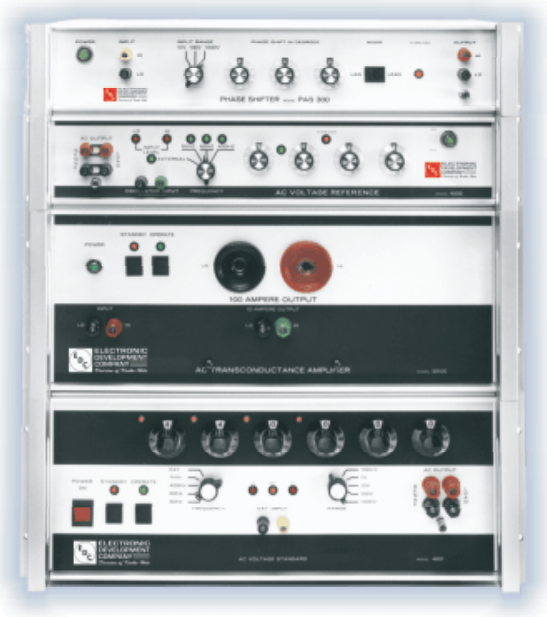
Model 4720/4721

Watt Calibration System



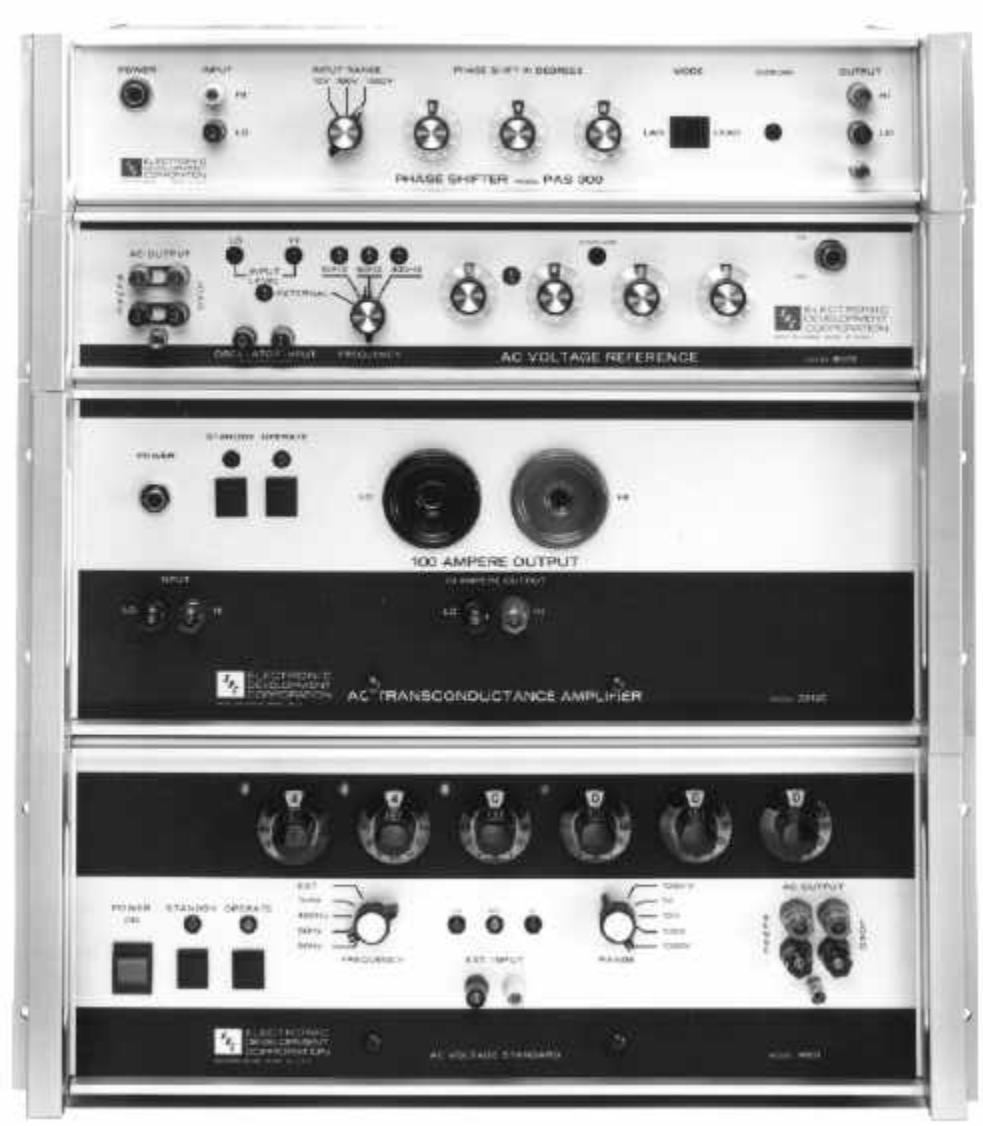
KROHN-HITE CORPORATION

Operating Manual

This page intentionally left blank.

SYSTEM MANUAL

4720/4721 SYSTEMS



4721 SYSTEM

TABLE OF CONTENTS

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

DRAWINGS & FIGURES

SECTION I

1.0.0. **INTRODUCTION**

The system consists of the following instruments:

Model 4601	AC Voltage Calibrator/Reference
Model 3200	(4720 Sys) 10A AC or DC current (Transconductance) Amplifier
OR	
Model 3210	(4721 Sys) 100A AC Current (Transconductance) Amplifier
Model 4032	AC Voltage Source to drive the 3200 or 3210
Model PAS300	Phase Angle Controller to set the phase angle between the current and voltage, i.e., to set the power factor.

1.1.0 Use as a System

The system may be used for direct calibration of watt meters, and watt transducers, data logging systems, process control systems, and power monitoring systems.

1.2.0 Use of Independent Instruments

The instruments may be used independently for direct calibration of AC DMM's, DVM's, analog meters and shunts, amplifiers, etc.

1.3.0 Specification for the Individual Instruments

These are contained in the individual instrument manuals.

SECTION II

SYSTEM POWER ACCURACY

Theory

The power delivered to the load is given by $P=V_1 I \cos\Theta$, where P is the power, V_1 is the 4601 output voltage, I is the 3200 or 3210 output current, and Θ is the phase angle of the current relative to the voltage. This may be written as: $P=V_1 V_2 G \cos\Theta$, where $V_2$is the 4032 output voltage and G is the 3200 or 3210 gain. The total power error due to the individual errors in the four parameters is given by:

$$\Delta P = \left(\Delta V_1 \frac{\delta}{\delta V_1} + \Delta V_2 \frac{\delta}{\delta V_2} + \Delta G \frac{\delta}{\delta G} + \Delta\theta \frac{\delta}{\delta\theta} \right) \left(V_1 V_2 \, G \cos\theta \right) =$$

$$\Delta V_1 \; V_2 \; G \cos\theta \; \Delta V_1 + \Delta V_2 \; V_1 \; G \cos\theta + \Delta G \; V_1 V_2 \cos\theta - \Delta\theta \; V_1 V_2 G \sin\theta$$

The % Power error is given by:

$$\frac{\Delta P}{P} \; X \; 100\% = \left(\frac{\Delta V_1}{V_1} + \frac{\Delta V_2}{V_2} + \frac{\Delta G}{G} - \tan\theta \; \Delta\theta \right) \; X \; 100\%$$

$$\Delta\theta = .1^\circ \; X \; \frac{2\pi}{360^\circ} \; (RAD) = .00175 \; (RAD)$$

Since the four variables are statistically independent, the RSS % power error is given by:

$$\frac{\Delta P}{P} \; X \; 100\% \; (RSS) = \sqrt{\left(\frac{\Delta V_1}{V_1} \right)^2 + \left(\frac{\Delta V_2}{V_2} \right)^2 + \left(\frac{\Delta G}{G} \right)^2 + (.00175 \tan\theta)^2} \; X \; 100\%$$

As an example, set the 4601 at 110V, the 4032 at 10V, and the 3200 at 10A. In this case:

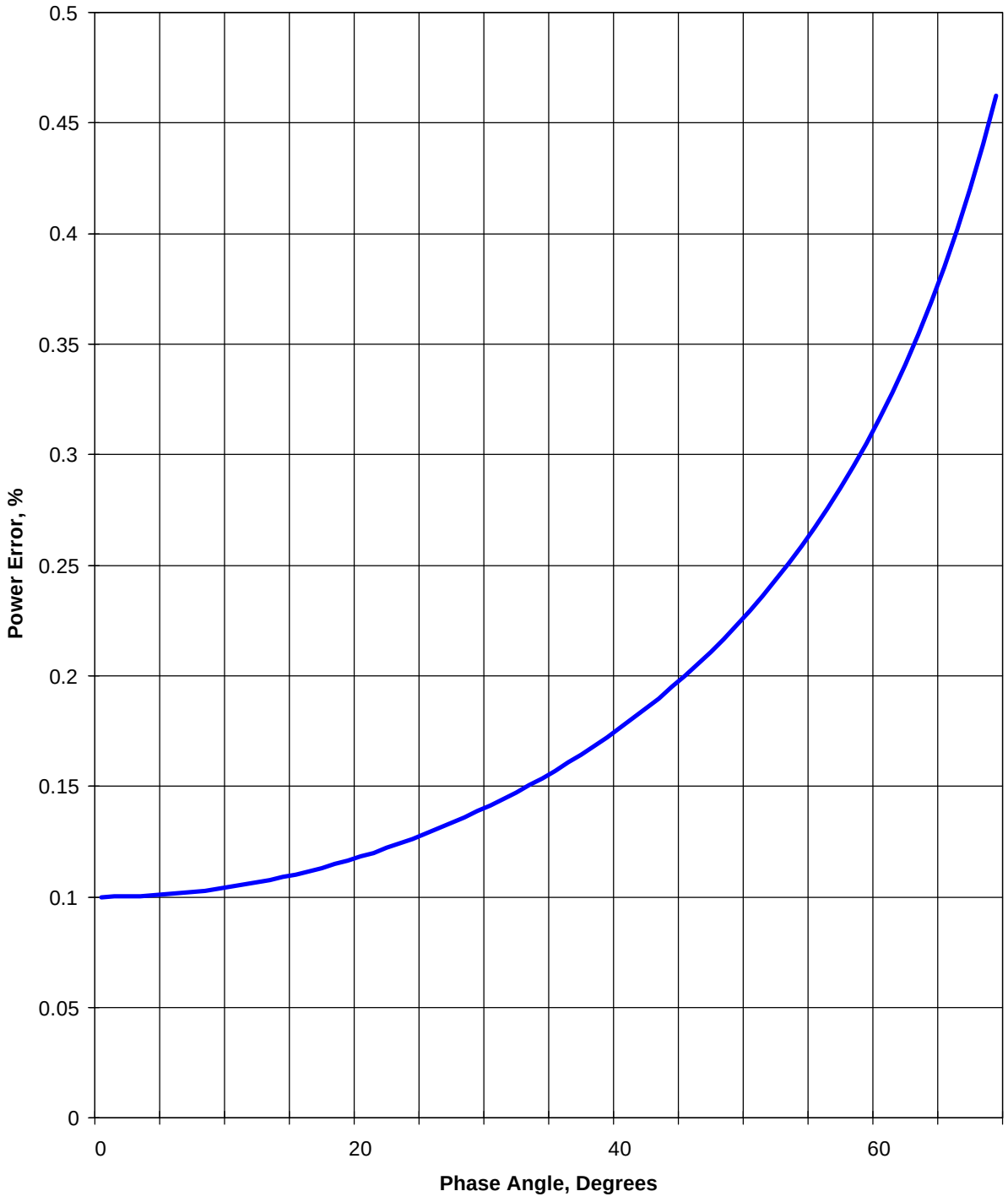
$$\frac{\Delta P}{P} \; X \; 100\% = \sqrt{(.0006)^2 + (.0006)^2 + (.0006)^2 + (.00175 \tan\theta)^2} \; X \; 100\%$$

$$.1\sqrt{1 + 3\tan^2\theta} \; \%$$

This is plotted in figure 1.

2.2.0 System Power Error chart

Fig. 1 System Power Error



SECTION III

3.0.0 SYSTEM HOOKUP

3.1.0 472X Watt Meter connections

3.1.1 For system hookup, refer to drawing A4559.

SECTION IV

4.0.0 CALIBRATION

4.1.0 System Calibration

4.1.1 First calibrate each individual instrument system performance, the following calibration should be performed on the PAS-300 when it is hooked up as part of the system.

4.1.2 Set the PAS-300 input range to 100V, and phase to 60º lag.

4.1.3 Connect the reference input of the phase meter to the input of the PAS-300.

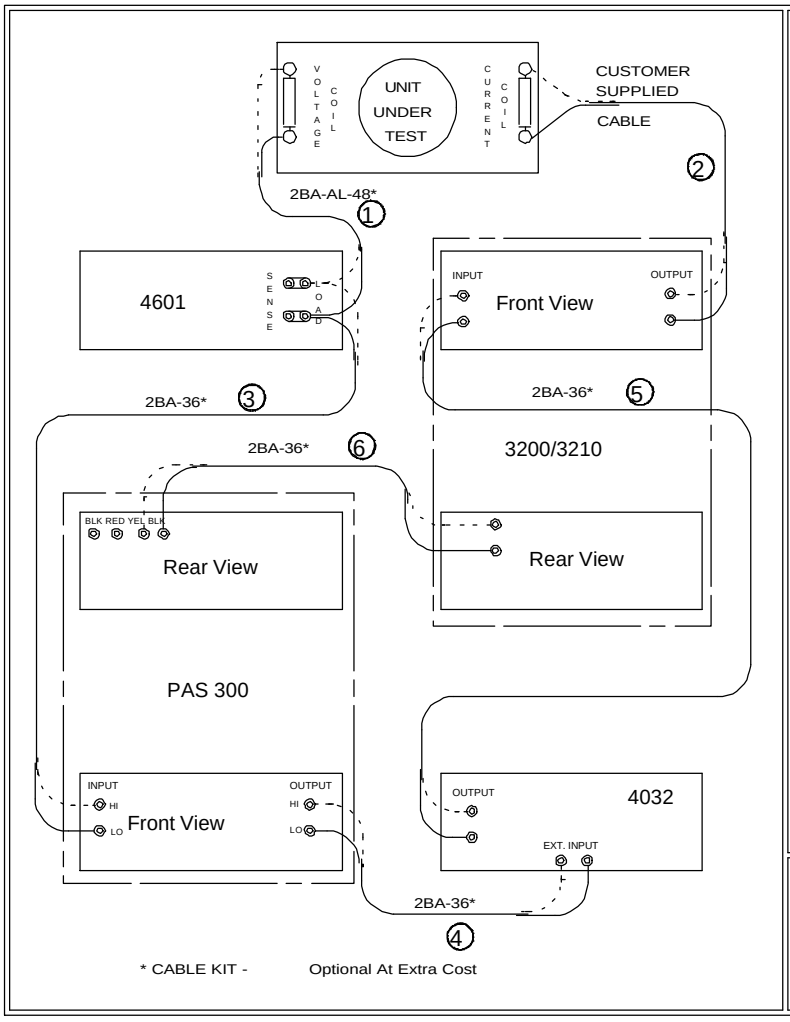
4.1.4 Connect the signal input of the phasemeter to the 3200 or 3210 phase output terminals.

4.1.5 Set the 4601 to 110V 60Hz.

4.1.6 Vary 4601 output from 110V to 10V and adjust R5 for equal readings. After this step, leave the 4601 set at 110V.

4.1.7 Alternately switch the 4032 output between 1V and 10V. Adjust R4 on the PAS-300 for equal readings; then adjust RA for a -60º reading of the phasemeter.

4.1.8 Set frequency on 4601 to 400Hz. Adjust RB for a reading of -60º.



INTER-CONNECT PROCEDURE:

1. Connect the 4601 output to the Voltage Input of the METER UNDER TEST.
2. Connect the 3200 (or 3210) output to the Current Input of the METER UNDER TEST.
3. Connect the 4601 Output to the Input on the PAS300.
4. Connect the Output from the PAS300 to EXT INPUT on the 4032.
5. Connect the Output from the 4032 to the input of the 3200.
6. Connect the SENSE INPUT on the rear of the PAS300 to the Rear Panel PHASE OUTPUT terminals on the 3200.

KROHN-HITE CORPORATION

WATT METER CALIBRATION SETUP

R11/98

A4559