



## Instructions

### Single-phase Undervoltage Relays for 25Hz

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These instructions cover special versions of the Types 27D and 27H Single-phase Undervoltage Relays for use on 25 Hz. systems or in variable frequency applications. Information in the basic book, IB 18.4.7-2 Issue E applies to these relays with the exception of the operating time curves.

These relays have been modified to provide operation at frequencies down to 20 Hertz with improved performance compared to the "standard" units of the Type 27H series. The main improvements are in the reduction of contact chatter and in the stability of the operating voltage threshold over the frequency range of 20 to 60 Hz.

The variation in ac operating voltage threshold is less than 5% of tap over the frequency range of 30 to 60 Hertz for any tap setting, and less than 10% over the range of 20-60 Hertz. (at constant temperature and constant dc supply voltage.)

**Type 27H, Instantaneous Relay**, with tap range 30-55vac, designated by catalog numbers of the form 411R02x5-TF, where "x" represents the digit that determines the dc control voltage rating.

The operating time curve TVC-605819 shown in the basic instruction book does not apply to this model. These relays have an operating time of 150 milliseconds or less.

**Type 27D, Definite Short-Time Relay**, with tap range 30-55vac, designated by catalog numbers of the form 411R62x5-TF, where "x" represents the digit that determines the dc control voltage rating.

Operating time curve TVC-605820 shown in the basic instruction book does not apply to this model. These relays have the following nominal operating times for a 25Hz signal:

Time Dial	# 1	# 2	#3	#4	#5	#6
Operating Time (sec)	0.20	0.30	0.37	0.54	0.70	1.0

Rev 1: 7/12/2000

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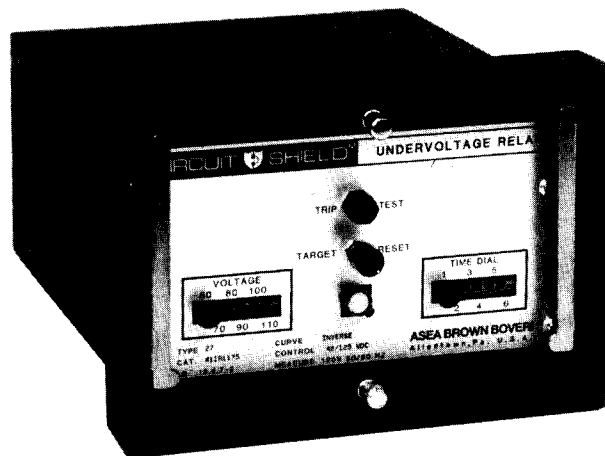
## INSTRUCTIONS

### Single-Phase Voltage Relays

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#### UNDERVOLTAGE RELAYS and OVERVOLTAGE RELAYS

TYPE 27, TYPE 27D, TYPE 27H	Catalog Series 211	Standard Case
TYPE 27, TYPE 27D, TYPE 27H	Catalog Series 411	Test Case
TYPE 59D, TYPE 59H	Catalog Series 211	Standard Case
TYPE 59D, TYPE 59H	Catalog Series 411	Test Case



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INTRODUCTION

These instructions contain the information required to properly install, operate, and test certain ABB Circuit-Shield™ single-phase undervoltage and overvoltage relays, Types 27, 27D, 27H, 59D, and 59H. See the section on Testing for single-phase voltage relays covered by earlier issues of this instruction book.

The relay is housed in a case suitable for conventional semiflush panel mounting. All connections to the relay are made at the rear of the case and are clearly numbered. Relays of the 411B, 411R, and 411C catalog series are similar to relays of the 211B, 211R, and 211C series. Both series provide the same basic functions and are of totally drawout construction; however, the 411B, 411R, and 411C series relays provide integral test facilities. Also, sequenced disconnects on the 411 series prevent nuisance operation during withdrawal or insertion of the relay if the normally-open contacts are used in the application.

Most settings are made on the front panel of the relay, behind a removable clear plastic cover. The target is reset by means of a pushbutton extending through the relay cover.

PRECAUTIONS

The following precautions should be taken when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with the connection diagram for the particular relay before energizing. *Important: connections for the 411 catalog series units are different from the 211 series units.*
2. Apply only the rated control voltage marked on the relay front panel. The proper polarity must be observed when the dc control power connections are made.
3. For relays with dual-rated control voltage, withdraw the relay from the case and check that the movable link on the printed circuit board is in the correct position for the system control voltage.
4. High voltage insulation tests are not recommended. See the section on testing for additional information.
5. The entire circuit assembly of the relay is removable. The unit should insert smoothly. Do not use excessive force.
6. Follow test instructions to verify that the relay is in proper working order.

**CAUTION:** *since troubleshooting entails working with energized equipment, care should be taken to avoid personal shock. Only competent technicians familiar with good safety practices should service these devices.*

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident, file a claim at once and promptly notify Asea Brown Boveri. Use normal care in handling to avoid mechanical damage. Keep clean and dry.

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## 2. INSTALLATION

### Mounting:

The outline dimensions and panel drilling and cutout information is given in Fig. 1.

### Connections:

Internal connections are shown on page 7. Typical external connections are shown in Figure 2. *Important: connections are different for 411B, 411R, and 411C series units compared to 211B, 211R, and 211C units.* Control power must be connected in the proper polarity.

For relays with dual-rated control power: before energizing, withdraw the relay from its case and inspect that the movable link on the lower printed circuit board is in the correct position for the system control voltage. (For units rated 110vdc, the link should be placed in the position marked 125vdc.)

Relays rated for use with 120vac control power have an internal isolation transformer connected to relay terminals 7 and 8. Polarity of the ac control power to these terminals need not be observed.

These relays have metal front panels which are connected through printed circuit board runs and connector wiring to a terminal at the rear of the relay case. The terminal is marked "G". In all applications this terminal should be wired to ground.

## 3. SETTINGS

### PICKUP (VOLTS)

The pickup taps are labelled by the actual value of ac input voltage which will cause the relay to operate. Note: operating voltage values other than the specific values provided by the taps can be obtained by means of an internal adjustment potentiometer. See section on testing for setting procedure.

On these relay models there is no adjustment for the differential between the operate and reset voltage values.

### TIME DIAL

The time dial taps are identified as 1,2,3,4,5,6. Refer to the time-voltage characteristic curves in the Application section. Time dial selection is not provided on relays with an Instantaneous operating characteristic.

## 4. INDICATORS

### Target:

An operation target is provided. The target is set electronically when the output contacts transfer. The target will retain its indication on loss of dc control power. In order to reset the target, normal dc control power must be present and a "normal" ac voltage condition must exist; in other words, for an undervoltage relay the voltage must be higher than the set point, and for overvoltage relays, lower.

## APPLICATION DATA

The ABB Circuit-Shield™ single-phase voltage relays covered by this instruction book provide a wide range of application including undervoltage protection for motors, over and undervoltage protection for generators, and automatic bus transfer. The relays provide good accuracy and repeatability, and have a flat response over a frequency range of 15 to 400 hertz.

### Undervoltage Relay, Type 27, catalog series 211B, 211R, 411B, and 411R:

Typical applications include general purpose undervoltage protection for incoming lines, and initiation of transfer in automatic bus transfer schemes.

Typical external connections are shown in Figures 2.

The relay has an inverse time curve as shown in TVC-605817.

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Undervoltage Relay, Type 27D, catalog series 211B, 211R, 411B and 411R:

Typical applications include the initiation of transfer in automatic bus transfer schemes.

Typical external connections are shown in Figure 3.

The Type 27D relay has a definite-time characteristic with 2 ranges available: 0.1-1 second and 1-10 seconds, as shown in TVC-605820 and TVC-605821.

Undervoltage Relays, Type 27H, catalog series 211B, 211R, 411B, 411R:

Typical applications include instantaneous undervoltage detection for bus transfer schemes, and for generator intertie schemes. The low range relay is used as a residual voltage detector in motor bus transfer schemes.

Typical connections are shown in Figure 3.

The relay has an instantaneous operating time as shown in TVC-605819.

Overvoltage Relays, Type 59H and Type 59D, catalog series 211C and 411C:

These instantaneous and definite time overvoltage relays are companions to the Type 27H and Type 27D undervoltage relays, and offer similar characteristics where overvoltage protection is required.

The time voltage characteristic for the Type 59D is given in TVC-605839. For the Type 59H the maximum operating time above 1.05 times pickup is 16 milliseconds.

Notes on the Use of AC Control Power  
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In general the use of a station battery to provide a reliable source of tripping and control power is preferred. However, many of the relay types described in this IB are available for use with 120 vac control power. The output contacts may be used in a 120 vac circuit or in a capacitor trip circuit where the capacitor voltage is no more than 170 vdc nominal. (Consult factory if the higher rating is required: "-CAP" catalog suffix.) The control power for these relays should never be taken from a capacitor trip circuit as the voltage is too high and the relay will drain the capacitor in the event of loss of AC supply.

Type 27 and Type 27D Undervoltage Relays used with 120 vac control power in the "self-powered" mode, with both signal and control power taken from the same source, will not maintain their timing characteristics if the voltage drops below approximately 65 volts. The relay will trip immediately. If this characteristic is undesirable for a particular application, the Type 27H instantaneous relay should be used followed by a pneumatic timer with time delay on dropout. A contact from the timer would be used to trip. The timer would be picked up by a contact of the Type 27H under "normal" line conditions. With undervoltage or loss of voltage, the timer would time out and close its contact in the tripping circuit. If the voltage loss were momentary, the timer would allow riding through the loss without tripping. This arrangement thus makes the time delay independent of control power and retains the benefits of accurate voltage sensing provided by the Type 27H relay.

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**SPECIFICATIONS**
**Input Circuit:**

Rating: 160V, 50/60 Hz. continuous.  
300V, 10 seconds.

Burden: 1.2 VA, 1.0 pf at 120 volts.

Taps: available models include:

Types 27, -27D, -27H : 60, 70, 80, 90, 100, 110v

Types 27D, -27H: 30, 35, 40, 45, 50, 55v

15, 18, 21, 24, 27, 30v

Types 59D, -59H: 100, 110, 120, 130, 140, 150v

60, 65, 70, 75, 80, 90v

Differential between Operate and Reset Voltages:

Type 27: less than 0.5 percent.

Types 27D, -27H, ITE-59D, -59H: approximately 3 percent.

Operating Time: See Time-Voltage characteristic curves that follow.

**Output Circuit:**

Each contact @ 125 Vdc: 30 ampere tripping duty.  
5 ampere continuous.  
0.3 ampere break.

Operating Temperature Range: -30 to +70 deg. C.

**Control Power:**

Models available for 48/125 vdc @ 0.08 A max.  
48/110 vdc @ 0.08 A max.  
24/ 32 vdc @ 0.08 A max.  
120 vac 50/60 Hz. @ 0.08 A.

Allowable variation: 24vdc nominal: 19- 29 vdc  
32vdc " 25- 38  
48vdc " 38- 58  
110vdc " 88-125  
125vdc " 100-140  
120vac " 95-135 vac

**Tolerances:** Operating Voltage: +/- 5%      These tolerances are based on the  
Operating Time: +/-10%      printed dial markings. By using  
the calibration procedures given  
later in this book, the relay may  
be set precisely to the desired  
values of operating voltage and  
delay with excellent repeatability.

Repeatability: variation in operating voltage for a 10 volt variation  
in control voltage: 0.2 volt, typical.

variation in operating voltage over the temperature  
range 20-40 deg C: 0.5 volt, typical.

**Dielectric Strength:**

1500 vac, 50/60 Hz., all circuits to ground.

**Seismic Capability:**

More than 6g ZPA biaxial broadband multifrequency vibration  
without damage or malfunction. (ANSI C37.98-1978)

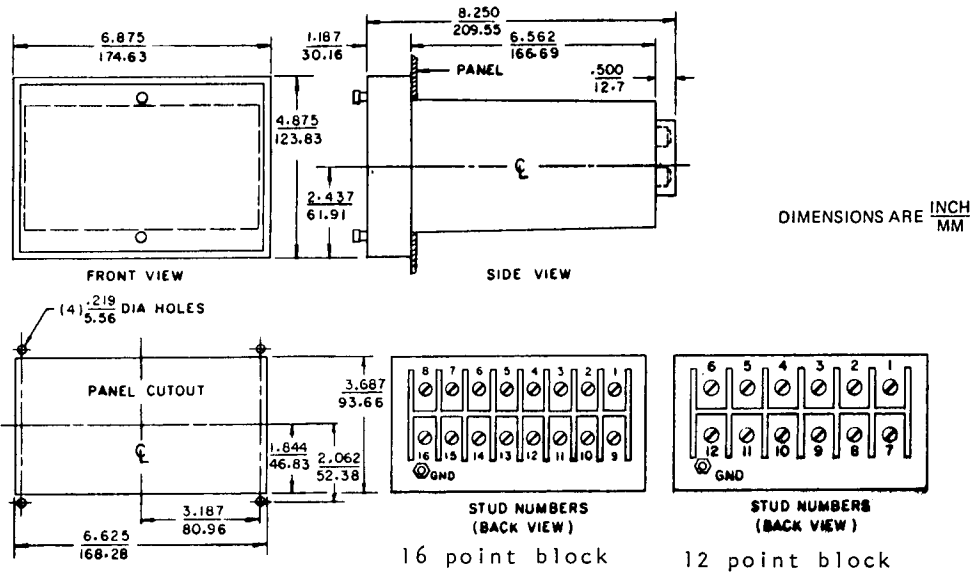


Figure 1: Relay Outline and Drilling

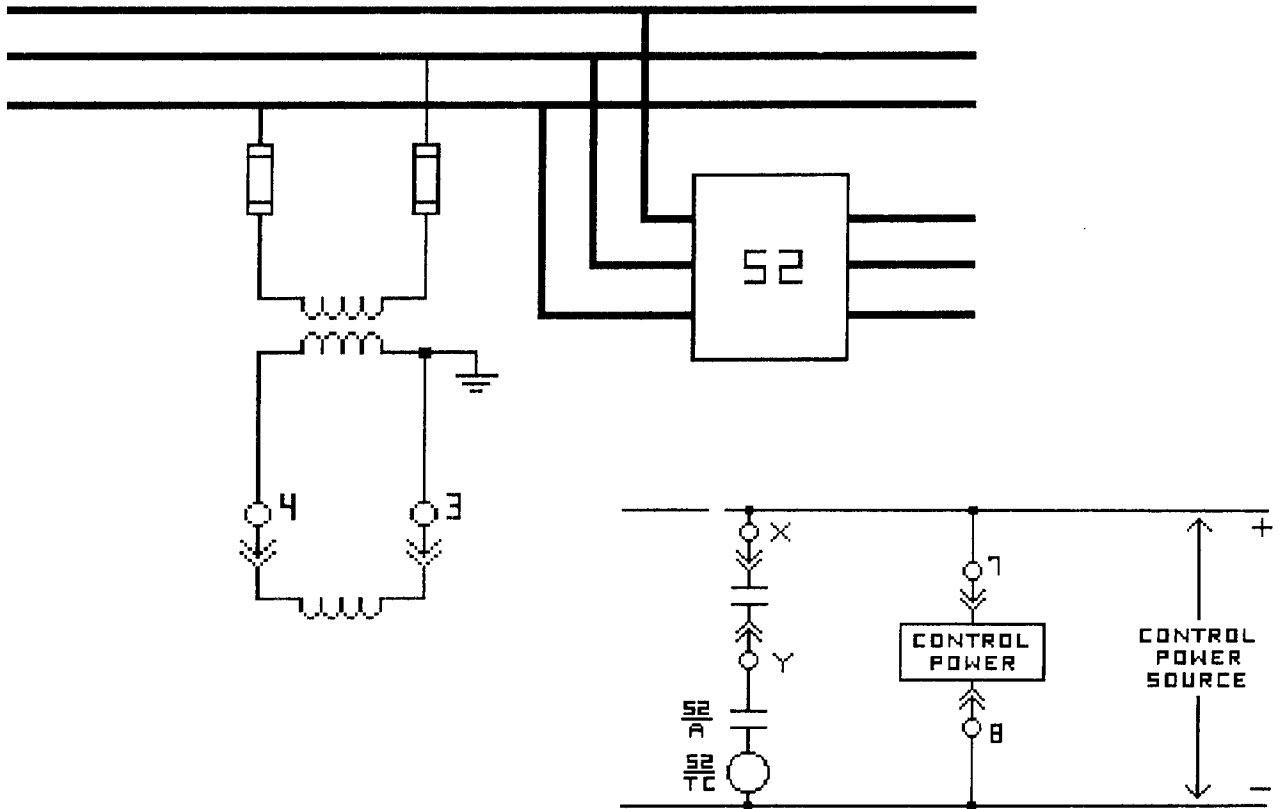


Figure 2: Typical External Connections

Note: Refer to Internal Connection Diagrams and Contact Logic Chart on page 7 to select the specific terminal numbers for the output contact ("X" and "Y") for the particular relay being used. Additionally, a table has been provided on page 15 as a cross-reference.

INTERNAL CONNECTION DIAGRAMS AND OUTPUT CONTACT LOGIC

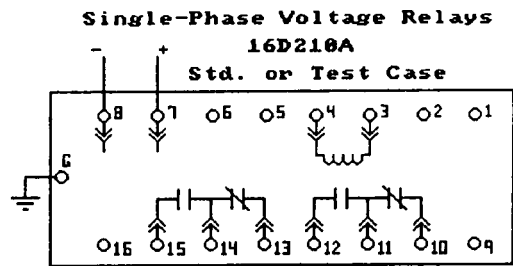
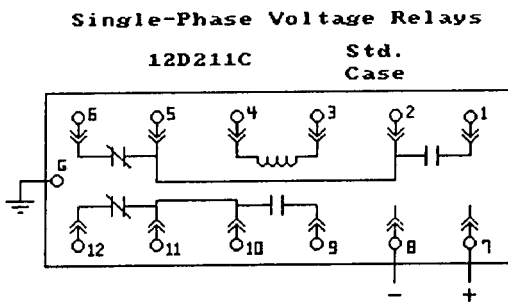
The following tables and diagrams define the output contact states under all possible conditions of the measured input voltage and the control power supply. "AS SHOWN" means that the contacts are in the state shown on the internal connection diagram for the relay being considered. "TRANSFERRED" means the contacts are in the opposite state to that shown on the internal connection diagram.

FOR DIAGRAM 12D211C

Condition	Contact State		
	Cat. Series: 211Rxxx5	211Bxx65	211Cxxx5
Normal Control Power	As Shown	As Shown	As Shown
AC Input Voltage Below Setting	As Shown	As Shown	As Shown
Normal Control Power	Transferred	Transferred	Transferred
AC Input Voltage Above Setting	Transferred	Transferred	Transferred
No Control Voltage	Transferred	As Shown	As Shown

FOR DIAGRAM 16D210A

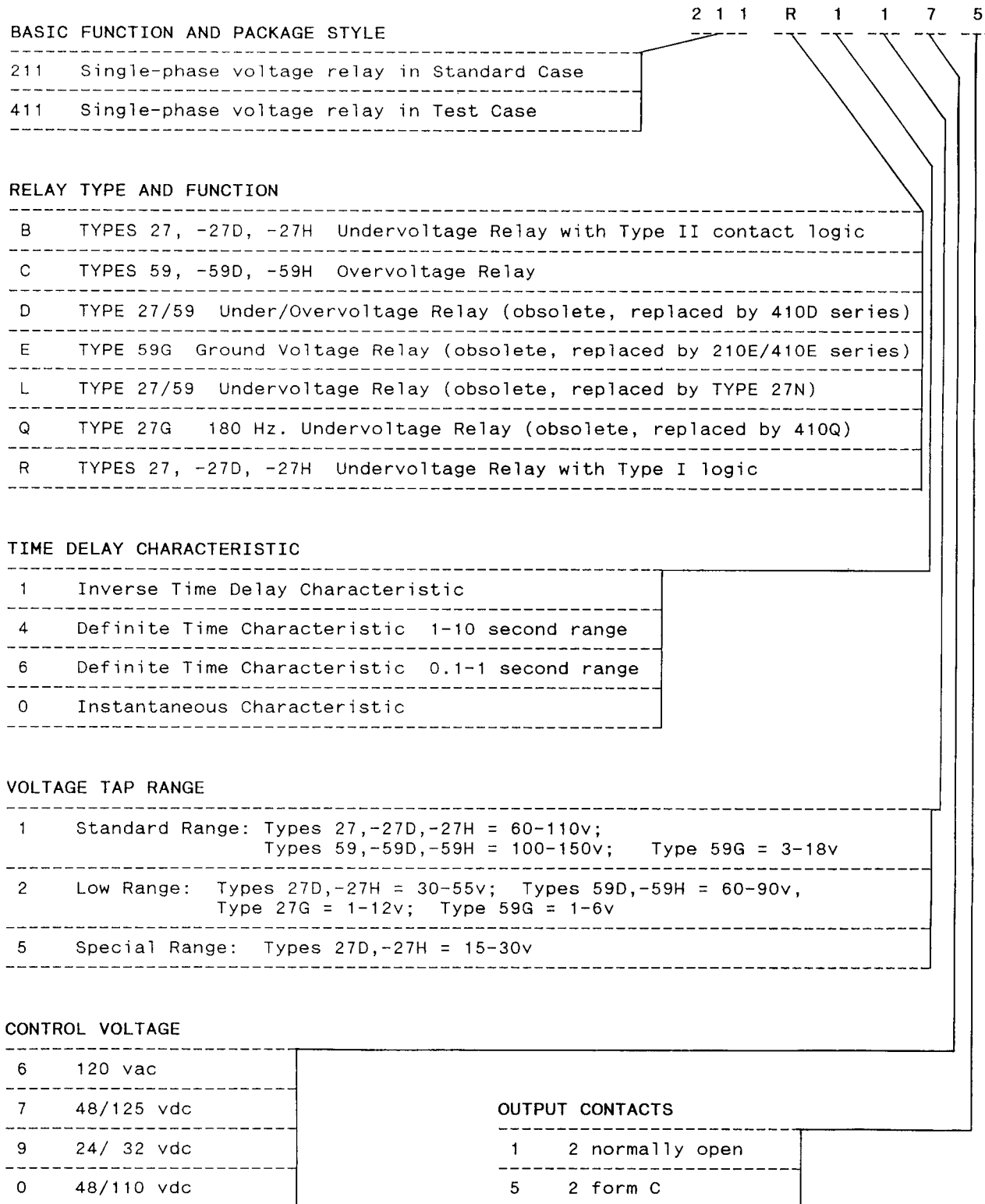
Condition	Contact State		
	Cat. Series: 411Rxxx5	411Bxx65	411Cxxx5
Normal Control Power	Transferred	Transferred	As Shown
AC Input Voltage Below Setting	Transferred	Transferred	As Shown
Normal Control Power	As Shown	As Shown	Transferred
AC Input Voltage Above Setting	As Shown	As Shown	Transferred
No Control Voltage	As Shown	Transferred	As Shown

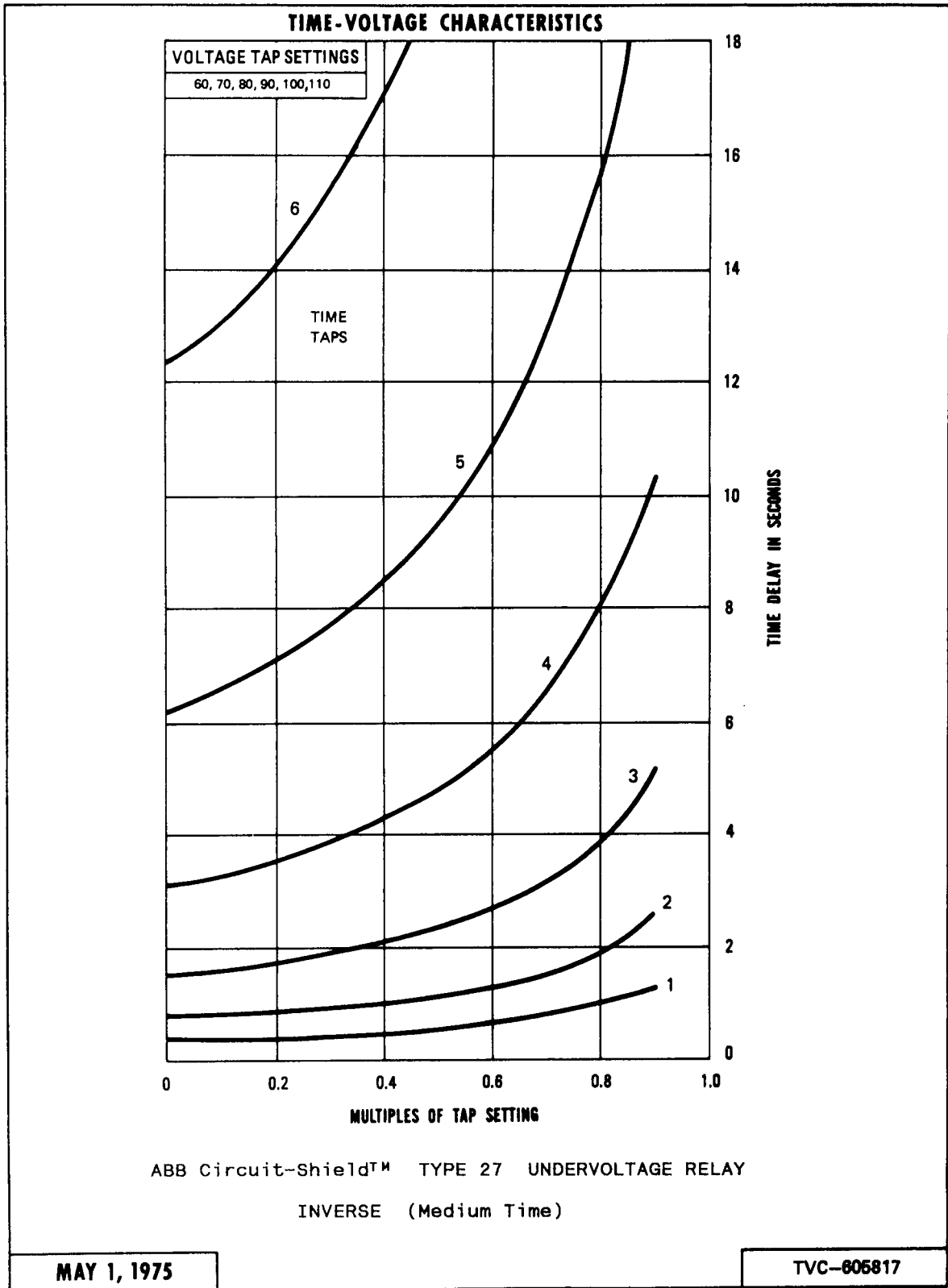


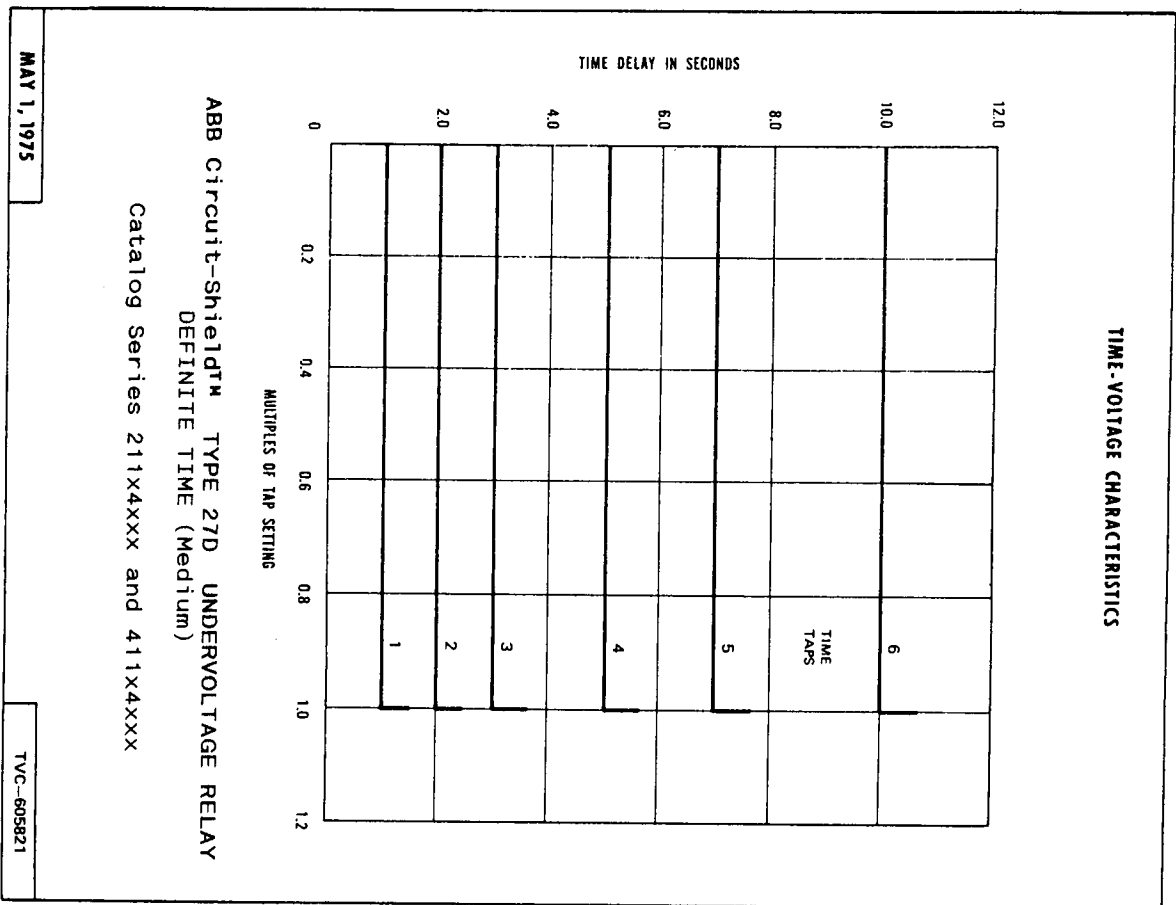
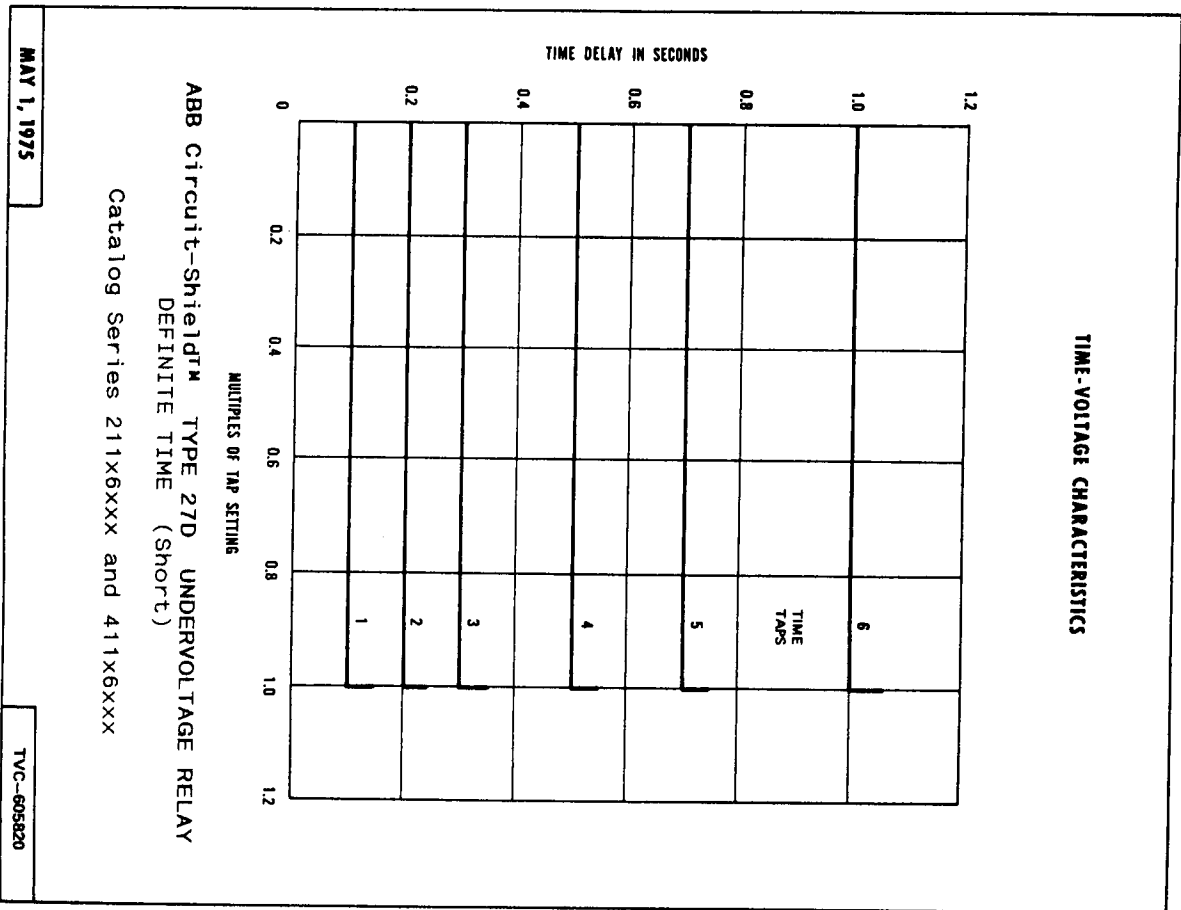


**CHARACTERISTICS OF COMMON UNITS**

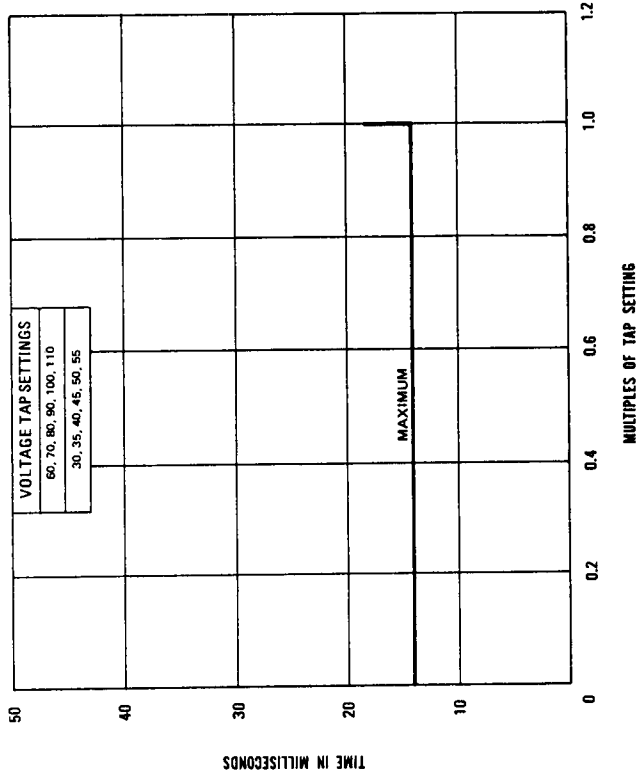
The following chart gives the basic characteristics of various Circuit-Shield™ single-phase voltage relays from their catalog number breakdown. The relay catalog number will always be found on the front panel of the relay. Do not interpret this chart as a way to specify a relay for purchase as not all combinations are available. For new projects refer to current catalog pages for the latest listing of standard relays, or contact the factory.







**TIME-VOLTAGE CHARACTERISTICS**



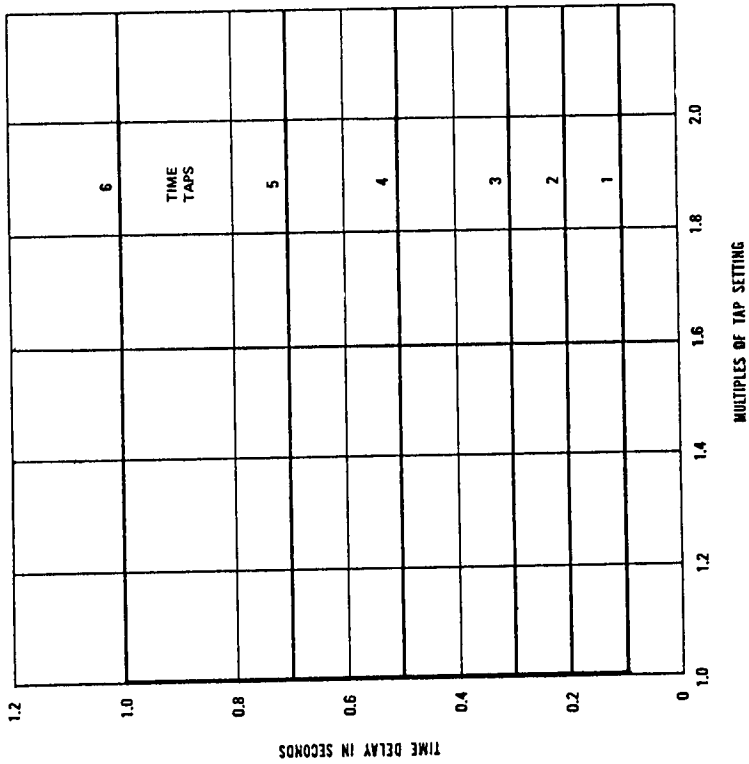
**ABB Circuit-Shield™ TYPE 27H UNDERVOLTAGE RELAY**  
Instantaneous

MAY 1, 1975

TVC-605819

**OVERVOLTAGE RELAY**  
**TIME-VOLTAGE CHARACTERISTICS**

**ABB Circuit-Shield™ TYPE 59D OVERVOLTAGE RELAY**  
DEFINITE TIME



**SHORT TIME Catalog Series 211C6xxx and 411C6xxx**  
TIME DELAY AS SHOWN

**MEDIUM TIME Catalog Series 211C4xxx and 411C4xxx**  
MULTIPLY TIME DELAY SHOWN BY 10

MAY 1, 1975

TVC 605699

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TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a schematic diagram, and in some cases a circuit description, can be provided on request. Renewal parts will be quoted by the factory on request.

There are many earlier versions of these single-phase voltage relays which are now obsolete and have been superseded. If you have a relay which has its front panel stamped with Instruction Book IB 18.4.7-2, but which is not covered by this Issue E of the book, you should request Issue D from the factory. Also see paragraph 6 on obsolete relays.

211 Series Units

Drawout circuit boards of the same catalog number are interchangeable. A unit is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom side of the drawout circuit board.

The board is removed by using the metal pull knobs on the front panel. *Removing the board with the unit in service may cause an undesired operation.*

An 18 point extender board (cat 200X0018) is available for use in troubleshooting and calibration of the relay.

411 Series Units

Metal handles provide leverage to withdraw the relay assembly from the case. Removing the unit in an application that uses a normally closed contact will cause an operation. The assembly is identified by the catalog number stamped on the front panel and a serial number stamped on the bottom of the circuit board.

Test connections are readily made to the drawout relay unit by using standard banana plug leads at the rear vertical circuit board. This rear board is marked for easier identification of the connection points.

A test plug assembly, catalog 400X0002 is available for use with the 411 series units. This device plugs into the relay case on the switchboard and allows access to all external circuits wired to the case. See Instruction Book IB 7.7.1.7-8 for details on the use of this device.

2. HIGH POTENTIAL TESTS

High potential tests are not recommended. A hi-pot test was performed at the factory before shipping. If a control wiring insulation test is required, partially withdraw the relay unit from its case sufficient to break the rear connections before applying the test voltage.

3. BUILT-IN TEST FUNCTION

Be sure to take all necessary precautions if tests are run with the main circuit energized.

The built-in test is provided as a convenient functional test of the relay and associated circuit. When you depress the button labelled TRIP, the measuring and timing circuits of the relay are actuated. When the relay times out, the output contacts transfer to trip the circuit breaker or other associated circuitry, and the target is displayed. The test button must be held down continuously until operation is obtained. For the undervoltage relays, the timing is equivalent to that for a complete loss of voltage.

#### 4. ACCEPTANCE TESTS

Follow calibration procedures under paragraph 5. On inverse or definite-time relays, select Time Dial #3. For undervoltage relays check timing by dropping voltage from 120 to 0 volts. For overvoltage relays check timing by increasing voltage to 150% of pickup. Tolerances should be within +/-5% for pickup and +/-10% for timing. Calibration may be adjusted to the final settings required by the application at this time.

#### 5. CALIBRATION

A typical test circuit is shown in Figure 3. Connect the relay to a proper source of control voltage to match its nameplate rating and internal plug setting for dual-rated units. The ac test source should be harmonic-free. Sources using ferro-resonant-transformer regulators should not be used due to high harmonic content.

For relays with time delay, the time-dial tap pin should be placed in position #1 (fastest) when checking pickup and dropout voltages. The voltage should be varied slowly to remove the effect of the time delay from the voltage measurements.

Pickup may be varied between the fixed tap values by adjusting the internal pickup calibration potentiometer. For 211 series units the 18 point extender board provides easier access to the internal pots. Place the voltage tap pin in the nearest value and adjust the internal pot, repeating the test until the desired operating voltage is obtained. If the internal pot has insufficient range, move the tap pin to the next closest value and try again. Similarly the time delay may be adjusted higher or lower than the values shown on the time-voltage curves by means of the internal pot.

The internal calibration pots are identified as follows:

Relay Type	Pickup	Time Delay	
Type 27, Type 59	R10	R25 *	* Note: RT can also be used as a secondary means of adjustment.
Types -27D, -27H Types -59D, -59H	R13	R38	

#### 6. OBSOLETE UNITS

The chart on page 8 indicates that certain of the 211 and 411 series single-phase voltage relays have been replaced by improved versions. The following gives a quick reference to the instruction books for the newer units. Should you need the instruction book for the earlier units that are nameplated to call for IB 18.4.7-2, request issue D from the factory.

Type 59, Inverse-time Overvoltage Relay:

Catalog series 211C11xx replaced by 210C11x5 and 410C11x5 series, see IB 7.4.1.7-1.

Type 59G, Ground Overvoltage Relay:

Catalog series 211E replaced by 210E and 410E series, see IB 7.4.1.7-9.

Type 27G, Third Harmonic Undervoltage Relay:

Catalog series 211Q replaced by 410Q series, see IB 7.4.1.7-9.

Type 27/59, Under/Overvoltage Relay:

Catalog series 211D replaced by 410D series, see IB 7.4.1.7-1.

Types 27/59A, -27/59D, -27/59H Under/Overvoltage Relay:

Catalog series 211L replaced by Type 27N, catalog series 211T and 411T, see IB 7.4.1.7-7. (Note: the 211L relays were not used for overvoltage protection; they were undervoltage relays with adjustable pickup and dropout voltages.)

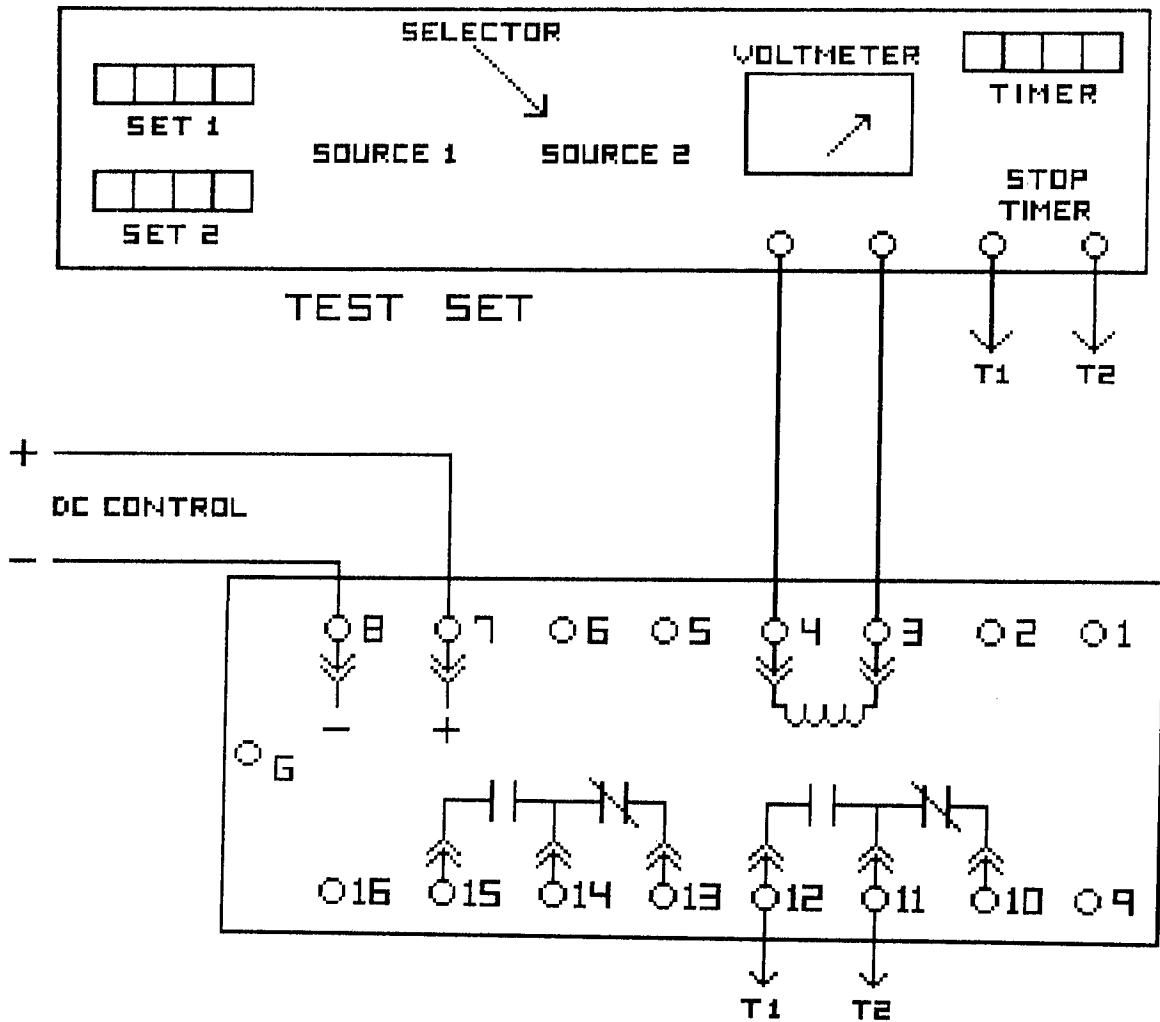


Figure 3: Typical Test Connections

Notes: Test connections shown for a 411C or 411R series unit. For other relays consult the Internal Connection Diagrams and Contact Logic Chart on pg 7 before selecting the output contact to use to stop the timer.

If the test set voltage level adjustment does not have sufficient resolution to properly check and set the pickup voltage, then insert a Variac (adjustable autotransformer) and external voltmeter between the test source and the relay input terminals.

Additional Notes on Figure 2, Typical External Connections:

The note with Figure 2 indicates that the terminal numbers associated with the output contact labelled "X" and "Y" in the diagram must be selected by referring to the internal connection diagram and contact logic chart for the particular relay being considered. As a cross-reference in this selection, the following table lists the terminals associated with the normally-open contacts that close for tripping for the basic relay function. In other words, for an undervoltage relay, the contacts that close for undervoltage, and for an overvoltage relay the contacts that close on overvoltage. An "x" in the catalog number represents any digit ("don't care").

Undervoltage Relays		Contacts that CLOSE on Undervoltage *	
Cat Series	211Rxxx5	5 - 6	11 - 12
	211Bxx65	5 - 6	11 - 12
	411Rxxx5	11 - 12	14 - 15
	411Bxxx5	11 - 12	14 - 15
Overvoltage Relays		Contacts that CLOSE on overvoltage *	
Cat Series	211Cxxx5	1 - 2	9 - 10
	411Cxxx5	11 - 12	14 - 15

\* (Contact closure is after appropriate time delay.)