

MODEL 418A  
RC OSCILLATOR  
INSTRUCTION MANUAL

KIKUSUI ELECTRONICS CORP.

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* CIRCUIT DIAGRAM	

## 1. GENERAL

The Model 418A RC Oscillator employs a solid-state Wien bridge which oscillates at 10 Hz - 1 MHz in five ranges. Being incorporated with a thermistor amplitude control circuit, the oscillator provides a sine wave with very minor output voltage variation against switching of the frequency range selector and turning of the frequency dial. Since no output voltage readjustment accompanying frequency range switching is required, the Oscillator is very convenient in actual use.

The Oscillator incorporates a square wave generator circuit ( Schmitt circuit ) which provides a square waveform with a fast rise time.

The output voltage level is adjustable for a very wide range through combined use of a continuously variable attenuator and a -20 dB stepwise attenuator.

## 2. SPECIFICATIONS

Power requirements	_____ V 50/60Hz, approx. 8VA															
Weight	Approx. 2.4kg															
Dimensions	110 W X 140 H X 252 D mm															
( Maximum dimensions )	( 115 W X 160 H X 280 D mm )															
Ambient temperature	5° C ~ 35° C ( Humidity : less than 85% )															
Oscillation frequency	10 Hz ~ 1 MHz, in 5 ranges															
Frequency ranges	<table border="0" style="margin-left: 20px;"> <tr> <td>X 10</td> <td>.....</td> <td>10 ~ 100 Hz</td> </tr> <tr> <td>X 100</td> <td>.....</td> <td>100 ~ 1000 Hz</td> </tr> <tr> <td>X 1 K</td> <td>.....</td> <td>1 k ~ 10 kHz</td> </tr> <tr> <td>X 10 K</td> <td>.....</td> <td>10 k ~ 100 kHz</td> </tr> <tr> <td>X 100 K</td> <td>.....</td> <td>100 k ~ 1 MHz</td> </tr> </table>	X 10	.....	10 ~ 100 Hz	X 100	.....	100 ~ 1000 Hz	X 1 K	.....	1 k ~ 10 kHz	X 10 K	.....	10 k ~ 100 kHz	X 100 K	.....	100 k ~ 1 MHz
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X 1 K	.....	1 k ~ 10 kHz														
X 10 K	.....	10 k ~ 100 kHz														
X 100 K	.....	100 k ~ 1 MHz														
Frequency accuracy	± ( 3 % + 1 Hz )															
Output impedance	600 Ω ± 10 %															
Output Attenuator	Continuously variable control plus ( 0 dB ) / ( -20 dB ) selector buttons															
Output terminal	12/16, 5-way type, 19 mm ( 3/4" ) distance															
Output waveform	Sine wave and square wave															
Sine wave ( at maximum output voltage )																
Output voltage	8 V rms or over ( open ) 4 V rms or over ( with 600 Ω load, at 25°C )															
Distortion factor	<table border="0" style="margin-left: 20px;"> <tr> <td>10 ~ 30 Hz</td> <td>2 % or less</td> </tr> <tr> <td>30 ~ 100 Hz</td> <td>1 % or less</td> </tr> <tr> <td>100 ~ 500 Hz</td> <td>0.5 % or less</td> </tr> <tr> <td>500 ~ 100 kHz</td> <td>0.15 % or less</td> </tr> <tr> <td>100k ~ 500 kHz</td> <td>0.5 % or less</td> </tr> </table>	10 ~ 30 Hz	2 % or less	30 ~ 100 Hz	1 % or less	100 ~ 500 Hz	0.5 % or less	500 ~ 100 kHz	0.15 % or less	100k ~ 500 kHz	0.5 % or less					
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Frequency characteristics	Within ± 0.5 dB    10 Hz ~ 1MHz															
( 1 kHz reference, 600 Ω load )	Within ± 0.3 dB    20 Hz ~ 500 kHz															

Square wave ( at maximum output voltage )

Output voltage                      8 Vp-p or over ( 600  $\Omega$  load )

Rise time                              0.2  $\mu$ sec or faster

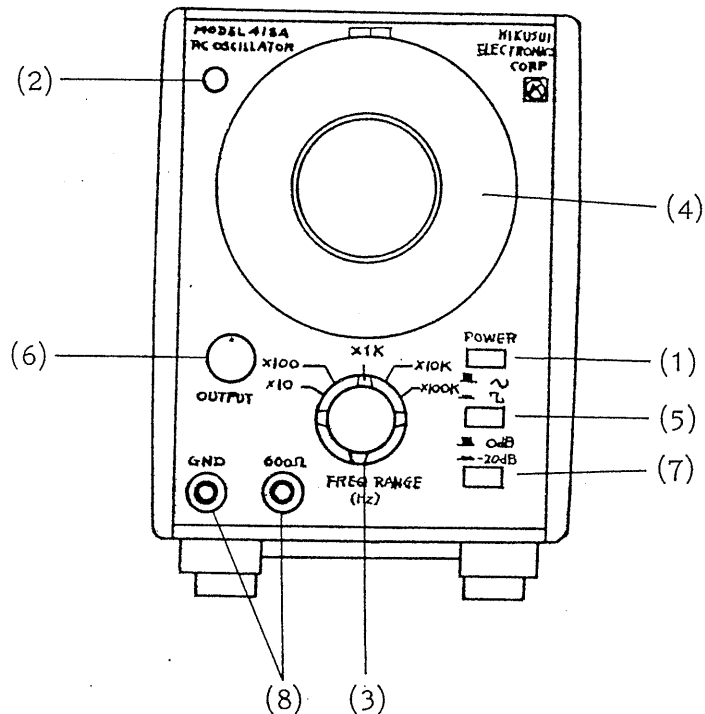
Overshoot                             2% or less

Sag                                      5% or less ( at 50 Hz )

Accessories                            Instruction manual ..... 1 copy

### 3. OPERATION PROCEDURE

#### 3.1 EXPLANATION OF PANEL CONTROLS AND SWITCHES



- (1) POWER                      The main power switch. Depressed state is for power on. Pressing again the switch resets it to the popped up state or the power off state.
- (2) Power pilot lamp              Lights when the power is on. The lamp actually is a light emitting diode and is free from filament failure unlike the incandescent pilot lamp.
- (3) FREQ RANGE  
    (Hz)                      Frequency range selector rotary switch. The dial reading multiplied by the factor selected by the corresponding button denotes the oscillating frequency.

- (4) **FREQ DIAL** For continuous variation ( up to 10 times ) of the oscillating frequency.
- (5)  $\sim$   $\square$  Buttons to select either sine wave or square wave output.  
Depressed position ( $\square$ ) : square wave ( $\square$ ).  
Non-locked position ( $\square$ ) : sine wave ( $\sim$ ).
- (6) **OUTPUT CONTROL** For continuously-variable adjustment of output voltage which increases as this control is turned clockwise.
- (7) 0 dB, -20 dB Select the factor ( 0 dB ( $\square$ ), -20 dB ( $\square$ ) ) to be multiplied to the level adjusted by **OUTPUT CONTROL 6** .
- (8) **GND, 600  $\Omega$**  The output binding-post terminals. The black terminal ( GND terminal ) is grounded to the chassis.

### 3.2 OPERATING PROCEDURE

- (1) **Turning on the power** Press the power switch. The pilot lamp ( light emitting diode ) will turn on and the Oscillator will become the stabilized oscillating state within a few seconds.
- (2) **Setting the oscillation frequency** Set the oscillation frequency with the **FREQ RANGE** selector and the **FREQ dial**. The oscillation frequency is determined by the **FREQ dial** reading multiplied by the factor selected by the **FREQ RANGE** selector

Example 1 Setting 50kHz

- (1) Set the **FREQ RANGE** selector to X10K.
- (2) Set the **FREQ dial** in the 5 position.

- (3) Output waveform selection      Select (  $\sim$  ) (  $\square$  ) or (  $\square$  ) (  $\square$  ) for a sine wave output or a square wave output.
- (4) Output voltage setting      Adjust the output voltage with the OUTPUT control 6 . The output voltage increases as this control is turned clockwise. The output attenuator 7 decreases the output voltage by the factor of - 20 dB ( 1/10 ) to be multiplied to the level adjusted by the OUTPUT control 6 .

### 3.3 CHANGE OF SUPPLY LINE VOLTAGE

Change the white wire connected to the 100V terminal to the 110V, 117V, 220V, 230V or 240V terminal of the power transformer, when operating this instrument with the supply line voltage of 110V, 117V, 220V, 230V or 240V.

### 3.4 PRECAUTIONS

- (1) Use this instrument under the range of 50Hz ~ 60Hz and 90V ~ 110V. ( Refer to " 3.3 CHANGE OF SUPPLY LINE VOLTAGE " when changing the supply line voltage. )
- (2) If the lead wires are too long, the specified output voltage/frequency characteristics may become attainable.  
Make the lead wires as short as possible.
- (3) Since a thermister is employed as the oscillation voltage control element, the output voltage is affected by ambient temperature. If a constant output voltage is required for a long period, check the output voltage with a voltmeter.
- (4) Ambient temperature must be 5°C ~ 35°C.  
Avoid using the Oscillator in dusty environment or highly humid atmosphere.



#### 4. OPERATING PRINCIPLE

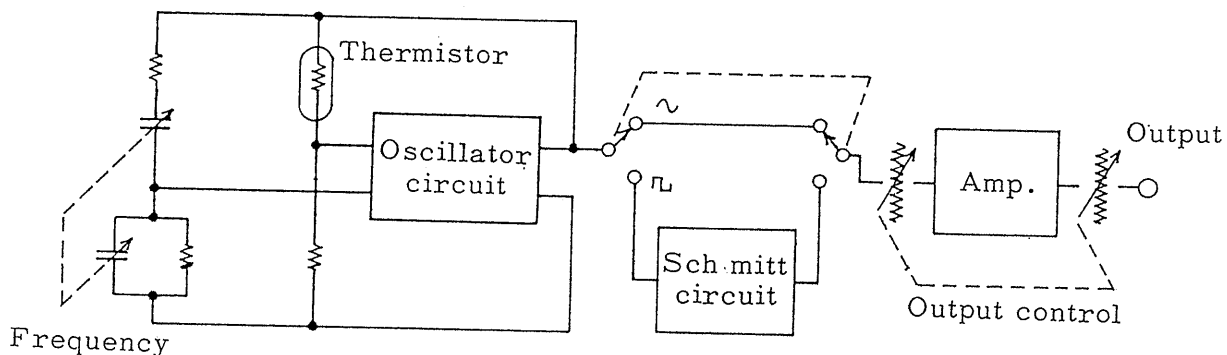


Fig. 1 Block diagram

Among low frequency oscillators, RC oscillators which employ R and C as frequency-determining elements are most common. Among RC oscillators, Wien bridge type is most popular. The Wien bridge has many advantages over other oscillation circuits. Its frequency is easily variable, and small distortion. The operating principle of the Wien bridge oscillator circuit is shown in Fig. 2.

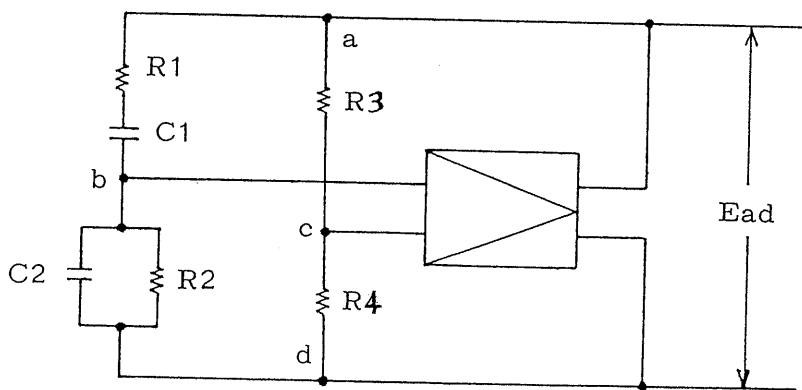


Fig. 2 Wien bridge oscillator circuit

Referring to Fig. 2, the phase of Ebc becomes the same with that of Ead when the below condition is satisfied.

$$f = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}} \quad (1)$$

The circuit oscillates when the below condition is satisfied.

$$E_{bc} = \left( \frac{1}{1 + \frac{R_1}{R_2} + \frac{C_2}{C_1}} - \frac{R_4}{R_3 + R_4} \right) E_{ad} \quad (2)$$

The circuit oscillates when the below condition is satisfied.

$$\frac{1}{1 + \frac{R_1}{R_2} + \frac{C_2}{C_1}} - \frac{R_4}{R_3 + R_4} \geq \frac{1}{A} \quad (3)$$

The circuit oscillates stably when the below condition is satisfied.

$$\frac{1}{1 + \frac{R_1}{R_2} + \frac{C_2}{C_1}} - \frac{R_4}{R_3 + R_4} = \frac{1}{A} \quad (4)$$

It is very difficult for the circuit of Fig. 2 to satisfy constantly the condition of equation (4). Oscillation will not start if the condition of equation (4) is satisfied from the beginning. The conditions of oscillation are determined by equations (1) and (3), and they are not related with the oscillation amplitude. Therefore, the condition of equation (3) must be maintained until the oscillation builds up to the required amplitude. Then, the circuit must satisfy the condition of equation (4). To accomplish this requirement, the resistance of R3 or R4 must automatically vary in response to the oscillation amplitude. This is accomplished by using a thermistor as for R3.

## 5. MAINTENANCE

### 5.1 CHASSIS INSPECTION

Remove two screws from the side of the case and two screws from the bottom of the case. Remove three rubber caps from the left side of the case and pull out the chassis from the housing.

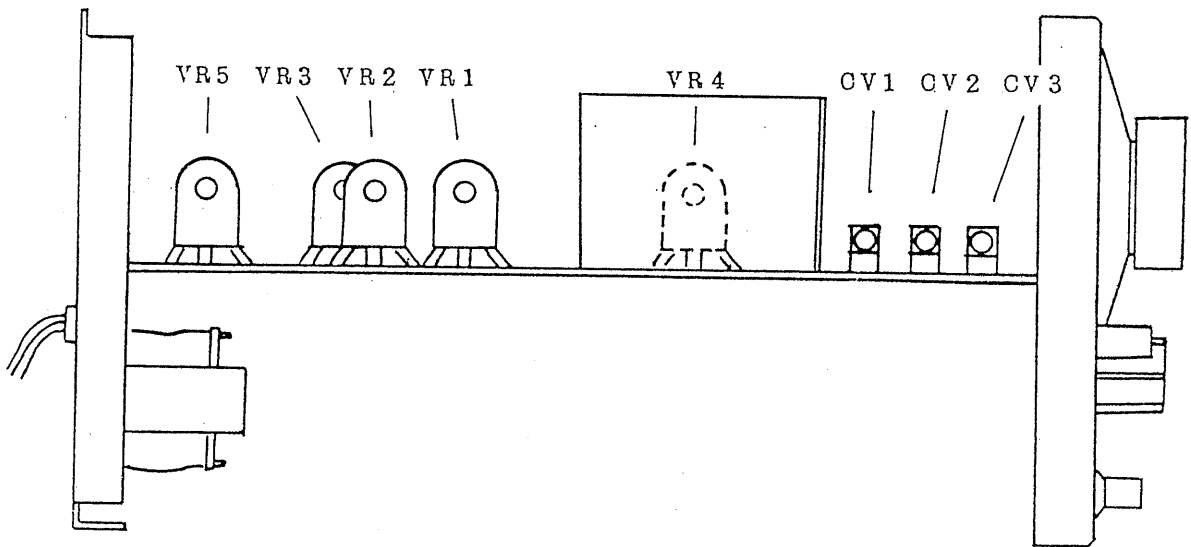


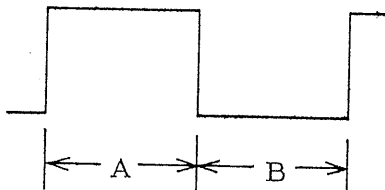
Fig. 3 Locations of controls

- VR1
  - VR2
  - VR3
- Oscillation circuit, DC balance adjustment
- VR4
- Schmitt circuit, waveform symmetry adjustment of square wave.
- VR5
- + 40V power supply circuit, voltage adjustment.
- CV1
  - CV2
  - CV3
- Frequency adjustment of the position 10 of the frequency dial.
- Frequency adjustment in the 10K range.
- Frequency adjustment in the 100K range.

## 5.2 ADJUSTMENTS

Referring to Fig. 3, make adjustments as below.

- (1) DC supply voltage ( + 40V ) adjustment  
Adjust the voltage as measured at TP6 of printed circuit board to + 40V + 0.5V by means of semi-fixed resistor VR5.
- (2) Oscillator DC balance adjustment  
Set the FREQ RANGE selector to  $\times 1K$ .  
Adjust the voltage as measured at TP3 of printed circuit board to + 20V  $\pm$  0.3V by means of semi-fixed resistor VR3.  
( This adjustment must be performed patiently because the response is slow as a large capacitor is connected in this circuit. )
- (3) Waveform symmetry adjustment of square wave  
Set the FREQ RANGE selector to  $\times 1K$  and set the output waveform to square wave. Observing the output with an oscilloscope, adjust the output waveform by means of semi-fixed resistor VR4 so that dimensions A and B illustrated below are made equal.



- (4) Frequency adjustment  
Follow the below procedure for this adjustment.
  1. Join surely the case to the chassis by tightening with screws.
  2. Measure the frequencies corresponding to "1" position of the FREQ dial and  $\times 100$ ,  $\times 1K$  and  $\times 10K$  ( 100Hz, 1kHz and 10kHz, respectively. ).

Adjust the FREQ dial to the position where the errors are made minimum, and fix the dial in this position.

3. Set the FREQ dial in the "10" position and set the FREQ RANGE selector to 1K position, and adjust CV1 so that the oscillation frequency is made 10.00kHz. In a similar manner, set to 10K position and adjust CV2 so that the frequency is made 100.0kHz. In a similar manner, set to 100K position and adjust CV3 so that the oscillation frequency is made 1000kHz.