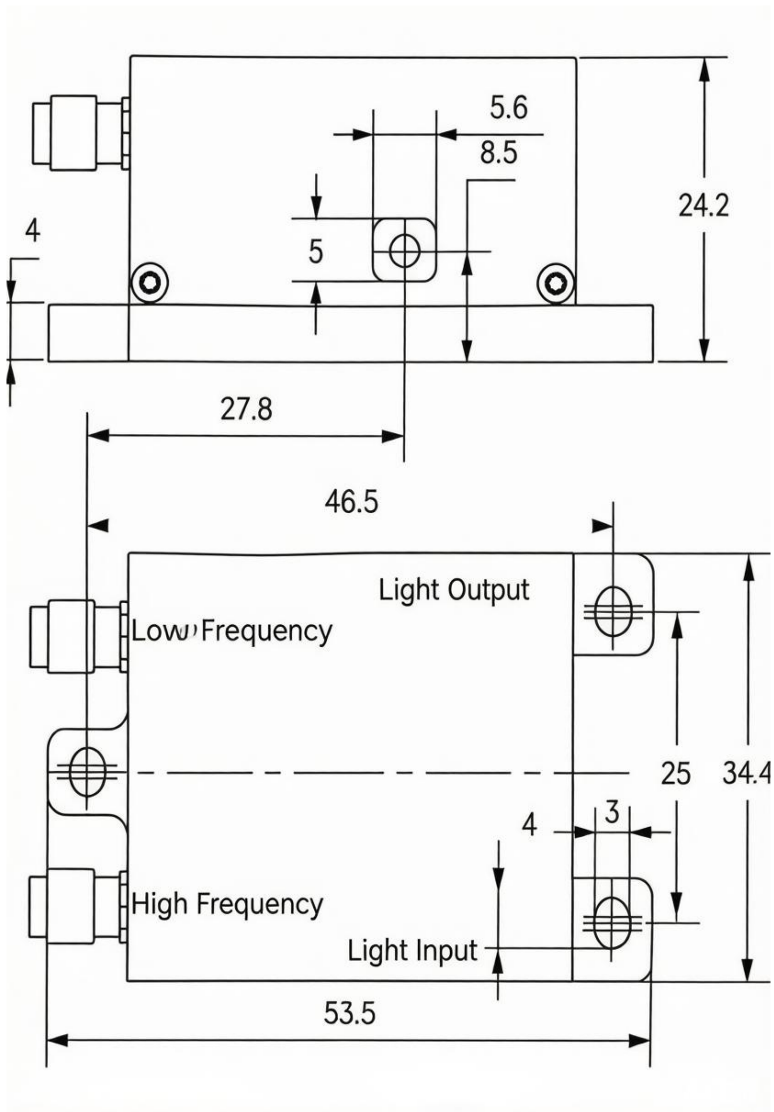

Figure 2 Device outline drawing

3.2 Optical Path Description

The incident beam enters the optical aperture perpendicularly and is split inside the acousto-optic medium into the zeroth-order beam (undiffracted) and the first-order diffracted beam, which exit at a separation angle. The first-order deflection angle is approximately 3°, and the separation angle is no less than 5.6°.

4 Operating Instructions

4.1 RF Input and Frequency Bands

The RF signal is fed into the device through the high-frequency band and the low-frequency band respectively. The high-frequency band covers 220 MHz to 90 MHz, and the low-frequency band covers 90 MHz to 42 MHz.

4.2 Diffracted Beam Alignment

When aligning the diffracted beam, place the device horizontally and let the incident beam enter the optical aperture perpendicularly. Apply an RF signal of the appropriate frequency, and the first-order diffracted beam at the corresponding wavelength will be filtered out.

4.3 Frequency–Wavelength Correspondence

The correspondence among optical wavelength, operating frequency, and spectral resolution is given in Table 1, and the frequency–wavelength characteristic curve is shown in Figure 4. The following fitted formula can be used for quick estimation:

$$\lambda = (0.46333 f^2 - 7.8339 f + 67878.86344) / (f + 2.59292)$$

where f is in MHz and λ is in nm.

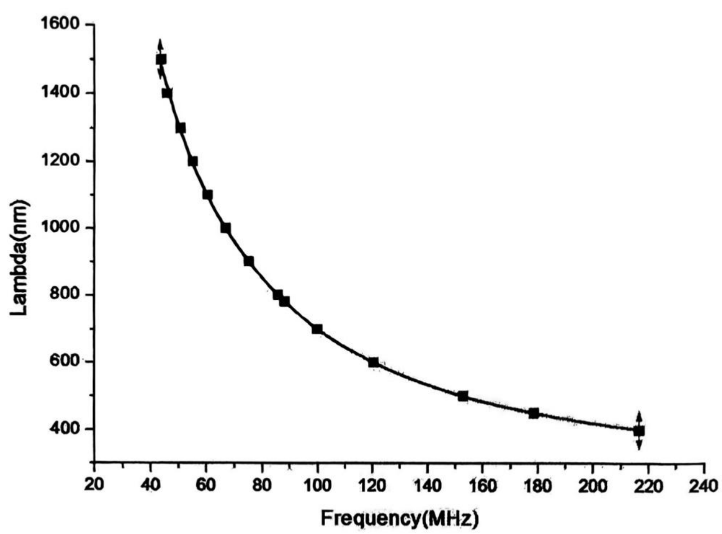

Figure 4 Frequency–wavelength characteristic curve

Table 1 Correspondence among optical wavelength, operating frequency, and spectral resolution

Band	Wavelength (nm)	Frequency (MHz)	Diffraction Efficiency (%)	Spectral Resolution (nm)	Level
HF	400	216.5	70	1.4	0.93

Band	Wavelength (nm)	Frequency (MHz)	Diffraction Efficiency (%)	Spectral Resolution (nm)	Level
	450	178.5	72	—	0.48
	500	152.7	73	—	0.46
	600	120.2	78	—	0.5
	700	99.7	76	—	0.53
	780	88.05	77	6.5	0.7
LF	780	88	75	2.9	0.38
	800	85.55	77	—	0.41
	900	75	79	—	0.39
	1000	66.85	74	—	0.38
	1100	60.25	82	—	0.41
	1200	54.95	80	—	0.55
	1300	50.5	74	—	0.68
	1400	46.65	77	—	0.66
	1500	43.35	78	11.9	0.64

5 Precautions

1) Mount the device on a heat-dissipation plate and keep the case temperature below 35 °C (20 °C recommended).

2) When aligning the diffracted beam, place the device horizontally and let the incident beam enter the optical aperture perpendicularly. Apply an RF signal of the appropriate frequency to filter out the diffracted beam at the corresponding wavelength.

3) Diffraction efficiency depends on the laser mode: the poorer the beam mode quality, the lower the diffraction efficiency; the closer the beam is to the fundamental mode, the higher the efficiency.

4) The RF drive power must be lower than the maximum power specified in the technical specifications (2 W); excessive RF power may degrade device performance or damage the device.

5) The device contains a crystal. Handle it with care.

6) The device contains gold wires. Keep it away from strong airflow — broken gold wires will cause device failure.

6 Test Report Summary

6.1 Test Conditions

Test item: Room-temperature performance specifications

Ambient temperature: 24 °C; relative humidity: 50 % RH

Sample quantity: 1 unit

6.2 Test Results

The sample passed all specified tests and is judged as qualified (PASS).

Detailed test data are given in Section 4.3 "Frequency–Wavelength Correspondence" (Table 1 and Figure 4). Tests were performed at room temperature only.