



Infrastructure Division Standard Operating Procedure

Audio Frequency Track Circuit Performance Verification Testing SIGM-SOP-P004

SUPERSEDES SIGSOP-P0012

Revision Level: 0

1.0 PURPOSE

The purpose of this procedure is to establish the basic procedures to test the proper performance and safe verification of track circuits in operation.

2.0 SCOPE

The scope of this procedure is limited to the procedures for verifying the proper safe performance of audio frequency track circuits which must be conducted periodically. This procedure does not address normal preventative maintenance of Audio frequency track circuits nor corrective maintenance procedures or requirements. See SIGM-SOP-P003 for preventative maintenance procedures of audio frequency track circuits.

NOTE: Proper PPE shall be worn at all times while working on the right-of-way.

3.0 DEFINITIONS

3.1 AF Track Circuit

The audio frequency (AF) track circuit consists, at its very basics, of a transmit impedance bond, a receive impedance bond, a module with transmit and receive boards, a track relay and twisted pair wires connecting the field devices to the AF modules in the signal house. AF track circuits detect the presence of a train in a particular section of track and also transmit a cab signal speed to the train.

3.2 Soft Shunt

A track shunt placed between the two running rails of a track circuit which has a nominal resistance level. This is defined as 0.06Ω at CTA. Only a CTA approved and supplied soft shunt strap shall be used for track circuit testing. The shunt must be securely connected to each of the running rails to ensure a proper shunt utilizing the shunt strap rail clamp.

3.3 Hard Shunt

A track shunt placed between the two running rails of a track circuit which has a nominal resistance level of 0.00Ω. Only a CTA approved and supplied hard shunt strap shall be used for track circuit testing. The shunt must be securely connected to each of the running rails to ensure a proper shunt using the shunt strap rail clamp.



Infrastructure Division Standard Operating Procedure

Audio Frequency Track Circuit Performance Verification Testing SIGM-SOP-P004

SUPERSEDES SIGSOP-P0012

Revision Level: 0

3.4 GRS II

Second generation audio track circuit system developed by GRS (modern day Alstom) in the mid to late 1970s. Reference Alstom Pamphlet 1482B.

3.5 AF-500

Original generation of CTA-installed audio track circuit system by US&S (modern day Ansaldo) in the 1980s to 1990s. Reference Ansaldo SM632.

3.6 AF-800

Latest generation of CTA-installed audio track circuit system by US&S (modern day Ansaldo) in the early 2000s to present day. Reference Ansaldo SM9292.

3.7 Harmon Audio

Audio track circuit system developed by Harmon (modern day GE Transportation). Reference GE Technical Manual 100091-004 AA0.

4.0 RESPONSIBILITY AND AUTHORITY

The Director, Power & Way Maintenance; Chief Engineer, Vice President, Infrastructure; and the Chief Infrastructure Officer shall have joint authority for approving this procedure.

4.1 Director, Power & Way Maintenance

The Director, Power & Way Maintenance, shall be responsible for ensuring implementation of this procedure.

4.2 Manager, Signal Maintenance

The Manager, Signal Maintenance shall be responsible for:

- Implementation of this procedure

4.3 Coordinator, Signal Maintenance

The Coordinator, Signal Maintenance shall be responsible for:

- Assuring adherence to this procedure.
- Analyzing and making recommendations from results of shunt testing sensitivity and spurious signal testing.



Infrastructure Division Standard Operating Procedure

Audio Frequency Track Circuit Performance Verification Testing SIGM-SOP-P004

SUPERSEDES SIGSOP-P0012

Revision Level: 0

- Auditing documentation related to this procedure.

4.4 Foreman, Signal Maintenance

The Foreman, Signal Maintenance shall be responsible for:

- Assuring adherence to this procedure.
- Auditing documentation related to this procedure.
- Developing a specific maintenance schedule that adheres to the SOP requirements.
- Supervising the investigation of problematic track circuits and making recommendation to the Coordinator, Signal Maintenance regarding circuits needing to be readjusted with a new baseline.

4.5 Signal Maintainer or Specialist

The Signal Maintainer or Specialist shall be responsible for:

- Conducting and documenting annual AF track circuit shunt testing.
- Conducting and documenting annual spurious signal test.

5.0 PROCEDURE

5.2 Shunt Sensitivity Testing

5.2.1 Notify Rail Control that there are personnel working on the right-of-way utilizing the 10-35 radio call code. Worker Ahead systems shall be utilized as appropriate.

5.2.2 Perform **annually** a minimum performance test as indicated in the following steps.

5.2.2.1 One maintainer shall be located in the signal house and shall install Tektronix or Fluke oscilloscope leads on the track circuit receive after filter and observe the waveform. The maintainer shall record the receive shunt peak to peak voltages on the Shunt Sensitivity Testing Data Sheet (Exhibit A).

5.2.2.2 Two maintainers on the wayside shall place a HARD shunt approximately 50 feet before the impedance bond at the



Infrastructure Division Standard Operating Procedure

Audio Frequency Track Circuit Performance Verification Testing SIGM-SOP-P004

SUPERSEDES SIGSOP-P0012

Revision Level: 0

receive end outside the track circuit limits. The maintainer in the signal house will record the peak-to-peak receive voltage level on the Shunt Sensitivity Testing Data Sheet and ensure the track circuit relay stays energized. Remove the shunt.

- 5.2.2.3 Maintainers on the wayside shall place a 0.06Ω SOFT shunt strap within 5 feet of the RECEIVE impedance bond. The maintainer in the signal house will record on the Shunt Sensitivity Testing Data Sheet the receive peak to peak voltage level inside the track circuit limits and verify the track relay de-energizes in the signal house. Remove the shunt and ensure the appropriate track relay energizes.
 - 5.2.2.4 Maintainers on the wayside shall place a 0.06Ω SOFT shunt strap within 50 feet of the center of the track circuit. The maintainer in the signal house will record on the Shunt Sensitivity Testing Data Sheet the receive peak to peak voltage level inside the track circuit limits and verify the track relay de-energizes in the signal house.
 - 5.2.2.5 Maintainers on the wayside shall place a 0.06Ω SOFT shunt strap within 5 feet of the TRANSMIT impedance bond. The maintainer in the signal house shall record on the Shunt Sensitivity Testing Data Sheet the peak-to-peak receive voltage level inside the track circuit limits and verify the track relay de-energizes in the signal house.
- 5.2.3 All audio track circuits shall be tested **annually** for spurious signals that may lead to an unsafe condition of the track circuit.
- 5.2.3.1 Maintainers shall utilize two HARD shunts a distance of approximately 75 feet apart, centered within the track circuit.
 - 5.2.3.2 Track circuits less than 400 feet in length shall have shunts placed approximately 1/3 of the distance from each impedance bond.



**Infrastructure Division
Standard Operating Procedure**

**Audio Frequency Track Circuit Performance Verification Testing
SIGM-SOP-P004**

SUPERSEDES SIGSOP-P0012

Revision Level: 0

- 5.2.3.3 A maintainer in the signal house shall use a Tektronix or Fluke scope and read the peak-to-peak receive voltage with the double hard shunts in place on the rail.
 - 5.2.3.4 Values of receive voltage in peak-to-peak shall be recorded along with a description of the waveform and verification that the track relay de-energized on the Spurious Signal Testing Data Sheet (Exhibit C)
 - 5.2.3.5 The Spurious Signal Testing Data Sheets from spurious signal testing shall be sent to signal management for further determination.
- 5.2.4 In the event that any track relay fails to de-energize appropriately, the maintainer shall take the track circuit out of service by turning off the transmit voltage or pulling the transmit board and ensuring the track circuit relay is de-energized. The maintainer shall tag the defective circuit.
- NOTE: At NO TIME may a track circuit be left in service for which a shunt does not de-energize the track relay. If a track fails to shunt, the maintainer shall turn off the track transmit voltage or pull the transmit board and immediately notify the foreman that the track circuit is out of service.**
- 5.2.5 Maintainers shall call off the 10-35 code notifying Rail Control and deactivate any Worker Ahead Zones they activated when they are clear of the right-of-way and testing is complete.

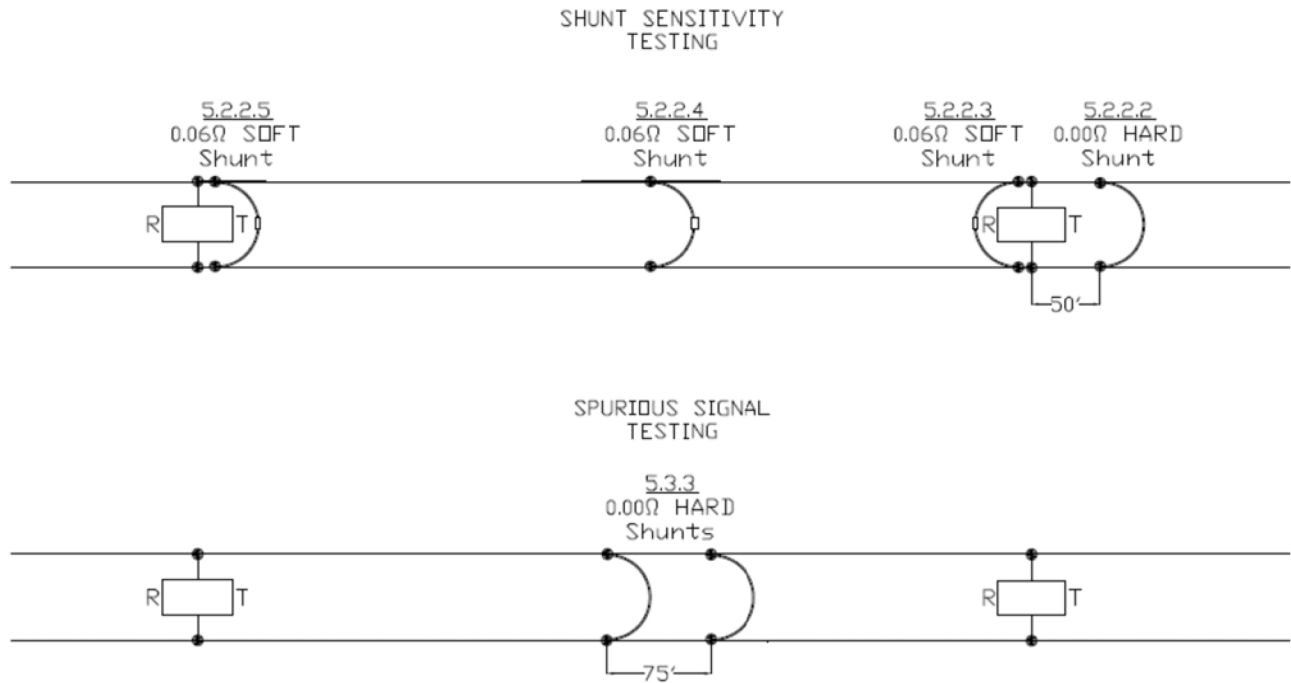


Infrastructure Division Standard Operating Procedure

Audio Frequency Track Circuit Performance Verification Testing SIGM-SOP-P004

SUPERSEDES SIGSOP-P0012

Revision Level: 0



6.0 GUIDELINES

- 6.1 All audio track circuits shall be read using a Tektronix or Fluke oscilloscope that has been calibrated in the past 4 years. All readings shall be recorded in peak-to-peak values unless specified otherwise. At no time shall audio track circuit readings be taken with a multi-meter.
- 6.2 Track circuit shunt testing requires at least three maintainers. Two on the right-of-way and one in the signal house, observing the operation of the circuit.

7.0 REFERENCE DOCUMENTATION

- 7.1 Exhibit A Shunt Sensitivity Testing Data Sheet
- 7.2 Exhibit B Shunt Sensitivity Diagram



**Infrastructure Division
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Revision Level: 0


- 7.3 Exhibit C Spurious Signal Testing Data Sheet
- 7.4 Exhibit D Spurious Signal Diagram
- 7.5 SIGM-SOP-P003 Audio Frequency Track Circuit Maintenance
- 7.6 GRS II, AF-500, AF-800 and Harmon Audio Track Circuit OEM Manuals


PROCEDURE APPROVAL AUTHORITIES:




Director, Power & Way Maintenance *11/26/14*
 Date



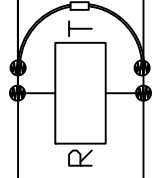
Chief Engineer *11/26/14*
 Date



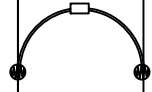
Chief Infrastructure Officer *11/26/14*
 Date

SHUNT SENSITIVITY
TESTING

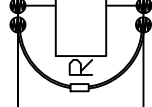
5.2.2.5
0.06Ω SOFT
Shunt



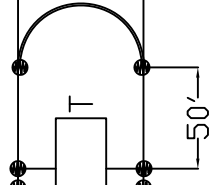
5.2.2.4
0.06Ω SOFT
Shunt



5.2.2.3
0.06Ω SOFT
Shunt



5.2.2.2
0.00Ω HARD
Shunt



SPURIOUS SIGNAL
TESTING

5.3.3
0.00Ω HARD
Shunts

