Model 408

Multifunction Modular Calibrator, GPIB Programmable

KROHN-HITE CORPORATION

Operating Manual

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MODEL 408
OPERATORS
MANUAL

Serial No._____

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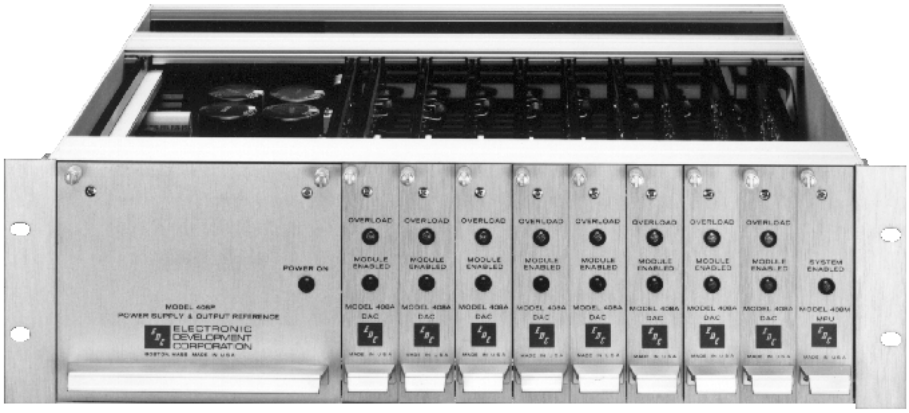

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TABLE OF CONTENTS

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

408 MANUAL

LIST OF DRAWINGS

DESCRIPTION	DRAWING #
Block Diagram	B-3978A
Power Supply Schematic	B-3974B
Input Filter Schematic	B-4323B
Output Reference Schematic	B-4871A
MPU-488 Interface Schematic	B-4048A
MPU-DAC Interface Schematic	B-3982B
DAC Module Schematic	B-3969G
408 Adjustments & Test Points Layout	A-4874A

LIMITED WARRANTY

The Krohn-Hite Corporation 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 Krohn-Hite 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 Krohn-Hite factory and upon examination be deemed defective.

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

Krohn-Hite 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 Krohn-Hite. No other person or persons is authorized to assume in the behalf of Krohn-Hite 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 Krohn-Hite 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 Krohn-Hite Representative. (See GeneralInformation 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 Krohn-Hite 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 (expect 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 model 408 is a remotely controlled, multiple output AC & DC voltage reference system for application with automatic test equipment. It is a highly versatile reference source, designed to meet the needs of computer systems, production line testing, ATE systems, and standards laboratories.

1.1.2 The instruments have a specified accuracy, and are traceable through a bank of saturated standard cells, to the National Institute of Standards and Technology.

1.1.3 The model 408 is programmable via the IEEE-488 bus.

1.1.4 The 408 has the following 10 plug-in modules:

A) 1 Power supply and output reference module - MODEL 408 P
B) 1 MPU module - MODEL 408 M
C) Up to eight (8) DAC Modules

1.1.5 The system is capable of putting out eight simultaneous, variable AC & DC voltages.

1.1.6 The instrument is overload and short-circuit proof, and is fully operational in normal environmental conditions.

1.1.7 The DAC modules will drive a short circuit indefinitely without damage to the instrument.

1.2.0 Output Specifications

1.2.1 Output:
AC Range: 1mV - 30 Vac rms
DC Range: ± 1mV - ± 30 Vdc

1.2.2 Resolution:
(Minimum Step Change): 1 mV

1.2.3 Maximum Output Current:
50 mA

1.2.4 Accuracy:
AC Mode: ±(0.05% of setting +5 mV)
DC Mode: ±(0.035% of setting +1 mV)

1.2.5 Temperature:

Calibration Temperature:	23° C ± 1° C
Ambient Temperature:	20° C to 30° C
Operating Limit:	10° C to 50° C
Storage Temperature:	-40° C to 85° C

1.2.6 Temperature Coefficient:
Ambient: ± 0.001%/° C
Operating Limit: ± 0.005%° C

1.2.7 Phase Angle Control:
0° or 180° relative to input reference (remotely selectable).

1.2.8 Phase Angle Accuracy:
± 1°

1.2.9 Frequency Range:
400 Hz ± 10%

1.2.10 Distortion:
<0.3%

1.3.0 Input Specifications

The user to supply the reference frequency with the following specifications:

1.3.1.1 Amplitude:
5 V ± 30% or 26 V ± 30% rms.

1.3.1.2 Frequency:
400 Hz ± 10%

1.3.1.3 Total Harmonic Distortion:
< 3%

1.3.1.4 Third Harmonic Distortion:
< 1%

1.3.2 Line Power:
115 Vac ± 10%, 50 Hz - 60 Hz ± 5%, 100 W

1.4.0 General Computer Interface Specifications

1.4.1 These systems are programmable via the IEEE-488 Interface Bus (GP-IB). Each system will have its own selectable bus address. Each of the eight modules may be programmed independently.

1.4.2 The interface capabilities of the K-H MODEL 408 are SH1, AH1, T6, L4, SR1, RL0, PP2, DC1, DT0, E1, (See para. 3.2.8 for PP2 exception.)

1.4.3 Each module has one independently variable output (amplitude), which will be programmed in BCD with 5 digit resolution plus one additional bit to control the phase angle.

1.5.0 Front Panel Configuration

1.5.1 The modules are placed in the mainframe in the following order from left to right: power supply and output reference module, up to 8 DAC modules, MPU module.

1.5.2 All of the DAC modules are interchangeable. The module's internal address is a function of the "slot" in which it is located. When any module is inserted into a slot it will assume the address of that slot.

1.5.3 An important feature of this design is the interchangeability and immediate replacement capability of the modules.

1.5.4 The power supply module has a ***POWER ON*** light.

1.5.5 Each DAC module will have two annunciators:

1) A red ***MODULE ENABLED*** light
2) A yellow ***OVERLOAD*** light

1.5.6 The MPU module has a ***MODULE ENABLED*** light.

SECTION II

2.0.0 INSTALLATION

2.1.0 Mounting

The 408 is designed for mounting in a standard 19" rack. It is recommended that nylon washers be placed under the rack mounting screws to prevent scratching the mounting ears.

2.2.0 Mating Connectors

All instruments are supplied with a mating AC power cord and input and output connectors.

The type connectors used are:

NOMENCLATURE	K-H PART NUMBER	QTY.
A.C. Power cord	CAB008	1
Input Connector	CON016 & CON052	1
I.C. Cable Clamp	CON013	1
Output Connector	CON047	8
O.C. Cable Clamp	CON049	8

2.2.1 Input Connector Pinout:

PIN A NC
PIN B 5V Reference Hi
PINS C&E Reference Lo
PIN D Chassis GND
PIN F 26V Reference Hi

2.2.2 Output Connector Pinout:

PIN A Channel n Hi
PIN B Chassis GND
PIN C Channel n Lo

2.3.0 IEEE STD. 488 Cable

A one or two meter IEEE 488 cable may be obtained from K-H.

NOMENCLATURE	K-H PART NUMBER
One meter 488 cable	CAB011
Two meter 488 cable	CAB010

SECTION III

3.0.0 OPERATION OF THE INSTRUMENT

3.1.0 Front Panel Indicators

3.1.1 POWER ON indicator: A red “power on” indicator is located on the power supply and output reference module - Model 408P. An on-off switch is located on the module's rear panel.

3.1.2 System Enabled Indicator: A red “system enabled” indicator is located on the MPU Module - Model 408M. This indicates that the MPU has received a valid MLA message from the 488 bus.

3.1.3 Module Enabled Indicator: A red module enabled indicator is located on each DAC Module - Model 408 A. This indicates that the module has been programmed with a 24 bit word from the MPU.

3.1.4 Overload indicator: A yellow overload indicator is located on each DAC Module - Model 408 A. This indicates a malfunction within the module, or that too much current is being drawn from the module's output terminals.

NOTE: THE OVERLOAD INDICATOR NORMALLY WILL NOT BE SEEN, AS THE MPU TURNS OFF A MODULE SENDING AN OVERLOAD SIGNAL.

3.2.0 IEEE 488 (GPIB)

3.2.1 The interface capabilities of the 408 are SH1, AH1, T6, L4, SR1, RL0, PP2, DC0, DT0, E1, (See para. 3.2.9 for PP2 exception.)

3.2.2 The Model 408 individual DAC Modules are controlled by a master MPU Module which interfaces with the IEEE Bus.

3.2.3 The bus address of the system is set by switches located on the 408 MPU module. The MPU Module addresses eight slots (locations) in the system. The modules location in the rack determines the “Address” of the module, i.e. A module in slot “1" is addressed as Module “1”, etc.

3.2.4 There are several groups of commands which the 408 will act upon when received over the bus.

A. Normal messages to program an individual module's output to a specified voltage.
B. Serial Poll in response to a SRQ.
C. Parallel Poll to indicate device status.
D. Messages requesting specific responses on the condition of the 408 .
E. Interface Clear (IFC)

3.2.5 Individual module amplitude sent over the bus is in BCD. Each decade is sent over as a BCD digit, the decimal point should not be included in the string. i.e.: 12.345 V would be sent "12345"; 1.234 V would be sent "01234". The K-H Model 408 keeps the decimal point fixed. Therefore, to program an individual module requires seven (7) bytes, in ASCII, of the form:

byte 1	module #	1-8
byte 2	MSDigit Amplitude	0-3
byte 3	2nd Digit "	0-9
byte 4	3rd Digit "	0-9
byte 5	4th Digit "	0-9
byte 6	5th Digit "	0-9
byte 7	0-180° Phase, Pos or Neg Polarity	0,1,4,5 (EOI)

Example 1: 25.6 Vac 0 phase to module 4 would be programmed: 4256000(EOI).
Example 2: - 3.697 Vdc to module 1 would be programmed: 1036975(EOI). The end message sent with the last byte. The seven byte word must be sent over each time unless programming the module off.

3.2.6 A module may be turned off by sending over the module number; n(eoi). This will set the modules output to zero, and remove its status from the Module On Line register. To reactivate the module the seven byte message must be sent.

NOTE: THE OUTPUT OF EACH MODULE IS HARD WIRED TO ITS OUTPUT CONNECTOR. THEREFORE, A SMALL RESIDUAL VOLTAGE MAY APPEAR ON THE CONNECTOR PINS. IT WILL BE LESS THEN 5 MILLIVOLTS.

3.2.7 The K-H Model 408 may be returned to the power-on condition, i.e. all modules at 0 output, the system enabled light off and in the listener idle state, by sending the addressed message "R" or "RESET".

3.2.8 The K-H Model 408 responds per IEEE-488 (GPIB)-1978 convention to a Serial Poll. A Serial Poll conducted in response to a SRQ sent by the 408, will result in the 408 transmitting over the bus one of the following status bytes:

a. Invalid Data received	DI1-DI7 false, DI8 true
b. Module failed	DI1-DI4 failed module#
c. Module not installed	DI1-DI4 missing module, DI8 true

CAUTION

A MODULE SHOULD NOT BE REMOVED OR INSTALLED WHILE POWER IS APPLIED TO THE SYSTEM. DAMAGE TO THE MODULE OR TO UNITS CONNECTED TO THE MODULE MAY OCCUR.

3.2.9 The K-H MODEL 408 does not permit the Parallel Poll Configure, (PPC) command as implemented in the IEEE-488 (GPIB)-1978 convention. However, the unit may be configured by transmitting an ASCII "P" followed by the PPR byte. From that point the K-H Model 408 will respond to Parallel Polling.

3.2.10 Talk Enable Modes

The controller may request specific status information from the K-H Model 408. The messages to be sent to the K-H Model 408 prior to sending an MTA are as follows:

a. Last Data Sent

1. Last Message sent over Bus B(eoi)
2. Last Data to n module Mn(eoi)
3. Last Data to all modules D(eoi)

b. Modules on line L(eoi)

c. Modules installed I(eoi)

d. What's wrong ?(eoi)

3.2.11 Upon receipt of any of the above messages, and upon receiving MTA, the K-H Model 408 will respond with the appropriate information:

a[1]. B: From 1 to 7 bytes
a[2]. Mn: Seven bytes of the form described in para. 3.2.5
a[3]. D: Seven bytes of the form described in para. 3.2.5, for each module active, with a delimiter, ASCII "US",(Unit Separator), between each group of seven bytes, and an "EOI" sent with the last byte.

b. L: ASCII message, with the number(s) of the modules on line.

c. I: ASCII message, with the number(s) of the modules installed.

d. ?: One of the following ASCII messages:
DE(eoi)data error
ASCII message,"F",followed with the number(s) of the failed module(s) (eoi).
ASCII message,"M",followed with the number(s) of the addressed Module(s) not present (eoi)

3.2.12 The "What's Wrong" request may be sent at any time, the K-H Model 408 will respond with, "NOTHING WRONG" or one of the messages of Para 3.2.11,d. It is also used when the controller responds to an SRQ with a PPE, and the 408 response signifies an error condition.

3.2.13 Sending over a ASCII "?", the model 408 will respond with an ASCII byte as described in para. 3.2.11d.