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C-995
Optical Chopper
Operating Manual

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Introduction

The C-995 Optical Chopper is a general purpose optical chopper designed for laboratory use. Equipped with a large five-digit LED readout, the C-995 controller enables digital entry of the desired chopping rate directly from the front panel. Additionally the C-995 is equipped with a bi-directional Rs-232 port that equips the user to set the desired chopping rate to a resolution of .001 Hz and to read the status of the instrument.

As the unit is designed with a phase-locked-loop control system, the chopping rate may also be synchronized to a user-supplied external clock ranging from 4 Hz to 5 KHz. The controller is then used to read the frequency of the external clock.

The C-995 chopping head is attached to the controller by means of a 10 foot coiled cord. The precision etched blade is fully enclosed for protection from inadvertent damage. There are two apertures and two blade sections (30 slots and 3 slots) for the high and low frequency ranges respectively. The aperture diameter is 15 mm with a slot width of 4.5 mm (30 slot section) or 15 mm (3 slot section).

The small 4.75 inch square outline and 2.5 inch maximum depth permits easy integration into compact optical setups. Dual #8-32 mounting holes permit the apertures to be placed at a height as low as 0.75 inches above an optical bench, or with the included ½ inch rod and stand, as high as 13 inches above the mounting surface.

Caution

The screw on the rod and stand included with the C995 Optical Chopper is set to allow a maximum insertion distance of 3/16” into the body of the chopping head. Inserting the stand screw greater than 3/16” will damage the pick-off board or the chopper blade. This damage is not covered under warranty.

C-995 Optical Chopper Specifications

Chopping Frequency Ranges	4 Hz to 500 Hz (Inner slots), 40 Hz - 5 KHz (outer slots)
Aperture Size	0.6 inch diameter (15 mm), and 0.6 inch by 0.2 inch (15 x 4.5 mm)
Frequency Control	Phase-Locked-Loop, Direct Digital Synthesis
Frequency Uncertainty	±.0025 % of setting
Phase Jitter	0.1 % peak to peak, 3 slot section, 1.0 % peak to peak, 30 slot section
Settling Time to Phase Lock	< 3 seconds
External Clock Input Requirements	TTL, CMOS Compatible Square Wave, 4 Hz to 5000 Hz
Sync Signal Output	TTL, CMOS Compatible Square Wave
Display	Five Digit, high intensity green, 0. 5 " high
Temperature Coefficient of Chopping Frequency	< 10 ppm/C
Frequency Resolution (using Rs-232 Control)	.001 Hz
Frequency Resolution (using Front Panel Control)	.01 Hz
Counter Resolution using External Clock	0.1 Hz, 1 Hz
Rs-232 Interface	9600 Baud, N-8-1, 3 wire
Chopper Head Mounting	Standard 8-32 tapped holes, mounting rod and stand is provided
Chopping Blade Diameter	4.1 inch diameter
Operating Temperature Range	0 - 40 C
Dimensions (Head)	4.5 " H x 4.5 " W x 2 " D, 114 mm x 114 mm x 51 mm
Dimensions (Controller)	2.7 " H x 7 " W x 9.1 " D, 69 mm, 178 mm, 231 mm
Interconnecting cable supplied	Coiled Cord 10 feet max length
Power Requirements	95-260 VAC, 50-60 Hz, 15 VA Max
CE Certification	Yes
Weight	3 lbs, 1.36 Kg
Accessories Provided	Mounting rod and stand, Rs-232 cable, Power Cord, Operating Manual
Standard Warranty	Two years, Components and Workmanship, 30 Day Satisfaction Guarantee
Application Software Provided	Downloadable from TTI website, www.terahertztechnologies.com

TTI reserves the right to change specifications without notice

Unpacking and Inspection

Prior to shipment this instrument was inspected and found to be free of mechanical and electrical defects. Upon acceptance by the carrier he assumes responsibility for its safe arrival. After unpacking, examine the unit for any evidence of shipping damage. Should you receive this instrument in a damaged condition, apparent or concealed, it must be noted on the freight bill or express receipt and signed by the carrier's agent. Failure to do so could result in the carrier refusing to honor the claim. Upon filing a claim TTI should be notified.

Power Requirements

The C-995 is equipped with a universal power supply that works anywhere in the world. The input range is from 85 to 260 V.A.C., 40 - 400 Hz. Both legs of the power line are switched and fused for safety. Replace fuses with 1 amp slo-blo, 5x20 mm types only.

Operation

After unpacking and inspecting the instrument, attach the rod and stand to the chopper head by screwing in the 8-32 threaded screw into the appropriate hole in the chopper head..

Caution

The screw on the rod and stand included with the C995 Optical Chopper is set to allow a maximum insertion distance of 3/16" into the body of the chopping head. Inserting the stand screw greater than 3/16" will damage the pick-off board or the chopper blade. This damage is not covered under warranty.

Adjust the height of the chopper head as needed. (The inner aperture should be used for the Low speed range and the outer aperture for the High speed range.) Connect the chopper head to the controller with the coil cord provided. Place the power cord into the IEC power entry module on the instrument rear panel and plug the power cord into a suitable power outlet. The instrument is now ready for use.

The front panel frequency select switch should be set to ***High*** for a desired chopping frequency in the range of 40 to 5000 Hz and to ***Low*** for a desired chopping frequency in the 4 - 500 Hz range. The power switch is located on the power entry module on the instrument rear panel. This switch may now be turned on. Insure that the ***Sync Select*** switch on the rear panel is in the ***Int***. position.

The display should now be energized and it should indicate either 1000.0 Hz or 100.00 Hz for the high and low frequency ranges respectively. These values are stored in the unit during the calibration process. (Frequency settings for each range are stored in non-volatile memory so that the unit is able to maintain the programmed chopping rate between periods of use.)

The TTL/CMOS level sync signal that is coincident with the chopped light is now available at the front panel BNC connector labeled ***Sync Output***. This signal may now be connected to a lock-in amplifier, oscilloscope or other instrument.

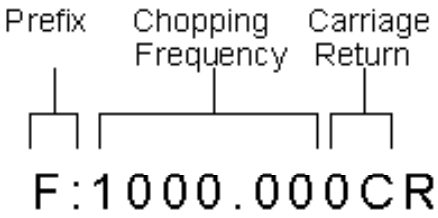
Setting the chopping rate from the Front Panel

The chopping frequency may be set from the front panel as follows. Push and release the frequency set control. The least significant digit of the display will now blink. Rotate the knob to select the digit value that is desired. Pressing and releasing the knob again will cause the next most significant digit to blink. Set this digit in like manner. Continue this process until the desired most significant digit is set. Pressing and releasing the knob one last time will cause the displayed frequency to be entered into the unit and also be stored in memory. The controller will now adjust the motor speed to chop precisely at the rate that has been selected. The unit will not allow speeds to be selected that are outside of the 4 - 500 Hz or 40 - 5000 Hz limits for the Low and High speed ranges respectively.

Setting the chopping rate via the Serial Port

The C-995 is equipped with a bi-directional "three-wire" Rs-232c interface. It permits the unit to be remotely controlled via an external computer and will report the unit's status on request.

An interface cable is supplied with each unit. Plug the Rj-14 (telephone style) connector into the port on the unit's rear panel. Plug the 9 pin D connector into the computer serial port. Using a communications program (such as WINDOWS Hyperterminal) set the appropriate communications parameters. The protocol is 9600 N 8 1, i.e. Baud Rate of 9600 Baud, no parity bit, 8 data bits, and one stop bit. The command structure is as follows:



To set the chopping rate to 1 KHz on the high speed range, send the following eleven character string:

"F:1000.000CR"

CR is Carriage Return, hex 0D, or Enter on a PC keyboard. The significance of the characters is as shown above.

All eleven digits must be present including leading zeros. For example, to set the unit to chop at 15.627 Hz on the low frequency range, send the following string:

"F: 0015.627CR"

A correct command will be met with the response: "OK".

An incorrect command will be met with the response: "Invalid Command".

To request the status of the unit, send the following string:

"F:STATUSRQCR"

The C-995 will return the following information:

INT(EXT) SYNC
HI (LO) SPEED RANGE
1000.000 HZ

When the unit is in the Ext. Sync mode, the measured chopping frequency will be returned.

Should the user attempt to enter an invalid frequency for the range in use, the following string will be sent:

"FOR THE RANGE IN USE, FREQ. IS TOO HIGH (LOW)"

The display will reflect the new frequency.

Setting the chopping rate via External Sync

To synchronize the C-995 to an external clock, set the Sync switch on the rear panel to the Ext. position. Apply a TTL/CMOS compatible clock to the rear panel BNC connector labeled External Sync.

Ensure that the clock frequency is appropriate for the range in use, i.e. 4 - 500 Hz for the Low speed range and 40 - 5000 Hz for the High speed range. The C-995 chopping rate will now be phase-locked to this external clock and will track it. The display will count the external frequency and display it to a resolution of 0.1 Hz in the High speed range and to 1 Hz in the Low speed range.

Note: It is recommended to energize the C-995 prior to applying the external sync signal.

Operating Considerations

The C-995 utilizes a precision Swiss-made DC motor. Motors do however, have a finite lifetime. It is thus recommended that the motor be used at the lowest speed that provides the needed chopping rate. For example, if a chopping rate of 400 Hz is desired, it is preferable to run the unit at the bottom of the High Frequency Range rather than at the top end of the Low Frequency Range. It is also desirable to turn the unit off when it is not being used. These simple precautions will maximize the life of your motor.

The outer sets of slots provides 30 chopping cycles per motor revolution while the inner set of slots provides three chopping cycles per revolution. Thus using the inner set of slots provides the minimum phase jitter. Use the inner set of slots in those applications where this criteria is important. Additionally the inner set of slots chops the largest diameter beam. For beams of more than 2-3 mm in diameter, the inner set of slots should be used.

The rise time of the chopped optical signal is essentially the time it takes for the blade to pass through the beam. Thus if this criteria is of importance, the inner set of slots should be used with the motor set to a faster speed or the beam should be focused at the plane of the chopper blade.

For High power lasers of 5 Watts or more, never leave the chopper blade exposed to the beam while it is not rotating or is rotating at low speed. Excessive heating of the blade can result and may cause it to warp.

Do not attempt to rotate the chopper head while the unit is rotating at high speed. Gyroscopic forces can bend the blade and force it into contact with the LED- phototransistor sensors. This could damage the unit.



Never plug or unplug the chopper head while the unit is powered up. To so may damage the unit.

Warranty And Repair Information

REPAIR INFORMATION

Products manufactured by Terahertz Technologies Inc. are designed and manufactured to provide reliable performance. However, in the event that service is required, both telephone technical assistance and factory repair services are available. Call (315) 736-3642, fax (315) 736-4078, e-mail info@teratec.us or visit our web site at www.teratec.us for more information or to request an RMA number.

For IN-WARRANTY REPAIRS, call us to obtain a Returned Material Authorization number, (RMA Number). All products are to be returned to TTI with freight charges pre-paid. Those products sent under warranty will be returned to our customers pre-paid. We cannot be responsible for returned products that do not reference the TTI RMA number.

For OUT-OF-WARRANTY repairs, services are billable for both time and materials.

LIMITED WARRANTY

TERAHERTZ TECHNOLOGIES INC. (TTI) WARRANTS THAT TO THE FIRST PURCHASER, FOR A PERIOD OF TWO YEARS FROM THE DATE OF RECEIPT, THAT THIS PRODUCT (THE PRODUCT) WILL BE FREE FROM DEFECTS IN MATERIALS AND MANUFACTURING. THE FOREGOING WARRANTY IS THE ONLY WARRANTY, EXPRESS OR IMPLIED, GIVEN BY TTI, I.E., THERE IS NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. TTI HEREBY DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY OTHER THAN THE WARRANTY IN THE FIRST SENTENCE TO THE FULLEST EXTENT PERMITTED BY LAW.

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