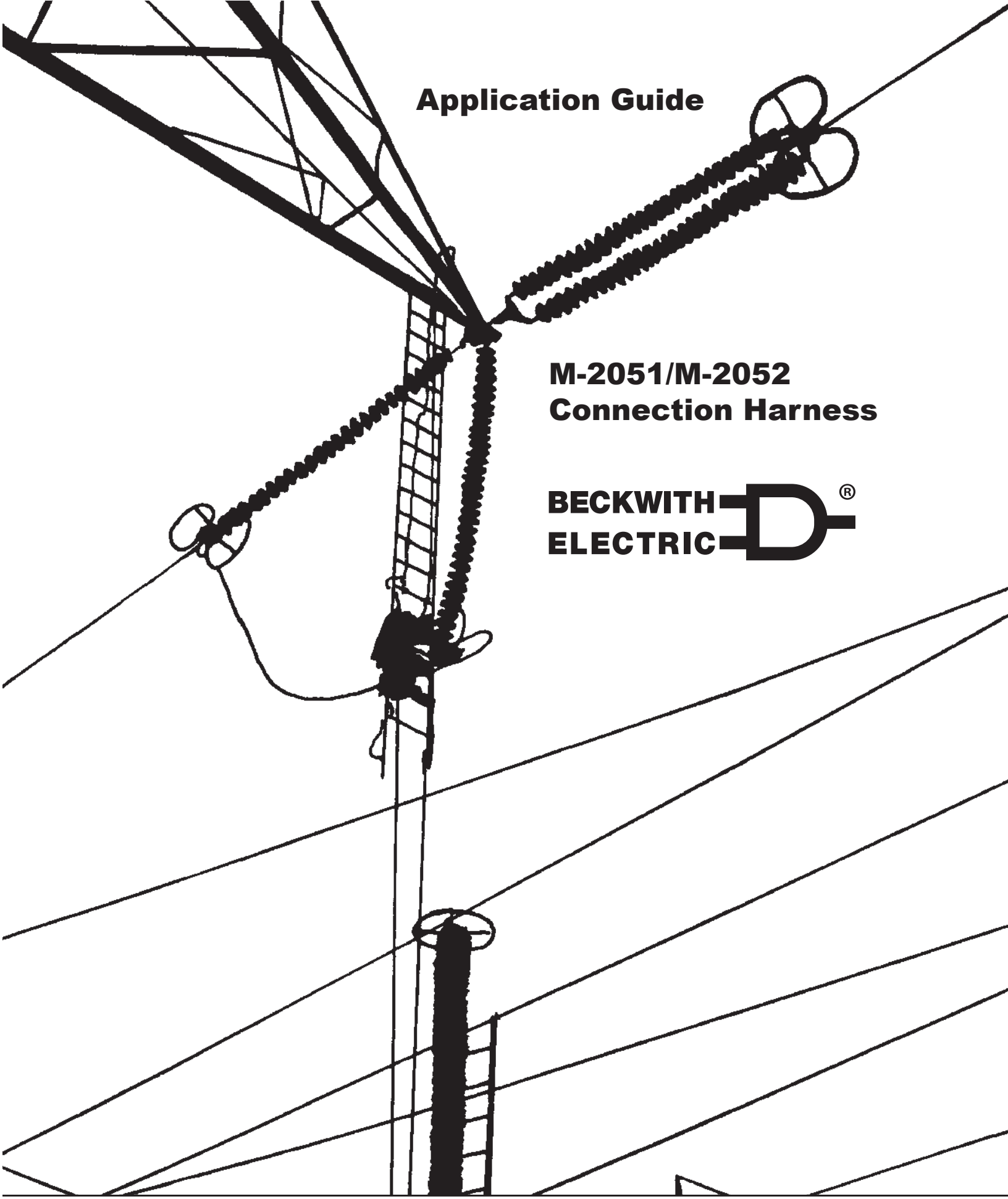
Application Guide



M-2051/M-2052
Connection Harness

BECKWITH ELECTRIC®

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TRADEMARKS

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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 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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In our efforts to provide accurate and informative technical literature, suggestions to improve clarity or to correct errors will receive immediate attention. Please contact the Marketing Services Department, specifying the publication and page number.

1.0 Introduction

The Beckwith Electric M-2051/M-2502 Connection Harness, 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.

1.1 Description

Standard Features

The M-2051/M-2502 Connection Harness, with the M-2001 Series Digital Tapchanger Control, provides a solid-state voltage control relay intended for applications involving the control of tapchanging transformers and regulators. The combination of the Tapchanger Control and Connection Harness 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° C to +80° 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 Vac 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.
4. A voltage sensing fuse and a spare fuse are provided.

2.0 Installation

The M-2051/M-2052 is a general purpose connection harness that is designed to be mounted on a panel.

2.1 Installation of the M-2001 Series Digital Tapchanger Control

Mount the M-2001 Series Digital Tapchanger Control to the back of a panel and secure with the four screws provided. The four screws are shipped in a drawstring bag which is attached to the connection harness. Install the connection harness to the back of the panel and insert the plug from the connection harness into the connector at the base of the M-2001. See Figure 1, M-2051 Panel Cutout and Hole Drill Dimensions, or Figure 2, M-2052 Panel Cutout and Hole Drill Dimensions.

2.2 Lightning Protection

It has been determined that transient voltages in excess of 1500 Vac rms can exist on the "ground" lead normally tied to TB1-3. In the Tapchanger Controls, these voltages are suppressed by varistors which still permit the unit to pass a 1500 Vac 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.

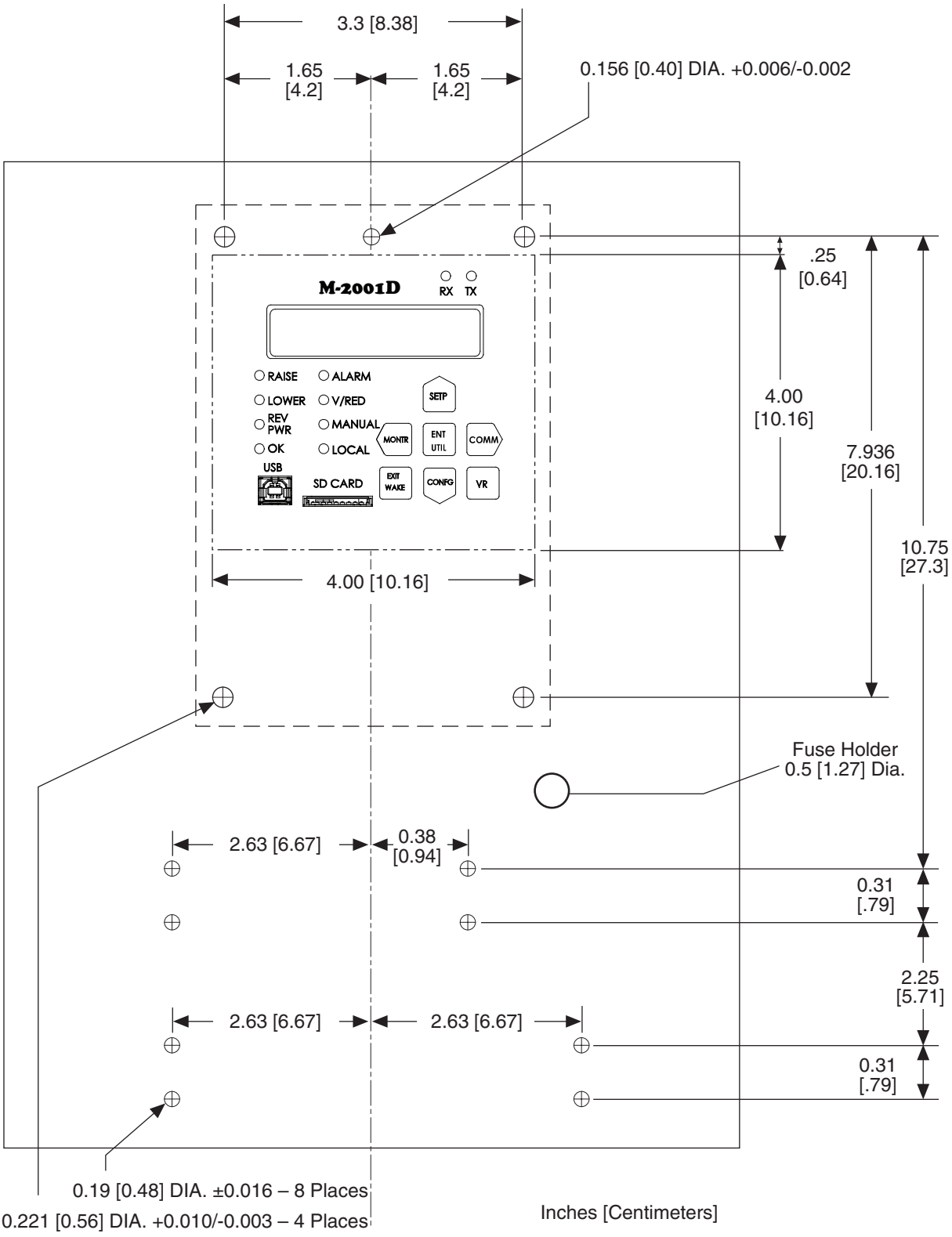


Figure 1 M-2051 Panel Cutout and Hole Drill Dimensions

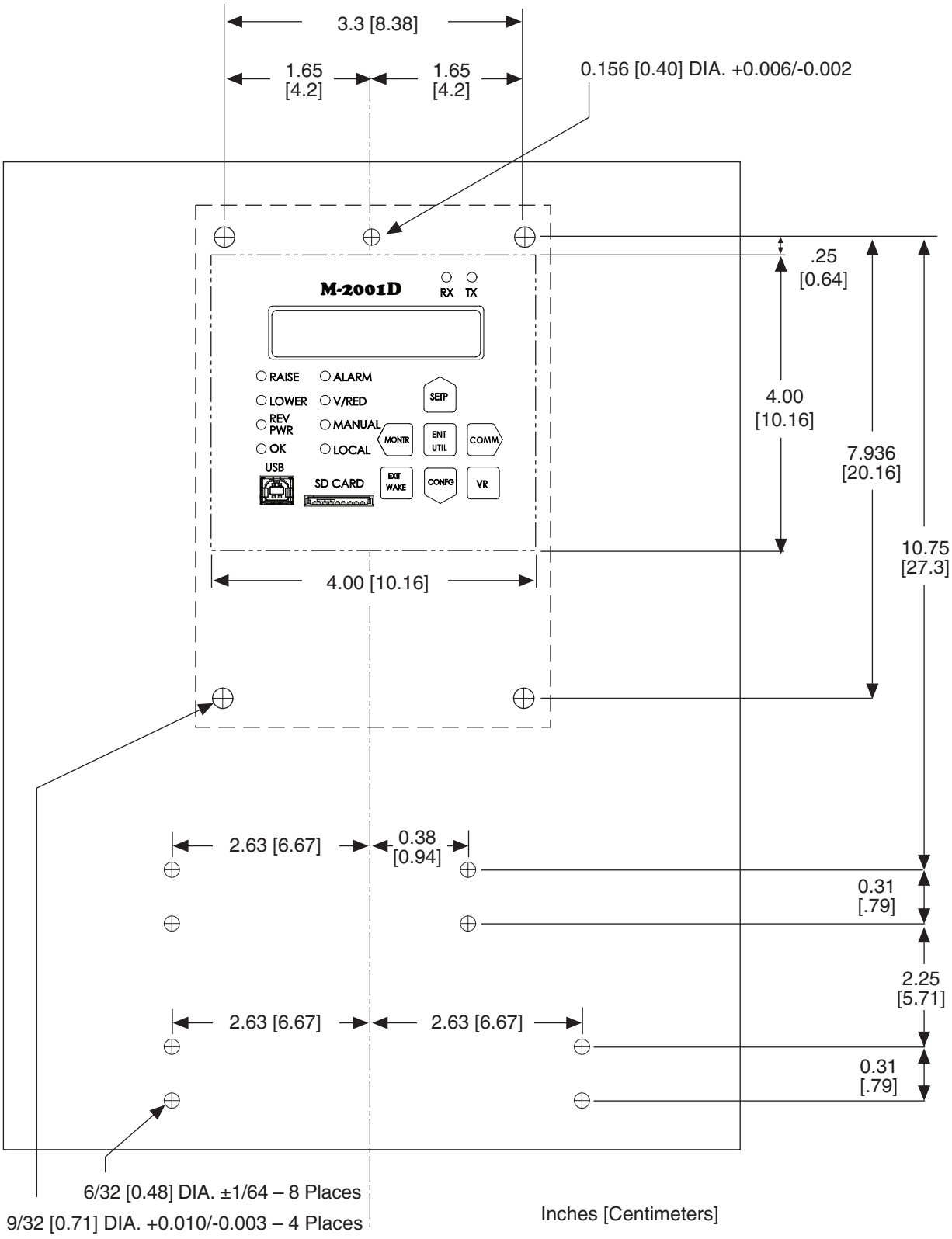


Figure 2 M-2052 Panel Cutout and Hole Drill Dimenstions

3.0 Application

External Connections

Power and voltage sensing are obtained either from a common source or from independent sources having a nominal 120 Vac 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-2051/M-2052 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 higher burden circuits, such as are found in paralleling schemes. Outputs of the auxiliary CTs are protected against overvoltage. If the load current input must be isolated, remove the jumper from TB1-2 to TB1-3. 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-2051/M-2052 are made to terminal blocks TB1 and TB2. The wiring harness and external connections for the M-2051/M-2052 are shown in Figure 3, M-2001 and M-2051/M-2052 Typical Connections.

3.1 Features

Non-Sequential Operation

▲**CAUTION:** Voltage applied through dry contacts to actuate non-sequential input *must* be nominal +12 Vdc obtained from pin TB1-13 of the M-2051 Connection Harness.

The operation of the M-2001 can be interrupted during tapchanger operation by applying the "wetting" voltage of the M-2051/M-2052 terminal TB1-13 to TB1-10 (timer reset for non-sequential operation input) on the printed circuit board through an external contact. This causes the output to de-energize and reinitialize the time delay circuit when the reset signal is removed. This function can be used to cause the LTC transformer, if so equipped, to wait for the unit to time out between tapchanges.

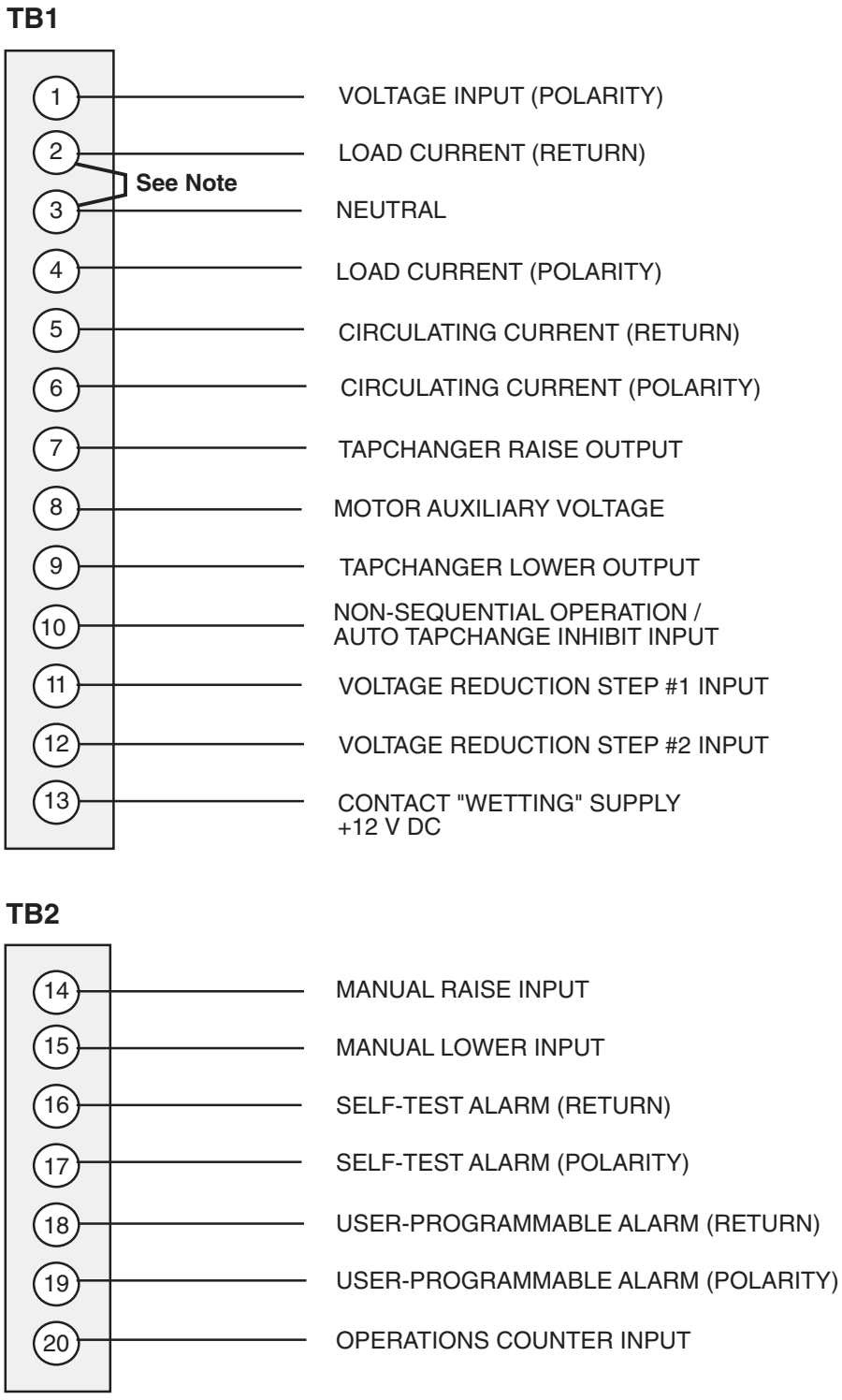
Multi-Step Voltage Reduction

On the M-2051/M-2052, TB1-11 and TB1-12 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 3, External Connections. Voltage reduction amounts are set within the M-2001 Series Digital Tapchanger Control software.

Voltage Reduction Setpoint: Multiplier Range	Apply "Wetting Voltage" from TB1-13 to Terminal #
Voltage Reduction Setpoint #1: 0 to 10%	TB1-11
Voltage Reduction Setpoint #2: 0 to 10%	TB1-12
Voltage Reduction Setpoint #3: 0 to 10%	TB1-11 and TB1-12

Table 1 Multi-Step Voltage Reduction External Connections

▲**CAUTION:** Voltage applied through dry contacts to actuate Voltage Reduction Steps 1, 2, and 3 *must* be nominal +12 Vdc obtained from pin TB1-13 of the M-2051/M-2052 Connection Harness.



■**NOTE:** To isolate the load current, remove the jumper from TB1-2 to TB1-3.

●**WARNING: Open CT secondary will result in high voltage at CT terminals. Death, severe injury or damage to equipment can occur.**

Do not operate with CT secondary open. Short circuit or apply burden at CT secondary during operation.

Figure 3 External Connections

Paralleling

The tapchanger controls are equipped for use in systems requiring the paralleling of two or more regulators or LTC transformers. The system operates by the circulating current method when used in conjunction with the Beckwith Electric M-0115 Paralleling Balancing Module. The M-0115 provides the minimum components required to parallel a regulator or LTC transformer, with a minimum of wires used for interconnection. With this scheme, a regulator or tranformer can be switched out for maintenance, and the remaining unit(s) will operate properly (in parallel, if more than two are being used). The M-0115 also ensures that proper line drop compensation will be maintained, whether the units are operating in parallel or alone. Refer to the M-0115 Instruction Book for complete application information.

The user is cautioned that proper paralleling operation requires that attention be given to the characteristics of the regulators or transformers, the system impedances and the controls. For best parallel operation, the regulators or transformers should be as nearly identical as practical. This means that the kVA rating, turns ratio, percent voltage change per tapchange step, and the impedance (self or with series reactors) should be nominally the same. The characteristics of the controls should be similar as well, since problems can occur when controls from different manufacturers are being paralleled. For example, if the paralleling input burden of a control from a different manufacturer is different from that of the Beckwith Tapchanger Control, an incorrect compensation will result.

Ideally, the Tapchanger Control should be paralleled with another control manufactured by Beckwith Electric whose paralleling input burden is the same. Beckwith Electric does not guarantee satisfaction if the Tapchanger Control is being paralleled with a control whose characteristics are incompatible with it.

For further information on this topic, obtain Beckwith Electric Application Note #11, "*Introduction to Paralleling of LTC Transformers by the Circulating Current Method*," and #13, "*Advanced Paralleling of LTC Transformers by the Circulating Current Method*."

⬢WARNING: When paralleling regulators without sufficient series impedance, such as transformer leakage reactance or reactors, a dangerous amount of circulating current will appear if the regulators are on different tap positions.

Death or severe electrical shock can occur.

One series reactor per regulator is required in this application. Consult Beckwith Electric for further details.

Operations Counter Input

▲ **CAUTION**: Do not apply either +12 Vdc or 120 Vac to this terminal.

An operations count is registered by momentarily grounding TB2-20 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-2051 Connection Harness / M-2001 Series Digital Tapchanger Control.

Typical Connections

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-2051/M-2052 with a M-2001 is shown in Figure 4, M-2001 and M-2051/M-2052 Typical Connections. Connections are simplified and may not show all functions required in a typical load tapchanging transformer control scheme; for example, limit switches, etc.

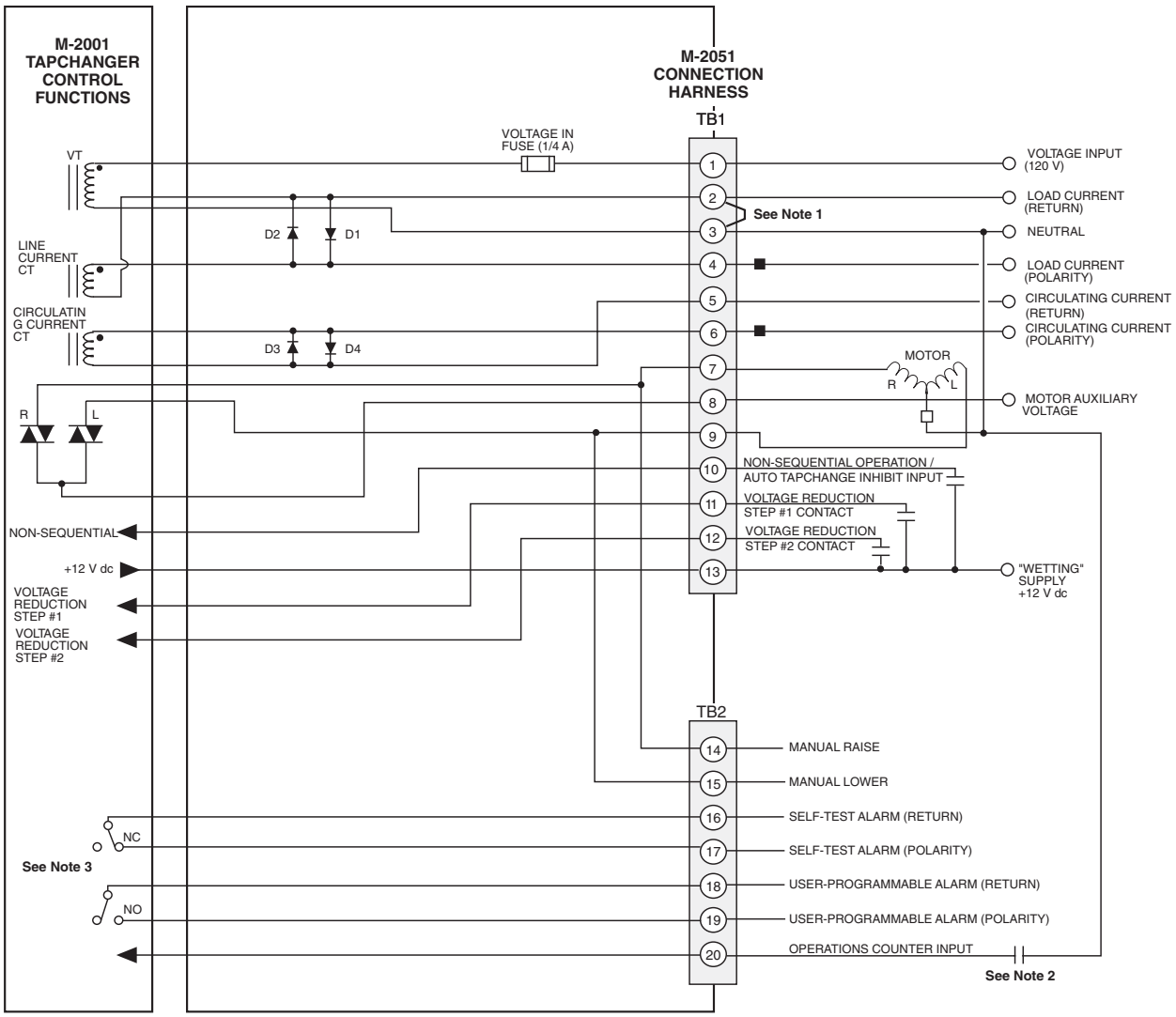


Figure 4 M-2001 and M-2051/M-2052 Typical Connections

■ NOTES:

1. To isolate the load current, remove the jumper from TB1-2 to TB1-3.
2. For counter operation, connect TB2-20 to neutral TB1-3 through an external dry contact.
3. 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.

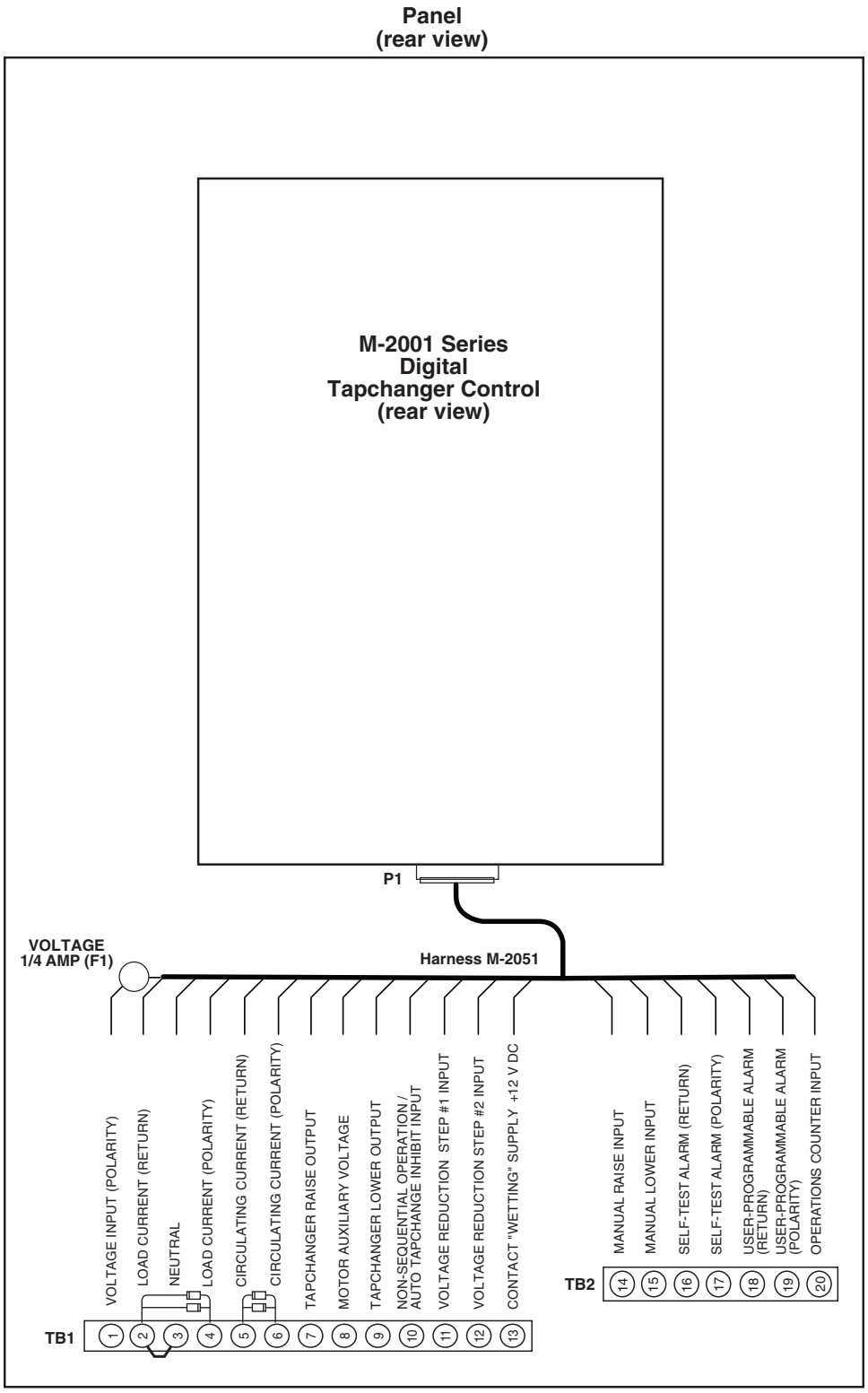


Figure 5 M-2051 Wiring Harness and External Connections

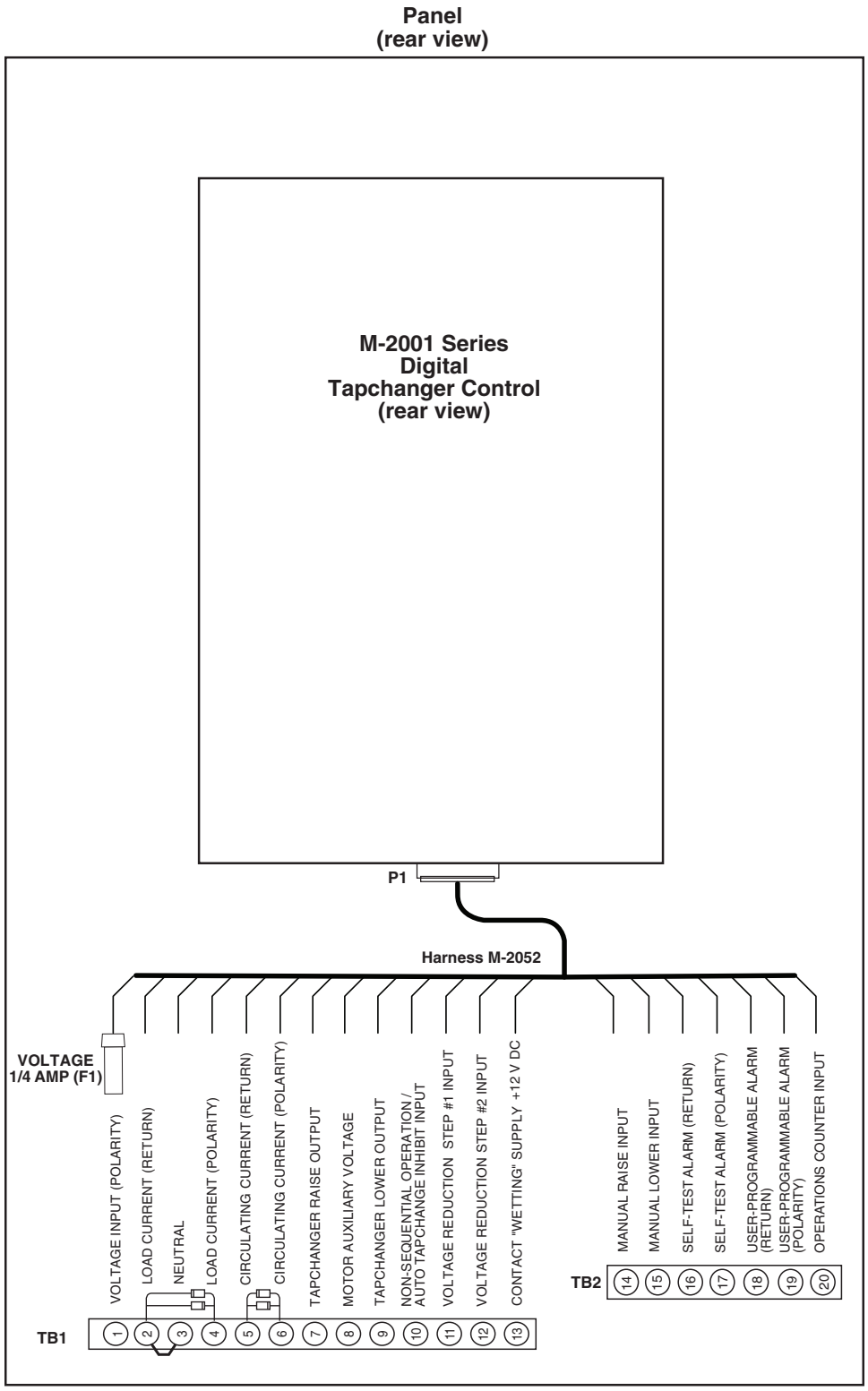


Figure 6 M-2052 Wiring Harness and External Connections

3.2 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 7, below, shows the typical interconnection of the two devices with motor auxiliary relays.

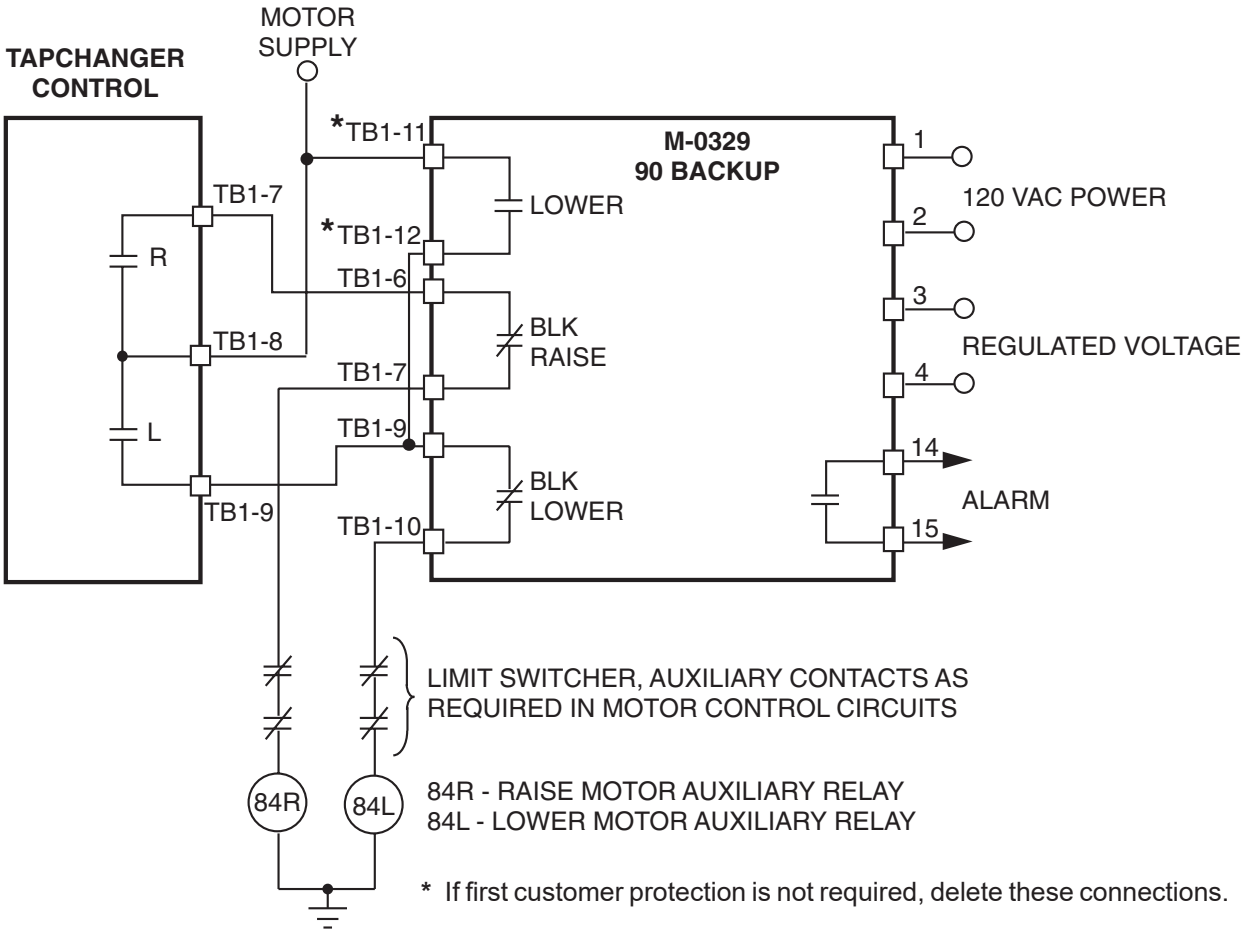


Figure 7 Tapchanger Control and LTC Backup Control Interconnections

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

4.0 Adjustment

M-2001 Series Digital 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."*

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 set slightly (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 Vac voltage source at 60 Hz
- High impedance true RMS voltmeter with accuracy on ac of at least ±0.2% of reading
- Accurate Stop watch

Set-Up Procedure

1. Make electrical connections as shown in Figure 8, M-2051/M-2052 Test Procedure External Connections.

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

2. 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

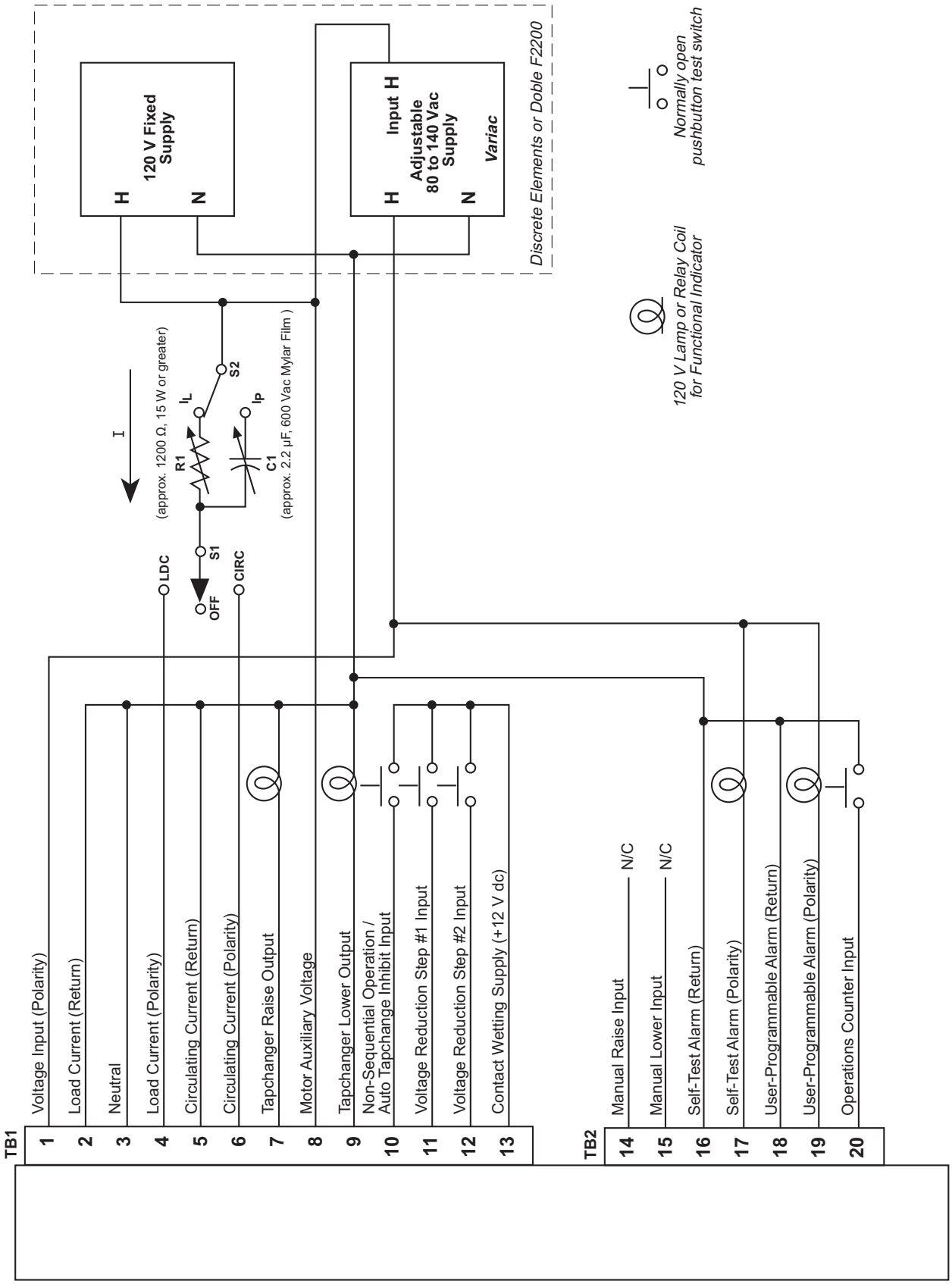


Figure 8 M-2051/M-2052 Test Procedure External Connections

5.1 Bench Test

■ **NOTE:** This test assumes that the M-2001 Series Digital Tapchanger Control is connected to the M-2051/M-2052 Connection Harness.

1. Apply 120.0 Vac from power source.
2. The display of the M-2001 will automatically advance to the 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 Vac. Wait for RAISE and LOWER LEDs to extinguish.
6. Increase voltage to 122.0 Vac.
7. Start timing when voltage passes 121.0 Vac.
8. Stop timing when the lamp connected to the LOWER output lights (should be 5 seconds).

Resistance

1. Apply 100.0 mA in-phase current to TB1-4 (load current-polarity) and TB1-2 (load current-return) of the connection harness. (Set S_1 to LDC and S_2 to I_L.)
2. Set LDC Resistance to 24.0 V; RAISE LED should light.
3. Increase input voltage to 132.0 Vac; 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 Vac; both RAISE and LOWER LEDs should extinguish.
6. Set LDC Resistance to 0.0 V.

Reactance

1. Apply 100.0 mA 90° leading current to TB1-4 (load current-polarity) and TB1-2 (load current-return) of the connection harness. (Set S_1 to LDC and S_2 to I_L.)
2. Set LDC Reactance to 24.0 V; LOWER LED should light.
3. Decrease input voltage to 108.0 Vac; RAISE and LOWER LEDs should be extinguished.
4. Set LDC Reactance to -24.0 V; RAISE LED should light.
5. Increase input voltage to 132.0 Vac; both RAISE and LOWER LEDs should be extinguished.
6. Set LDC Reactance to 0.0 V.

Paralleling

1. Apply 100.0 mA 90° leading current to TB1-6 (circulating current-polarity) and TB1-5 (circulating current-return) of the connection harness. (Set S_1 to CIRC and S_2 to I_P.)
2. LOWER LED should light.
3. Decrease voltage to 108.0 Vac; both RAISE and LOWER LEDs should be extinguished.
4. Set S_1 to OFF.

Counter

1. Set the M-2001 Tapchanger Control to display the Operations Count screen.
2. Verify counter operation by depressing the switch wired to TB2-20 (counter in).
3. Operations Counter should increment.

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 unit 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—

5.2 M-2001 Checkout Procedure

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

Basic Operational Test

1. Set VT Ratio Correction = 0 V; CT/VT phasing = 0°.
2. Apply 120.0 Vac to TB1-1 (hot) and TB1-3 (neutral) of the connection harness.
3. Verify local voltage ≈ input voltage ±0.3 V.
4. Apply 100.0 mA in-phase current to TB1-4 (load current-polarity) and TB1-2 (load current-return). Verify Control Load I^3 100 mA and Power Factor ≈ 1.0 ±0.02.
5. Apply 100.0 mA 90° leading current to TB1-6 (circulating current-polarity) and TB1-5 (circulating current-return).
6. Verify Control Circ I ≈ 100.0 mA ±2 mA.
7. Verify **UP**, **DOWN** and **ENTER** buttons work.

—Checkout Procedure Complete—

5.3 In-Service Test

1. Set the M-2001 Series Digital Tapchanger Control to display the 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

6.0 Checkout Procedure

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

Inspect the voltage fuse to ensure it is correctly sized and has not blown.

6.1 Power

● **WARNING: Voltage applied at TB1-1 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 TB1-1.

▲ **CAUTION:** Do not reverse the ground and hot wires when connecting an external source.

1. Remove any external connection between TB1-1 (voltage input) and TB1-8 (motor auxiliary voltage) of the connection harness terminal blocks. Using a voltmeter, make sure that the voltage applied to TB1-1 is nominal 120 Vac with respect to TB1-3 (neutral).

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.

2. Apply motor auxiliary voltage to TB1-8 (motor auxiliary voltage) and TB1-3 (neutral). Verify that the motor runs in the proper direction when conditions of sensed voltage result in activation of Raise and Lower outputs.
3. As shown in Figure 9, Setup for Curent Checkout Procedure, temporarily place a shorting device across the LDC-CT secondary to short the line drop compensator circuit, and place another shorting device across TB1-5 and TB1-6 to short the circulating current paralleling input, for the load current check. Insert an ammeter between the polarity input and TB1-4. 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.

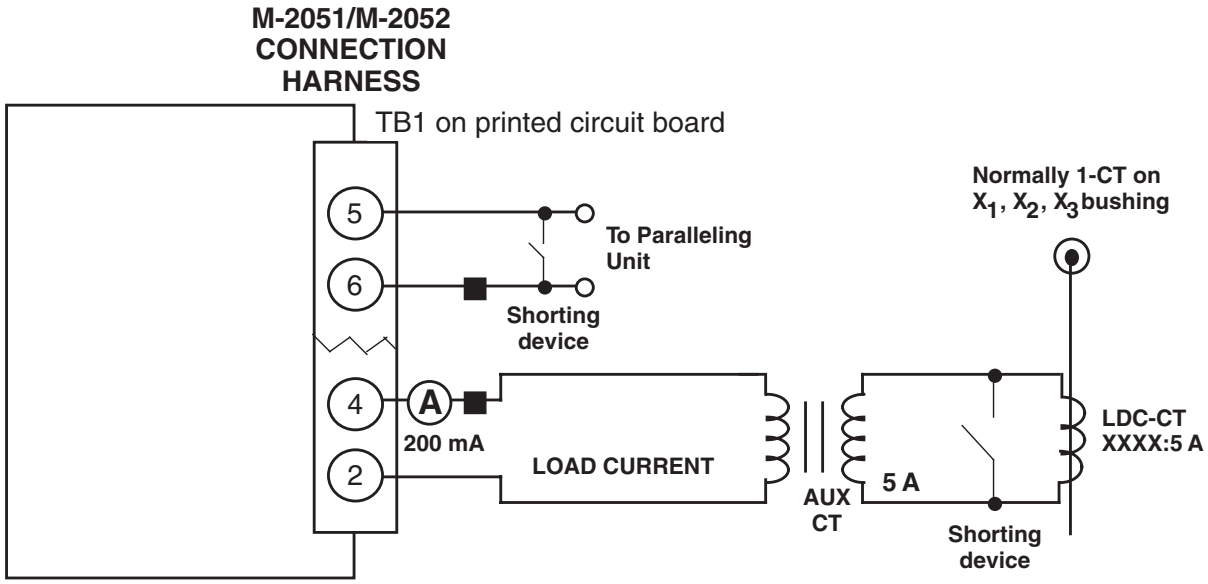


Figure 9 Setup for Current Checkout Procedure

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.

4. 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.

7.0 Maintenance

Due to the nature of the circuitry in the M-2001 Series Digital 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 a blown fuse on the Connection Harness. If the Tapchanger Control is still not operating properly, disconnect it and return it 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:** Connection harnesses 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 connection harness 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.

Legal Information

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.

Notice:

Any illustrations and descriptions by Beckwith Electric are for the sole purpose of identification.

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M-2051-2052-AG-02 10/23