



Table of Contents

Introduction	1
Description	1
Battery Installation	4
Operation	6
Calibration	8
Maintenance & Battery Replacement	12
Troubleshooting	13

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Introduction

Moore Industries' Current Loop Calibrator (CLC) is a hand-held, battery-operated, combination current source/transmitter simulator. Its high degree of accuracy and ease-of-use, even under the rigors of harsh, industrial environments, allows it to be employed in a wide variety of applications. It can even be used as a device for calibrating other calibration equipment.

This manual contains all of the information needed to use, calibrate, maintain, and troubleshoot the CLC. It includes a brief description of the unit, including its operational and performance specifications, and an explanation of Moore Industries' system of unit data tracking system, which is based on individual unit model and serial numbers. There is also an overview of the available CLC options, and a set of instructions for battery installation.

Notes" and "Cautions" are used in this manual to call attention to practices that otherwise may result in inconveniences for the user (NOTE) or damage to the CLC (CAUTIONS).

Description

The CLC is a self-contained calibrator packaged in Moore Industries' ergonomic, hand-held housing. It comes complete with a unique carrying cord and sliding handle that functions as a "keeper" when hanging the CLC from piping or conduit, or as a stand to prop up the unit on a flat surface.

The housing has both internal and external cushioning to protect unit circuitry from most kinds of physical abuse. The front panel too is chemical-resistant.

The unit can be ordered with easily-replaced, alkaline batteries, or with rechargeable, nicad cells. A fresh alkaline battery pack yields an average of approximately 40 hours of operating time, a fully charged nicad pack will keep the CLC running for an average of approximately 120 hours.

Controls and Indicators

CLC external controls and indicators are on the unit's front panel. There are 2 slide-type selector switches, and 16 membrane push buttons. There are two LED's at the top of the front panel, and eight more down the middle.

The labeled slide switches turn the unit ON or OFF, and select SOURCE or SINK mode of operation.

The membrane push buttons, when pressed, select the level of CLC output at its terminals on the top endcap.

The LED's at the top of the front panel indicate an over-range and low battery power condition. There is an LED for each pair of level-select push buttons. These flash to indicate the output level selection made.

Internally, there are 7 potentiometers (pots) on the CLC printed circuit board (PCB). Each controls the output produced by the unit when the corresponding membrane push button is pressed.

NOTE

The pots are set at the factory before unit shipment. No initial CLC calibration is necessary.

Table 1 lists the CLC operational and performance specifications.

Figure 1 gives the unit's outline dimensions.

Accessories

There are several optional and replacement accessories available with the CLC. Consult your Moore Industries' Sales Representative for more information about each of the following:

Battery Charger Kits – These come with any of three available plug styles and charger voltages appropriate for use in the United Kingdom, other European countries, the United States and Canada. They include six nicad batteries.

Table 1. CLC Operational and Performance Specifications

Characteristic	Specifications																											
Input	Keypad. User "inputs" selection by pressing labeled membrane push button on unit front panel.																											
Output	<p>0-20 mA, selected in discrete levels shown on input keypad.</p> <table border="1"> <thead> <tr> <th>Levels (in mA)</th> <th>Linear Output %</th> <th>D/P Flow %</th> </tr> </thead> <tbody> <tr> <td>20</td> <td>100</td> <td>100²</td> </tr> <tr> <td>19.84</td> <td>99</td> <td>99.5²</td> </tr> <tr> <td>16</td> <td>75</td> <td>86.6²</td> </tr> <tr> <td>12</td> <td>50</td> <td>70.71²</td> </tr> <tr> <td>8</td> <td>25</td> <td>50²</td> </tr> <tr> <td>4.16</td> <td>1</td> <td>10²</td> </tr> <tr> <td>4</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>-</td> <td>-</td> </tr> </tbody> </table> <p>Drive Capability: 300Ω, continuous Voltage Limits (Sink Mode): 45 Vdc</p>	Levels (in mA)	Linear Output %	D/P Flow %	20	100	100 ²	19.84	99	99.5 ²	16	75	86.6 ²	12	50	70.71 ²	8	25	50 ²	4.16	1	10 ²	4	0	0	0	-	-
Levels (in mA)	Linear Output %	D/P Flow %																										
20	100	100 ²																										
19.84	99	99.5 ²																										
16	75	86.6 ²																										
12	50	70.71 ²																										
8	25	50 ²																										
4.16	1	10 ²																										
4	0	0																										
0	-	-																										
Power	<p>Internal Battery Pack. Customer selects type when unit is ordered. 6 replaceable, AA-size, 1.5 V, alkaline batteries. 6 rechargeable, AA-size, 1.2 V, nicad batteries (charger kit available).</p>																											
Controls & Indicators	<p>ON/OFF - Labeled slide switch SOURCE/SINK Mode - Labeled slide switch Output - Membrane push buttons select any one of 8 discrete levels between 0 and 20 mA LED's - 2 at top of unit front panel light to indicate OVER-RANGE and LOW BATTERY. Each available output level has an LED that flashes when selection is made.</p>																											
Performance	<p>Accuracy: ±0.05% of rated unit full-scale. Power Supply Effect: Negligible. Operating Window: Alkaline Battery Pack affords 40 hours (average) at maximum load. Nicad Battery Pack affords 120 hours at 50Ω between chargings. Ambient Temperature Effect: ±0.01% of rated span (less than 100 ppm) per °C change.</p>																											
Environmental Ratings	<p>Ambient Temperature Operating Range: 0 to 70 °C (-32 to 158 °F) Recommended Storage Temperature Range: -40 to 70 °C (-40 to 160 °F)</p>																											
Weight	765 grams (approximately 1 lb 11 oz), with battery packs installed.																											

Battery Replacement Packs – Direct from the factory, both disposable alkaline cells and rechargeable nicad cells are available.

Charger-compatible Endcaps – If reconfiguring your unit for use with nicad batteries, the bottom endcap must be replaced with the type that has an access hole for the charger plug.

Carrying Cases – Though shipped as part of the original CLC package, replacement carrying cases are available from Moore Industries.

Probe Kits – Though shipped as part of the original CLC package, replacement probe kits are available from Moore Industries.

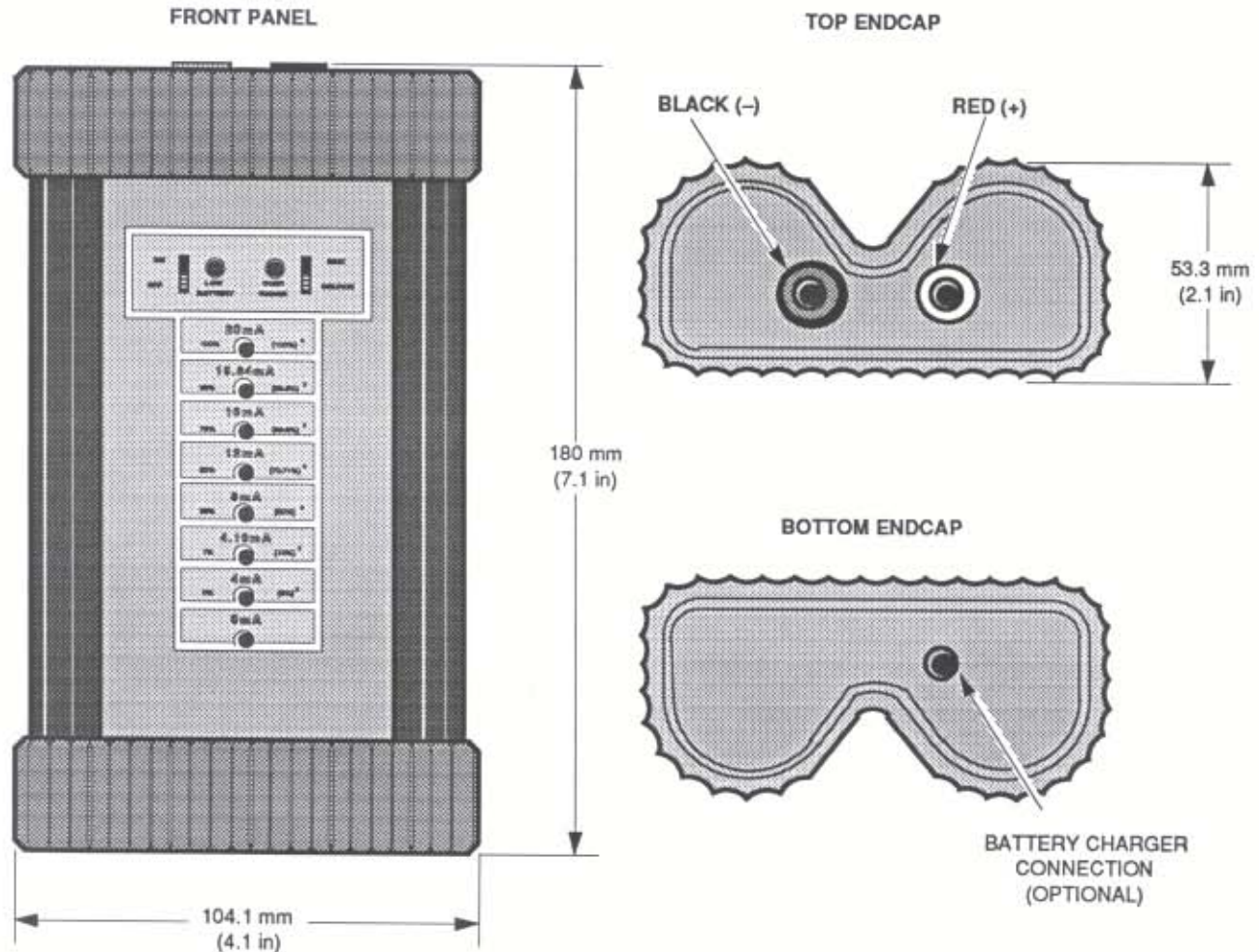


Figure 1. CLC Outline Dimensions

Model/Serial Number. Moore Industries uses a system of individual unit model and serial numbers to keep track of factory configuration and options for all CLC's shipped or serviced.

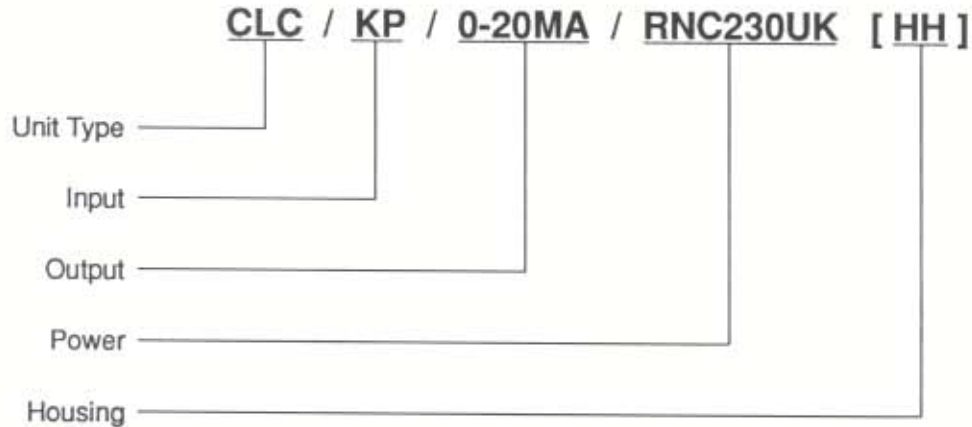
If service information or assistance is required for your CLC, provide the unit's model and serial number to the factory or the Moore Industries Customer Service Department nearest you (the offices are listed on the back cover of this manual). This will assist our professional technicians in their effort to give you prompt, efficient service.

The serial and model numbers for the CLC are printed on an adhesive label which is affixed to the bottom endplate. The endplate is protected by the bottom cushioning endcap.

The following example outlines the significance of each of the information fields in the CLC model number.

CLC

EXAMPLE



Options

The only options available with the CLC are the selections available for unit powering. They are listed in the "Power" field of the CLC model number, and are summarized here for convenience.

BP – Alkaline Battery Pack only.

NC – Nicad Battery Pack only.

RNC120 – Nicad Battery Pack plus 120 Vac recharger.

RNC230CE – Nicad Battery Pack plus 230 Vac recharger.

RNC230UK – Nicad Battery Pack plus 230 Vac recharger with UK-style plug configuration.

Battery Installation

For safety reasons, the batteries of the CLC are packaged separately from the unit for shipment.

Use figure 2, which illustrates the extent to which the unit must be disassembled, and the following procedure to install the batteries.

1. Pry off both protective rubber endcaps with fingers. It is suggested to grasp the flat, front panel section of endcap, and to "work it" over curved back panel.

CAUTION

Do not use a screwdriver or any other sharp instrument to remove the protective endcaps from the CLC.

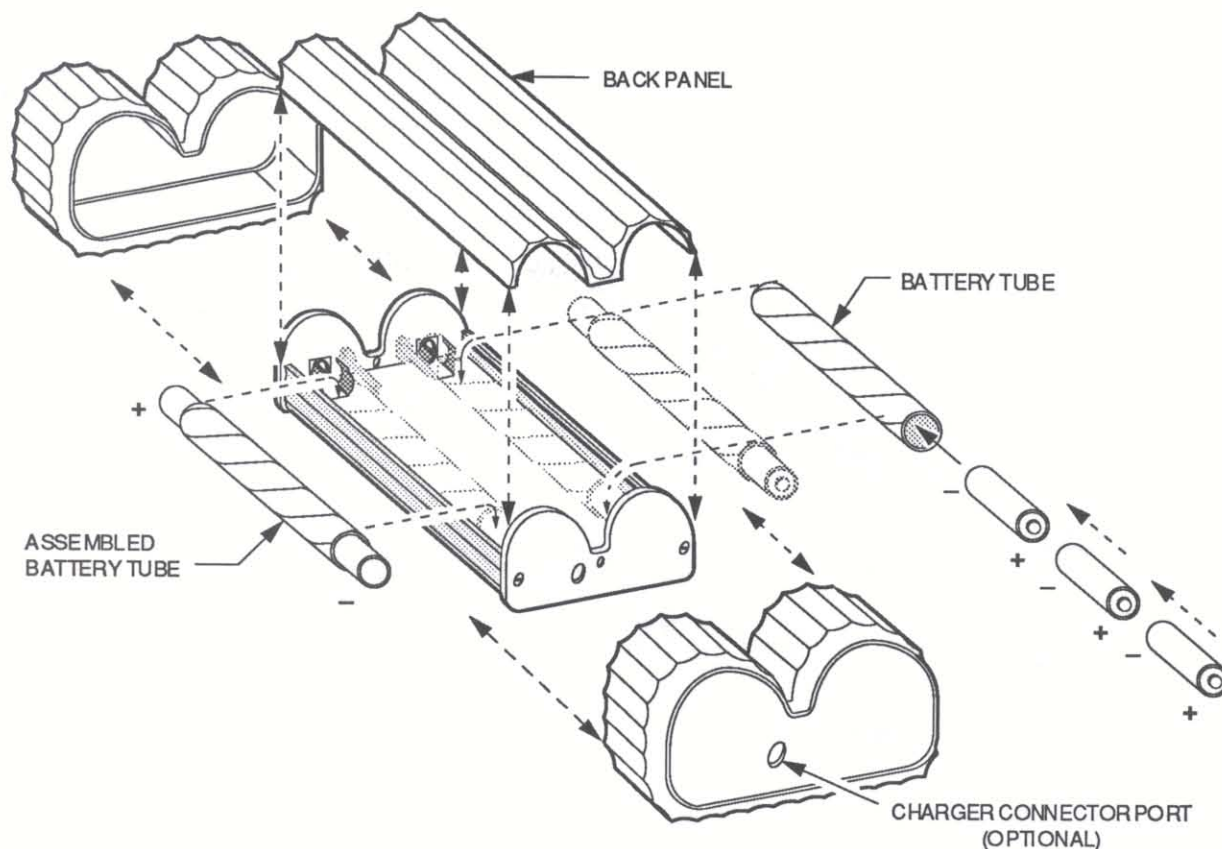


Figure 2. Disassembly of the CLC

2. Remove unit back panel.
3. Locate battery tubes, shipped separately, and six batteries.
4. Insert batteries, three per tube, ensuring that proper polarity is maintained as shown in figure 2.

NOTE

A diagram showing the correct arrangement of the batteries also appears on the printed circuit board (PCB) of the unit itself.

5. Install tubes in clips on the PCB. Place positive end (+) of battery/tube assembly into clip labeled "+" on the PCB. Place negative end (-) of battery/tube assembly into clip labeled "-".

NOTE

Improper polarity of the battery/tube assembly will result in CLC dysfunction.

6. Re-install back panel and protective endcaps.

CAUTION

The back panel of the CLC is held in place solely by the protective rubber endcaps. Damage to these endcaps may make it impossible to secure the unit's back panel.

CLC

Operation

Operation of the CLC consists of properly connecting the unit in your application, selecting SOURCE or SINK mode, and pressing the appropriate front panel push button to obtain the desired output.

Figure 3 diagrams the CLC connected in a Source mode application. Figure 4 shows the connections for Sink mode applications.

Connect the unit as appropriate according to the type of calibrating you'll be doing, and refer to the following paragraphs for information on the CLC operation in Source and Sink modes.

Source Mode

When the mode selector is set to the SOURCE position, the CLC provides precise, discrete levels of current at its output terminals.

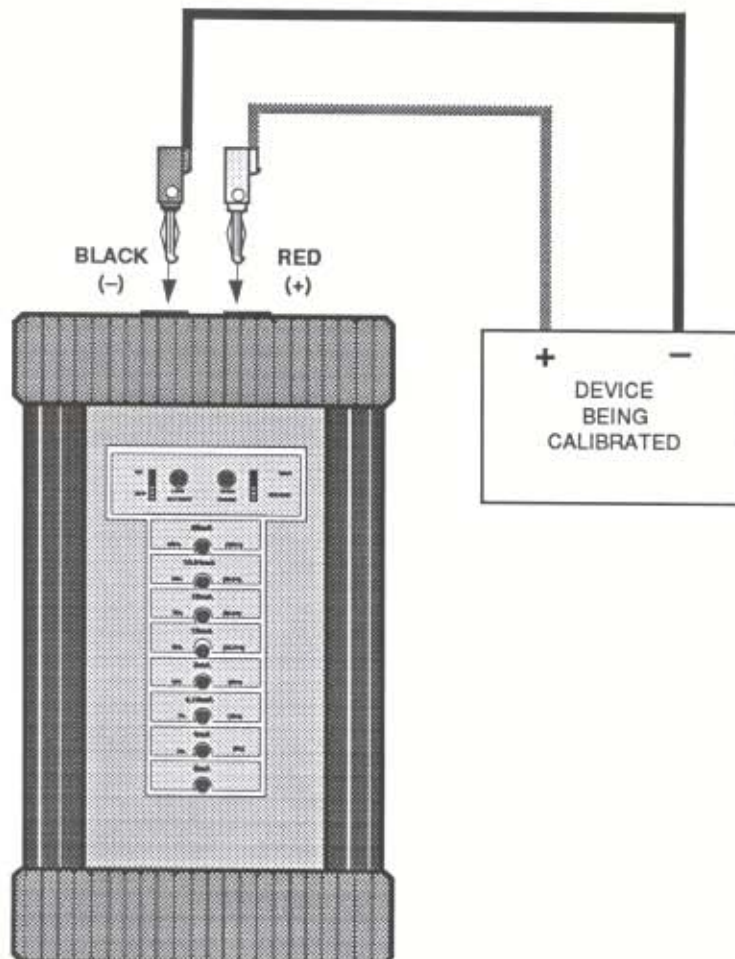


Figure 3. CLC Hookup for Source Mode Applications

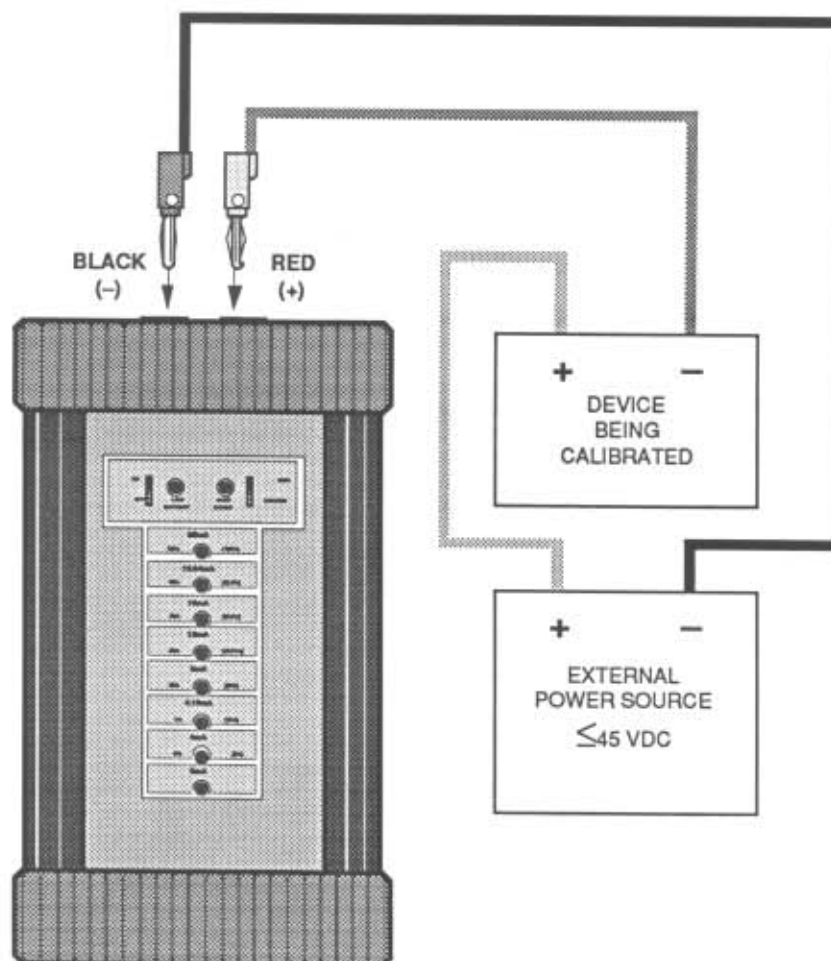


Figure 4. CLC Hookup for Sink Mode Applications

Press the membrane push button on either side of the LED corresponding to the desired output level. The selections are indicated by the column of labels along the left side of the front panel. When the LED begins to flash, the CLC is providing that output at its terminals, accurate to within $\pm 0.05\%$ of rated unit full-scale.

This mode is useful in calibrating or setting trip points from two- or four-wire devices such as current-to-pressure (I/P) converters, recorders, indicators, controllers, or alarms.

Sink Mode

When the mode selector is set to the SINK position, the CLC provides precise, discrete levels of square root output (proportional to flow) at its output terminals.

Press the membrane push button on either side of the LED corresponding to the desired output level. The selections as indicated by the column of labels along the right side of the front panel.

CLC

When the LED begins to flash, the CLC is "sinking" the desired level of current in the loop, accurate to within $\pm 0.05\%$ of rated unit full-scale.

This mode is useful in simulating the output from a remote, differential pressure (D/P) transmitter when calibrating a receiving device or indicator.

CAUTION

When operating the CLC in Sink Mode, ensure that the external power source does not exceed 45 Vdc.

The Carrying Cord and Handle. The CLC comes with a uniquely designed carrying cord and handle that provides for several types of "hands-free" operations.

Slide the handle along the cord, and fit the protrusion on its bottom into the notch on the back panel of the unit. When the CLC is placed on a flat surface, the handle angles the unit slightly up, making it easier to see the front panel LED's.

The cord can also be looped around piping or conduit and wrapped back around the handle. See figure 5 for an illustration of this type of operation.

Calibration

The design and construction of the CLC is intended to provide for years of trouble-free operation.

If at any time the performance of the CLC is called into question, the unit can be calibrated by the user.

The procedure is comprised of unit disassembly, the connection of test equipment, the adjustment of output control pot settings, and unit re-assembly.

The adjustment of the output control pots is made while taking readings of the voltage drop across a precision resistor placed across the CLC's output terminals.

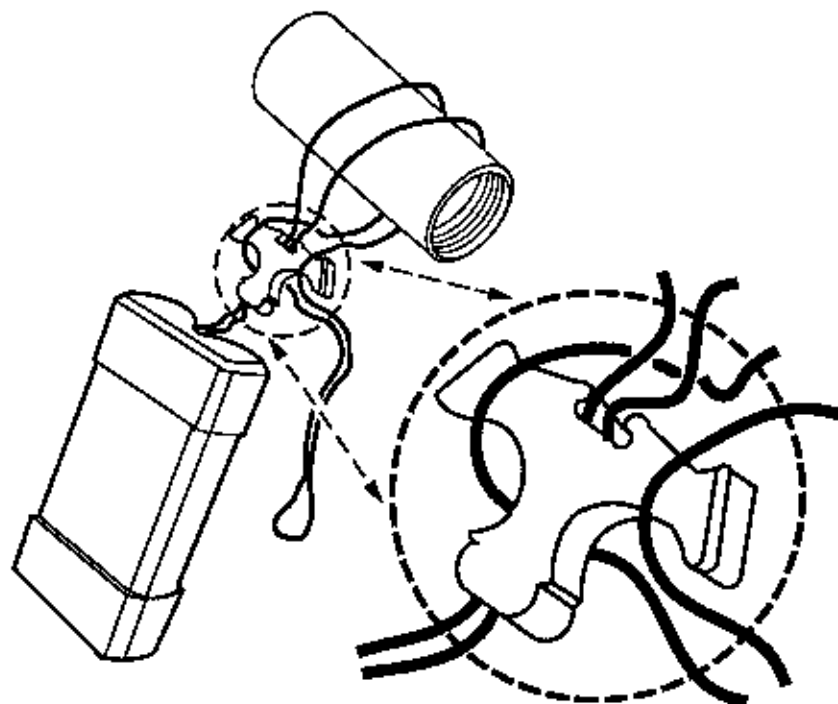


Figure 5. Using the CLC Carrying Cord and Handle

Setup. Table 2 lists the equipment required in order to calibrate the CLC.

The first step in the procedure is the disassembly of the unit. Figure 2, shown earlier in this manual in the Battery Installation Section, illustrates this.

NOTE

Do not remove the internal batteries when calibrating the CLC.

When the unit is disassembled (except for the batteries) remove the two Phillips-head screws from the top panel (only).

CAUTION

The sockets on the top panel of the CLC are wired to the unit's internal PCB. When working on the CLC with its top panel loose, take care not to damage or disconnect the wiring.

The pots that are used to control the CLC output levels are located on the back of the PCB (the side opposite the batteries). They are in a line along the top edge of the board, and with the top panel of the unit removed, are easily accessible. Figure 6 shows their location.

Table 2. CLC Recalibration Equipment

Equipment	Characteristics
Multimeter	Preferably digital, capable of measuring voltage across the load resistor in the calibration setup (minimum 5-digit read-out). Fluke model 8842 or equivalent unit with accuracy of $\pm 0.005\%$ of full scale, minimum. Also should be capable of measuring milliamp output in the 0 to 20 mA range, with readings accurate to within $\pm 0.05\%$ of full scale.
Precision Resistor	250 Ω $\pm 0.005\%$, 1 Watt.
Power Source	12 - 40 Vdc (required for calibrating CLC Sink Mode only).
Batteries	Calibrating the unit with "fresh" batteries is strongly recommended. If equipped with alkaline cells, install new batteries. If equipped with nicad cells, charge unit for eight hours.

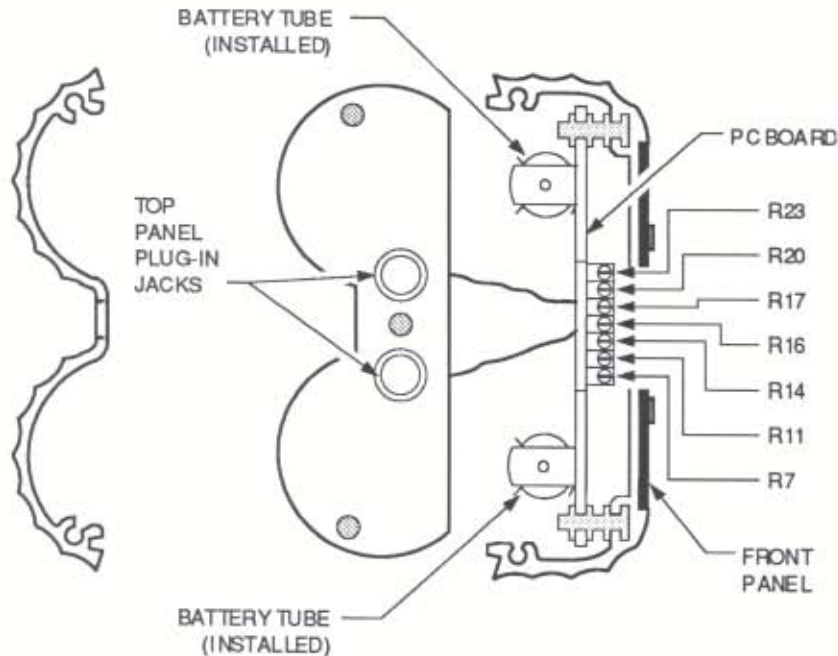


Figure 6. CLC Adjustment Pots

Use the equipment listed in the table, and with the unit disassembled, connect the CLC as shown in the calibration hookup illustration, figure 7.

Special Consideration — Calibrating in Sink Mode. Though not recommended, the CLC may be calibrated in Sink Mode if desired. The break out in figure 7 illustrates the incorporation of the power source in the setup for calibrating the unit in Sink Mode.

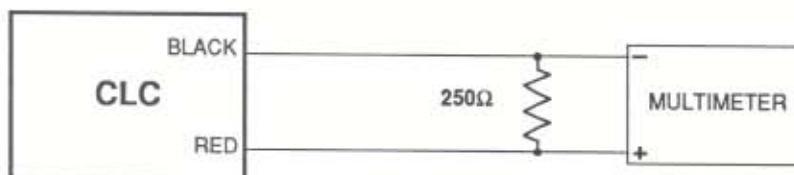
NOTE

The tolerance for the meter reading in each step is ± 0.0025 V when calibrating in Sink Mode.

When this setup is complete, apply dc power, and turn the CLC on.

1. Set selector switch to "SOURCE" or "SINK".
2. Verify that "0mA" LED is flashing. If not, press "0mA" membrane push button located in black area of label, left of "0mA" printing.
Meter will read 0.000 V, ± 0.0005 V.
3. Press "20mA" membrane push button.
"0mA" LED goes out, "20mA" LED turns on.
4. Adjust potentiometer R23 until reading of 5.0000 V, ± 0.0005 V is achieved.
5. Press "19.84mA" membrane push button.
"20mA" LED goes out, "19.84mA" LED turns on.
6. Adjust potentiometer R7 until reading of 4.9600 V, ± 0.0005 V is achieved.
7. Press "16mA" membrane push button.
"19.8mA" LED goes out, "16mA" LED turns on.

FOR CALIBRATION IN SOURCE MODE:



FOR CALIBRATION IN SINK MODE, ADD THE SPECIFIED POWER SOURCE:

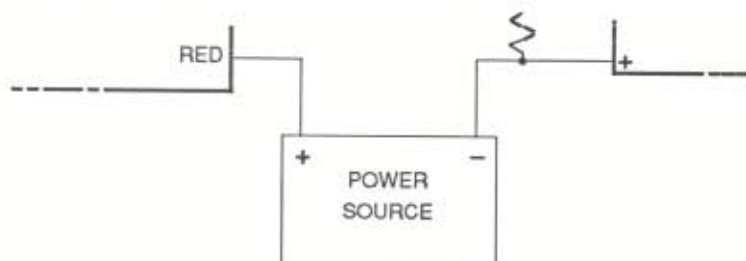


Figure 7. CLC Recalibration Hookup

8. Adjust potentiometer R11 until reading of 4.0000 V, ± 0.0005 V is achieved.
9. Press "12mA" membrane push button.
"16mA" LED goes out, "12mA" LED turns on.
10. Adjust potentiometer R14 until reading of 3.0000 V, ± 0.0005 V is achieved.
11. Press "8mA" membrane push button.
"12mA" LED goes out, "8mA" LED turns on.
12. Adjust potentiometer R16 until reading of 2.0000 V, ± 0.0005 V is achieved.
13. Press "4.16mA" membrane push button.
"8mA" LED goes out, "4.16mA" LED turns on.
14. Adjust potentiometer R17 until reading of 1.0400 V, ± 0.0005 V is achieved.
15. Press "4mA" membrane push button.
"4.16mA" LED goes out, "4mA" LED turns on.
16. Adjust potentiometer R20 until reading of 1.0000 V, ± 0.0005 V is achieved.
17. Press "0mA" membrane push button.
Verify that "4mA" LED goes out, and "0mA" LED turns on.
18. Verify potentiometer settings by switching voltmeter to measure mA and removing precision resistor from setup in figure 7. With setup modified in this way, and with CLC in Source Mode, meter will read mA output at each level when appropriate labeled membrane push button is pressed.
Output will be within $\pm 0.05\%$ of full scale.
19. Disconnect calibration equipment and re-assemble unit.

If problems with unit performance or function continue, refer to the Troubleshooting Section of this manual.

Maintenance/Battery Replacement

CLC maintenance is limited to replacing the internal alkaline batteries, when so equipped, or recharging the internal nicad packs with the charger supplied.

The front panel LED lights when the strength of the unit's batteries has been depleted enough to effect unit performance. When the LED is lit, if alkaline batteries are being used, they should be changed, or if nicad batteries are being used, they should be recharged.

CAUTION

Never attempt to recharge alkaline batteries. They may, under some circumstances, rupture causing damage to the CLC.

Replacing Alkaline Batteries

To replace alkaline batteries, make sure that the unit is disconnected from all external equipment, and that it is turned off. Refer to the section earlier in this manual that describes battery installation. Figure 2 illustrates the disassembly of the CLC, and shows the polarity required for the replacement cells.

Always dispose of old alkaline cells properly. Heed all pertinent environmental restrictions and guidelines.

Recharging Nicad Batteries

If the CLC is equipped with internal, nicad batteries, the front panel LED labeled "LOW BATTERY" lights whenever they need charging.

After approximately 120 hours of use under typical loads, the nicad batteries of the CLC equipped with them will need recharging.

See figures 1 or 2, which show the location of the port for connection of the battery charger in the bottom of the CLC housing. Refer to the following procedure:

1. Disconnect all external devices from CLC, and turn unit off.
2. Verify charger type, shown in the POWER field of unit model number. Units are configured at the factory to accept input from 120 Vac chargers, or from either of two types of 230 Vac chargers.
3. Plug charger lead into port in bottom endcap of CLC.
4. Plug charger unit into appropriate ac source, 120 or 230 V.

NOTE

A completely dissipated set of nicad batteries will require approximately eight hours to recharge.

Troubleshooting

The design of the CLC is such that, aside from charging discharged batteries, installing new batteries, re-installing improperly installed batteries, and verifying the polarity of connections to external equipment, there is little that lends itself to any "field repair".

If the unit ever fails to operate, or if it is determined that the CLC is not providing output with the precision stated in the specifications table, perform the following:

- Check for improperly installed batteries. See figure 2 to verify polarity.
- If alkaline batteries are used, replace them. If nicad cells are used, recharge them. Refer to the Maintenance Section of this manual.

- Verify the polarity of the instruments or devices being calibrated with the CLC. Check figures 3 and 4.
- Verify load. In SOURCE mode, the CLC will indicate an over range condition when the load exceeds 300 Ω . Select Sink mode for higher resistance loads.

If problems persist, perform a unit calibration, as described in the Calibration Section, earlier in this manual.

If unit function or performance are still unacceptable after calibration contact your local Moore Industries Customer Service Representative, or return the CLC to the Customer Service Center nearest you, according to the instructions on the back cover of this manual.

The toll-free numbers of Moore Industries' Customer Service Centers may be found listed inside the front cover of this manual.

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

Warranty Repair –

If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

Non-Warranty Repair –

If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
 - a) A note listing the symptoms that indicate the unit needs repair
 - b) Complete shipping information for return of the equipment after repair
 - c) The name and phone number of the person to contact if questions arise at the factory
3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.
4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

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RETURN POLICY

For a period of thirty-six (36) months from the date of shipment, and under normal conditions of use and service, Moore Industries ("The Company") will at its option replace, repair or refund the purchase price for any of its manufactured products found, upon return to the Company (transportation charges prepaid and otherwise in accordance with the return procedures established by The Company), to be defective in material or workmanship. This policy extends to the original Buyer only and not to Buyer's customers or the users of Buyer's products, unless Buyer is an engineering contractor in which case the policy shall extend to Buyer's immediate customer only. This policy shall not apply if the product has been subject to alteration, misuse, accident, neglect or improper application, installation, or operation. THE COMPANY SHALL IN NO EVENT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.



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