

OPERATING INSTRUCTIONS
for the
KNOPP TYPE KATC-V
AUTOMATIC TRANSFORMER COMPARATOR



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OPERATING INSTRUCTIONS

KNOPP TYPE KATC-V

AUTOMATIC TRANSFORMER COMPARATOR

1. General Information

The Knopp Automatic Transformer Comparator (KATC-V) is used to measure the ratio and phase angle errors of voltage transformers with respect to a "standard" transformer. This microprocessor-based instrument automatically selects the optimum measurement range, computes the results, and digitally displays the transformer errors, the ANSI accuracy class for which the transformer qualifies, and the test voltage.

The KATC-V has protective circuitry that helps prevent damage when the Transformer-Under-Test (TUT) is improperly connected. Options allow connection to a computer via an RS-232C serial port.

2. Specifications

Input Power:	120 VAC, 50/60 Hz, less than 0.2A
Test Frequency:	60 Hz (50/60 Hz optional)
Test Voltage Range:	50 to 150V (in the secondary of the TUT)
Ratio Error Range:	-100% to +1000% (0 to 10 Ratio Correction Factor)
Phase Error Range:	-1000 to +1000 minutes
Accuracy Class Range:	0 to 100
Accuracy:	$\pm(0.75\%$ of reading + 1 Least Significant Digit)
Interlock Relay:	Capable of carrying 120/240 Volts at a maximum of 10 Amperes
Burden on Standard Transformer:	Less than 0.2 VA at 120V
Burden on TUT:	Less than 0.05 VA if within 0.6 accuracy class

Resolution:

	RCF	Phase Angle (Minutes)	Accuracy Class
$0.0 \leq \text{Accuracy Class} < 0.2$	0.00001	0.01	0.01
$0.2 \leq \text{Accuracy Class} < 0.7$	0.00001	0.1	0.01
$0.7 \leq \text{Accuracy Class} < 1.4$	0.0001	0.1	0.01
$1.4 \leq \text{Accuracy Class} < 10$	0.0001	1	0.01
$10 < \text{Accuracy Class}$	0.0001	1	0.1

3. Installation

3.1 Portable Use

Figure 1 shows the transformer connections to be made to the terminal board on the rear panel of the KATC-V when the KATC-V is being used in a portable environment (not mounted in a transformer test system). The "AC Supply" shown on the drawings should be variac-controlled — such that you can apply voltage *gradually*.

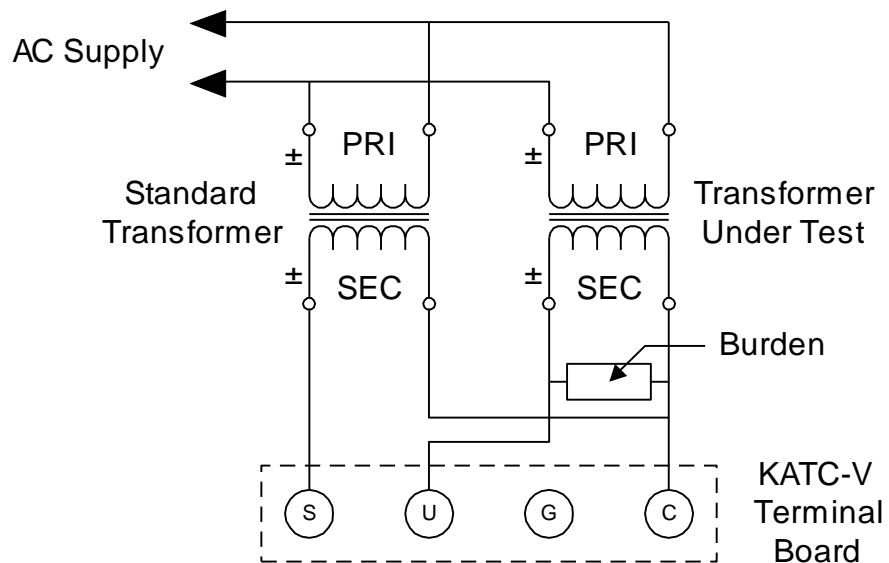


Figure 1 - KATC-V Portable Use

Notes:

1. Terminal G is internally connected to the KATC-V front panel and chassis — and grounded through the power cord plug.
2. If the power cord is ungrounded, connect G to system ground.
3. If the power cord is grounded, and one of the secondary leads is at system ground, **do not** connect G to system ground.
4. If the power cord is grounded, and it is desired to ground the transformer secondary, this may be accomplished by connecting G to S, U, or C, as appropriate.

One-to-One Test

The One-to-One test is a method for checking the calibration of the KATC-V and associated standard transformer. The One-to-One test shown in Figure 2 is to be used if you are not using the KATC-V with the Knopp KVTS or 1G2 Transformer Test System. If the KATC-V is installed in a KVTS or 1G2, see the instruction manual included with that unit for information on running the One-to-One test.

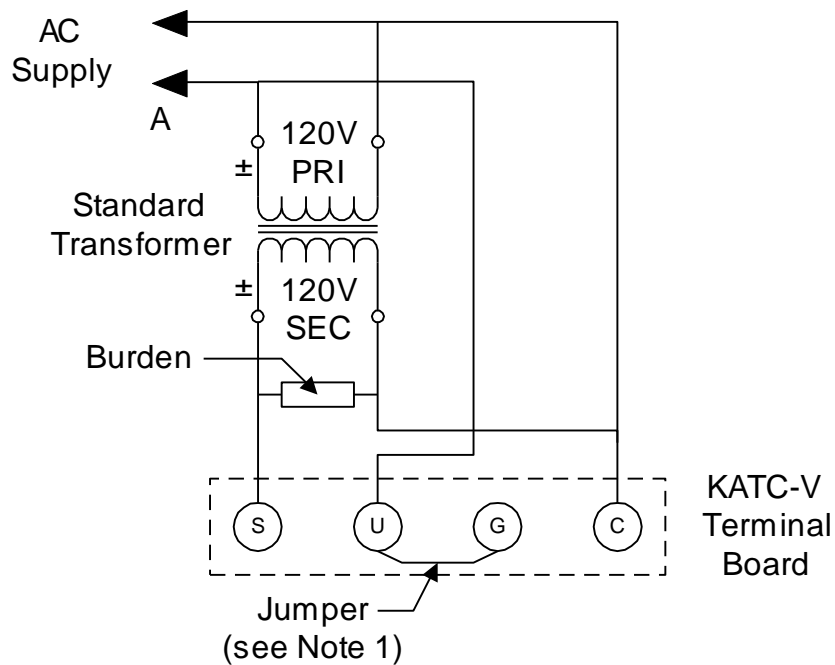


Figure 2 - One-to-One Test

Notes:

1. If point "A" is a neutral ground, remove jumper between U and G.
2. The ± terminals of the transformer **cannot** be connected together.

3.2 Installation In Knopp Type KVTS Transformer Test System

See the instruction manual supplied with the KVTS.

4. Operation



4.1 Description of Controls

- | | |
|-------------------------------------|--|
| ON/OFF Switch: | Controls 120 VAC power to the KATC-V. |
| PERCENT/RCF Switch: | Allows the ratio error to be displayed in Ratio Correction Factor (RCF) or Percent Ratio Error. [$Percent\ Ratio\ Error = 100 \times (RCF - 1)$] |
| MINUTES/MILLIRADIANS Switch: | Allows the phase angle error to be displayed in Minutes or Milliradians. [$1\ Minute = 0.29089\ Milliradians$] |
| HOLD/PRINT Push-button: | <ol style="list-style-type: none">1. The first press "freezes" the displayed data so that the test voltage can be reduced to zero — with the error results still available. A "box" () is displayed next to the voltage to denote the HOLD status.2. Pushing HOLD/PRINT a second time will send the data to an RS-232C serial port (optional).3. Each time the HOLD/PRINT |

button is pressed, the voltage at which the test results were taken is recalled to the display. After a short time, the display will again indicate the applied voltage (if any) in real-time.

- RESET Push-button:**
1. Clears "HOLD/PRINT" status.
 2. Used to reset the KATC-V after correcting an error that caused an "alarm" condition.

4.2 Operating Procedures


Normal Test

1. If you are using the KATC-V without one of the Knopp Transformer Testing Systems, connect the standard transformer and transformer-under-test as shown in Figure 1 (earlier in this manual). When using the KATC-V with the KVTs or 1G2, refer to the instruction manual for your system for transformer connection instructions.
2. When power is first applied to the KATC-V, the display will momentarily show **RESET**. After this message disappears, test voltage data is displayed.
3. *Slowly* adjust the test voltage (secondary voltage of the Transformer) to the desired value. **Note that the data will not be displayed until the Test Voltage reaches 10 VAC!!!**

CAUTION

IF THE TEST VOLTAGE IS APPLIED TOO QUICKLY, THE KATC-V ALARM MAY BE FALSELY TRIGGERED. ALTHOUGH THE KATC-V HAS CIRCUITRY TO MINIMIZE THE EFFECTS OF EXCESSIVE ERROR VOLTAGE, THE PROTECTION IS NOT TOTAL. IF A GENUINE ERROR CONDITION EXISTS (WRONG POLARITY OR WRONG RATIO), APPLYING VOLTAGE TOO QUICKLY WILL INCREASE THE CHANCES OF DAMAGE TO THE KATC-V AND TO ASSOCIATED EQUIPMENT.

4. After the data is displayed (RATIO ERROR, PHASE ERROR, and ACCURACY CLASS), press HOLD/PRINT — then reduce the voltage to zero.

The HOLD status is denoted by the appearance of a "box" () on

the KATC-V display next to the display of test voltage.

Each time the HOLD/PRINT button is pressed, the voltage at which the displayed results were taken is recalled to the display for a short time. The display then returns to showing the presently applied voltage.

5. Record the data. If you have the RS-232C option, the data is automatically sent to the output device upon pressing HOLD/PRINT a second time.
6. Press RESET to clear the HOLD status.

4.3 One-to-One Test

The One-to-One Test is a method for checking the calibration of the KATC-V and associated standard transformer.

1. If you are using the KATC-V without one of the Knopp Transformer Testing Systems, connect the standard transformer as shown in Figure 2 (earlier in this manual). When using the KATC-V with the KVTS or 1G2, refer to the instruction manual for your system for One-to-One test instructions.
2. When power is first applied to the KATC-V, the display will momentarily show **RESET**. After this message disappears, test voltage data is displayed.
3. *Slowly* adjust the test voltage to the desired value. **Note that the data will not be displayed until the Test Voltage reaches 40 VAC!!!**

CAUTION

IF THE TEST VOLTAGE IS APPLIED TOO QUICKLY, THE KATC-V ALARM MAY BE FALSELY TRIGGERED. ALTHOUGH THE KATC-V HAS CIRCUITRY TO MINIMIZE THE EFFECTS OF EXCESSIVE ERROR VOLTAGE, THE PROTECTION IS NOT TOTAL. IF A GENUINE ERROR CONDITION EXISTS (WRONG POLARITY OR WRONG RATIO), APPLYING VOLTAGE TOO QUICKLY WILL INCREASE THE CHANCES OF DAMAGE TO THE KATC-V AND TO ASSOCIATED EQUIPMENT.

4. After the data is displayed (RATIO ERROR, PHASE ERROR, and

ACCURACY CLASS), press HOLD/PRINT — then reduce the voltage to zero. This data should be compared to any One-to-One data originally taken with the equipment. Errors in excess of $\pm 0.025\%$ on ratio or ± 2 minutes on phase angle should be investigated.

5. Record the data. If you have the RS-232C or Printer option, the data is automatically sent to the output device upon pressing HOLD/PRINT a second time.
6. Press RESET to clear the HOLD status.

4.4 Alarm Conditions

1. If the test voltage exceeds 159.5 volts or the error voltage (the difference in secondary voltages of the precision transformer and the transformer-under-test) exceeds 5 volts, the display will indicate **REDUCE VOLTAGE, THEN RESET**, the audible alarm will sound, and power will be removed from the loading system — provided that you have connected the "interlock" feature properly. The same response will occur if test voltage is applied too quickly. Excessive error voltage can result if the TUT is connected with wrong polarity or if the wrong ratio is chosen.
2. The following messages indicate a malfunction within the KATC-V and are discussed in the Troubleshooting and Repair Section (5).

**No zero crossing (LOW) (or HIGH)
EOC Does not go low (or high)**

3. If the limits of RATIO ERROR, PHASE ERROR, or ACCURACY CLASS (as defined under Specifications above) are exceeded, over-range arrows (^^) will appear in the appropriate places on the display. This will *not* trigger the alarm.

5. Troubleshooting and Repair

You Can Contact Knopp At:
(510) 653-1661

5.1 *Doesn't Work The First Time*

If your KATC-V doesn't work after you have just unpacked it and applied power for the first time, the problem is probably a bad connection resulting from shipment. Remove the rear door and "re-seat" all the printed circuit cards and the ribbon cables. Make sure that the cards "snap" into place. Also check your connections to the transformer(s) and to the loading system.

5.2 *Alarm Too Sensitive*

This could be caused by applying the test voltage too quickly. Try increasing the voltage *gradually*. If necessary, the sensitivity can be adjusted as follows:

- a. Remove the KATC-V rear cover and locate R11 on Card 3 (Error Amp). [See *Figure 3, below, for card location.*]
- b. Turn the potentiometer counterclockwise to reduce the sensitivity (in $\frac{1}{4}$ -turn increments).

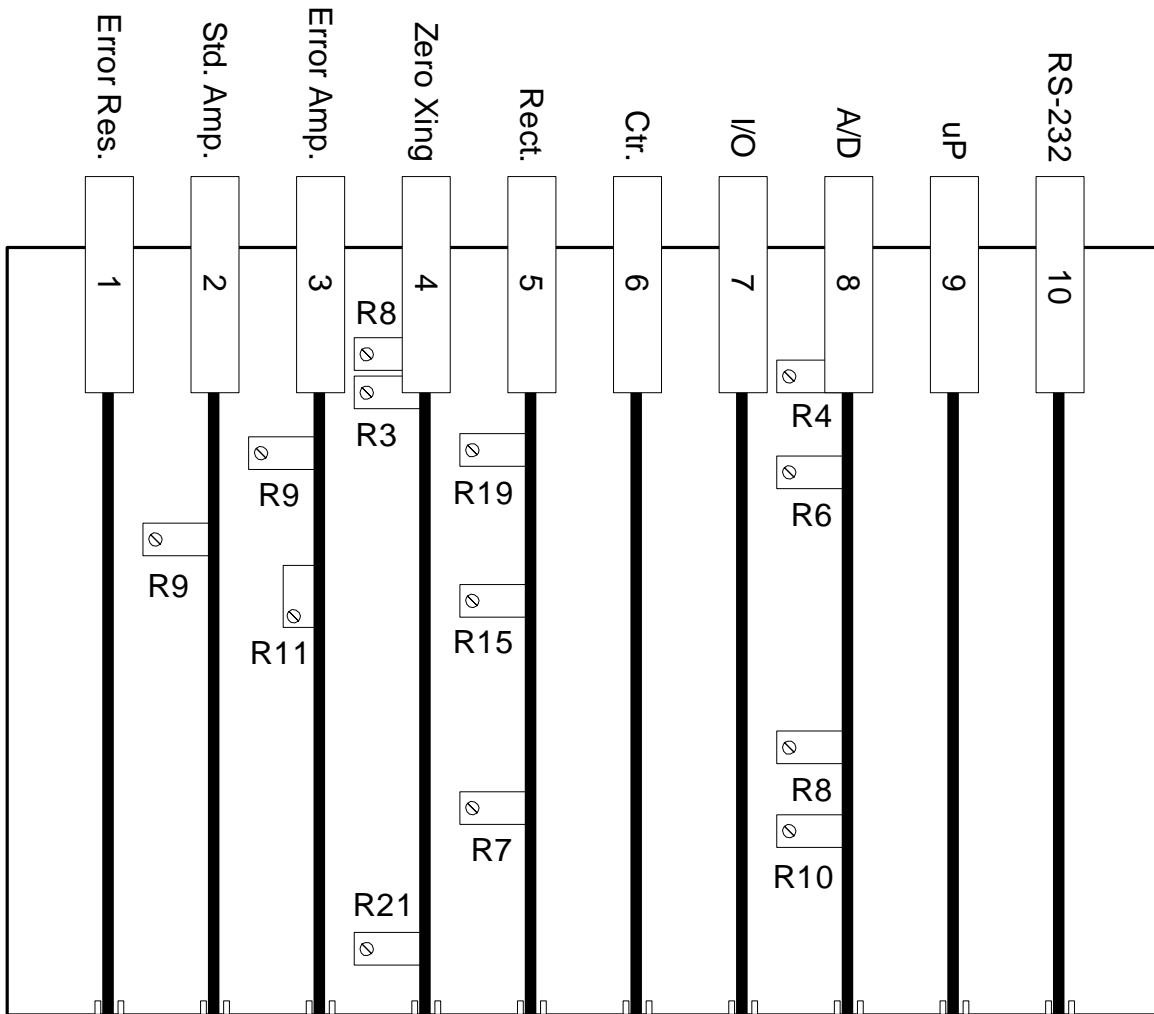
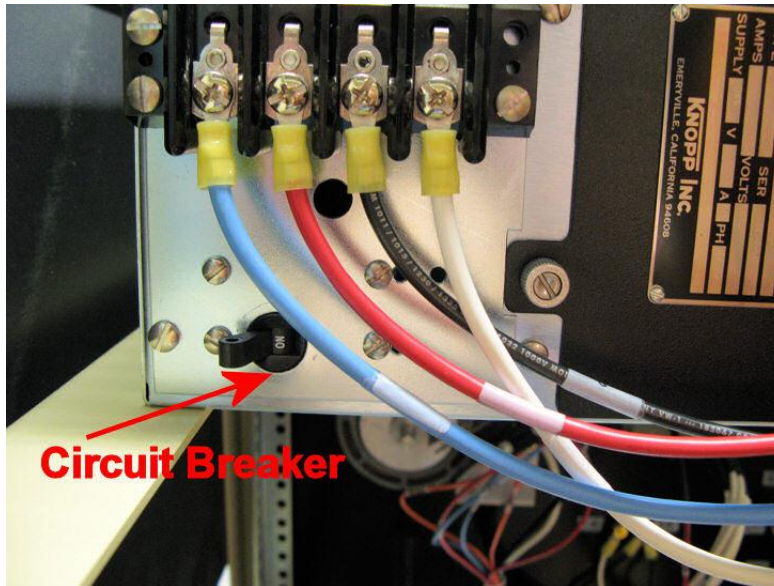


Figure 3 - KATC-V Printed Circuit Cards

5.3 Test Voltage Display Remains at (or Near) Zero

If the digital voltage display on the KATC-V does not increase as the variac knob on the test equipment is turned, or the test results are not believable, the most probable reason is a tripped circuit breaker on the rear of the KATC-V. Check the breaker and, if it is tripped, reset it. The Red neon light on the front panel will light if the Breaker is tripped.



The most probable causes of a tripped breaker are:

1. the selection of an improper voltage range for the transformer-under-test or,
2. the improper connection of the transformer-under-test.

Make sure that the "interlock" feature is connected to help prevent future problems.

Note that the internal KATC-V interlock relay is capable of carrying a maximum of 120 or 240 Volts at 10 Amperes. If this relay is being used to interrupt the main supply of a voltage source, it may be necessary to use the KATC-V interlock relay to control a larger "contactor" type relay in order to minimize the voltage and/or current passed through the KATC-V interlock relay.

5.4 "No Zero Crossing" Message

If you see a message that reads **No Zero Crossing (LOW)** or **No Zero Crossing (HIGH)**, and can be caused by a problem with any of the eight PC Cards . Contact the factory for further troubleshooting.

5.5 "EOC" Message

If you see a message that reads **EOC Does not go low** or **EOC Does not go high**, Card 8 (A/D) may be defective. Contact the factory for further

troubleshooting.

5.6 *Test Voltage Display Inaccurate*

The KATC-V display of secondary test voltage can be changed by adjusting R9 on Card 2 [See Figure 3, above].

1. Place an accurate voltmeter across terminals S and C on the KATC-V rear terminal strip.
2. Adjust R9 until the KATC-V display matches the reading on the voltmeter.

6. Optional Features

6.2 *Serial (RS-232C) Output Port*

If the RS-232C port option was purchased, the DB-25 connector on the rear of the KATC-V can be connected to a computer with a serial port. Pressing the HOLD/PRINT button initiates a printout. A sample printout is shown below:

```
{CR}{LF}{CR}{LF}
VT TEST:                               {CR}{LF}
TEST      RATIO      PHASE      ACCURACY {CR}{LF}
VOLTAGE   ERROR      ERROR      CLASS   {CR}{LF}
(VOLTS)   (%)        (MINUTES)  (%)    {CR}{LF}
120.0     +0.002     +0.26     0.01  {CR}{LF}
{CR}{LF}{CR}{LF}
```

where {CR}{LF} indicates a Carriage Return, Line Feed sequence.

This printout will vary depending on the position of the front panel switches.

The KATC-V communicates at 1200 baud, 8 data bits, no parity, and one stop bit.

6.3 RS-232 DATA RECORD FORMATS

There are four possible data records for the KATC-V:

Ratio Error and Minutes

Ratio Error and Milliradians

Ratio Correction Factor and Minutes

Ratio Correction Factor and Milliradians

Data files of KATC-V data are written in ASCII format and can be printed as ASCII files. They will appear in the same formats as the examples shown later in this document. Each record of data will be stored as one long string of bytes. Thus, to locate a particular field of data, you must know in which byte it begins. The record layouts given here show the *exact* byte locations for the data fields in each of the four records.

All data records are of *fixed* format. Each record is 218 bytes in length.

Included in this document is an example of each type of KATC-V record, in ASCII format and record layout. {CR}{LF} indicate 2 bytes in the record for Carriage Return and Line Feed at the end of each line. To provide blank lines, extra {CR}s and {LF}s are inserted.

In the record layouts, the data fields are delimited by a double line (||). The first byte of each field is indicated by the byte position above it.

Also in the record layouts:

* = {CR} CARRIAGE RETURN (hexadecimal 0D)

= {LF} LINE FEED (hexadecimal 0A)

6.3.1 RATIO ERROR AND MINUTES

ASCII format:

```
{CR}{LF}{CR}{LF}
VT TEST:                      {CR}{LF}
TEST    RATIO                 PHASE    ACCURACY {CR}{LF}
VOLTAGE ERROR                 ERROR    CLASS  {CR}{LF}
(VOLTS) (%)                   (MINUTES) (%) {CR}{LF}
120.0  +0.002                 +0.26   0.01  {CR}{LF}
{CR}{LF}{CR}{LF}
```

Record layout:

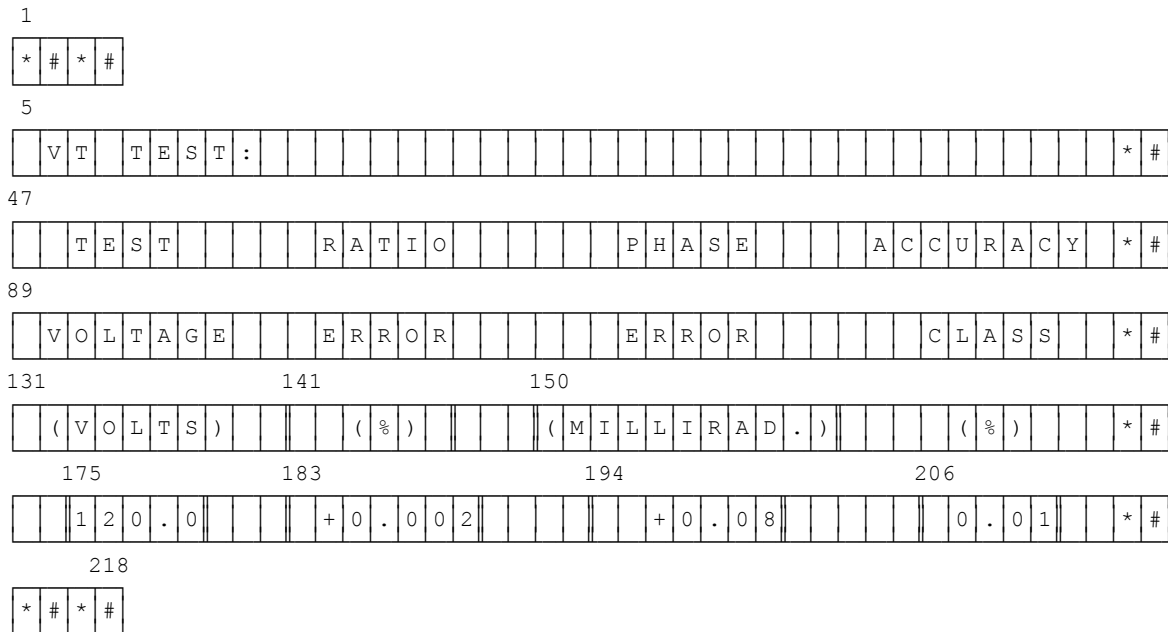
1	* # * #																																
5	V	T	T	E	S	T	:																*	#									
47		T	E	S	T			R	A	T	I	O			P	H	A	S	E			A	C	C	U	R	A	C	Y	*	#		
89	V	O	L	T	A	G	E			E	R	R	O	R			E	R	R	O	R				C	L	A	S	S	*	#		
131	141											150																					
	(	V	O	L	T	S	)			(	%	)			(	M	I	N	U	T	E	S)			(%)	*	#			
175	183							194							206																		
		1	2	0	.	0				+	0	.	0	0	2																	*	#
218	* # * #																																

6.3.2 RATIO ERROR AND MILLIRADIANS

ASCII format:

```
{CR}{LF}{CR}{LF}
VT TEST: {CR}{LF}
TEST      RATIO      PHASE      ACCURACY {CR}{LF}
VOLTAGE   ERROR      ERROR      CLASS   {CR}{LF}
(VOLTS)   (%)         (MILLIRAD.) (%)    {CR}{LF}
120.0     +0.002          +0.08      0.01    {CR}{LF}
{CR}{LF}{CR}{LF}
```

Record layout:

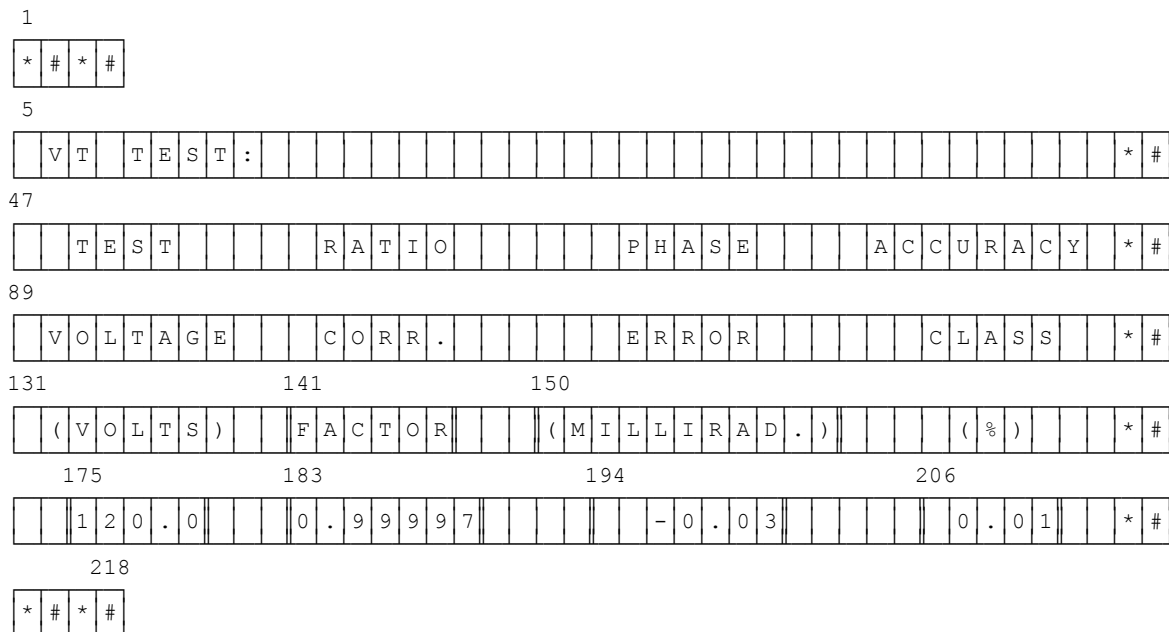


6.3.4 RATIO CORRECTION FACTOR AND MILLIRADIANS

ASCII format:

```
{CR}{LF}{CR}{LF}
VT TEST: {CR}{LF}
TEST      RATIO      PHASE      ACCURACY {CR}{LF}
VOLTAGE   CORR.      ERROR      CLASS   {CR}{LF}
(VOLTS)   FACTOR      (MILLIRAD.) (%)      {CR}{LF}
120.0    0.99997      -0.03      0.00   {CR}{LF}
{CR}{LF}{CR}{LF}
```

Record layout:



7. Warranty

The Knopp Type KATC-V Automatic Transformer Comparator is warranted against defects in materials and workmanship for a period of ONE YEAR.

If the KATC-V does not perform in accordance with stated operating specifications during the warranty period, necessary parts and assistance will be supplied under warranty to restore the equipment to service.

Normal service is accomplished through telephone consultation with the Knopp Engineering Department.

Parts are shipped by overnight carrier.

APPROVAL/ CHANGE RECORD

Approval Record

Originator: Jameson Kern Title: Technical Manager Date: 12-Sep-19

Change Record

Revision No.	Date	Responsibility	Description
A	12-Sep-19	Jameson Kern	Initial