



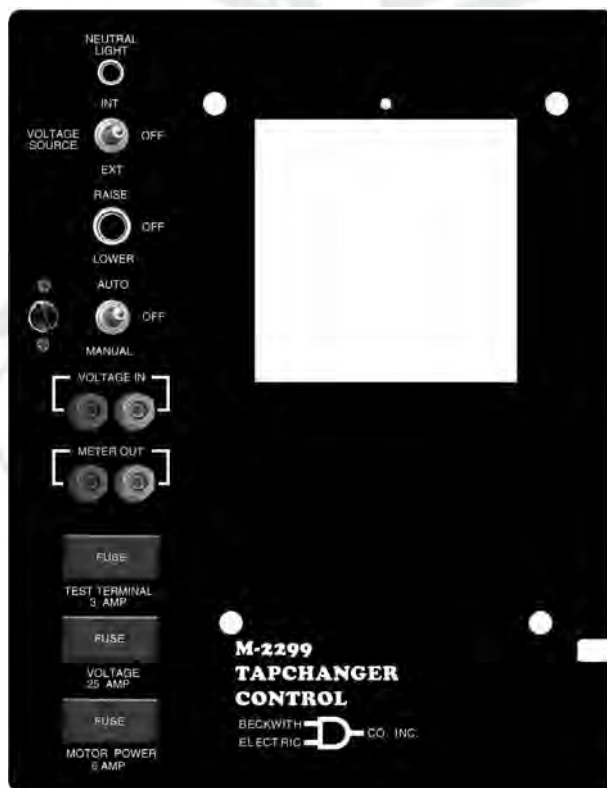
**Application Guide**

**M-2299 Adapter Panel**

**BECKWITH  
ELECTRIC**  **CO. INC.**

# Adapter Panel M-2299

**Adapts M-2001 Series Digital Tapchanger Control  
to Replace Toshiba TB-R800 Regulators**



- **Connects easily to the M-2001 Series Digital Tapchanger Control using mounting screws and 24-pin connector**
- **Provides direct mechanical replacement of the existing regulator control**
- **Provides built-in CT shorting protection when the M-2001 Series Digital Tapchanger Control is removed**

The M-2299 is an adapter panel which, when combined with the M-2001 Series Digital Tapchanger Control, provides convenient direct replacement of Toshiba TB-R800 Regulators. The M-2299 mounts into the control cabinet using the same two hinge pins which *must be saved* from the original regulator.

## Interface

External connections are made via a wiring harness that connects from a fifteen-position terminal block to the "BT" terminal block on the existing control cabinet. An additional terminal block provides access to auxiliary functions, including self-test alarm, user-programmable alarm, auto disable and manual raise/lower.

## Features

Separate fuses for test terminal, voltage sensing and motor power are on the front panel. Spare fuses for each are in the fuse holder.

Binding posts on the front panel allow easy connections for test procedures.

**RAISE/OFF/LOWER, AUTO/OFF/MANUAL, and VOLTAGE SOURCE** switches and **NEUTRAL LIGHT** are standard.

**NEUTRAL LIGHT** will light to indicate that the regulator is in the neutral position, for those regulators equipped with a circuit for this purpose.

## Testing Specifications

**High Voltage:** All input and output terminals will withstand 1500 V ac rms to chassis or instrument ground for one minute with a leakage current not to exceed 25 mA, for all terminals to ground. Input and output circuits are electrically isolated from each other, from other circuits and from ground.

**Surge Withstand Capability:** All input and output circuits are protected against system transients. Units pass all requirements of ANSI/IEEE C.37.90.1-1989 defining surge withstand capability.

**Radiated Electromagnetic Withstand Capability:** All units are protected against electromagnetic radiated interference from portable communications transceivers.

## Environmental

**Temperature Range:** Functionality is maintained from  $-40^{\circ}$  to  $+85^{\circ}$  C.

**Humidity:** Functionality is maintained under 95% relative humidity (non-condensing).

**Fungus Resistance:** A conformal printed circuit board coating inhibits fungus growth.

## Physical

**Size with M-2001 Series Digital Tapchanger Control:** 12" high x 9-1/4" wide x 4-1/8" deep  
(30.48 cm x 23.5 cm x 10.48 cm)

**Approximate Weight:** 2 lbs (0.9 kg)

**Approximate Shipping Weight:** 5 lbs, 7 oz (2.47 kg)

**Approximate Weight with M-2001 Series Digital Tapchanger Control:** 6 lbs, 2 oz (3.23 kg)

**Approximate Shipping Weight with M-2001 Series Digital Tapchanger Control:** 11 lbs, 2 oz (5.1 kg)

## Warranty

The M-2299 Adapter Panel is covered by a five year warranty from date of shipment.

*Specification subject to change without notice.*

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ISO 9001:2008

# WARNING

**DANGEROUS VOLTAGES, capable of causing death or serious injury, are present on the external terminals and inside the equipment. Use extreme caution and follow all safety rules when handling, testing or adjusting the equipment. However, these internal voltage levels are no greater than the voltages applied to the external terminals.**

## **DANGER! HIGH VOLTAGE**



- This sign warns that the area is connected to a dangerous high voltage, and you must never touch it.

## **PERSONNEL SAFETY PRECAUTIONS**

*The following general rules and other specific warnings throughout the manual must be followed during application, test or repair of this equipment. Failure to do so will violate standards for safety in the design, manufacture, and intended use of the product. Qualified personnel should be the only ones who operate and maintain this equipment. Beckwith Electric Co., Inc. assumes no liability for the customer's failure to comply with these requirements.*



- This sign means that you should refer to the corresponding section of the operation manual for important information before proceeding.



### **Always Ground the Equipment**

To avoid possible shock hazard, the chassis must be connected to an electrical ground. When servicing equipment in a test area, the Protective Earth Terminal must be attached to a separate ground securely by use of a tool, since it is not grounded by external connectors.

### **Do NOT operate in an explosive environment**

Do not operate this equipment in the presence of flammable or explosive gases or fumes. To do so would risk a possible fire or explosion.

### **Keep away from live circuits**

Operating personnel must not remove the cover or expose the printed circuit board while power is applied. In no case may components be replaced with power applied. In some instances, dangerous voltages may exist even when power is disconnected. To avoid electrical shock, always disconnect power and discharge circuits before working on the unit.

### **Exercise care during installation, operation, & maintenance procedures**

The equipment described in this manual contains voltages high enough to cause serious injury or death. Only qualified personnel should install, operate, test, and maintain this equipment. Be sure that all personnel safety procedures are carefully followed. Exercise due care when operating or servicing alone.

### **Do not modify equipment**

Do not perform any unauthorized modifications on this instrument. Return of the unit to a Beckwith Electric repair facility is preferred. If authorized modifications are to be attempted, be sure to follow replacement procedures carefully to assure that safety features are maintained.

## **PRODUCT CAUTIONS**

*Before attempting any test, calibration, or maintenance procedure, personnel must be completely familiar with the particular circuitry of this unit, and have an adequate understanding of field effect devices. If a component is found to be defective, always follow replacement procedures carefully to that assure safety features are maintained. Always replace components with those of equal or better quality as shown in the Parts List of the Instruction Book.*

### **Avoid static charge**

This unit contains MOS circuitry, which can be damaged by improper test or rework procedures. Care should be taken to avoid static charge on work surfaces and service personnel.

### **Use caution when measuring resistances**

Any attempt to measure resistances between points on the printed circuit board, unless otherwise noted in the Instruction Book, is likely to cause damage to the unit.

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The Beckwith Electric M-2299 Adapter Panel, used in conjunction with the M-2001 Series Digital Tapchanger Control, uses modern electronic digital design and digital processing circuitry to achieve an overall stability and resolution unattainable with electromechanical and analog design tapchanger controls. CMOS semiconductors are used throughout the design.

■ **NOTE:** The hinge pins *must be saved* from the original control. The BT terminal blocks remain in the control cabinet.

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## 1.0 Description

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### Standard Features

The M-2299 Adapter Panel, with the M-2001 Series Digital Tapchanger Control, provides a solid-state voltage control relay designed to directly replace the Toshiba TB-R800 control. The combination of the Tapchanger Control and Adapter Panel includes the following features:

1. Voltage waveform sampling and digital processing circuitry ensure accurate rms voltage sensing in the presence of distortion on the input voltage and current.
2. Accuracy exceeds the ANSI/IEEE C57.15-1986 Class 1 specification over the temperature range of  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ .
3. Input and output circuits are protected against system transients. Units pass all requirements of ANSI/IEEE C37.90.1-1989, which defines surge withstand capability. All input and output terminals will withstand 1500 V ac rms to chassis or instrument ground for one minute with a leakage current not to exceed 25 mA, from all terminals to ground. Input and output circuits are electrically isolated from each other, from other circuits and from ground.
4. Separate motor power, test terminal and voltage sensing fuses are easily changed from the front panel and spare fuses are provided in their respective fuseholders.
5. Easily tested by use of the following:
  - a. **VOLTAGE SOURCE** switch disconnects the voltage transformer input and connects the **VOLTAGE IN** binding posts to the voltage input and motor circuit.
  - b. **VOLTAGE IN** binding posts on the front panel allow application of a 120 V rms nominal voltage to the unit for test procedures.
  - c. **METER OUT** binding posts on the front panel allow reading of the input voltage when used in conjunction with the **BIAS TEST VOLTAGE** screen of the M-2001 Series Digital Tapchanger Control.
  - d. **RAISE** and **LOWER** band edge LEDs on the M-2001 Tapchanger Control indicate when the input voltage is outside the voltage band.
6. **NEUTRAL** light illuminates when the regulator is in the neutral tap position.
7. **AUTO/OFF/MANUAL** switch allows manual operation of the control.



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## 2.0 Installation

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The M-2299 has hinges on the right side that allow easy mounting into the existing Toshiba regulator cabinet. Refer to Figure 1, below.

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### 2.1 Removal of the Toshiba Regulator

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Refer to Figure 1, and Figure 3, Outline Dimensions.

1. Open the cabinet door of the Toshiba regulator.
2. Loosen the two thumbscrews on the control panel and swing the panel outward.
3. Disconnect the three plugs that connect the wiring harness to the rear of the Toshiba control panel.

4. Remove and save the two hinge pins and lift the Toshiba control panel off of the hinges.

■ **NOTE:** The two hinge pins *must be saved* from the original control.

5. Remove all control side wiring harness connections from the BT1 terminal block.
6. Remove all wiring connections from the capacitor.
7. Remove the “**AUTO/MANUAL, RAISE/LOWER** switch” bracket from the cabinet by removing the two screws (save screws).
8. Remove the panel for the “Operations Counter, Fuse Holder and Test Jack Fixture” (save screws).

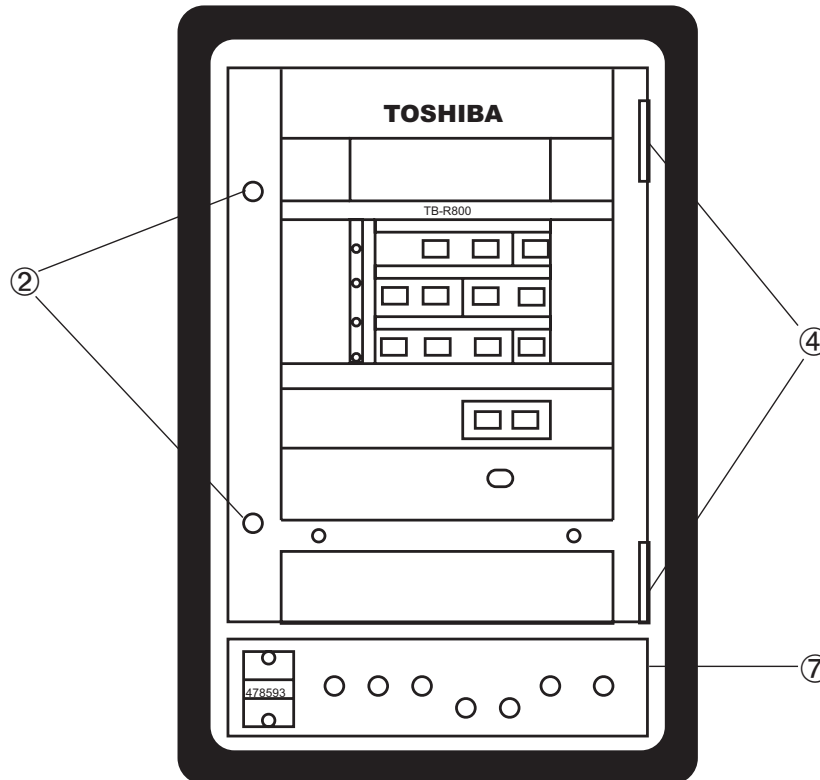


Figure 1 Toshiba Regulator in Cabinet

## 2.2 Installation of the M-2001 Series Digital Tapchanger Control

Mount the M-2001 Tapchanger Control to the back of the M-2299 Adapter Panel and secure with the four screws provided. The four screws are shipped in a drawstring bag which is attached to the adapter panel.

## 2.3 Installation of the M-2299

Refer to Figure 2, below.

1. Mount the supplied printed circuit board against the rear of the cabinet in the screw holes from the "AUTO/MANUAL, RAISE/LOWER switch" bracket, utilizing saved screws. See Figure 4, Wiring Harness and External Connections.
2. Connect the supplied printed circuit board TB1 wiring harness to the BT1 terminal block and capacitor. Refer to Figure 4 for wiring connections.
3. Mount the M-2299 Adapter Panel (with the M-2001) onto the hinges in the control cabinet and install the two hinge pins saved from the original regulator. Leave the panel swung outward so that the back of the panel is accessible.
4. Connect the M-2299 and M-2001 Series wiring connectors to the supplied circuit board and Neutral Light. Refer to Figure 4 for wiring connections.
5. Swing the adapter panel closed and turn knob to latch securely.

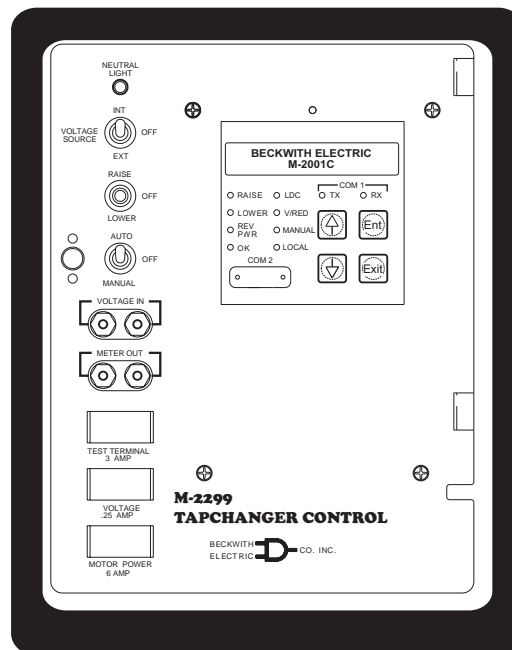
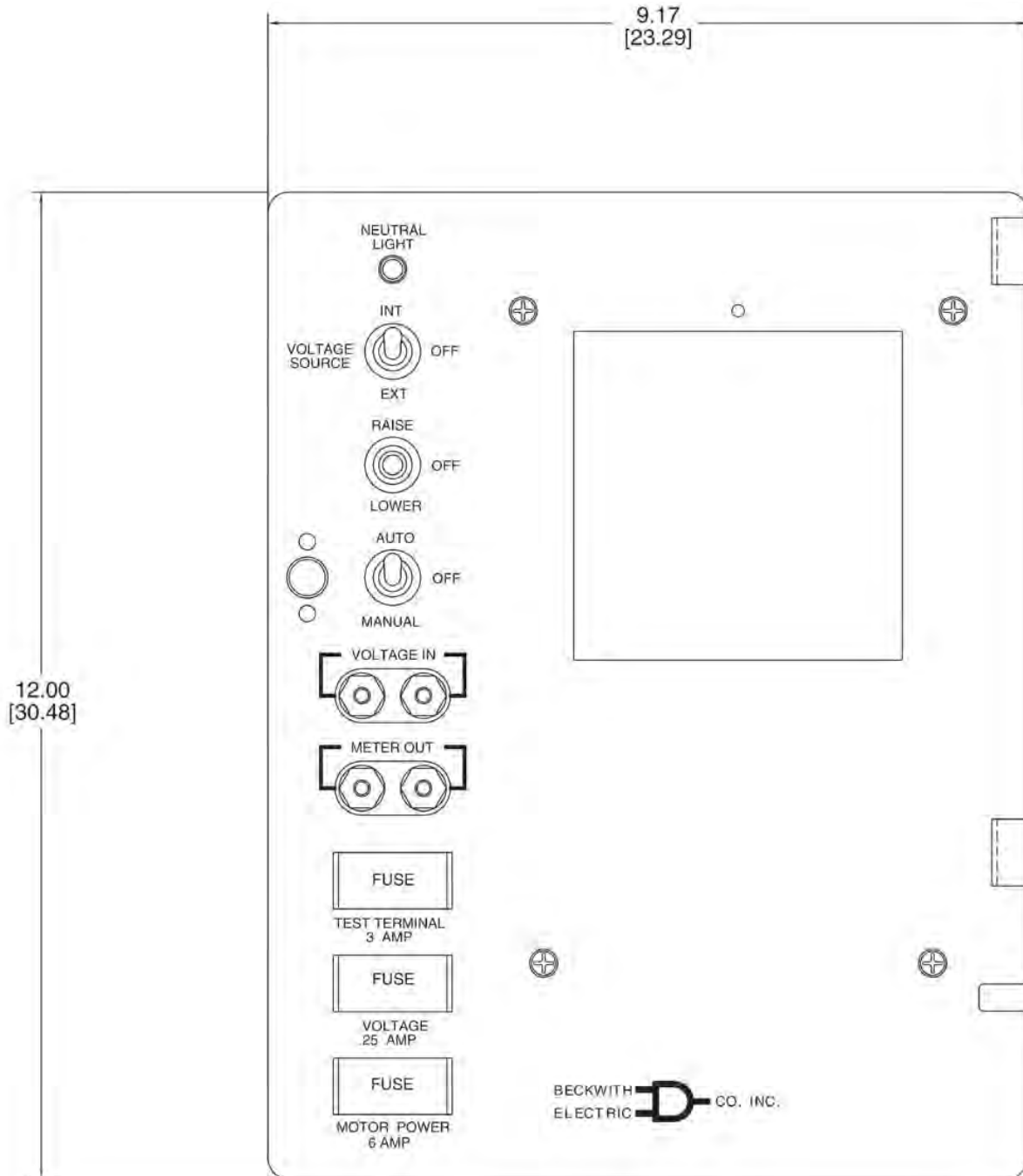


Figure 2 M-2299 Adapter Panel and M-2001 Tapchanger Control in Cabinet



■ **NOTE:** Values in brackets are in centimeters.

*Figure 3 Mounting Dimensions*

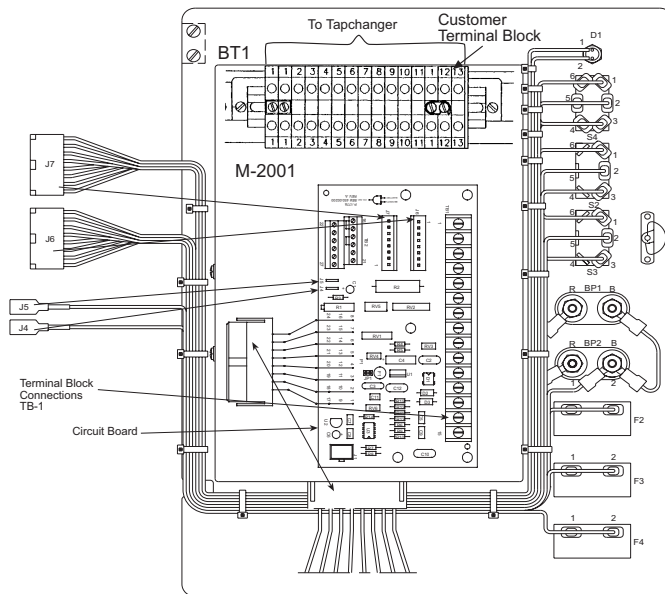
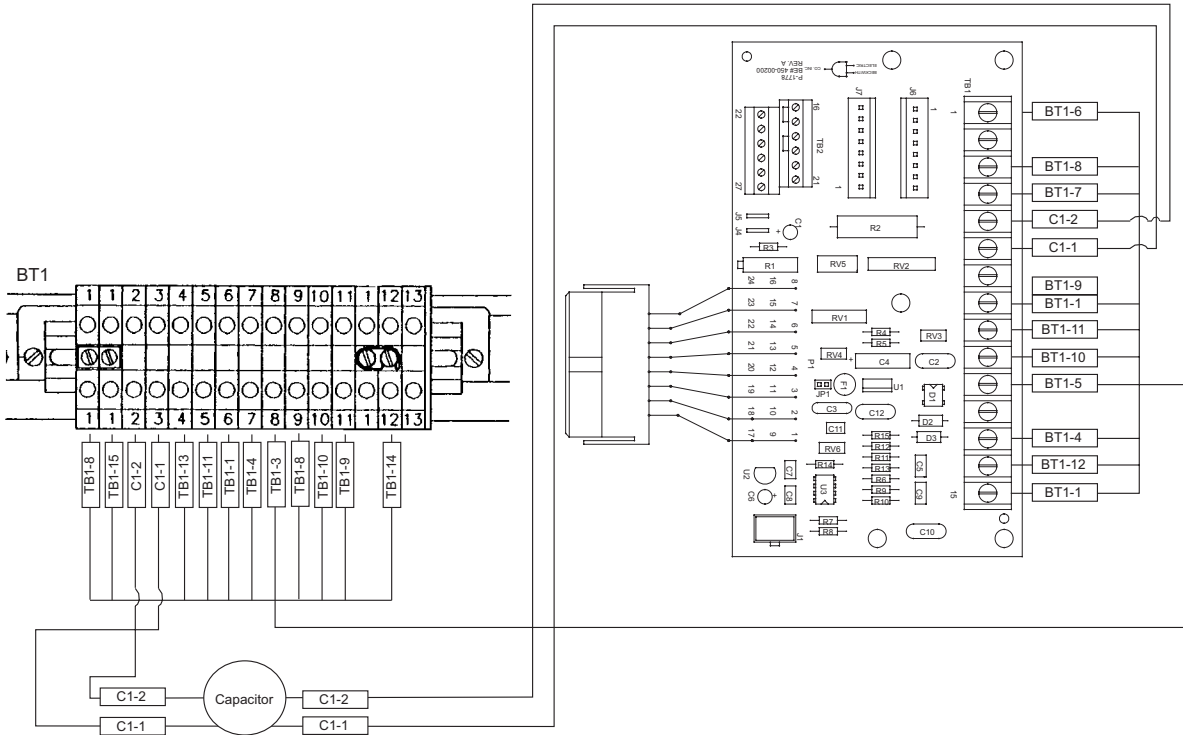


Figure 4 M-2299 Wiring Harness and External Connections

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## 2.4 Lightning Protection

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It has been determined that transient voltages in excess of 1500 V ac rms can exist on the “ground” lead normally tied to TB1-8 on the printed circuit board. In the Tapchanger Controls, these voltages are suppressed by varistors which still permit the unit to pass a 1500 V ac Hi Pot test for one minute with a leakage current of approximately 15 mA, all terminals to ground.

**▲ CAUTION:** For proper protection against system surges, chassis ground must be connected to earth ground.

Multiple VT grounds far apart must be avoided since a varying difference in ground voltage could add or subtract from the effective voltage and cause variation in the Tapchanger Control’s bandcenter voltage setpoint.

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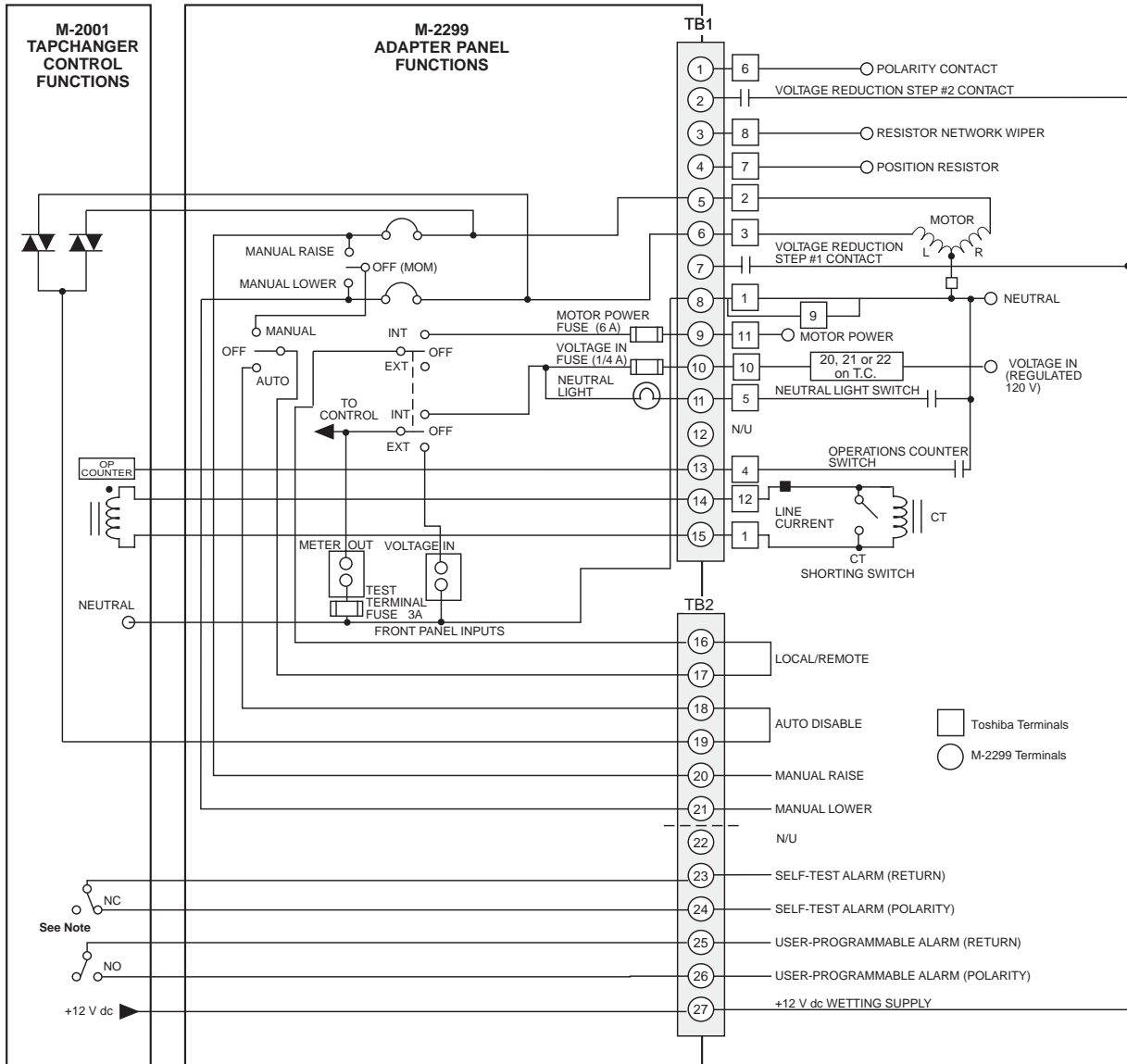
## 3.0 External Connections

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Power and voltage sensing are obtained either from a common source or from independent sources having a nominal 120 V ac output. Normally, this is line-to-neutral voltage, although line-to-line voltage can also be used if recognition is made of any phase shift between the voltage and current signals when using line drop compensation.

Load current must be reduced by an appropriate auxiliary current transformer to 0.2 A “full scale” before connecting to the M-2299 current inputs. The Beckwith Electric M-0121 (5.0 A to 0.2 A) or M-0169 (5.0 A or 8.66 A to 0.2 A) Auxiliary Current Transformer can be used for this purpose. The M-0121 can be used with Beckwith Electric Tapchanger Controls when the only burden present is the Line Drop Compensator circuit of the voltage regulating relay. The M-0169 is used in high burden circuits, such as are found in paralleling schemes. Outputs of the auxiliary CTs are protected against overvoltage. For further information, obtain Beckwith Electric Application Note #17, “Basic Considerations for the Application of LTC Transformers and Associated Controls.”

The external connections for the M-2299 are made to terminal blocks TB1 and TB2 on the printed circuit board. The wiring harness and external connections for the M-2299 are shown in Figure 4, Wiring Harness and External Connections, and Figure 5, M-2001 and M-2299 Typical Connections.



■ **NOTE:** The self-test alarm and user-programmable alarm contacts are shown in the de-energized state (no voltage applied). The self-test alarm contacts open after the M-2001 passes the self-test; the user-programmable alarm contacts close when an alarm is recognized.

● **WARNING:** In no case should the line current circuit be interrupted with the regulator or transformer energized.

Do not remove auxiliary current transformers without shorting the current inputs. Death or severe electrical shock can occur.

Figure 5 M-2001 and M-2299 Typical Connections

### 3.1 Features

#### Neutral Light Circuit

The M-2299 is prepared for use with regulators which use a neutral light. Toshiba products require that the Neutral Light terminal TB1-11 (BT-5) be grounded when the light is to be illuminated.

#### Auto Disable Input

To disable automatic operation of the M-2299, remove the jumper between TB2-18 and TB2-19 on the printed circuit board. If SCADA is used to enable and disable this function, a contact rated at 6 A minimum can be connected between the terminals.

#### Local/Remote Input

Removing the jumper between TB2-16 and TB2-17 prohibits operation by disabling the M-2001 Tapchanger Control's automatic raise and lower outputs and also by disabling the M-2299 Adapter Panel's manual **RAISE/OFF/LOWER** toggle switch. Removing this jumper does *not* disable the SCADA-supplied motor voltage input to the manual raise/manual lower contacts on the adapter panel.

#### Multi-Step Voltage Reduction

On the M-2299, TB1-2 and TB1-7 on the printed circuit board are used together to provide up to three levels of voltage reduction. The external connections to achieve these steps are shown in Table 1, below, and Figure 5, M-2001 and M-2299 Typical Connections. (Voltage reduction amounts are set within the M-2001 Tapchanger Control software.)

**▲ CAUTION:** Voltage applied through dry contacts to actuate Voltage Reduction Steps 1, 2, and 3 *must* be +12 V dc obtained from pin TB2-27 of the M-2299 adapter panel.

#### Operations Counter Input

An operations count is registered by momentarily grounding TB1-13 through an external dry contact from the load tapchanger. The input is level-sensitive. Make sure that any "wetting" voltages are removed from the counter contacts before installing the M-2299 Adapter Panel/M-2001 Tapchanger Control.

**▲ CAUTION:** Do not apply either +12 V dc or 120 V ac to this terminal.

Voltage Reduction Setpoint: Multiplier Range	Apply "Wetting Voltage" from TB2-27 to Terminal #
Voltage Reduction Setpoint #1: 0 to 1	TB1-7
Voltage Reduction Setpoint #2: 0 to 1	TB1-2
Voltage Reduction Setpoint #3: 0 to 1	TB1-7 and TB1-2

Table 1 Multi-Step Voltage Reduction External Connections

### 3.2 Typical Connections for Toshiba Regulators

In general, the tapchanger motor must be operated from a different transformer than the VT used to measure regulated voltage. If this is not done, hunting at the upper band edge may result. As soon as the motor starts and before it is sealed in, the motor current can drop the voltage within the band and reset the control. Some motor seal-in schemes are fast enough to prevent this, but others are not.

A typical connection for an M-2299 is shown in Figure 5, M-2001 and M-2299 Typical Connections.

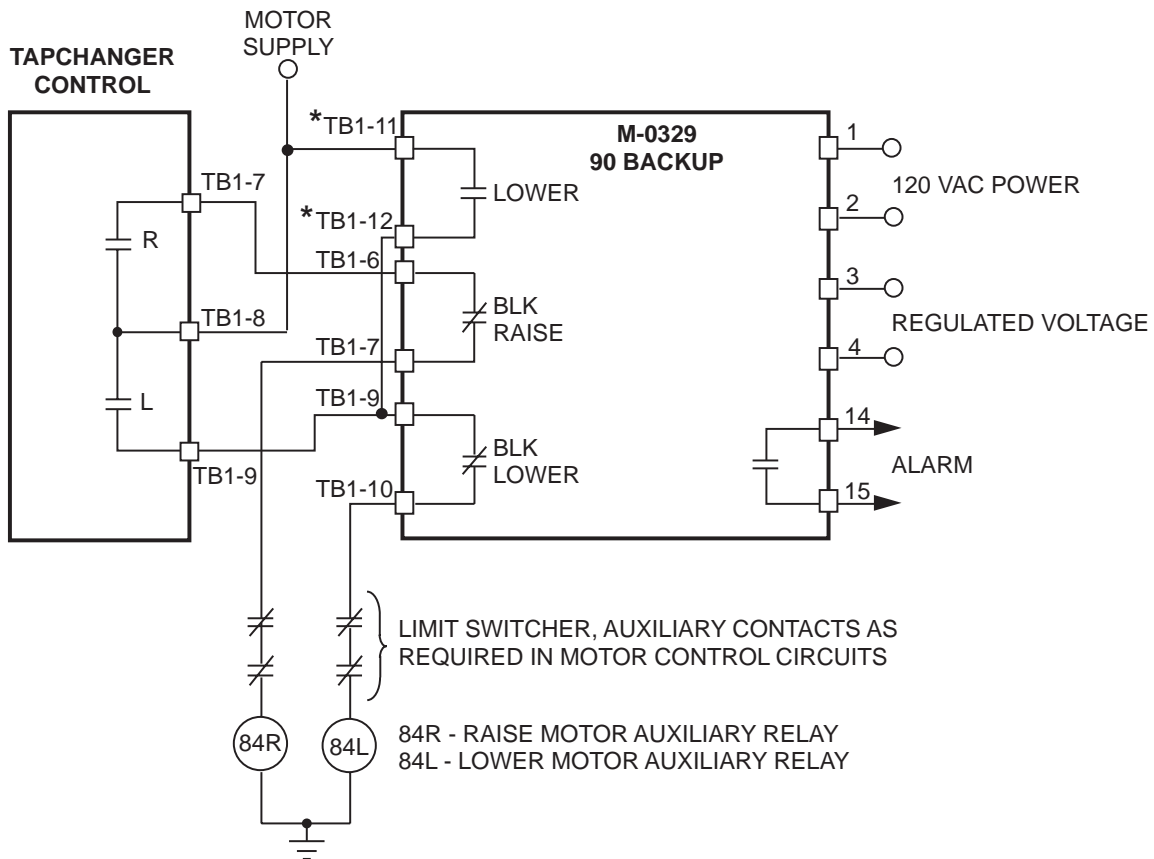
Connections are simplified and may not show all functions required in a typical load tapchanging transformer control scheme; for example, seal-in contacts, limit switches, etc.

### 3.3 Use of the M-0329 LTC Backup Control with the Tapchanger Control

The M-0329 is a single-phase, solid-state backup control that prevents a defective tapchanger control from running the voltage outside the upper and lower voltage limits. The Block Raise and Block Lower voltage levels are set by accurately calibrated dials.

The M-0329 LTC Backup Control is connected as a two terminal device to the voltage transformer. Figure 6, below, shows the typical interconnection of the two devices with motor auxiliary relays.

The M-0329 Instruction Book is available on request and gives added details. Please refer to the M-0329 Instruction Book for complete ordering information.



\* ■ **NOTE:** If first customer protection is not required, delete these connections.

Figure 6 Tapchanger Control and LTC Backup Control Interconnections



## 4.0 M-2001 Tapchanger Control Software Settings

Adjust the **BANDCENTER** setting to the nominal voltage desired. Adjust the **BANDWIDTH** setting to the desired voltage band, centered on the Bandcenter setpoint, that the voltage must exceed before timer and subsequent tapchanger operation occurs. Adjust the **TIME DELAY** setpoint to a sufficient amount to eliminate excessive tapchanger operations. The **LINE DROP COMPENSATOR** should be set for the line impedance from the transformer to the load center. For further information, obtain Beckwith Electric Application Note #17, “*Basic Considerations for the Application of LTC Transformers and Associated Controls.*”

## 4.1 M-0329 LTC Backup Control Settings

The **BANDCENTER** and **BANDWIDTH** dials on the M-0329 LTC Backup Control should be set so that the Block Lower limit is a small amount (approximately 2 V) below the lower band limit of the Tapchanger Control, and the Block Raise limit is a similar amount above the upper limit if line drop compensation is not used.

If line drop compensation is used, the M-0329 Block Raise limit should be set at the maximum voltage desired at the transformer secondary under full load.

The M-0329 LTC Backup Control also includes a deadband or runback function that regulates the maximum voltage from the transformer. This “Lower” function operates slightly above the Block Raise limit and is connected to force the tapchanger to lower the voltage if the upper limit is exceeded.

## 5.0 Test Procedures

### Equipment Required

- 0–200 mA current supply with phase angle settings of 0° to +90°
- 90–145 V ac voltage source at 60 Hz
- High impedance true RMS voltmeter with accuracy on ac of at least  $\pm 0.2\%$  of reading
- Accurate Stop watch

### Set-up Procedure

1. Make electrical connections as shown in Figure 7, Test Procedure External Connection.

■ **NOTE:** There is a one second delay between out-of-band condition and panel LED indication.

2. Initial settings

Initial Settings	
Bandcenter	120.0 V
Bandwidth	2.0 V
LDC Resistance	0.0 V
LDC Reactance	0.0 V
Paralleling	Circulating Current Method
Block Raise	135.0 V
Block Lower	105.0 V
Deadband	2.0 V
Timer	5.0 seconds

Table 2 Initial Settings

## 5.1 Bench Test

■ **NOTE:** This test assumes that the M-2001 Tapchanger Control is connected to the M-2299 Adapter Panel.

1. Apply 120.0 V ac from power source.
2. The display of the M-2001 will automatically advance to Local Voltage screen.
3. Increase voltage to 121.2; **LOWER** LED should light.
4. Decrease voltage to 118.8; **RAISE** LED should light.
5. Set input voltage to 120.0 V ac. Wait for **RAISE** and **LOWER** LEDs to extinguish.
6. Increase voltage to 122.0 V ac.
7. Start timing when voltage passes 121.0 V.
8. Stop timing when lamp connected to **LOWER** output lights (should be 5 seconds).

### Resistance

1. Apply 100.0 mA in-phase current to TB1-14 (load current-polarity) and TB1-15 (load current-return) of the adapter panel. (Set  $S_1$  to LDC and  $S_2$  to  $I_R$ .)
2. Set LDC Resistance to 24.0 V; **RAISE** LED should light.
3. Increase input voltage to 132.0 V ac; **RAISE** and **LOWER** LEDs should be extinguished.
4. Set LDC Resistance to -24.0 V; **LOWER** LED should light.
5. Decrease input voltage to 108.0 V ac; both **RAISE** and **LOWER** LEDs should extinguish.
6. Set LDC Resistance to 0.0 V.

### Voltage Source Switch

1. Set **AUTO/OFF/MANUAL** switch to **OFF**.
2. Set **VOLTAGE SOURCE** switch to **EXT**.
3. Verify no manual Raise or Lower output.
4. Attach voltmeter to Meter Out terminals.
5. Verify no voltage is present.
6. Apply 120 V ac to the Voltage In jack (Black-Neutral, Red-Hot).
7. Set **AUTO/OFF/MANUAL** switch to **AUTO**.
8. Verify normal raise and lower operation.
9. Return the **VOLTAGE SOURCE** switch to **INT**.

### Counter/Neutral Light

1. Set the M-2001 Tapchanger Control to display the Operations Count screen.
2. Verify counter operation by connecting a switch between TB1-13 (operations counter input) and TB1-8 (neutral) of the adapter panel.
3. Jumper TB1-11 (neutral light) to TB1-8 (neutral).
4. The neutral light on the adapter panel should light.
5. Remove the jumper.

### Block Raise/Block Lower/Dead Band

1. Set Block Raise to 126.0 V.
2. Set Block Lower to 114.0 V.
3. Set the M-2001 Tapchanger Control to display the Bias Voltage screen.
4. Press **ENTER**.
5. Increase voltage to 126.5 V; **BR** should appear on the screen.
6. Increase voltage to 128.5 V; **BR** goes off and **FL** appears on the screen.
7. Decrease voltage to 113.5 V; **BL** appears on the screen.

—Bench Test Complete—

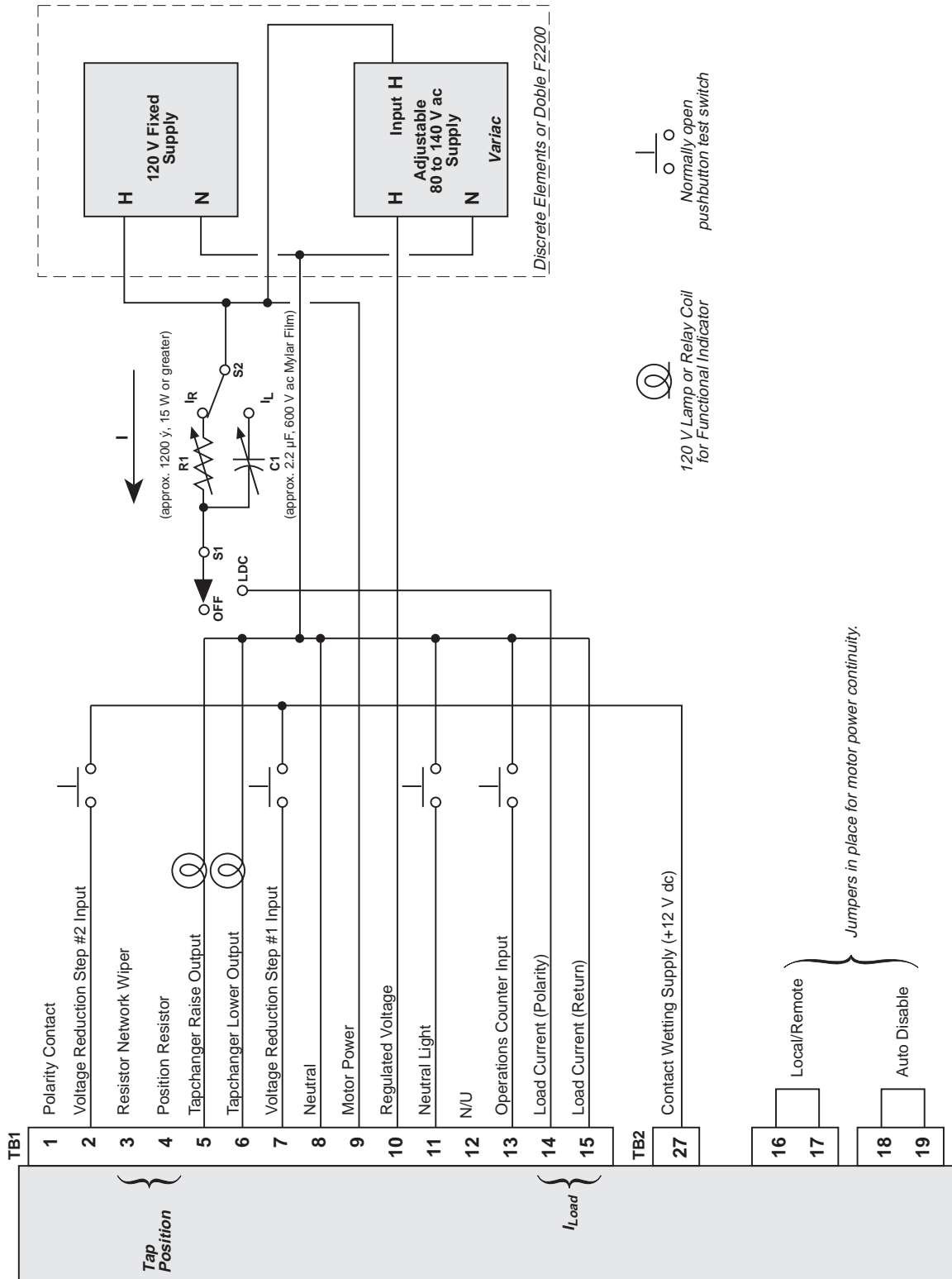


Figure 7 M-2299 Test Procedure External Connection

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## 5.2 M-2001 Checkout Procedure

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■ **NOTE:** This test of the M-2001 assumes that the unit remains connected to the adapter panel.

### Basic Operational Test

1. Apply 120.0 V ac to TB1-9 (motor power) and TB1-10 regulated voltage) of adapter panel.
2. Connect neutral to TB1-8 (neutral).
3. Verify local voltage equals input voltage  $\pm 0.3$  V.
4. Apply 100.0 mA in-phase current to TB1-14 (load current-polarity) and TB1-15 (load current-return) of the adapter panel. Verify Control Load I equals 100 mA and Power Factor equals  $1.0 \pm 0.02$ .
5. Verify **UP**, **DOWN** and **ENTER** buttons work.

—Checkout Procedure Complete—

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## 5.3 In-Service Test

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1. Set the M-2001 Tapchanger Control to display Bias Voltage screen.
2. Press **ENTER**.
3. Use **UP** and **DOWN** buttons to cause **RAISE** and **LOWER** outputs.

—In-Service Test Complete—

**Return unit to desired settings**

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## 6.0 Checkout Procedure

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■ **NOTE:** All Beckwith Electric units are fully calibrated at the factory. There is no need to recalibrate the units before initial installation.

Set the **AUTO/OFF/MANUAL** switch to **OFF**. Inspect the **MOTOR POWER** and **VOLTAGE** fuses to ensure they are correctly sized and have not blown.

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### 6.1 Power

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1. Remove any external connection between TB1-9 and TB1-10 which are located on the adapter panel printed circuit board. Also remove any voltage applied to TB1-9 externally. Using a voltmeter, make sure that the voltage applied to TB1-10 is nominal 120 V ac with respect to TB1-8 (neutral). Apply power to TB1-10 (hot) and TB1-8 (neutral).

● **WARNING:** Voltage applied at the **METER OUT** test terminal may energize the regulator or transformer to a high voltage through the voltage transformer.

**Death or severe electrical shock can occur.**

**Do not connect any voltage source at the METER OUT test terminal.**

2. Connect a voltmeter to the **METER OUT** test terminal on the front of the adapter panel. 120 V ac should be indicated.

▲ **CAUTION:** Do not reverse the ground and hot wires when connecting an external source. A 3 AG fuse (F2) is installed to protect the relay from damage if these connections are accidentally reversed. Spare fuses are supplied inside the fuse holders. Units returned with only a blown fuse are not covered by warranty, and a nominal repair charge will be made for replacement of the fuse. Please check the fuse before returning the unit for repair, in order to avoid unnecessary repair charges.

3. Apply motor power to TB1-9 (hot) and TB1-8 (neutral). Set the **AUTO/OFF/MANUAL** switch to **MANUAL** and using the **RAISE/OFF/LOWER** switch, verify that the motor runs in the proper direction when this switch is in the **RAISE** and **LOWER** positions.
4. Set the **AUTO/OFF/MANUAL** switch to the **AUTO** position. Refer to the Field Checkout Procedure as found in the Status & Setpoint Review Guide of the M-2001 Tapchanger Control Instruction Book for test/operation procedures.
5. As shown in Figure 6-1, Typical External Connections, in the M-2001 Series Instruction Book, temporarily place a shorting device across the LDC-CT secondary to short the line drop compensator circuit, and place another shorting device across TB1-3 and TB1-4 to short the circulating current paralleling input, for the load current check. Insert an ammeter between the polarity input and TB1-14. Open the load current shorting device and with a known load on the transformer or regulator, measure the current in the load current circuit to ensure that this current is correct for 0.2 A full load.
6. Replace the shorting device across the load current input and remove the ammeter. Reconnect polarity to the unit and remove both jumpers. The **LINE DROP COMPENSATOR** will be activated. Correct CT polarity can be checked by simply incorporating sufficient +R compensation. The regulator should time out and run so as to raise the output voltage.

**WARNING:** In no case should the load current circuit be interrupted with the regulator or transformer energized.

**Do not remove auxiliary current transformers without shorting the current inputs.**

**Death or severe electrical shock can occur.**

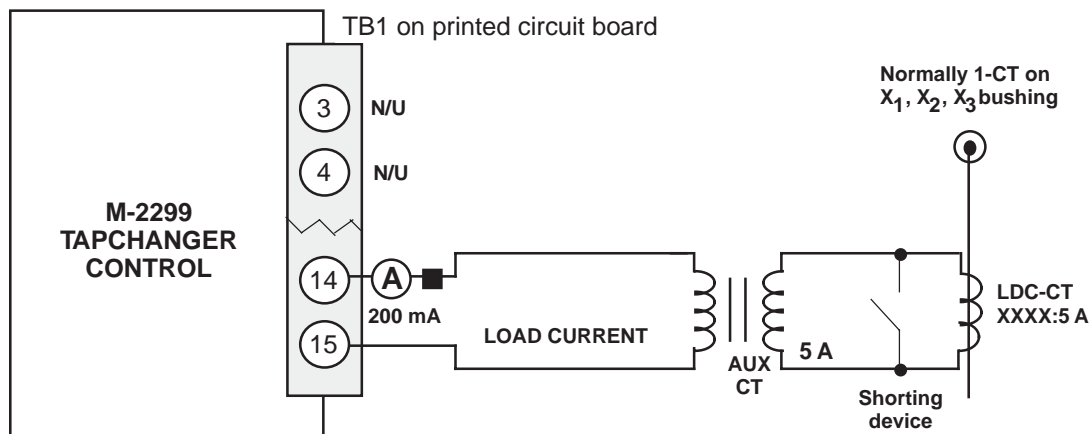


Figure 8 Setup for Current Checkout Procedure

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## 6.2 Voltage Source Switch

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The **VOLTAGE SOURCE** switch will disconnect all power from the unit when in the **EXT** position with no source connected to the front panel voltage and motor power inputs.

▲ **CAUTION:** Do not reverse the ground and hot wires when connecting an external source. A 3 AG (F2) is installed to protect the relay from damage if these connections are accidentally reversed.

With the **VOLTAGE SOURCE** switch in the **EXT** position, the sensing and motor power circuits are connected to the **VOLTAGE IN** binding post on the front panel. The unit can be tested using an external 120 V rms source of proper polarity applied to these terminals. Testing can be accomplished by adjusting the amplitude of the external source.

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## 7.0 Maintenance

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Due to the nature of the circuitry in the M-2001 Tapchanger Control, field repair is not recommended. All units are fully calibrated at the factory prior to shipment; there is no need to recalibrate a unit prior to initial installation. In the event that a unit does not operate properly, it should be established that the problem is caused by a malfunction of the Tapchanger Control and not caused by an external fault or wiring error. Check for blown fuses on the Adapter Panel. If the Tapchanger Control is still not operating properly, set the **AUTO/OFF/MANUAL** switch on the Adapter Panel to **MANUAL**. Once this is accomplished, the Tapchanger Control can be disconnected and returned to Beckwith Electric. Pack the unit carefully (in the original carton if possible), assuring that there is adequate packing material to protect the contents.

■ **NOTE:** Any equipment returned for repair must be sent with transportation charges prepaid. The equipment must remain the property of the user. The warranty is void if the value of the unit is invoiced to Beckwith Electric at the time of return or if the unit is returned with transportation charges collect.

If under warranty, units will be repaired rapidly and returned at no cost and with return transportation paid if the fault is found to be due to workmanship or failure of material. If a unit is under warranty and express shipment for return of the repaired unit is requested, shipping charges will be billed at the current rate. If the fault is due to abuse or misuse, or if the unit is out of warranty, a modest charge will be made. Repair can normally be expected to take two weeks, plus shipping time. If faster service is required, it should be requested at the time of return.

■ **NOTE:** Adapter panels returned with only a blown fuse are not covered by warranty and a nominal repair charge will be made for replacement of the fuse. Please check the fuses before returning the adapter panel for repair in order to avoid unnecessary repair charges.

To help in analyzing the problem, a complete description of the malfunction and conditions leading to the failure should be included with the unit.

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## Patent

The units described in this manual are covered by U.S. Patents, with other patents pending.

Buyer shall hold harmless and indemnify the Seller, its directors, officers, agents, and employees from any and all costs and expense, damage or loss, resulting from any alleged infringement of United States Letters Patent or rights accruing therefrom or trademarks, whether federal, state, or common law, arising from the Seller's compliance with Buyer's designs, specifications, or instructions.

## Warranty

Seller hereby warrants that the goods which are the subject matter of this contract will be manufactured in a good workmanlike manner and all materials used herein will be new and reasonably suitable for the equipment. Seller warrants that if, during a period of five years from date of shipment of the equipment, the equipment rendered shall be found by the Buyer to be faulty or shall fail to perform in accordance with Seller's specifications of the product, Seller shall at his expense correct the same, provided, however, that Buyers shall ship the equipment prepaid to Seller's facility. The Seller's responsibility hereunder shall be limited to replacement value of the equipment furnished under this contract.

*Seller makes no warranties expressed or implied other than those set out above. Seller specifically excludes the implied warranties of merchantability and fitness for a particular purpose. There are no warranties which extend beyond the description contained herein. In no event shall Seller be liable for consequential, exemplary, or punitive damages of whatever nature.*

Any equipment returned for repair must be sent with transportation charges prepaid. The equipment must remain the property of the Buyer. The aforementioned warranties are void if the value of the unit is invoiced to the Seller at the time of return.

## Indemnification

The Seller shall not be liable for any property damages whatsoever or for any loss or damage arising out of, connected with, or resulting from this contract, or from the performance or breach thereof, or from all services covered by or furnished under this contract.

In no event shall the Seller be liable for special, incidental, exemplary, or consequential damages, including but not limited to, loss of profits or revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of purchased power, cost of substitute equipment, facilities or services, downtime costs, or claims or damages of customers or employees of the Buyer for such damages, regardless of whether said claim or damages is based on contract, warranty, tort including negligence, or otherwise.

Under no circumstances shall the Seller be liable for any personal injury whatsoever.

It is agreed that when the equipment furnished hereunder are to be used or performed in connection with any nuclear installation, facility, or activity, Seller shall have no liability for any nuclear damage, personal injury, property damage, or nuclear contamination to any property located at or near the site of the nuclear facility. Buyer agrees to indemnify and hold harmless the Seller against any and all liability associated therewith whatsoever whether based on contract, tort, or otherwise. Nuclear installation or facility means any nuclear reactor and includes the site on which any of the foregoing is located, all operations conducted on such site, and all premises used for such operations.

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