INSTRUCTION MANUAL

For

NETWORK PROTECTOR TEST SET

MODEL NTS-300

It is essential that this instruction book be read thoroughly before putting the

Part _ 12432
Rev. 3

equipment in service.

REVISION HISTORY

Revision	ECN #	Date
2		09/03/92
3	25929	05/11/94

IMPORTANT

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SAFETY PRECAUTIONS

WARNING:
VOLTAGES GENERATED BY THIS INSTRUMENT ARE HAZARDOUS

This instrument has been designed for operator safety; however, no design can completely protect against incorrect use. Electrical circuits are dangerous and can be lethal when lack of caution and poor safety practices are used. There are several standard safety precautions that should be taken by the operator.

WARNING:

Failure to follow instructions in this manual could result in DAMAGE TO PROPERTY and/or SERIOUS INJURY OR DEATH to the operator.

The following are some specific safety related items associated with the NTS test system.

Always start with the INPUT SEL Switch OFF, before connecting power cable. Make sure outputs are off before attempting to make test connections.

Always use properly insulated test leads. The test leads supplied with the unit are rated for the continuous output ratings of the test system, and should be properly used and cared for. Do not use cracked or broken test leads.

Before turning ON the test set, make sure that all other personnel in the area are a safe distance from the protector under test.

Once the test set is switched ON, lethal voltages are present on exposed breaker components. It is recommended that safety gloves be used at all times.

Always turn the test system off before disconnecting test leads. Make sure the TEST ON light is OFF by pressing the STOP button and the INPUT SELECT Switch is in the OFF position.

UNDER NO CIRCUMSTANCES SHOULD THE OPERATOR PUT HIS HANDS OR TOOLS INSIDE THE TEST SYSTEM CHASSIS WITH THE TEST SYSTEM CONNECTED TO A POWER SOURCE AND TURNED ON. LETHAL VOLTAGES ARE PRESENT AND WILL CAUSE SERIOUS INJURY OR DEATH!

TABLE OF CONTENTS

Table of contents continued

SAFETY PRECAUTIONS

WARNING

Potentially lethal voltages can be present on the output leads, when test set is in operation. The operator is responsible for ensuring the safety of all personnel while he is operating it. While making tests, keep all personnel at a safe distance from the device being tested.

CAUTION

For safety of the operator, it is absolutely essential that the test set be properly and effectively grounded.

THEORY OF OPERATION

Description of Controls

This section of the instruction manual describes the function of all the various controls switches, etc., which are located on the Multi-Amp Model NTS-300. All controls are clearly marked and logically grouped.

Control Section:

The Control Section of the NTS-300 is devoted to the Input and Function Selector Switches, output control, indicator lamps, and fuses. A description of each of these controls follows.

PHASE SEQUENCE INDICATOR	Indicates rotation of input power either ABC or CBA. Also energized phases or loss of phase.
15A Output Fuses	Designated F1, F2, and F3 on the schematic, these fuses provide internal protection to the test set power train.
OUTPUT, Variable Autotransformer	Provides control of output voltage and current.
TRIP Light and CLOSE Light	Indicates the position of the protector.
POWER ON Light	Indicates when input power to the test set is available.
TEST ON Light	Indicates when output is energized.
TRIP/CLOSE Switch	Used when performing mechanism operation test. This switch will manually trip or close the protector.
START/STOP Push Buttons	Used to selectively START or STOP the output test voltage or current.

SSNPR/NORMAL Switch	Used when monitoring the trip/close contacts of electromechanical relays (NORM) or voltage output of solid-state relays (SSNPR, MPCR).
FUNCTION Switch	Used to select the test to be performed, mechanism (MECH) or RELAY test.
INPUT SEL Switch	The 216V or 480V refers to the input voltage of the test set. Test set can operate off of either 216V or 480V input. When in the OFF position, the test set is not energized.
	CAUTION *This switch should remain in the OFF position until all test connections to the protector and test set are made.*
Input/Output Connector	Connect Test Cable to this connector. Only the Test Cable will properly connect.
Inter Connector	Connect interconnect cable to this connector. Connectors are keyed, cable will only go on one way.
Ground Lug	Use this lug to provide a safety ground for the front panel.

Meter Section:

The Meter Section of the NTS-300 is devoted to the metering of the output voltages and currents, and the phase angle control.

VOLTMETER	Used in conjunction with the INPUT/OUTPUT VOLTS Switch. Meter will read either input voltage or output voltage.
AMMETER	Used to measure line current through the protector. AMMETER LINE SEL Switch selects the phase which the ammeter measures.
PHASING Switch	Used to select direction of power. Angles indicated are all leading angles.
AMMETER LINE SEL Switch	Selects phase A, B, or C to measure current applied to the protector.

INPUT/OUTPUT VOLTS Switch	This switch is used to determine which voltage the voltmeter will indicate. When in the INPUT position the meter will indicate input voltage to the test set either phase-to-phase or phase-to-neutral. When in the OUTPUT position it will indicate the Phasing voltage applied to the protector.
1.5A Control Fuse	Designated F4 on the schematic provides protection to the digital meters.
TIMER ON/OFF Switch	Used to control the TIMER operation. When in the ON position, the TIMER will start when the START pushbutton is pressed.
NORM/STOP OUTPUT Switch	Used to STOP (de-initiate) the output, when the TIMER stops due to a trip signal from the protector.
TIMER	Used to measure trip times of protectors equipped with time delay relays. Measures in either seconds or cycles, (Switch Selected). NOTE: TIMER RESET Pushbutton must be pressed prior to performing timing tests.

Preparation For Operation

The Model NTS-300 provides two types of tests for both General Electric and Westinghouse network protectors:

1.Overall operational test
2.Fault finding tests on network relays and mechanism components.

Variable currents and voltages are provided for the overall operational tests and fault finding tests on the network relays. Both fixed and variable auto transformers, and resistors provide a smooth continuous control of output voltages and currents for fault finding test on mechanism components.

If field testing a protector, the protector should be disconnected from the grid and the network transformer. Before connecting the tester, check to insure the value of the line voltage, 216 or 480 volts. Make all test connections prior to switching power on, and Review Safety Precautions.

TESTING MASTER NETWORK RELAYS
GENERAL ELECTRIC TYPES CAN OR CHN

GENERAL

If field testing, disconnect network protector from the transformer on the transformer side, and remove protector fuses.

TYPES OF TESTS

CLOSING TEST
REVERSE POWER TRIP TEST
TIME DELAY TRIP TEST
PRELIMINARY SET-UP: Network protector open with handle in automatic position.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

TROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	RELAY
PHASING Switch	0°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	NORM

CLOSING TEST

1.Make test connections as shown in Figure 1. If it is desired to test the relay without operating the protector and indicate closing of the relay contacts by means of an indicating light, see instructions on page 12.

2.Switch INPUT SEL Switch to the appropriate position (depends upon input voltage being used), POWER ON Light should glow.

3.The protector's rated voltage should be indicated on the VOLTMETER. Check Phase Sequence Indicator on control section to insure proper rotation of input voltage.

4.Press START Pushbutton, TEST ON light should glow.

5.Switch VM INPUT/OUTPUT VOLTS Switch to the OUTPUT position (A∅, B∅ or C∅). Rotate OUTPUT Source Control Knob clockwise until relay closing contacts close. (If the CAL or CHL contacts remain open, block closed for this test).

6.Read and record closing voltage on VOLTMETER. Return OUTPUT control knob to zero. Press STOP button.

REVERSE POWER TRIP TEST

1.If the closing test has just been completed, proceed to step 2, otherwise repeat steps 1 through 4 for the Closing Test.

2.Switch PHASING Switch to the 180° position.

3.If protector is not closed, close manually at this time.

4.Press START Pushbutton, TEST ON Light should glow. Rotate OUTPUT Source Control Knob clockwise until the relay tripping contacts make. The network protector will trip.

NOTE: On protectors equipped with the type PYC time delay relay, when the tripping contacts make, the time delay relay is energized and the timing cycle is started, when completed the protector will trip (see TIME DELAY TRIP TEST).

5.Read and record trip current on AMMETER. Return OUTPUT Control Knob to zero and switch INPUT SEL Switch to the OFF position.

TIME DELAY TRIP TEST

1.Repeat steps 1 through 3 for REVERSE POWER TRIP TEST. Connect the relays trip contacts per instructions on page 12.

2.Press START Pushbutton, TEST ON light should glow. Rotate OUTPUT Source Control Knob until desired test current is observed on AMMETER. Press STOP Pushbutton.

NOTE: On protectors equipped with a short time delay, set the test current quickly.

3.Once test current is set, switch TIMER ON/OFF Switch to ON, select either SEC. (seconds) or CYCLES. If it is desired to de-initiate the output when the protector trips, switch the OUTPUT NORM/STOP Switch to the STOP position.

4.For relays equipped with a thermal time delay element, allow the relay to cool to normal operating temperature. Press the TIMER RESET Pushbutton. Press the START Pushbutton to start the test. When protector trips, de-initiate the output by pressing the STOP Pushbutton and return the OUTPUT CONTROL to zero.

TESTING PHASING RELAYS
GENERAL ELECTRIC TYPES CAL OR CHL

GENERAL

If field testing, disconnect network protector from the transformer on the transformer side, and remove protector fuses.

TYPE OF TESTS

CLOSING TEST

PRELIMINARY SET-UP:Network protector open with handle in automatic position.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	RELAY
PHASING Switch	60°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM	NORM

CLOSING TEST

1.Make test connections as shown in Figure 1. If it is desired to test the relay without operating the protector and indicate closing of the relay contacts by means of an indicating light, see instructions on page 12.

2.Switch INPUT SEL Switch to the appropriate position (depends upon input voltage being used), POWER ON Light should glow.

3.The protector's rated voltage should be indicated on the VOLTMETER.

4.Check Phase Sequence Indicator on control section to insure proper rotation of input voltage

5.Switch VM INPUT/OUTPUT VOLTS Switch to the OUTPUT position (A∅). Press START Pushbutton. Rotate OUTPUT Source Control Knob clockwise until relay closing contacts close.

6.Read and record closing voltage on VOLTMETER. Return OUTPUT control knob to zero, press STOP Pushbutton.

TESTING SOLID-STATE NETWORK RELAY
GENERAL ELECTRIC TYPE SSNPR

GENERAL

If field testing, disconnect network protector from the transformer on the transformer side, and remove protector fuses.

TYPES OF TESTS

CLOSING TEST
REVERSE POWER TRIP TEST
TIME DELAY TRIP TEST
PHASE DELAY TRIP TEST
PHASE DETECTOR (FUNCTIONAL) TEST
WATT-VAR MODULE (TRIP) TEST
PRELIMINARY SET-UP:Network protector open with handle in automatic position.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	RELAY
PHASING Switch	0°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	SSNPR

CLOSING TEST

1.Make test connections as shown in Figure 1. If it is desired to test the relay without operating the protector and indicate closing of the relay contacts by means of an indicating light, see instructions on page 12.

2.Switch INPUT SEL Switch to the appropriate position (depends upon input voltage being used), POWER ON Light should glow.

3.The protector's rated voltage should be indicated on the VOLTMETER.

4.Check phase sequence indicator on control section to insure proper rotation of input voltage

5.Switch VM INPUT/OUTPUT VOLTS Switch to the OUTPUT position (A∅, B∅ or C∅). Press the START Pushbutton. Slowly rotate OUTPUT Source Control Knob clockwise. Observe reclose indicating light on the relay, when light comes on the protector will close.

NOTE: Depending upon the phase angle setting of the relay, it may not close at 0°, if not return the control knob to zero, switch the PHASING Switch to the 10° position and repeat the test.

6.Read and record closing voltage on VOLTMETER. Return OUTPUT control knob to zero, press STOP Pushbutton.

REVERSE POWER TRIP TEST

1.If the closing test has just been completed, proceed to step 2, otherwise repeat steps 1 through 4 for the Closing Test.

2.Switch PHASING Switch to the 180° position.

3.If protector is not closed, close manually at this time.

4.Press START Pushbutton and rotate OUTPUT Source Control Knob clockwise until the relay tripping contacts make. The relay trip indication light will come on and the protector will trip.

NOTE: On relays equipped with time delay module, when the tripping contacts make, the time delay module is energized and the timing cycle is started, when completed the protector will trip. The module can be removed from the relay without effecting the settings and will provide instantaneous trip response at the trip current.

5.Read and record trip current on AMMETER. If you desire to perform TIME DELAY TRIP TEST, leave OUTPUT control knob at present position, otherwise, return OUTPUT Control Knob to zero. Press the STOP Pushbutton.

TIME DELAY TRIP TEST

1.If the Trip Test has just been completed, proceed to step 2, otherwise repeat steps 1 and 2 of TRIP TEST.

2.If the Time Delay Module was removed from the SSNPR relay, return it to its proper position.

3.If the Trip Test was just completed, and the OUTPUT Control Knob was left at the pick-up point, rotate the Control Knob about 10% above the pick-up point. Otherwise, determine pick-up point and set control knob accordingly. This will assure a good trip action.

NOTE: If protector is not closed, close manually at this time.

4.Switch the TIMER ON/OFF Switch ON, select either SEC. (seconds) or CYCLES. If it is desired to de-initiate the output when the protector trips, switch the OUTPUT NORM/STOP Switch to the STOP position.

5.Connect the relay's trip contacts per instructions on page 12.

6.Reset timer by pressing Timer RESET pushbutton. Initiate test by pressing the START Pushbutton. The test current should flow and the timer should start timing. When the relay trips and protector opens, Timer should stop.

PHASE DETECTOR (FUNCTIONAL) TEST

1.Repeat steps 1 through 4 for CLOSING TEST.

2.Switch PHASING Switch to 0° position. Make notation of Phase Angle Adjust setting on the SSNPR relay, then turn adjustment to +5° (maximum counter clockwise) position.

3.Switch VM INPUT/OUTPUT VOLTS Switch to the OUTPUT position (A∅), press START Pushbutton.

4.Rotate OUTPUT Source Control Knob clockwise until a voltage (150%) of reclose voltage is achieved. Note that the relay does not close.

5.Return OUTPUT Source Control Knob to zero. Adjust the relay's Phase Angle Adjust to -15° position.

6.Rotate OUTPUT Source Control Knob clockwise slowly and observe reclose indicating light on relay. When light comes on the protector will close. This verifies the functioning of the Phase Detector.

7.Return OUTPUT Source Control knob to zero. Restore the relay's Phase Angle Adjust to the original setting. Press the STOP pushbutton.

WATT-VAR MODULE (TRIP) TEST

NOTE: Protector must be CLOSED with handle in the automatic position before performing this test.

1.Repeat steps 1 through 4 of CLOSING TEST.

2.Switch PHASING Switch to the 120° position.

3.Press the START Pushbutton, increase current by rotating OUTPUT Source Control Knob clockwise slowly until trip contacts close. Trip indication light on the relay will come on and protector will trip. Record trip current.

4.Return OUTPUT SOURCE CONTROL Knob to zero and press STOP Pushbutton.

TESTING OF GENERAL ELECTRIC NETWORK RELAYS USING TEST SET INDICATING LIGHTS

GENERAL

If it is desired to test the relay without resultant network protector operation, the closing and opening of the protector can be simulated with the CLOSE and OPEN indicating lights, which are controlled by the closing of the appropriate contacts on the relay.

CONNECTION PROCEDURE

1.Remove the insulated pad located on the lower sub-panel of the network protector. Remove the appropriate test switch button that will separate the relay contacts from the protector close-trip circuit (see G.E. Instruction Manual for proper terminals). For example:

	Terminals
For Types MG-8 and MG-9	11 and 21
For type MG-14 Open-Type D-10 Frame	10 and 20

2. For testing Master Relays CAN, CHN or SSNPR make the following connections: Refer to Figure 2.

CAUTION: The trip and close contacts must be isolated from the relays. Do not connect X, S and T to energized circuits except for the SSNPR relay (see step 4 below).

a. Lead X from test set to terminal 11 on the relay terminal board.

b. Lead T from test set to terminal 41 (trip) on the relay terminal board.

c. Lead S from test set to terminal 6 (close) on the relay terminal board.

3. For testing Phasing Relays CAL or CHL make the following connections

a. Lead X from test set to terminal 6A on relay terminal board.

b. Lead S from test set to terminal 6 on relay terminal board.

4. Proceed with each test. When relay contacts pick up for a trip or close position, a green or red indicating light on the test set will light. Observe indicating lights closely. They will remain lit only as long as the condition that created the operation is present.

WARNING: On SSNPR relays, switch the NORM/SSNPR Switch to the SSNPR position. The SSNPR relay switches an ac voltage through the trip/close contacts. To prevent blowing the TRIP and CLOSE lamps, this switch must be in the proper position.

MECHANISM OPERATION TEST OF GENERAL ELECTRIC NETWORK PROTECTORS

GENERAL

This test verifies the operating characteristic of the mechanism at reduced voltages.

PRELIMINARY SET-UP: Remove network relays from protector. Network protector either open or closed, with handle in the automatic position. In order to perform this test with the protector rolled out on its arms, a jumper must be placed across the terminals that would correspond to the contacts of the phasing relay if the relay were installed. On G.E. protectors, these terminals are typically found to be terminals 6 and 6A of the phasing relay fixture, while on Westinghouse protectors they are typically terminals 4 and 5 of the phasing relay fixture. This jumper would not be necessary when doing mechanical tests on a network protector that uses a single solid state network relay. Great care should be taken to verify that these are the proper terminals according to the network protector manufacturer's literature.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET-UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	MECH
PHASING Switch	0°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	NORM

TO TEST

1. Make test connections as shown in Figure 1. Make additional connections for Trip-Close Switch on test set as shown in Figure 3.

2. Switch INPUT SEL Switch to the appropriate position (depends upon input voltage being used), POWER ON Light should glow.

3. Check Phase Sequence Indicator on control section to insure proper rotation of input voltage.

4. Press the START Pushbutton. Rotate the OUTPUT Source Knob until the desired voltage for the particular test is reached (see Table A).

5. Operate the TRIP/CLOSE Switch to open or close the network protector.

6. Vary the voltages between the limits shown in Table A to insure that the control system will operate within range.

NOTE: When checking low voltage close of motor, motor control relay has to be operated manually.

TABLE A

FUNCTION	%NORMAL VOLTAGE	125/216V	277/480V
Closing Range	80-106%	173-230V L-L	220-295 L-N
Tripping Range	7 1/2-106%	16-230V L-L	36-295 L-N
Trip Free	106%	230V L-L	295V L-N
Low Close on Motor	73%*	157V L-L	200V L-N
Motor Control	83% always P.U.	180V L-L	230V L-N
Pick-Up ± 80%	77% never P.U.	167V L-L	212V L-N

*Figured line to neutral if motor is connected line to neutral.

NOTE

Control voltage tests and adjustments are general in nature. Consult manufacturer's instructions prior to performing tests.

GENERAL TEST PROCEDURE:

Tripping Voltage Range:

1. Network protector closed.

2. Adjust voltage to minimum 7 1/2%.

3. Turn test switch to Trip. Protector should trip.

4. Adjust voltage upward to a maximum of 106%.

5. Repeat test at various voltages.

Trip-free Voltage:

1. Network Protector open.

2. Adjust voltage to 106%.

3. Hold up hand trip finger.

4. Hold test switch in close position. Allow motor to repeat charging cycle 2-3 times.

5. Release trip finger and close. Motor mechanism should close protector and stop.

Closing Voltage Range:

1. Network protector open.

2. Adjust voltage to 80%.

3. Turn handle to close. Protector should close.

4. Adjust voltage to 106%.

5. Repeat test. Check at various voltages.

Motor Control Pick-up.:

1. Network protector open.

2. Adjust voltage to 77%.

3. Turn test switch to CLOSE. Mechanism should not pick up. Repeat ten times. If it picks up, adjust calibrating nut per manufacturer's instruction book.

4. Adjust voltage to 83%.

5. With network protector open, turn test switch to CLOSE. Protector should close. If it does not, turn calibrating nut as described in instruction book (MG-14 does not have nut).

6. Repeat both minimum and maximum tests until operation falls between 77 and 83% voltage values. Mechanism closing pick-up operation is approximately 80% of normal operating voltage, but should never pick up at the minimum setting.

Low Voltage Close on Motor:

1. Network protector open.

2. Hold motor mechanism relay closed by hand.

3. Adjust voltage to 73%.

4. Turn test switch to CLOSE. Motor should operate and close protector.

TESTING MASTER NETWORK RELAYS
WESTINGHOUSE TYPE CN-33

GENERAL

If field testing, disconnect network protector from the transformer on the transformer side, and remove protector fuses.

TYPES OF TESTS

CLOSING TEST
REVERSE POWER TRIP TEST
TIME DELAY TRIP TEST
PRELIMINARY SET-UP: Network protector open with handle in automatic position.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	RELAY
PHASING Switch	0°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	NORM

CLOSING TEST

1. Make test connections as shown in Figure 4. If it is desired to test the relay without operating the protector and indicate closing of the relay contacts by means of an indicating light, make additional connections as shown in Figure 5.

2. Switch INPUT SEL Switch to the appropriate position (depends upon input voltage being used), POWER ON Light should glow.

3. The protector's rated voltage should be indicated on the VOLTMETER.

4. Check Phase Sequence Indicator on control section to insure proper rotation of input voltage.

5. Switch VM INPUT/OUTPUT VOLTS Switch to the desired OUTPUT position. Press the START Pushbutton and Rotate OUTPUT Source Control Knob clockwise until relay closing contacts close.

6. Read and record closing voltage on VOLTMETER. Return OUTPUT control knob to zero and press STOP Pushbutton.

REVERSE POWER TRIP TEST

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1. If the closing test has just been completed proceed to step 2, otherwise repeat steps 1 through 4 for the Closing Test.

2. Switch PHASING Switch to the 180° position.

3. If protector is not closed, close manually at this time.

4. Press START Pushbutton, TEST ON light should glow. Rotate OUTPUT Source Control Knob clockwise until the relay tripping contacts make. The network protector will trip.

NOTE: When the test is made, the de-sensitizing relay, a BN connection plate, or a jack plate must be present to complete the current coil.

On protectors equipped with time delay relay, when the trip contacts make, the time delay cycle is started, when completed the protector will trip (see TIME DELAY TRIP TEST).

WARNING: The Reverse Current adjustment screw may be energized. Do not attempt to adjust relay with test set energized. See manufacturers literature on how to adjust relay.

TIME DELAY TRIP TEST

1. Repeat steps 1 through 3 for REVERSE POWER TRIP TEST. Connect the relay's trip contacts per instruction in Figure 5.

2. Press START push button, TEST ON light should glow. Rotate OUTPUT Source Control knob until desired test current is observed on AMMETER. Press STOP Pushbutton.

NOTE: Set the test current quickly to reduce the heating of the time delay trip element.

3. Switch the TIMER ON/OFF Switch ON, select either SEC. (seconds) or CYCLES. If it is desired to de-initiate the output when the protector trips, switch the OUTPUT NORM/STOP Switch to the STOP position.

4. After allowing the thermal time delay trip element to cool to normal operating temperature, press the TIMER RESET Pushbutton. Press the START Pushbutton to start the test. When the protector trips, de-initiate the output by pressing the STOP Pushbutton and return the OUTPUT control to zero.

5. Read and record trip current on AMMETER. Return OUTPUT Control Knob to zero and switch INPUT SEL Switch to the OFF position.

TESTING PHASING RELAY
WESTINGHOUSE TYPE CNJ

GENERAL

If field testing, disconnect network protector from the transformer on the transformer side, and remove protector fuses.

TYPE OF TESTS

CLOSING TEST

PRELIMINARY SET-UP: Network protector open with handle in automatic position.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	RELAY
PHASING Switch	60°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	NORM

CLOSING TEST

1. Make test connections as shown in Figure 4. If it is desired to test the relay without operating the protector and indicate closing of the relay contacts by means of an indicating light, make additional connections as shown in Figure 6.

2. Switch INPUT SEL Switch to the appropriate position (depends upon input voltage being used), POWER ON Light should glow.

3. The protector's rated voltage should be indicated on the VOLTMETER.

4. Check Phase Sequence on control section to insure proper rotation of input voltage.

5. Switch VM INPUT/OUTPUT VOLTS Switch to the OUTPUT position (A∅). Press START Pushbutton and rotate OUTPUT Source Control Knob clockwise until relay contacts close.

NOTE: The CNJ relay is set at the factory to close at .5 to 2 volts at 60° when closing characteristic curves 6, 7 or 8 are used. Unless otherwise specified, characteristic curve number 8 is shipped from the factory.

6. Read and record closing voltage on VOLTMETER. Return OUTPUT Control Knob to zero and press STOP Pushbutton.

TESTING DESENSITIZING RELAY
WESTINGHOUSE TYPE BN

GENERAL

If field testing, disconnect network protector from the transformer on the transformer side, and remove protector fuses.

TYPE OF TESTS

TIME DELAY TEST
INSTANTANEOUS TRIP TEST
PRELIMINARY SET-UP: The CN-33 Master Relay is removed when testing this relay, and a jumper is placed between Terminals 1 and 2 of the relay terminal block on the protector.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	RELAY
PHASING Switch	0°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	NORM

TIME DELAY TEST

1. Make connections as shown in Figure 7. The protector must be closed before performing this test. Reset timer by pressing RESET button, select seconds or cycles.

2. Switch INPUT SEL Switch to the appropriate position (depends on input voltage being used). POWER ON Light should glow.

3. The timing cycle begins when the START Pushbutton is pressed. The cycle stops when the green indicating lamp on the test set glows. The timing cycle is independent of the current flowing through the protector as long as Terminals 1 and 2 of the relay terminal blocks are jumped.

4. After completing test press the STOP Switch and switch the INPUT SEL Switch OFF.

INSTANTANEOUS TRIP TEST

1. Make connections as shown in Figure 8.

2. Back-out relay terminals as indicated in Figure 8, so that the test current can be applied directly to the relay instantaneous trip coils. One instantaneous trip element is connected between terminals 7 and 8, 9 and 10, and 11 and 12.

3. Switch INPUT SEL Switch to the appropriate position and press the START Pushbutton. Vary test current using the OUTPUT Source Control Knob until the indicating lamp glows. Read and record the instantaneous pickup point.

CAUTION

More than 25 amperes output is possible from this test set , however, the wire size in the interconnect and test cables is sized to withstand up to 25 amperes . Current higher than 25 amperes may damage the insulation of the wire if maintained for an excessive period of time.

TESTING SOLID-STATE NETWORK RELAY
WESTINGHOUSE TYPE MPCR

GENERAL

When testing in the field, disconnect the network protector from the transformer on the transformer side, and remove the protector fuses.

TYPES OF TESTS

CLOSING TEST
REVERSE POWER TRIP TEST
TIME DELAY TRIP TEST
PHASE DELAY TRIP TEST
PHASE DETECTOR (FUNCTIONAL) TEST
WATT-VAR MODULE (TRIP) TEST
PRELIMINARY SET-UP: The network protector should be open with the handle in automatic position.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT VOLTS Switch	A-N
FUNCTION Switch	RELAY
PHASING Switch	0°
OUTPUT Source Control Knob	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	NORM

CLOSING TEST

1. Make the test connections as shown in Figure 4.

NOTE: When system voltage is applied to the protector, the MPCR relay indicating lights should turn on sequentially CPU, FLOAT, TRIP, FLOAT (FLOAT remains on).

2. Switch the INPUT SEL switch to the appropriate position (depends upon input voltage being used). The POWER ON Light should glow.

3. The protector's rated voltage should be indicated on the VOLTMETER.

4. Check the phase sequence indicator on the control section to insure proper rotation of the input voltage.

WARNING: DO NOT CONNECT SETTING PENDANT TO RELAY WHILE TESTING PROTECTOR. SEE MANUFACTURERS INSTRUCTION BOOK FOR PROPER OPERATION AND SETTINGS.

5. Switch the VM INPUT/OUTPUT VOLTS Switch to the OUTPUT position (A∅, B∅, or C∅). Press the START Pushbutton. Slowly rotate OUTPUT Source Control Knob clockwise. Observe the CLOSE indicating light on the relay. When the light comes on the protector will close. After the protector closes the FLOAT light should come back on and stay on.

NOTE: Depending upon the phase angle setting of the relay, it may not close at 0°. If not, return the control knob to zero, switch the PHASING Switch to the 10° position and repeat the test.

6. Record the closing voltage on the VOLTMETER. Return the OUTPUT control knob to zero. Press the STOP Pushbutton.

REVERSE POWER TRIP TEST

1. If the closing test has just been completed, proceed to step 2, otherwise repeat steps 1 through 4 for the Closing Test.

2. Switch the PHASING Switch to the 180° position.

3. If the protector is not closed, close it manually at this time.

WARNING: DO NOT CLOSE PROTECTOR WITH SETTING PENDANT CONNECTED TO THE RELAY.

4. Press the START Pushbutton and rotate the OUTPUT Source Control Knob clockwise until the relay tripping contacts make. The relay trip indicating light will come on and the protector will trip.

NOTE: On relays set with time delay, when the tripping sequence starts, the time delay is

energized and the timing cycle is started. When the time delay is completed, the protector will trip. After the protector trips, the FLOAT light should come on and stay on.

5. Read and record the trip current on AMMETER. Return the OUTPUT Control Knob to zero. Press the STOP Pushbutton.

PHASE DETECTOR (FUNCTIONAL) TEST

1. Repeat steps 1 through 4 for the CLOSING TEST.

2. Switch the PHASING Switch to 0° position. Make notation of Phase Angle Adjust setting on the MPCR relay, and then adjust it to the +5° position.

CAUTION: DO NOT CONDUCT TEST WITH SETTING PENDANT CONNECTED TO RELAY. SEE MANUFACTURERS INSTRUCTION BOOK FOR PROPER OPERATION AND SETTING INSTRUCTIONS.

3. Switch the VM INPUT/OUTPUT VOLTS Switch to the OUTPUT position (A∅). Press the START Pushbutton.

4. Rotate OUTPUT Source Control Knob clockwise until 150% of reclose voltage is achieved. Note that the relay does not close.

5. Return the OUTPUT Source Control Knob to zero. Adjust the relay's Phase Angle Adjust to the -5° position.

CAUTION: DO NOT CONDUCT TEST WITH SETTING PENDANT CONNECTED TO RELAY. SEE MANUFACTURERS INSTRUCTION BOOK FOR PROPER OPERATION AND SETTING INSTRUCTIONS.

6. Slowly rotate the OUTPUT Source Control Knob clockwise and observe the close indicating light on relay. When the light comes on, the protector will close. This verifies the function of the Phase Detector.

7. Return the OUTPUT Source Control Knob to zero. Restore the relay's Phase Angle Adjust to the original setting. Press the STOP pushbutton.

WATT-VAR (TRIP) TEST

NOTE: The protector must be CLOSED with the handle in the automatic position before performing this test. Do not close protector with setting pendant connected to relay.

1. Repeat steps 1 through 4 of the CLOSING TEST.

2. Switch the PHASING Switch to the 120° position.

3. Press the START Pushbutton. Increase the current by rotating the OUTPUT Source

Control Knob slowly clockwise until the trip contacts close. The trip indication light on the relay will come on, and protector will trip. Record the trip current.

4. Return the OUTPUT SOURCE CONTROL Knob to zero and press STOP Pushbutton.

MECHANISM OPERATION TEST
WESTINGHOUSE NETWORK PROTECTOR

GENERAL

If field testing, disconnect network protector from the transformer on the transformer side, and remove protector fuses.

PRELIMINARY SET-UP: Remove Type CN-33, CNJ and BN relays from protector during these tests. In order to perform this test with the protector rolled out on its arms, a jumper must be placed across the terminals that would correspond to the contacts of the phasing relay if the relay were installed. On G.E. protectors, these terminals are typically found to be terminals 6 and 6A of the phasing relay fixture, while on Westinghouse protectors they are typically terminals 4 and 5 of the phasing relay fixture. This jumper would not be necessary when performing mechanical tests on network protectors that use a single solid state network relay. Great care should be taken to verify that these are the proper terminals according to the network protector manufacturer's literature.

WARNING:
DO NOT CONNECT LEADS "X", "S" and "T" TO ENERGIZED CIRCUIT.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SET UP OF CONTROLS

CONTROL	POSITION
INPUT SEL Switch	OFF
AMMETER LINE SEL Switch	A
VM INPUT/OFF/OUTPUT Switch	A-N
FUNCTION Switch	MECH.
PHASING Switch	0°
OUTPUT Source Control Knobs	0%
TIMER ON/OFF Switch	OFF
OUTPUT NORM/STOP Switch	NORM
SSNPR/NORM Switch	NORM

1. Make test connections per Figure 9. Switch the INPUT SEL Switch to the appropriate position (depends upon input voltage being used), POWER ON Light should glow.

NOTE: Test voltage is controlled by the variable autotransformer. When testing a 120/208 volt, 3 phase, 4 wire star system, the voltage applied to the motor, control relay and shunt trip is indicated on the supply voltmeter when VM INPUT/OFF/OUTPUT VOLTS Switch is switched to the INPUT "A - C" position. For a 277/480 volt, 3 phase, 4 wire star system without a control power autotransformer, voltage applied to the motor, control relay, and shunt trip is indicated on the voltmeter with the INPUT VOLTS Switch in the "A - N" position.

For 277/480 volt, 3 phase, 4 wire star system with control power autotransformer or for a 480, 460, or 440 volt, 3 phase, 3 wire delta system, the voltage applied to the motor, control or shunt trip is not indicated directly on the test set. For these types of protectors the voltage to the motor, control relay, or shunt trip is supplied through a control power autotransformer which is connected across two phases of network protector on the transformer side. To determine the test voltage being supplied to the motor, control relay or shunt trip, line-to-line voltage between Phases A and C is read on the voltmeter when the INPUT VOLTS Switch in "A - C" position. Then using the tabulation below, the test voltage supplied to the device being tested is found.

TABULATION OF VOLTAGE

Voltmeter Reading	Test Voltage applied to Motor, Control Relay Shunt Trip
480	248
460	238
440	228
330	170
312	160
308	150
34	15

2. Test voltage is applied to the protector the same way voltage is applied to the control circuit in actual service. The supply is turned on by pressing the START Pushbutton and variable autotransformer increased from zero until the desired test voltage is applied to the protector, which will then close or trip, depending on test being made. The motor, control relay, and shunt trip should be tested using voltages found for these devices in manufacturer's instruction book (see TABLE A for typical limits).

TABLE A
Closing Voltage Range, Volts

Rated Voltage of Network Protector, Volts	L-L or L-N	Control Relay 80-106 Percent	Closing Motor 73-106 Percent	Tripping Voltage Range, Volts 7-1/2 - 106 %
125/216	L-L	173 - 230	157 - 230	16 - 230
240	L-L	192 - 254	175 - 245	18 - 254
240/416	L-L	330 - 440	300 - 440	31 - 440
277/480	L-N	220-295	200 - 295	36 - 510*
277/480	L-L	385 - 510	350 - 510	36 - 510
331/575	L-L	480 - 610	420 - 610	43 - 610

*Trip coil connected line-to-line.

SERVICE DATA

Servicing

The test set utilizes straightforward circuits and components which require little or no service except for routine cleaning, tightening of connections, etc. The test set should be serviced in a clean atmosphere away from energized electrical circuits. The following maintenance is recommended:

1. Open the unit every six months and examine for:

a. dirt

b. moisture

c. corrosion

2. Remove dirt with dry, compressed air.

3. Remove moisture as much as possible by putting test set in a warm, dry environment.

4. As corrosion my take many forms, no specific recommendations can be made for its removal.

Service and Repair Order Instructions

If factory service is required or desired, contact the factory for return instructions.

A Return Authorization (RA) number will be assigned for proper handling of the unit when it arrives at the factory.

If desired, a letter with the number and instructions can be provided.

Provide the factory with model number, serial number, nature of the problem or service desired, return address, your name, and where you can be reached should the factory need to contact you.

A purchase order number, cost limit, billing, and return shipping instructions may also be provided if desired.

National Bureau of Standards traceable calibration and certification of two types is available, if desired, at additional cost.

Class One: A certificate is provided verifying the traceability and calibration of the equipment.

Class N: That which is required for nuclear power plants. A certificate of traceability and calibration along with "as found" and "as left" data are provided.

If an estimate is requested, provide the name and contact information of the person with approval/disapproval authority.

Pack the equipment appropriately to prevent damage during shipment. If a reusable crate or container is used, the unit will be returned in it if in suitable condition.

Put the RA number on the address label of the shipping container for proper identification and faster handling.

NOTE: Ship the equipment ***without*** instruction manuals or nonessential items such as test leads, spare fused, etc. These items are not needed to conduct repairs. ***Do*** ship the equipment with ***all*** interconnect cables, etc. which make the unit operational.

Preparation for Reshipment

Save the shipping container that your unit came in. The shipping container you unit came in is designed to withstand the normal bumps and shocks of shipping via common commercial carrier. For example, you may wish to reship you unit to Multi-Amp for annual calibration certification.

Warranty Statement

Multi-Amp Corporation warrants to the original purchaser that the product is free from defects in material and workmanship for a period of one (1) year from date of shipment. This warranty is limited and shall not apply to equipment which has damage, or cause of defect, due to accident, negligence, improper operation, faulty installation by purchaser, or improper service or repair by any person, company or corporation not authorized by the Multi-Amp Corporation.

Multi-Amp Corporation will, at its' option, either repair or replace those parts and/or materials that it deems to be defective. Any costs incurred by the purchaser for the repair or replacement of such parts and/or materials shall be the sole responsibility of the original purchaser.

THE ABOVE WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED ON THE PART OF THE MULTI-AMP CORPORATION, AND IN NO EVENT SHALL THE MULTI-AMP CORPORATION BE LIABLE FOR THE CONSEQUENTIAL DAMAGES DUE TO THE BREACH THEREOF.

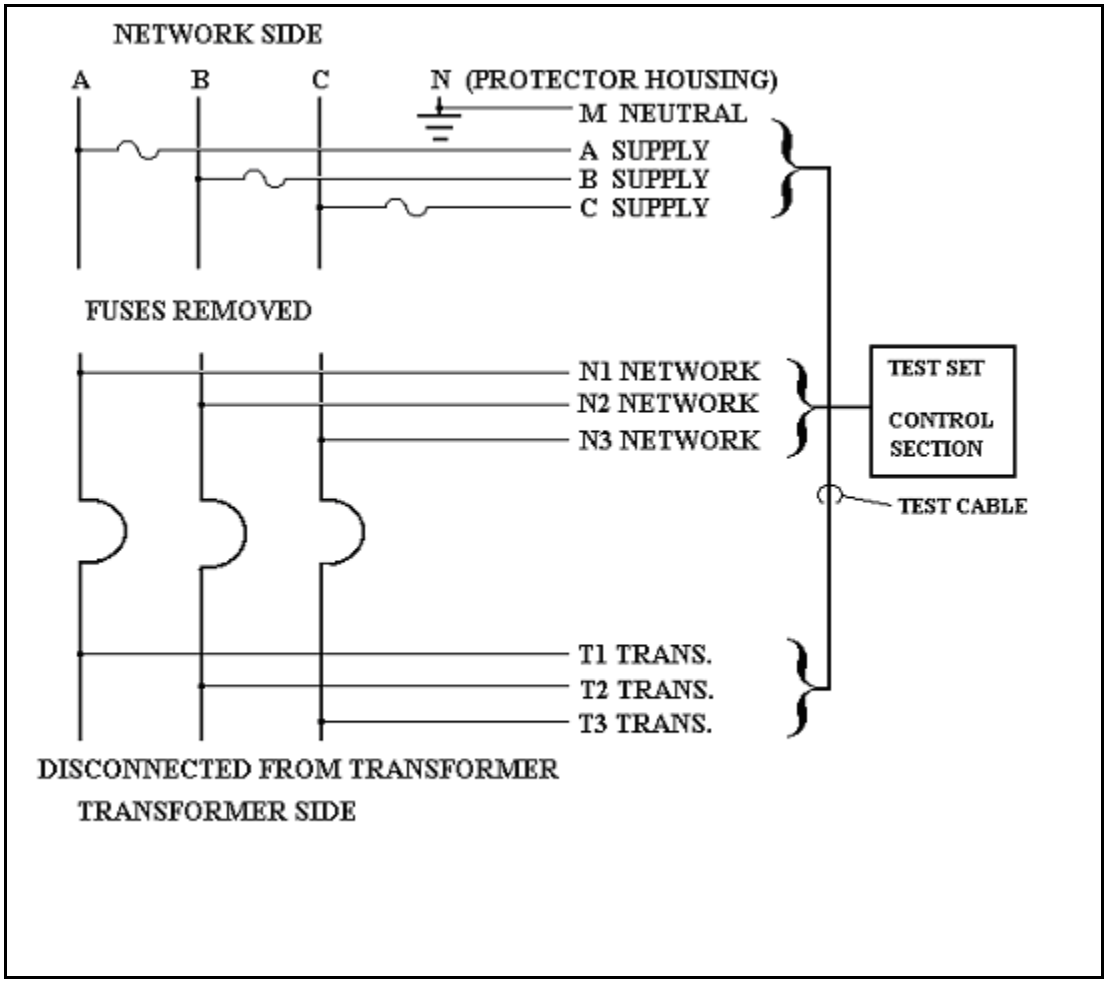

FIGURE 1. Test Connections for General Electric Network Protector

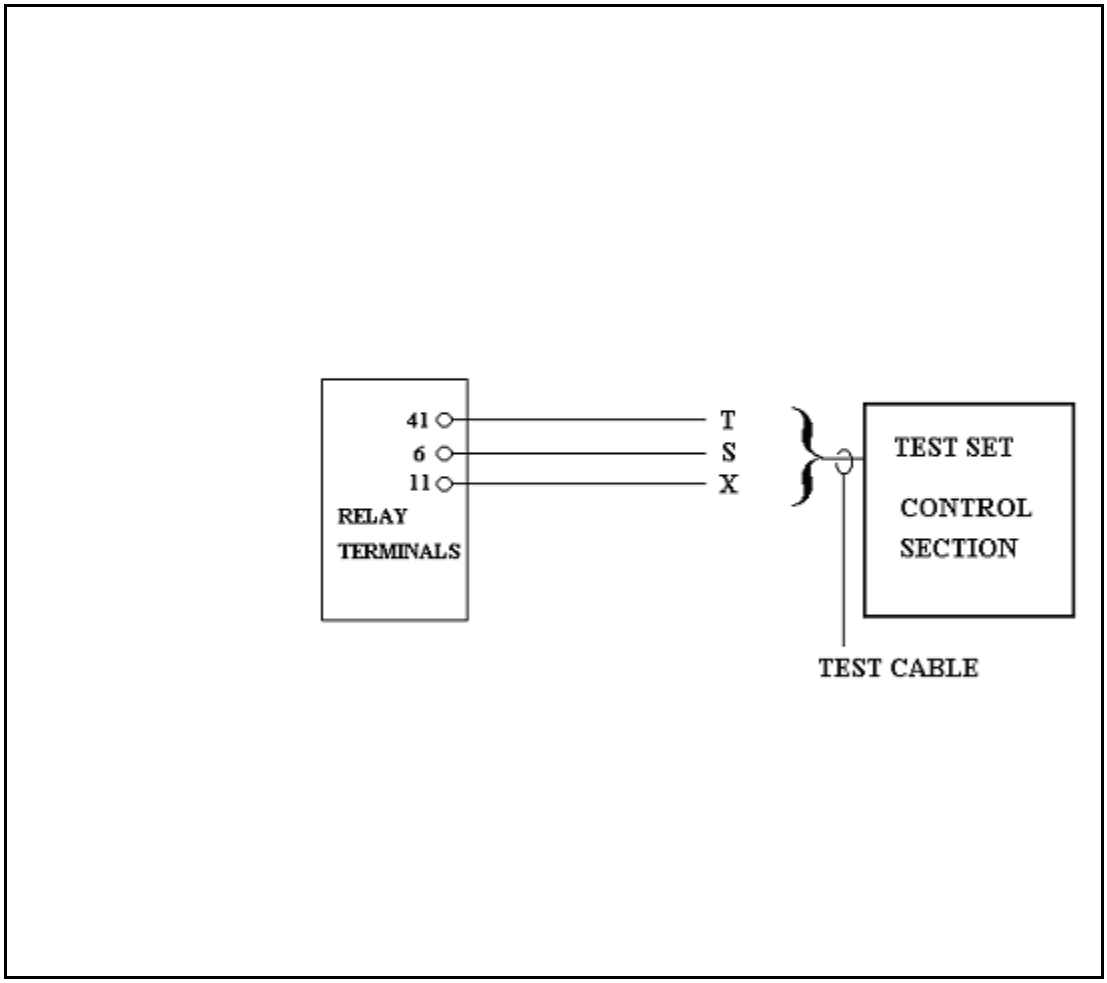

FIGURE 2. Additional Connections for Testing General Electric Network Relays Using Indicating Lights

WARNING

DO NOT CONNECT LEADS "X", "S" and "T" TO ENERGIZED CIRCUITS, WITHOUT SWITCHING THE SSNPR/NORMAL SWITCH TO THE SSNPR POSITION.

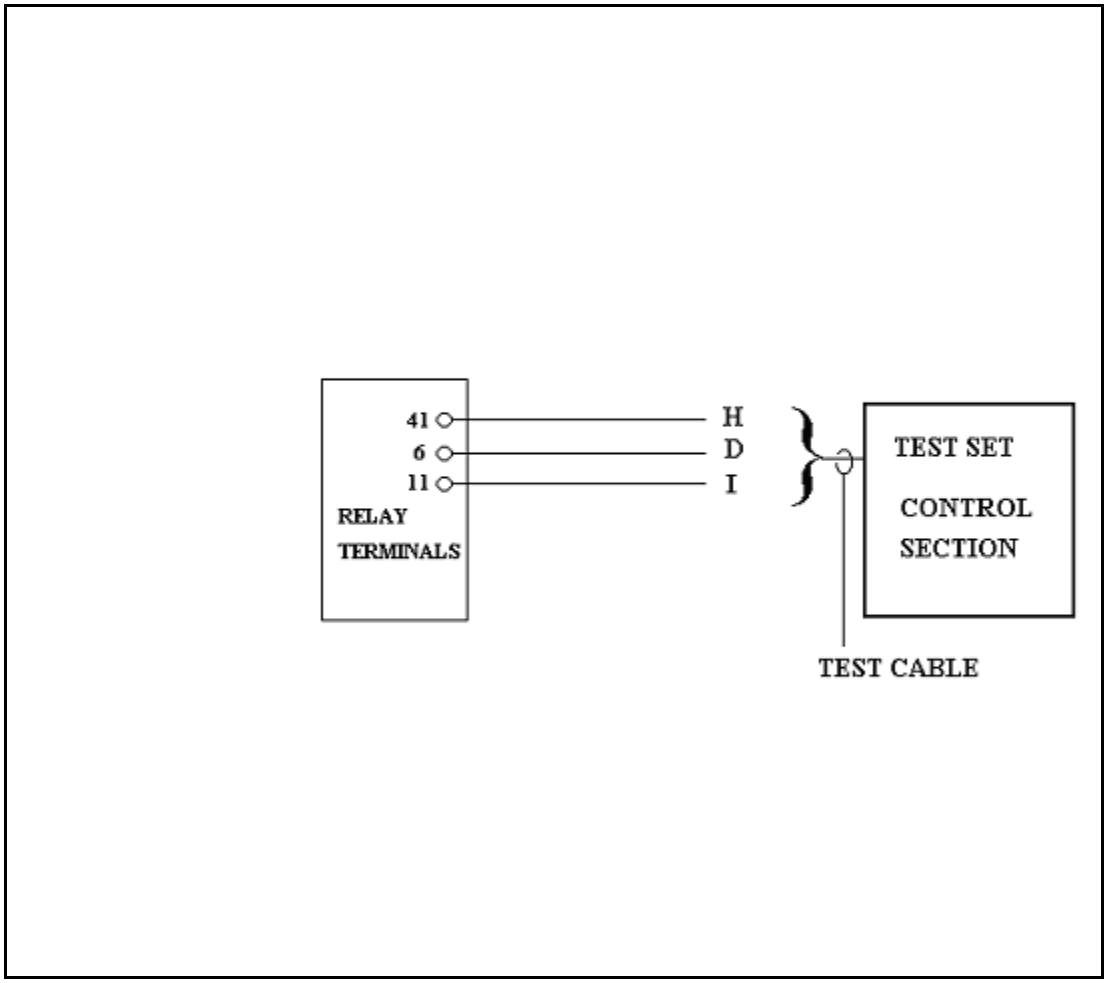

FIGURE 3. Test Connections for Mechanism Operation Test of General Electric Network Protectors

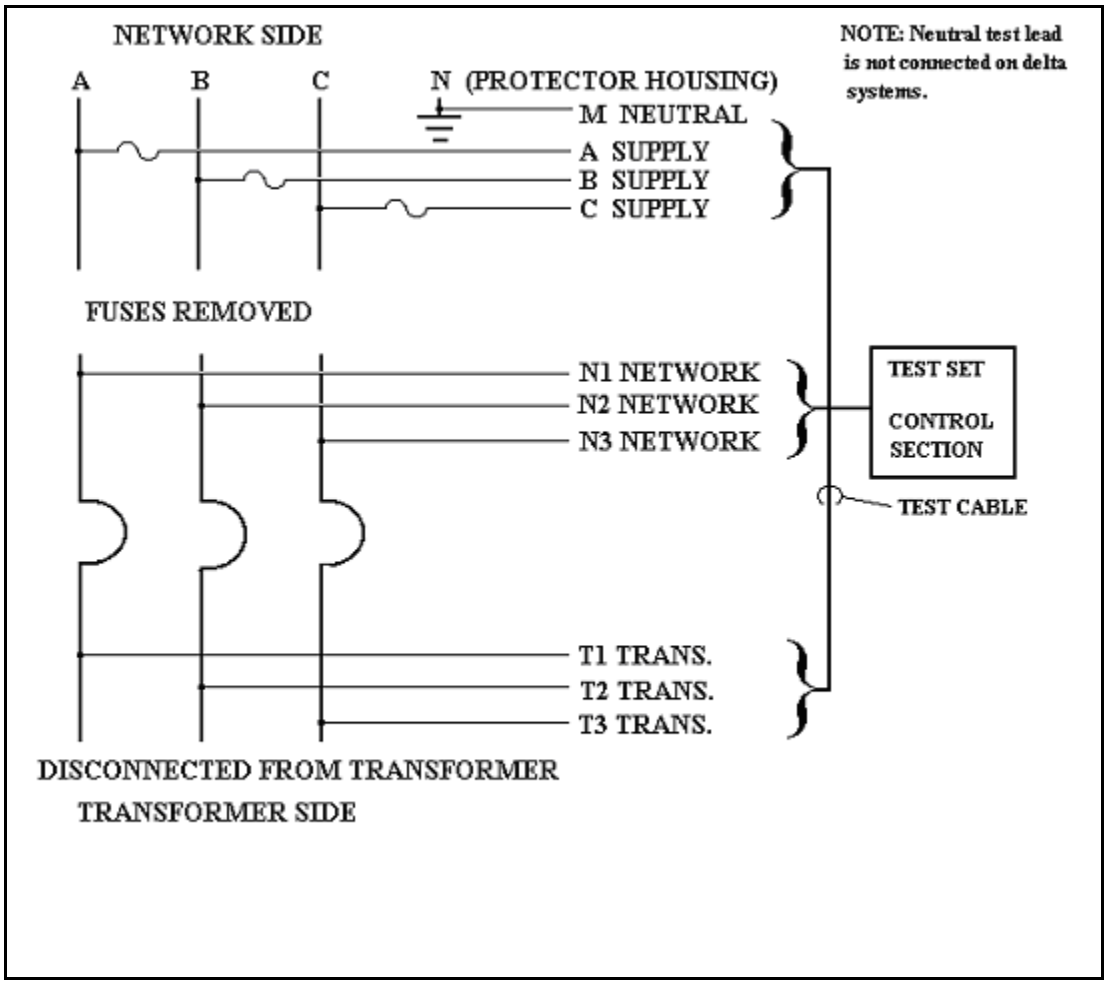

FIGURE 4. Test Connections for Westinghouse Network Protector

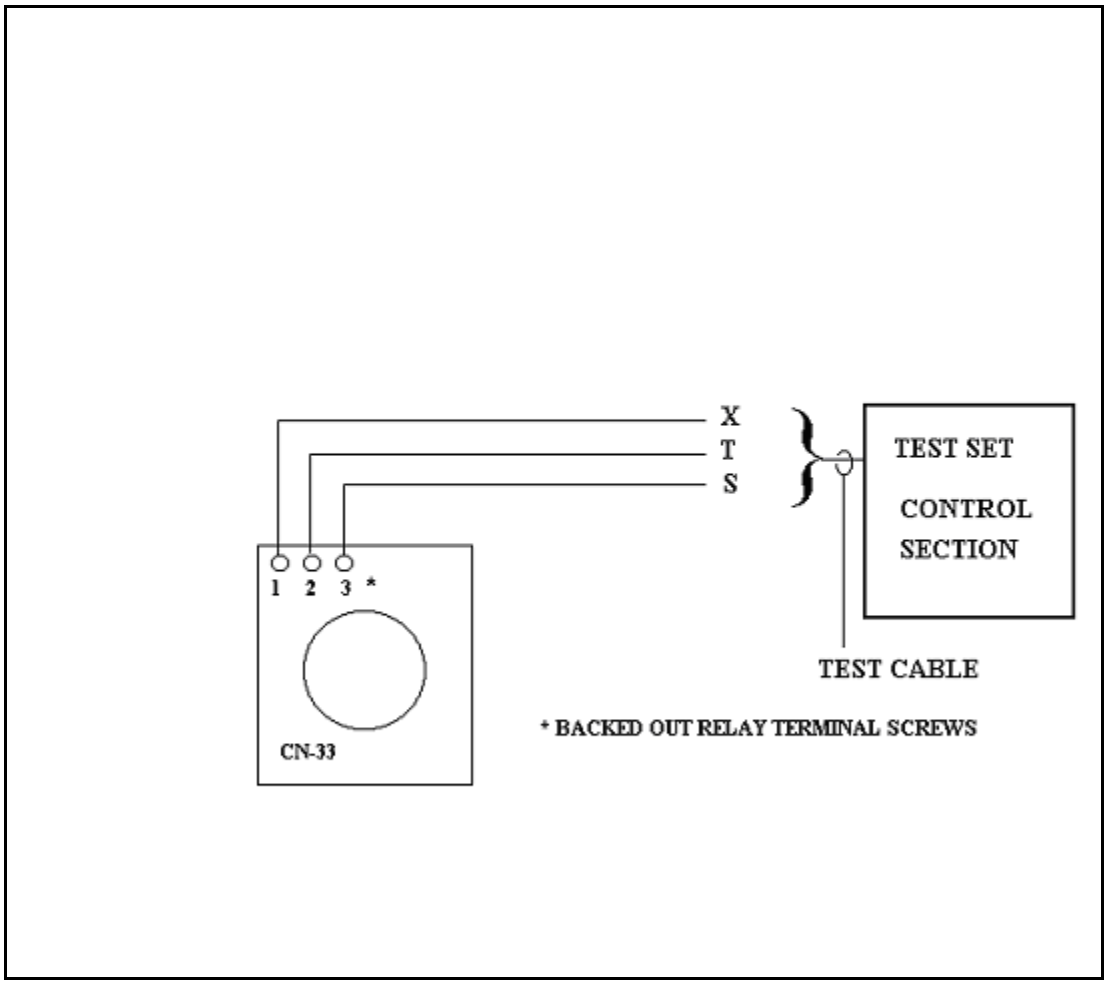

FIGURE 5. Additional Connections for Testing Westinghouse CN-33 Network Relays Using Indicating Lights

WARNING

DO NOT CONNECT LEADS "X", "S" and "T" TO ENERGIZED CIRCUITS. IF TESTING THE MPCR, DO NOT REMOVE RELAY TERMINAL SCREWS OR CONNECT X, S and T LEADS.

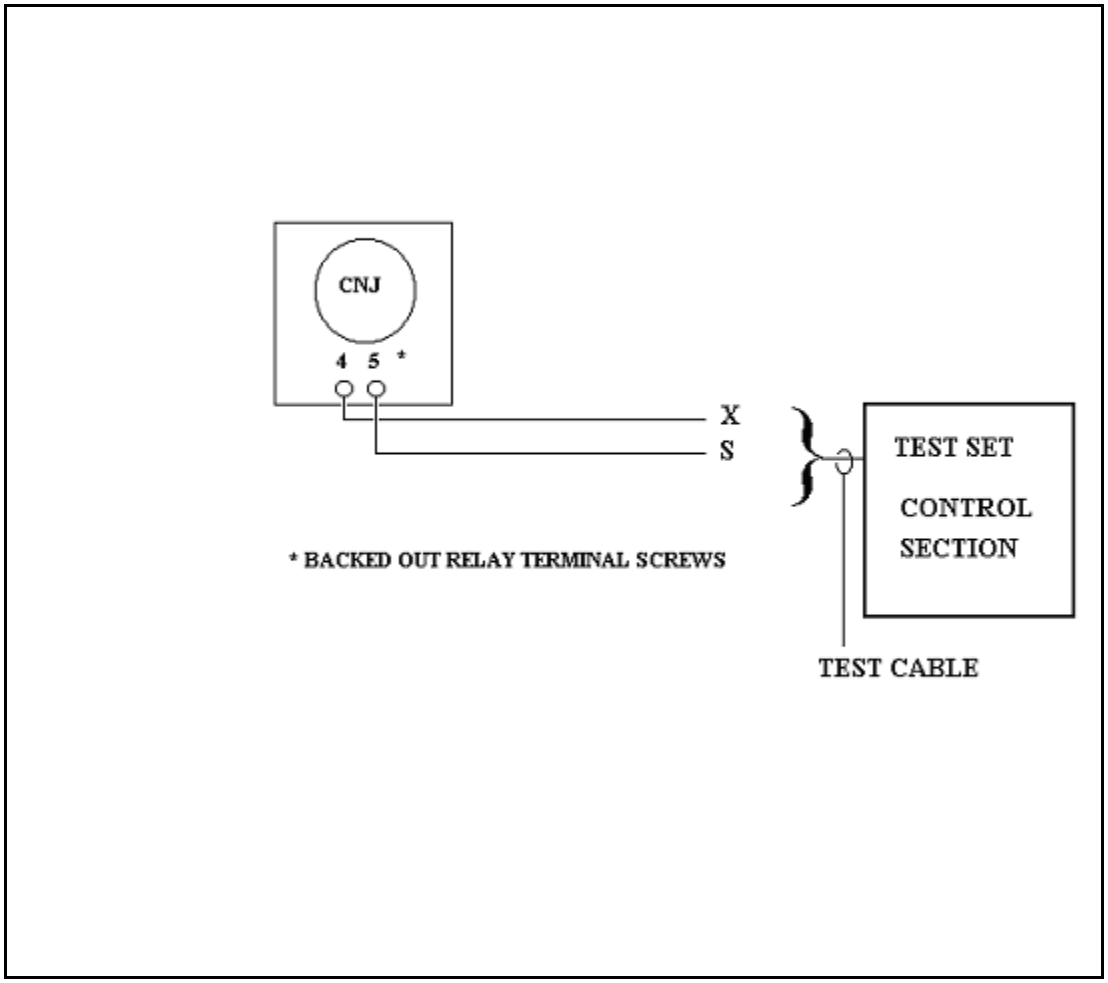

FIGURE 6. Additional Connections for Testing Westinghouse CNJ Network Relays Using Indicating Lights

WARNING

DO NOT CONNECT LEADS "X" and "S" TO ENERGIZED CIRCUITS.

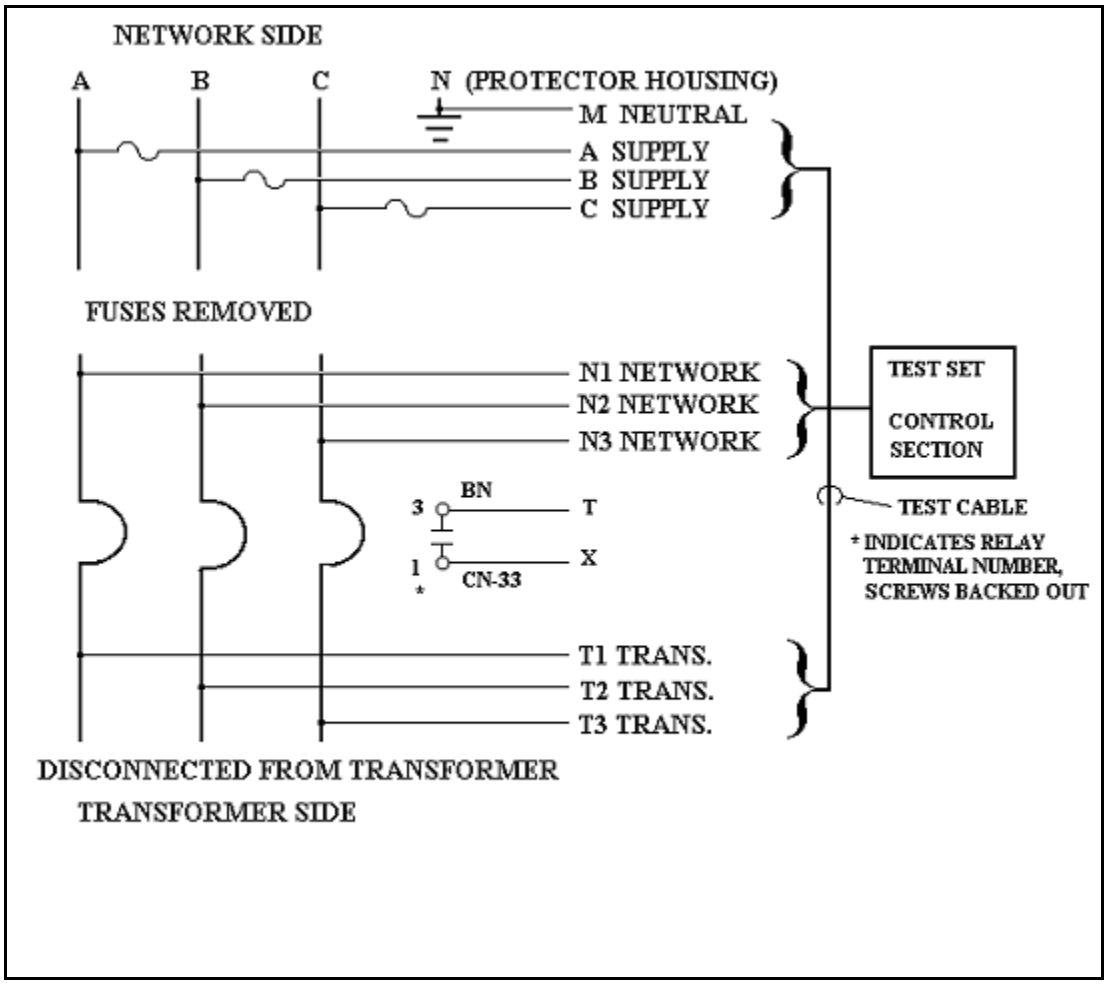

FIGURE 7. Test Connections for Westinghouse BN Relay Time Delay Trip Test

WARNING
DO NOT CONNECT LEADS "X" and "T" TO ENERGIZED CIRCUITS.

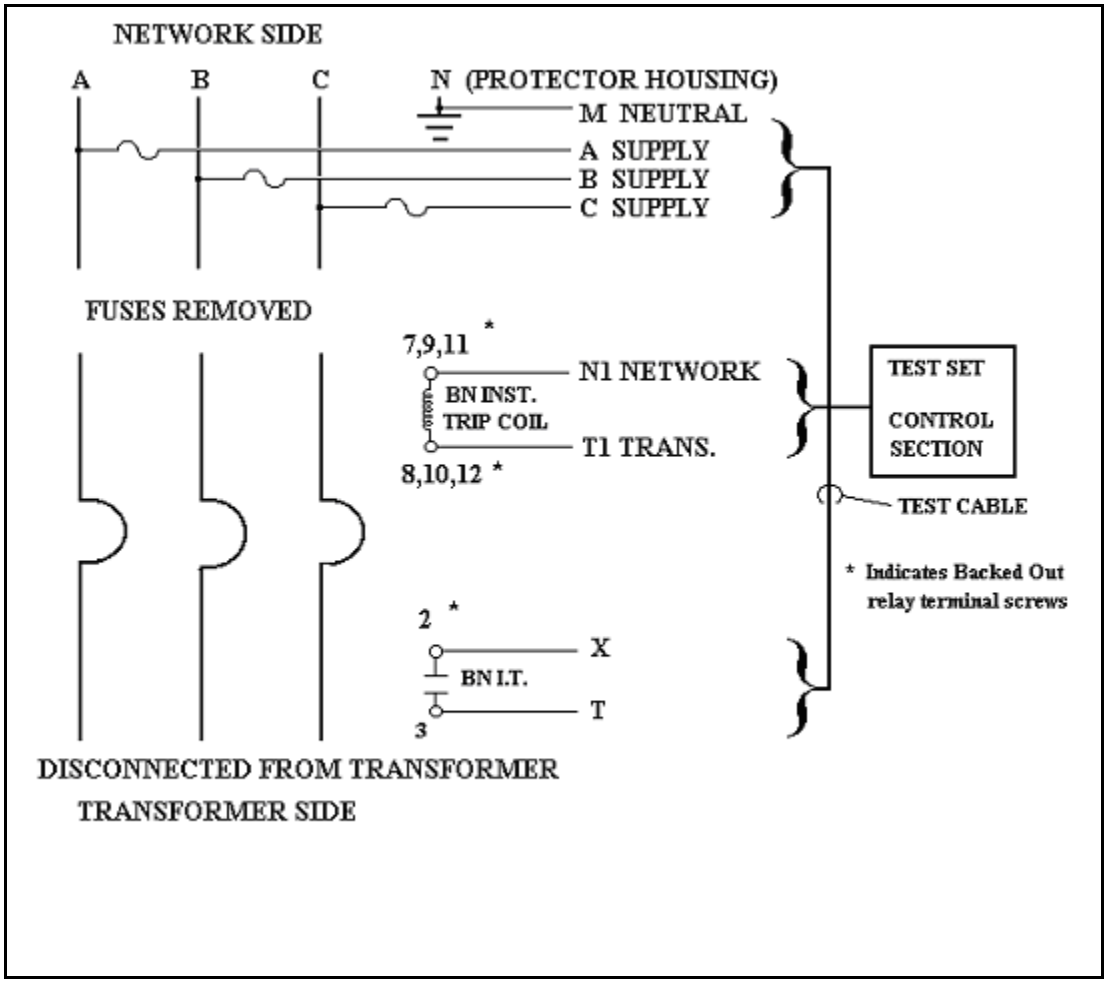

FIGURE 8. Test Connections for Westinghouse Instantaneous Trip Test

WARNING

DO NOT CONNECT LEADS "X" and "T" TO ENERGIZED CIRCUITS.

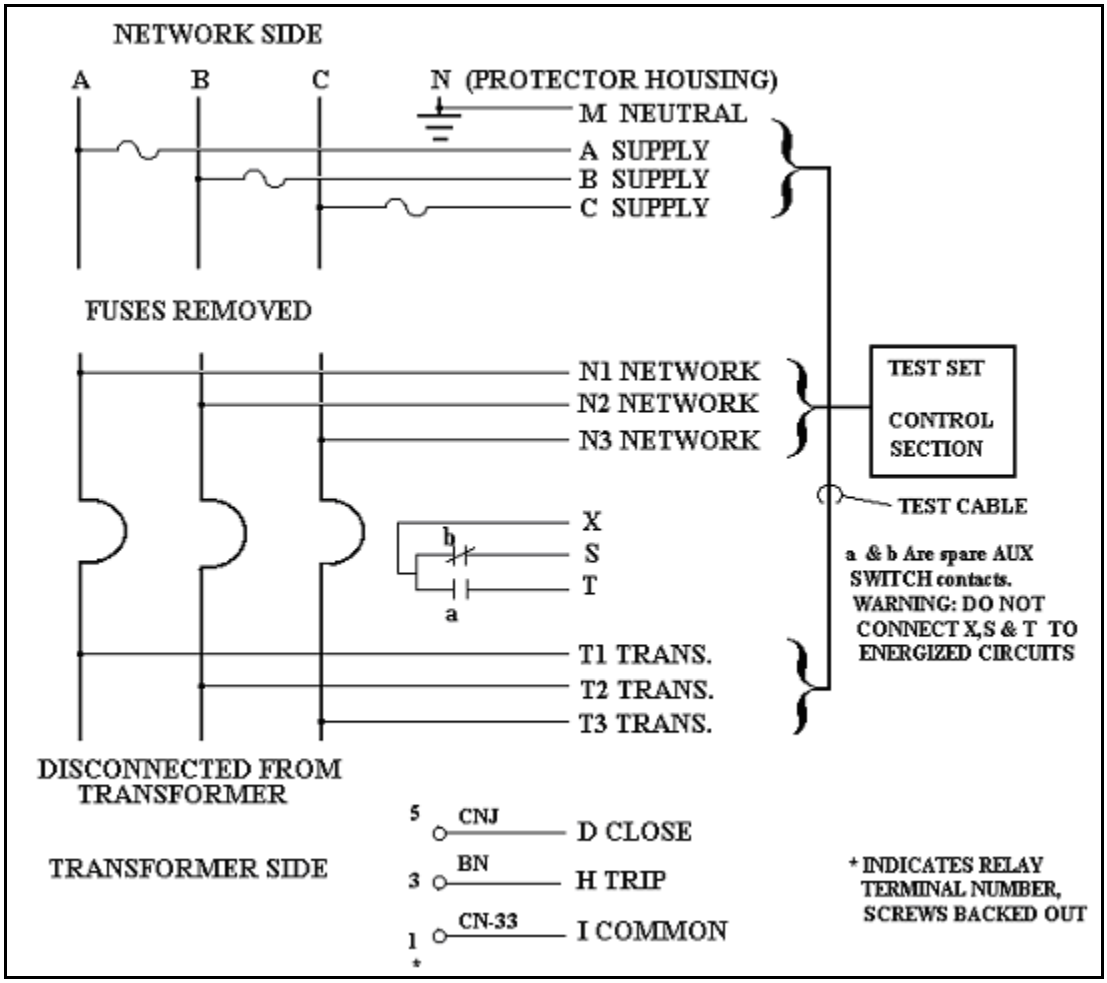

FIGURE 9. Test Connections for Westinghouse Mechanism Operation Test

WARNING

DO NOT CONNECT THE LEADS "X", "S" and "T" TO ENERGIZED CIRCUITS. USE "DRY" SPARE AUX. SWITCH CONTACTS ONLY (IF AVAILABLE).

22676D

EASI FILE CORP. IRVINE, CA EFH 22

DWG. NO. 22676D			
REVISIONS			
REV	ECN	DATE	REMARKS
1	20249	1-26-86	
2	22773	9-22-87	
3	21235	12-9-87	
4	21280	12-23-87	
5	21898	2 2 89	
6	22857	7 16 90	
7	23004	11 12 90	
8	23380	1 25 91	
9	23868	8 26 91	
10	25899	5 16 94	
11	28820	9-25-00	
12	29218	3-8-02	

REF.DES	PART NO	DESCRIPTION	QTY
TD1	12034	TIMER	1
L1,L2	4425	LAMP, NEON	2
T4	11277	TRANSF. 480/88V. AUTO 451/480 V. AUTO	3
T5	11278	ISO. 240/120 V.	3
T3	6722	OUTPUT 277/24V	1
T2	10863	TRANSF. VAR. 226V.-3	3
T1	6116	LAMP, NEON	1
L3-5	4426	SHUNT 25A 250 MV.	3
SH1-3	10864		3
S9	36	SWITCH 3PDT	1
S8	98	DPDT	1
S7	36	3PDT	1
S6	736	TRIP CLOSE	1
S5	10986	AM. LINE SEL.	1
S4	10982	VOLTMETER	1
S3	10907	PHASING	1
S2	730	FUNCTION SEL.	1
S1	12783	SWITCH INPUT SELECT	1
R5	8766	RESISTOR 1K 50W ADJ.	1
R3,4	2894	RESISTOR 1.5K 25W	2
R1,2	1373	RESISTOR 50Ω 225W ADJ.	2
X1,X2	3849	RELAY 3PDT 120V.	2
C1	3087	RELAY 4PDT 120V.	1
PB2	4795	SW PUSH BUTTON RED	1
PS1	5306	PHASE SEQ. IND. PCA	1
PB1,2	4535	SW. CONTACT BLOCK	2
PL2	364	LAMP HOLDER GREEN	1
PL1,3,4	363	HOLDER RED	3
PL3,4	365	125V. 656	2
PL1,2	355	LAMP 48V. 656	2
PB1	4796	SW PUSH BUTTON BLACK	1
M2	8838	ASSY. DPM ACMA	1
M1	9056	ASSY. DPM ACV	1
F4,5	949	FUSE HOLDER 1P 30A 250V.	2
F1-3	11141	HOLDER 1P 600V.	3
F5	952	5A 250V. MDA	1
F4	950	1.5A 250V. MDA	1
F1-3	11140	FUSE 15A 600V. KTK-R	3

multi-amp Electrical Sciences, Inc.
4271 Bronze Way
Dallas, Texas 75237 U.S.A.
Telephone: (214) 333-3201
TWX: 910-861-9052

DWN. RMD | APPD. | SCALE NONE
CHKD. | DATE 1-23-87 | SH. 1 OF 1

TITLE SCHEMATIC NTS-300

PART NO. | DWG. NO. 22676D | REV. 12

TOLERANCES UNLESS NOTED
3 PLACE DEC. ± .005
2 PLACE DEC. ± .02
FRACTIONS ± 1/32 +.004 -.008
HOLES THRU 1/2" DIA.
ANGLES ±0° 30'

INTERCONNECT CABLE
UNIT 1
A Ø
B Ø
C Ø
INTERCONNECT CABLE
INPUT CABLE
INPUT: 124/216V. 3Ø Y OR 277/480V. 3Ø Y 60HZ
NEUTRAL
CHASSIS GROUND
PHASE SEQ. IND.
AMMETER M2
VOLTMETER M1
CHASSIS GROUND
COMM. CLOSE TRIP
START PB1
STOP PB2
1W 1GN 1R 1BE STOP 1BN TD1 10 START 1Y 1BK 1V

S4 VOLTMETER

POS.	A	B	C	D	E	F	G	H
A Ø	X							X
B Ø		X						
C Ø			X					
OFF								
A-N	X			X				
B-N		X		X				
C-N			X		X			
A-B	X				X			
B-C		X				X		
C-A			X				X	

S8 OUTPUT

POS	A	B	C	D
NORM	X		X	
STOP		X		X

S7 TIMER

POS	A	B	C	D	E	F
ON	X		X			X
OFF		X		X	X	

S6 TRIP CLOSE

POS.	A	B
TRIP	X	
OFF		
CLOSE		X

S1 INPUT SEL.

POS.	A	B	C	D	E	F	G	H	J
216		X		X			X	X	X
OFF									
480	X		X		X		X	X	X

S2 FUNCTION SEL.

POS.	A	B	C	D	E	F	G	H	J
MECH		X		X		X			
RELAY	X		X		X		X	X	X

S9 NORM-SSWPR

POS	A	B	C	D	E	F
NORM	X		X			X
SSWPR		X		X	X	

S5 AMMETER

POS	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	NN	PP	QQ	RR	SS	TT	UU	VV	WW
OFF																																												
A	X																																											
B		X																																										
C			X																																									

S3 PHASING

PHASING	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	NN	PP	QQ	RR	SS	TT	UU	VV	WW
0°	X	X	X	X	X	X																																						
10°										X	X	X	X	X	X	X	X	X																											
60°										X	X	X	X	X	X	X	X	X																											
120°										X	X	X	X	X	X	X	X	X																											
180°										X	X	X	X	X	X	X	X	X																											
240°										X	X	X	X	X	X	X	X	X																											

S1 INPUT SEL.

POS.	A	B	C	D	E	F	G	H	J
216		X		X			X	X	X
OFF									
480	X		X		X		X	X	X

S2 FUNCTION SEL.

POS.	A	B	C	D	E	F	G	H	J
MECH		X		X		X			
RELAY	X		X		X		X	X	X

S9 NORM-SSWPR

POS	A	B	C	D	E	F
NORM	X		X			X
SSWPR		X		X	X	

S5 AMMETER

POS	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	NN	PP	QQ	RR	SS	TT	UU	VV	WW
OFF																																												
A	X																																											
B		X																																										
C			X																																									

S3 PHASING

PHASING	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	NN	PP	QQ	RR	SS	TT	UU	VV	WW
0°	X	X	X	X	X	X																																						
10°										X	X	X	X	X	X	X	X	X																											
60°										X	X	X	X	X	X	X	X	X																											
120°										X	X	X	X	X	X	X	X	X																											
180°										X	X	X	X	X	X	X	X	X																											
240°										X	X	X	X	X	X	X	X	X																											

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