

# *Model 4601*

*AC Voltage Calibrator/Standard*



**KH KROHN-HITE  
CORPORATION**

*Operating Manual*

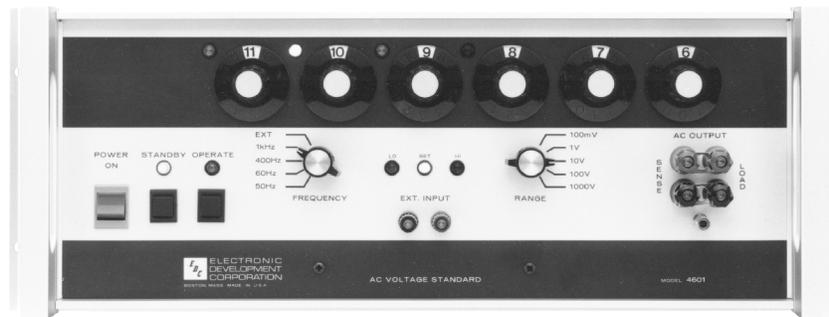
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4601  
OPERATORS  
MANUAL

Serial No. \_\_\_\_\_

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# 4601 OPERATORS MANUAL



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*NOTE: Errata and addendum (if any) will appear in the back of this manual.*

# 4601 MANUAL

## LIST OF DRAWINGS

DESCRIPTION	DRAWING #
Frequency Switching & Osc Level Lights Schematic	A-4754
System Block Diagram	B-4039C
Power Supply, Control Circuit, D.C. Ref. Schematic	B-4038E
Sinewave Oscillator Schematic	B-4078M
A.G.C. & P.A. Schematic	B-4037K
Range & Output Switching Schematic	B-3990L
Adjustments & Test Points Layout	B-4041D
Reference Drawing	930727A

# LIMITED WARRANTY

The Krohn-Hite Corporation (K-H) warrants to the original purchaser each instrument manufactured by them to be free from defects in material and workmanship. This warranty is limited to servicing, repairing and/or replacing any instrument or part thereof returned to the K-H factory for that purpose in accordance with the instructions set forth below; and furthermore to repair or replace all materials, except tubes, fuses, transistors and other semiconductor devices which shall within ONE YEAR of shipment to the original purchaser be returned to the K-H factory and upon examination be deemed defective.

K-H instruments may not be returned to the factory under the terms of this warranty without the prior authorization of the K-H Service Department. All instruments returned to K-H for service hereunder should be carefully packed and shipped. All transportation charges shall be paid by the purchaser.

K-H reserves the right to discontinue instruments without notice and to make changes to any instrument at any time without incurring any obligation to so modify instruments previously sold.

This warranty is expressly in lieu of all other obligations or liabilities on the part of K-H. No other person or persons is authorized to assume in the behalf of K-H any liability in the connection with the sale of its instruments.

***CAUTION:*** *The instrument you have purchased is a precision instrument manufactured under exacting standards. Any attempts to repair, modify or otherwise tamper with the instrument by anyone other than an K-H employee or authorized representative may result in this warranty becoming void.*

# FACTORY SERVICE REQUEST AND AUTHORIZATION

## WARRANTY SERVICE

Instruments may be returned only on prior authorization. Please obtain a RETURN AUTHORIZATION NUMBER either directly from the factory or from an authorized K-H Representative. (See General Information below.)

## CHARGEABLE REPAIRS

If requested, an estimate of charges will be submitted prior to repairs. We suggest that you request a RETURN AUTHORIZATION NUMBER to facilitate handling.

## GENERAL INFORMATION

A) Please provide the following information in order to expedite the repair:

- 1) Indicate MODEL
- 2) Serial Number
- 3) Complete description of the trouble:

Symptoms, measurements taken, equipment used, lash-up procedures, attempted repairs, suspected location of failure and any other pertinent information.

- B) Freight Charges must be PREPAID.
- C) The RETURN AUTHORIZATION NUMBER should be noted on your documentation.
- D) See Packing Suggestions - next page.

## PACKING SUGGESTION

Although your K-H instrument is built for laboratory, production environment and some field environment, it is NOT ruggedized. Therefore ...

1. Be sure the carton is **STRONG** enough to carry the weight of the instrument, e.g. use double wall corrugation.
2. Be sure the carton is **LARGE** enough to allow for sufficient packing material, e.g., at least 2 inches all around the instrument. The packing material should be able to be compressed and then return to its approximate original volume.
3. For better handling, the shipment should always be by **AIR FREIGHT** (except for short distances). You might use either UPS "blue label" or common air freight carrier, second day air.

Please do not bounce it across the country in a truck. It may not hurt it, but it certainly is not going to do a laboratory instrument much good.

4. **QUESTIONS?** Just contact us. We will be pleased to help you.

# **SECTION I**

## **1.0.0 DESCRIPTION AND SPECIFICATIONS**

### **1.1.0 General Description**

- 1.1.1 The precision AC voltage standard source is an inexpensive, highly versatile reference voltage source, designed to meet the needs of computer systems and standards laboratories. The unit has a specified absolute voltage accuracy and is laboratory calibrated against an AC measuring system having traceability accuracy to a precision DC standard having a calibration of 0.002%. The calibration of this unit is traceable to the National Institute of Standards and Technology (N.I.S.T.) through reference standards maintained at Krohn-Hite Corporation, and calibrated periodically.
- 1.1.2 The instrument is a highly accurate voltage reference which can be used in standard laboratories for calibration meters, scopes, and other AC voltage measuring devices. Its output capacity also enables it to be used for precise voltage control of single phase devices such as motors, relays, stepping switches, etc. Calibration of amplifiers is simplified by eliminating the need of input monitoring devices which makes this instrument practical for production testing of input-output devices.
- 1.1.3 The unit is short circuit protected. An automatic overload protection circuit is activated in the event of a short circuit. Removal of the short and resetting the unit restores normal operation.
- 1.1.4 The unit has provisions for an external oscillator input. This permits the use of a frequency source which has insufficient output to drive the device to be calibrated, but having the desired frequency characteristics to be used in the calibration. External oscillators must be capable of delivering 3 volts rms into a 10 K load at the external input terminals of the AC voltage standard.

## 1.2.0 Applications

1.2.1 One of the major applications of the AC standard source is in device calibration. Constant monitoring of the standard is not required. This eliminates several additional pieces of equipment formerly required in AC calibration set ups. The reduction of calibration source errors permits calibration to more precise, and in many cases, more realistic specifications.

1.2.2 Devices requiring moderate power from the calibrating source are now readily calibrated and/or controlled to:

Calibrate AC instruments precisely

Calibrate DVM

Calibrate thermocouple voltmeters

Drive AC transducer

Drive resolvers

Drive gyros

Watt meters (with additional K-H instruments)

1.2.3 The light weight of the unit makes it a desirable laboratory instrument, as it may be hand carried from station to station. The only set up required of the operator, is to select and dial the frequency and voltage outputs desired.

## 1.3.0 Electrical Specifications

1.3.1 Voltage ranges: AC rms 1000 V, 100 V, 10 V, 1 V and 100 mV with 20% over ranging. The 100 mV is attained via a precision divider network which is selected by a front panel rotary switch. The range selected is indicated by a lighted, moving decimal point.

1.3.2 Resolution: 1 ppm on all ranges.

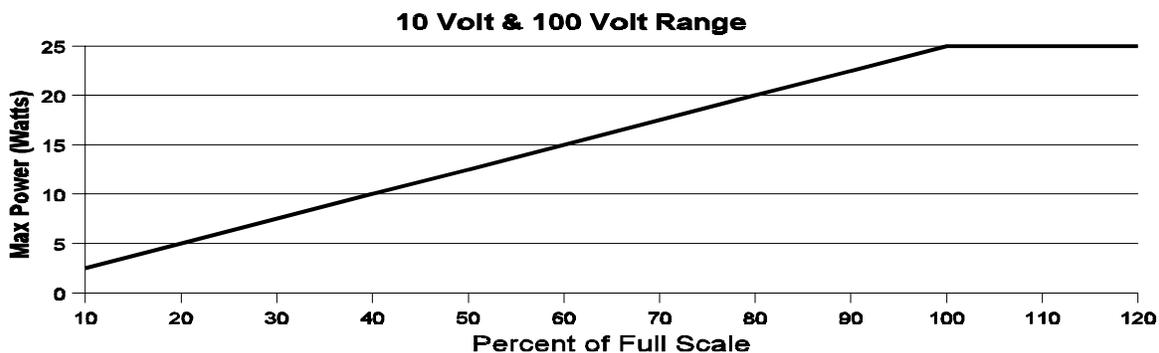
1.3.3 Voltage accuracy: limit of error method\*: all peripheral specifications, ie, error for line and load changes, temperature change within the “nominal operating temperature range” of 23° C ± 5° C, drift and noise are listed for information and are \*non-additive to the accuracy statement.

Note: customer may specify the calibration frequency. No charge at time of purchase. The accuracies stated are at all frequencies and at all voltage settings:

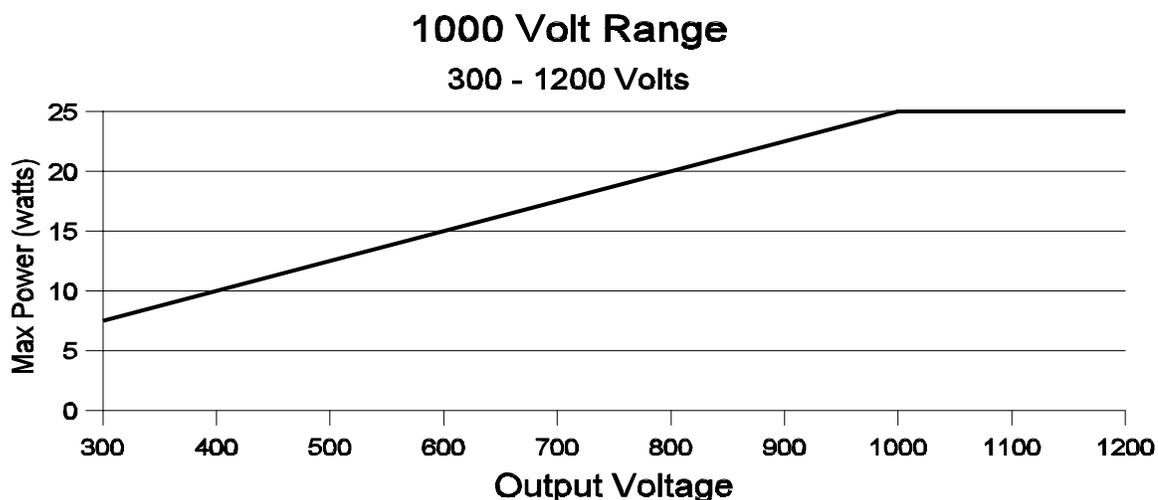
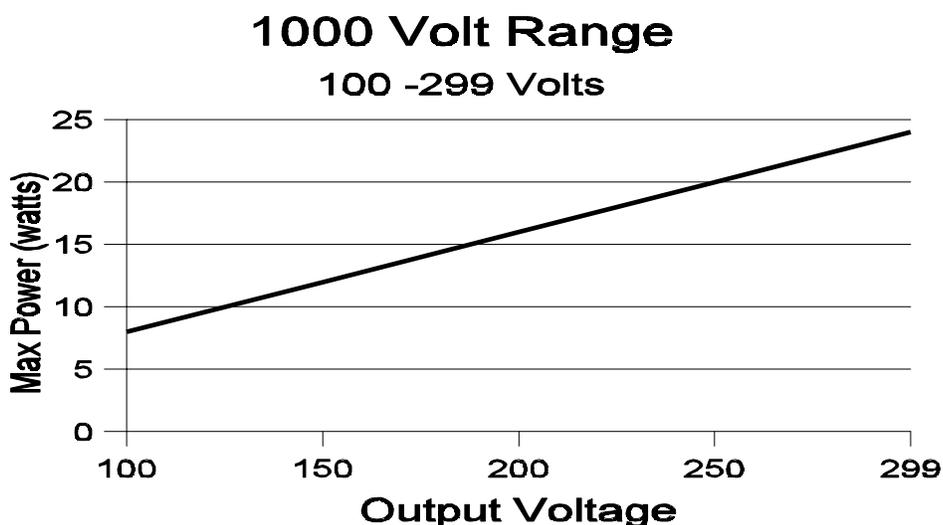
1000 V, 100 V, 10 V ranges:  $\pm(0.05\%$  of setting +0.005% of range)

1 V and 100 mV ranges:  $\pm(0.05\%$  of setting +0.05% of range)

### 1.3.4 4601 Maximum Output Power Curves



Maximum power output is proportional to the output voltage expressed as a percent of full scale, and is ~ 25 watts at 100% of range.



Maximum power is proportional to output voltage up to a maximum of ~ 25 Watts. On the 1000V range, the output transformer taps are switched at 300V. The maximum power output varies between 8 and 25 watts between 100V and 299V, and again between 300V and 1000V. On the 1V range the maximum current is 1Amp. Therefore, the power output at 1V = 1 Watt, and at 0.1V, it is 0.1 Watt. The 100mV range is a divided output, with 10 Ohms

output impedance.

1.3.5 Voltage stability: 8 hrs.  $\pm(0.0075\%$  of setting  $+0.001\%$  of range)  
6 mo.  $\pm(0.015\%$  of setting  $+0.005\%$  of range)

1.3.6 Output impedance: 1000 V - 1 V range: = (See 1.3.7)  
100 mV range: 10 ohm constant.

1.3.7 Regulation to load: 0.005% \*(non-additive)

1.3.8 Regulation to line: 0.0025% \*(non-additive)

1.3.9 Overload protection- Automatic-trip, lighted front panel indicator, push-button reset.

1.3.10 Frequency range: 45 Hz to 1 kHz

Internal: Four internal frequencies, factory installed:50 Hz, 60 Hz, 400 Hz, and 1kHz.

External: This instrument accepts the frequencies within 45 Hz to 1 kHz from an external oscillator. Input amplitude between 3 V and 5 V which may be monitored by the "operate level" lights on the front panel.

1.3.11 Frequency accuracy:  $\pm 0.01\%$

1.3.12 Frequency long term stability:  $\pm 0.001\%$ /year

1.3.13 Distortion: 0.5% this is limit of distortion throughout the entire frequency spectrum of 45 Hz to 1 kHz at all voltage settings.

1.3.14 Amplitude modulation: 0.02% rms max of output voltage at 59 Hz and 61 Hz.

1.3.15 Temperature & temperature coefficient:  
Temperature operating limit: 0° C to 50° C  
Temperature coefficient: 0.002% /° C (0° C to 18° C and 28° C to 50° C)

1.3.16 Power: 300 W, 105 - 125 VAC, 50/60 Hz  $\pm 5\%$  or  
210 - 240 VAC, 50/60 Hz  $\pm 5\%$

1.3.17 Recommended calibration cycle: 12 months.

#### 1.4.0 Mechanical Specifications

1.4.1 Size: 19" x 7" x 13 3/4": 48.26 x 17.78 x 34.93cm

1.4.2 Weight: 50 lbs.; 18.14 kg

## **SECTION II**

### **2.0.0 INSTALLATION**

#### **2.1.0 Mounting**

2.1.1 The instrument is designed for mounting in a standard 19" wide rack and is also available for bench mounting. No additional modification to the unit is necessary for either installation.

2.1.2 All units are supplied with handles and weigh only 42 pounds. The overall size is 7" high, 19" wide and 15" deep, behind front panel.

Power requirements are 117 VAC, or 230 VAC  $\pm 10\%$ ; 60 Hz or 50 Hz. Slide switch, located on the rear panel, permits selection of 117 Vac or 230 Vac. The change to 50 Hz or 60 Hz is automatic.

2.1.3 The unit is designed to be easily transported from one lab to another and to be in operation in less than one minute from turn on time.

2.1.4 This unit is self-contained and needs no further unpacking other than connecting the power.

#### **2.2.0 Supplied Connectors, Cables**

All instruments are supplied with a mating AC power cord.

<u>Nomenclature</u>	<u>K-H Part Number</u>	<u>Quantity</u>
1) AC Power Cord	CAB008	1 ea.

**\*\*\*\*\*CAUTION\*\*\*\*\***

***UNUSED TAPS ON HIGH VOLTAGE  
OUTPUT TRANSFORMER MAY BE AS  
HIGH AS 1000 VOLTS!!!***

## **SECTION III**

### **3.0.0 OPERATION OF THE INSTRUMENT**

#### **3.1.0 General setup**

3.1.1 Set the 110/220 switch on the rear panel. The power cord of the standard source should be plugged into any convenient outlet of 115 VAC or 230 VAC, 50-60 Hz.

3.1.2 The level lights on the front panel will indicate the correct operation of the internal oscillators. If an external oscillator is used, it is adjusted at this time, until the green led is illuminated. If the internal oscillator is to be used, frequency selection should be made at this time.

3.1.3 The desired output voltage can now be selected by use of the range and decade switches. The load is connected to the output terminals. The "operate" push button switch may now be depressed, which will apply the preset voltage to the output terminals.

Important: For optimum performance in "external osc. mode" adjustments of level and major (decade) frequency changes must be made with the unit in "STANDBY" red led on. An attempt to adjust the input level with the unit in operate may cause distortion in the output of the unit or an erroneous output voltage!!!

3.1.4 It is good practice to make large voltage and load changes in the standby mode. Under some conditions the above changes can cause over voltage of 15% of the desired output.

3.1.5 In the event of an overload of 50% or a short circuit the unit automatically recycles itself to "standby" mode. Depressing the "operate" switch with the short or overload still present at the output terminals will cause the unit to return to "standby" immediately. Below 10 V, a short circuit can be maintained at a rate of approximately 50 mA per volt.

### 3.2.0 Front Panel Controls

- 3.2.1 Power switch: A rocker on-off line power.
- 3.2.2 Stand By: An illuminated momentary push-button places unit in standby mode.
- 3.2.3 Operate: An illuminated momentary push-button places unit in operate mode.
- 3.2.4 Frequency select: Five position rotary switch selects one of up to 4 internal frequencies. This switch also provides a means to select an externally applied oscillator.
- 3.2.5 Range switch: Five position rotary switch selects the desired range. The ranges are: 100 mV, 1 V, 10 V, 100 V, and 1,000 V. One may span from 10% to 120% of full scale range with the decade switches. The MSD can not be dialed to zero.
- 3.2.6 Decade switches: The decade switches are used to select the desired output voltage. The place value of each switch is referenced to the decimal light. For example: in the 1,000 V range, if all other switches were set at 10 and the MSD switch at 1, the output voltage would be 211.110 volts rms. It is possible to resolve any output selected in one ppm steps.
- 3.2.7 Level led's: the level led's monitor the output of the oscillator buffer. The correct operating level is indicated when the green led is on by itself. This may also be used to set the input level of an external oscillator.

## **CAUTION**

When the instrument is turned on the "standby" lamp will illuminate. This is normal.

During normal operation, the "operate" lamp will be illuminated. If the "standby" lamp illuminates, without being selected, use the following procedure:

- 1) Check to see if there is a short circuit in the device that you are testing.
- 2) Remove any leads and depress the "operate" push button *momentarily*.

**Do Not Force** the instrument by continuing to hold down the "operate" button. Serious and extensive damage may occur.

If the instrument does not respond to a momentary touch of the "operate" button try again. After that, consult the trouble shooting section in the manual.

### 3.3.0 Operation as a Voltage Source

3.3.1 The precision AC voltage source has been designed to provide a rugged, simple damage proof tool for electronics labs and industries. When using the instrument as a precision reference standard source, these steps should be followed: set the 110-220 switch to the desired setting. Connect the power cord to a power source, 115 VAC or 230 VAC, 50-60 Hz. Connect the output of the unit as required. Connect the external oscillator to the "external" terminals if it is to be used.

*Note: In some applications it may be necessary to isolate the chassis from line common - however, this is not recommended.*

3.3.2 Turn the power switch on.

3.3.3 Select frequency with the "frequency" select switch, observing the level led's for correct indication. If external position is used, adjust external oscillator amplitude until the green led is on.

3.3.4 Select range with the "range" select switch.

3.3.5. Dial the desired output voltage on each decade switch.

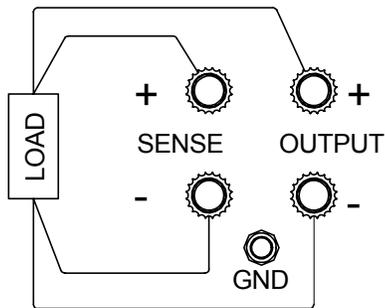
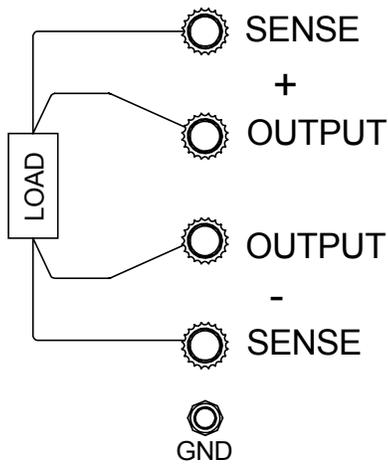
3.3.6. Press the operate switch, the green light indicates the output of the voltage source is connected to the output terminals.

3.3.7. Before changing the range or frequency, switch the unit to standby.

**NOTICE:**     *THE SENSING CIRCUIT MUST BE COMPLETE!*  
*Please refer to Drawing #930727, in the rear of this manual, for the two-wire and four-wire connections.*

# SENSE CONNECTIONS

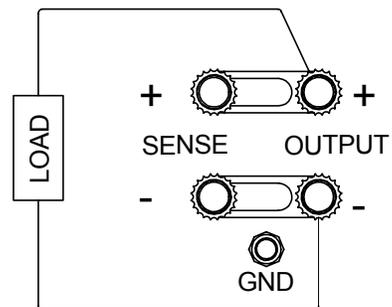
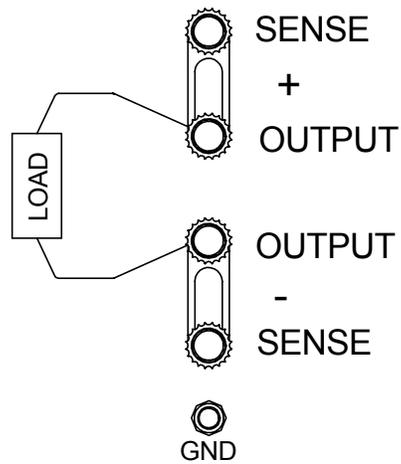
## HIGH CURRENT LOAD



[ Sense Links Removed ]

FIG 1

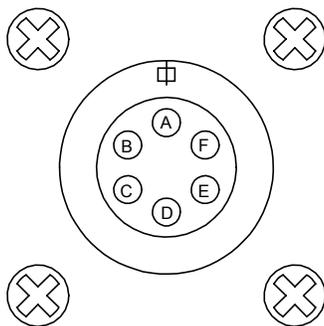
## LIGHT LOAD



[ Sense Links Installed ]

FIG 2

## OUTPUT CONNECTOR PIN FUNCTIONS



- PIN A Chassis Ground
- PIN B + Output
- PIN C - Output
- Pin D Not Used
- Pin E - Sense
- Pin F + Sense

FIG 3