

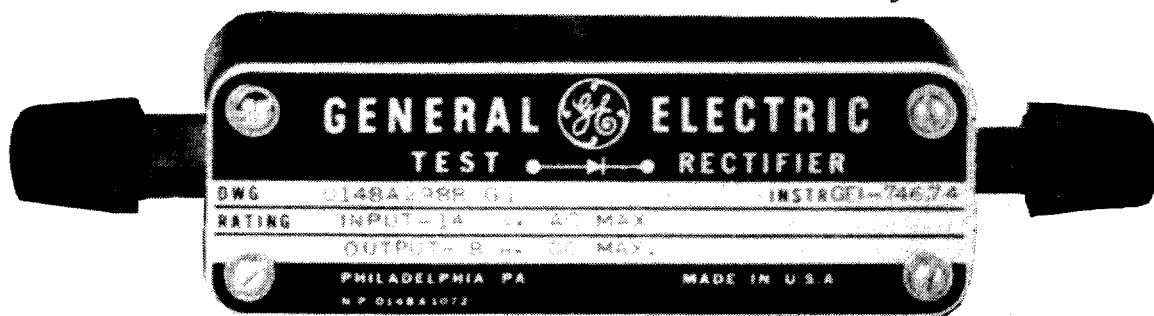


INSTRUCTIONS

GEI-74674B

SUPERSEDES GEI-74674A

TEST RECTIFIER
CAT. 0148A2988



GENERAL  ELECTRIC

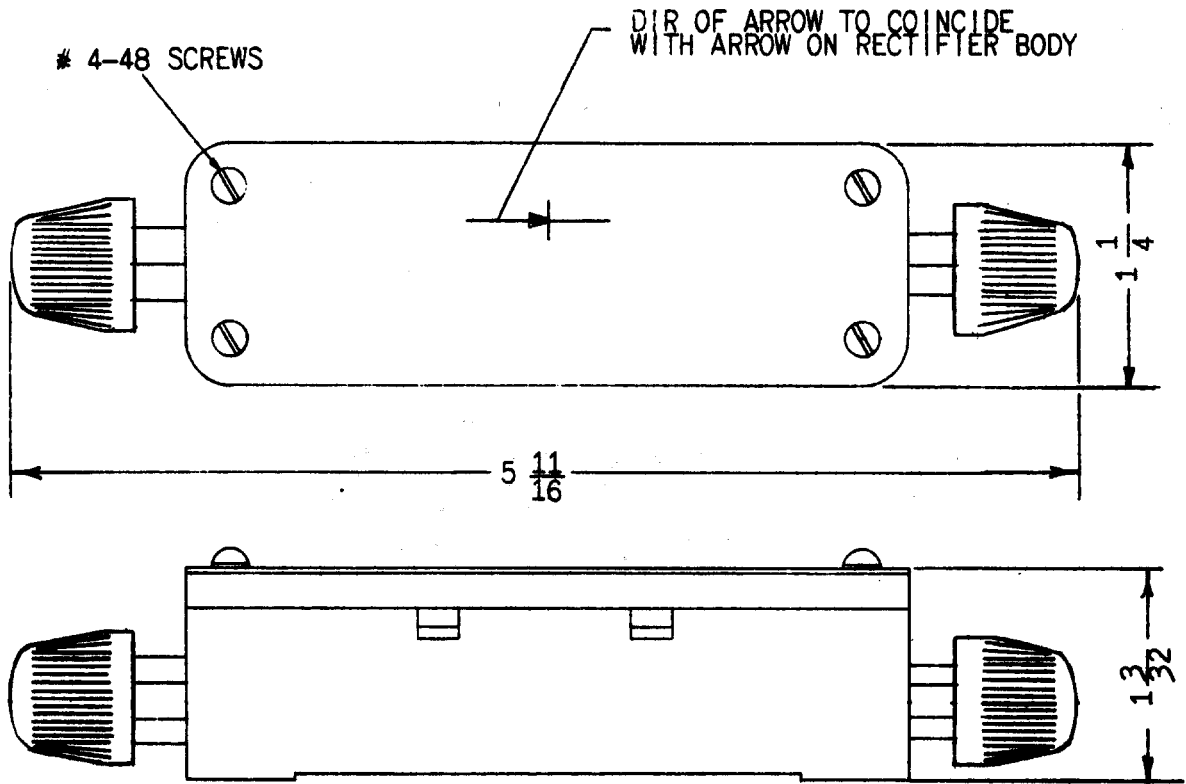


FIG. 1 (0148A2994) Outline Dimensions For Test Rectifier

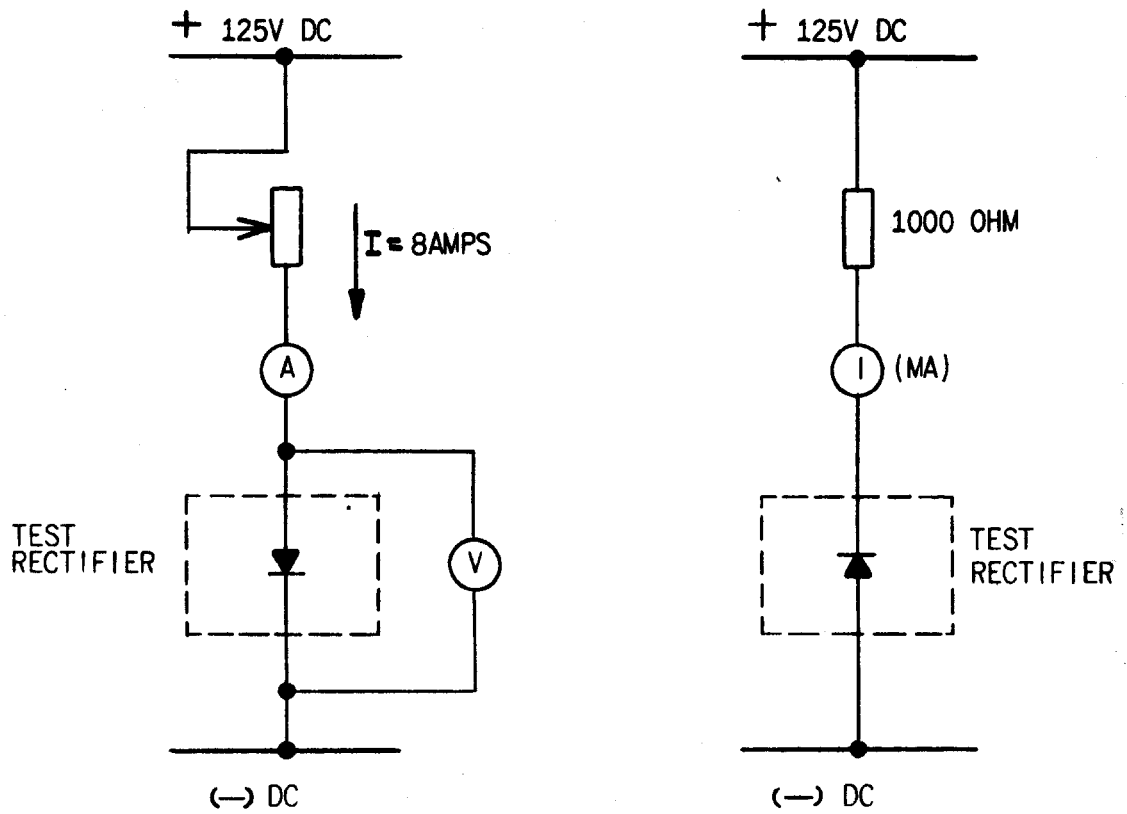


FIG. 2 (0148A4001-0) Test Connection Diagram For Test Rectifier

* TEST RECTIFIER

CAT. 0148A2988

DESCRIPTION

Test rectifier 0148A2988 is a compact portable piece of test equipment designed for testing the second harmonic restraint characteristics of type HDD, BDD and STD transformer differential relays and the BFC harmonic restraint overcurrent relay. Use this test rectifier in the manner prescribed in the "Calibration Procedure" section along with the instruction book for the particular relay under test.

APPLICATION

Inrush current in a power transformer contains both second and third harmonics as well as higher frequency components in addition to the DC and fundamental components. Normally a relay receives the difference in magnetizing inrush currents for two phases. Usually only one phase has a magnetizing inrush, but occasionally two cores have simultaneous inrushes. This is the most severe condition because if these two currents are equal, the third harmonic will be largely cancelled due to the 120 degree relationship of the two phases. For this reason it is desirable to set the harmonic restraint adjustment on those relays using second harmonic since this will provide a good match with critical service conditions.

CAUTION: This test device is not intended for use as a tripping or blocking rectifier in DC trip circuits.

All the transformer differential relays and the harmonic restraint overcurrent relays were calibrated at the factory on the second harmonic using a test rectifier. The theory and calculations for second harmonic testing can be found in the "Relay Calibration With Test Rectifier" section of this instruction book. Check the relay instruction book for stud connections.

RATINGS

The maximum ratings of these test rectifiers are shown in the following tables. The Group 1 unit would normally be used on a nominal 115 volt AC source. The Group 2 unit would be used on a nominal 230 volt AC source.

Test Rectifier	Max. RMS Volts Input	Max. DC Amps Output
0148A2988 G-1	140	8
0148A2988 G-2	260	8

CONSTRUCTION

Test Rectifier 0148A2988 consists of a medium power silicon rectifier mounted on an appropriate heat sink in a small molded case. Connections to the terminals at each end of the case may be made by clamping leads or terminal under the molded thumb nuts, or by clipping the leads directly to the hexagonal portion of the terminal. A half wave rectifier symbol is shown on the nameplate to facilitate proper choice of DC meter connections. The outline dimensions are shown in Fig. 1.

RECEIVING, HANDLING AND STORAGE

The test rectifiers will be supplied in cartons designed to protect them from damage. Immediately upon receipt of the device, examine it for evidence of any damage sustained in transit. If any such shipping damage is evident, file a claim with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

The compact rugged design of this test rectifier makes it equally suitable for storage on a laboratory shelf or in a tool kit.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

ACCEPTANCE TESTSVISUAL INSPECTION

Check the nameplate stamping to insure that the model number and ratings of the device agree with the requisition. Also check the molded case to make sure there are no signs of physical damage.

ELECTRICAL CHECKS - (Use 125 volt DC source).

1. Forward Voltage Drop Test:

Pass 8 amperes DC through the test rectifier in the forward direction and check to see that the forward voltage drop is less than 1.3 volts DC, See Fig. 2 for test circuit.

2. Reverse Leakage Current Test:

Check to see that the reverse current is less than 5 milliamperes with 125 volts DC applied in the reverse direction through a 1000 ohm series protective resistor. See Fig. 2 for test circuit.

NOTE: It should not be necessary to remove the nameplate or covers from the test rectifier. If, however, the nameplate is removed be certain that it is replaced so that the rectifier symbol on the nameplate agrees with the polarity of the rectifier. (A similar symbol is stamped on the rectifier body).

RELAY CALIBRATION WITH TEST RECTIFIERGENERAL CONSIDERATIONS

The second harmonic test using the Test Rectifier consists basically of passing a fixed amount of half wave rectifier current and a variable amount of fundamental current through the relay differential circuit to determine the percent second harmonic required to just operate the relay. The analysis of a single phase half wave rectified current shows the presence of fixed percentages of DC fundamental and second harmonic components, as well as negligible percentages of all even higher harmonics. Although the percent second harmonic is fixed, the overall percent second harmonic in the current applied to the relay is varied by adding a controlled amount of fundamental current which bypasses the rectifier.

The following expression shows the relationship between the percent second harmonic, DC component, and the by-pass current:

$$\% \text{ SECOND HARMONIC} = \frac{0.47 \times I_{DC} *}{I_{AC} + 1.1 I_{DC}}$$

Figure 3 is a plot of the above expression and shows the percent second harmonic corresponding to the various values of by-pass current I_{AC} for a constant I_{DC} set at 4.0 amperes.

It is quite important that the AC test source used for these second harmonic calibrations should have a low source impedance, reliable frequency, and a good wave shape.

The second harmonic test connections for the transformer differential and the harmonic restraint overcurrent relays are shown in figure 4. Check the instruction book for relay under test to locate the proper stud connections. Rated D.C. should also be connected to the appropriate studs on the relay to operate the auxiliary circuit when the main circuit operates. The slope tap or potentiometer should be set in the 25 percent position. The current taps can be set at any convenient value, however the 5 ampere taps are suggested for convenience since the various other relay characteristics such as pickup, slope etc. are usually tested on the 5 ampere taps.

TYPE BDD15B - BDD16B
STD15B - STD16B
BFC11A RELAYS.

These relays have been adjusted at the factory using a test rectifier for 20 percent second harmonic restraint.

The value of I_{DC} should be set for 0.8 times tap value by means of the DC load box. For 20 per cent second harmonic restraint, the relay will just pick up when I_{AC} is increased, by means of the AC load box, to a value of 1.0 times tap. The relay should be within 19-21 per cent second harmonic restraint. For this test on the 5 ampere tap, the current values would be: $I_{DC} = 4.0$ amp., $I_{AC} = 5.0$ amp (limits

4.5-5.5 amp). The rectifier may be connected with either polarity since both the operating and restraint circuits inside the relay are rectified. If the pickup value of I_{AC} is out of limits the R_2 in the relay should be readjusted to bring the second harmonic restraint characteristic within limits. If any adjustment of R_2 is made, the pickup and slope calibrations should also be checked, since they are not completely independent.

TYPE BDD15A AND BDD16A RELAYS

These relays were originally calibrated at the factory for 25% third harmonic using a test reactor. They should be adjusted in the same manner as the BDD15B and BDD16B relays, except the available adjustment on these units will be between 19-25 per cent. The units should still be set as close to the 19-21 per cent limits as possible.

TYPE HDD15A AND HDD16A RELAYS

These relays were also calibrated at the factory on third harmonic. These relays should be tested in the same manner as the BDD15B and BDD16B relays except that when testing these relays with the test rectifier it will be noted that the per cent second harmonic restraint obtained for any given setting of the harmonics restraint resistor R_3 will depend slightly on the polarity of the test rectifier in the test circuit. This slight difference is due primarily to the fact that the HDD relays employ a rectified restraint circuit and an unrectified operate circuit. Because of this, the percent harmonic restraint should be measured with the test rectifier connected with one polarity, and then measured again with the test rectifier reversed. The relay should be adjusted so the mean of these two values is as close to 20 percent as possible. The available mean level of second harmonic restraint should lie between 19 and 30 percent for these HDD relays. Any adjustments of harmonic restraint should be followed by a check and adjustment, if necessary, of pickup and slope in accordance with the appropriate instruction book, as was the case with Type BDD relays.

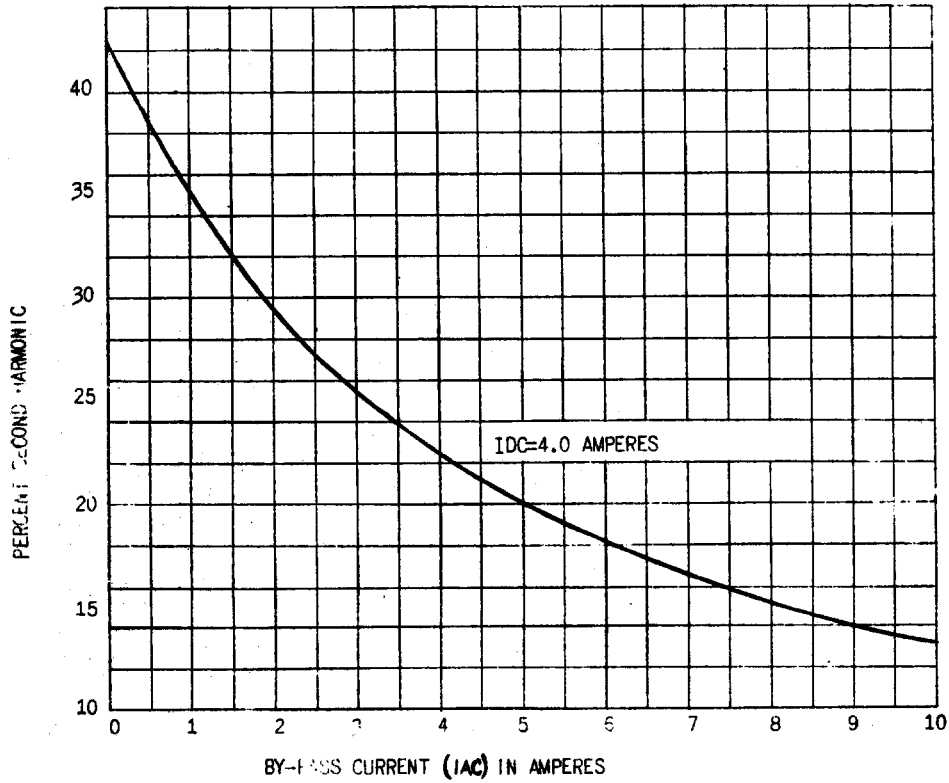


FIG. 3 (418A798-2) Curve Showing Relationship Between Percent Second Harmonic And Bypass Current With 1 DC Set At 4.0 Amps

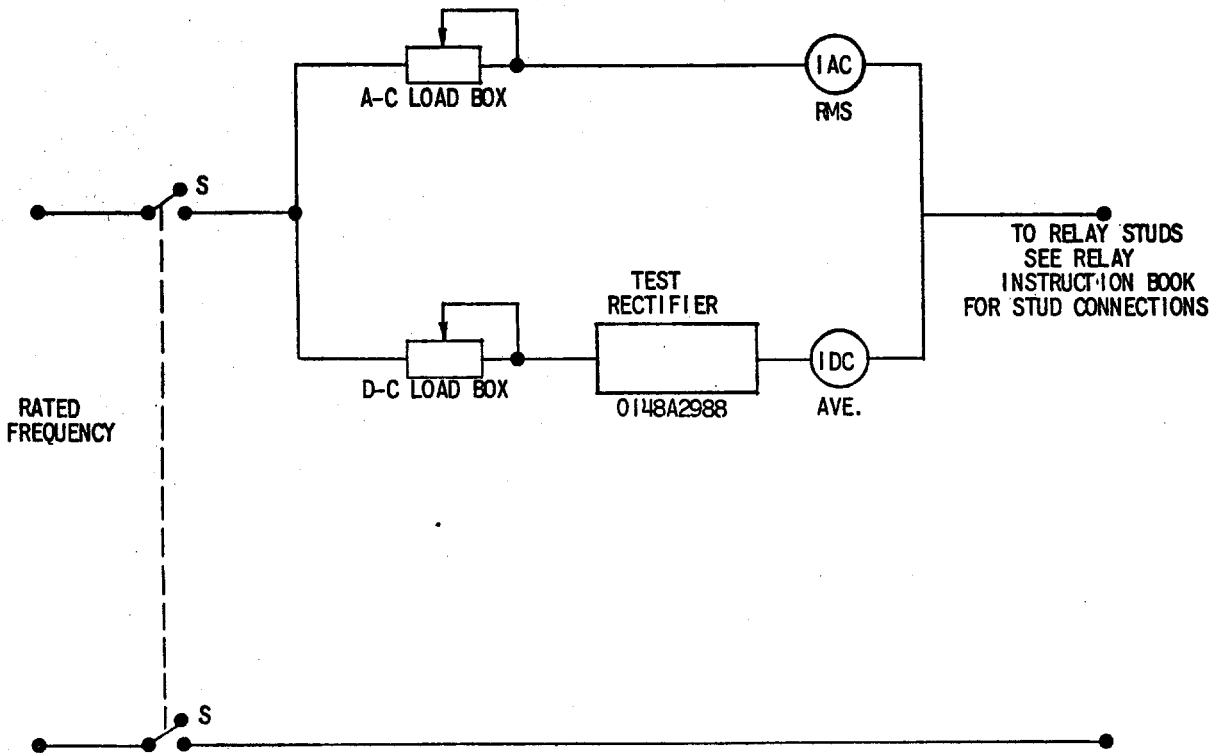


FIG. 4 (0227A7064-0) Second Harmonic Test Connections For BDD, HDD, STD, And BFC Relays Using Test Rectifier

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