

Model 6200B

10Hz TO 1MHz

DIGITAL PHASEMETER



SERIAL NO. _____

OPERATING AND MAINTENANCE MANUAL



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SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

The Krohn-Hite Model 6200B measures the difference in phase angle between two sine waves or two square waves of coincident frequency, over a range of 10Hz to 1MHz, and provides a direct readout of the phase angle, in degrees, with 0.1° resolution. The 6200 provides a basic accuracy of 0.5°, and accepts input signal levels between 0.1 volts and 120 volts RMS. A 3-1/2 digit, planar gas discharge display provides the direct readout of the phase angle for leading or lagging angles, between $\pm 180.0^\circ$.

The 6200 is designed for virtual “hands-off” operation. The wide input voltage range provides a continuous dynamic range of better than 60dB between the two input signals. The exceptional stability of the 6200 (better than 0.2°/month) eliminates the need for daily readjustment of zero and full scale calibration. An auto-sensing circuit in the 6200 determines the correct polarity sign to be displayed, for leading or lagging angles.

Additional features of the Model 6200 include an analog output, equal to 10mV per degree of phase, for use with an external meter or strip chart recorder, plus an optional BCD output.

The instrument is carefully inspected, aged and adjusted before shipment, and should be ready for operation when it is unpacked. If it appears to have been damaged in shipment, make a claim with the carrier and notify Krohn-Hite immediately.

1.2 SPECIFICATIONS

Frequency Range

10Hz to 1MHz.

Accuracy

Sine Waves: 0.5°, 10Hz to 1KHz; rising to 1° at 50kHz; 1.5°/50kHz above 50kHz.

Square Waves: 1.5°, 10Hz to 50kHz; 1.5°/50kHz above 50kHz.

Input Signal Amplitude

0.1 volts RMS to 120 volts RMS. (Derate accuracy specifications by a factor of 2 for input levels between 0.1 volts and 1.0 volts RMS and between 20 volts and 120 volts RMS on either input).

Input Waveforms

Sine waves or square waves.

Input Impedance

Greater than 100k ohms in parallel with 50pf.

Maximum DC Component

± 200 volts.

Response

Time Constant: Approximately 1 second.

Settling Time (to within 1° of reading): Between 1 and 10 seconds, dependent upon change in input.

Display

0.55°, 7-segment, planar gas discharge. Continuous, -180.0° to +180.0°.

Resolution

0.1°

Repeatability

±1 digit

Drift

±0.2°/30 days

Temperature Coefficient

±0.03°/°C.

Ambient Temperature Range

0°C to 55°C.

Analog Output

(For use with an external meter or strip chart recorder): 0 to +1.8 volts DC, 10mV/degree phase, 600 ohms output impedance. Separate +/- polarity output line to indicate leading or lagging phase.

+ angle: $V_{oh} = 2.4V$, $I_{source} = -1mA$

- angle: $V_{ol} = 0.4V$, $I_{sink} = 20mA$

BCD Output (Optional)

Provides 13 lines of parallel BCD output, equivalent to phase angle reading, plus 1 polarity output and 4 separate 3-state control lines. Compatible with DTL, RTL and TTL logic.

(May be externally connected for serial operations; all output lines are 3-state, i.e. "high", "low" and "high Z" to permit serial, multiplex, etc. operation. Consult Factory for details).

BCD and +/- Output Levels:

$V_{oh} = 2.5V$, $I_{source} = -4.2mA$

$V_{ol} = 0.4V$, $I_{sink} = 2.1mA$

3-State Output Leakage Current

±7.5 uAdc, max.

Disable Input Levels:

$V_{oh} \geq 3.5V$

; $R_{load} = 47K \text{ ohms}$

$V_{ol} \geq 1.5V$

Terminals

Front Panel: REF (BNC), SIG (BNC).

Rear Panel: REF (BNC), SIG (BNC), AC power receptacle.

Power Requirements

105-125 volts, or 210-250 volts, single phase, 50-60 Hz, 10 watts.

Dimensions and Weights

3-1/2" high, 8-5/8" wide, 11" deep, 6 lbs./3 kgs net, 8 lbs./4 kgs shipping.

Specifications apply at 25°C, $\pm 5^\circ\text{C}$ unless otherwise noted.

Optional Rack-Mounting Kit

Part No. RK-38; permits installation of 6200 into a standard 19" rack spacing.

Specifications are subject to change without notice.

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SECTION 2 OPERATION

2.1 POWER REQUIREMENTS

The Model 6200 may be used with either a 105-125 volt, 50-60Hz AC line, or a 21-250 volt, 50-60Hz AC line. A rear panel LINE switch selects the proper mode of operation. When the line voltage is 115 volts, a 1/8 ampere slow blow fuse is required; when the line voltage is 230 volts, a 1/16 ampere fuse must be used. A detachable, 3-wire line cord is provided with the unit.

2.2 OPERATION

To operate the 6200 Phasemeter, first make the appropriate power connections outline in the previous section, and push the POWER switch on the ON (recessed) position; allow the instrument to warm up for at least 30 minutes to obtain rated accuracy.

Connect the reference signal to the Phasemeter's REF input; connect the unknown phase to the SIG input. (The use of two similar length cables is recommended to avoid errors due to stray capacitance, particularly at high frequencies). The phase angle between the two inputs, in degrees, will be displayed by the front panel Digital Panel Meter. Additional phase measurements can be made by simply observing the meter display.

NOTE: The 6200 displays the phase angle by which the SIG input leads or lags the REF input, as determined by the display's polarity indicator.

The 6200 covers a phase measurement range of -180.0° to $+180.0^\circ$ and will automatically shift the reading by 360.0° if the phase angle exceeds the full scale range in either direction. For example, if the phase angle being measured exceeds $+180.0^\circ$, say $+200.0^\circ$, it will be shifted 360.0° so that the meter will now read -160.0° . The meter display allows approximately 5° overrange before it shifts the reading.

The accuracy specifications of the 6200 are outlined in Section 1.2, and apply for two sine wave or two square wave inputs, with amplitudes between 1.0 and 20 volts RMS. The accuracy specification must be derated a factor of 2 if the input voltage on either channel falls above or below the 1-20 volt range.

The Phasemeter accuracy will also be affected if a sine wave is used for one input, while a square wave is used on the other. The exact error produced in this case cannot be predicted; an estimate would be in the order of 1 to 3 degrees.

2.3 ADDITIONAL SOURCES OF ERRORS

2.3.1 Input Signal Distortion

Typically, any effects due to input signal distortion will be minimal; however, if the peak of the distortion occurs at the crossover point of one or both of the input waveforms, the worst case error may be approximately $\pm 0.6^\circ$ per 1% distortion. Similar distortion on both inputs, however, will tend to cancel the error.

2.3.2 Random Noise

Another source of phase error is caused by random, or broadband noise present on either or both input waveforms. Typically, an error of 0.1° can occur for a signal to noise ratio of 30:1 on both input signals. (Noise bandwidth: 500kHz; input frequency: 10kHz).

2.3.3 Non Symmetrical Square Waves

Typical errors produced by variations in the symmetry of the two input waveforms will generally be proportional to the percentage of variation.

2.4 ANALOG OUTPUT

The analog output provides a positive DC voltage equal to 10mV per degree of phase displayed, and may be used with an external meter or strip-chart recorder. The analog output is located on the rear panel. Output impedance is 600 ohms.

A separate output marked “ \pm ” provides a TTL output level that indicates whether the polarity of the display is plus or minus. The output goes “high” (~2.4V) for positive angles, and “low” (~0.4V) for negative angles.

2.5 BCD OUTPUT (OPTIONAL)

This option provides an equivalent BCD output of the front panel display, plus 5 additional control lines and a programming ground return. The logic levels are compatible with DTL, RTL and TTL logic.

Each digit of the display, with the exception of the 100's digit, is represented by 4 data output lines coded in a 1-2-4-8 format (pins 4-15); the 100's digit is represented by a single output line (pin 3).

The polarity (+/-) output line (pin 1) indicates when the polarity sign of the display is plus or minus; the output logic level remains “high” for positive angles and switches to its “low” state for negative angles.

The 4 remaining control lines, labeled “3-state control” (pins J, K, L, and M) provide a disable function for each digit. The “3-state control” refers to the 3 possible states of the data output lines. When the control lines are left “low” or open-circuit, the digits will be enabled; all data output lines will be “high” or “low” depending on the digits displayed. The source impedance of the output lines is low during the enable state. When the control lines are pulled “high” transfer of data will be inhibited; all output lines disabled will be at zero output level and exhibit a high source impedance. The advantage of this “3-state control” is that it allows the user to externally reconnect the data output lines for serial or multiplex operation, without the need for additional buffer stages.

Table 1 provides the programming pin connections for this option. A programming edge connector, TRW type 251-15-30-160 is also provided.

<u>Pin</u>	<u>Function</u>	<u>Description</u>
1	+/-	"high" for pos. angle
2	N/C	"low" for neg. angle
3	100.0	
4	080.0	
5	040.0	
6	020.0	
7	010.0	
8	008.0	
9	004.0	
10	002.0	Phase angle
11	001.0	BCD outputs
12	000.8	
13	000.4	
14	000.2	
15	000.1	
J	100's 3-state control	
K	10's 3-state control	"high" for "high Z"
L	1's 3-state control	"low" or open-circuit
M	0.1's 3-state control	for enable
S	GND	programming ground

Programming edge connector, TRW type 251-15-30-160 is provided.

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SECTION 3

INCOMING INSPECTION AND CHECKOUT

3.1 INTRODUCTION

The following procedure is used to verify that the phasemeter is operating within specifications, both for incoming inspection and for routine servicing. Tests should be made with all covers in place, and the procedure below should be followed in sequence.

3.2 TEST EQUIPMENT REQUIRED

- a) Precision Phase Standard or phase generator, that will provide two sine wave or two square wave signals with adjustable phase from zero to $\pm 180^\circ$, with better than 0.1° accuracy from 10Hz to 10kHz (Dytronics Models 311/RT-717S, 312, 410 or equivalent).

or,

Variable phase sine/square generator, adjustable from zero to $\pm 180^\circ$, for frequencies between 10Hz to 50kHz, with sine wave distortion no greater than 0.1% (Hewlett-Packard Model 203A or equivalent), plus a precision digital phasemeter with at least 0.1° accuracy from 10Hz to 50kHz, for accurately setting the phase output of the generator (Krohn-Hite Model 6600 or equivalent).

- b) High impedance AC voltmeter, zero to at least 10 volts RMS.

3.3 PROCEDURE

Before operating the phasemeter, refer to Section 2.1, Power Requirements, for the appropriate AC line voltage and fuse required. Connect the phasemeter's line cord to the AC power source and push the POWER switch to the ON (recessed) position; allow the unit to warm up for a few minutes before beginning the procedure.

Connect the outputs of the Phase Angle Source to the 6200 respective inputs. The reference signal is connected to the 6200 REF input; the unknown phase is connected to the SIG input.

The 6200 displays the phase angle by which the SIG input leads the REF input.

Refer to Section 1.2, Specifications when performing accuracy checks. Table 2 is provided to simplify the accuracy test.

TABLE 2. Performance Check

Phase Angle Range	REF & SIG Input Voltage Range	Frequency Range	Specifications	
			Sine	Square
-180.0° to +180.0°	1-10V RMS	10Hz-10kHz 10kHz-50kHz 50kHz	0.5° 1.0° 1.5°/ 50kHz	1.5° 1.5° 1.5°/ 50kHz
-180.0° to +180.0°	0.1-1.0V RMS or 10-120V RMS	10Hz-1MHz	derate above specifications by a factor of 2	

3.4 ANALOG OUTPUT CHECK

The analog output is a positive DC voltage equal to 10mV per degree of phase angle displayed. To check the analog output, connect the DCVM to the rear panel terminal marked "<" the output should be approximately 10mV times the absolute value of the displayed reading.

The polarity output is a TTL logic level that indicates when the reading is plus (+) or minus (-). Connect the DCVM to the rear panel terminal marked "+/-"; a logical "1" (2.4V) indicates a plus or leading angle, while a logical "0" (0.4V) indicates a minus or lagging angle.

3.5 OPTIONAL BCD OUTPUT CHECK

To check the optional BCD output, connect the phase generator to the respective phasemeter inputs; adjust the phase generator to obtain the readings found in Table 1, page 6, and measure the logic level of each data output line for each reading in the table. A logical "1" is approximately 2.4V and a logical "0" is approximately 0.4V. Be sure to connect the common of the DCVM to the BCD output digital ground (pin S).

The +/- polarity indicator (pin 1) provides a logical "1" (2.4V) for plus or leading phase angle readings, and a logical "0" (0.4V) for minus or lagging readings.

NOTE: This output should not be confused with the +/- polarity output provided for the analog output.