



CH-10 and CH-20 Resonant Optical Modulator

FEATURES AND ADVANTAGES

ONE FIXED FREQUENCY

CH-10: from the range of 10 Hz to 1 kHz

CH-20: from the range of 200 Hz to 6 kHz

Aperture up to 10mm for the CH-10, 5mm for the C

Small size/lightweight

Withstands shock and vibration

Low power drive electronics

Rugged, no wearing parts

Maintenance free

High reliability

High frequency stability (to 0.005%)

High amplitude stability <.01%

Vacuum operation (to 10^{-10} Torr.)¹

High/low temperature operation (Cryo to 200°C)¹

Jitter free operation

No radiated electromagnetic interference (EMI)

Reference signal available

Single vane for alternate beam chopping¹

Metal vanes are standard, mirrors, prisms or

lenses optional¹

¹ Available as a special order



DESCRIPTION

The FIXED FREQUENCY resonant optical modulator is an electromagnetically driven tuning fork device, which uses vanes, of different shapes and surface characteristics, attached to moving tines, to chop a light beam with a sinusoidal motion. A range of factory set fixed frequency modulation waveforms (sine, half sine and pulse) is available. The modulating frequency range of the CH-10 chopper is from 10 Hz to 1 kHz and that of the CH-20 chopper is from 200 Hz to 6 kHz, **fixed at any one value** within the range. The aperture is inversely proportional to the frequency, and is a function of the size of the vanes and the type (duty cycle). Operation at the natural resonant frequency is sustained by a feedback amplifier, the **AGC** driver or the **ED** driver, supplied separately. The driver controls the aperture and provides a reference signal. The **PLD-1C** driver will phase lock the device to an external stable source. The **PLD-2C** driver will lock two choppers in a master/slave mode.

The most common type of aperture is the half open in the rest position, 90% duty cycle. It is used for a large beam diameter. When the modulator is operating in this configuration the maximum aperture is produced. The vanes are factory adjusted so that when fully illuminated the maximum excursion condition (controlled by the drive electronics) generates an almost complete sine wave as shown in figure 1.B. Typically, the light is transmitted for 90% of each cycle. The 50% duty cycle modulation is used for a small beam diameter, shown in figure 1.A. The vanes are factory adjusted to be just closed in the rest position. Full aperture for 50% duty cycle is one half of the 90% duty cycle.

Balanced operation and high "Q" insure frequency stability, low electrical drive power and low reaction forces.

High flexural stiffness provides good resistance to shock and vibration. The standard operating temperature is -40°C to +65°C. Tuning fork choppers are cryogenic and high temperature (200°C) capable. They can be constructed of low outgassing materials for ultra high vacuum (10^{-10} torr) applications.

Tuning fork choppers are especially suitable for long life dedicated applications, OEM, built into an instrument/system, and for portable systems. When working in tight spaces or when high vacuum or cryogenic conditions are required choppers are the best solution. An important use of the chopper is in the communication and data acquisition environments, where optical signals are obscured by noise. A fixed frequency modulated signal can be filtered from background noise much more readily than an unmodulated signal. This is best achieved using a lock-in amplifier. In this arrangement, the detected signal and the reference signal, mixed with the frequency of the tuning fork chopper, cause the frequency of interest to appear as a pure dc output level. All other signals are filtered with the low pass filter. Once noise is removed, proper signal measurements can be obtained.

Applications include: test equipment, noise detection (with a lock-in amplifier), pollution and gas detection, radiometry, radiation pyrometry, military, scientific, environmental and aerospace and atmospheric research, non-invasive medical research and laboratory research.

CH-10 SPECIFICATIONS

FREQUENCY Hz	50% DUTY CYCLE		90% DUTY CYCLE	
	FULL APERTURE		FULL APERTURE	
	mm	Inches	mm	Inches
10-150	5.1	.20	10.2	.40
200	4.0	.16	8.1	.32
250	3.8	.15	7.6	.30
300	3.1	.12	6.1	.24
400	2.4	.10	4.8	.19
450	2.0	.08	4.0	.16
500	1.8	.07	3.6	.14
600	1.5	.06	3.0	.12
700	1.2	.05	2.0	.09
800	1.0	.04	2.0	.08
900	0.8	.03	1.6	.07
1000	0.6	.03	1.2	.05

THE ABOVE SHOULD SERVE AS GUIDELINES ONLY

50% DUTY CYCLE

1. VANES POSITION AT REST:

 $B_0 \approx 0$
 B_0 IS THE OPENING AT REST

2. VANE POSITION $B(t)$ AS A FUNCTION OF TIME:

 FULL APERTURE
 VANES OPEN
 B_0
 50% VANES CLOSED

90% DUTY CYCLE

1. VANES POSITION AT REST:

 $B_0 \approx 1/2$ FULL APERTURE
 B_0 IS THE OPENING AT REST

2. VANE POSITION $B(t)$ AS A FUNCTION OF TIME:

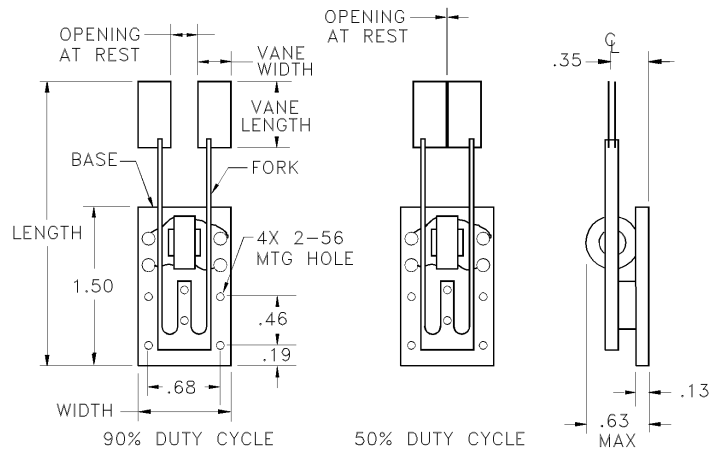
 FULL APERTURE
 B_0
 90% VANES OPEN
 10% VANES CLOSED

- NOTES: 1) FOR 50% DUTY CYCLE: THE OPENING AT REST IS ZERO
 2) THE STANDARD BASE HOLDS A SINGLE COIL.
 A BASE WITH TWO COILS IS RECOMMENDED FOR LOW FREQUENCIES AND HIGH AMPLITUDE STABILITY (WITH THE AGC DRIVER) AND FOR A WIDE TEMPERATURE RANGE
 A BASE WITH THREE COILS IS RECOMMENDED FOR HIGH FREQUENCIES AND HIGH AMPLITUDE STABILITY (WITH THE AGC DRIVER) AND FOR A WIDE TEMPERATURE RANGE
 3) THE VANE MOTION IS SINUSOIDAL

FREQUENCY Hz	CHOPPER			VANE		OPENING AT REST
	LENGTH INCH	WIDTH INCH		LENGTH INCH	WIDTH INCH	
		SINGLE COIL	DOUBLE/TRIPLE COIL			
10-50	2.81	.88	1.00	.63	.37	.20
60-200	2.69	.88	1.00	.63	.31	.20
200-400	2.56	.88	1.00	.50	.31	.20-.10
400-600	2.40-2.00	.88	1.00	.40	.24	.10-.06
600-800	2.00	.88	1.00	.40	.24	.06-.04
800-1000	2.00	.88	1.00	.40	.23	.04-.03

CH-10 OUTLINE DRAWING





DIMENSIONS ARE IN INCHES
METRIC MOUNTING OPTIONAL

CH-20 SPECIFICATIONS

FREQUENCY	50% DUTY CYCLE		90% DUTY CYCLE	
	mm	Inches	mm	Inches
200	2.5	.10	5.0	.20
400	1.5	.06	3.0	.12
800	1.0	.04	2.0	.08
1000	.85	.03	1.7	.07
1500	.70	.03	1.4	.06
2000	.40	.02	.80	.03
2500	.25	.01	.50	.02
3000	.20	.008	.40	.016
5000	.15	.006	.30	.012
6000	.10	.004	.20	.008

THE ABOVE SHOULD SERVE AS GUIDELINES ONLY

50% DUTY CYCLE

1. VANES POSITION AT REST:
 $B_0 \approx 0$
 B_0 IS THE OPENING AT REST

2. VANE POSITION $B(t)$ AS A FUNCTION OF TIME:

90% DUTY CYCLE

1. VANES POSITION AT REST:
 $B_0 \approx 1/2$ FULL APERTURE
 B_0 IS THE OPENING AT REST

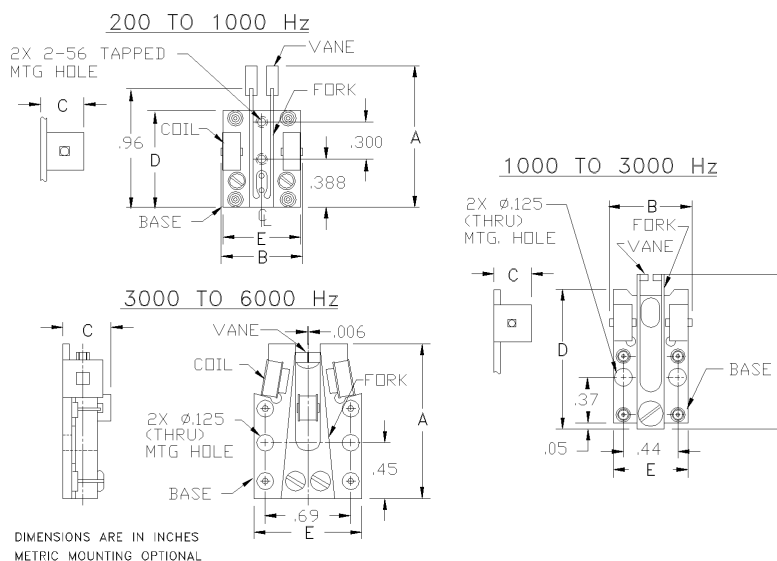
2. VANE POSITION $B(t)$ AS A FUNCTION OF TIME:

NOTES: 1) FOR 50% DUTY CYCLE: THE OPENING AT REST IS ZERO
2) THE VANE MOTION IS SINUSOIDAL

FREQ. Hz	CHOPPER			BASE		OPENING AT REST INCH
	LENGTH INCH	WIDTH INCH	HEIGHT INCH	LENGTH INCH	WIDTH INCH	
200-400	1.70	.68	.35	.78	.625	.10
400-800	1.40	.68	.35	.78	.625	.06
800-1000	1.30	.68	.35	.78	.625	.04
1000-1200	1.62	.68	.30	1.13	.625	.03
1200-1500	1.52	.68	.30	1.13	.625	.03
1500-1700	1.33	.68	.30	1.13	.625	.02
1700-2000	1.25	.68	.30	1.13	.625	.02
2000-2500	1.25	.68	.30	1.13	.625	.01
2500-3000	1.06	.68	.30	1.13	.625	.007
3000	.96	.68	.30	1.13	.625	.006
3000-6000	1.25	.88	.39	1.25	.875	.006



CH-20 OUTLINE DRAWING



ORDERING INFORMATION

TYPE [CH-20]; DUTY CYCLE [%]; VANE [B=bright or D=dark]; FREQUENCY [Hz]

Example: PART NO. CH20-50D3000. This part number specifies the model CH-20 chopper, with 50% duty cycle, dark vanes and a 3 kHz operating frequency.

Special vane configurations, modulating waveforms and shapes are available on special order. Consult factory.

Drive electronics with different package, regulation, reference signal and power supply options are available.

Special pricing for OEM applications.

APPLICATION NOTES

An important use of the chopper is in the communication and data acquisition environments, where optical signals are obscured by noise. A fixed frequency modulated signal can be filtered from background noise much more readily than an unmodulated signal. This is best achieved using a lock-in amplifier. In this arrangement, the detected signal and the reference signal, mixed with the frequency of the tuning fork chopper, cause the frequency of interest to appear as a pure dc output level. All other signals are filtered with the low pass filter. Once noise is removed, proper signal measurements can be obtained.

Another significant use is in aerospace and atmospheric research. The CH-10 and CH-20 type choppers were part of many space research projects:

- Goddard Space used a reflective tuning fork chopper on board the Cosmic Background Explorer (COBE) in the Diffuse Infrared Background Experiment (DIBRE) to interrupt a beam of IR radiation.
- Texas Instruments Corporation used a tuning fork chopper on board the Mariner Space Vehicle for the Jupiter/Saturn/Uranus mission, to “see” the deep space environment as well as to be a critical component in precision optical experiments.
- Westinghouse Electric Corporation, Aerospace Division, used a tuning fork chopper in the Defense Meteorological Satellite Program sensor system. The SNOW/CLOUD instrument sensed reflected solar energy to provide cloud cover information in both “visible” and thermal spectral bands.
- Jet Propulsion Laboratory used a tuning fork chopper to modulate and detect radiation in the near-infrared mapping spectrometer (NIMS) aboard the GALILEO spacecraft.



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