

OPERATING INSTRUCTIONS

360 Ground Finder

(Rev. 7/22/15)

TABLE OF CONTENTS

	<u>Page No.</u>
I. Warranty	3
II. Certification of Calibration	3
III. Do FIRST!	4
IV. General Description of 360 Ground Finder	5
V. Specifications	6
VI. Features	
A. Unit Features	7
B. Feature Callout (Fig. 1)	8
C. Components & Accessories	9
D. Components & Accessories (Fig. 2)	9
VII. Safety	10
VIII. Set Up	
A. Safety, Again	11
B. Unique Operating Characteristics	11
C. Pre-Test of the Ground Finder	12
IX. Testing For Grounds	
A. Safety, One More Time	14
B. False Red Indication	14
C. Confirming Earth Ground	14
D. Making Ground Tests	16
X. FRA/Transport Canada Requirements for Ground Tests	19
XI. Replacing the Internal Battery	20
XII. Trouble Shooting	20
XIII. Calibration and Repair Services	21
IXV. Ordering References	22

I. WARRANTY

THIS LIMITED WARRANTY IS GIVEN TO THE PURCHASER BY S&C DISTRIBUTION COMPANY AND IS THE SOLE AND EXCLUSIVE WARRANTY GIVEN IN CONNECTION WITH THE MODEL 360 GROUND FINDER. ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, ARE EXCLUDED TO THE FULL EXTENT PROVIDED BY LAW.

S&C Distribution Company hereby warrants the Model 360 Ground Finder, exclusive of batteries, to be free from defects in material and workmanship for a period of one year following the date of shipment. Any manufacturing defect arising during this warranty period shall be corrected at the manufacturer's expense (except in-bound shipping and handling charges).

1. To obtain warranty services, a claim by the purchaser in writing must be made to S&C Distribution Company, at the address shown at the end of this Instruction Manual. Such claim must be accompanied by proof of purchase.

2. This Limited and Exclusive Warranty only covers repairs of Manufacturer's defects and requires that in-bound freight charges be prepaid.

3. S&C Distribution Company shall not be responsible for any injury to persons, damage to property, or any of its contents or for any other consequential damages or losses, whether arising out of breach of contract, breach of warranty, or otherwise. Some states do not allow the exclusion or limitation of incidental or consequential damage so this limitation or exclusion may not apply to you.

4. This Limited and Exclusive Warranty may give you specific legal rights according to the laws of your state.

5. The Warranty contained in this agreement shall not apply to any Model 360 Ground Finder which shall have been repaired or altered outside of the Manufacturer's facilities or tampered with in any way, or in the Manufacturer's sole judgment has been subject to misuse, negligence or accident not attributable to Manufacturer.

6. This Warranty is issued to the original purchaser only and is not transferable.

7. This Warranty replaces and supersedes any and all previously issued warranties.

II. CALIBRATION CERTIFICATION

S&C Distribution Company hereby certifies that this product was calibrated with instruments meeting United States National Institute of Standards and Technology (NIST) standards. Further, the manufacturing procedures employed are designed and controlled to assure that the Ground Finder will meet its published specification. S&C Distribution Company further certifies that, annually, our instruments are calibrated to NIST standards. This document is not a certificate of calibration or traceability. To have your Ground Finder formally calibrated and sealed, and thus obtain a certificate of calibration and traceability, contact S&C Distribution Company (708-444-4908) for a Return Goods Authorization (RGA). A nominal fee is charged for this service.

III. DO FIRST!

Three steps that should be taken prior to all others after receiving your new Model 360 Ground Finder are as follows:

1. If you have purchased the **Calibration Check Device** (PN: 360-30) confirm calibration of the Ground Finder and its alarm function as follows.

- a. Current version Ground Finders - Turn the Function Switch to "TEST"
 - 1). Plug the Calibration Check Device into the lead sockets.
 - 2). Beeper should sound, the red LED should light and the Voltmeter should read "02.2" (VDC), +/- one count. In the unlikely event that the reading is less than "02.1", or greater than "02.3", the unit needs calibration.
- b. Early version Ground Finders (hardwired negative lead) - Turn the Function Switch to "TEST":
 - 1). Connect the black Ground Lead Clip to one banana plug on the Calibration Check Device and insert the Probe (red) into the banana jack on the opposite side of the Cal. Check Device (see Fig. 2).
 - 2). Beeper should sound, the red LED should light and the Voltmeter should read "02.2" (VDC), +/- one count. In the unlikely event that the reading is less than "02.1", or greater than "02.3", the unit needs calibration.
- c. All versions - Again, with the Function Switch set to "TEST":
 - 1). Short Test positive lead (red) Probe to Ground Lead Clip.
 - 2). Beeper should sound, the red LED should light and the Voltmeter should read "22.2" to "23.0" (VDC). Readings in excess of "23.0" indicate a Ground Finder in need of repair.

2. If you have not purchased the Calibration Check Device, confirm the calibration of the Ground Finder as follows:

a. With the Function Switch set to "TEST":

1). Short Test Probe (red) to black Ground Lead Clip.

2). Beeper should sound, the red LED should light and the Voltmeter should read "22.2" to "23.0" (VDC). Readings in excess of "23.0" indicate a Ground Finder in need of repair.

b. Move Function Switch to the "CONFIRM" position.

1). Short red Test Probe to Ground Lead Clip.

2). Ammeter should read: greater than "08.0" (mA).

3. Check Operation of the Polarity Reversing Pushbutton

Because there is no visible indication that the polarity of the output of the 360 is reversing, for your benefit and understanding, we recommend that the operation of the reversing switch be confirmed upon receipt of the Ground Finder. To do this, hook up the output of the 360 to a Model 355 Signalman's Meter, or similar, on the Volts scale. Turn the 360 on, to the "TEST" mode, and without pushing the polarity reversing button (the small black button to the left of the negative lead terminal), read the output of the 360 with the Meter. The reading should show (a positive) 19-20 volts, approximately. The rest of the output of the 360 will show up on the meter of the Ground Finder, approximately 2.3 to 2.5 volts, for a total of 22.3 to 22.5 volts. With the Meter still connected to the 360, depress the button and hold it down briefly. The reading on the 355 Meter should be a negative reading of the same value you had without the button pressed.

From this point forward, it is recommended that periodic checks be made to confirm that the contacts of the push-button are functioning correctly. To do this, turn the Ground Finder on to the "TEST" mode, short the leads together and depress the button and hold it down briefly. The reading on the meter should be 22.5 volts. This test will confirm that the polarity reversing contacts in the switch are functioning properly. A lower reading normally indicates a weak battery.

4. **Read this Manual** completely and carefully before using your new Ground Finder. Please pay particular attention to **Section VII, Safety**, and to Section VIII.B, Unique Operating Characteristics.

IV. GENERAL DESCRIPTION

Testing of railroad signal locations for grounds is a Federal requirement that can be time consuming, and awkward, depending on the tools used to make the tests. S & C Distribution Company has developed a Ground Finder that is rugged, compact, and easy-to-use. An internal, 9VDC transistor radio battery powers the unit. The tester comes ready to use with four foot lead (red, with crocodile clip) and eight foot (black, with a clip termination) low temperature test leads and a carrying pouch with a pocket for storing an extra battery. The Crocodile Probe Clip, is integral to the positive lead furnished with the tester. It allows the user to maintain contact with a grounded conductor, hands-free.

Testing voltage is 22.5VDC, reflecting a standard common with several railroads. We have designed the tester to allow its use under traffic by limiting the output current in the "TEST" mode to less than 1.0mA. When testing for grounds, the unique "touch-and-go" operation greatly accelerates the process. You don't even have to look at the meter until the audible alarm sounds. It should also be noted that, unlike conventional meters used in ground testing applications, with the Model 360 it is not necessary to switch polarities to detect both positive and negative grounds, where circuit voltage is 16VDC, or less. Where circuit voltage is over 16VDC it will be necessary to make both positive and negative ground tests.

Because the meter input impedance is 1000 ohms per volt (same as TS-111 meter), the likelihood of "ghost grounds" is virtually eliminated. If an alarm sounds when the maintainer checks a separate wire or a positive or negative battery bus, and the meter displays a voltage of 09.0 VDC or greater, he should note the wire or bus for further checking when he has track and time authority. After he gets the authority, he can continue, in the "TEST" mode, to identify the specific conductor or conductors that are grounded using the "TEST" mode. Once the grounded circuits are identified, he can switch the Ground Finder to the "CONFIRM" mode to confirm the strength of any ground identified. In the "CONFIRM" mode, full-scale output is 10.0mA at 22.5VDC (limited to extend tester operating battery life). A cross-reference table is provided in Section VIII, Set-Up, of this Manual (also in the Quick-Start booklet) indicating current values at 22.5 VDC, comparable to railroad ground criteria at voltages in common service in railroad signaling applications.

Built "railroad-tough" to withstand the usual working environment, the Model 360 is designed with circuitry that gives protection against damage due to momentary contact with 110VAC. And, because output is current-limited, connection of the tester to a high current ground will not damage it. Two forms of instruction are provided with the unit: a complete, printed manual and a plastic-paged booklet with Quick-Start, day to day user instructions.

A Calibration Check Device (PN: 360-30) accessory is available, to confirm that the tester will alarm at the proper ground value, and to verify Ground Finder calibration. Use of the accessory Dual Meter Case (PN: 360-20) provides a single item for the maintainer to carry into the house to make his monthly or quarterly tests. The Ground Finder fits into one pocket of the Case, and a Fluke or similar VOM into the other pocket.

It has been found that if the 360 Ground Finder, or any meter with a battery, is attached with a clip lead to an operating red signal being driven by a VLD-R16S lamp driver (GE Electro-Logic IXS component), within 12 to 60 seconds of continuous attachment, it will cause a "Lamp Out" condition which could result in red signals being displayed in adjacent blocks. Because the Ground Finder permits "touch and go" testing for grounds, this condition is unlikely to ever occur under normal circumstances. Note that it is likely that other brand electronic interlocking system, with an internal ground check feature, will be similarly affected.

V. SPECIFICATIONS

- a. "TEST" Mode Output: 22.5VDC @ less than 1.0mA
- b. "TEST" Mode Current Required For Ground Detection: 0.10mA
- c. "CONFIRM" Mode Output: Will not exceed 10.0mA @ 22.5VDC
- d. Isolation: 1000 Ohms per volt (through meter)
Designed to absorb momentary connection to 110VAC
Plastic case, insulated probe provides operator & short protection
- e. Indicators: Ground Detection - Red LED, Beeper
Adequate Internal Battery - 22.2 VDC or greater, in "TEST"
mode, with neg. lead clipped to probe.
- f. Battery: Type: Lithium, 9V transistor radio battery provided
Service Life: 30 hours with lithium battery, 20 hrs with alkaline battery
- g. Temperature: -10C (+12F) to +45C (120F), with lithium battery.
- h. Physical: Case: 6.75 in. long x 3.50 in wide x 1.50 in. high
Test Lead: 48" long, including crocodile clip
Ground Lead: 8 ft. long, with claw clip.

VI. FEATURES

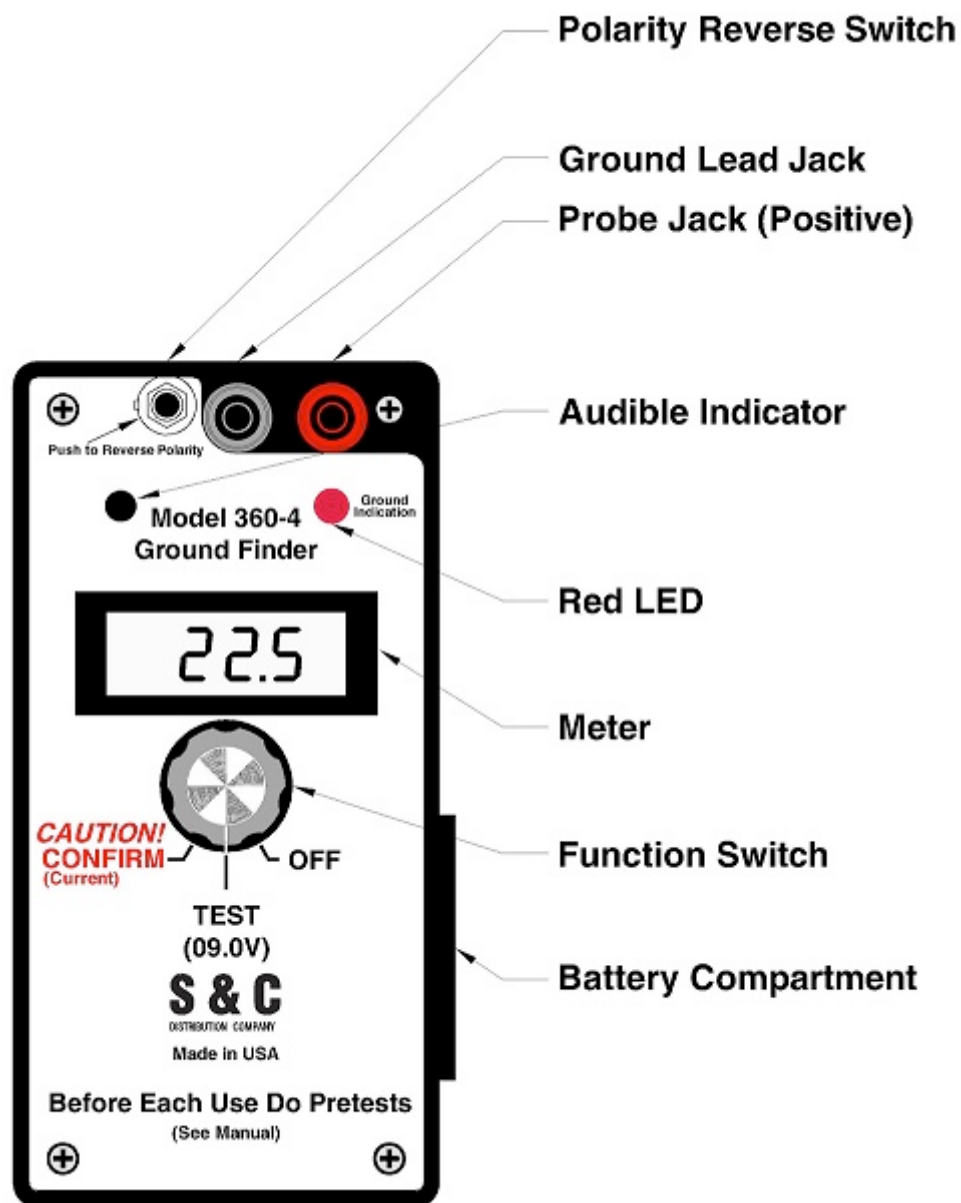
The following pages provide a detailed description of the features of the Model 360, the test probe provided with the positive test lead and Calibration Check Device.

A. Unit Features (Refer to Figure 1, following)

1. **Positive and Negative Lead Jacks:** Outputs for testing power for Ground Finder. Points where positive and negative test leads connect to the 360 tester.
3. **Polarity Reversing Switch:** Use for reversing polarity when checking for positive and negative grounds.
3. **LED:** Red LED is on when a ground is detected.
4. **Beeper:** Beeper indicates when ground is detected. A ground is reportable when the meter, in the "TEST" mode, reads "09.0" volts, or higher. Audio output level of the Beeper is approximately 70 dBA.
5. **3.5 Digit Meter**
 - a. **As Voltmeter:** Displays voltage being fed into the load of a ground. A zero ohm ground is 22.2 to 23.0 VDC.
 - b. **As Ammeter:** Provides current readings from 0.1mA to 10.0mA.
6. **Function Switch:** Switches tester between "Off", "TEST" and "CONFIRM".
7. **Battery Compartment:** Access to operating battery (9VDC) for status-check and replacement purposes. Drawer-style battery holder greatly facilitates installation and removal of the battery.

Feature Callout

(Fig. 1)



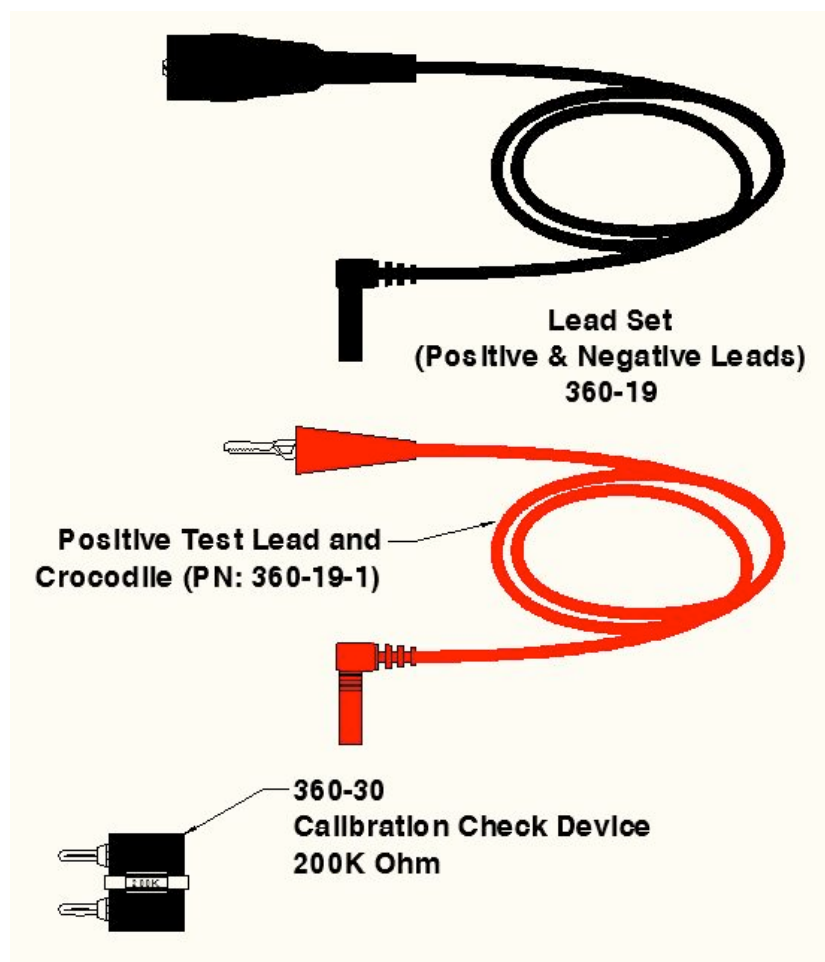
VI. FEATURES, Cont'd

A. Test Leads (Refer to Figure 2, below) **Positive and Negative Test Leads** are furnished with the 360 Ground Finder. The Positive Lead is four feet long and is equipped with a crocodile clip that allows “touch and go” testing. The Negative Test Lead is eight feet long and is equipped with a battery clip. Insulation on the test leads is rated at 1000V, 5.0A. Test Lead Set, PN: 360-19.

B. Accessory (Refer to Figure 2, below). **Calibration Check Device** (optional). A 1% accuracy test load can be purchased to match the ground detection calibration point of the 360 tester. This Calibration Check Device permits you to confirm calibration of the tester, it's alarm circuitry and it's operation. The Device also permits you to extend the once a year calibration cycle to once every five years, or more. We recommend that one Device be purchased for every ten Ground Finders in service and used verify Ground Finder calibration. Calibration Check Device, PN: 360-30.

Components & Accessories

(Fig. 2)



VII. SAFETY

The following safety considerations must be kept in mind when handling the Model 360 Ground Finder.

A. Eight important safety considerations when using the Model 360 to conduct ground tests are:

1. It is critical to remember that in the “CONFIRM” mode, the Ground Finder output can be as high as 10.0mA, at 22.5VDC.

NOTE: THIS CURRENT IS HIGH ENOUGH TO ENERGIZE RELAYS CONTROLLING TRAIN MOVEMENTS. DO NOT USE THE “CONFIRM” MODE OF THE TESTER WITHOUT FIRST OBTAINING PROPER AUTHORITY!

2. It is critical to remember that a Ground Finder that outputs more than 23.0 VDC in the “TEST” mode is malfunctioning. It should be returned to the factory for repair.

NOTE: IF THE OUTPUT VOLTAGE IN THE “TEST” MODE IS GREATER THAN 23.0 VDC, THE CURRENT OUTPUT MAY BE HIGH ENOUGH TO ENERGIZE RELAYS CONTROLLING TRAIN MOVEMENTS. DO NOT USE A GROUND FINDER THAT HAS A SHORTED-LEAD OUTPUT GREATER THAN 23.0 VDC!

3. Know where any trains are and how your tests will affect train operation or the safety of the public.
4. Insure that no unsafe conditions are created by your use of the Model 360 Ground Finder. See items 1 and 2 above.
5. Electrostatic charge may be present on conductors that will be tested. In a worst case situation, these electrostatic charges can kill you. Before and after making your tests, it is good safety practice to briefly short or ground the conductors to avoid receiving a shock or damaging the tester. Note that grounding can be done only if you have “track and time” authority.
6. Another hazard to be considered when conducting ground tests is induction caused by adjacent high voltage AC power lines. Induction voltages cannot be removed by grounding and they too can be dangerous. If there is a possibility that such voltages are present, it would be best to check the conductors for such extraneous voltages before handling the conductors.

7. Yet another hazard to be aware of is lightning. If you are conducting tests during lightning season, handle all wiring and cabling with great care, and be aware of weather conditions that may be threatening.
8. At the conclusion of your tests, insure that all signal apparatus functions as intended.

VIII. SET-UP

A. **SAFETY, AGAIN.** If you have not read the preceding Safety Section, please do so.

B. **UNIQUE OPERATING CHARACTERISTICS** of the Model 360 Ground Finder.

1. Unlike conventional meters used in ground testing applications, it is not necessary with the Model 360 to switch polarities to detect both positive and negative grounds, where circuit voltage is 16VDC, or less. Where circuit voltage exceeds 16VDC, it will be necessary to make both positive and negative tests on each bus. For the negative test, press the Reverse Polarity Button each time reversal is required, to momentarily reverse the polarity of the 360. In the "TEST" mode, when the meter indicates a reading of "09.0" volts, or greater, the ground is in the reportable range.
2. Railroads usually classify a reportable ground as being either 1mA or 2mA. Determine which of the below tables you should use to identify a reportable ground.

Reportable 1.0mA Ground/ Bus Voltage	Model 360 "CONFIRM" Mode Equivalent
1.0mA @ 10VDC	01.8mA
1.0mA @ 12VDC	01.6mA
1.0mA @ 14VDC	01.4mA
1.0mA @ 16VDC	01.2mA
1.0mA @ 18VDC	01.1mA
1.0mA @ 24VDC	00.8mA
1.0mA @ 28VDC	00.7mA

25mA @ 120VDC	03.1mA
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Reportable 2.0mA Ground/ Bus Voltage	Model 360 "CONFIRM" Mode Equivalent
2.0mA @ 10VDC	03.0mA
2.0mA @ 12VDC	02.6mA
2.0mA @ 14VDC	02.4mA
2.0mA @ 16VDC	02.1mA
2.0mA @ 18VDC	02.0mA
2.0mA @ 24VDC	01.6mA
2.0mA @ 28VDC	01.4mA

25mA @ 120VDC	03.1mA
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VIII. SET-UP, CONT'D

3. The 360 Ground Finder has been built "railroad-tough". It will withstand momentary contact with 110 AC voltage. Also, because output is current-limited, connection of the tester to a high current ground will not damage it.
4. AC voltages above 16VAC, whether they are intentionally applied to the wires under test or are impressed/induced in the wires due to case or bungalow proximity to high voltage power lines, etc., will cause the Model 360 to indicate a ground (beeper and LED activate and meter reads DC voltage and current in "TEST" and "CONFIRM" modes). In one instance, an induced 75VAC was reflected in the 360 tester readings as 10.8VDC in the "TEST" mode and 2.0mA in the "CONFIRM" mode.

The user of the Ground Finder may be able to differentiate between AC induction simulating a ground and a real ground by listening to the beeper. A real ground causes the beeper to emit a clear, steady beep. AC induction appearing to be a ground may cause the beeper to sound "ratty" (the beeper oscillates at 60Hz). A sure way to confirm that AC voltages are causing the Ground Finder to alarm is to use a VOM to measure the AC potential between the wires/buses and ground.

5. When operating the Ground Finder, to accommodate the natural response delay of an LCD meter, and any capacitance that may exist in the conductors being tested, it will be necessary to leave the Probe on the conductor terminal long enough to attain a maximum value reading. This "dwell" time should not exceed two seconds.
6. Due to the type of components used, a very low reading (static charge) may show on the LCD meter. These readings should be ignored and will not influence the accuracy of the Ground Finder.

C. **PRETEST** the 360 Ground Finder. We recommend that these Pretests be performed at the beginning of each day you plan to use the tester. We recommend that you purchase one Calibration Check Device (PN: 360-30) for every ten Ground Finders in service. This device permits users to periodically verify proper calibration of the Model 360.

1. Check Battery.

- a. Set the Function Switch to "TEST/Voltage".
- b. Short the Test Probe to the Ground Lead Clip.
- c. Voltmeter should read 22.2 to 23.0 VDC.
- d. If reading is less than 22.2 VDC, replace the internal 9.0VDC battery.
- e. If reading is greater than 23.0 VDC, the Ground Finder should be sent to the factory for repair.

VIII. SET-UP, Cont'd

2. Check tester Operation

a. With the Function Switch set to "TEST":

- 1). Short red Test lead to Ground Lead Clip.
- 2). Beeper should sound, the red LED should light and the Voltmeter should read "22.2" to "23.0"(VDC).
- 3). If the reading is greater than "23.0", the tester should be sent to the factory for repair.
- 4). If the reading is less than "22.2", replace the battery.

b. Move Function Switch to the "CONFIRM" position.

- 1). Short red Test lead to Ground Lead Clip.
- 2). Ammeter should read greater than "08.0" (mA).

3. Check Crossfeed Between Leads

(Before conducting the below checks, install the leads in the Model 360. Insure that leakage does not exist between the test leads by taking the following action.

- 1). Twist the leads loosely together (like a twisted pair cable), insuring that the free ends of the leads are separated and clear of all objects.
- 2). Set the Function Switch to "CONFIRM".
 - a). The meter should indicate no current flow (00.0).
 - b). If any leakage exists, the leads should be replaced. It is recommended that this test be repeated periodically during the life of the tester.

4. Check Operation of the Polarity Reversing Pushbutton

Because there is no visible indication that the polarity of the output of the 360 is reversing, for your benefit and understanding, we recommend that the operation of the reversing switch be confirmed upon receipt of the Ground Finder. To do this, hook up the output of the 360 to a Model 355 Signalman's Meter, or similar, on the Volts scale. Turn the 360 on, to the "TEST" mode, and without pushing the polarity reversing button (the small black button to the left of the negative lead terminal), read the output of the 360 with the Meter. The reading should show (a positive) 19-20 volts, approximately. The rest of the output of the 360 will show up on the meter of the Ground Finder, approximately 2.3 to 2.5 volts, for a total of 22.3 to 22.5

volts. With the Meter still connected to the 360, depress the button and hold it down briefly. The reading on the 355 Meter should be a negative reading of the same value you had without the button pressed.

From this point forward, it is recommended that periodic checks be made to confirm that the contacts of the push-button are functioning correctly. To do this, turn the Ground Finder on to the "TEST" mode, short the leads together and depress the button and hold it down briefly. The reading on the meter should be 22.5 volts. This test will confirm that the polarity reversing contacts in the switch are functioning properly. A lower reading normally indicates a weak battery.

IX. TESTING FOR GROUNDS

A. **SAFETY, ONE MORE TIME.** Safety considerations must be kept in mind when conducting insulation resistance tests. Please reread Section VII entitled “SAFETY”.

B. Keep in mind that It has been found that if the 360 Ground Finder, or any meter with a battery, is attached with a clip lead to an operating red signal being driven by a VLD-R16S lamp driver (GE Electro-Logic IXS component), within 12 to 60 seconds of continuous attachment, it will cause a “Lamp Out” condition which could result in red signals being displayed in adjacent blocks. Because the Ground Finder permits “touch and go” testing for grounds, this condition is unlikely to ever occur under normal circumstances. Note that it is likely that other brand electronic interlocking systems, with an internal ground check feature, will be similarly affected.

C. **CONFIRMING EARTH GROUND.** For ground tests to be valid, it is essential that signal case or house earth ground is present and of low resistance. The method for confirming earth ground is:

1. Put the Ground Finder in the TEST mode.
2. Connect the negative lead to an alternative ground (track wire, power company ground, etc.) and touch the positive probe to the signal ground to be used in the ground tests.
3. The reading on the Ground Finder should be at least 22.2.
4. This ground confirmation process should be done every time you are going to test a location for grounds, even if you have tested the location in the past and had an acceptable reading.

Typically, ground confirmation TEST mode readings are in the 22.2 to 22.5 range. A reading of as low as 19.0 (approximately 3300 ohms) can be used, under certain circumstances. Use one of the following two procedures to continue your ground tests if your TEST mode reading falls between 22.2 and 19.0.

1. Single Conductor Grounds (Such as a power company ground).
If you encounter a lower (22.1 to 19.0) TEST mode reading when confirming earth ground on an alternative ground such as a power company ground, to make effective ground tests, you must mentally reduce the go-no-go TEST mode value of 9.0. To do this:

IX. TESTING FOR GROUNDS, Cont'd

- a. Determine the difference between 22.5 (shorted lead Ground Finder reading) and the value just obtained when confirming your earth ground. For instance, if the Ground Finder reading in the earth ground confirmation test was 19.0, the difference between this number and 22.5 is 3.5.
- b. Subtracting 3.5 from 9.0 results in a value of 5.5. This is the value you must use as the go-no-go point (instead of 9.0) when testing for grounds at that location.

2. Track Wire Pairs

- a. If you encounter a lower (22.1 to 19.0) or higher (above 22.5) TEST mode reading using a track wire as an alternative ground, the first thing to do is to make the same test on the other wire of the track wire pair.
- b. If the second wire reads in the acceptable range (22.2 or greater) conduct your ground tests in the normal manner.
- c. If the second wire of the track wire pair has the same low reading you obtained on the first wire, to make effective ground tests, you must mentally reduce the go-no-go TEST mode value of 9.0. To do this you should:
 - 1). Determine the difference between 22.5 (shorted lead Ground Finder reading) and the value just obtained when confirming your earth ground. For instance, if the Ground Finder reading in the earth ground confirmation test was 19.0, the difference between this number and 22.5 is 3.5.
 - 2). Subtracting 3.5 from 9.0 results in a value of 5.5. This is the value you must use as the go-no-go point (instead of 9.0) when testing for grounds at that location.

Note that our explanation of how to use the low-end earth confirmation reading of 19.0 does not constitute an endorsement of a ground value of 3300 ohms. This is a very bad ground and may constitute an unsafe condition as well as one that may result in equipment damage during a lightning storm or other surge environment. As a point of reference, the US National Fire Protection Association requires a

IX. TESTING FOR GROUNDS, Cont'd

ground resistance of no more than 25 ohms, and even this low level may not provide much protection from a surge. As grounding networks go, the lower the resistance to ground the better.

Note also that while the Ground Finder can be used for the purposes of confirming earth ground for monthly and quarterly ground tests, simulating what has been historically done with various meters in ground test applications, this test is not sufficient to constitute a test of the signal system grounding network. Commercially available made ground testers should be used for this purpose.

D. MAKING GROUND TESTS. Procedure for making Ground Tests is as follows. Tests must be made when the wires, cables or insulated parts are dry.

1. Reread and utilize the safety recommendations found in Section VII, entitled "Safety".
2. Confirm earth ground (see Section C, above).
3. Turn on the tester and set it's function switch to "TEST".
4. Perform Ground Finder pretests. Pay particular attention to the "TEST" mode shorted-lead reading. It should not exceed 23.0 VDC.
5. Check both positive and negative battery buses of all battery systems in case or house, and all separate wires normally checked for grounds.
 - a. Conductor insulation must not be punctured while conducting ground tests.
 - b. Connect the Negative (Black) lead of the tester to ground.
 - c. Set the Function Switch to "TEST".

NOTE: Take great care to insure that the Ground Finder Function Switch is on "TEST" and not "CONFIRM", unless you have "track and time" authority from the dispatcher.

- d. In turn, touch the Positive (Red) lead to a terminal on each positive and negative battery bus, and all separate wires, in the case or house. Allow time to accommodate meter delay and circuit capacitance before moving the lead to the next test point. If circuit

IX. TESTING FOR GROUNDS, Cont'd

voltage on a bus or wire exceeds 16VDC, it will be necessary to make both positive and negative tests on that bus or wire. For the negative test, reverse Ground Finder lead connections.

- e. If a ground is detected, the Beeper will beep and the red LED will light. Make both positive and negative tests on the bus or wire. If, in either polarity, the voltage indicated on the meter is "09.0" volts or greater the ground is in the reportable range.

NOTE: Be sure to read Paragraph 4 of the Unique Operating Characteristics section (Pg. 11) of this Manual. AC induction can cause a false ground detection.

- f. Obtain proper authority (track and time) to begin the work of identifying the precise circuit that is grounded.
 - 1). Isolation of the ground is the key to locating it. A good first step is to disconnect one side of the case or house battery from its bus (both sides if you have means to do this without disarranging the signal system). Doing this will prevent the Ground Finder from detecting a ground on the opposite bus by reading through the battery. Also, disconnecting the battery eliminates it as a source of your ground. If you cannot disconnect both sides of the battery at the same time, repeat the process on the opposite bus after concluding your ground test procedure on the first bus.
 - 2). To determine the strength of the ground, switch the Model 360 to the "CONFIRM" mode and connect it to the bus or wire and ground in the same hook-up configuration that originally detected the ground.
 - 3). Read the value. Note that while the output of the Model 360 is limited to 10.0 mA, the actual ground current draw could be greater. Following is a cross-reference table of values showing the reading that will appear on our Ground Finder meter that corresponds to a particular railroad standard for a reportable and correctable ground.

IX. TESTING FOR GROUNDS, Cont'd

Reportable 1.0mA Ground/ Bus Voltage	Model 360 “CONFIRM” Mode Equivalent
1.0mA @ 10VDC	01.8mA
1.0mA @ 12VDC	01.6mA
1.0mA @ 14VDC	01.4mA
1.0mA @ 16VDC	01.2mA
1.0mA @ 18VDC	01.1mA
1.0mA @ 24VDC	00.8mA
1.0mA @ 28VDC	00.7mA
25mA @ 120VDC	03.1mA

Reportable 2.0mA Ground/ Bus Voltage	Model 360 “CONFIRM” Mode Equivalent
2.0mA @ 10VDC	03.0mA
2.0mA @ 12VDC	02.6mA
2.0mA @ 14VDC	02.4mA
2.0mA @ 16VDC	02.1mA
2.0mA @ 18VDC	02.0mA
2.0mA @ 24VDC	01.6mA
2.0mA @ 28VDC	01.4mA
25mA @ 120VDC	03.1mA

- 4). If the ground is the same value as or is greater than the appropriate value above, you must now identify the specific wire or wires that are grounded.
- 5). Return the function switch to the “TEST” mode.
- 6). When on a bus, you must test each wire independently of all others by taking loose one end of each wire. To avoid disarranging your signal location do this one wire at a time, refastening the first wire before loosening the next.

IX. TESTING FOR GROUNDS, Cont'd

- 7). Once a wire end is free, touch the positive (red) lead to the wire or eyelet. Connect the tester to the wire and ground in the configuration (normal or reverse tester lead connections) that originally detected the ground.
 - 8). When a ground is detected, the Beeper will sound and the red LED will light. If the meter indicates a reading of "09.0" volts, or greater, the ground is in the reportable range.
 - 9). To determine the strength of the ground, switch the tester to the "CONFIRM" mode and touch the Probe to the wire or eyelet.
 - 10). Read the value. Refer back to the chart, above or in the Quick-Start booklet, if necessary.
 - 11). Repeat this process until all grounds have been detected.
- .
- g. Reconnect all wires and cables. Make all necessary or required operational tests to insure the safety of the signal system.
 - h. Close "track and time" authority.

X. Federal Railroad Administration & Transport Canada Requirements For Ground Tests

To assist users who are not familiar with Federal Railroad Administration (FRA) or Transport Canada (TC) ground testing requirements, they are summarized in the following paragraphs. Under no circumstances should you consider the following information complete or definitive. Consult your company's instructions concerning the testing of grounds for complete information, or obtain a copy of the appropriate FRA or TC rules and regulations.

A. Ground Tests -

1. FRA Rule: 236.2 Grounds - Each circuit, the functioning of which affects the safety of train operations, shall be kept free of any ground or combination of grounds which will permit a flow of current equal to or in excess of 75 percent of the release value of any relay or other electromagnetic device in the circuit, except circuits which include any track rail and except the common return wires of single-wire, single break, signal control circuits using a grounded common, and alternating current power distribution circuits which are grounded in the interest of safety.
2. FRA Rule: 236.107 Ground Tests
 - a. Except as provided in paragraph (b) of this section, a test for grounds on each energy bus furnishing power to circuits, the functioning of which affects the safety of train operation, shall be made when such energy bus is placed in service, and shall be made at least once every three months thereafter.
 - b. The provisions of this rule shall not apply to track circuit wires, common return wires of grounded common single-break circuits, or alternating current power distribution circuits grounded in the interests of safety.
3. Transport Canada Rules

Transport Canada requires adherence to American Railway Engineering & Maintenance Association (AREMA) requisites and guidelines, except where the railroad has properly justified and documented an alternative. In this case, AREMA standards closely parallel the rules established by the FRA (shown above).

XI. REPLACING THE INTERNAL BATTERY

A. Replacing the Battery in 360-1 and 360-2 Versions. The Model 360 Ground Finder operates on a 9VDC transistor radio battery. It is located behind the removable panel which is located below the Function Switch on the face of the Tester. When the meter shows a reading of “22.2” volts or less, with the Positive (red) Lead shorted to the Ground Lead Clip, the battery should be replaced. We recommend using a high quality,alkaline battery (Mallory, RAOVAC AL-95, Eveready 522, etc.) for the replacement.

NOTE: the fabric ribbon associated with the internal battery holder makes installation and removal of the battery much easier. To use the ribbon effectively:

1. Installation: With the battery aligned with the holder terminals and the ribbon around the LH end (bottom) of the battery, pull the ribbon toward the RH end (top) of the battery. The battery terminals will “snap” into the holder terminals.
2. Removal: Pull the ribbon up and away from the battery. The battery will literally “pop” out of its holder.

B. Replacing the Battery in the 360-3 and 360-4 Versions. The 9VDC lithium battery in the 360-3 version of the Ground Finder resides in the drawer on the RH side of the side of the Ground Finder, as you face it. Using the slot in the front of the drawer to assist you, lift the drawer up and pull it toward you. Observe polarity when installing the battery (The bottom of the drawer is marked to show polarity and the back end of the drawer has cutouts for the battery terminals that allow only proper-polarity installation of the battery.

XII. TROUBLE-SHOOTING

The following checks can be used to identify problems or provide data helpful in diagnosing problems with your Ground Finder. (Before conducting the below checks, install the leads in the tester).

- A. Insure that leakage does not exist between the test leads.
 - 1. Twist the leads loosely together (like a twisted pair cable), insuring that the free ends of the leads are separated and clear of all objects.
 - 2. Turn the Ground Finder on, with the function Switch set to "TEST".
 - 3. The meter should indicate infinity (00.0).
 - 4. If any leakage (meter reading anything other than "00.0") exists, the leads should be replaced.
- B. Insure that the unit will read Zero ohms.
 - 1. With the Function Switch set to "TEST", short the leads together.
 - 2. The meter should read "22.2" to "23.0" (VDC).
 - 3. If the reading is greater than "23.0", the Ground Finder should be returned to the factory for repair.
- C. If you have purchased the Calibration Check Device (PN: 360-30) confirm operation of the Ground Finder alarm function and calibration of the Voltmeter and Ammeter as follows.
 - 1. Current version Ground Finders - Turn the Function Switch to "TEST"
 - a. Plug the Calibration Check Device into the lead sockets.
 - b. Beeper should sound, the red LED should light and the Voltmeter should read "02.2" (VDC), +/- one count. In the unlikely event that the reading is less than "02.1", or greater than "02.3", the unit needs calibration.
 - 2. Early version Ground Finders (hardwired negative lead) - Turn the Function Switch to "TEST":
 - a. Connect the Ground Lead Clip to one banana plug on the Calibration Check Device and insert the Probe into the banana jack on the opposite side of the Cal. Check Device (see Fig. 2).
 - b. Beeper should sound, the red LED should light and the Voltmeter

XII. TROUBLE-SHOOTING, Cont'd

should read "02.2" (VDC), +/- one count. In the unlikely event that the reading is less than "02.1", or greater than "02.3", the unit needs calibration.

D. Tester won't work. Meter shows: "00.0".

1. Are test leads connected properly?
2. Check leads themselves. Does one of them have a loose connection?

E. Tester won't work. Meter is off.

1. Is Function Switch set to "TEST" or "CONFIRM"?
2. Is internal battery securely in its holder?
3. Check the internal battery for proper voltage.

XIII. CALIBRATION & REPAIR SERVICES

S&C Distribution Company recommends that, unless you have purchased the appropriate Calibration Check Device for your application, the Model 360 Ground Finder should be calibrated every year at a location that employs instruments meeting United States National Institute of Standards and Technology (NIST) standards. Said calibration can be accomplished by a qualified calibration station, by S&C Distribution Company, or possibly by qualified railroad personnel (Write for free calibration instructions). If you use the Calibration Check Device, as long as the tester readings match those observed when the tester was new, calibration service is required once every five years instead of annually.

Certified calibration is available at S&C Distribution Company. With this calibration service the tester is sealed afterward, and a Certificate of Calibration and Traceability is provided.

If you choose to send the unit to us for calibration, contact us per the coordinates supplied on the last page of this booklet, to obtain a Return Goods Authorization (RGA) and other pertinent information, indicating at the time whether or not you want a certificate of calibration and traceability.

IXV. ORDERING REFERENCES**Assemblies, Accessories and Commonly Replaced Parts**

Description	Part Number
360 Ground Finder with Crocodile Clip Positive Lead & Tool Pouch Case. Can also be used to create Dual-Meter Case Kit with 355 Signalman's Meter	360-4
360 Ground Finder in Dual-Meter Case to accommodate Fluke Meter	360-1003
Calibration Check Device accessory	360-30
Dual-Meter Case to accommodate Fluke meter	360-20
Lead Set, replacement	360-19
9 Volt Battery, Lithium, replacement	04-1015
Tool Pouch Case, replacement, accommodates Dual-Meter Kitting with 355 Signalman's Meter	360-12

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