

# Optical Wavelength/Frequency Counter



MF9630A

0.6 to 1.6  $\mu\text{m}$ /500 to 187 THz



Because of rapid developments in optical communications, precise measurements of light sources oscillation frequency and wavelength have become necessary. The MF9630A Optical Wavelength/Frequency Counter has an accuracy of  $\pm 0.5$  ppm and a resolution of better than 0.1 pm/12 MHz. The MF9630A brings greater precision than ever before to the measurement of the oscillation frequency for frequency division multiplex communications (FDM) and to the evaluation of frequency-stabilized light sources.

## $\pm 0.5$ ppm High-Accuracy Measurement



### Optical Wavelength/Frequency Calibration Using The $^{127}\text{I}_2$ Stabilized He-Ne Laser Light Source

The measurement accuracy of the MF9630A is determined by comparing MF9630A wavelength measurement to an iodine-stabilized He-Ne laser recommended by the CIPM\*\* (International Metrology Committee) to define reference meter length. The uncertainty of the optical wavelength/frequency for the He-Ne laser source is  $10^{-9}$ . When this is measured by the MF9630A, the error is  $\pm 70$  fm, which is small enough compared to the specified accuracy of  $\pm 0.5$  ppm (approx. 310 fm for every  $0.633 \mu\text{m}$ ).

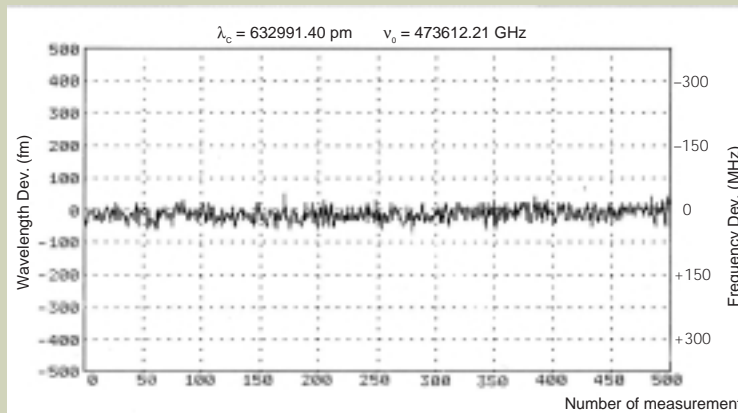
\* These measurements were done under the technical guidance of the National Research Laboratory of Metrology (Japan), with a Ne-He laser tuned to the iodine absorption line [ $^{127}\text{I}_2$ , 11-band, i component of R(127)].

The following values were used as the vacuum wavelength  $\lambda_0$  and frequency  $\nu_0$  of the oscillated He-Ne laser light.

$$\lambda_0 = 632\,991\,398.1 \text{ fm}$$

$$\nu_0 = 473\,612\,214.8 \text{ MHz}$$

\*\*CIPM: Comité International des Poids et Mesure



MF9630A Measurement repeatability data of iodine-stabilized He-Ne laser

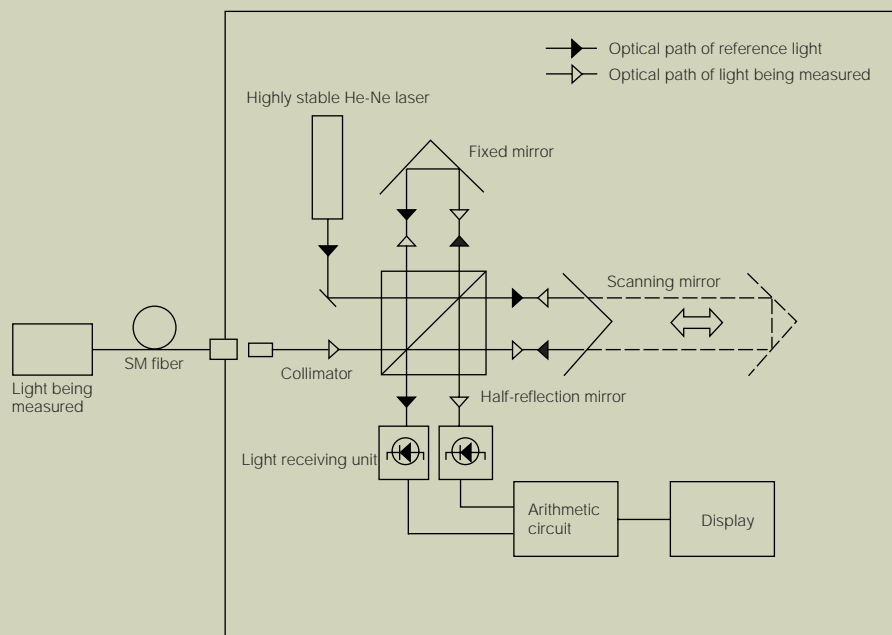


# 0.1 pm/12 MHz Ultra-High Resolution

## ■ Principle of operation

The MF9630A uses a Michelson interferometer to count the number of intensity fringes in the interference patterns of both the reference light source and the light source being measured. It then determines the wavelength and frequency of the light source being measured from the ratio of these numbers.

The MF9630A schematic diagram is shown below.



# One-Touch Selection of Optical Wavelength



**Hz/m key**  
 Alternately switches between frequency and wavelength.  
 The displayed wavelength/frequency is converted to the wavelength in a vacuum.



## Display section

The frequency is displayed as a 9 digit (max.) value, while the wavelength is displayed as a 10 digit (max.) value. Ninth digit becomes effective at AVERAGE mode when measuring wavelength/frequency of light with  $\leq 100$  MHz spectral FWHM. The READY lamp comes on when measurement can be performed.

## STANDBY lamp (LED)

## Power supply switch



## GP-IB LOCAL key

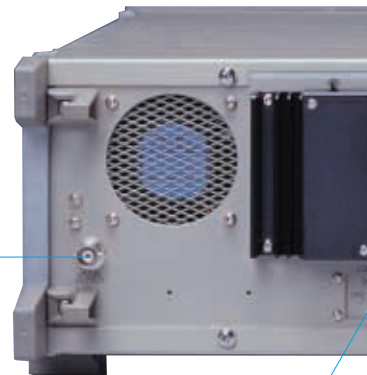
## Measurement of Wavelength/frequency variation

### RELATIVE ON/OFF key, 0.1 V/GHz OUTPUT connector

Used when measuring variations in optical wavelength/frequency. The value displayed before the RELATIVE key is pressed becomes the reference value. Therefore, deviations from this reference value are displayed. Moreover, an analog voltage corresponding to these deviations is output from the rear-panel BNC connector.

This analog voltage is output at a ratio of 0.1 V/GHz for both frequency and wavelength measurements to a maximum of  $\pm 10$  Vdc.

**AVERAGE ON/OFF key**  
 When ON, the average of measurements is displayed.



## LOCK lever

Set this lever to ON when transporting the MF9630A to secure the optical unit.

## AC power supply input connector

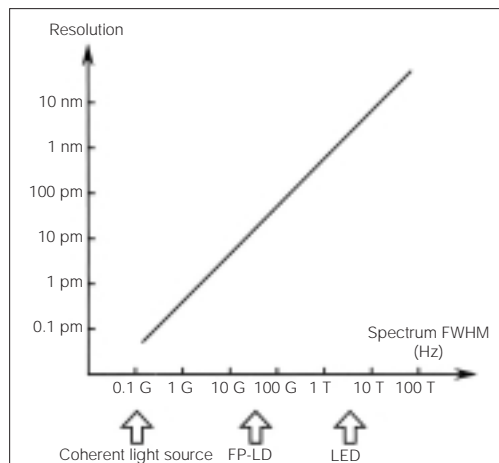
# Length or Frequency Display

between the frequency displays. Length denotes cumulative.

## Automatic Setting of the Number of display digits According to the Characteristics of the light being Measured

### RESOLUTION-AUTO/MANUAL key and BLANKING key

The measurement resolution is determined automatically from the spectral full width at half maximum (FWHM) of the light to be measured and the number of displayed digits are set accordingly. Consequently, both incoherent (LED, etc.) and coherent light can be measured at optimum resolution. Also, in the MANUAL mode, the number of digits can be set from 4 to 10 via the BLANKING key.



Relationship between spectral FWHM and resolution



### MONITOR

Alternately switches between optical level and polarization monitoring mode.

### POLARIZATION ADJUST

Adjusts polarization of light to be measured

### OPTICAL INPUT

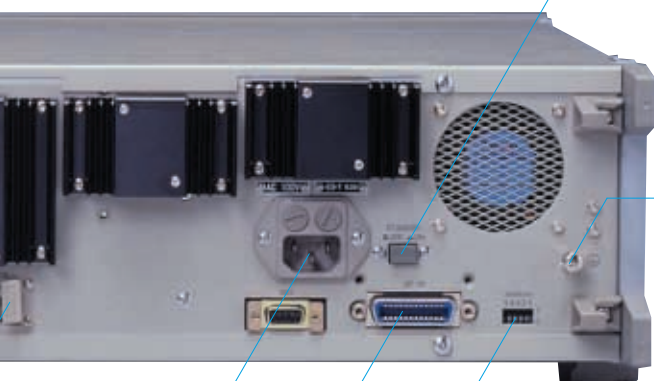
### MEASURE ON/OFF key

### MEASURE ON/OFF key

Displays the average of the previous 10 measurements.

### STANDBY switch

Turns internal reference light source ON/OFF. The front STANDBY LED lights when this switch is ON. Generally, the internal reference light source must be warmed-up for about 30 minutes.



### Frame grounding terminal

### GP-IB address switch

### GP-IB connector

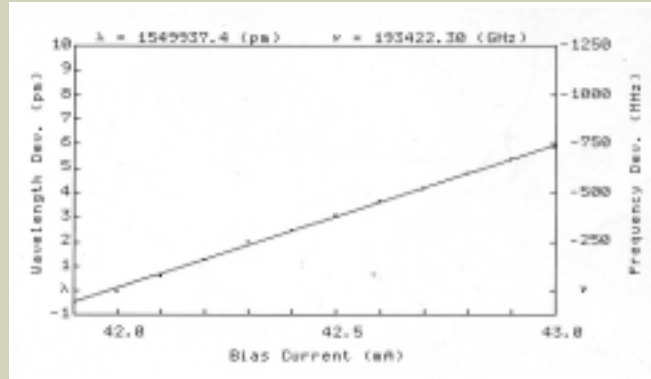
## ▼ Measurement Examples

### 1. LD Bias Current vs. Oscillation Wavelength/Frequency Characteristics

It is known that the LD oscillation wavelength/frequency changes with the bias current.

The figure on the right shows the wavelength/frequency of a 1.55  $\mu\text{m}$  LD as the bias current is changed in 0.1 mA steps over a 1 mA range.

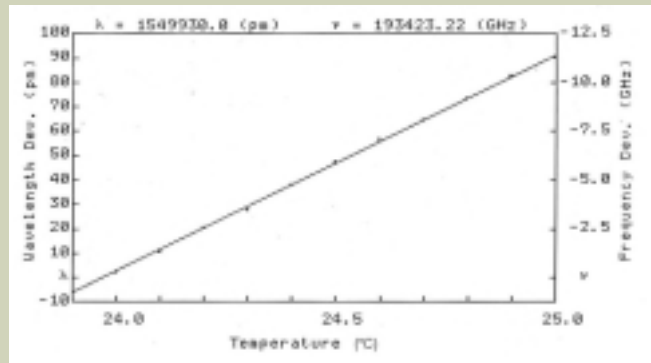
Since the MF9630A has a resolution of 0.1 pm, it plays a powerful role in monitoring the wavelength/frequency of frequency-stabilized and variable wavelength light sources.



### 2. Temperature Characteristics of LD Oscillation Wavelength/Frequency

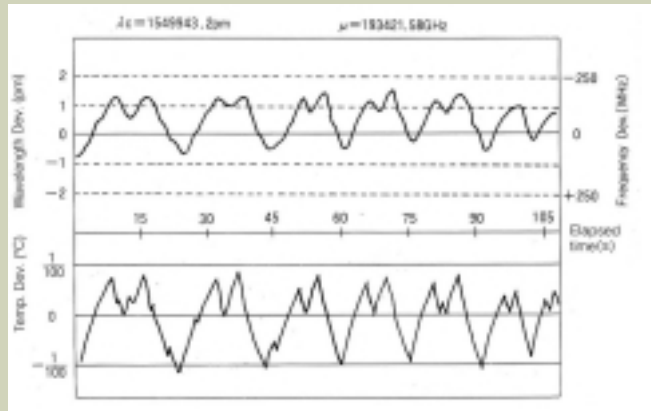
An important factor in frequency-stabilized light sources is temperature control.

The figure on the right shows the variation in wavelength/frequency of 1.55  $\mu\text{m}$  LD when its temperature is changed over a 1°C range, in 0.1°C steps.



Bias current—Oscillation wavelength/frequency characteristics

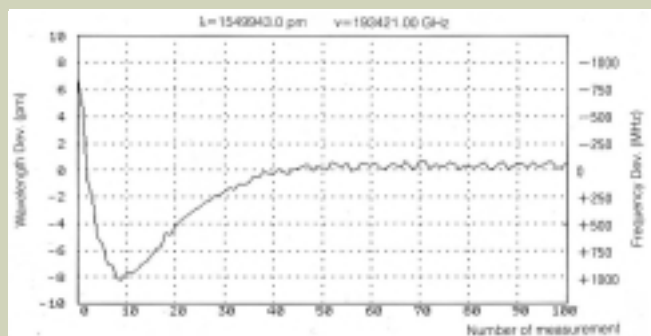
The figure on the right shows the variation in oscillation wavelength/frequency when the LD temperature is controlled to within  $\pm 1/100^\circ\text{C}$ .



LD temperature vs. wavelength/frequency deviations

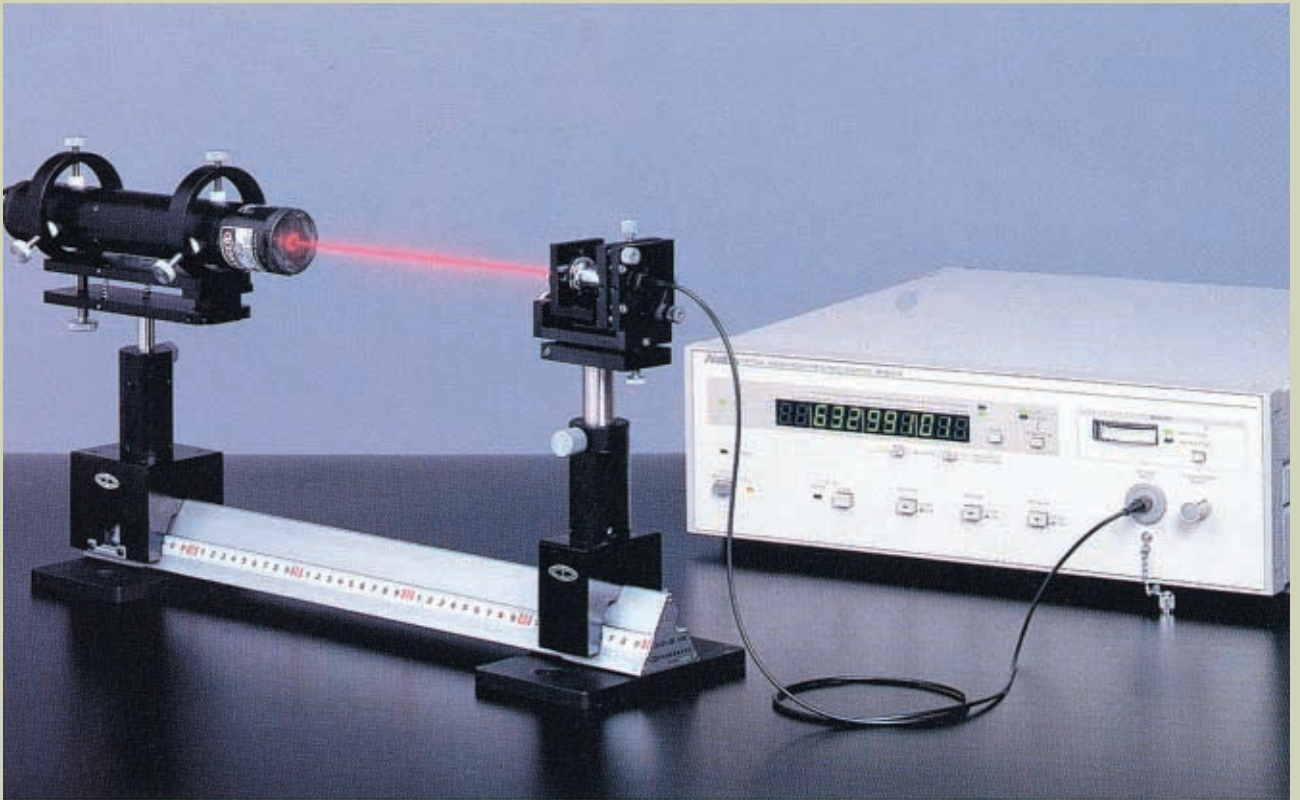
### 3. Wavelength/Frequency Variations After Power is Applied

The figure on the right illustrates the oscillation wavelength/frequency from the moment power is applied until characteristics are stable.



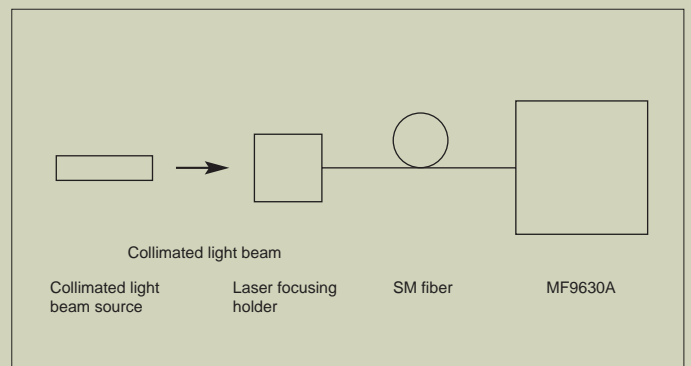
Wavelength/frequency variations after power is applied

## ▼ Applications



### Laser Beam Measurement

When measuring the wavelength/frequency of collimated light beam sources such as He-Ne laser, use a laser focusing holder to concentrate light at the tip of the optical fiber to be input to the MF9630A.



## ▼ Specifications

Range	Wavelength	0.6 to 1.6 $\mu\text{m}$
	Frequency	187 to 500 THz
Optical input level		-25 to 0 dBm (CW)
Applicable light sources		LD, LED, GAS laser, etc.*1
Accuracy		$\pm 0.5$ ppm*2
Resolution		$< 0.1$ pm*3
Measuring interval		$< 1.5$ s
Connector		FC-type*4

Modulation signal		AM, $> 5$ MHz
Display	Frequency	9 digits (LSD 1 MHz)
	Wavelength	10 digits (LSD 1 fm)
Ambient temperature		0° to 40°C (Usable) 25° $\pm$ 5°C (Spec. meet)
GP-IB		Conforms to IEEE-488. I
Power		*Vac +10/-15%, 50/60 Hz
Dimensions and weight		426W $\times$ 132.5H $\times$ 451D mm, $< 22$ kg

\* Please specify a line voltage between 100 and 240 V when ordering.  
Maximum operating voltage is 250 V.

\*1 When spectral FWHM  $< 20$  THz (corresponds to approx. 112 and 160 nm for every 1.3 and 1.55  $\mu\text{m}$ )

\*2 For  $\lambda = 0.633$   $\mu\text{m}$  and relative humidity 50%. The accuracy for other wavelength conditions was not investigated, but was confirmed theoretically.  
(Using a highly stable light source whose wavelength = 1.53  $\mu\text{m}$  and whose frequency stability  $5 \times 10^{-9}$ , the repeatability was shown to be  $\pm 0.3$  pm)  
For accurate measurement, the optical fiber must be a single-mode fiber matched to the wavelength of the DUT.

Built-in reference light source; Frequency stability  $1 \times 10^{-9}$  He-Ne laser.

\*3 Depends on FWHM of light source (See the graph on 5 page.)

\*4 Optical connector of standard model is FC-type. For other connectors, please consult nearest Anritsu representative.  
(For precise measurements, the optical fiber must be a single-mode fiber that is matched to the wavelength of DUT.)

## ▼ Ordering Information

Please specify the model/order no. name and quantity when ordering

Model/Order No.	Name	Remarks
MF9630A	<p align="center">– Main frame –</p> Optical Wavelength/Frequency Counter <p align="center">– Standard accessories –</p> Power cord, 2.5 m: 1 pc Fuse, 6.3 A: 2 pcs MF9630A operation manual: 1 copy <p align="center">– Optional accessories –</p>	T6.3A250V
F0014 W0591AE		
MZ7005A G0041 J0056A J0581 G0046 J0008	Stand Rail Optical fiber cord, 1 m Optical fiber cord, 1 m Laser Focusing Holder GP-IB cable, 2 m:	For 1.3 $\mu\text{m}$ , 1.55 $\mu\text{m}$ For 0.63 $\mu\text{m}$ , 0.85 $\mu\text{m}$ Sigma KOHKI ( $\Sigma$ -77F) 408JE-102

# Anritsu

Specifications are subject to change without notice.

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