
SSIT-201 Circuit Ground & Isolation Fault Test

Purpose

Circuit ground and isolation fault tests shall be performed to ensure there are no grounds and/or battery isolation faults that allow enough current flow to interfere with proper functionality of the site circuitry and equipment.

Rail Safety

Employee shall ensure the site is safe for employees, the public, vehicular traffic and train operations as defined in *SSIT-8 Protecting Train Operations* prior to performing tests and inspections.

Caution

Do not turn AC power off or on while warning system is activated.

Test Intervals

Refer to *SSIT-7 Signal System Inspection and Test Intervals* for all test intervals. Employee shall inspect and test all battery cells and isolated power supplies when installed, as required, and at least **once every three (3) months** for isolation faults and grounds. In addition, tests are to be performed in any of the following circumstances:

- prior to any tests or modifications to circuits connected to battery bank.
- following modifications of wiring or equipment involving battery bank circuits.
- prior to leaving the location where there is on-going work which could potentially create a circuit ground or isolation fault.
- following exposure/damage of cable from excavation or MOW programs (If insulation resistance test cannot be performed immediately).



Caution

An ammeter (or S&C 360 Ground Finder in the “Confirm” mode) is effectively a short circuit and a short circuit applied to a signal circuit which is suspected of being grounded may provide a second path to complete a wrong side failure. Always ensure Positive protections is applied in accordance with SSIT-8 when testing for circuit grounds.

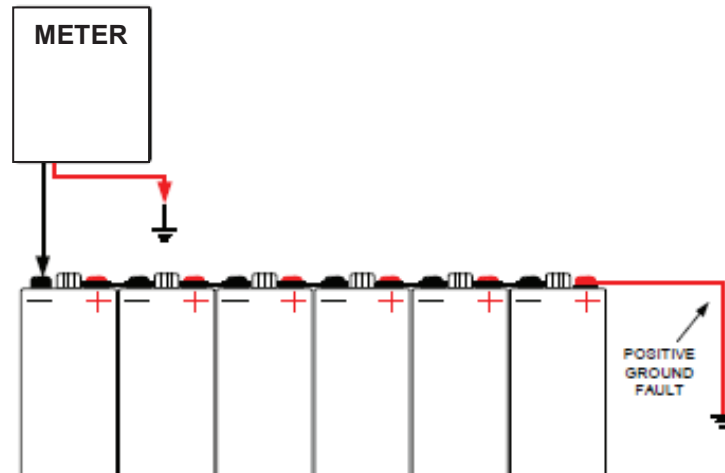
- Before applying voltmeter in a circuit ensure the meter is set on its highest scale.
- Do not attempt to perform ground measurement with two meters simultaneously attached to the same energy source as the internal resistance may result in false ground readings.
- The S&C Ground Finder may cause MOV lighting arresters connected to the vital energy circuits to conduct, which may appear as a ground fault. If this is suspected the offending MOV arresters should be isolated from ground while performing tests.
- Before inserting an ammeter into the circuit, ensure the meter is set on its highest scale at the start of the test, and select proper scale to determine the ground current.



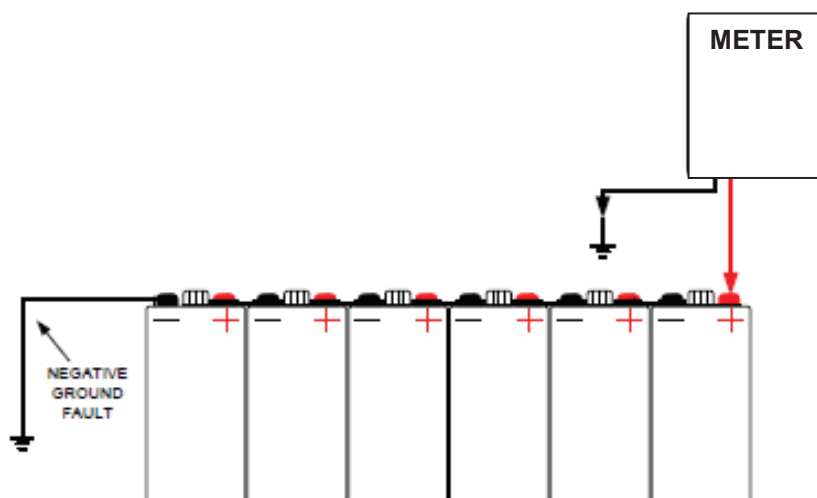
If the insulation of a wire or cable appears or is suspected of being damaged, the wire(s) should be tested prior to performing full test. Refer to *SSIT-302 Wire & Cable Resistance* for testing procedure.

Understanding Circuit Ground Testing

A positive ground, the most hazardous type of ground fault, can be detected if a voltage reading is detected when the negative lead of the meter is connect to the - terminal post of the battery and the + lead of the meter is connect to ground.



A negative ground can be detected if a voltage reading is detected when the positive lead of the meter is connect to the + terminal post of the battery and the - lead of the meter is connect to ground.



Circuit Grounds (Using S&C 360 Ground Finder Device)

The following tests are to be performed when the S&C 360 Ground Finder device is used to perform circuit ground checks:

Step	Procedure
1. Check Ground Connections	<ul style="list-style-type: none"> → Check the ground rods have good penetration into ground. → Check the ground rods are connected to the ground network. → Check the connections between prime ground terminals and ground are in good condition.
2. Calibrate Ground Finder	<ul style="list-style-type: none"> • Calibrate Ground Finder as per manufacturer instructions.
3. Test for Positive and Negative Grounds	<ul style="list-style-type: none"> • Set the Ground Finder (FF) to "TEST" (or equivalent). • Test for Positive Grounds - Connect the red (+) GF lead to ground and the black lead to each energy buss and then repeat for each wire leaving the entrance. Hold for 2 seconds per buss / wire. • Test for Negative Grounds - Connect the black (-) GF lead to ground and the red (+) meter lead to each energy buss and then repeat for each wire leaving the entrance rack. Hold for 2 seconds per buss / wire. <p>If Ground Finder beeps steadily: reverse the leads to test negative bus as well.</p> <p>If Ground Finder shows 9.0V or greater in either polarity: Proceed to step 4 for isolating the ground fault.</p>
4. Locate Fault (if applicable)	<p>Perform the following checks until the fault is located:</p> <ul style="list-style-type: none"> • To determine if the fault is from source outside the housing, individually isolate each external wire connected to battery bank to find voltage. • To determine if the fault is in the internal circuitry, isolate each internal circuit connected to battery bank individually to find voltage. • To determine if fault is from source, isolate and test energy source.
5. Eliminate Fault (if applicable)	<ul style="list-style-type: none"> • Replace faulty wires, circuit components, or equipment one element at a time as required. <p>If the repair is too extensive to complete prior to leaving site: Refer to step 6 for direction on providing adequate protection.</p>
6. Apply Protection (if applicable)	<ul style="list-style-type: none"> • Obtain positive track protection. • Contact the ONR S&C Supervisor to arrange fix as soon as possible. • Switch Ground Finder to "CONFIRM" and measure ground current. <p>If the reading exceeds 3.1mA on 120V: Circuits need to be protected. Disable portion(s) containing ground faults.</p> <ul style="list-style-type: none"> • Check the field DA rating as recorded on the relay specification label for current rating, use 110% for metering variances. <p>If the reading is below 110% of lowest relay drop away value on lower voltage: Current may prevent relays from de-energizing. Circuits need to be protected. Disable circuit(s) containing ground faults.</p>

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Step	Procedure
7. Repeat Tests for each Power Switch (if applicable)	Repeat steps 3 to 6 on switch operating bank. Repeat testing for every switch in each of the following configurations: <ul style="list-style-type: none"> • Normal • Switching between positions • Reverse
8. Repeat Tests for Warning System with Gate Mechanism (if applicable)	Repeat steps 3 to 6 on the gate operating bank with the gates in each configuration: <ul style="list-style-type: none"> • Up position • Travelling between up and down • Down position
9. Repeat Tests with Power off	<ul style="list-style-type: none"> • Turn AC power off, and wait 5 minutes for standby battery bank voltage to stabilize. Repeat steps 3 to 6 on each battery bank and all circuits leaving the entrance board.
10. Reconnect AC Power	<ul style="list-style-type: none"> • Turn AC power back on.

Battery and Circuit Grounds (Using Multimeter)

The following tests are to be performed when a Multimeter device is used to perform ground checks:

Step	Procedure
1. Check Ground Connections	→ Check the ground rods have good penetration into ground. → Check the ground rods are connected to ground network. → Check the connections between prime ground terminals and ground are in good condition.
2. Calibrate Multimeter	A low impedance multimeter is required for ground tests. If the multimeter is high impedance, connect a minimum 15kΩ resistor between leads for testing. <ul style="list-style-type: none"> • Connect the red lead to + terminal and the black lead to – terminal of meter. • Test the voltage reading on known voltage point. Start at highest scale and work back until reading is established. • Test the current reading across known resistor value. Start at highest scale and work back until reading is established. • Test earth ground by checking between a track connection and ground. If the multimeter is not working: Test on other points to verify. Obtain new meter if it is not displaying the values expected.

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Step	Procedure
3. Test for Positive and Negative Grounds	<ul style="list-style-type: none"> Switch the meter to Voltage setting. Test for Positive Grounds - Connect the red (+) meter lead to ground and the black lead to each energy buss and then repeat for each wire leaving the entrance. Hold for 2 seconds per buss / wire. Test for Negative Grounds - Connect the black (-) meter lead to ground and the red (+) meter lead to each energy buss and then repeat for each wire leaving the entrance rack. Hold for 2 seconds per bus / wire. <p>If the meter jumps out of the expected voltage range: Proceed to step 4 for isolating the ground fault.</p>
4. Isolate Fault (if applicable)	<p>Perform the following checks until the fault is located:</p> <ul style="list-style-type: none"> To determine if a fault is from source outside the housing, individually isolate each external wire connected to the battery bank to find a voltage. To determine if the fault is in the internal circuitry, isolate each internal circuit connected to battery bank individually to find a voltage. To determine if a fault is from another source, isolate and test each energy source.
5. Eliminate Fault (if applicable)	<ul style="list-style-type: none"> Replace any faulty wires, circuit components, or equipment one element at a time as required. <p>If the repair is too extensive to complete prior to leaving site: Refer to step 6 for direction on providing adequate protection.</p>
6. Apply Protection (if applicable)	<ul style="list-style-type: none"> Obtain positive track protection. Contact the ONR S&C Supervisor to arrange fix as soon as possible. Switch meter to measure ground current. <p>If the reading exceeds 25mA on 120V: Circuits need to be protected. Disable any circuit(s) containing a ground fault.</p> <ul style="list-style-type: none"> Check the field DA rating as recorded on the relay specification label for current rating, use 110% for metering variances. <p>If the reading is below 110% of lowest relay drop away value on lower voltage: Current may prevent relay from de-energizing. Circuits need to be protected. Disable any circuit(s) containing a ground fault.</p>
7. Test Faults on Standby Power	<ul style="list-style-type: none"> Turn AC power off, and wait 5 minutes for standby battery bank voltage to stabilize. Repeat steps 3 to 6 on each battery bank and all circuits leaving the entrance board.
8. Repeat Tests for Approach Lighting (if applicable)	<ul style="list-style-type: none"> Repeat steps 3 to 6 on the approach lights operating bank with lighting circuits energized.
9. Repeat Tests for each Power Switch (if applicable)	<p>Repeat steps 3 to 6 on switch operating bank. Repeat testing for every switch in each of the following configurations:</p> <ul style="list-style-type: none"> Normal Switching between positions Reverse

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Step	Procedure
10. Repeat Tests for Warning System with Gate Mechanism (if applicable)	Repeat steps 3 to 6 on the gate operating bank with the gates in each configuration: <ul style="list-style-type: none"> • Up position • Travelling between up and down • Down position
11. Repeat Tests on each Block with Normally Lined Traffic (if applicable)	Repeat steps 3 to 6 on the block operating bank with: <ul style="list-style-type: none"> • traffic lined in one direction. • traffic lined in opposite direction. If not practical to observe traffic in both directions: Note direction tested and perform the test with the opposite direction lined in the future when available.
12. Reconnect AC Power	<ul style="list-style-type: none"> • Turn AC power back on.

Battery Isolation Faults

The following tests are to be performed to complete battery isolation checks:

Step	Procedure
1. Identify Power Sources	<ul style="list-style-type: none"> • List all standby power sources. • List any additional power sources. • Combinations – list all pairs of power sources.
2. Calibrate Multimeter	<p>High impedance multimeter required for ground tests. If multimeter is low impedance, connect a minimum 15kΩ resistor between leads for testing.</p> <ul style="list-style-type: none"> • Connect red lead to + terminal and black lead to – terminal of meter. • Test voltage reading on known voltage point. Start at highest scale and work back until reading is established. • Test current reading across known resistor value. Start at highest scale and work back until reading is established. • Test earth ground by checking between track connection and ground. <p>If multimeter not working: Test on other points to verify. Obtain new meter if it is not displaying the values expected.</p>
3. Connect Leads	<ul style="list-style-type: none"> • Switch meter to Voltage setting. • Connect red lead to + terminal of #1 energy source. • Connect black lead to – terminal of #2 energy source. • Note voltage (if any). • Connect red lead to + terminal of #2 energy source. • Connect black lead to – terminal of #1 energy source. • Note voltage (if any).

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Step	Procedure
4. Isolate Fault (if applicable)	Perform the following checks until the fault is located: <ul style="list-style-type: none"> To determine if fault is from source outside the housing, individually isolate each external wire connected to battery bank to find voltage. To determine if the fault is in the internal circuitry, isolate each internal circuit connected to battery bank individually to find voltage. To determine if fault is from source, isolate and test energy source.
5. Eliminate Fault (if applicable)	<ul style="list-style-type: none"> Replace faulty wires, circuit components, or equipment one element at a time as required. If repair too extensive to complete prior to leaving site: Refer to step 6 for direction on providing adequate protection.
6. Apply Track Protection (if applicable)	<ul style="list-style-type: none"> Obtain positive track protection. Contact the ONR S&C Supervisor to arrange fix as soon as possible.
7. Test All Power Source Pairs	<ul style="list-style-type: none"> Repeat steps 3 to 6 to test between each pair of power sources.

Record Test Results

Record the test results for each primary battery tested:

Step	Procedure
1. Update Battery Card	<ul style="list-style-type: none"> Add values observed for each bank tested for reviewing battery depletion. Include date, time and initials.
2. Update Log Book	<ul style="list-style-type: none"> Add any notes of issues observed, or adjustments made.
3. Complete Test Form	<ul style="list-style-type: none"> Record the test as completed on SSIT test form.