Section 8: Model 75 Overlay with Servo 8909/ACS Scanners

(Work Procedure 5)

Train Control Engineering

Defect Detector Work Procedure
Number 5

Equipment: Harmon Model 75 Overlay with Servo 8909/ACS Scanners

Purpose: Weekly, Monthly, Quarterly Tests as per Rule 27.0

WEEKLY

Test Equipment Needed:
(see Figure 8-1)

Simpson 260
Fluke 27, 87, or equivalent
Soldering iron

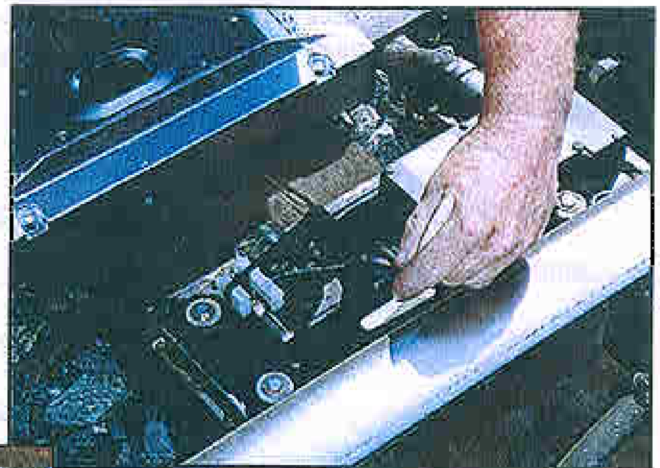
Figure 8-1: Simpson 260, Fluke meter, and soldering iron

1. Give the entire detector location a good visual inspection. Check, tighten, and/or replace any loose bolts and broken parts on the transducers, scanner bases, deflector blocks, and dragger. Inspect the ground rods and connections and replace or repair them to the CSX standard. (Refer to the *Signal Construction and Maintenance Standards* manual shown in Figure 8-3.) Replace any badly damaged paddles on the dragger. Remove any debris or obstructions from the dragger. Check the dragger switch gasket to ensure that water is not getting into the switch contact.

Figure 8-2: Inspecting the ground rods and connections

Figure 8-3: Signal Construction and Maintenance Standards *manual*

2. Remove the scanner covers and clean out the inside of each scanner base using a soft brush. Clean the scanner lenses and mirrors by carefully washing off any dirt and grime using a spray bottle with clean water ~~or alcohol~~. Then finish cleaning them with a soft cloth. Do **NOT** clean with an ammonia-based product because it will damage the lenses. Check to ensure that the scanner cover heaters and shutter mechanisms operate properly. Replace the scanner covers and clean them with a cleaning solution. If the scanner covers are still dingy or dull, paint them aluminum.



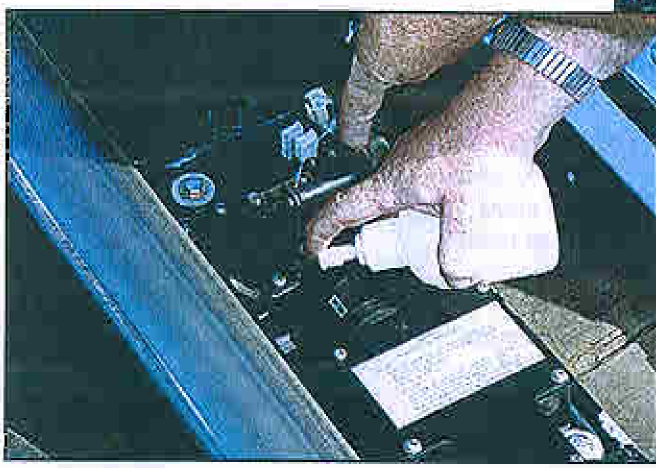


Figure 8-4: Cleaning the scanner lenses

3. Check the chart recorder for a 4mm to 5mm deflection. Check the chart recorder for proper operation to see if the desired information (such as train direction, train profile, proper gating, wheels missing, reverse gating, error information and/or codes) is being recorded. Be sure that the chart recorder has enough paper to last until the next inspection. Adjust the stylus pens, if necessary, to make a clear readable graph. Date and initial the graphs when you remove them from the recorder and keep them for 30 days.

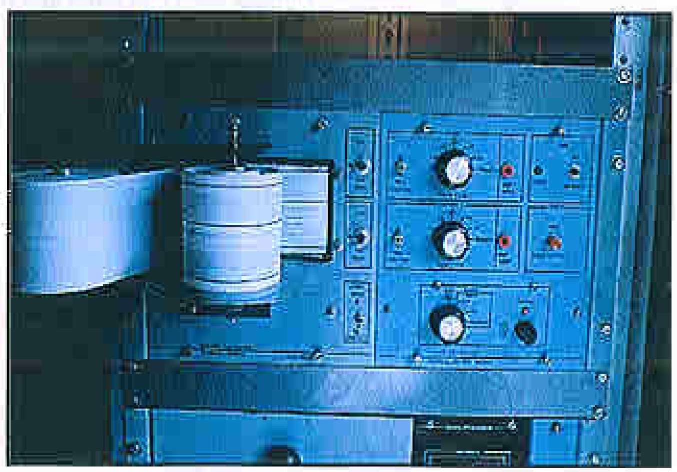


Figure 8-5: Checking the chart recorder

4. Check the printer (if so equipped) for proper operation. Replace the ribbon if necessary to make a good readable printout, and check the paper supply. Date and initial the printouts and retain them for 30 days. Inspect the header information to be sure that it is correct.

5. With the Simpson 260 or the Fluke 27/87 or equivalent, check and record in the log book the following voltages:

Servo Overlay Board	Adjustment	Test Point	Allowable range
+200VDC	R44	TB2-10 to TB2-11	+195VDC to +205VDC
-200VDC	R44	TB2-12 to TB2-11	-195VDC to -205VDC
	NOTE:	+ and -200 must be within 5 volts.	
+24 VDC (adj 12-24)	R9	TB4-9 to TB4-10	+14VDC to +16VDC

Harmon power supply	Adjustment	Test Point	Allowable range
+12VDC	R4	+12VDC test point to common test point	+11.6VDC to +12.4VDC
-12VDC	N/A	-12VDC test point to common test point	-11.6VDC to -12.4VDC
+5VDC	R5	+5VDC test point to common test point	+4.9VDC to +5.2VDC

6. Run the functional self test. This mode tests the system by generating signals that simulate a train passing. Check that all alarms, time and date, and diagnostic messages are printed.

7. Switch the Data Display Mode switch to the continuous Test Train Mode "E." Heat pulses can be seen by the system if a heat source is held in front of the scanner in this mode. Wave a heated soldering iron in front of each scanner and verify that the detector fires on both sides. Activate the dragging equipment device. Be sure that the correct side fires for each channel and that the dragger activates properly.

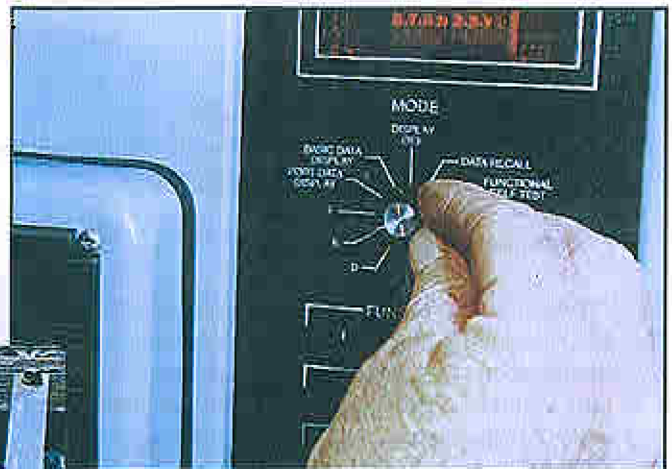


Figure 8-6: Data display mode

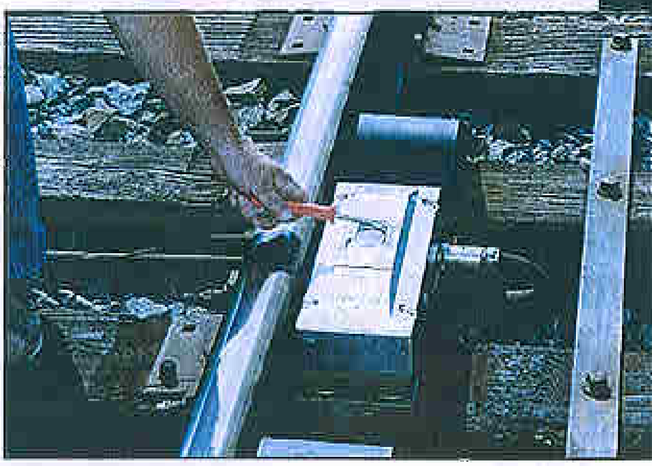


Figure 8-7: Using a soldering iron to fire hot boxes from the rail

8. Open the Motion Detector Test switch and, with a metal object, strike the transducer one time to activate the system and create a greeting message. Verify with the vehicle or handheld radio that the audible message is clear (not distorted) and has proper amplitude. Close the motion detector test switch.

9. Be sure that the radio is on, sweep the floor, and lock the location.

Figure 8-8: Train Control Safety sticker

MONTHLY

Additional Tools Needed: Saddle
Servo function simulator/generator
Thermometer

1. Perform the weekly tests.

2. Place the function simulator/generator outside in the shade for about 15 minutes to be sure that the reference chopper wheel is at ambient temperature. Determine the ambient temperature using a thermometer placed in the shade near the detector bungalow. Set the simulator/generator to 130 degrees above ambient and allow the simulator 5 minutes to stabilize and for the light to go out. (The generator will take about 15 minutes.) You now have 15 minutes to do the calibration. If the calibration takes longer than 15 minutes, the simulator/generator must be turned off, placed in the shade, and allowed to cool before using it again.

Figure 8-9: Placing the function simulator outside in the shade

3. Turn off the power to the Harmon unit and place the Servo Overlay Interface board on the extender card socket of WCO-34 Processor. Turn the power back on to the Harmon unit. Place the function simulator/generator on the scanner cover, and put the system in the CHOP mode position.

4. Press the Data Advance switch to initiate CHOP mode. Pressing the Data Advance switch causes the digital readout to display heat values for CH 1 and CH 2. With the function simulator/generator set at 130 degrees above ambient, the display should indicate 12.0 mm. Move the simulator to the other rail and check the other side. If it is necessary to change the values, adjust R68 to change CH 1 and adjust R85 to change CH 2.

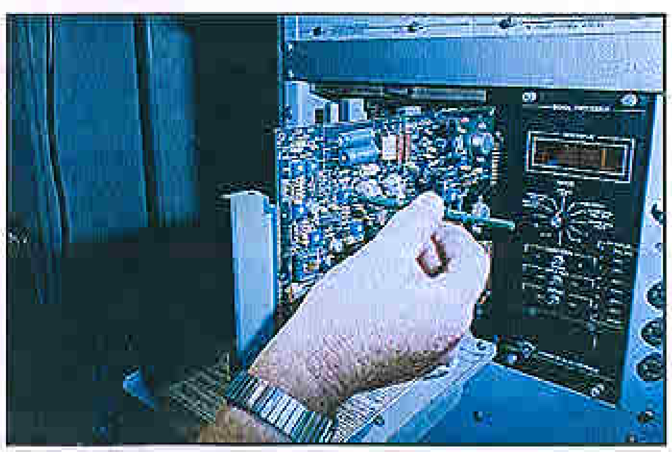


Figure 8-10: Adjusting the gain on rail 1 and rail 2

5. Press the Reset switch to end CHOP mode. Turn off the power to the Model 75 overlay chassis. Carefully remove the Servo interface board from the extender card socket and replace it in the Model 75 overlay chassis.

6. Reapply power to the Model 75 overlay chassis and set the Data Display Mode switch to the DISPLAY OFF position.

QUARTERLY

Additional Tools Needed: Metal tape line
(See Figure 8-11)
Servo alignment fixture 200099-81-X
Mirror cap
Appropriate hand tools

Figure 8-11: Additional tools needed

1. Perform the weekly and monthly tests.

2. Using a triangulation method, check to be sure the scanners are located squarely across from each other.

Figure 8-12: Maintainers using a triangulation method

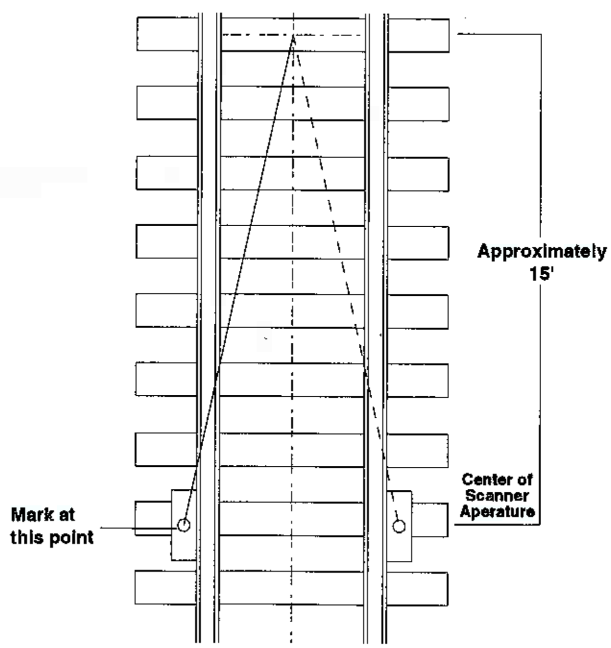


Figure 8-13: Diagram of triangulation

3. Place the alignment fixture across the rails, approximately centered between the A and B transducers. Be sure the alignment fixture is square with the rails. Remove the scanner cover and place a mirror cap on the scanner lens. Be sure that the cap is squarely seated against the end of the lens barrel.

Figure 8-14: Setting up the alignment fixture and lens cap

CAUTION: A small error here can cause a large alignment error.

4. Look through the peep hole in the target plate toward the scanner and move the upright post left or right on the fixture bar as necessary to center the red dot in the circle. To lower the dot, move the fixture closer to the scanner. To raise the dot, move the fixture away from the scanner. After centering the red dot in the circle, observe where the index mark the upright post is in relationship to the scale on the fixture bar. This dimension should be 7 inches plus or minus 1/4 inch Change the scanner cant nuts, if necessary, to achieve this dimension.

Figure 8-15: Looking through the peep hole to check the alignment

NOTE: Both cant nuts on a scanner must be on the same number.

Figure 8-16: Adjusting to 7 inches ± 1/4 inch

When you are finished, the fixture should be at the center of the A and B transducers, plus or minus 1 inch. Repeat for the other side. When you are finished, be sure to remove the mirror cap from the scanner lens.

Figure 8-17: Alignment fixture in the center of A and B transducers ± 1 inch

5. The alignment fixture should now be centered between the A and B transducers. Measure from the center of the alignment fixture to the center of the A and B transducers. This dimension should be 12 inches, plus or minus one inch. If the transducers must be moved, the center of the A transducer should be 8 inches from the center of the scanner aperture. The center of the B transducer should be 24 inches from the center of the A transducer.

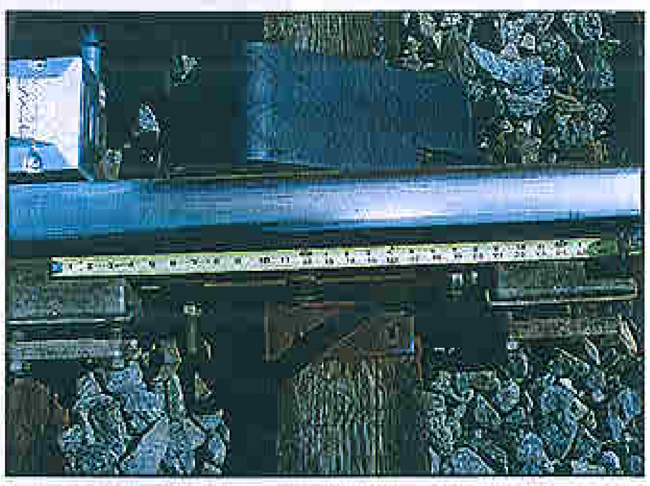


Figure 8-18: Measuring 24 inches between the centers of the A and B transducers

6. Check the Harmon 1140B Motion Detector by doing the following:

   a. Using the Simpson 260, the Fluke 27/87, or the equivalent, insert the positive lead into the red test jack on the motion detector module.

   b. Insert the black lead into the black test jack on the power amplifier card. The meter should read 200VDC ± 5VDC. Adjust the potentiometer on the transmitter board, if necessary, to obtain this reading.

   c. Set the island adjustment by placing a .06 ohm shunt 3 feet outside the receive track leads.

   d. Monitor the voltage across the island relay and adjust the receiver sensitivity potentiometer full clockwise. Voltage across the relay should read ± 1VDC of the battery supply voltage.

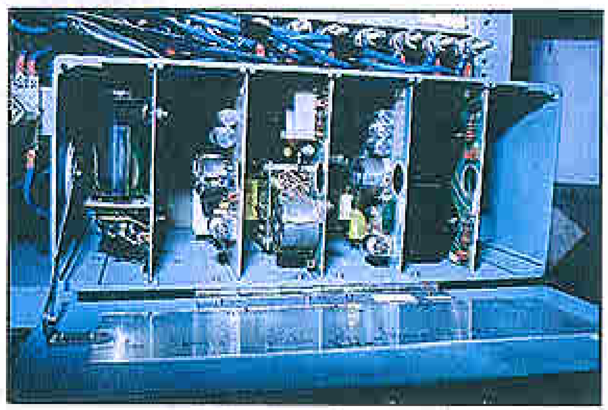


Figure 8-19: Front view 1140B Motion Detector with panel lowered

   e. Reduce the potentiometer slowly counterclockwise until the relay voltage drops to 0 volts.

   f. Tighten the lock nut.

   g. Remove the shunt and the relay should energize ± 1VDC of the battery supply voltage.

7. Measure the track gauge and check the surface of the track by observing the passing of a train. Notify proper authorities if the track conditions do not meet CSX standards.

Figure 8-20: Measuring the track gauge

Harmon Model 75 Overlay

General Description

The Harmon Model 75 Overlay System is designed to operate with Servo ballast or rail mounted scanners. It provides all normal hot box detector functionality and has the capability to provide several types pf alarm analysis including:

- Simple Ratio
- Differential
- Absolute
- Carside Slope

The Model 75 Overlay System broadcasts information via radio transmission to the train that was scanned most recently. The message broadcast conveys all faults detected by the system. Information passed to the crew and printed on a local printer includes the:

- Length of the train in feet
- Train speed
- Axle number
- Side of the train
- Direction of travel
- Site location
- Type(s) of alarms detected

If one or more hot boxes have occurred, a summary of all heat levels for all journals on any car having a defect is printed. If dragging equipment (D.E.) is detected, then the D.E. number and the corresponding nearest axle number are printed. Otherwise "No Alarms" is printed.

NOTE: If a hot box is detected, the defective axle number is given as a count from the head of the train. If a hot box is detected with a high or wide load (assuming the high or wide load option was selected), a *nearest* axle count is included.

Model WCO-2 or WCO-27 Data Recorder

The Model WCO-2 or WCO-27 chart data recorder is a dual channel, thermal writing strip chart recorder. A significant feature of this recorder is its ability to use analog pens to reproduce digital data.

The channel one pen records the train direction, time, and date immediately after train passage. The channel two pen provides a printout of the total axle count, total cars, train speed, train length and type, and number of alarms. If the Model 34 signal processing unit is equipped with a Data Communications Processor (DCP), the channel two pen will print out train direction, and date and time of train passage.

This micoprocessor-based recorder has its logic circuitry, pen motor amplifiers, and power supplies all on a single plug-in Printed Wiring Board (PWB).

The front panel of the recorder includes test points, attenuator switches, and chart drive controls that allow the recorder to be used as a troubleshooting device.

Model 75 Electronics Chassis

The signal processing unit consists of a rack-mounted enclosure containing a plug-in power supply card, built-in card extender, display/control panel, and a set of system cards.

All control, self tests, and readouts are available at the control panel. The main power switch controls all power supplies for the system cards. The LED above the power switch indicates that the 5 volt power supply is operative. Individual circuit breakers are provided for the +5 VDC, +12VDC, and -12VDC supplies. The main power switch is also a circuit breaker that aids in protecting the primary side of the circuitry.

Inside the front panel door is a label outlining the system configuration and basic control usage. The built-in card extender is located on the right side behind the front panel door, and any system function card can be tested and adjusted while plugged into the extender card. The system function cards operate in any card slot and in any order. It is recommended that all cards be placed in consistent order to maintain uniformity among WCO-32 sites.

System Setup

The software documentation contains switch settings that are specific to each railroad since the software is customized to meet operating rules. Refer to the software documentation and the railroad operating rules before attempting to set up the system.

Analog Board Potentiometer Settings

Alarm levels can be set by using one of two methods. The first method is through potentiometers (pot) on the analog boards. The other method is to set them through a Data Communications Processor (DCP). If a DCP is installed, it is advisable to set and verify the alarm levels on the analog boards with the DCP turned off.

pot 1 (R28 on Analog II, R116A on Analog I)
Low Limit for simple (single) alarm analysis

pot 2 (R29 on Analog II, R116B on Analog I)
High Limit for absolute alarm analysis

pot 3 (R30 on Analog II, R122C on Analog I)
Carside Slope for carside alarm analysis

pot 4 (R31 on Analog II, R122D on Analog I)
Carside Low Limit for carside alarm analysis

pot 5 (R32 on Analog II, R123E on Analog I)
Gate Transducer Spacing

pot 6 (R33 on Analog II, R123F on Analog I)
Hot Wheel Limit (if installed)

Pot	Parameter	Mimimum	Maximum	CSX values
1	Low Limit	5 mm	15 mm	8
2	High Limit	5 mm	24 mm	16
3	Carside Slope	.68	2.36	1.31
4	Carside Low Limit	5 mm	15 mm	7
5	Transducer Spacing	15 inches	30 inches	24
6	Hot Wheel Limit	15 mm	24 mm	N/A

Universal Processor Board

This board contains four DIP switches that are used for many different purposes, but are mainly for the selection of the type of scanners that are installed. Because the hot box detector software performs different integrity tests depending on the scanner type, it is necessary to select the type of scanners installed. (Refer to the software documentation for specific switch settings.)

Speech Board

The system milepost location is set on the speech board. DIP switches S1 and S2, located at the upper rear corner of the speech board, are used to set the milepost location.

The maximum number of alarms can also be set on the speech board. DIP switch S3 controls the maximum number of alarms that a system processes before an integrity failure condition exists.

DCP-3 Board & Parameters

The DCP-3 is an add-on product that adds data storage and data communication capabilities to the hot box detector overlay.

For operating parameters and physical parameters, see the CSX DCP-3 software documentation.

Display Board

There are 16 DIP switches located on the front panel of the display board. These switches are used for many different purposes, for example, multi-track selection, selecting data logging features selection of, safety messages, etc. (Refer to the software documentation for specific switch settings.)

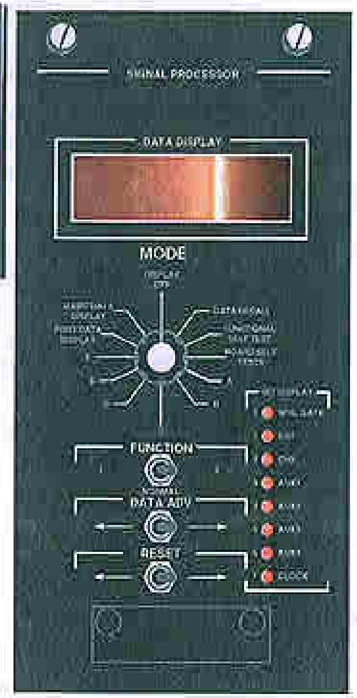
Servo Overlay Interface Board

This board provides the power supplies and amplifiers required for Servo scanners.

Mode Switch Options:

- Display Off
- Data Recall
- Functional Self Test
- Board Self Test
- A-Display Pot Settings
- B-CHOP
- C-Set Time and Date
- D-Recorder Calibration
- E-Continuous Test Train
- F-Tone Test/Display Temp
- Port Data Display
- Basic Data Display

Figure 6-16: Display board



NOTE: Refer to the owner's manual for the description and operation of all tasks accessed through the mode positions.

Servo Overlay Board
HPN 226171-000/003

The Servo overlay interface board provides an interface between the Servo scanner and the Harmon Hot Box Detector. The overlay board provides $\pm$200 volts to the scanner to Bais the bolometer. It also provides 160VDC for Model 7621 and 7707 sensors, and 24/15VDC for Models 8808 and 8909, and ACS sensors.

The overlay board also provides an interface to the Servo graph chart recorder by providing a $\pm$180 volt pen power and pen drive circuitry.

The output from the sensors is conditioned by the overlay board before entering the analog board on the HBD. Depending on the model of the Servo sensor, different gain settings are used on the board. An adjustment pot is provided to adjust the gain. Refer to *Model 34/75 Technical Reference* for information concerning the proper jumper setting.

Physical Layout

The basic system is configured on a standard 84-inch relay rack containing the following system units:

- Model WCO-2/WCO-27 Data Recorder
  - Recorder Module
  - Recorder Control Module

- Model 34 Signal Processor

- Digital I/O Board	HPN 225809-000
- Display & Test Board	HPN 226046-000
- Analog II I/O Board	HPN 226348-000/007
- Universal Processor Board	HPN 225807-000
- Memory Board	HPN 225814-000
- Speech Board	HPN 225815-000
- DCP-3 Board	HPN 226459-000
- Serial I/O - Time and Date Board	HPN 226264-000
- Main Power Supply	HPN 225850-000
- Servo Overlay Interface Board	HPN 226171-000/003

- Wilmore Model 1403-12--500 Watt Inverter

Specifications

Power Requirements

Model 75 Electronics Chassis
120VAC, 60 Hz., less than 200 watts

Environmental Temperature

- 40 degrees C to + 60 degrees C (- 40 degrees F to + 140 degrees F)

Train Speed

8 MPH to 150 MPH

Tie/Ballast Mount Scanner

Power Requirements

Input Voltage +15VDC at 1 amp
110VAC
Heater Rating 175/350 watts at 110VAC
Approximately 54.5 degrees C

Operating Temperature
- 40 degrees C to 60 degrees C

Model 75 Overlay with Servo 8909/ACS Scanners

Parts Identification

Figure 8-22: System layout

Model 75 Overlay with Servo 8909/ACS Scanners

Parts Identification

Harmon Model 1140B

WCO 2/27 Chart Recorder

Harmon Model 75 Overlay

Overlay Cable Interface Panel

HBD Surge Arrester Panel

Inverter

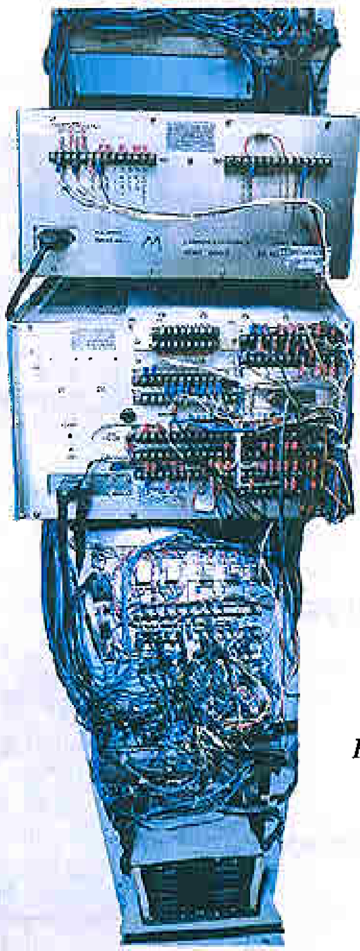


Figure 8-23: Rear view

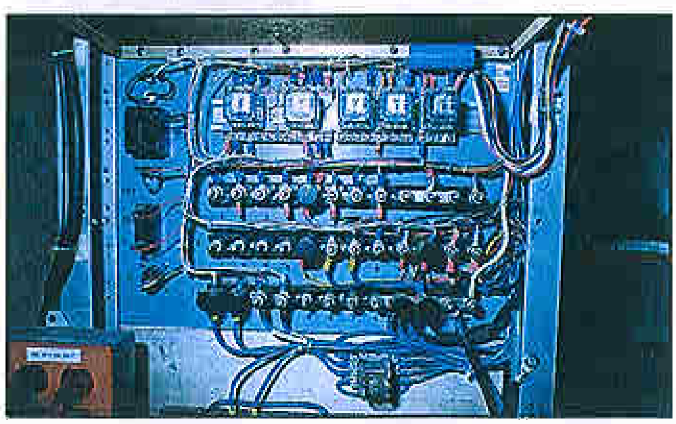
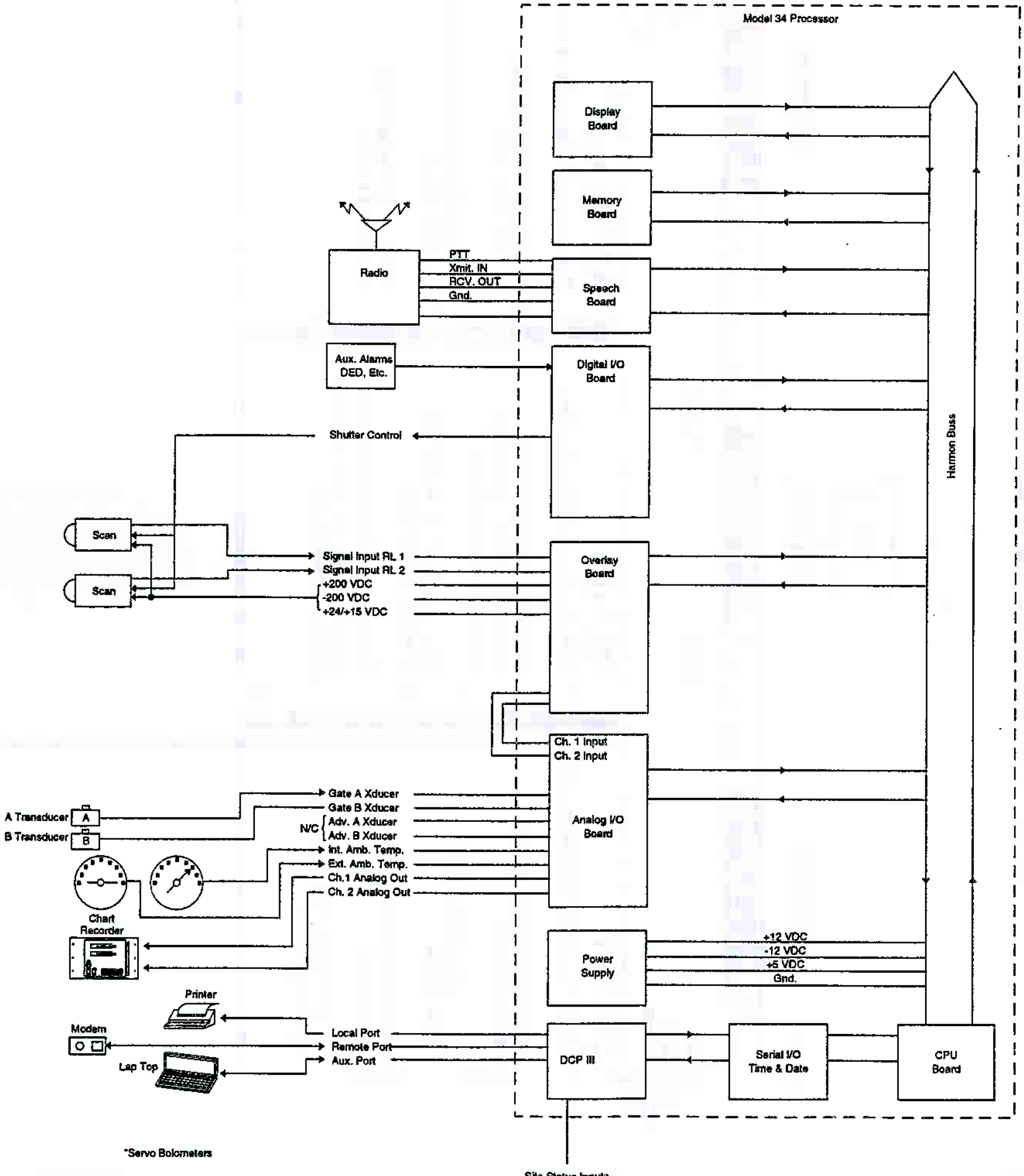


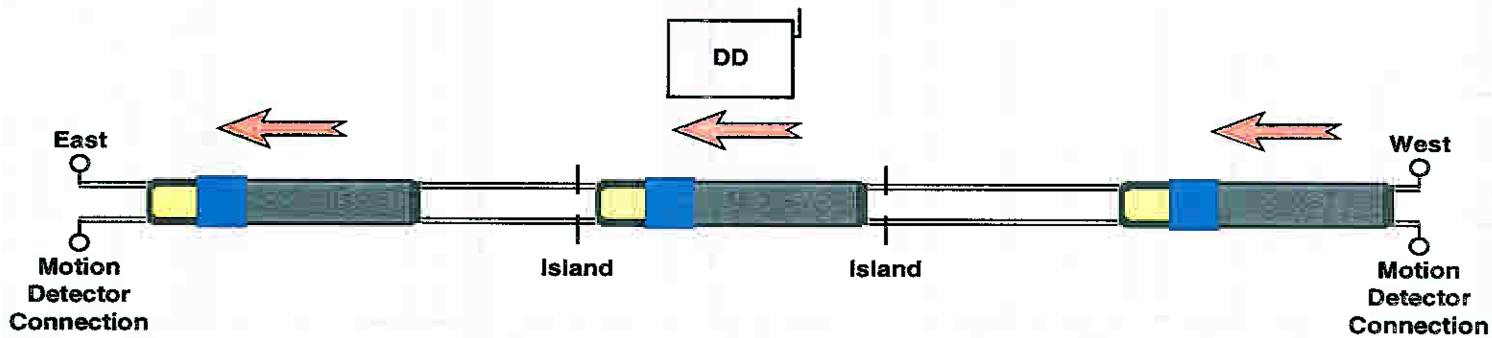
Figure 8-24: Overlay cable interface panel rear view

Model 75 Overlay with Servo 8909/ACS Scanners

Block Diagram



Basic Operation and Train Movement Chart



OFFSITE

The island circuit is deactivated.

The system performs the post-train test.

The motion detector is deactivated.

The departing message is transmitted.

The chart recorder prints the train information.

ISLAND

The island circuit is activated.

The chart recorder starts recording and the greeting message is transmitted.

The system establishes the direction of the train.

The system checks all axles and stores/charts the data, issuing alarms if necessary.

APPROACH

The motion detector is activated.

The system performs the pre-integrity test.

The case heaters turn off and the shutters open.

The system passes the pre-integrity test.

Harmon Model 75 Overlay with 8909/ACS Scanners

Expanded Train Movement Description

The sequence of events for the following three train-processing categories are described in detail:

- Train approach
- Train on the island circuit
- Train off site

Train approach

- The motion detector is activated. The motion detector relay (MDR) drops or de-energizes.
- The hot box detector performs a pre-integrity test. An internal heater is activated causing the pre-amplifier to read an absolute alarm on each channel.
- The shutters open and remove power from the scanner cover heaters.
- The system either passes or fails the pre-integrity test.

Train on the island circuit

- The train enters the island circuit of the motion detector. The island circuit relay (ISR) drops or de-energizes.
- The chart recorder starts recording the activity.
- The greeting message is transmitted.
- After more than 3 wheelgates have occurred, the system establishes the direction of the train.
- The system checks all axles and stores/charts all data. Alarms are broadcast as they occur via a 4-second tone.

Train off site

- The island circuit energizes the ISR.
- The shutter heaters turn on for 2 seconds. The system performs the post-train test. If results are greater that 5mm on both channels, the system passes; if less than 5mm, the system fails.
- Once the the train leaves the motion detector circuit or 8 seconds elapse since the last wheelgate, the hot box detector transmits the departing message with appropriate alarms and locations given from the head of the train. The chart recorder prints the information.

Arrival Messages

The following chart identifies the arrival messages and alarms that occur:

Condition	Message Spoken	Alarm
Passes system integrity tests.	1/4 second 1000Hz tone "CSX Equipment Defect Detector" "Milepost zzx Point x" (Leading zeros not spoken.) (If all digits are zero, the milepost phrase is not spoken.) "Track Number x" - or - "North/South/East/West Track" (Select the number or direction of the track if double track installation.) "Dragging Equipment Malfunction" (Announced if dragging equipment test failed.) "High Load Malfunction" (Announced if high load equipment test failed.) "Wide Load Malfunction" (Announced if wide load equipment test failed.)	3 second 1kHz tone (Sounds for each alarm upon detection.)
Fails system integrity tests.	1/4 second 1000Hz tone "CSX Equipment Defect Detector" "Milepost zzx Point x" (Leading zeros not spoken.) (If all digits are zero, the milepost phrase is not spoken.) "Track Number x" - or - "North/South/East/West Track" (Select the number or direction of the track if double track installation.) "Dragging Equipment Malfunction" (Announced if dragging equipment test failed.) "High Load Malfunction" (Announced if high load equipment test failed.) "Wide Load Malfunction" (Announced if wide load equipment test failed.) "Hot Box Detector Malfunction" "End of Transmission"	No real time alarm tones are transmitted.

Post-Train Messages

The following chart identifies the post-train messages that occur:

Condition	Message Spoken
Passes system integrity tests with no alarms.	"CSX Equipment Defect Detector" "Milepost zzx Point x" (Leading zeros not spoken.) (If all digits are zero, the milepost phrase is not spoken.) "Track Number x" - or - "North/South/East/WesT Track" (Select the number or direction of track if double track installation.) "No Defects" (Announced if there are no hot box defector malfunction conditions.) "Hot Box Defector Malfunction" (Announced if the end-of-train integrity tests failed.) "Axle Count Malfunction" (Announced if the train is too slow, stopped, or reversed its direction.) "Dragging Equipment Malfunction" (Announced if dragging equipment test failed.) "High Load Malfunction" (Announced if high load equipment test failed.) "Wide Load Malfunction" (Announced if wide load equipment test failed.) "Train Length zzzx Feet" (Announced if the front panel switch is selected.) "Train Speed zzx Miles Per Hour" (Announced if the front panel switch is selected.) "Total Axles zzx" (Announced if there is not an axle count malfunction condition and if the front panel switch is selected.) "Total Cars zzx" (Announced if the front panel switch is selected.) "Temperature zzx Degrees" (Announced if the front panel switch is selected.) Message announced 1-3 times. ***Safety Message Switch Selectable*** "End of Transmission"

Post-Train Messages (continued)

Condition	Message Spoken
Passes system integrity tests with alarms.	"CSX Equipment Defect Detector " "Milepost zzx Point x" (Leading zeros not spoken.) (If all digits are zero, the milepost phrase is not spoken.) "Track Number x" - or - "North/South/East/West Track" (Select the number or direction of track if double track installation.) "Count from Head of Train" (Announced if there is not an axle count malfunction condition.) "First Hot Box - N/S/E/W Rail - Axle zzx" (If there is an axle count malfunction, the axle phrase is not spoken.) "Second Hot Box - N/S/E/W Rail - Axle zzx" (If there is an axle count malfunction, the axle phrase is not spoken.) "First Dragging Equipment - Near Axle zzx" (If there is an axle count malfunction, the axle phrase is not spoken.) "First High Load Near Axle zzx" (If there is an axle count malfunction, the axle phrase is not spoken.) "First Wide Load - N/S/E/W Rail -Near Axle zzx" (If there is an axle count malfunction, the axle phrase is not spoken.) "Second Wide Load - N/S/E/W Rail - Near Axle zzx" (If there is an axle count malfunction, the axle phrase is not spoken.) "Hot Box Defector Malfunction" (Announced if the end-of-train train integrity tests failed.) "Axle Count Malfunction" (Announced if the train is too slow, stopped, or reversed its direction.) "More Defects" (Announced if the maximum number of defects is exceeded.) "Dragging Equipment Malfunction" (Announced if dragging equipment test failed.) "High Load Malfunction" (Announced if high load equipment test failed.) "Wide Load Malfunction" (Announced if wide load equipment test failed.) "Train Length zzzx Feet" (Announced if the front panel switch is selected.) "Train Speed zzx Miles Per Hour" (Announced if the front panel switch is selected.) "Total Axles zzx" (Announced if there is not an axle count malfunction condition and if the front panel switch is selected.)

Condition	Message Spoken
Passes system integrity tests with no alarms. (continued)	"Total Cars zzx" (Announced if the front panel switch is selected.) "Temperature zzx Degrees" (Announced if the front panel switch is selected.) Message announced 1-3 times. ***Safety Message Switch Selectable*** "End of Transmission"
Fails system integrity tests.	No post train message transmits.

Harmon Model 1140B/1141B Motion Detectors

General Description

1. The Harmon Model 1140B and 1141B Motion Detectors are designed for use as restart circuits in conjunction with Harmon Audio Frequency Train Activated Circuit (AFTAC) or existing track circuit systems in grade crossing protection applications. The device detects the decreasing level of its transmitted signal in the rail caused by the circuit shortening effect of the approaching train. The motion detector is sensitive enough to provide detection when the rate of signal level decrease reaches .1 db per second. Therefore, the detection distance of the motion detector is a function of train speed.

   Detection distance is relatively stable over a wide range of varying ballast conditions, but it is reduced in instances of very poor ballast resistance and other heavy track load conditions. Under nominal conditions, the motion detector should provide 25 seconds or more warning time at train speeds to 35 m.p.h.

   Channels are provided in the frequency spectrum from .5 KHz to 10.2KHz. Detection distances under good track conditions may be expected to 2,500 feet up to 4 KHz for fast-moving trains. Slow-moving trains are provided about 25 seconds warning time, but an appropriately shorter detection distance results. Channels above 3.5 KHz are attenuated more and provide shorter detection distances. The higher frequencies can be employed when it is desired to limit the "look" distance of the unit. Since track conditions affect the distance capability, the chart in the specification section may be used only as a rough guide.

   Since the motion detector does not sense a slow-moving train until it is relatively close for 25 seconds warning time, time-out circuits should be planned for track circuits in which slow-moving trains might stop prior to initial detection. If the train continues to approach the motion detector at the reduced speed (or after a stop and subsequent acceleration), it is "reacquired" by the motion detector when its speed is such that the decreasing signal level rate reaches the pre-set sensitivity level.

2. The motion detector contains an island circuit that is adjustable from a point about 10 feet from the points of coupling to the rail to its maximum distance. The "ring-by" of the island circuit is about 5 feet. The motion detector also contains a positive island circuit, which, when employed, provides a failsafe island section. If the positive island circuit is used, two 1,000 ohm neutral relays must also be used.

3. The motion sensing circuit relay output is redundant and is fed in series through two mercury-wetted relay contacts.

4. The motion detector, beyond the established island circuit, does not have built-in protection against either an open rail or a shorted rail situation. To provide this safety feature, an AFTAC or other wrap-around circuit is recommended. The circuit should be set up to withhold control of the crossing protection relays until the motion detector has acquired the train. (See the schematic drawing section in the *Harmon Model 1140B/1141B Motion Detector* manual for sample relay logic.)

5. The unit operates on any stable nominal 12VDC (10.5 to 14VDC) externally provided power source and contains internal regulation, a rectifier surge protection panel, and 230VDC gas gap discharge devices across connections to the rail for protection against external overvoltages to a front steepness of up to

5 KV per microsecond (5,000 amps over 20 microseconds). The unit draws approximately 1 amp (2 ohm load).

6. The relay output power provides about 12VDC to a 500-ohm relay if the battery source is 12VDC. If the battery source is less than 12VDC and the relay is less than 500 ohms (or two 1,000 ohm relays if the positive island circuit is used), then the relay output is proportionately lower than 12 volts.

7. Both the transmitter section and receiver section connections to the rail must be made through railroad provided external lightning protection devices (an equalizer and two heavy-duty arrestors for both sets of leads).

   CAUTION: Polystyrene capacitors are used in the motion detector for frequency stability; therefore, it should not be subjected to temperatures over 160 degrees F.

8. When insulated joints exist within the desired track circuit, series-tuned coupling units are available for by-passing the insulated joints.

9. If the motion detector is connected to the rail employing the same leads as the battery of a DC track circuit, a reactor must be placed in series with one of the battery leads and rail (not between the motion detector and the rail). The reactor reluctance should be 10 ohms or higher at the motion detector frequency.

10. Typical circuit block diagrams appear in the schematic section of the *Harmon Model 1140B/1141B Motion Detector* manual.

11. When the motion detector is employed on a rusty rail, a time constant prevents the premature release of crossing protection that would be created by a train moving from shiny to rusty rail within the motion detector limits. It should be noted that this time constant also provides some false activation of crossing protection if transient shorts are experienced. The time constant is by-passed within the island circuit limits so that excessive "ring-by" does not occur. Unless otherwise specified, the time constant is approximately 15 ± 5 seconds. If it is desired to reduce the loss of shunt pickup delay, replace the 2mfd capacitor C8 on the motion detector (124B-1) module. Note that .68mfd provides about 8 seconds and .33mfd provides about 3 seconds. Due to inherent circuitry delays, a lower pickup delay cannot be obtained.

    NOTE: The motion detector contains mercury-wetted relays mounted on the surge panel; therefore, the cabinet should be mounted in a horizontal position.

12. Since the motion detector senses decreases in its own signal level strength in the rail, it is also sensitive to power source fluctuations and inductively induced spikes. Momentary power source drops exceeding .5V DC cause the motion detector to "drop out." For this reason, surge suppressors should be provided in any circuit that draws any appreciable load, and a suitable reactor/capacitor should be provided in DC power leads to the motion detector.

    The 1141A Motion Detector has a frequency modulated transmitter module (121A-7) for use as a transmitter with an FM AFTAC Receiver. The lowest modulating rate (Subtone A - 1OHz) cannot be used in the 1141A Motion Detector. Subtones B through F (16-84 Hz) can be utilized without detrimental effects.

Installation

1. Mount the cabinet in the physical location.

2. Attach the physical ground to the GND terminal.

3. Make rail connections (after lightning protection) to four rail terminals. (Two for the transmitter and two for the receiver). To effectively define the center of the crossing, connect the transmitter and receiver on opposite sides of the crossing.

   NOTE: If the same leads are used for the DC track circuit connections, a reactor unit must be in one of the battery leads so that the battery will not present a "short" to the motion detector. Connect the motion detector leads between the reactor and rail.

4. If the motion detector is to be used beyond the limits of existing insulating joints, by-pass coupling units must be installed between the insulated joint connections.

5. Observing polarity, connect the (-) and (+) terminals to the 12VDC power source. Internal regulating is provided in the motion detector, and proper operation can be obtained from any stable 10-14VDC external power. Power below 12VDC, of necessity, results in reduced transmitter output and/or receiver relay output.

6. To adjust the motion detector transmitter output power, insert a voltmeter (250V scale) positive lead in the red test jack on the motion detector module, and insert the negative lead in the black test jack on the power amplifier. Turn on the transmitter potentiometer and adjust for 200VDC. This setting is the optimum transmitter output power and motion detecting sensing level. Lower levels can be used with slightly reduced sensitivity when the circuit is artificially shortened by a hardwire shunt. Tighten the lock nut. This should provide voltage on the test point of 200V ± 5V, and the voltage level on the rail will be 0db ± 5db.

7. Check the island circuit "ring-by" with a .06 ohm shunt. Under favorable ballast conditions, it should be 3-5 feet beyond the point of shunt connection during adjustment.

8. When the motion detector transmitter is used to activate a receiver at an adjacent location and additional power to the rails is required due to low ballast conditions, the following procedure can be used:

   a. Increase the transmitter output by turning the potentiometer R5 clockwise to the desired output level.

   b. Record this level for future adjustments. If a frequency selective voltmeter is not available, remove the track leads from the transmitter output, terminate the output with a 2 ohm load, and record the output level.

   c. Place a DC voltmeter across the 200V test point and ground on the motion detector module. Reduce the input by turning the potentiometer R1 counterclockwise until the meter reads 200VDC.

   NOTE: This procedure is applicable only on the Model 124B-1 Motion Detector module. The earlier versions do not have the input adjustment available.

Island Circuit Adjustment

1. Connect the voltmeter across the "relay" terminals, with the relay connected.

2. Connect an .06 ohm shunt across the rails at a point 3 feet beyond the desired island distance (for example, for a 100 foot island circuit, 53 feet from the center of the crossing). Only a C clamp type rail connection should be used on the shunt. A poor shunt means a long island during train passage.

   NOTE: The island circuit should extend at least 3 feet beyond the motion detector rail connections.

   If the ballast conditions are low or questionable, connect the shunt across the rails 10 feet beyond the desired island circuit distance. (This will result in somewhat longer "ring-by," that is, 25 to 30 feet from the island limit.) If the rails are rusty, it would be best to use an engine to set the island and monitor the rail with AC VTVM.

3. Observing the relay voltage on the meter, adjust the receiver sensitivity potentiometer (lower front section on the receiver printed circuit board) full clockwise (full turn of the pot to the right). The voltage across the relay should read battery supply voltage. Reduce the potentiometer slowly counterclockwise until the relay voltage drops to 0 volts. Tighten the lock nut.

4. Remove the shunt. The relay should energize ± 1 VDC of the battery supply voltage.

Harmon 1140B/1141B Motion Detector

Parts Identification

Figure 8-25: Model 1140B Motion Detector

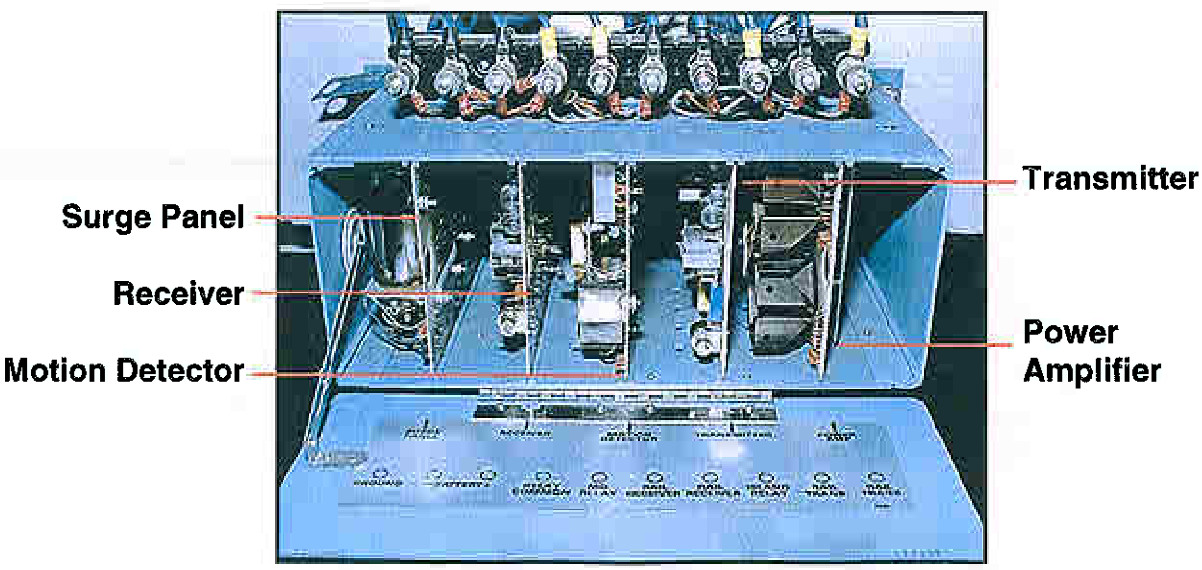


Figure 8-26: Model 1140B Motion Detector panel lowered

Servo Advanced Concept Scanner (ACS)

General Description

1.1 Scanner

The Servo (Phase II) Advanced Concept Scanner (ACS) is used in conjunction with trackside and wayside equipment for Hot Box Detector and Hot Box Detective Systems manufactured by the Servo Corporation. The ACS is a new lightweight, simplified, compact design scanner that is capable of viewing a variety of roller and plain bearing assemblies. Secured to the rail using the ISO-Clamp shock and vibration assembly, the scanner mounts closer to the rail for improved scanning performance.

The ACS can be configured with either a standard Germanium lens or a short focal length Germanium lens. Both lenses are functionally the same; the differences exist only in the lens mounting and in the lens target diagram. The standard lens has a target diameter of 1"; the short focal length lens has a target diameter of 1-1/2". Two scanners are required for each train inspection site. CSX presently uses the standard lens.

The Advanced Concept Scanner has fewer components than other scanners, which improves reliability and ease of maintenance. The ACS has the following features: a new Cant Cam clamp, a removable scanner cable with positive locking for the connector, an improved optic system with rotary lens focusing, a new aperture shutter mechanism, and replaceable cover heaters.

1.2 Features

A. ISO-Clamp/Cant Cam Assembly

The ACS mounts to the rail using the ISO-Clamp shock and vibration assembly, which allows for rapid rail-to-rail interchangeability. The newly designed Cant Cam simplifies rail cant angle adjustments; the 6-position Cant Cam offers accurate alignment in 1/2° increments. The ISO-Clamp assembly establishes a fixed relationship between the bearing target, the scanner, and the gating transducers. This assures increased scanning/gating accuracy by eliminating the effects of rail run, pumping, and foundation settling.

B. Removable Scanner Cable

The ACS cable allows for disconnections from the scanner in the field, without removing the scanner from the rail. The connector is tamper-resistant due to a positive locking feature that is accessible only when the scanner cover is removed. The cable can be replaced without unsoldering terminal connections. Scanner cable orientation can be changed easily for rail-to-rail interchange ability. Refer to the *Servo Phase II Advanced Concept Scanner Installation* instructions for more information.

The cable is available in standard 15', 35', and 65' lengths, as well as in customized lengths.

C. Optic System and Aperture Shutter Mechanism

A positive rotary lens focusing technique has been implemented, which allows optimum lens adjustment to be quickly achieved.

The aperture shutter mechanism features a fast flap-type self-locking unit that incorporates an integrity heater on the shutter flap. The mechanism is mounted directly on the scanner housing for ease of maintenance.

D. Scanner Cover Heaters

Removable scanner cover heaters minimize moisture accumulations and reduce the build-up of snow and ice on the scanner cover and around the aperture shutter mechanism. Each scanner cover heater uses 175 watts, for a total of 350 watts. The removable heaters are easily replaced, which minimizes maintenance time and costs. (The thermostat closes at 80° and opens at 100° F.)

Servo Advanced Concept Scanner (ACS)

Parts Identification

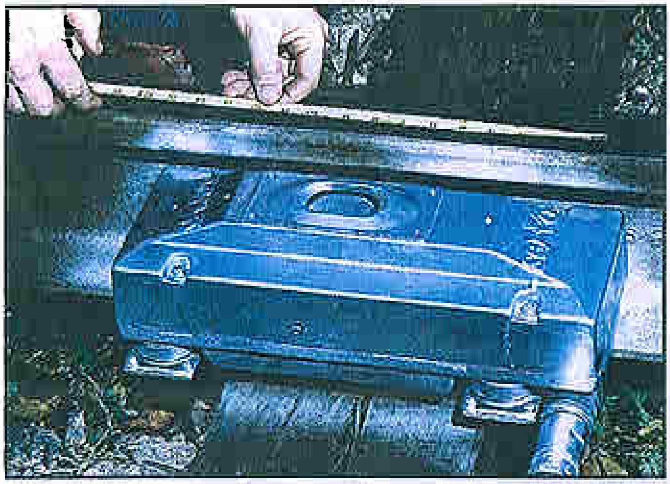


Figure 8-27: Servo Advanced Concept Scanner

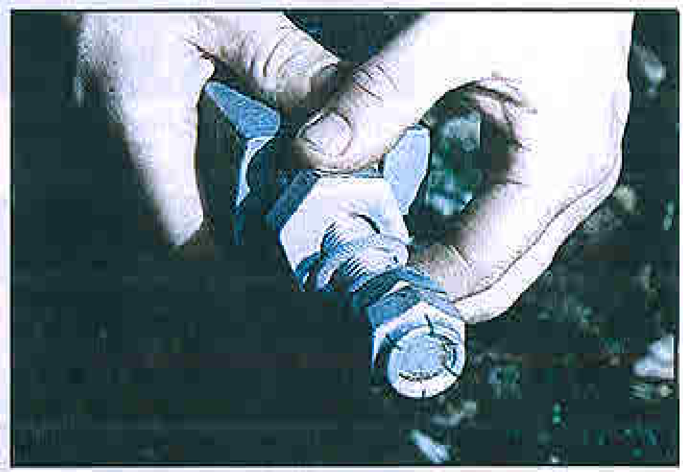


Figure 8-28: Scanner adjustment (cant nut)

Figure 8-29: Typical ACS track layout

Servo Advanced Concept Scanner (ACS)

Parts Identification

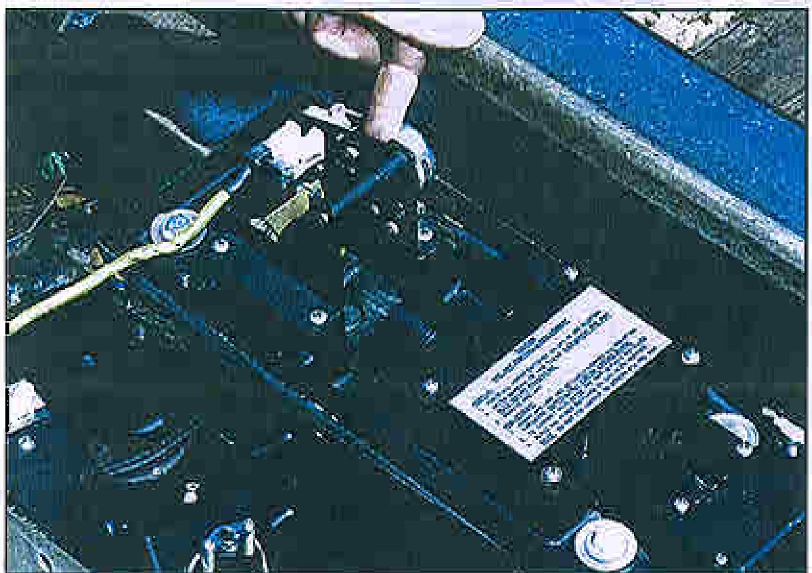


Figure 8-30: ACS scanner base

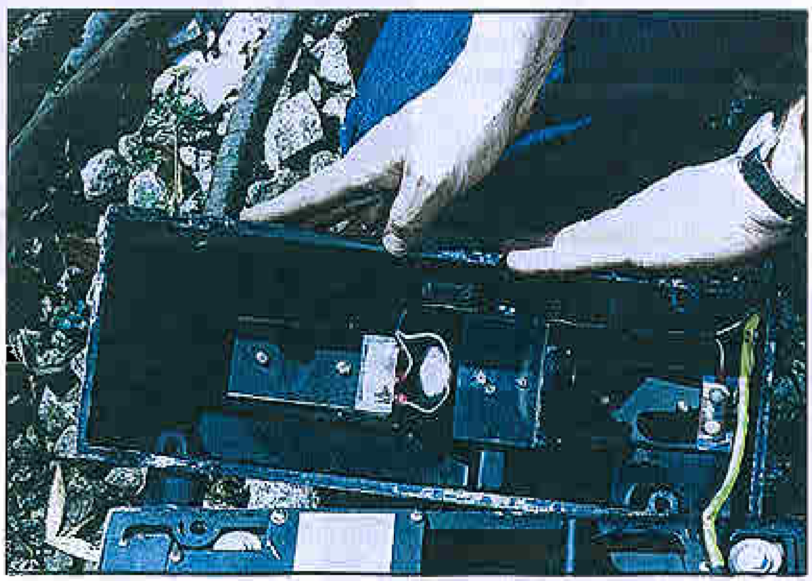


Figure 8-31: Internal ACS scanner cover

Servo Advanced Concept Scanner (ACS)

Scanner Adjustment

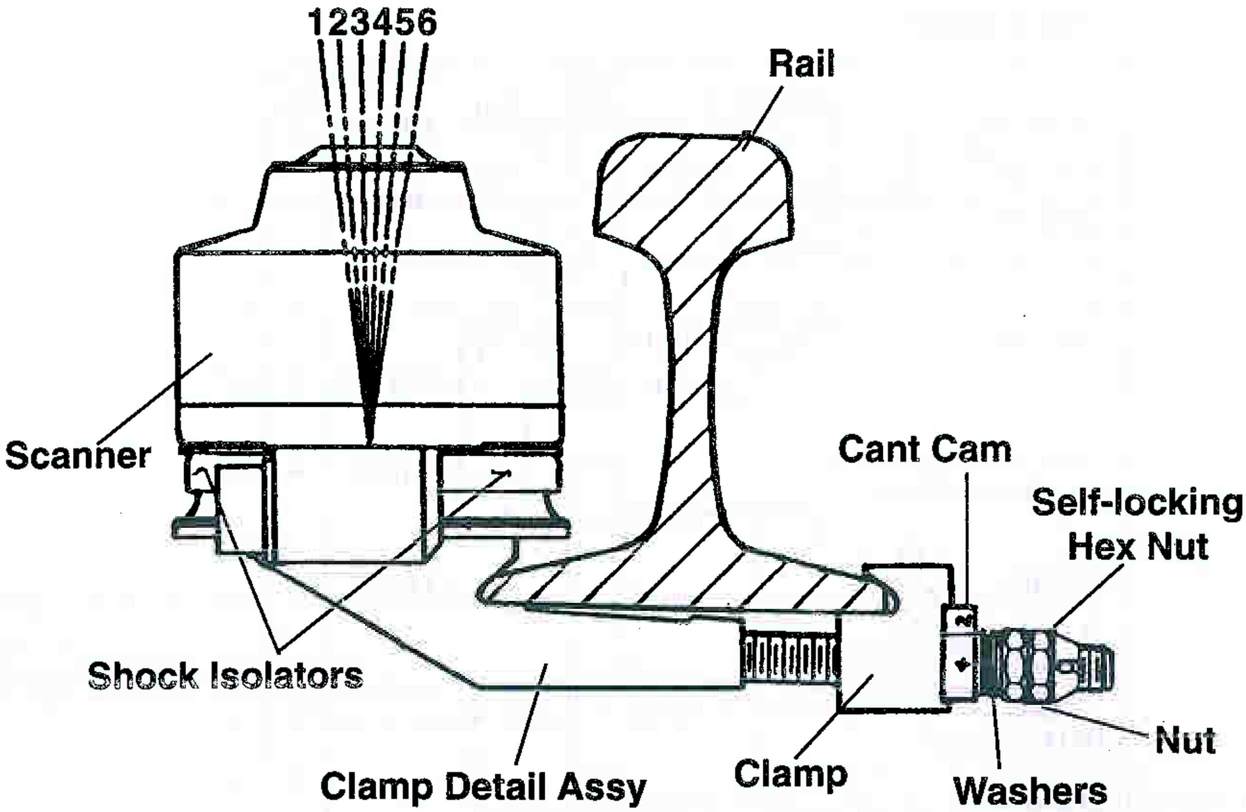


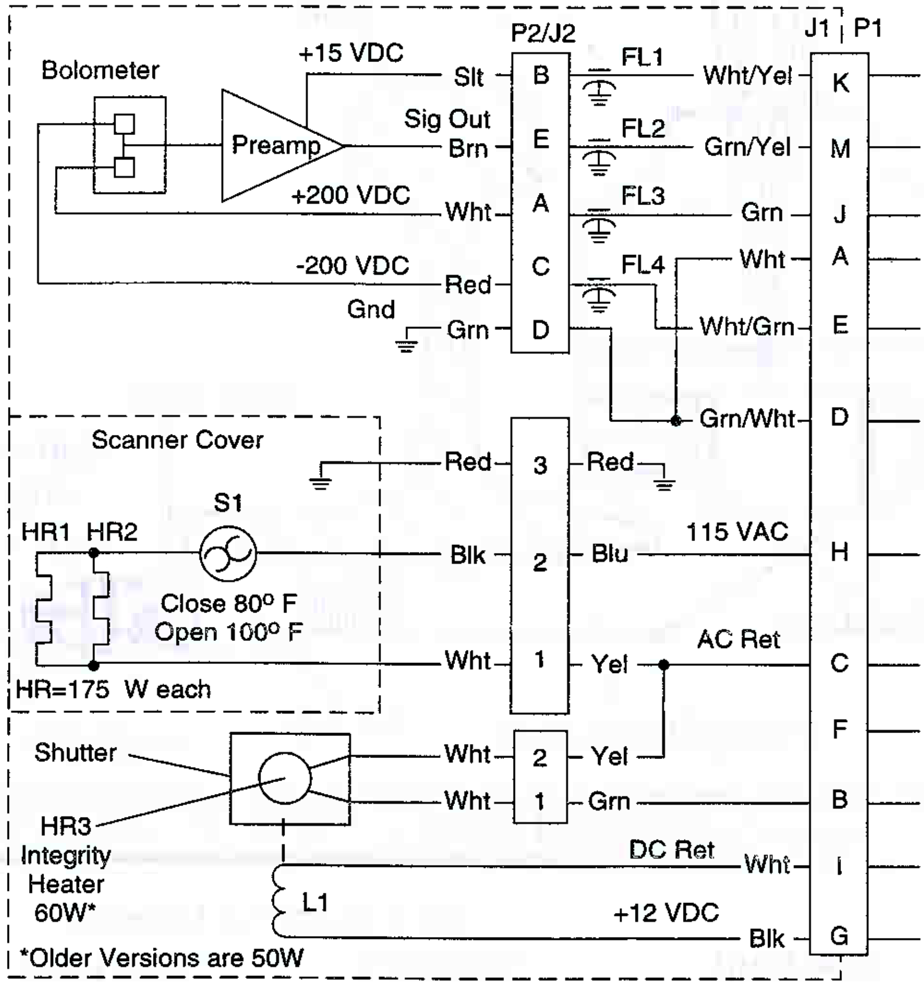
Table 8-1			
Rail		Cant Cam Nut Number	
	1/40 Cant	1/40 Cant	1/40 Cant
115 lb.	4	2	6
132 lb., 136 lb., 140 lb.	6	4	
155 lb.	6	4	

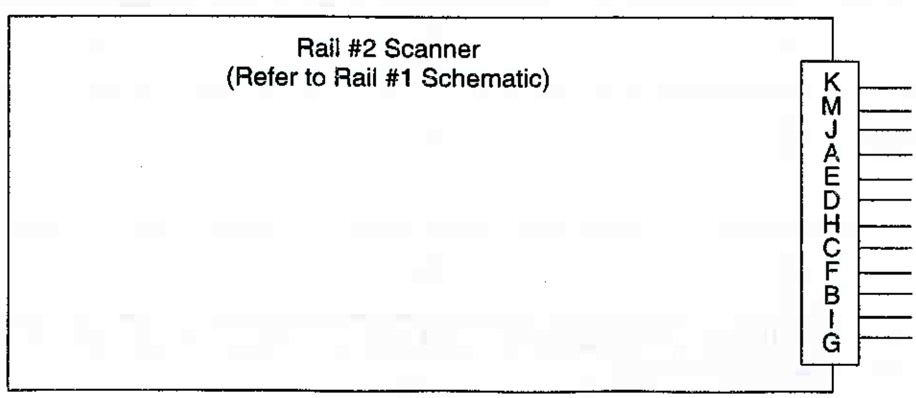
NOTE: Cant nut numbers given are to be used as a starting point only. Actual numbers after alignment will vary.

Servo Advanced Concept Scanner (ACS)

Schematic Rail 1 Scanner

Rail #1 Scanner





Servo Model 8909 Scanner

General Description

The Servo 8909 Hot Box Detector (HBD) scanner is a third-generation solid state trackside system designed for early detection of overheated journals on passing trains.

The Servo 8909 infrared scanner looks at journals on trains passing at speeds ranging from 5 to 150 mph and can detect significant differences in heat radiation from one bearing to the next.

A thermistor bolometer, with an integral sun filter, is placed at the focal point of the lens. This unit changes its resistance almost instantaneously, in proportion to the amount of heat energy focused on it. Since the bolometer is in a bridge circuit, its instantaneous change of resistance causes a signal to appear at the bridge circuit output. The signal is proportional to the amount of heat energy focused on the bolometer. Each journal viewed by the sensor, therefore, will cause a signal to be generated at the output of the bolometer bridge. The amplitude of the signal will depend on the heat radiation from the journal box being scanned. Since the output of the bolometer bridge circuit is in microvolts, it is necessary to amplify this heat signal several hundred times before applying it to the data processing unit (DPU).

The pre-amplifier has a gain of approximately 200; therefore, a 20 microvolt signal at the output of the bolometer bridge is amplified to a 5 millivolt signal at the output of the pre-amplifier.

The bolometer and pre-amplifier are designed as a single assembly that mounts inside a cast aluminum sensor housing with the scanner. The lens is mounted at the front of the sensor housing so that the entire unit forms a precision infrared sensor assembly. The assembly requires positive and negative 200V bolometer bias and positive 15V pre-amplifier bias. The bolometer/pre-amplifier assembly is a sealed unit and provides a voltage gain of approximately 200 (46db). The assembly is plug coupled inside the sensor housing for easy removal.

Servo Model 8909 System

Parts Identification

Figure 8-32: Model 8909 scanner

Figure 8-33: Model 8909 scanner cover

Servo Model 8909 System

Parts Identification

Figure 8-34: Aperature moving freely

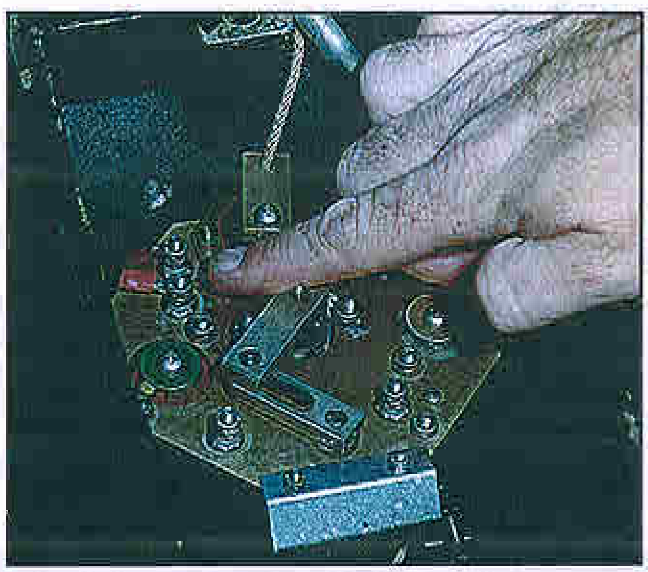


Figure 8-35: 110V AC terminals

Figure 8-36: Model 8909 scanner base with pre-amp

Standard Troubleshooting Procedure

System troubleshooting consists of observing the system performance for the purpose of isolating trouble to a major assembly and then further isolating the trouble to a specific component or components within the major assembly.

First determine whether the problem is the processor unit. First follow the internal steps to troubleshooting the hot box detector and then move to the external scanners, rack wiring, cables, transducers, pre-amp, etc.

In order to effectively troubleshoot a defect detector system, the maintenance personnel should be familiar with how the system operates and be able to read and understand the block diagrams and circuit plans.

A defect system can be broken down into two basic sections:

- Rail or trackside equipment related to signal input
  - Transducers (provides approach or gating inputs)
  - Sensors (provide heat input)
  - Junction boxes, cabling, scanners (enable inputs to be sent to the house)

- Wayside equipment related to signal output:
  - Model 75 electronic chassis (amplifies heat signal and output for processing)
  - Recorder (charts heat profile of passing trains)
  - Power supplies (provide voltages for Harmon rack)

The Standard Troubleshooting Procedure is a general approach that can be applied to repairing defect detector equipment.

STANDARD TROUBLESHOOTING PROCEDURE	
Step 1: Identify the trouble symptom.	The trouble system lets the maintainer know that something is wrong with the equipment and will provide clues as to where the trouble can be found.
Step 2: Sectionalize the problem.	Each system or piece of equipment is divided into basic sections. Careful analysis of the trouble symptom (step 1) will direct the maintainer to the section that is in trouble.
Step 3: Localize the problem.	Each section of the equipment or system is further divided into circuits or components.
Step 4: Isolate the problem.	After localizing the faulty unit, circuit, or component, the trouble can be found by multimeter readings or a thorough visual inspection. Any voltage reading out of tolerance is a good indication of a problem in that circuit, or one feeding that circuit.

STANDARD TROUBLESHOOTING PROCEDURE, continued	
Step 5: Repair the problem.	Correct the circuit fault, or replace the defective unit or component.
Step 6: Perform an operational check.	Always check for proper equipment operation. Do not assume that the equipment is repaired by finding one fault.

A simplified example of applying the Standard Troubleshooting Procedures to the repair of defect detectors follows:

> Upon arrival, take several minutes to analyze the visual evidence. Check the recorder graph and printout, if equipped with a printer. Check the AC power source and all power supplies in the system, making sure that all readings are normal. A careful examination of these sources, along with the trouble report information conveyed by the train crew and dispatcher, should enable the maintainer to analyze and accurately determine what section the trouble is in. Refer to the system block diagram and proceed in sectionalizing the problem area.
>
> Now that the area of the equipment in trouble has been determined, further localize the problem to a specific card or module. Substitute a known good card or module for the suspected bad unit. If this clears up the trouble, perform an operational check and return the equipment to normal operation. If the trouble still exists, further isolate the problem to the faulty unit by checking the voltages in the area you have localized. The problem area frequently can be identified by finding an incorrect voltage level. If the voltage readings are not within specifications, repair or replace the faulty unit or component, and then perform the required operational checks to ensure that the problem is corrected. After successfully completing operational checks, restore the site to normal operation.

Normal voltage readings of all power supplies and gains that were previously logged should be referred to when proceeding through the troubleshooting procedure. Note that the block diagrams and/or truth tables supplied in the system manual are useful in helping to logically troubleshoot the defect detector system.

During train passage, both self-diagnostics and external system integrity checks are invoked. If a system error (malfunction) has occurred, then a detector malfunction message is sent to the train crew.

When a WCO-2 or WCO-27 chart recorder is used with the system, information regarding the trains passing the site is recorded and can be retrieved from memory for up to 4 trains. Other information and error codes can be printed after a train's heat profile and alarm messages (if any) are printed. These refer to program (software) and/or hardware deviations that might or might not have cleared up. Refer to the Harmon manual *Information and Error Codes* for an explanation of these error codes and possible action. This information can be very helpful in identifying and isolating trouble.

Troubleshooting the Harmon Model 75 Electronics Chassis

System malfunction problems and corrective actions are shown in the following table:

PROBLEM	ACTION
Equipment defect detector malfunction	1. Run a functional self test to determine whether the problem is within the signal processor or external to it (for example, the scanners or other sensors, rack wiring, cable, radio, etc.) 2. Check the power supply voltages. Refer to "Work Procedure Number 4, Weekly." NOTE: If voltages do not exist or are not within the allowable range or if the circuit breakers on the signal the processor are tripped, refer to the chassis troubleshooting manual. 3. Check to see if the Micro-monitor LED is flashing (at the lower edge of the processor board). If it is, the main program is not running correctly. Replace the processor board.
Error codes BD0 through BD7 and XBD0 through XBD7	1. Run a board self test. a. If the boards are OK, go to step 2. b. If the boards fail: 1. **TURN OFF THE POWER.** 2. Replace the boards identified. c. If boards (analog, speech, or digital) still fail: 1. Disconnect the front connector. 2. Re-run the board self test. (If it passes with the connector disconnected, the problem is external, for example, dragger, radio malfunction, car clearance detector, etc.) NOTE: There is no error code for the overlay card. 2. If there is no display present, replace the display board. NOTE: Refer to the detector owner's manual for the display board removal procedures. 3. If the problem appears to be external to the signal processor, check the voltages out of the Servo overlay card. (Voltages should comply with the weekly work procedure requirements.) If not, adjust to the proper voltages. If the voltages cannot be brought within tolerances, replace the overlay card.

Troubleshooting the Servo ACS Scanners

System malfunction problems and corrective actions are shown in the following table:

PROBLEM	ACTION
Does not see enough heat (error code NO MIN LEVEL, CH-1 or CH-2 SENSOR)	1. Check the signal gain of the pre-amplifier. a. Mount the function simulator on the scanner with the scanner cover saddle (be sure that the saddle is over the alignment pins). b. Place the system in CHOP mode to verify that the shutters open. If not, replace the shutter assembly or the defective part. 2. Verify on the WCO-2/WCO-27 chart recorder or display panel display that the scanner produces approximately 12 mm of signal at 130 degrees F above ambient temperature. 3. Replace any malfunctioning pre-amplifier that cannot be brought to tolerance. 4. If the scanners check out okay, check the scanner alignment according to the Work Procedure Number 5 quarterly test.
Fails pre-train integrity (error code NO INTEG)	1. Run the functional self test and check that the pre-integrity heat test is greater than 16 mm for each channel/rail. 2. Replace the defective sensors.
Fails post train test	1. Run the functional self test and check that the post train test is greater than 5mm per channel. 2. Replace the defective or weak shutter heaters.

Troubleshooting the Servo 8909 Scanners

Scanner problems, possible causes, and corrective actions are shown in the following table:

PROBLEM	POSSIBLE CAUSES
Recorder shows pedestal only; No heat signals.	Cause: Faulty bolo bias supply Faulty 12VDC power supply Faulty sensor or scanner junction box insert Action: Isolate and replace the defective unit(s). Perform operational checks.
Recorder chart shows noise on both rails.	Cause: Faulty bolo bias supply Main power supply Faulty 12VDC power supply Scanners or sensors Action: Isolate and replace the defective unit(s). Perform operational checks.
Recorder chart shows noise on one rail.	Cause: Defective scanner cable sensor Action: Interchange the W1001/W1002 cables at the Junction Box, and check for noise appearing at the other rail. Replace the cable if it is defective. The sensors can be interchanged in the same manner to determine the faulty unit(s).
Aperture blade is inoperative.	Cause: Defective aperature blade solenoid - one rail Action: Isolate and replace the defective unit(s).
Housing heater is inoperative	Cause: Defective heater element Defective breaker Action: Isolate and replace the defective unit(s).

Troubleshooting the Servotrip Transducers

Transducer problem and corrective actions are shown in the following table:

PROBLEM	ACTION
Axle count malfunction (Error codes DR, XA, XB, XA REV?, XB REV?, W4, and W7)	NOTE: On W7, the train direction was reversed during train passage. No action needed. 1. Disconnect the cable for the suspect transducer or isolate the cable inside the wayside junction box. 2. Verify the wire polarity: a. Connect a DC voltmeter with the positive lead connected to the black wire and the negative lead to the white wire. b. Place a metal bar (keeper bar) at rest on both magnets. c. Quickly remove the bar while watching the DC voltmeter. If a positive deflection is seen, the black wire is positive and white wire is negative. d. Check the resistance with a TS-111 (Simpson). It should read a resistance of 550-650 ohms between the transducer leads. 3. If no deflection is seen or if the resistance is not within the allowable range, replace the transducer. NOTE: Due to the strength of the magnets, it may be necessary to periodically clean metal filings from the top of the wheel transducers.

Troubleshooting the WCO-2 or WCO-27 Data Recorder

Before checking the internal workings of the unit, a few preliminary checks should be made:

1. Be sure that all input connections, including power, HBD inputs, train passage and direction inputs (if any), proper interface option resistors used and proper interface jumpers are used as shown on CSX drawings.
2. Check that all controls are set up for the desired response from the recorder.
3. Check that the fuse is good.

If the problem still appears to be internal, the modules can be slid out together or independently (as required) to gain access to the recorder module, circuit board, etc. The recorder module contains only the recorder mechanism, pen heating transformers and controls, and the recorder drive relay. The remainder of the circuitry is in the recorder control module, mostly on the single circuit card.

CAUTION: The system can be run with the modules slid out, but line voltage is present at various points on the chassis.

Data recorder problems and corrective actions are shown in the following table:

PROBLEM	ACTION
Event pens not properly positioned.	Adjust the pen position potentiometer on the front panel for base line or zero millimeters on the chart paper.
Incorrect pen deflection (either high or low)	While holding in the print switch, adjust the gain potentiometers R84 (for channel 1) and R85 (for channel 2) for 15 mm deflection. These potentiometers are located on the circuit board inside the recorder control module.
Excessive pen overshoot or undershoot	1. While holding in the print switch, adjust the damping potentiometers R82 (for channel 1) and R83 (for channel 2) for pulses that are as flat as possible. These potentiometers are located on the circuit board inside the recorder control module. 2. Check the gain for 15 mm deflection.
Recorder take-up reel slipping.	Replace the take-up reel drive belt.

Troubleshooting the 1140B and 1141B Motion Detectors

The motion detector problems and corrective actions are shown in the following table:

PROBLEM	ACTION
No output relay voltage when no train present or no short exist between rails in island circuit	1. Check all wiring connections, fuses, and external power. Trouble can be traceable to dirty module tail plugs. 2. Check for broken track leads. 3. Check termination (WBS, NBS, hardwire). 4. Check the fuse. 5. Check for signs of severe lightning damage to printed circuit boards. 6. Check for 200VDC in the motion detector module (124B-1) test point. Level on the rail should be 1.4 to 3.2VAC. If this cannot be achieved, trouble may be in the transmitter or power amp. 7. Connect ACVTVM across terminals A and B of 121A board and check voltage for .5 to 1.5VAC. 8. If present, check the DC voltages from negative common to collectors of Q1, Q2, and Q3 for 8 to 12VDC in the 121A board. 9. Check the voltage across R8 for .1VDC ± .02VDC on 121B board contacts 1 and 7. 10. Check the DC voltage negative common to collectors Q1 and Q2 for 8 to 12VDC on the 122A power amplifier 11. Chech the DC resistance across terminals A and C on the power amplifier with the unit unplugged. (Continuity indicates a shorted capacitor.) 12. If the level on the rail is okay but it is still not possible to obtain 200VDC, check the voltage present at the collector of Q1 on the motion detector board (should be 10-12VDC). Check th bias on the emitter of Q1 (should be .15VDC across R7 - 1 ohm 1W resistor). Check for shorts on T1, T2, C1 through C6, and D1 through 7.

Troubleshooting the 1140B and 1141B Motion Detectors, continued

PROBLEM	ACTION
No output relay voltage when no train present or no short exists between rails in island circuit (continued)	13. If 200VDC is present but there is not relay voltage, use a Simpson VOM to check for minimum range between 3 and +12V on pins R and S on the tail plug of the motion detector board. If either of these points is below 3V, the trouble may be due to a faulty Q2 or Q3 on the motion detector board. CAUTION: These are field effect transistors and must be handled with care. They are also matched units and whenever possible, replacement should be done by factory. 14. If proper voltages appear on pins R and S, trouble could be a faulty relay 1 or 2 but would more likely be in the receiver. To determine this, check pins A and B of the receiver board for relay voltage. If no voltage appears, trouble is in the receiver. On the 131A receiver board, check the DC voltage from negative common to collectors of Q1, Q2, and Q3 for 8 to 12VDC.