



Application Guide

**M-2054
Surface Mounting Kit**

BECKWITH  **ELECTRIC**



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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.

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1.0 Introduction

The Beckwith Electric M-2054 Surface Mount Kit, 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-2054 Surface Mount Kit, 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 Surface Mount Kit 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 Application

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-2054 with a M-2001 is shown in Figure 1, M-2001 and M-2054 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.

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-2054 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-2054 are made to terminal blocks TB1 and TB2. The wiring harness and external connections for the M-2054 are shown in Figure 2, External Connections.

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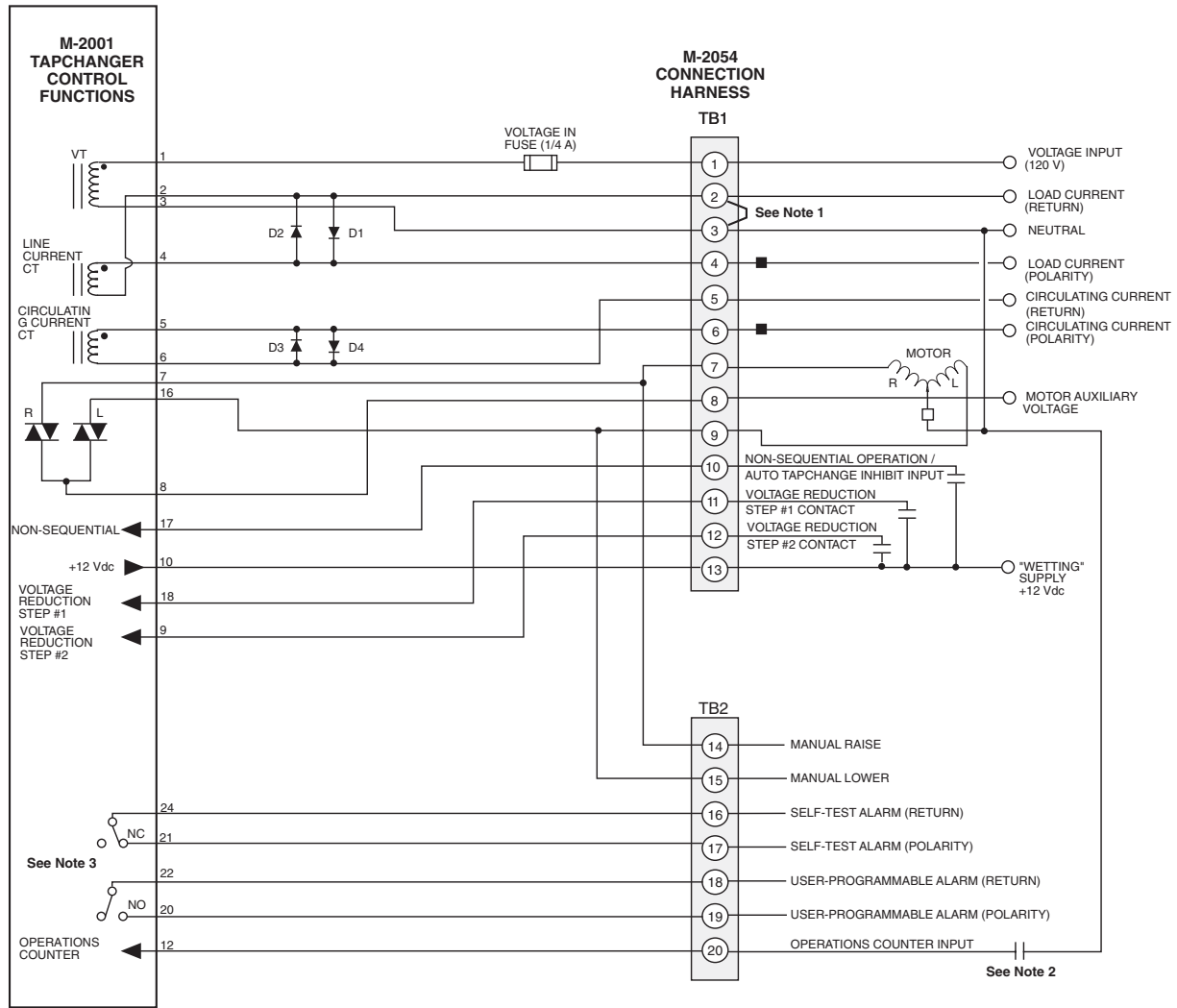


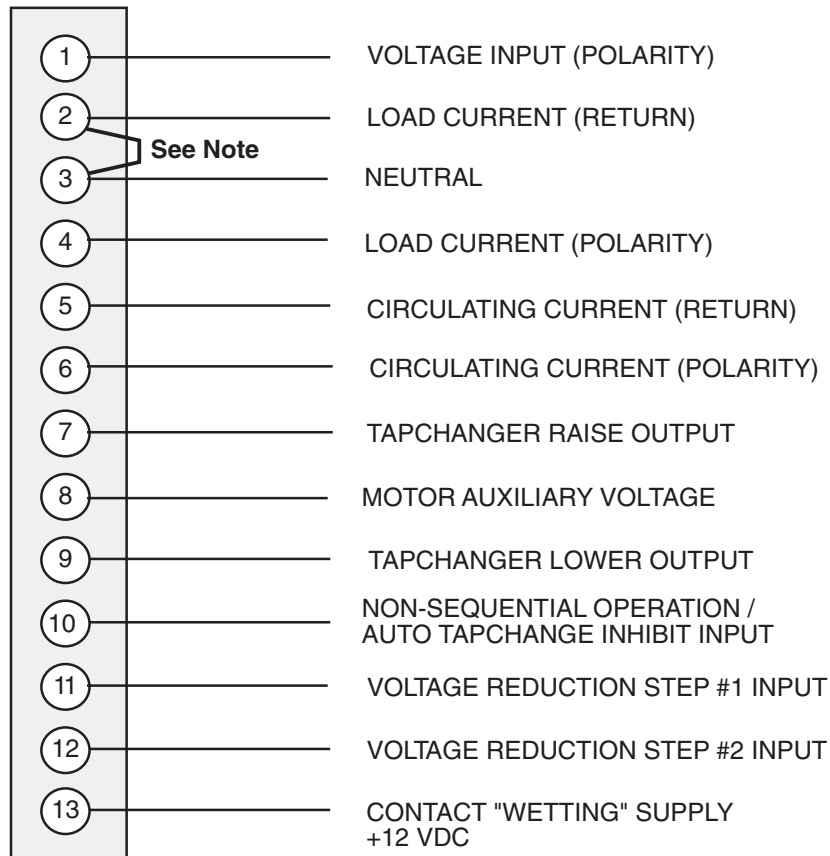
Figure 1 M-2001 and M-2054 Typical Connections

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.

TB1



TB2

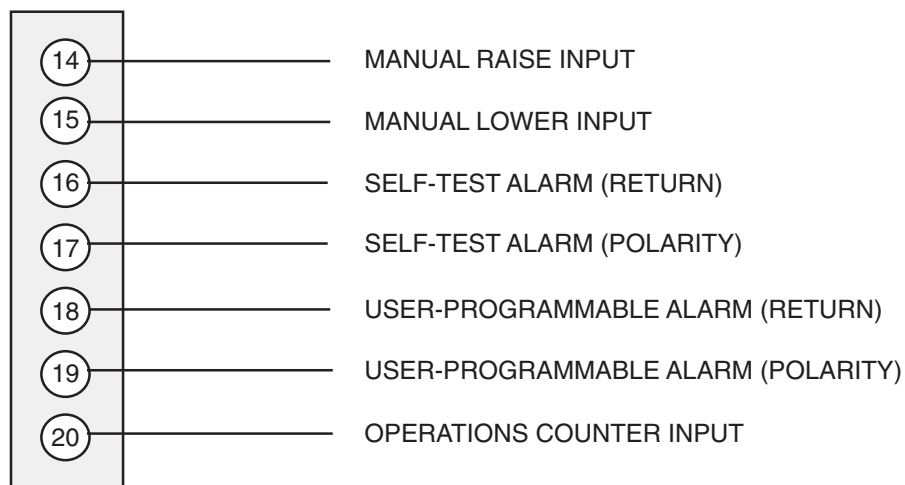


Figure 2 External Connections

■ **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.

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-2054 Surface Mount Kit.

The operation of the M-2001 can be interrupted during tapchanger operation by applying the "wetting" voltage of the M-2054 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-2054, 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 2, External Connections. Voltage reduction amounts are set within the M-2001 Series Digital Tapchanger Control software.

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.

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-2054 Surface Mount Kit.

Paralleling

See the applicable M-2001 Series Instruction Book.

●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

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-2054 Surface Mount Kit/M-2001 Series Digital Tapchanger Control.

3.0 Installation of the M-2001 Series Digital Tapchanger Control

■NOTE: Four mounting bracket screws are shipped in a drawstring bag which is attached to the connection harness.

1. Attach the two surface mounting brackets to the M-2001 Series Digital Tapchanger Control using the four screws provided.
2. Mount the M-2001 and associated terminal blocks, consistent with the layout illustrated in Figure 3, M-2054 Outline Dimensions.

■NOTE: The blue connector is keyed by a "V" notch in the middle to prevent incorrect mating (see below). Check location of the key before plugging connector into the M-2001.

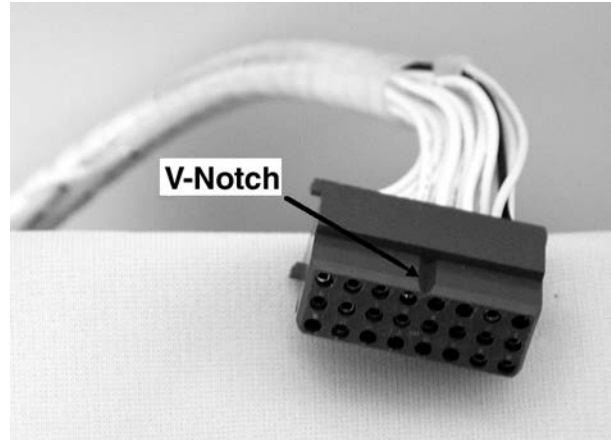


Figure 3 M-2001 Harness Connector

3. Plug the blue connector of the M-2054 harness into the bottom of the M-2001 (below).

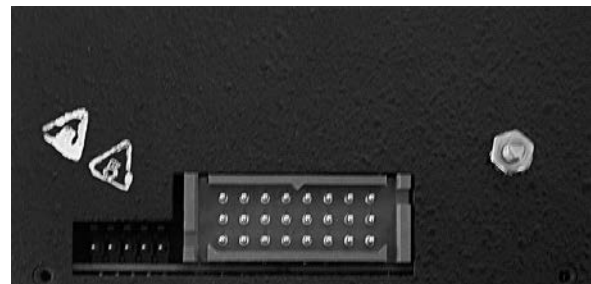


Figure 4 M-2001 V-Notch Orientation

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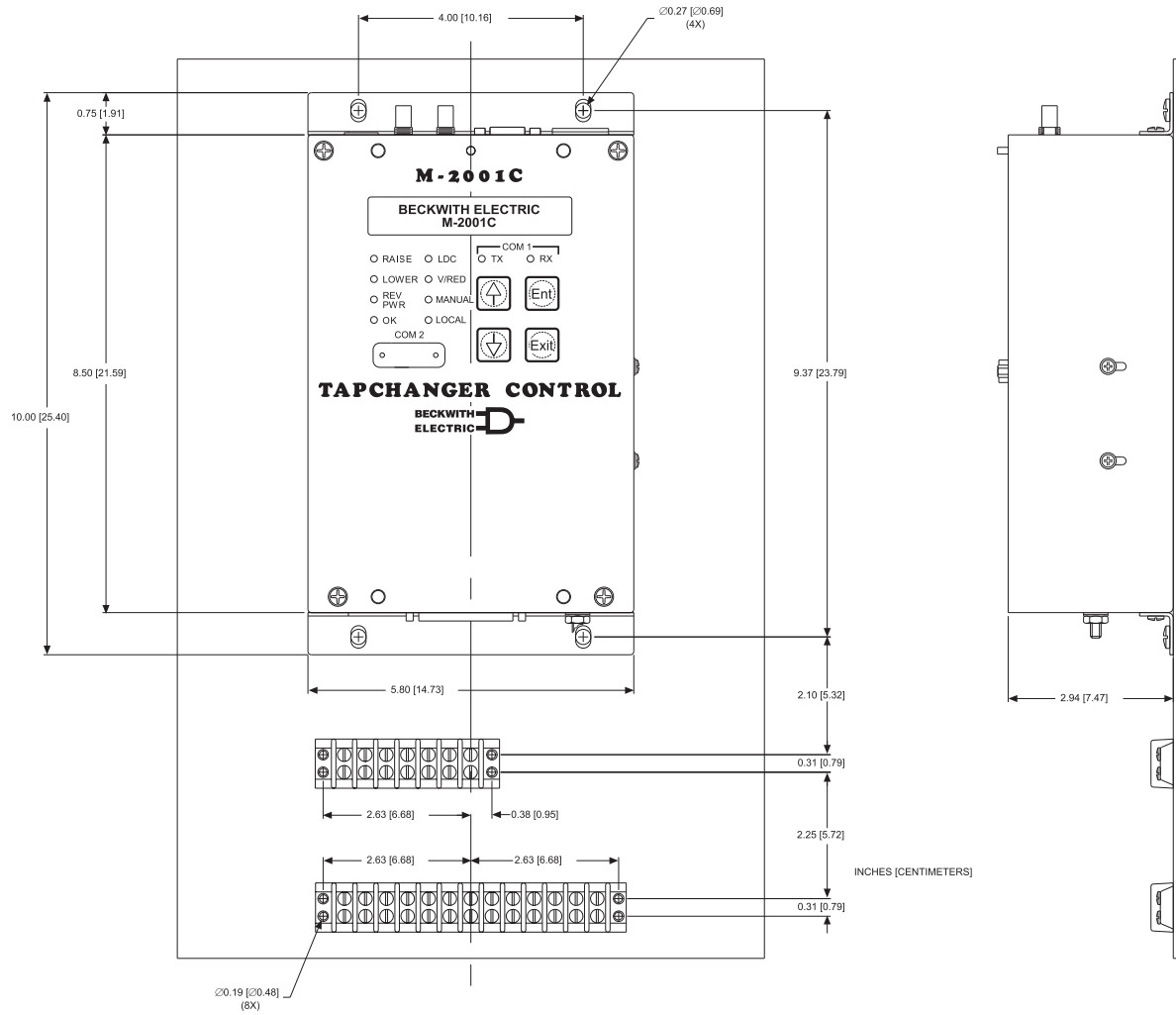


Figure 5 M-2054 Outline Dimensions

4.0 Checkout Procedure

● **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).
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 6, below, 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.
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.

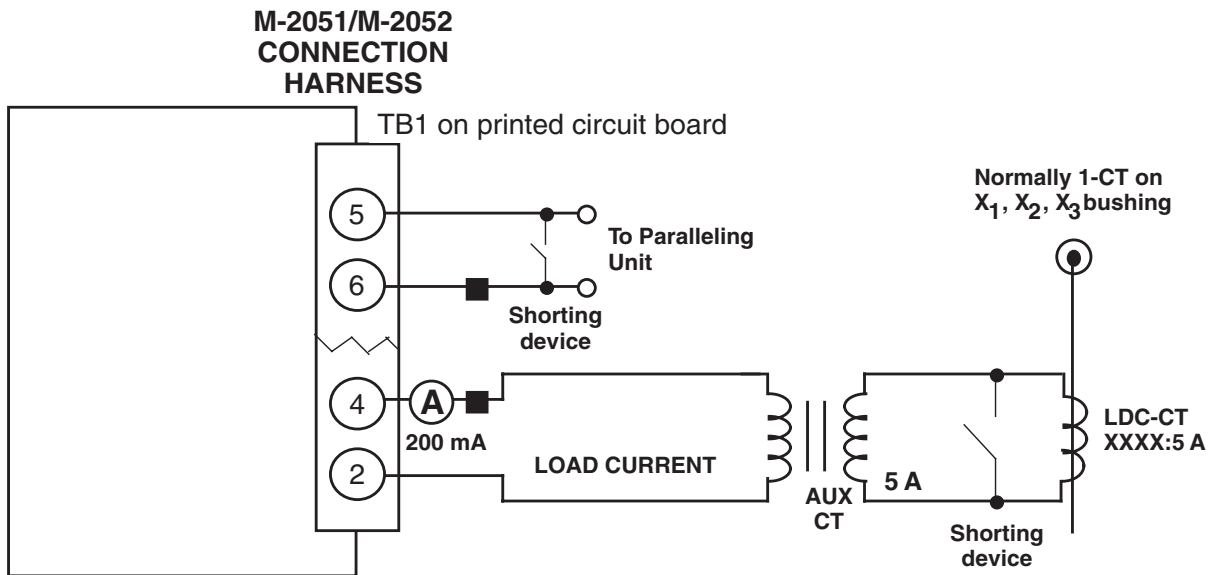


Figure 6 Setup for Current Checkout Procedure

● **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.

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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.

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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

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