

Trig-Tek

360C

Ratio Generator

User Manual

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FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.



This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.



If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.



Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.



Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.
2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

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DOCUMENT CHANGE HISTORY

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Chapter 1

Introduction

The 360C Ratio Generator See (**Figure 1-1**) is a unique instrument that will accept an input signal and provide at the output a ratio of the input frequency. A front panel three-digit NUMERATOR switch allows multiplying the input signal from 1 to 999, and a three-digit DENOMINATOR switch divides the signal by 1 to 999. This signal is brought out on a rear panel BNC connector, marked RATIO OUTPUT. A front panel frequency counter and a four-position selector switch allow the user to monitor the REF A input, the REF B input, the X1, or the RATIO output.

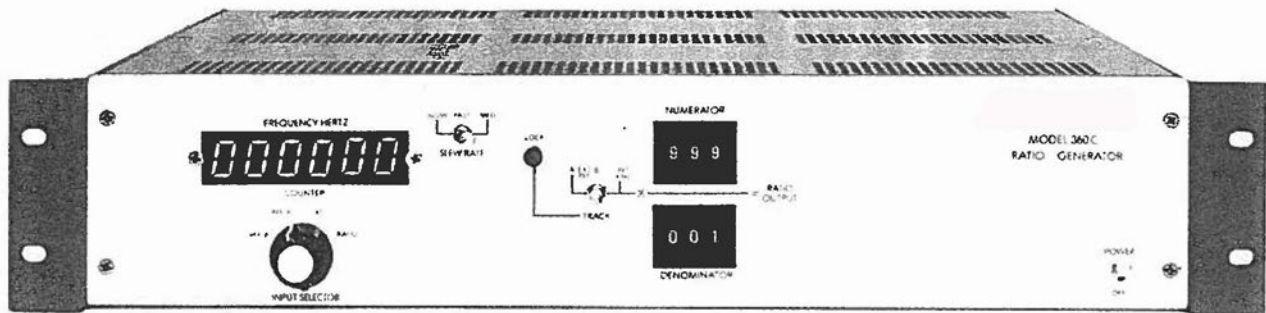


Figure 1-1, 360C Ratio Generator

REF A and REF B allow front panel selection of either of two reference input signals. When the INT 1 KHZ input is selected, the unit becomes a synthesizer where the setting of the numerator and denominator multiplies and divides the crystal controlled one kilohertz input signal.

One of the applications of this instrument is for use with turbine engines where the shaft frequency is not directly available; but a signal usually derived from a tachometer, or a multi-toothed gear attached to the shaft, provides a frequency related to the fundamental shaft. This related signal can be connected to the input of the 360C, the NUMERATOR and DENOMINATOR switch set to multiply by the proper ratio, to provide the actual fundamental shaft frequency at the ratio output. This frequency can then be used as the reference input of a tracking filter, such as the 530 B , and the filtered output can provide, for example, shaft vibration at fundamental shaft frequency as the engine is increased and decreased in speed. Refer as needed to the block diagram in (**Figure 1-2**).

Specifications

REF A Input

Impedance	100 K ohms
Frequency Range	5 Hz-50 kHz
Level	30 millivolts P-P to 300 volts P-P.
Waveform	Any periodic waveform, sine triangular, square or pulse. Pulse width must be at least 10 us.
Connector	Isolated BNC

REF B Input

Impedance	100 K ohms
Frequency Range	5 Hz-50 kHz
Level	1000 millivolts P-P to 50 volts P-P.
Waveform	Any periodic waveform, sine triangular, square or pulse. Pulse width must be at least 10 us.
Connector	Isolated BNC

X1 Output

Impedance	Less than 50 ohms
Level	10 \pm 3 Volts PK-PK
Waveform	Square wave
Phase (Related to REF)	In-Phase
Connector	BNC

Ratio Output

Impedance	Less than 50 ohms
Level	10 \pm 3 Volts PK-PK
Waveform	Square wave
Connector	BNC

Controls

Power switch	Applies power to the circuits when placed to POWER
Counter Input Selector switch	Selects REF A, REF B, RATIO, or X1 as the counter input signal
Slew Rate switch	Selects SLOW, FAST or MED slew rate to permit tracking to a lower frequency when in the SLOW position
INT 1 KHz-EXT REF A or B switch	Selects a fixed 1 kHz crystal frequency to the input of the ratio MULTIPLIER when on the INT 1 KHz position and the designated REF signal when on the EXT REF A or B position
Numerator switch	The NUMERATOR switch is a three-decade position thumbwheel switch that selects from 001 to 999 times the input signal as the numerator.
Denominator switch	The DENOMINATOR switch is a three-decade thumbwheel switch to select 001 to 999 as the denominator.

Indicators

Counter	Six-digit display indicating frequency in hertz
Lock Light	Led above the Track position of the Mode switch. When illuminated, it indicates the PLL (Phase-Lock-Loop) is locked, and the signal to the reference input is proper.

Dimensions

	3.5" high, 13.0" deep, 19.0" wide
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Power Requirements

	Operates with 115 or 230 volts AC with under 10 watts of power
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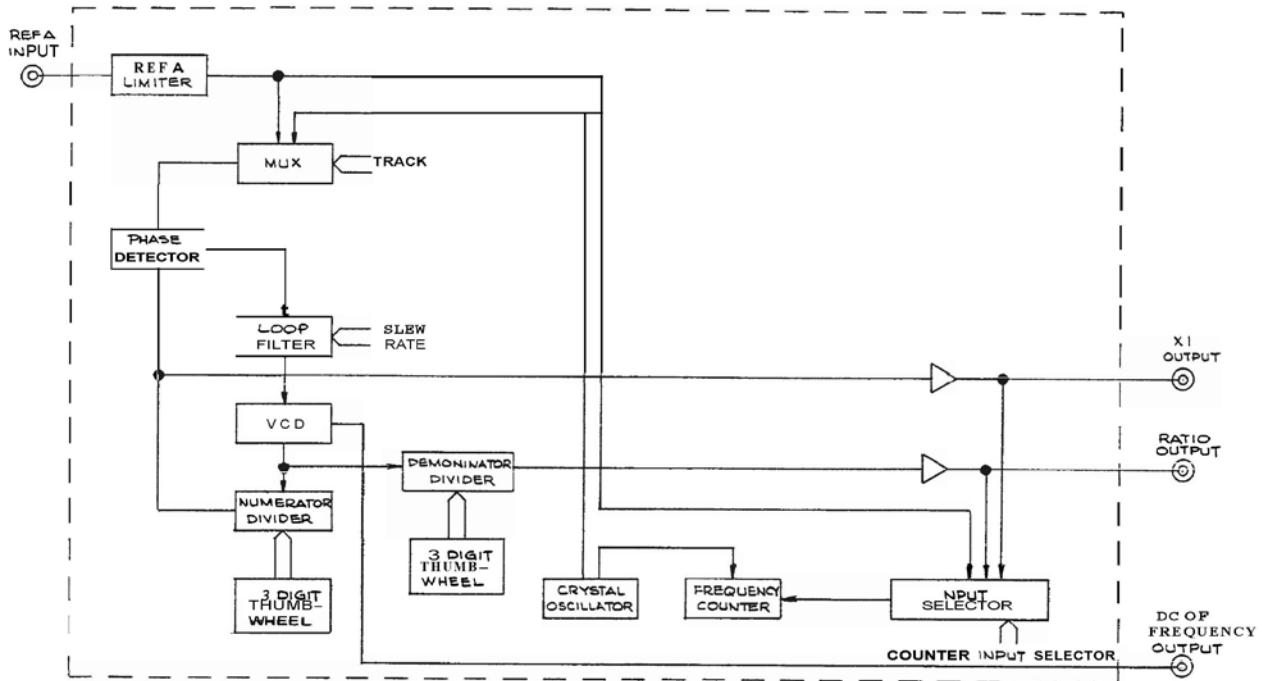


Figure 1-2, Block Diagram 360C Multi-Ratio Generator

Chapter 2

Performance Test

The following performance test procedure should be run to verify that the unit is performing within the manufacturer's specifications. The unit uses integrated circuits, very stable parts, and should not require calibration more often than every six months. In the event that a reading is out of tolerance, the unit may require calibration see **Chapter 4** of this manual.

Test Equipment

Note: Equivalent equipment can be used.

AC-DC Voltmeter	Keithley 191
Signal Generator	Astronics Test Systems 346B Calibrator

Initial Switch Setting

Prior to turning the 360C power ON, set the switches to the following:

- INPUT SELECTOR switch to RATIO
- SLEW RATE switch to MED
- TRACK switch to INT 1 KHz
- NUMERATOR switch to 100
- DENOMINATOR switch to 010
- POWER switch to POWER.

Performance Test Procedure

1. Observe an indication of 10,000 on the front panel counter. The LOCK light should illuminate.
2. Set the Denominator switch to 100.
3. Observe an indication of 1000 on the front panel counter.
4. Place the INPUT SELECTOR switch to X1.
5. Observe an indication of 1000 on the front panel counter.
6. Connect the signal generator to REF A INPUT jack.

7. Place the INPUT SELECTOR switch to REF A and the TRACK switch to EXT REF A.
8. Set the signal generator for an indication of 10,000 \pm 50 Hz on the front panel counter. The level of the signal should be about 1 volt RMS.
9. Connect the DC voltmeter to the DC of FREQ OUTPUT jack.
10. Observe an indication of 10.0 \pm 0.2 volts on the DC voltmeter.
11. Set the signal generator for an indication of 100 Hz on the front panel counter.
12. Observe an indication of 100 \pm 2 millivolts on the DC voltmeter.
13. Connect the signal generator to REF B INPUT Jack.
14. Set the generator for 100 Hz \pm 1% and a level of about 1 volt RMS.
15. Place the INPUT SELECTOR switch to REF B and the TRACK switch to EXT REF B.
16. Observe an indication of 100 Hz \pm 1% on the front panel counter.
17. Place the INPUT SELECTOR switch to X1.
18. Observe an indication of 100 Hz \pm 1% on the front panel counter.
19. Place the INPUT SELECTOR switch to RATIO, the NUMERATOR switch to 100, and the DENOMINATOR switch to 020.
20. Observe an indication of 500 Hz \pm 1% on the front panel meter.

Chapter 3

Operation

The Ratio Generator is designed to produce ratio related frequencies of a reference frequency. Although the ratio producing feature is its main one, the 360C will operate as a frequency synthesizer. This section will describe the use of the controls and indicators to best accomplish these features.

Input Selector Switch

The counter INPUT SELECTOR switch has four positions, to select REF A, REF B, X1, or RATIO as inputs to the frequency counter. Any one of the four parameters can be selected without affecting the operation of the unit.

Track Switch

The TRACK switch selects REF A, REF B, or the INT 1 KHz as the input to the ratio generator. When a signal of proper frequency and level is at the input, the ratio loop will lock and TRACK LOCK light will illuminate. The two reference inputs A and B are provided to allow front panel selection of two different frequencies. This is especially useful where a sweep is required to make amplitude versus frequency plots, and a sweep generator is needed to sweep the frequency axis. The sweep generator can be connected to REF B and selected as the input by the TRACK switch.

When the INT 1 KHz position of the TRACK switch is selected, the ratio loop is locked to a one kilohertz signal generated by a crystal oscillator. Using this stable one kilohertz signal as input, precise frequencies can be synthesized using the NUMERATOR switch as a multiplier and the DENOMINATOR switch as a divider to produce a multitude of frequencies.

Slew Rate Switch

The SLEW RATE switch selects the SLOW, FAST, or MED slew rate for the ratio loop. The switch will normally be set in the MED position. The slew rate of the loop deals with the ability of the loop to track a signal where the frequency is either increasing or decreasing as a function of time. In the MED position, the loop will track from 10 Hz to 50 Hz at approximately 30 Hz/sec, 50 to 150 at approximately 100 Hz/sec, and 150 Hz and up at approximately 750 Hz/sec. The FAST rate will double the slew rate; the SLOW position will cause the rate to be one-half the slew rate of the MED position.

Numerator and Denominator Switches

The NUMERATOR and DENOMINATOR switches are each a three-digit thumb wheel used to program three decade counters. The NUMERATOR switch can be set from 1 to 999 and will multiply the input signal frequency by the set-in number. The DENOMINATOR switch can also be set from 1 to 999 and divides the above set product by the set-in number. Thus, any ratio from 1/999 to 999/1 can be set in as the ratio. For example, ratio input frequency 100 Hz, numerator 50, and denominator 20, the ratio output will be $100 \times 50/20 = 250$ Hz.

Chapter 4

Calibration Procedure

The Ratio Generator has three adjustments on the main board and one adjustment for each of the six harmonic channels. A method of adjusting each follows:

Test Equipment

Note: Equivalent equipment can be used.

Digital Multimeter	Keithley 191
Signal Generator	IEC F31
Oscilloscope	Tektronix 922B

Preparation and Switch Settings

Remove the top cover. Place the INPUT SELECTOR switch to XI, the SLEW RATE to MED, and the TRACK switch to EXT REF A. See (Figure 4-1).

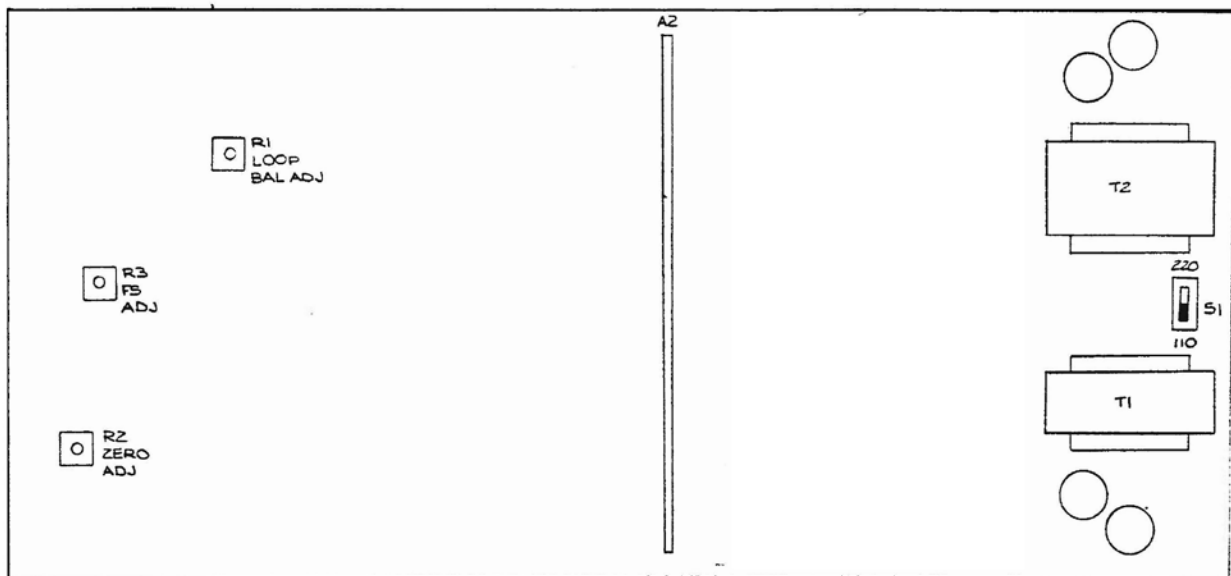


Figure 4-1, 360C Multi-Ratio Generator Parts Location Drawing

Loop Balance Adjustment

1. Connect the signal generator to the REF A INPUT jack.
2. Set the signal generator for 10 Hz and approximately 1 V RMS.
3. Set the NUMERATOR to 010 and the DENOMITATOR to 001.
4. With the oscilloscope at the RATIO output, set R1 for minimum jitter of the observed waveform.

DC of Frequency Adjustments

1. Connect the signal generator to the REF A INPUT jack. Set the level for approximately 1 V RMS.
2. Set the NUMERATOR and DENOMINATOR to 001.
3. Set the generator for a frequency of 10,000 \pm 25 Hz as indicated on the front panel counter.
4. Connect a DC voltmeter to the DC of FREQ OUTPUT.
5. Set the FS ADJ R3 for a 10.00 \pm 0.05 V indication on the DC voltmeter.
6. Set the generator to 100 \pm .05 Hz as indicated on the front panel counter.
7. Set the ZERO ADJ R2 for a 100 \pm .05 mV indication on the DC voltmeter