Section 5:
Devtronics 68178/68278/MA1B
Servo Model 8909 Scanners

(Work Procedure 2)

Train Control Engineering
Defect Detector Work Procedure
Number 2

Equipment: Devtronics 68178/68278/MA1B
Servo Model 8909 Scanners

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

WEEKLY

Test Equipment Needed:
(See Figure 5-1)

Motorola AC Voltmeter (flat meter)
Simpson 260
Fluke 27, 87 or equivalent
Soldering iron

Figure 5-1: Simpson 260, Simulator, Fluke meter, Motorola AC voltmeter, thermometer, and simulator saddle

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, junction boxes, 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 as shown in Figure 5-2.) 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.

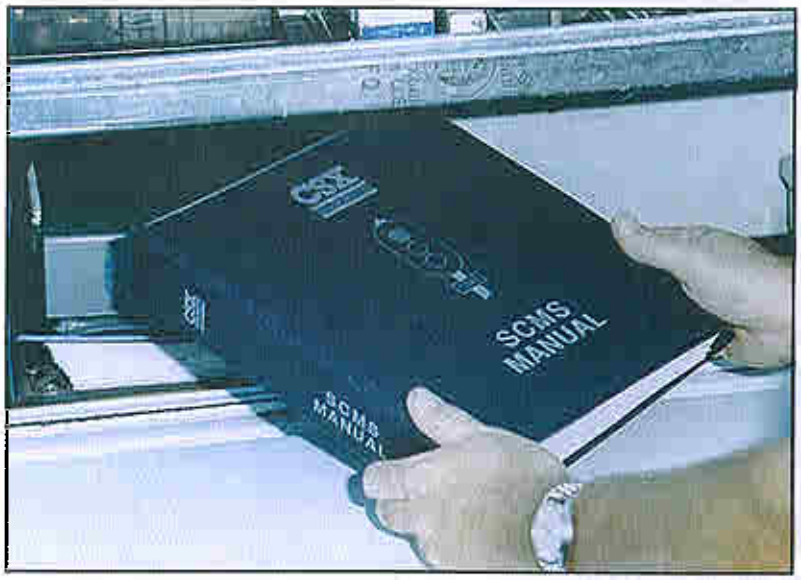


Figure 5-2: Signal Construction and Maintenance Standards Manual

Figure 5-3: Inspecting the ground rods and connections

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. Then finish cleaning them with a soft cloth. Do NOT clean with an ammonia-based product because it will damage the lenses. Check the proper operation of the scanner cover heaters and the shutter mechanisms. Replace the scanner covers and clean them with a cleaning solution. If the scanner covers are still dingy or dull, paint them aluminum to help reflect heat away from the scanner.

Figure 5-4: Cleaning the scanner lenses

3. Check the graph for proper gating, missing wheels, back gating, and normal heat levels of 5 to 6 mms. Be sure the graph 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 retain them for 30 days.

Figure 5-5: Checking the graph for proper gating

4. Check the printer for proper operation. Replace the ribbon if necessary to make a good readable printout, and check the paper supply. Date and initial the printouts when you remove them from the printer 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:

Module/System	Voltage	Allowable Range
Unreg AC	110V AC	109V AC - 120V AC
Reg AC	118V AC	115V AC - 120V AC
Main power supply	200V DC	180V DC - 205V DC
Main power supply	24V DC	23.5V DC - 24.5V DC
Unreg 12V supply	12V DC	12V DC - 14V DC
Reg 12V supply	12V DC	11.5 V DC - 12.5V DC
Bolometer bias supply	+300V DC	270V DC - 300V DC
Bolometer bias supply	-300V DC	270V DC - 300V DC

NOTE: The + and - 300V DC should be within 5V of each other.

6. Using the Fluke meter on the AC scale or the Motorola AC voltmeter, check the following test points for AC noise:

Module	Test Point		Maximum allowed
Pulse processor	Input	Rail 1/Rail 2	5mV
Pulse processor	Output	Rail 1/Rail 2	20mV
Main power supply	200V DC		300-400 mV
Main power supply	24V DC		5mV
12V power supply	12 V reg		5mV
12V power supply	12V unreg		100mV
Bolometer bias supply	+300V DC		10mV
Bolometer bias supply	-300V DC		10mV

7. Run a continuous roller bearing test using the test set and apply heat to each scanner using a heated soldering iron. Activate the dragging equipment device. The detector must announce proper locations of all

detections, with proper graph and printer outputs.

8. Run a short test train using the test set and listen to the voice transmission over the vehicle radio to be sure that it is clear and not distorted and has proper amplitude.

9. Sweep the floor. Check that test leads are removed, the test set is off, and the radio is on. (Note the sticker, shown in Figure 5-6 that serves as a reminder.) Secure the location.

Figure 5-6: Train control safety sticker "Is the Radio On?"

MONTHLY

Test Equipment Needed: 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 the light to go out. (The generator will take about 15 minutes.) You now have about 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 off before using it again.

Figure 5-7: Placing the function simulator/ generator in the shade

3. Start the calibration procedure by plugging the test leads of the Motorola AC voltmeter into the output jack of the pulse processor, rail 1. Turn on the gate on the function simulator/generator and adjust the pulse processor pedestal for 11 db peak reading (2mm). Place the simulator/generator on the scanner cover saddle and adjust the pulse processor gain adjustment for 18 db peak (10mm). Recheck the pedestal and gain adjustment until they are both correct, because a change to the pedestal will affect the gain and vice versa. Repeat the procedure for rail 2. Depending on the type of graph at the location, the graph should read:

Recorder	Pedestal	Heat
Servo 3-inch graph	2mm	10mm - 11mm
Servo 5-inch graph	2mm	10mm - 11mm
Harmon graph	2mm	10mm - 11mm

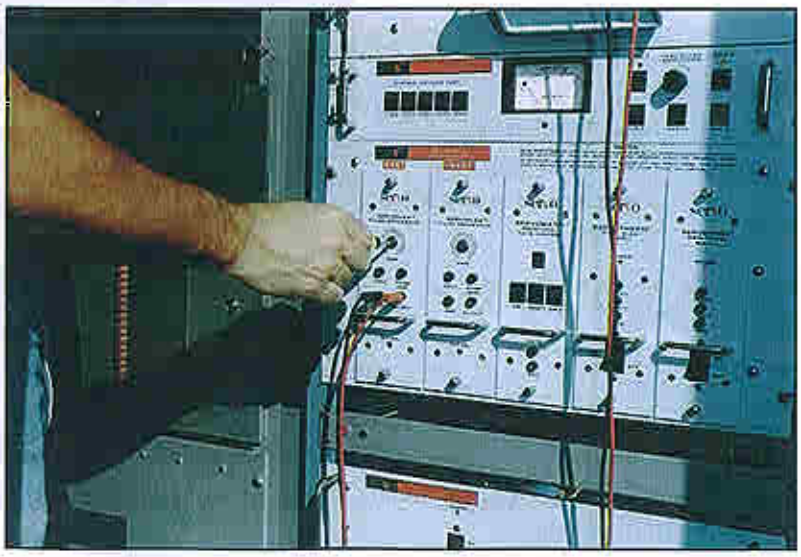


Figure 5-8: Using the Motorola AC voltmeter to check calibration

QUARTERLY

Additional Tools Needed:
(See Figure 5-9)

Tape-line
Servo alignment fixture 200099-81-X
Mirror cap
Appropriate hand tools

Figure 5-9: Servo alignment fixture, adjustable wrenches, and tape line

1. Perform the weekly and monthly tests.

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

Figure 5-10: Maintainers using triangulation to ensure squaring of the scanners

Triangulation, illustrated in Figure 5-11, is a procedure used to square the scanners to each other in reference to the A and B transducers.

To triangulate, do the following:

Step 1 Place a small nail at the exact center of the track in a tie approximately 15 feet from the scanners.

Step 2 Using a metal tape-line, measure the distance from the nail to the middle of the scanner aperture installed on the same rail as the transducers. Note this distance.

Step 3 Measure the distance from the nail to the center of the other scanner aperture. It should be the same (within 1/2 inch) as the distance measured in step 2. If not, move the scanner until it is.

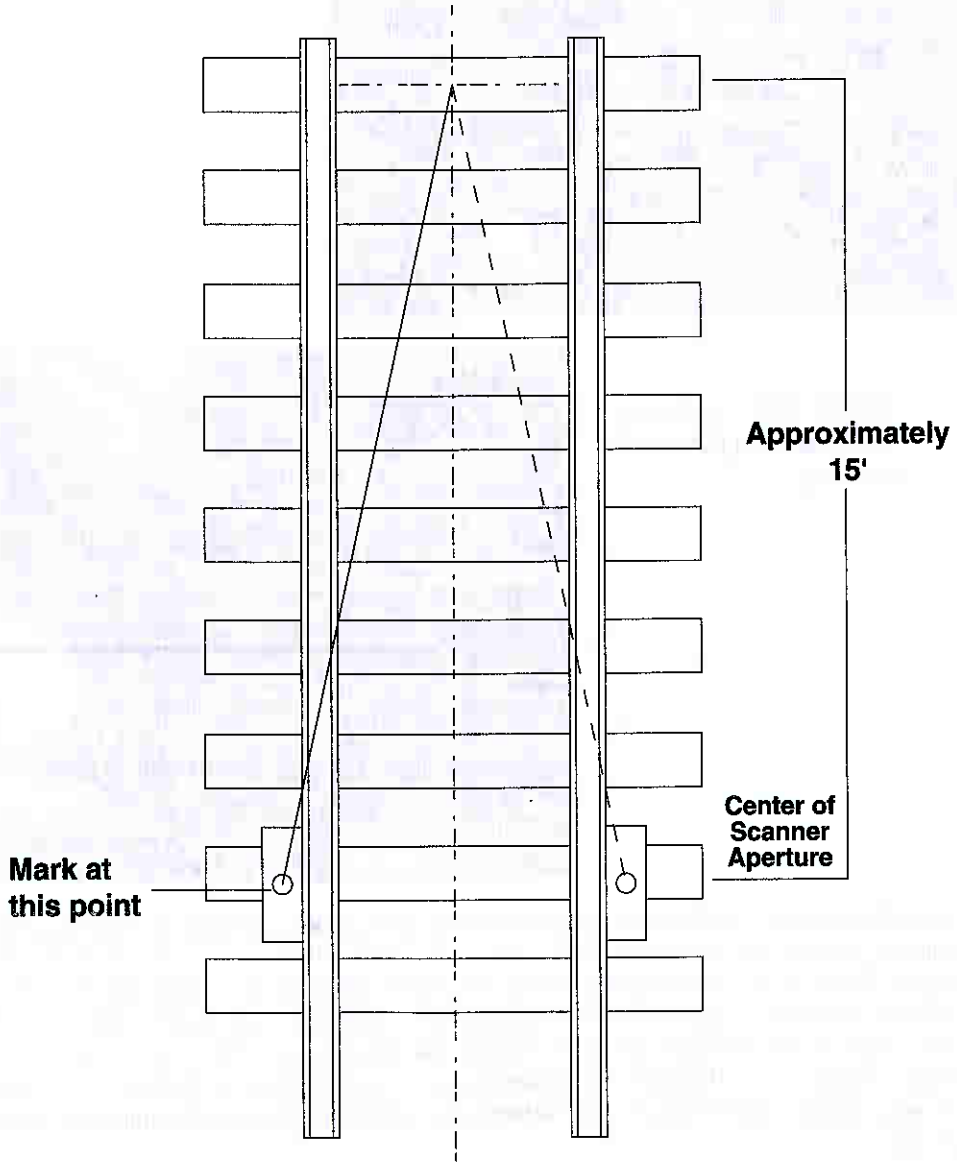


Figure 5-11: Diagram of triangulation

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 the mirror cap on the scanner lens. Be sure that the cap is squarely seated against the end of the lens barrel.

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

Figure 5-12: Setting up the alignment fixture and lens cap

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 on the upright post is on 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. 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 5-13: Looking through the peep hole to check the alignment

Figure 5-14: Scanner adjustment of 7 inches

Figure 5-15: Center of the A transducer to the center of the scanner aperture

5. As a result of the previous step, 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 5-16: 24 inches between the A and B transducers

6. Test the equal-heats feature to be sure that the detector will malfunction if the selected number of cold trains (3 or 5) is simulated. Test the zero-heat feature (68278/MA1B only) by carefully pulling out the pulse processors one at a time and running a test train. The detector should malfunction with one train. Check the detector scaling using the Devtronics scaling procedure. Do not extend the circuit card unless necessary to adjust.

NOTE: Turn off power before removing or installing any 8909 Module.

7. Measure the track gauge and check the surface of the track by observing the passing of a train. Notify the proper authority if the track condition does not meet the CSX standard.

Figure 5-17: A maintainer observing the surface of the track as a train passes

Devtronics 68178
General Description

1.1 Capabilities

The 68178 system receives train advance approach information from either the southbound or northbound approach transducers. Wheel gate information is derived from the A and B wheel gate transducers. Heat information is input to the processor system from the outputs of the pulse processors for rail 1 and rail 2. Dragging equipment information is received from the D.E. sensor switch. Other inputs may be used in conjunction with this system, such as hot wheel, high load, wide load, and loose wheel sensors.

From the above inputs, the 68178 system performs the following operations and provides the following information:

A. Controls operation of the red and white lights.

B. Controls start-up of the strip chart recorder.

C. Controls radio keying and voice transmission over the radio.

D. Controls defect alarm tone to the train crew.

E. Analyzes heat information for determining overheated axle bearings and classifies defective axles as either roller or friction type bearings.

F. Analyzes wheel gate information for determining overheated axle bearings and classifies defective axles as either roller or friction type bearings.

G. Prints on a local printer the following:
- Defect detector geographical location
- Month, day, and time of day
- Length of train in feet
- Speed in M.P.H.
- Direction of train travel
- Total number of axles in the train
- Software version currently operating

If one or more hot boxes have occurred, a summary of all heat levels for all journals on any car having a defect will be printed. If a D.E. has occurred, then the D.E. number and the corresponding nearest axle number will be printed. Otherwise "No Defect" is printed.

NOTE: All defective axle numbers are given as a count from the head or rear of the train. If hot

wheel, high load, and wide load option has been selected, then a nearest axle count will be included for any of these inputs that are active.

H. Enunciates defect information to the train crew.

I. Makes a malfunction enunciation to the train crew.

1.2 Physical Layout

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

A. Unit 1

This unit contains all the microprocessor buss oriented sub assemblies (printed circuit boards). It contains the basic processor mainframe (processor host motherboard), +12V, -12V, +5V processor power supplies, and rack mounted mainframe enclosure.

The motherboard hosts the following circuit boards:

M68MM01A2(D) 1 each 1A1 MAIN PROCESSOR MONOBOARD

178-001-1 1 each 1A3 DIGITAL INPUT MULTIPLEXER PCB

178-002 1 each 1A4 PROGRAMMABLE TIMER AND 1k RAM PCB

178-001-3 1 to 6 each 1A5 DIGITAL VOICE MEMORY BOARD

B. Unit 2

This unit has been superseded and integrated into UNIT 1.

C. Unit 3

This unit contains the interface to all external system inputs and outputs. The front is hinged to provide direct access to the 4 I/O printed circuit boards hosted by a backframe motherboard.

The motherboard hosts the following I/O circuit boards:

178-003-1 1 each 3A 1 TRANSDUCER INPUT INTERFACE PCB

178-003-8 1 each 3A 2 HEAT AND WHEEL GATE INTERFACE PCB

178-003-3 1 each 3A3 ERROR LITE AND RELAY DRIVER PCB

178-003-9 1 each 3A4 SPEED CONVERTER AND DISPATCHER CONTROL PCB

NOTE: PC board designations are from left to right.

D. Unit 4

Unit 4 is comprised of a Chronolog calendar clock with digital display of date and time information that is used by the processor for printout purposes.

This unit is a stand alone device containing a 24-hour battery for emergency operations.

E. Unit 5

Unit 5 is a keyboard programmable test set capable of being programmed with hot boxes and dragging equipment defects. The test set generates friction and roller bearing heat levels and properly spaces axles to simulate any train length up to 999 axles.

This unit hosts 4 circuit boards on a backplane mounted motherboard as follows:

178-005-1 1 each 5A1 KEYBOARD INTERFACE PCB

178-005-2 1 each 5A2 DATA STORAGE LATCHES AND DISPLAY CONTROL PCB

178-005-3 1 each 5A3 BIN TO BCD AND BCD TO BIN CONV & COUNT GENERATOR PCB

178-005-4 1 each 5A4 HEAT GEN, TRUCK INTERCAR SPACING CONTROL PCB

178-005-5 1 each 5A5 FRONT PANEL LED DISPLAY

178-005-12 1 each 5A9 MEMORY ZERO GENERATOR (FRONT PANEL MOUNTED)

F. Unit 6

Unit 6 hosts the +5V, the ±15V, and the +12V power supplies necessary to power all logic and relay operations external to the processor mainframe. Sub assembly designations are as follows:

178-006-1 1 each 6A1 RELAY PCB

178-006-1 1 each 6A2 +5 POWER SUPPLY

178-006-1 1 each 6A4 +12V POWER SUPPLY

178-006-1 1 each 6A5 POWER DISTRIBUTION PCB

G. Unit 7

This unit contains the local speaker, hot box mechanical totalizing counters, D.E. counter, and speaker cut-off switch.

H. Unit 8

Unit 8 contains 3 each 20 terminal barrier strips (8TB1, 8TB2, and 8TB3) with all connections necessary for external hook-up.

I. Unit 9

Unit 9 represents all individual (distributed) subassemblies used as interface controls. Most of these sub units are enclosed in individual Bud miniboxes and are mounted on the telephone (interface) board and behind Unit 8 on a rear sub panel.

9A1 Dispatcher Phone Ring-of (telephone board mounted)

9A2 Radio Adapter and Keying Control (telephone board mounted); refer to drawing 178-009-2 in the Devtronics manual.

9A3 Radio Power-on Relay (telephone board mounted); refer to drawing 178-009-2 in the Devtronics manual.

9A5 Dispatcher Phone Line Disconnect (telephone board mounted)

9A6 Phone Line Control Relay Opto-Isolator (Unit 8 rear panel mounted)

9A7 Dispatcher Phone Line Matching (Unit 8 rear panel mounted)

9A8 Approach Transducer Opto-Coupler Isolation (3 each, Unit 8 rear panel mounted); refer to drawing 178-009-8 in the Devtronics manual.

9A9 Differential alarm comparator PCB (panel mounted below K40 board); refer to drawing 178-009 in the Devtronics manual.

9A10 Hot Wheel Opto-Isolator

9A11 D.E. Opto-Isolator (rear K40 mounted); reference drawing ECN 47- 68178 in the Devtronics manual.

1.3 Specifications

Operating environment:
35 to 120 degrees F
5 to 95 percent relative humidity without condensation
Power consumption:
200 WATTS 115V 60 HZ
DC to AC inverter operation requires 18 AMP 12V DC
Load impedance:
Rail 1 and rail 2 input impedance 100K OHMS
Input heat signal voltage range:
0 to 100V Peak

Communications:

Radio audio output adjustable to 4.0V peak (MAX) into 600 OHMS
Dispatcher phone line audio level adjustable to +6 DBM into 300 OHMS
Phone line loading greater than 10k OHMS

Printer:

EIA standard RS-232c output

Power filtering and regulation:

A. Input AC power is Sola regulated with 500 VA Harmonic Neutralized Ferrite Resonant Constant Voltage Transformer. Output voltage will be maintained + or - 3 percent for A + or - 15 percent input power fluctuation. Output current 6.5 AMPS maximum.
B. Power line filtered with triple section Corcom EMI noise filter rated 10 AMP 115V AC.
C. Transformer primaries protected with GE MOV thyrites for transient over-voltage protection.
D. All DC power supplies are voltage regulated over-current protected and over-voltage protected.

Devtronics 68178
Parts Identification

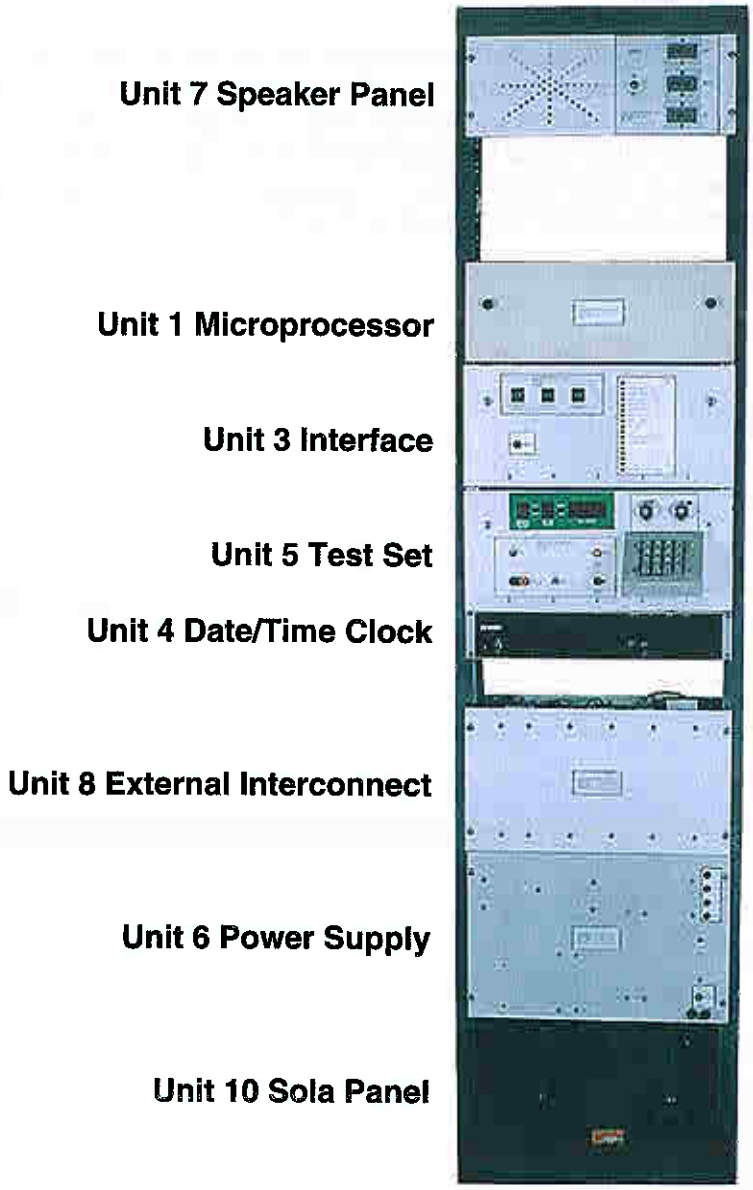


Figure 5-18: 68178 system layout

Devtronics 68178
Parts Identification

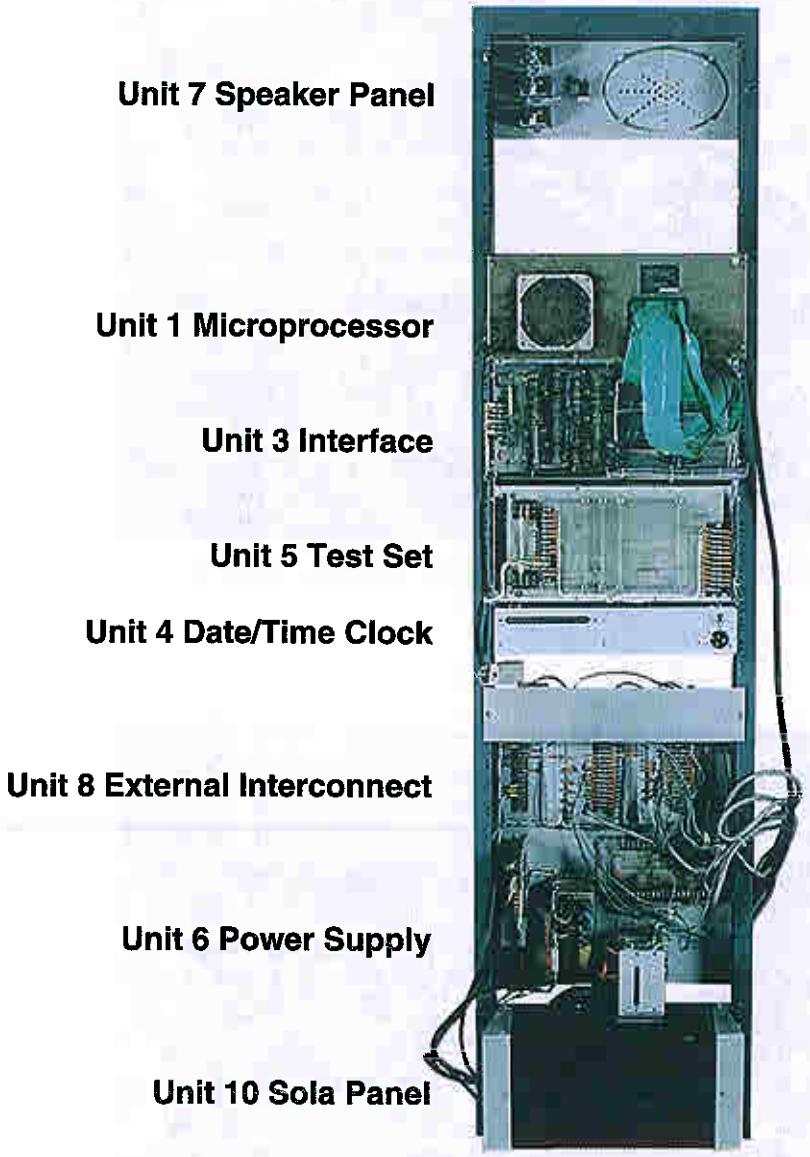


Figure 5-19: 68178 system rear view

Devtronics 68178
Parts Identification

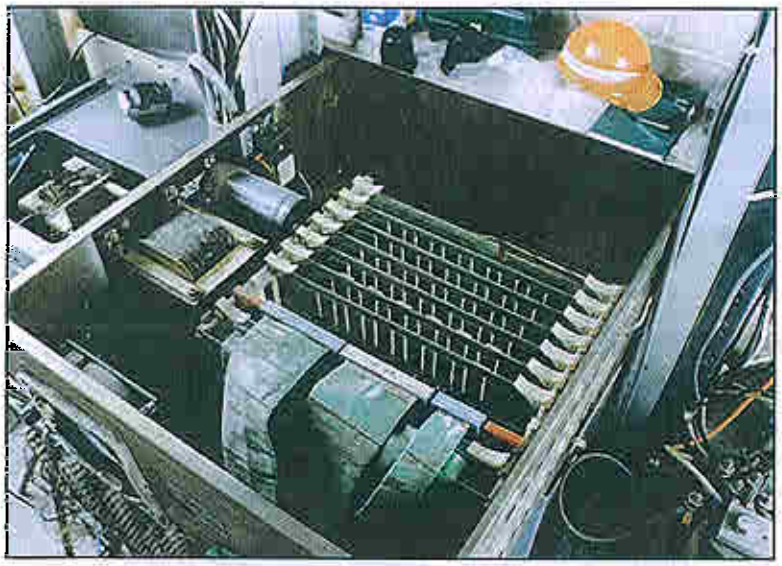


Figure 5-20: Unit 1 microprocessor mainframe top view

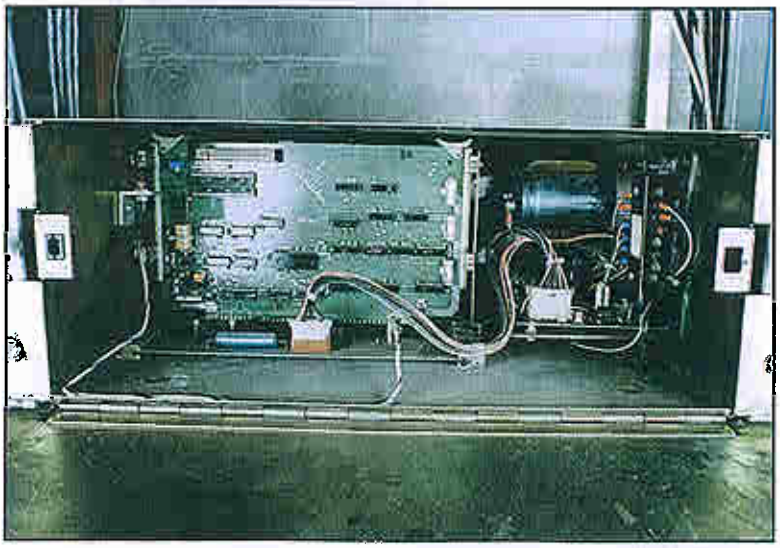


Figure 5-21: Unit 1 microprocessor mainframe front view

Devtronics 68178
Parts Identification

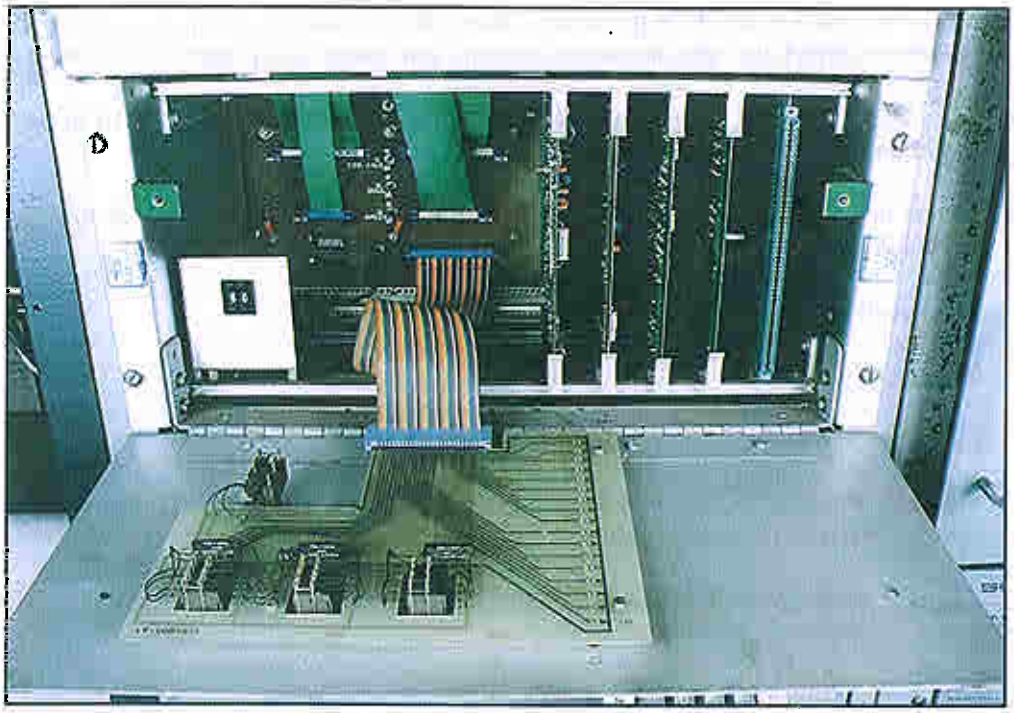


Figure 5-22: Unit 3 front view with panel lowered

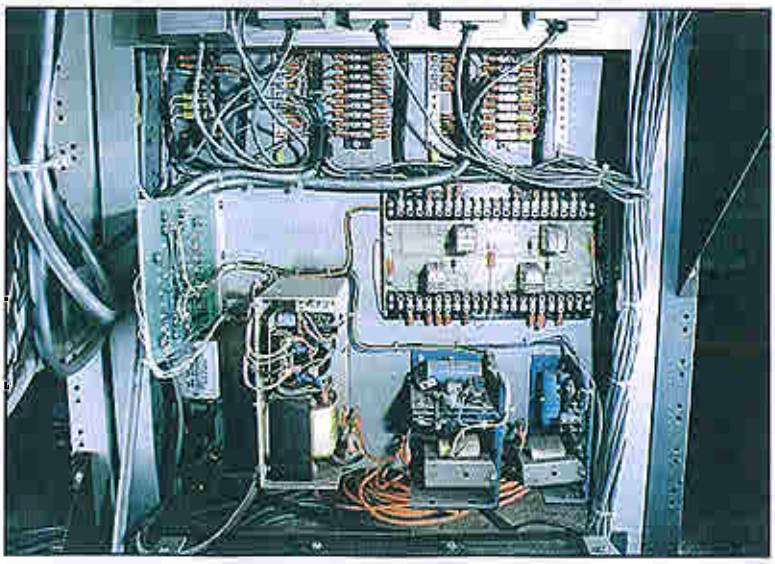


Figure 5-23: Units 6 and 8 rear view

Devtronics 68178/8909
Scaling Procedure

NOTE: Prior to scaling setup of the processor system, the heat sensing system must be properly calibrated which includes: scanner alignment, gain levels, and proper pedestal level settings.

WARNING: The DEV68178 will not process trains if Unit 3 motherboard, S2-01 is left in the ON position.

NOTE: Refer to markings on the Unit 3 motherboard, S2-01 switch to determine ON and OFF positions.

To scale, do the following:

Step 1 Insure the Servo calibration is complete before proceeding.

Step 2 Remove the power to Unit 3.

Step 3 Put 3A2 on its extender card. Place Motorola VTVM on 8909 pulse processor output jack of rail being calibrated.

Step 4 Select heats to printer option by turning Unit 3 motherboard S2-01 ON. This will direct all heats to the printer.

Step 5 Apply power to Unit 3 and reset the Unit 1 processor.

Step 6 Set the function simulator/generator heat selector to 130 degrees F above ambient. After the light goes out, set the function simulator/generator on the scanner for the rail being calibrated.

Step 7 Turn on the gate switch, located on the function simulator/generator.

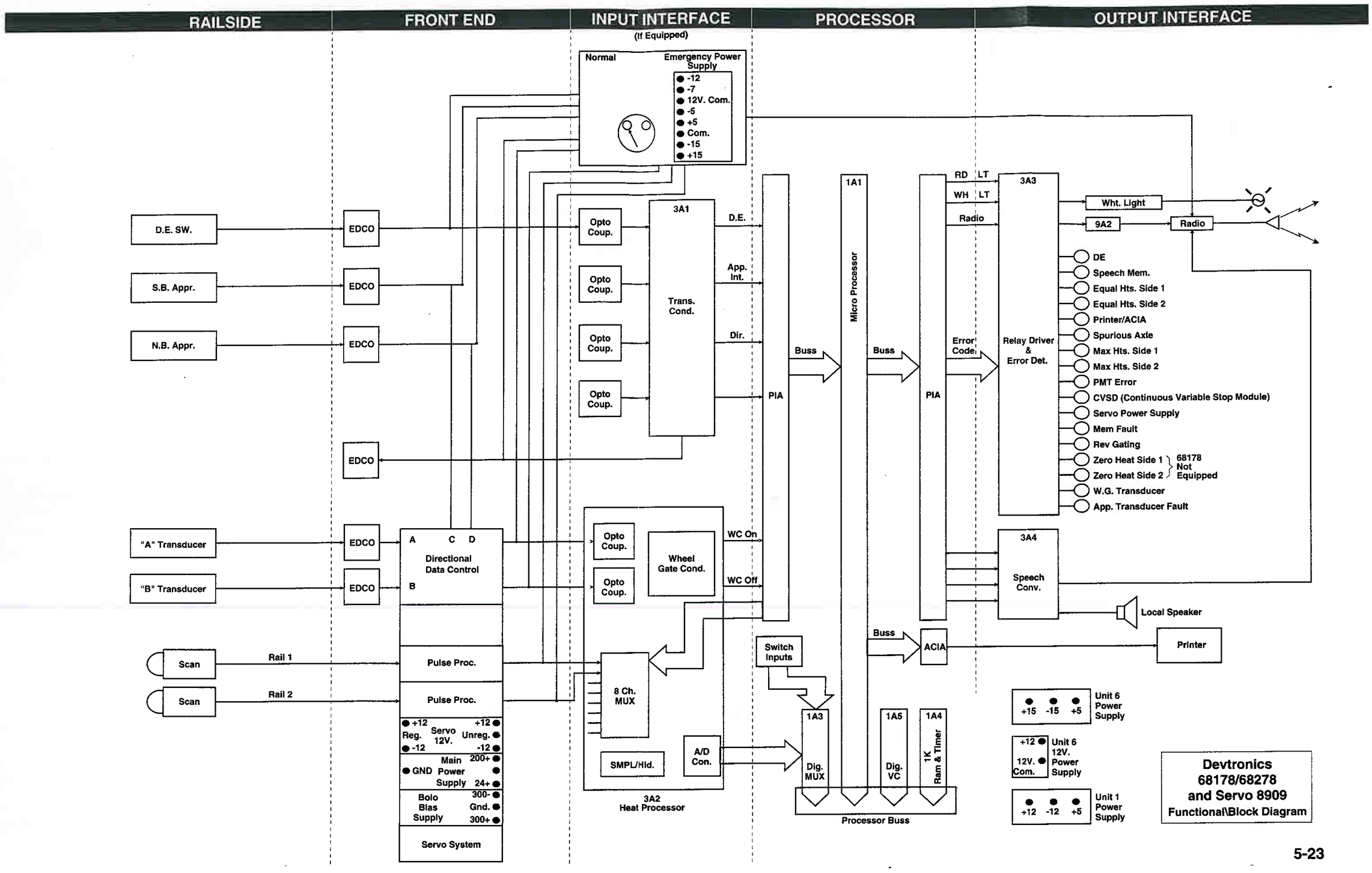
Step 8 Return to the 3A2 board on Unit 3 and adjust R4 for rail 1 or R2 for rail 2. At this time the Motorola VTVM should be indicating +18 db as obtained in step 1. Now adjust the appropriate rail potentiometer (pot) until the output printout indicates a reading of "100" (corresponding to an equivalent 10.0mm of chart deflection).

Step 9 Move the function simulator/generator to the other rail and repeat steps 6 through 8.

Step 10 Remove the power to Unit 3 and remove the 3A2 board from the extender card.

Step 11 Turn Unit 3 motherboard, S2-01 OFF. Apply power to Unit 3 and RESET the DEV68178 system.

Step 12 Run a continuous roller bearing test using the test set and apply heat to each scanner using a heated soldering iron. Activate the dragging equipment device. The detector must announce proper locations of all detections, with proper graph and printer output.


RAILSIDE
FRONT END
INPUT INTERFACE
(If Equipped)
PROCESSOR
OUTPUT INTERFACE
Normal
Emergency Power Supply
-12
-7
12V. Com.
-5
+5
Com.
-15
+15
D.E. SW.
S.B. Appr.
N.B. Appr.
EDCO
Opto Coup.
3A1
Trans. Cond.
D.E.
App. Int.
Dir.
PIA
Buss
1A1
Micro Processor
RD LT
WH LT
Radio
3A3
Relay Driver & Error Det.
Error Code
Wht. Light
9A2
Radio
DE
Speech Mem.
Equal Hts. Side 1
Equal Hts. Side 2
Printer/ACIA
Spurious Axle
Max Hts. Side 1
Max Hts. Side 2
PMT Error
CVSD (Continuous Variable Stop Module)
Servo Power Supply
Mem Fault
Rev Gating
Zero Heat Side 1
Zero Heat Side 2
68178 Not Equipped
W.G. Transducer
App. Transducer Fault
"A" Transducer
"B" Transducer
A C D
Directional Data Control
B
Wheel Gate Cond.
WC On
WC Off
3A4
Speech Conv.
Local Speaker
Scan
Rail 1
Rail 2
Pulse Proc.
8 Ch. MUX
Switch Inputs
ACIA
Printer
+12 Reg.
-12
Servo 12V.
+12 Unreg.
-12
Main Power Supply
200+
GND
24+
Bolo Bias Supply
300-
Gnd.
300+
Servo System
SMPL/Hld.
A/D Con.
3A2
Heat Processor
1A3
Dig. MUX
1A5
Dig. VC
1A4
1K Ram & Timer
Processor Buss
+15 -15 +5
Unit 6 Power Supply
+12 12V. Com.
Unit 6 12V. Power Supply
+12 -12 +5
Unit 1 Power Supply
Devtronics
68178/68278
and Servo 8909
Functional\Block Diagram

Devtronics 68278
General Description

1.1 Capabilities

The 68278 system receives train advance approach information from either the southbound or northbound approach transducers. Wheel gate information is derived from the A and B wheel gate transducers. Heat information is input to the processor system from the outputs of the pulse processors for rail 1 and rail 2. Dragging equipment information is received from the D.E. sensor switch. Other inputs may be used in conjunction with this system, such as hot wheel, high load, wide load, and loose wheel sensors.

From the above inputs, the 68278 system performs the following operations and provides the following information:

A. Controls operation of the red and white lights.

B. Controls start-up of the strip chart recorder.

C. Controls radio keying and voice transmission over the radio.

D. Controls defect alarm tone the train crew.

E. Analyzes heat information for determining overheated axle bearings and classifies defective axles as either roller or friction type bearings.

F. Analyzes wheel gate information for determining speed, length, and total axles in the passing train.

G. Prints on a local printer the following:
- Defect detector geographical location
- Month, day, and time of day
- Length of train in feet
- Speed in M.P.H.
- Direction of train travel
- Total number of axles in the train
- Software version currently operating

If one or more hot boxes have occurred, a summary of all heat levels for all journals on any car having a defect will be printed. If a D.E. has occurred then the D.E. number and the corresponding nearest axle number will be printed. Otherwise "No Defect" is printed.

NOTE: All defective axle numbers are given as a count from the head or rear of the train. If hot wheel, high load, and wide load option has been selected, then a nearest axle count will be included for any of these inputs that are active.

H. Enunciates defect information to the train crew.

I. Makes a malfunction enunciation to the train crew.

1.2 Physical Layout

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

A. Unit 1

This unit contains all the microprocessor buss oriented sub assemblies (printed circuit boards). It contains the basic processor mainframe (processor host motherboard), +12V, -12V, +5V processor power supplies, and rack mounted mainframe enclosure.

The motherboard hosts the following circuit boards:

M68MM01A2(D) 1 each 1A1 MAIN PROCESSOR MONOBOARD

68178-101-006 1 each 1A3 DIGITAL INPUT MULTIPLEXER PCB

68278-101-003 1 each 1A4 PROGRAMMABLE TIMER AND DATE/TIME CLK.

68178-101-008 1 each 1A5 DIGITAL VOICE MEMORY BOARD

68278-101-002 1 each 1A9 CLOCK DISPLAY

B. Unit 3

This unit contains the interface to all external system inputs and outputs. The front is hinged to provide direct access to the four I/O printed circuit boards hosted by a backframe motherboard.

The motherboard hosts the following I/O circuit boards:

68178-103-001U 1 each 3A1 TRANSDUCER INPUT INTERFACE PCB

68178-103-011 1 each 3A2 HEAT AND WHEEL GATE INTERFACE PCB

68178-103-003 1 each 3A3 ERROR LITE AND RELAY DRIVER PCB

68178-103-010c 1 each 3A4 SPEECH CONVERTER AND DISPATCHER CONTROL PCB

68178-103-006 1 each 3A6 UNIT #3 FRONT PANEL CRITERIA SELECT PCB

NOTE: PC board designations are from left to right on card cage as viewed from front of equipment.

C. Unit 5

Unit 5 is a test set capable of selecting pre-programmed trains with hot boxes and dragging equipment defects. The test set generates friction and roller bearing heat levels and properly spaced axles to simulate a typical train.

This unit hosts 1 circuit board mounted on rear of front panel:

68178-501-001 1 each 5A1 TEST SET PCB

D. Unit 6

Unit 6 hosts the +5V, ±15V, and the +12V power supplies necessary to power all logic and relay operations external to the processor mainframe. Subassembly designations are as follows:

68278-0115-11 1 each Relay PCB

68278-0115-11 1 each 6A8 +5V ±15V Power Supply

68278-0115-11 1 each 6A4 +12V Power Supply

68278-0115-11 1 each 6A5 Power Distribution PCB

68278-106-004 1 each 6A6 Interface Isolation PCB

E. Unit 7

This unit contains the local speaker and speaker level control. Refer to drawing 68278-107-003 in the Devtronics manual for layout.

F. Unit 8

Unit 8 contains 6 each 20 terminal barrier strips (8TB1, 8TB1A, 8TB2, 8TB2A, 8TB3, and 8TB3A) with all connections necessary for external hook-up. Refer to drawing 68178-108-002 in the Devtronics manual for terminal designations.

G. Unit 9

Unit 9 controls the radio and supports the dispatcher's phone line disconnect relay and ring-off circuitry.

Drawing designations are as follows:

68278-109-014 1 each Unit 9 Telephone Board

H. Unit 10

The Sola AC line voltage regulating transformer, mounted to the rear below Unit 8 or wall mounted, is designated Unit 10.

I. Unit 12

This panel contains all circuitry necessary for emergency switch over to red and white light operation in the event of microprocessor failure or other maintenance requirements.

68278-0107-11 1 each Emergency Panel Hookup

J. Unit 13

This panel contains the EDCO hybrid lightning protection devices bridged onto all lines coming in the DD house from railside.

68278-0241-11 1 each Thyrite Board to Emergency Panel Hookup

1.3 Specifications

Operating environment:
35 to 120 degrees F
5 to 95 percent relative humidity without condensation
Power consumption:
200 watts 115V 60 HZ
DC to AC inverter operation requires 18 AMP 12V DC
Load impedance:
Rail 1 and rail 2 input impedance 100 K OHMS
Input heat signal voltage range:
0 to 100V peak
Communications:
Radio audio output adjustable to 4.0V peak (MAX) into 600 OHMS
Dispatcher phone line audio level greater than 10K OHMS
Printer:
EIA standard RS-232c output
Power filtering and regulation:

A. Input AC power is Sola regulated with 500VA harmonic neutralized ferrite resonant constant voltage transformer. Output voltage will be maintained + or -3 percent for a + or - 15 percent input power fluctuation. Output current 6.5 amps maximum.
B. Power line filtered with triple section corcom EMI noise filter rated 10 AMP 115V AC.
C. Transformer primaries protected with GE MOV thyrites for transient over-voltage protection.
D. All DC power supplies are voltage regulated, over-current protected and over-voltage protected.

Devtronics 68278
Parts Identification

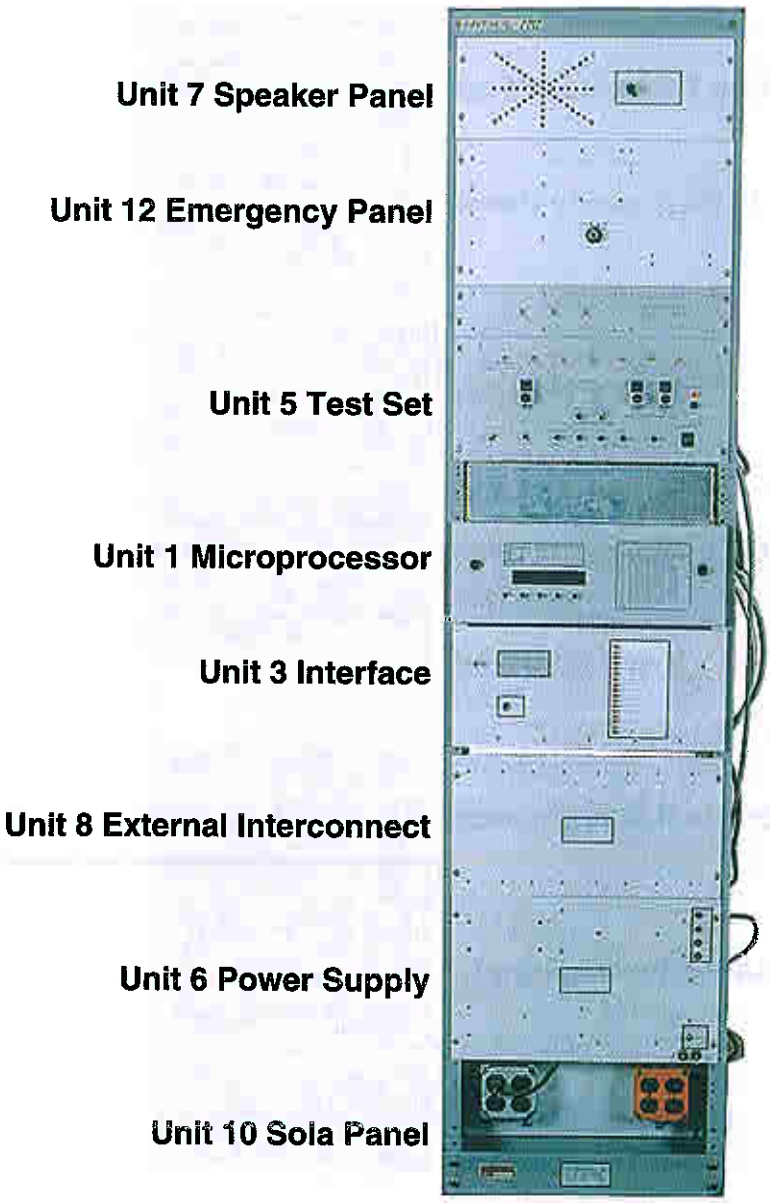


Figure 5-24: 68278 system layout

Devtronics 68278
Parts Identification

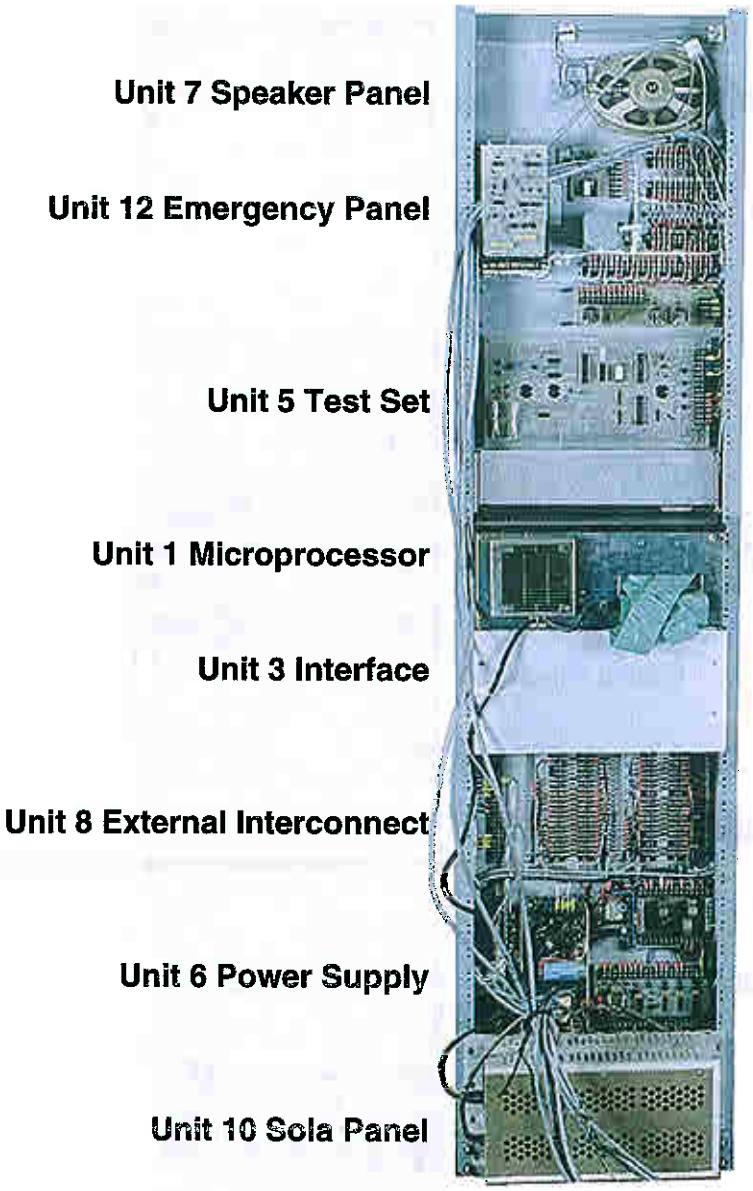


Figure 5-25: 68278 system rear view

Devtronics 68278
Parts Identification

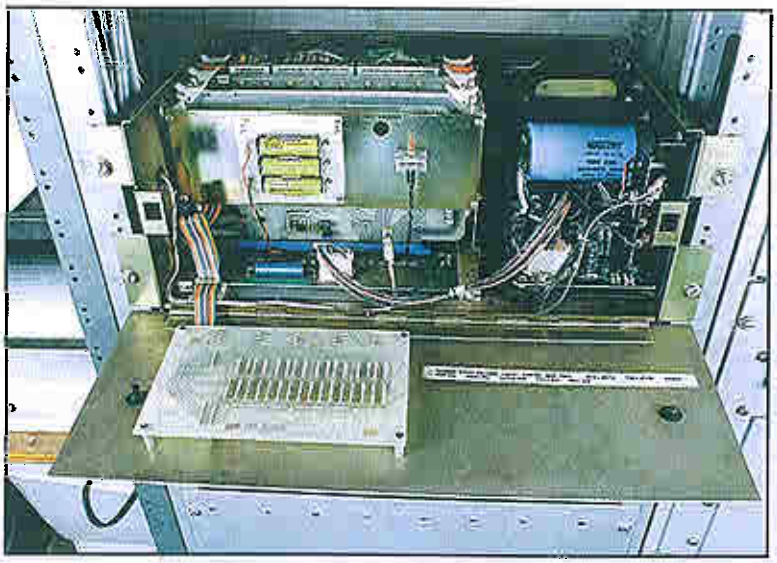


Figure 5-26: Unit 1 microprocessor mainframe

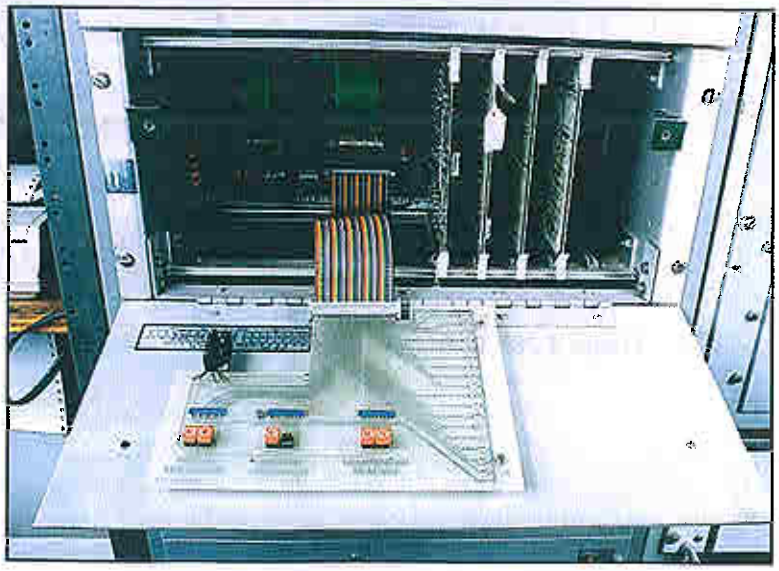


Figure 5-27: Unit 3 front view with panel lowered

Devtronics 68278
Parts Identification

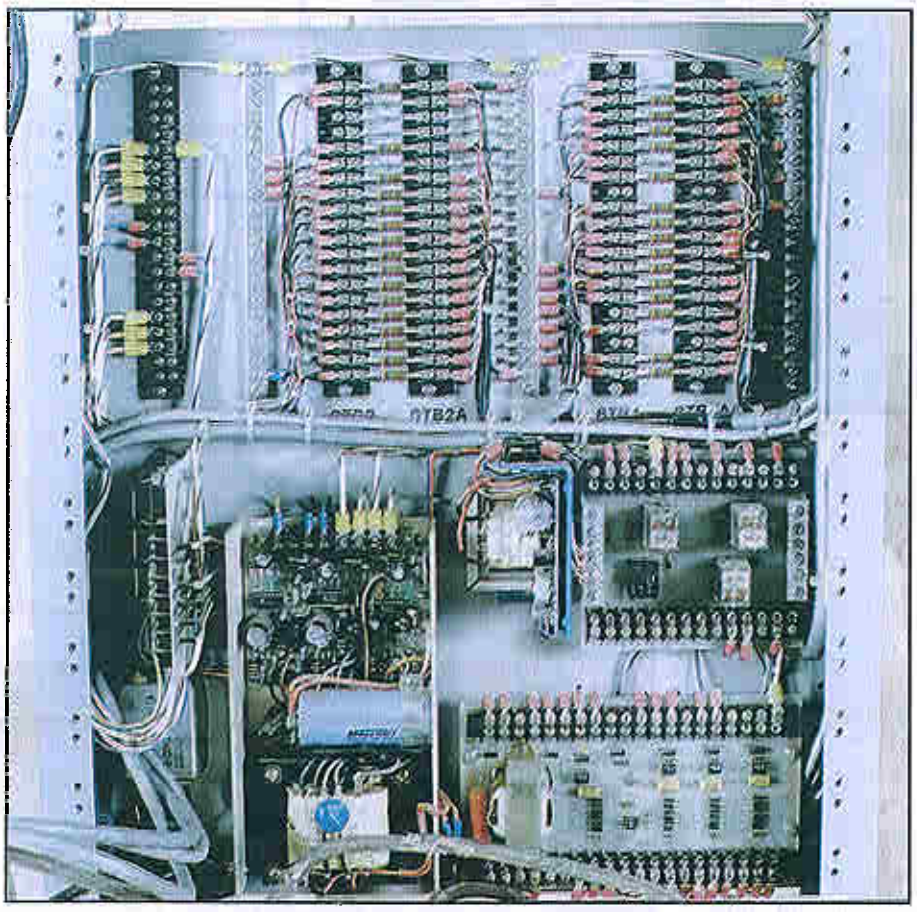


Figure 5-28: Units 6 and 8 rear view

Devtronics 68278/8909
Scaling Procedure

NOTE: Prior to scaling setup of the processor system, the heat sensing system must be properly calibrated which includes: scanner alignment, gain levels, and proper pedestal level settings.

WARNING: The DEV68178 <u>will not</u> process trains if Unit 3 motherboard, S2-01 is left in the ON position.

NOTE: Refer to markings on the Unit 3 motherboard, S2-01 switch to determine ON and OFF positions.

To scale, do the following:

Step 1 Insure the Servo calibration is complete before proceeding.

Step 2 Remove the power to Unit 3.

Step 3 Put 3A2 on its extender card. Place Motorola VTVM on 8909 pulse processor output jack of rail being calibrated.

Step 4 Select heats to printer option by turning Unit 3 motherboard S2-01 ON. This will direct all heats to the printer.

Step 5 Apply power to Unit 3 and reset the Unit 1 processor.

Step 6 Set the function simulator/generator heat selector to 130 degrees F above ambient. After the light goes out, set the function simulator/generator on the scanner for the rail being calibrated.

Step 7 Turn on the gate switch, located on the function simulator/generator.

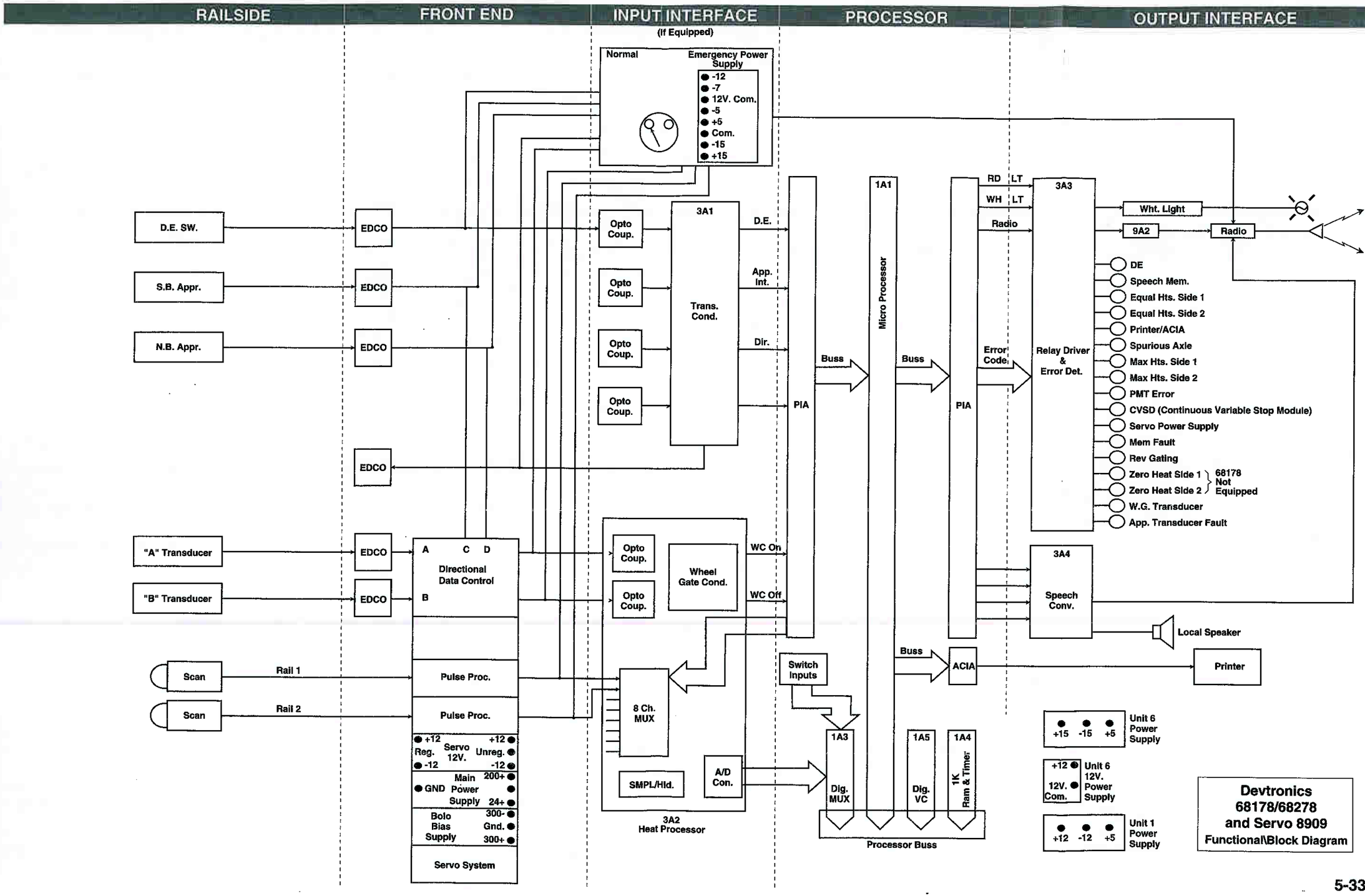
Step 8 Return to the 3A2 board on Unit 3 and adjust R4 for rail 1 or R2 for rail 2. At this time the Motorola VTVM should be indicating +18 db as obtained in step 1. Now adjust the appropriate rail potentiometer (pot) until the output printout indicates a reading of "100" (corresponding to an equivalent 10.0mm of chart deflection).

Step 9 Move the function simulator/generator to the other rail and repeat steps 6 through 8.

Step 10 Remove the power to Unit 3 and remove the 3A2 board from the extender card.

Step 11 Turn Unit 3 motherboard, S2-01 OFF. Apply power to Unit 3 and RESET the DEV68178 system.

Step 12 Run a continuous roller bearing test using the test set and apply heat to each scanner using a heated soldering iron. Activate the dragging equipment device. The detector must announce proper locations of all detections, with proper graph and printer output.


RAILSIDE
FRONT END
INPUT INTERFACE
(If Equipped)
PROCESSOR
OUTPUT INTERFACE
Normal
Emergency Power Supply
-12
-7
12V. Com.
-5
+5
Com.
-15
+15
D.E. SW.
S.B. Appr.
N.B. Appr.
EDCO
Opto Coup.
3A1
Trans. Cond.
D.E.
App. Int.
Dir.
PIA
Buss
1A1
Micro Processor
RD LT
WH LT
Radio
Error Code
3A3
Relay Driver & Error Det.
Wht. Light
9A2
Radio
DE
Speech Mem.
Equal Hts. Side 1
Equal Hts. Side 2
Printer/ACIA
Spurious Axle
Max Hts. Side 1
Max Hts. Side 2
PMT Error
CVSD (Continuous Variable Stop Module)
Servo Power Supply
Mem Fault
Rev Gating
Zero Heat Side 1
Zero Heat Side 2
68178 Not Equipped
W.G. Transducer
App. Transducer Fault
"A" Transducer
"B" Transducer
A C D
Directional Data Control
B
Scan
Rail 1
Rail 2
Pulse Proc.
+12 Reg.
-12
Servo 12V.
+12 Unreg.
-12
GND
Main Power Supply
200+
24+
Bolo Bias Supply
300-
Gnd.
300+
Servo System
Wheel Gate Cond.
WC On
WC Off
8 Ch. MUX
SMPL/Hld.
A/D Con.
3A2
Heat Processor
Switch Inputs
1A3
Dig. MUX
1A5
Dig. VC
1A4
1K Ram & Timer
Processor Buss
3A4
Speech Conv.
Local Speaker
ACIA
Printer
Unit 6 Power Supply
+15 -15 +5
Unit 6 12V. Power Supply
+12 12V. Com.
Unit 1 Power Supply
+12 -12 +5
Devtronics 68178/68278 and Servo 8909 Functional\Block Diagram

MA1B
General Description

1.1 Capabilities

The MAIB system receives train advance approach information from the northbound or southbound approach transducers. Wheel gate information is derived from the A and B wheel gate transducers. Heat information is input to the processor system from the outputs of the analog pulse processors for rail 1 and rail 2. Dragging equipment information is received from the D.E. sensor switch. Other inputs may be used in conjunction with this system, such as hot wheel, high load, wide load, and loose wheel sensors.

From the above inputs, the MA1B system performs the following operations and provides the following information:

A. Controls radio keying and voice transmission over the radio.

B. Controls dispatcher's line relay and voice to the dispatcher (if used).

C. Controls defect alarm tone the train crew.

D. Analyzes heat information for determining overheated axle bearings and classifies bearings scanned as to roller or friction type.

E. Analyzes heat information for determining overheated axle bearings and classifies bearings scanned as to roller or friction type.

F. Prints on a local printer the following:
- Defect detector geographical location and/or milepost location
- Month, day, and time of day
- Direction of train travel
- Total number of axles in the train
- Software version currently operating

If one or more hot boxes has occurred, a summary of all heat levels for all journals on any car having a defect will be printed. If a D.E. has occurred then the D.E. number and the corresponding nearest axle number will be printed. Otherwise "No Defect" is printed.

NOTE: Defective axle numbers are given as a count from either the rear or the head of the train. If hot wheel, high load, and wide load option has been selected, then a nearest axle count will be included for any of these inputs that are active.

G. Enunciates defect information to the train crew and dispatcher.

H. Makes a malfunction enunciation to the train crew and dispatcher.

I. Controls operation of the red and white lights.

J. Controls operation of the strip chart recorder.

1.2 Physical Layout

The basic system is configured in a mainframe enclosure capable of standard 19 inch wide relay rack mounting. The enclosure occupies 7 inch panel space and is about 21 inch deep. This unit is designated Unit 1 and is found just below Unit 14 relay panel.

In addition a relay control panel is supplied which also occupies 7 inch of relay rack space. The RCP is designated Unit 3 and should be mounted just above the MA1B Unit 12 emergency system enclosure.

The physical sequence of the units as they appear on the rack are:

Unit 3 Unit 12 Unit 14 Unit 1 Unit 5 Unit 10

Mounted elsewhere in the DD house are:

Unit 9 Unit 13

A. Unit 1

This unit contains all the microprocessor buss oriented sub assemblies (printed circuit boards). It contains the basic processor mainframe (processor host motherboard) +15V. -15V. +5V processor power supplies, and rack mounted mainframe enclosure.

The motherboard hosts the following circuit boards:

MA001-0081-11	1A1	Audio & Fault Driver Board
MA001-0083-11	1A2	System Timing & Clock Board
27000-0481-11	1A3	Voice Memory Board
(Spare Slot)	1A4	(for future assignment)
(Spare Slot)	1A5	(for future assignment)
MA001-0082-11	1A6	Switch Input Board
M68MM017	1A7	Microprocessor Board
(Spare Slot)	1A8	(for future assignment)
MA001-0085-11	1A9	Heat Processor & Approach Board

(Spare Slot)	1A10	I/O Interface Board
MA001-0089-11	1A11	Clock Display Board
MA001-0087-11	1A12	Malfunction Fault Display Board

This unit is mounted on the inside of the left rear panel of chassis.
MA001-0240-11 1A16 MULTITRACK HANDSHAKE BOARD

This unit is mounted on the inside front of the left panel of chassis.
68278-0234-11 1A13 BATTERY BOARD

Refer to MA1B Mini-Analyzer Unit 1 System Configuration drawing in the MA1B manual for layout references.

B. Unit 3 Relay Control Board

This unit contains all relays for external controls. Refer to drawing #MA001-0099-31A "MA1B Relay Control Panel Unit 3 CSX Interface" in the MA1B manual.

C. Unit 5 Test Set

Refer to Chapter 3 in the MA1B manual.

D. Unit 9 Telephone Board

Refer to Chapter 7 MA1B Telephone Board in the MA1B manual.

E. Unit 12 Emergency System

Refer to Chapter 7 Emergency System in the MA1B manual.

F. Unit 13 EDCO Protection Panel

Refer to Chapter 7 EDCO Protection Panel in the MA1B manual.

G. Unit 14 Red/White Light/Southbound Relay Panel

Refer to Chapter 7 Relay Panel in the MA1B manual.

1.3 Specifications

Operating environment:
-40 degrees F to 130 degrees F
5 to 95 percent relative humidity without condensation

Power consumption:
200 Watts 115V 60 HZ.

DC to AC inverter operation requires 18 AMP 12V DC

NOTE: Be sure that all electrical equipment AC or DC is tied in to the protected side of the electrical system.

Load impedance:
Rail heat input impedance 100K OHMS
Input heat signal voltage range:
0 to 100V peak

Communications:
Radio audio output adjustable to 4.0V peak (Max) into 600 OHMS
Dispatcher phone line audio level adjustable to +6 DBM into 300 OHMS
Phone line loading greater than 10K OHMS

Printer:
EIA Standard RS-232c Output

Power filtering and regulation:
A. Transformer primaries protected with GE MOV thyrites for transient over voltage protection.

B. All DC power supplies are voltage regulated, over-current protected and over-voltage protected.

NOTE: The 5V DC ** "Brownout Circuit" ** goes low at +4.7V DC and goes high at +4.9V DC.

Heater strip:
This unit is connected to an Emerson "Thermo Disc" Type 36T21.

Specification are as follows:
A. Open temp. 65 degrees F - tolerance + or - 5 degrees F
B. Close temp. 50 degrees F - tolerance + or - 6 degrees F

Fan:
This unit is connected to an Emerson "Thermo Disc" Type 36T22.

Specifications are as follows:
A. Open temp. 55 degrees F - tolerance + or - 5 degrees F
B. Close temp. 70 degrees F - tolerance + or - 6 degrees F

MA1B
Parts Identification

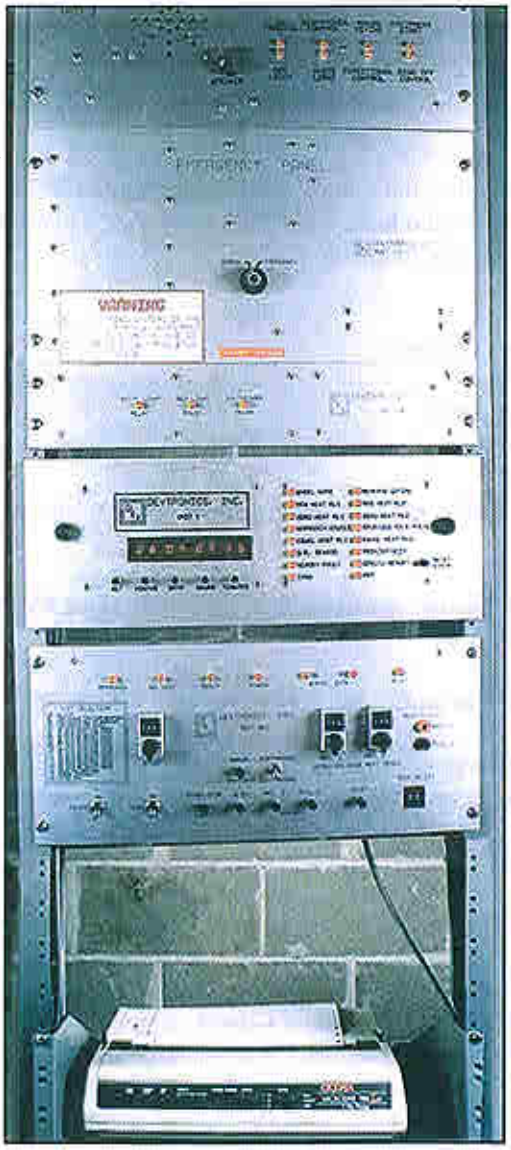


Figure 5-29: MA1B system layout

MA1B
Parts Identification

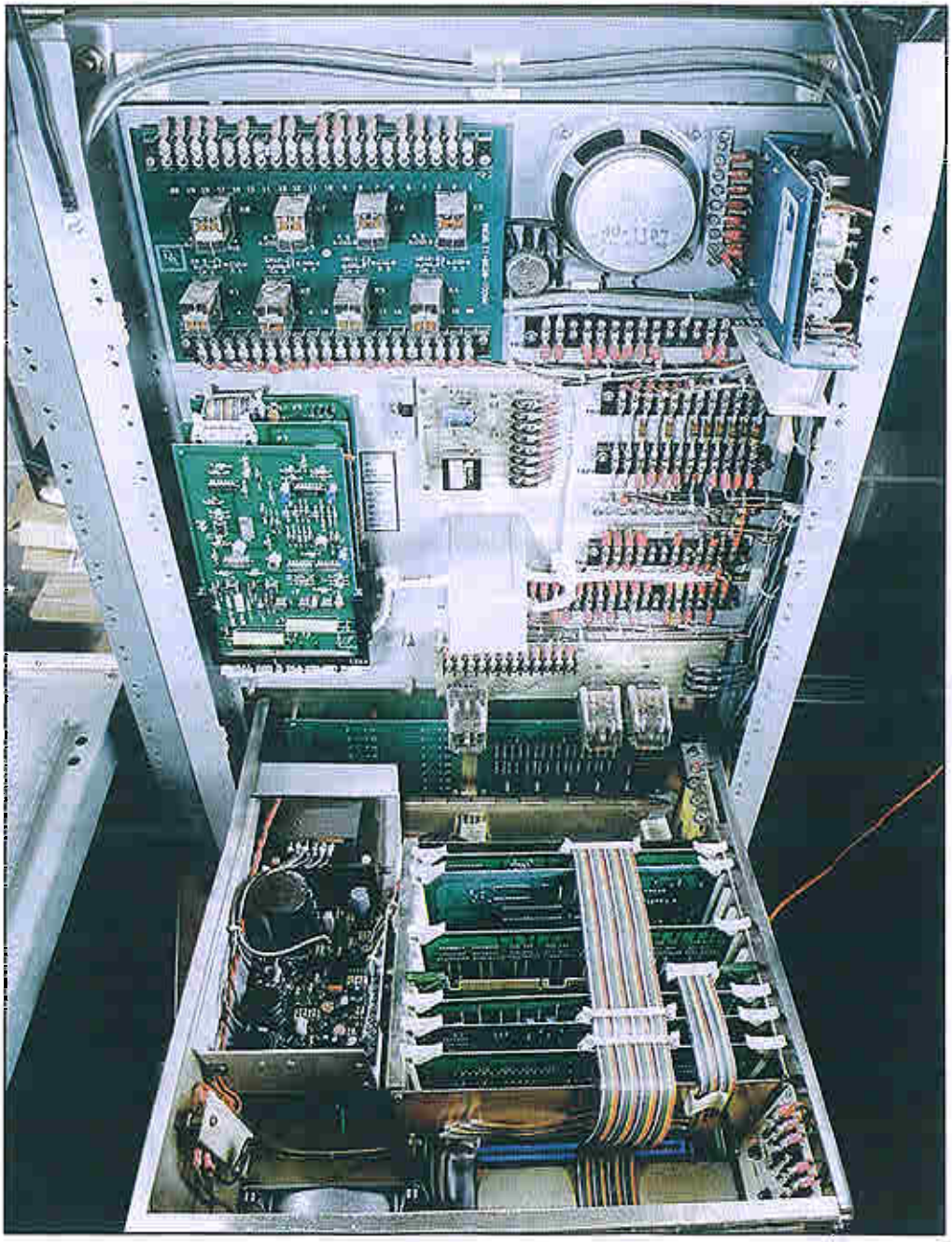


Figure 5-30: MA1B system rear view

MA1B
Parts Identification

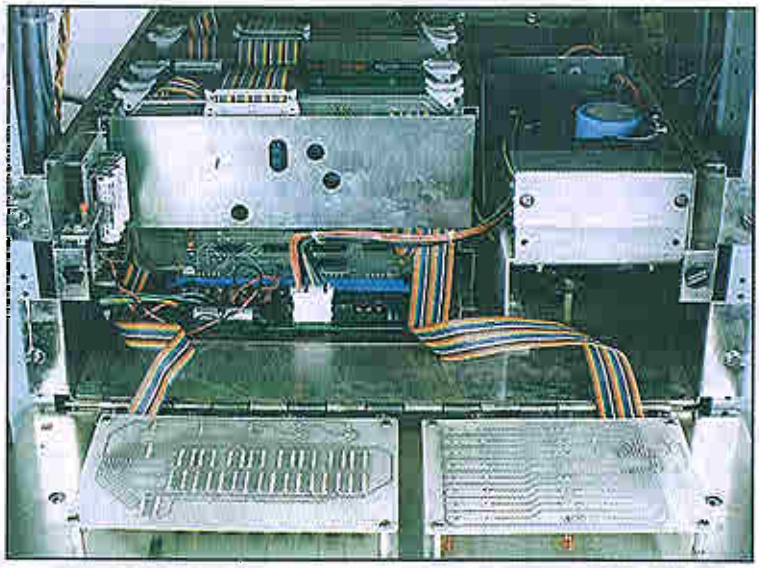


Figure 5-31: Unit 1 microprocessor mainframe front view

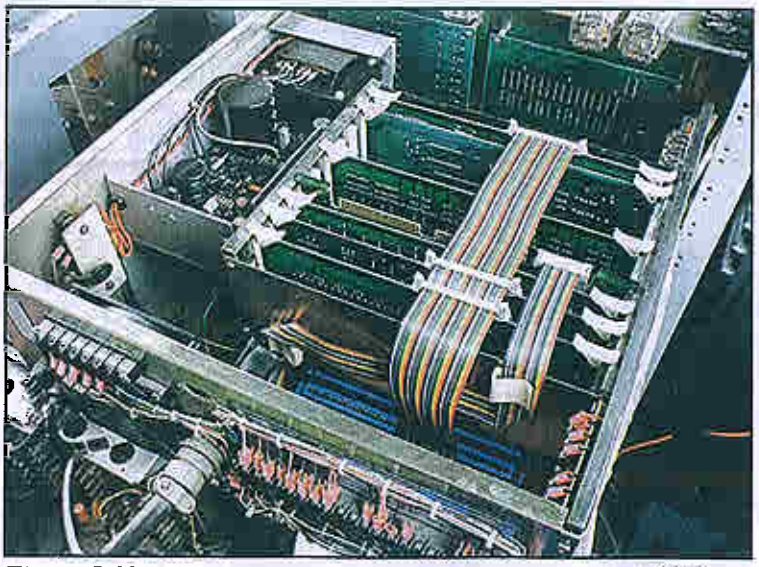


Figure 5-32: Unit 1 microprocessor mainframe top view from rear

MA1B/8909
Scaling Procedure

NOTE: Prior to scaling setup of the processor system, the heat sensing system must be properly calibrated which includes: scanner alignment, gain levels, and proper pedestal level settings.

WARNING: The Devtronics MA1B <u>will not</u> process trains if the Bin 2-08 switch input card (1A6) is left in the ON position.

To scale, do the following:

Step 1 Insure the Servo calibration is complete before proceeding.

Step 2 Remove the Unit 1 top cover to allow access for scaling adjustments as required.

Step 3 Locate the Switch Input board (1A6) and turn the Bin 2 switch position 8 to the ON selection.

Step 4 You must now initiate a processor reset (depress the red reset button on Unit 1).

Step 5 Digitized heat readings are now directed to the clock display for calibration purposes.

Step 6 Set the function generator heat selector to 130 degrees F above ambient. After the light goes out, set the function generator on the scanner for the rail being calibrated.

Step 7 Turn on the gate switch, located on the function generator.

Step 8 Adjust R5 for rail 1 and R6 for rail 2 heat level settings. At this time the Motorola VTVM should be indicating +18 dbm as obtained in Step 1. Now adjust the appropriate rail potentiometer (pot) until the heat display indicates a reading of "100" (corresponding to an equivalent 10.0mm of chart deflection).

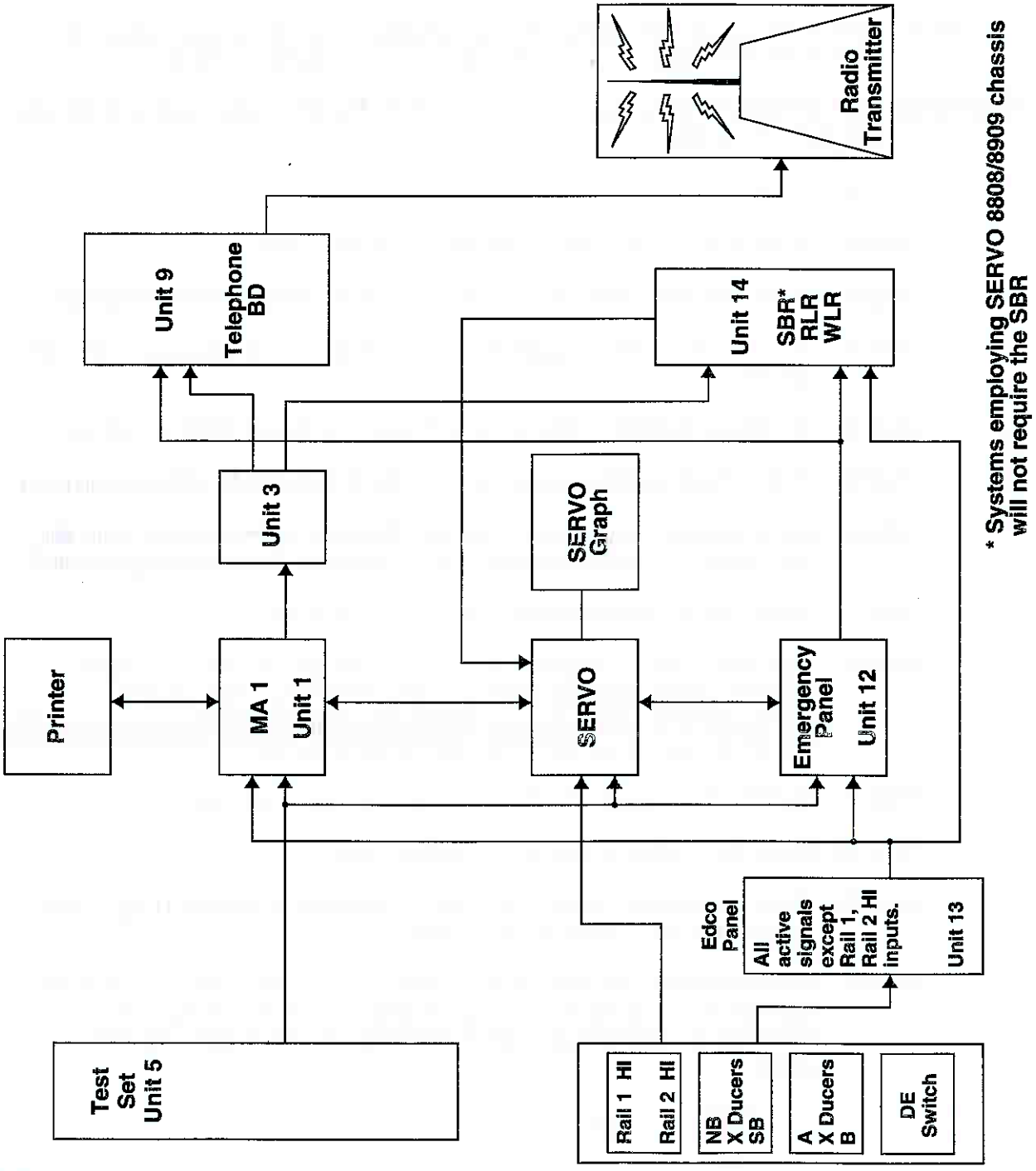
Step 9 Move the function generator to the other rail and repeat steps 6 - 8.

Step 10 Return Bin 2 switch position 8 to the OFF selection.

Step 11 The Unit 1 system reset button must now be initiated to accomplish a final system reset to return the system to normal operation.

Step 12 Run a continuous roller bearing test using the test set and apply heat to each scanner using a heated soldering iron. Activate the dragging equipment device. The detector must announce proper locations of all detections, with proper graph and printer output.

MA1B
Block Diagram



Servo Model 8909 System

General Description

The Servo 8909 Hot Box Detective (HBD) 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. This scan information is output locally to a "Servograph" recorder. The readout from the recorder is a graphical presentation that represents the condition of all journals on the train. By properly interpreting this information, you can determine the car position, journal number, journal heat radiation, and side of the train.

The major functional areas of the model 8909 HBD system are signal processing, control circuits, power supplies, and the test panel. The interrelationship of these functional areas is shown on the overall system block diagram (See Servo 8909 Manual, figure 3-1, page 3-2) and described below.

1.1 Signal Processing

Bolometer/preamplifier (sensor unit). The bolometer and preamplifier are designed as a single assembly that mounts inside a cast aluminum sensor housing with the scanner (See Servo 8909 Manual, figure 3-6, page 3-10). 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 preamplifier bias. The bolometer/preamplifier 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.

Scanner Junction Box.

The scanner junction box is connected to the scanner via the scanner cable. Contained within the junction box are the signal amplifier Q2, the bolometer bias regulator circuit, and a 15V DC regulator that provides operating voltages for the scanner preamplifiers.

Pulse Processor.

The pulse processor is a high-gain gated pulse amplifier. The input signal is obtained from the scanner junction box via cable W1001 (rail 1) and W1002 (rail 2). The output is a specially designed pulse used to drive the Servograph recorder-pen motor. The pulse processor gain is variable by means of a front panel potentiometer and can provide a voltage gain of about 500 (55db). A pedestal control is provided so that an adjustable pedestal (0-3mm) can be added to the signal output pulse.

1.2 Control Circuits

Transducers.

A rail-mounted electromagnetic device that produces a voltage pulse when a railcar wheel passes over it. The transducers are used in the model 8909 for providing approach information and for wheel gating.

Directional Data Control.

The directional data control processes the direction sense and gate on/gate off pulses received from the transducers and generates control functions required for system operation. The directional data control also controls the k701 heater/aperture relay.

1.3 Power Supplies

Line Voltage Regulator (Sola transformer).

This unit is a tuned transformer that stabilizes the AC supply voltage at 118V + or - 1.2V AC. This regulated voltage is used in all 8909 circuits except the scanner heaters and the recorder.

12V DC Power Supply.

This unit, operating from regulated 118V AC, supplies both regulated and unregulated 12V DC. The unregulated portion is used for high current loads such as relays, solenoids, and displays. The regulated portion is used primarily in signal processing circuits.

Main Power Supply.

The main power supply receives 118V AC from the line voltage regulator and provides two voltages:

1. Unregulated +200V to each of the pulse processors
2. Regulated +24V DC to the pulse processors, which is fed to the scanner junction boxes

Bolometer Bias Supply.

The bolometer bias supply receives regulated 118V AC from the line voltage regulator. The supply provides negative and positive unregulated high voltage used by the 200V low noise regulators in the scanner junction boxes. The output is nominally designated as + or - 300V DC, although its actual voltage is about 280V under typical system operating conditions when it is loaded by two scanner junction boxes. The 200V low noise regulator assembly (bolometer bias regulator) produces a highly regulated 200V DC + or - 1V DC. The regulator is fed unregulated 300V DC from the bolometer bias supply.

1.4 Test Panel

The test panel gives you metering capability and the ability to monitor and simulate signaling, gating, and direction.

Metering

The following voltages can be metered:

+ 24 V from the main power supply
+ 200 V from the main power supply
+ 300 V from the bolometer bias supply
- 300 V from the bolometer bias supply
- 12 V regulated from the 12V power supply

Refer to the Servo 8909 HBD manual for complete test set operational description (SCA-TM77-09-26R10-78).

Servo Model 8909 System
Parts Identification

Figure 5-33: 8909 scanner

Figure 5-34: 8909 scanner cover

Figure 5-35: Cleaning the scanner

Servo Model 8909 System
Parts Identification

Figure 5-36: Aperture moving freely

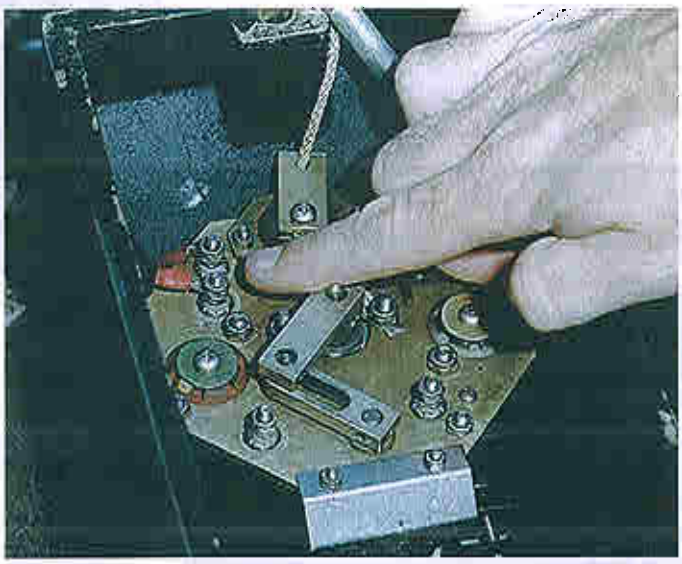


Figure 5-37: 110V AC terminals

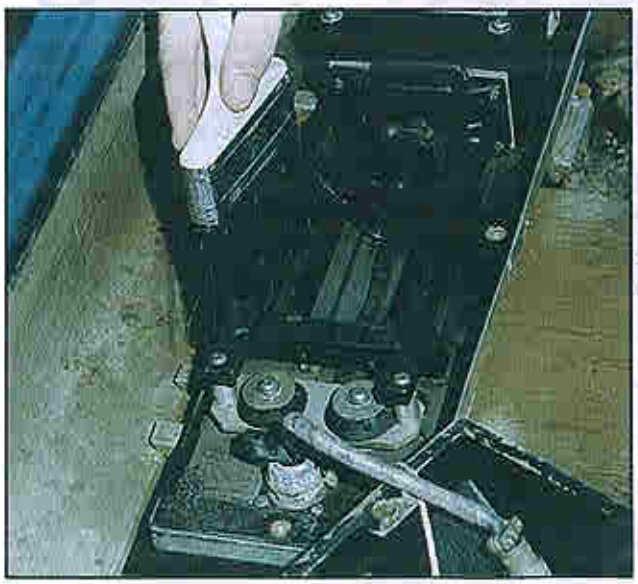


Figure 5-38: 8909 scanner base with pre-amp

Servo Model 8909 System
Parts Identification

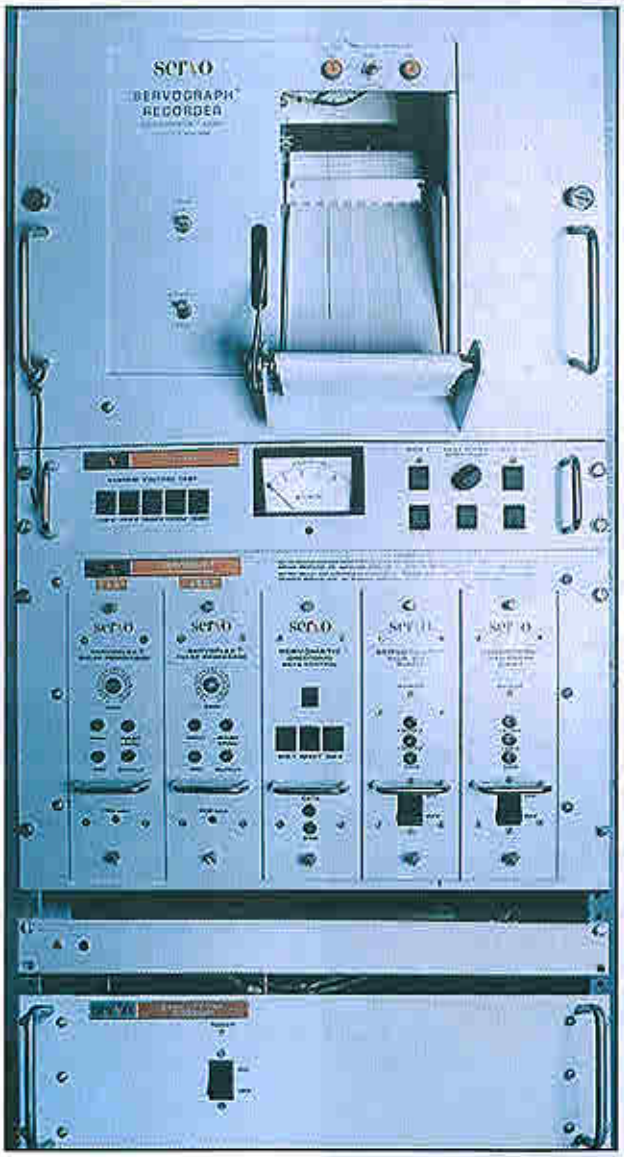


Figure 5-39: Front view of the 8909 rack

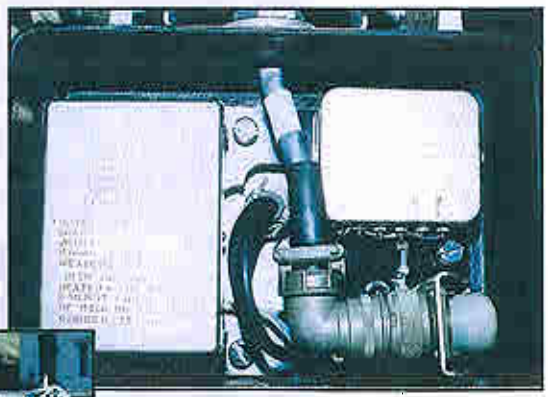


Figure 5-40: 8909 Junction box

Servo Model 8909 System
Parts Identification

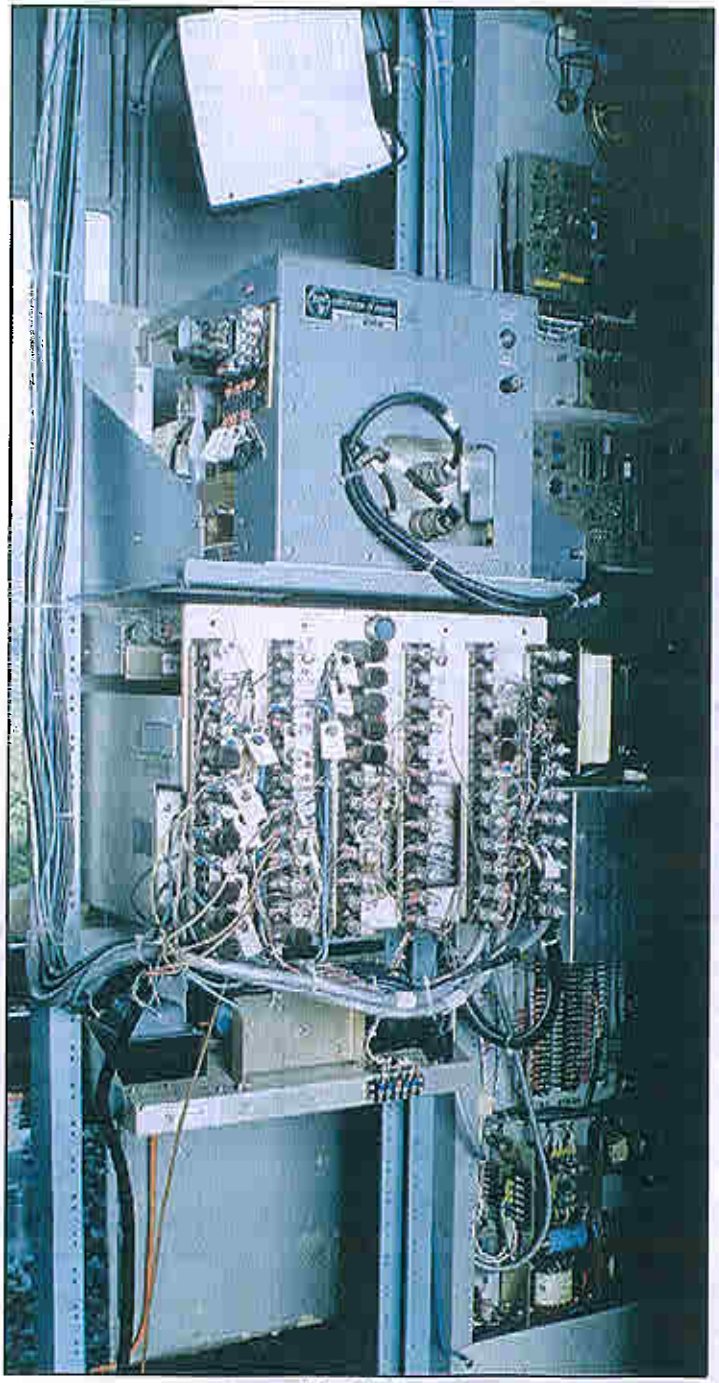
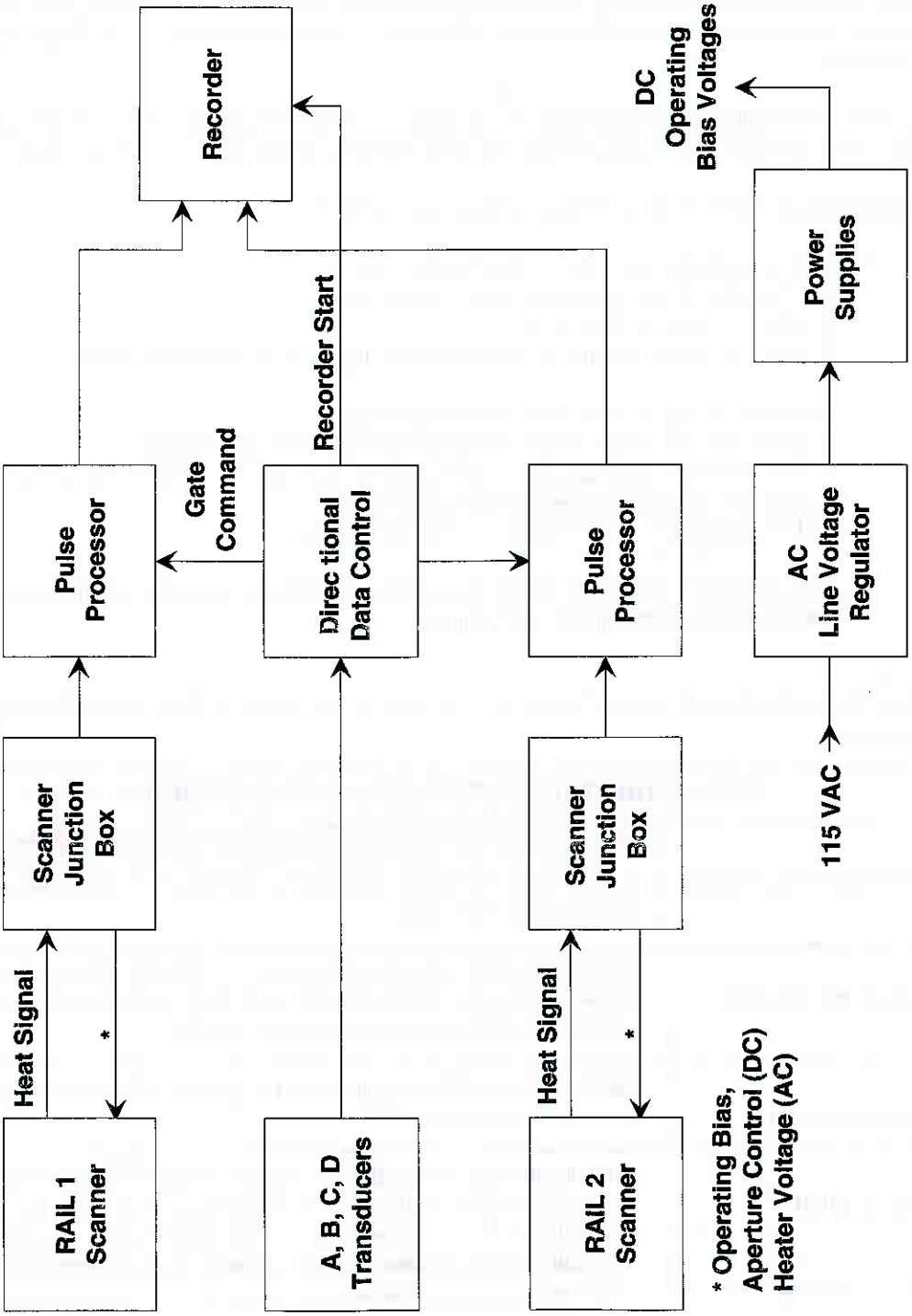


Figure 5-41: Rear view of the 8909 rack

Servo Model 8909
Block Diagram



Devtronics 68178/68278/MA1B and 8909 Scanners
Troubleshooting

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

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 detector system can be broken down into three basic sections:

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

- Servo processing system related to signal output:
  A. Pulse processors (amplify heat signal and output for processing)
  B. Data control (gates heat signal to recorder and Devtronics system and starts the system)
  C. Recorder (charts heat profile of passing trains)
  D. Power supplies (provide voltages for Servo rack)

- Devtronics rack (processes inputs and outputs from Servo, performs alarm analysis, and outputs information to radio and printer)

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 symptom 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	
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, printer printout, and Devtronics error light indicators. Check the AC power source and all power supplies in the system, making sure 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 systems 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 particular 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 particular 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 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. Also utilizing the block diagrams and/or truth tables supplied in the system manual can be useful in helping to logically troubleshoot the defect detector system.

During no train activity, the 68178/68278/MA1B system runs the self-diagnostic routines checking for processor system internal faults. During train passage, both self-diagnostics and external system integrity checks are invoked. If a system error (malfunction) has occurred, then a detector malfunction enunciation is made to the train crew.

Front panel error lights

All system faults will illuminate a front panel error light corresponding to the specific fault(s) found.

The error light indicator panel is located on Unit 3.
Once the problem is corrected, use the reset switch located on the front panel.

System malfunction causes and system responses are as shown in the following table:

MALFUNCTION CAUSES	RESPONSES
Approach transducer fault	If after 8 axles have passed the wheel gating transducers and no approach pulses have been detected, then the following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Possible causes include faulty operation of any of the following: • Power supplies • Transducers • Edco device, Transorbs, Opto coupler • 3A1 card • Transducer cable
CVSD error (speech clock faulty)	If the CVSD clock is inoperative, then the system cannot make any vocal enunciations. When a train passes and the system tries to talk, the following occurs: A. The alarm tone is transmitted on the radio. B. An error message is printed on the local printer. Possible causes include faulty operation of any of the following: • Power supplies • 3A4 card
Equal heats side 1 and/ or side 2	If after a train has cleared the DD site and no heats are shown on the graph for side 1 and side 2 for three consecutive trains (i.e., pedestal only) or if one side shows good heat and the other does not, the following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Possible causes include faulty operation of any of the following: • Shutter • Pulse processor • Directional data control unit • Sensor • Power supply • Devtronics problem
Faulty D.E. sensor switch	If the D.E. switch fails while the train is passing the DD site, the following occurs:

MALFUNCTION CAUSES	RESPONSES
Faulty D.E. sensor switch	A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Possible causes: • Faulty Servo 12V power supply • Dragger arm obstructed • Dragger switch out of adjustment • DED opto coupler faults
Maximum heat side 1 and/or side 2	If 16 successive heats have exceeded the absolute maximum level of 15mm on the chart recorder for side 1 and/or side 2, the following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Possible causes include faulty operation of any of the following: • Power supplies • Sensor • Scanner feed thru capacitors • Pulse processor • Junction box insert Note: Allow system 30 minutes to stabilize after replacing insert.
Memory fault (RAM)	If a RAM (random access memory) fault occurs that causes improper system operation, a fatal error message is printed on the local printer. No further activity occurs and the system will remain silent. Possible causes include faulty operation of any of the following: • Power supplies • 1A1 card
No wheel gating	The following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Possible causes include faulty operation of any of the following: • Power supplies • Directional data control unit

MALFUNCTION CAUSES	RESPONSES
No wheel gating	• Transducers • 3A2 card
PMT error (programmable timer error)	The failure of the PMT renders the processor system inoperative and is classified as a fatal malfunction. The PMT will be checked once every 23 seconds during the time no trains are present. If failure is detected, a fatal error message is printed on the local printer. No further activity occurs and the system will remain silent. Check the Devtronics Unit 1 and the associated power supply.
Printer or ACIA malfunction	If the printer runs out of paper, is turned off, is unplugged, has the front cover lifted up, is placed in self-test, or the ACIA is defective, the printer immediately goes into alarm mode and the error light on Unit 3 illuminates. No other action occurs. Check the power input. Possible causes include any of the following: • Defective printer • Defective 1A1 card
Reverse gating	The following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Possible causes include faulty operation of any of the following: • Power supplies • Directional data control unit • Transducers
Servo power supply fault	This is applicable only to those systems having a power supply monitor installed. If the diagnostic checks find the Servo power supply monitor in alarm mode, the following occurs upon passage of the next train: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Check the power supplies.

MALFUNCTION CAUSES	RESPONSES
Speech memory error	If after a train has cleared the DD site and the system attempts to talk and finds a speech memory fault, then the following occurs: A. The alarm tone is transmitted on the radio. B. An error message is printed on the local printer.
NOTE: If the speech error does not lie in the chips containing the site's geographical location, then the only enunciation that occurs is the location enunciation (which occurs twice.)	
	Possible causes include faulty operation of any of the following: • Power supplies • 1A5 card • 3A4 card
Spurious axle pulses	If extra wheel gate pulses occur and the time duration of these pulses is shorter than the time required for a train traveling over 100 MPH, the following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. Possible causes include faulty operation of any of the following: • Power supply • Transducers • Directional data control unit
Zero heat (68278 only)	If a zero heat (no pedestal) condition is detected on either side, then the following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a "detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. D. The error light is lit. Possible causes include faulty operation of any of the following: • Power supplies • Sensor • Cable • Pulse processor
Zero heat (MA1B only)	If a zero heat (no pedestal) condition is detected for 5 consecutive axles on either side, then the following occurs: A. The alarm tone is transmitted on the radio. B. Ten-to-fifteen seconds later, the tone stops and a

MALFUNCTION CAUSES	RESPONSES
Zero heat (MA1B only)	"detector malfunction" enunciation is made to the train crew. C. An error message is printed on the local printer. D. The error light is lit. Possible causes include faulty operation of any of the following: • Power supplies • Sensor • Cable • Pulse processor

Servo Model 8909 System
Troubleshooting

NOTE: After replacing any module, or making any adjustments, full operational test of system must be made.

PULSE PROCESSOR problems, possible causes, and corrective actions are as shown in the following table:

PROBLEM	POSSIBLE CAUSE AND ACTION
No signals or pedestal on both rails	Cause: Directional data control or main power supply Action: Replace with a known good unit. Perform operational checks.
Low or no gain on rail 1 or rail 2	Cause: Weak or defective pulse processor Action: Check input to the pulse processor in trouble, if the input voltage is within allowable specifications, replace pulse processor with known good spare. Perform operational checks. If the input signal is not within allowable limits, utilize the standard troubleshooting procedure to check associated power supply and sensor, scanner jct. box etc. to locate fault.

DIRECTIONAL DATA CONTROL problems, possible causes, and corrective actions are as shown in the following table:

PROBLEM	POSSIBLE CAUSE AND ACTION
Entire directional data control inoperative	Cause: Loss of -12V DC regulated Action: Check for voltage at pin 20 of J703. If o.k., check for AC input to the directional data control. If proper input voltages present, replace unit with known good module, perform operational checks.
Missing wheel gates, spurious axles, etc. either or both rails	Cause: Defective directional data control unit Action: Replace with a known good unit, after thorough check of associated circuitry. Note: A thorough investigation of transducers, and associated circuitry should be performed before assuming a directional data control problem.

BOLO BIAS SUPPLY PROBLEMS, possible causes, and corrective actions are as shown in the following table:

NOTE: Before changing 8909 modules, make sure input power to the module is off.

PROBLEM	POSSIBLE CAUSE AND ACTION
Recorder chart shows pedestal only	Cause: -12V DC supply out of tolerance Action: Check wiring. If o.k., replace 12V DC supply with known good unit and perform operational tests.
No output voltages from the bolo supply	Cause: Faulty 12V DC power supply, improper AC input or bad bolo bias supply Action: Take voltage readings to determine which module is at fault. Replace with known good spare and perform operational tests.
Noise on both rails	Cause: Faulty bolo bias supply Action: Check for AC noise trackside; ie. sensors, junction box, AC feed etc. If trouble is determined tobe in bolo bias supply, replace with known good spare and perform operational tests.

MAIN POWER SUPPLY problems, possible causes, and corrective actions are as shown in the following table:

PROBLEM	POSSIBLE CAUSE AND ACTIONS
No 24V at test point. 200V checks o.k.	Cause: Bad 24 volt section Action: Replace U1-MC7824CK and recheck the voltage. If there is still no output, replace it with a known good supply. Perform operational tests.
No 200V at test point. 24V checks o.k.	Cause: Bad 200V section Action: Eliminate the load and take a voltage reading. If still no output, replace the supply with a known good spare. If after unloading the supply, the voltage returns to normal, utilize the block diagram to locate the unit causing the short. Replace with a known good spare and perform operational checks to clear.
No output at the 200V and 24V test points	Cause: Bad main power supply or no AC input Action: Check the AC input to the unit or rocker switch on the unit front panel. If o.k. change supply with know good unit. Perform operational tests.

12 VOLT POWER SUPPLY

Maintenance and troubleshooting is limited to the most basic procedures.

A voltage reading should be taken from the test terminals on the rear of the supply (regulated 12v terminal 1 and 2; unregulated terminal 4 and 5).
If the voltages are not within allowable limits, simply remove the wires from the terminals, take another voltage reading.

1. If the proper voltages are now present, utilize the block diagram to locate the source of the short.

2. If voltage is still not within allowable range with wires removed, replace the supply with a known good spare.

3. Perform operational test.

Caution: Tape the wires when removed to prevent possible catastrophic damage to associated equipment.

RAIL MOUNTED SCANNER problems, possible causes, and corrective actions are as shown in the following table:

PROBLEM	POSSIBLE CAUSE AND ACTION
Recorder shows pedestal only. No heat signals	Cause: Faulty bolo bias supply Faulty 12V DC power supply Faulty sensor or scanner junction box insert Action: Isolate and replace defective unit(s). Perform operational checks.
Recorder chart shows noise on both rails.	Cause: Faulty bolo bias supply Main power supply Faulty 12V DC power supply Defective scanner junction box inserts Scanners or sensors Action: Isolate and replace defective unit(s). Perform operational tests.
Recorder chart shows noise on one rail.	Cause: Defective scanner cable sensor or pulse processor Defective scanner junction box insert Action: Interchange the W1001/W1002 cables at the data processing unit, and check for noise appearing at the other rail. Replace the cable if it is defective. The pulse processors and sensors can be interchanged in the same manner to determine the faulty unit(s).
Aperture blade is inoperative.	Cause: Defective aperture blade solenoid - one rail Defective directional data control - both rails K701 relay defective - both rails Action: Isolate and replace defective unit(s).
Housing heater is inoperative.	Cause: Defective heater element Defective breaker (CB701 or CB 702) Faulty directional data control K701 relay defective Action: Isolate and replace defective unit(s).

To check **TRANSDUCER** problems, perform a transducer operational check by following these steps:

1. Connect a voltmeter across the transducer terminals in the junction box. Put the positive lead on the black wire and the negative lead on the white wire.

2. Set the voltmeter on the low voltage scale.

3. Insert a metal object into the transducers' magnetic field.

Inserting the metal object should result in a positive meter movement. Retracting the object should result in a negative deflection. If no meter movement is indicated in the above test, check for an open transducer coil using an ohmmeter. The transducer should read approximately 600 OHMs.

Notes:

Notes: