NOISE, FAULT, SURGE, AND RADIO FREQUENCY INTERFERENCE TEST REPORT

Westinghouse Eagle-21 Digital Family as used in QDPS, PSMS, RVLIS, and ICCM

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ABSTRACT

This report documents the Noise, Fault, Surge, and Radio Frequency Interference (RIF) Test Program. The primary objective of this test program was to demonstrate that the system under test remained fully operational and accurate when subjected to noise, fault, surge withstand, and RFI testing. Other objectives were to demonstrate that the simulated inputs and actual outputs of the system were not affected by the tests and that the isolation barriers prevented any propagation of noise or faults through the system.

The Noise, Fault, Surge, and RFI Test Program convincingly demonstrated that the system performance met its defined acceptance criteria and did not degrade even when subjected to abnormal electrical conditions which far exceed those that can be reasonably postulated.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

Section	Title	Page
1	INTRODUCTION	
2	SYSTEM CONFIGURATION	
2.1	System Description	2-1
2.2	System Layout	2-4
2.3	Cable Connections	2-11
2.3.1	Field Cable Connection	2-11
2.3.2	Alternative Configurations	2-11
3	ISOLATION DEVICES PHILOSOPHY	
3.1	Description	3-1
4	TEST DESCRIPTION	
4.1	Noise and Fault Tests	4-1
4.1.1	Noise Tests	4-1
4.1.1.1	Description	4-1
4.1.1.2	Test Outline	4-1
4.1.1.2.1	Random Noise Test	4-5
4.1.1.2.2	Crosstalk Noise - Chattering Relay Test	4-5
4.1.1.2.3	Military Specification Noise Test	4-8
4.1.1.2.4	High Voltage Transient Noise Test	4-8
4.1.2	Fault Tests	4-11
4.1.2.1	Description	4-11
4.1.2.2	Test Outline	4-11
4.1.2.2.1	Short Circuit	4-13
4.1.2.2.2	Common Mode Fault Tests	4-13
4.1.2.2.3	Line-to-Line Fault Tests	4-18

TABLE OF CONTENTS (Cont)

Section	Title	Page
4.2	Surge Withstand Capability (SWC) Test	4-29
4.2.1	Description	4-29
4.2.2	Test Outline	4-29
4.2.2.1	Common Mode Test	4-30
4.2.2.2	Transverse Mode Test	4-30
4.2.3	Implementation of Test Procedures	4-30
4.3	Radio Frequency Interference (RFI) Susceptibility Test	4-33
4.3.1	Test Methodology	4-33
4.3.2	Test Location	4-33
4.3.3	Test Equipment	4-33
4.3.4	Test Procedure	4-34
4.3.5	Calibration Test	4-34
4.3.6	Modulation Test	4-37
4.3.7	Keying Test	4-42
5	TEST SETUP AND MONITORING	
5.1	Test Setup	5-1
5.1.1	System Connections	5-1
5.1.2	Simulated Input Signals	5-4
5.1.3	Data Acquisition System and Analog Outputs	5-4
5.1.3.1	Tape Recorder	5-4
5.1.3.2	Data Logger	5-11
5.2	Test Monitoring	5-14
5.2.1	Display Monitoring	5-14
5.2.2	Data Link Tester	5-15
5.2.3	Analog Output	5-15
6	ACCEPTANCE CRITERIA	
6.1	Description	6-1
6.1.1	Noise and Fault Acceptance Criteria	6-1
6.1.2	Surge Withstand Acceptance Criteria	6-1
6.1.3	Radio Frequency Interference Acceptance Criteria	6-1

TABLE OF CONTENTS (Cont)

Section	Title	Page
7	TEST RESULTS	
7.1	Description	7-1
7.2	Noise and Fault Test Results	7-1
7.2.1	Noise Test Results	7-1
7.2.1.1	Random Noise Test Results	7-1
7.2.1.2	Crosstalk Noise -- Chattering Relays	7-1
7.2.1.2.1	Ac Chattering Relay	7-1
7.2.1.2.2	Dc Chattering Relay	7-2
7.2.1.3	Military Specification Noise	7-2
7.2.1.3.1	Noise Source No. 1	7-2
7.2.1.3.2	Noise Source No. 2	7-2
7.2.1.4	High Voltage Transient Noise	7-2
7.2.2	Fault Test Results	7-2
7.2.2.1	Short Circuit Fault	7-2
7.2.2.2	Common Mode Fault	7-3
7.2.2.2.1	250 Vdc	7-3
7.2.2.2.2	580 Vac	7-3
7.2.2.3	Line-to-Line Fault	7-3
7.2.2.3.1	Internal Fuse Installed	7-3
7.2.2.3.2	Internal Fuse Shorted	7-4
7.3	Surge Withstand Fault Test Results	7-5
7.3.1	Common Mode	7-5
7.3.2	Transverse Mode	7-5
7.4	Radio Frequency Interference Test Results	7-5
7.4.1	Modulation Tests	7-5
7.4.1.1	3 V/m Field Strength	7-5
7.4.1.1.1	Vertical Polarization	7-5
7.4.1.1.2	Horizontal Polarization	7-5
7.4.1.2	10 V/m Field Strength	7-6
7.4.1.2.1	Vertical Polarization	7-6
7.4.1.2.2	Horizontal Polarization	7-6
7.4.1.3	20 V/m Field Strength	7-6

TABLE OF CONTENTS (Cont)

Section	Title	Page
7.4.1.3.1	Vertical Polarization	7-6
7.4.1.3.2	Horizontal Polarization	7-6
7.4.2	Keying Test	7-7
7.4.2.1	3 V/m Field Strength	7-7
7.4.2.1.1	Vertical Polarization	7-7
7.4.2.1.2	Horizontal Polarization	7-7
7.4.2.2	10 V/m Field Strength	7-7
7.4.2.2.1	Vertical Polarization	7-7
7.4.2.2.2	Horizontal Polarization	7-7
8	CONCLUSION	
Appendix A	List of Noise, Fault, Surge and Radio Frequency Interference Tests	
Appendix B	Fault Test, Fuse Shorted Photographs	
Appendix C	Microprocessors and I/O Boards Description	
Appendix D	Test Procedures	
Appendix E	System Configuration Drawings	
Appendix F	Test Equipment	

LIST OF ILLUSTRATIONS

Figure	Title	Page
2-1	Block Diagram of Typical RPU/DPU Architecture	2-2
2-2	Typical Block Diagram of RPU and DPU Subsystems	2-3
2-3	Test Configuration Schematic	2-5
2-4	RPU/DPU Split Bay Cabinet	2-6
4-1	Random Noise Test Connections	4-6
4-2a	Crosstalk Noise - Chattering dc Relay Test Connections	4-7
4-2b	Crosstalk Noise - Chattering ac Relay Test Connections	4-7
4-3	Military Specification Noise Sources	4-9
4-4	High Voltage Transient Noise Test Connections	4-10
4-5	Short Circuit to Ground Test Injection/Recorder	4-14
4-6	250 Vdc Common Mode Fault Test	4-15
4-7	Dc Power Supply Fault Connections	4-17
4-8	580 Vac Common Mode Fault Test	4-21
4-9	Ac Fault Connections	4-22
4-10	Transformer Connection for the 580 Vac Fault Source	4-23
4-11	125 Vac Line-to-Line Fault Test	4-24
4-12	Transformer Connection for the 125 Vac Fault Source	4-25
4-13	125 Vdc Line-to-Line Fault Test	4-26
4-14	250 Vdc Line-to-Line Fault Test	4-27
4-15	580 Vac Line-to-Line Fault Test	4-28
4-16A	Common Mode Surge Withstand Capability Test Connection	4-31
4-16B	Transverse Mode Surge Withstand Capability Test Connection	4-31
4-16C	Block Diagram of Surge Withstand Capability (SWC) Test	4-32
4-17	Radio Frequency Interference Equipment Test Setup	4-35
4-18	Radio Frequency Field Calibration	4-36

LIST OF ILLUSTRATIONS (Cont)

Figure	Title	Page
4-19	Block Diagram of Radio Frequency Interference Calibration Tests	4-38
4-20	Cabinet Subject to Radio Frequency Field	4-39
4-21	Block Diagram of Radio Frequency Interference Modulation Tests	4-40
4-22	Block Diagram of Radio Frequency Interference Keying Tests	4-44
5-1	Cabinet and Field Cable Setup	5-2
5-2	Noise, Fault, and Surge Test Equipment Setup	5-3
5-3	4-20 mA Transmitter Simulator	5-7
5-4	Resistor Temperature Detector (RTD)	5-8
5-5	4-20 mA Current Loop Output	5-9
5-6	Analog Output Channel Recording	5-12
5-7	Contact Output Connection	5-13
5-8	Fault Test Data Sheet	5-16
5-9	Noise Test Data Sheet	5-17
5-9A	Surge Test Data Sheet	5-18
5-10	Tape Recorder Log Sheet	5-19
5-11	Page 1 Primary Data	5-20
5-12	Page 3 Primary Data	5-21
5-13	Page 8 CCW and RHR Data	5-22
5-14	Page 2 DPU Status	5-23
5-15	Page 3 RPU Status	5-24

LIST OF TABLES

Table	Title	Page
2-1	Circuit Board Locations, RPU	2-7
2-2	Circuit Board Locations, DPU	2-8
2-3	Circuit Board Locations, Display Units	2-9
2-4	I/O Board Configuration	2-10
4-1	I/O Component Tested in Noise and Fault Test	4-2
4-2	Noise Injection Field Connections	4-3
4-3	Alternate RPU TB101 and 102	4-4
4-4	Fault Injection Field Connections	4-12
4-5	Keying Test Frequencies	4-43
5-1	Simulation of Normal Parameter Values	5-5
5-2	Tape Recorded Data	5-10
7-1	Noise Tests	7-8
7-2	Radio Frequency Interference Noise Test	7-9
7-3	Fault Test	7-10
7-4	Line-to-Line Fault Fuse Installed	7-12
7-5	Line-to-Line Fault Fuse Shorted	7-14

SECTION 1
INTRODUCTION

The Noise, Fault, Surge and Radio Frequency Interference (RFI) Test Program is applicable to the following Westinghouse Eagle 21 Digital Family systems:

- Qualified Display Processing System (QDPS)
- Plant Safety Monitoring System (PSMS)
- Reactor Vessel Level Instrumentation System (RVLIS-86)
- Inadequate Core Cooling Monitor (ICCM)

The primary objective of the program was to demonstrate that the system under test remained fully operational and accurate when subjected to noise, fault, surge withstand, and RFI testing.

Other objectives included verifying that the simulated inputs and actual outputs were not affected by the tests, and that the isolation barriers prevented any propagation of noise or faults through the system.

The remainder of this report provides detailed discussions of all aspects of the testing, including supporting illustrations and tables. The information is presented in the following order:

- Section 2 shows the configuration of the representative system used for test implementation. Descriptions of the system hardware and layout, and field cable connections are also included.

- Section 3 defines the philosophy upon which the isolation methods and devices were based.

- Section 4 contains a general description of each type of test (i.e., noise, fault, surge withstand, and RFI) and outlines the procedures and methods used during testing.

- Section 5 describes the test system connections, the simulated input signals, and the methods and equipment used to monitor, record and document the status of the system, the test data, and the test results.

- Section 6 defines the acceptance criteria that the test results were required to meet.

- Section 7 provides a detailed description of the noise, fault, surge withstand, and RFI test results. Tables presented at the end of the section and in Appendix A contain data that support the test effects.

- Section 8 presents the conclusions reached as a result of this testing program.

SECTION 2
SYSTEM CONFIGURATION

2.1 SYSTEM DESCRIPTION

The system under test was configured as a Class 1E data acquisition system similar to a portion of a QDPS or PSMS, consisting of a remote processing unit (RPU), a database processing unit (DPU), and a display module. The RPU and DPU were put into the upper half and lower half, respectively, of a standard Westinghouse split-bay seismic cabinet.

Each section of the cabinet was powered by a power supply module located in the upper part of that section. The $[\ ]_{a,c}$ processor boards of the RPU and the $[\ ]_{a,c}$ processor boards of the DPU were installed in the card cages, and I/O boards were located in termination frames in the rear of the cabinet to provide the interface between the field signals and the processor input/output interface.

Figure 2-1 shows the typical architecture of both RPU and DPU subsystems and the internal processors and input/output modules. Figure 2-2 illustrates an I/O and communication block diagram of the system. The interconnections designated "B" were "buffered" electrical separations only, while the isolation barriers had the "I" symbol indicating the existance of physical separation also.

The RPU of the system performed data acquisition on the simulated analog inputs and sent the accumulated data to the DPU. The DPU performed a variety of signal processing and then transmitted the data to the system display module via the DPU/display data link.

A detailed description of the processor and I/O boards is given in Appendix C.

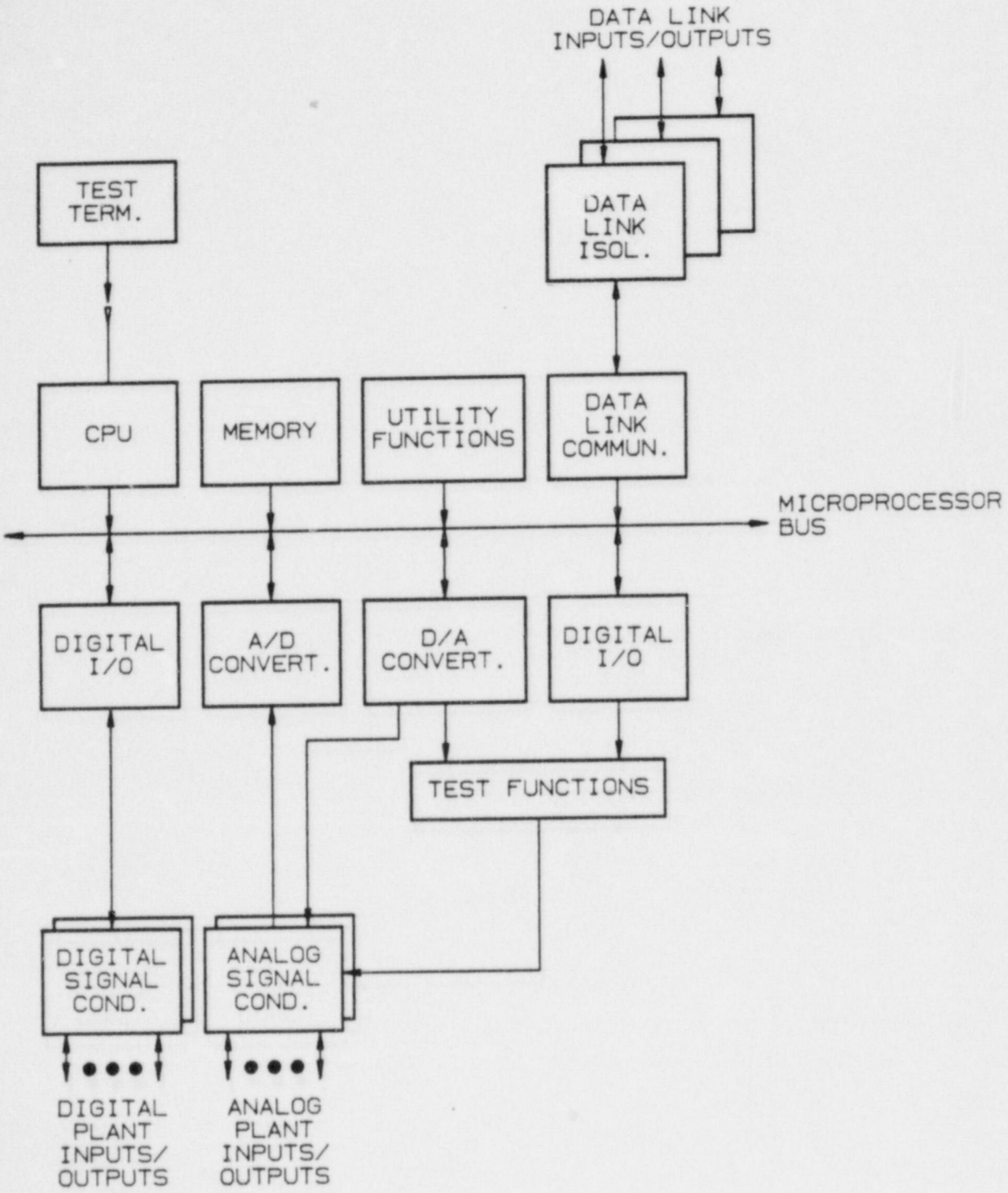


Figure 2-1. Block Diagram of Typical RPU/DPU Architecture

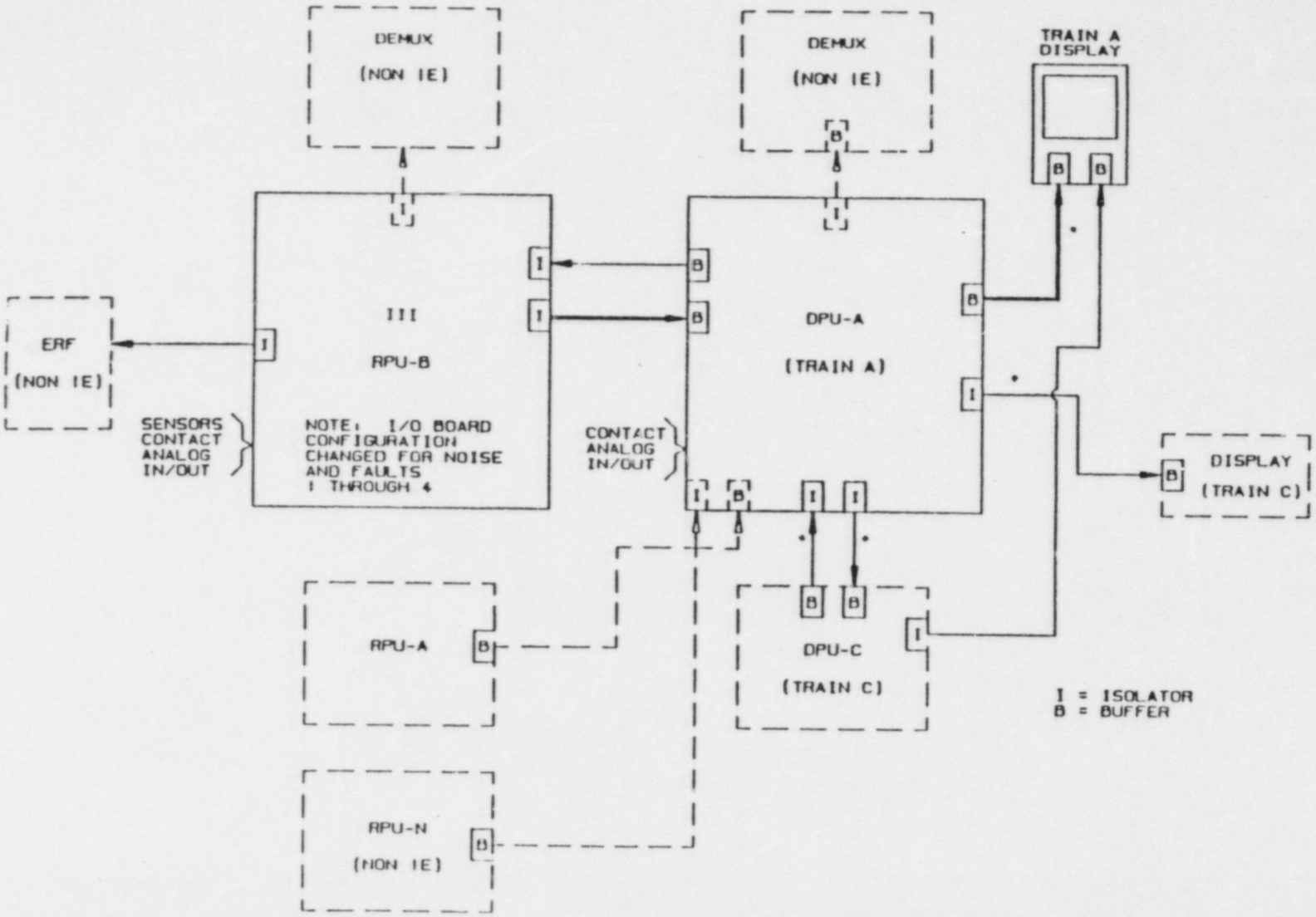


Figure 2-2. Typical Block Diagram of RPU and DPU Subsystems

2.2 SYSTEM LAYOUT

Figure 2-3 shows the system test configuration schematic which contains an RPU and DPU with their associated status panels and I/O boards, a display module and keyboard, RPU/DPU field cable connections, and a data link tester. The figure shows the patch panel on which the simulated input signal and analog output signal of the system were mounted. In addition, it shows the data acquisition system which consists of a digital data logger, buffer amplifiers and a tape recorder. Figure 2-4 shows the front and the side view of the RPU/DPU split bay cabinet.

Tables 2-1 and 2-2 list the respective processor boards and input/output boards for the RPU/DPU test configuration. Table 2-3 lists the processor boards in the display.

The configurations of boards listed in Tables 2-1 and 2-2 were defined by configuration drawing 2D33550 and 2D33551, design Specifications 955882 and 955905, and Table 2-4, respectively. The configuration drawings are included in Appendix E. The generic designations listed in the table became specific components for test configuration slot locations by virtue of specification data relating to jumpers, switches, and components which effect input/output functions and/or digital address designators for the respective multibus slot or I/O frame locations (TB).

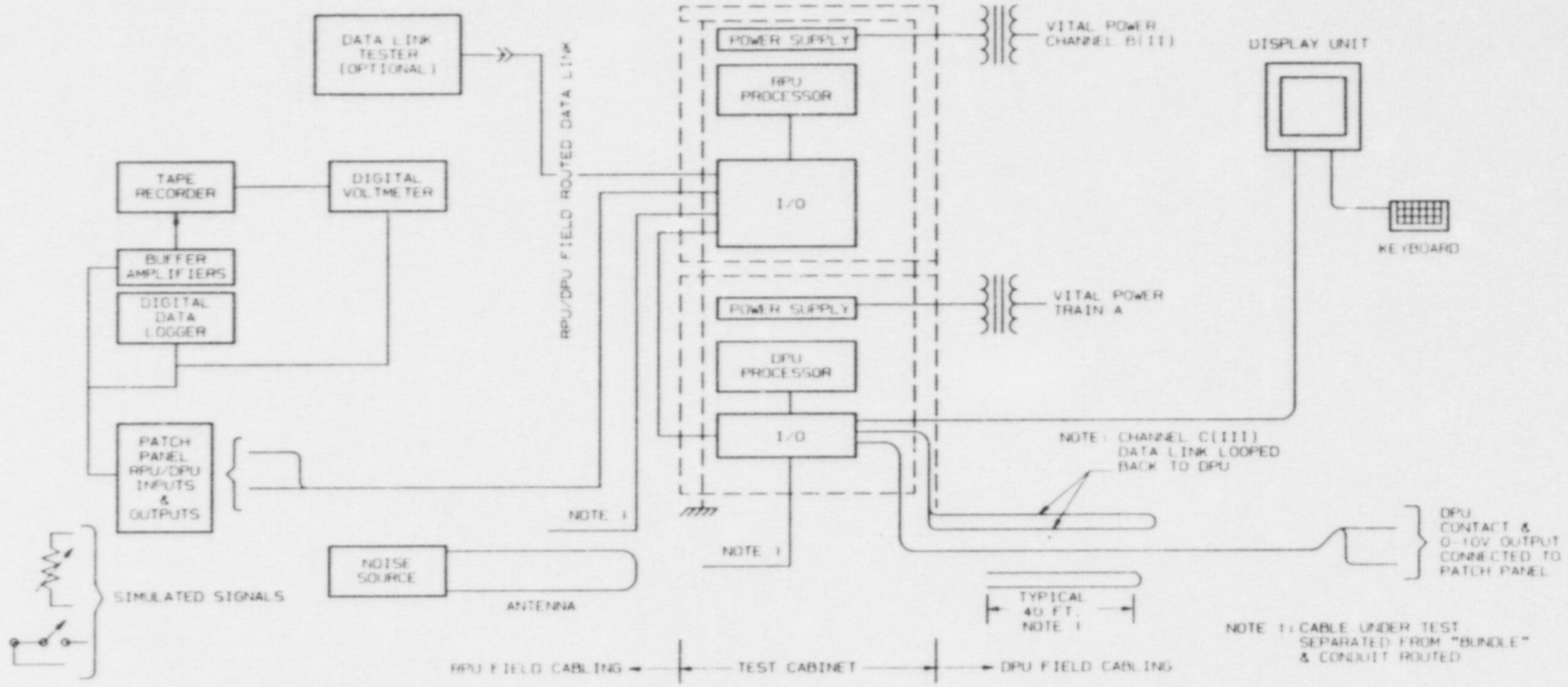
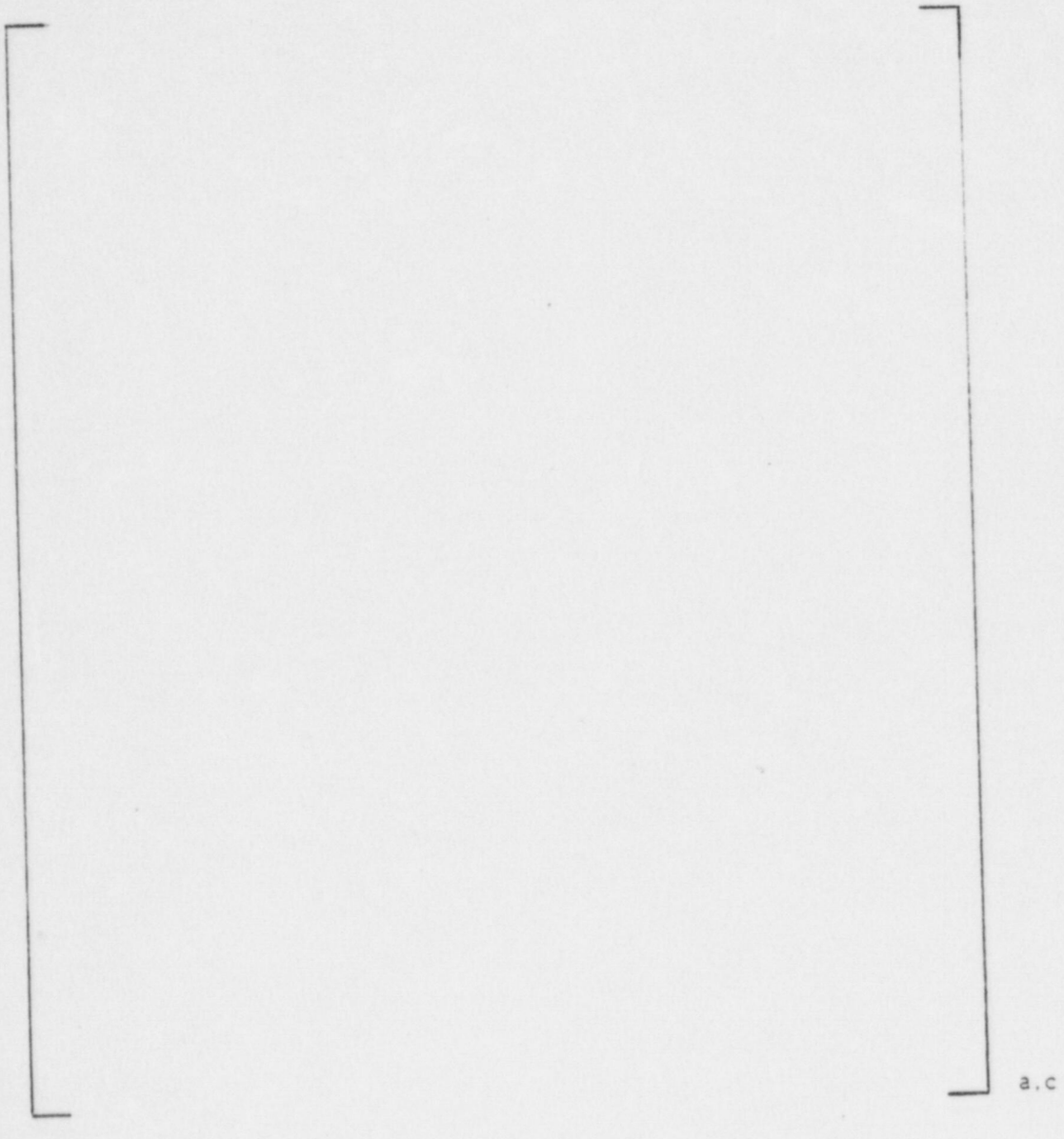


Figure 2-3. Test Configuration Schematic



a.c

Figure 2-4. RPU/DPU Split Bay Cabinet

TABLE 2-1
CIRCUIT BOARD LOCATIONS, RPU

Circuit Board Type		Quantity	Chassis Slot or Termination Frame
Processor Boards (See Note)			
[ ] a,c	Main processor Memory non-volatile Self health Programmable digital I/O Programmable A/D A/D D/A RAM memory. Data link communications EPROM	[ ] a,c	
Input/Output Boards (See Note)			
2334D63G01	RS-422 Data link	1	TB101
2344D04G01	Digital contact output	1	TB108
2344D01G02	Digital contact input	1	TB105
2D33170G01	Appendix R current loop input	2	TB103,* TB109*
2D33172G01	Appendix R RTD	2	TB104, TB107
2D31856G01	Current loop output	1	TB106
2D32406G01	RS-422 Encode/Decode data link	1	TB102

*Configuration TB107 output derived the output of TB103; TB109 was configured as an "analog repeater."

NOTE: P.C. board configuration per Design Specification 955882 and Table 2-4.

TABLE 2-2
CIRCUIT BOARD LOCATIONS, DPU

Circuit Board Type		Quantity	Chassis Slot or Termination Frame
Processor Boards (See Note)			
[ ] a.c	Main processor Memory non-volatile Self Health Programmable I/O D/A RAM memory Data link communications EPROM	[ ] a.c	
Input/Output Boards (See Note)			
2D32406G01	RS-422 Encode/ Decode data link	3	TB201, TB202, TB203
2344D04G01	Digital contact output	1	TB205
2344D02G01	High level voltage output	1	TB204

NOTE: P.C. board configuration per Design Specification 955905 and Table 2-4.

TABLE 2-3
CIRCUIT BOARD LOCATIONS, DISPLAY UNIT

Circuit Board Type	Quantity	Chassis Slot or Termination Frame
[ ] a,c	Main processor EPROM Communications Interface relocate 2D33043 RAM memory	[ ] a,c

Reference: Assembly Drawing 1721E43G01 and Keyboard Drawing 1849E07G01.

TABLE 2-4
I/O BOARD CONFIGURATION

Location In System Under Test	Board Configuration As Listed In Design Specification	Modification
RPU		
TB101	TB103	
TB102	TB101	
TB103	TB118	
TB104	TB120	
TB105	TB106	
TB106	TB126	
TB107	TB121	
TB108	TB105	
TB109	TB119	Except jumper analog repeating
DPU		
TB202	TB101	
TB201	TB103	
TB203	TB108	
TB204	TB114	
TB205	TB111	

2.3 CABLE CONNECTIONS

2.3.1 Field Cable Connection

The field cable system connection was implemented in a way to provide a separation between the 1E system input and the non-1E system output. The field cables of the simulated signals and the analog and digital outputs were a nominal 40-foot length. Shields and grounding were standard installation practice. Field cables used 22-gage twisted shielded wire, except digital contact input/output used two unshielded conductors. Field cable connections are shown in Appendix E.

2.3.2 Alternative Configurations

To allow testing of all I/O configurations, two alternative configurations of data link boards were required during testing to accommodate each transmit and receive channel of the RS-422 Encode/Decode data link and RS-422 data link I/O boards. The data link boards were not removed from their termination frames but the internal cabling interface to the communication control processor board was changed.

SECTION 3

ISOLATION DEVICES PHILOSOPHY

3.1 DESCRIPTION

System design made principal use of the input/output (I/O) boards to effect 1E separation functions and also provided separation of the processor elements from field cabling connections. The processor elements were electrically buffered from all input and output functions at the I/O board interface.

[ ] a,c

The 1E functions were additionally buffered from design bases faults on all non-1E I/O connections by surge protection and fault limiting devices. The non-1E function may or may not have been lost dependent on the nature of the fault or transient. (Where internal fuses were normally provided as fault-limiting devices, these were short circuited for worst case test representation.) Surge protection per IEEE-472-1974 was provided in all field input/output connections.

In cases where connection between different 1E trains or to non-1E equipment is required, physical separation is normally provided within the cabinet by means of terminal boxes and flexible metal conduit between field connections and I/O terminals. Testing was performed with that configuration for a representative number of cases to prove the wiring, and then the remainder of the testing employed signal injection directly onto the I/O board terminal block connections.

SECTION 4
TEST DESCRIPTION

4.1 NOISE AND FAULT TESTS

The purpose of the noise and fault tests was to demonstrate that a noise or fault injected into the non-1E input/output wiring would not affect or degrade Class 1E system performance. The simulated signal was retained in place through the entire test.

The system I/O components used for isolation or fire protection buffering are identified in Table 4-1. These components had both noise and faults applied. The table lists the maximum credible fault voltages for each case.

4.1.1 Noise Tests

4.1.1.1 Description

The noise tests were designed to ensure that separation criteria were met for the system by demonstrating that noise injected into the non-1E field wiring was not propagated through the isolator or picked up wire to wire. Magnetic or capacitive coupling from adjacent wiring in cable trays were considered in the test setup.

Radiated noise was individually applied for 2 minutes to each defined non-1E field wire listed in Tables 4-2 and 4-3. The effects of the test were observed and recorded on data sheets.

4.1.1.2 Test Outline

Four types of radiated noise testing were implemented, as follows:

1. Random Noise Test
2. Crosstalk Noise - Chattering Relay Test
3. Military Specification Noise Test
4. High Voltage Transient Noise Test

TABLE 4-1
I/O COMPONENTS TESTED IN NOISE AND FAULT TESTS

Type of I/O Board	I/O Board Assembly Drawing and Revision		Maximum Credible Fault Vdc	Maximum Credible Fault Vac
High level voltage output	2344D02G01	Rev. 3	250	580
Current loop output	2D31856	Rev. 2	250	580
Digital contact output	2344D04G01	Rev. 1	250	580
Normally closed				
Normally opened				
Digital contact input	2344D01G02	Rev. 2	250	580
RS-422 Encode/Decode Data Link	2D32406G01	Rev. 2		
Transmit			250	580
Receive			250	580
RS-422 Data Link	2334D63G01	Rev. 4		
Transmit			250	580
Receive			250	580
Appendix R current loop input	2D33170G01	Rev. 2		
Current loop output			125	125
Test injection			125	125
Test interlock			125	125
Appendix R RTD	2D33172G01	Rev. 2		
Current loop Output			125	125
Test injection			125	125
Test interlock			125	125

TAbLE 4-2
NOISE INJECTION FIELD CONNECTIONS

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB102	2	3	NC	RS-422 Encode/Decode Data Link	2D32406	Data link TX
DPU	TB201	2	3	NC	RS-422 Encode/Decode Data Link	2D33406	Data link TX
RPU	TB101	19	20	NC	RS-422 data link	2334D63	Data link RX
DPU	TB203	16	1.	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train C display
DPU	TB203	2	3	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train A/Train C
DPU	TB203	5	6	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train C/Train A
DPU	DISPLAY	Train C connector			SWDK	2D33403	Data link Train C/display
DPU	TB204	5	6	N/A	High Level Voltage Output	2344D02	Output
DPU	TB205	8	9	N/A	Digital Contact Output (open)	2344D04	Output
DPU	TB205	8	10	N/A	Digital Contact Output (closed)	2344D04	Output
RPU	TB103	11	12	NC	Appendix R current loop input (nonrepeating)	2D33170	Output
RPU	TB104	12	13	NC	Appendix R RTD	2D33172	Output
RPU	TB105	5	6	N/A	Digital Contact Input (input open)	2344D01	Input
RPU	TB105	5	6	N/A	Digital Contact Input (input closed)	2344D01	Input
RPU	TB106	5	6	NC	4-20 mA Current Loop Output (powered)	2D31856	Output
RPU	TB108	5	6	N/A	Digital Contact Output (NO)	23344D04	Output
RPU	TB108	5	7	N/A	Digital Contact Output (NC)	23344D04	Output
RPU	TB109	11	12	NC	Appendix R Current Loop Input (analog repeating)	2D31856	Output

TABLE 4-3
ALTERNATE RPU TB101 AND 102

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB101	2	3	NC	RS-422 Data Link	2334D63	Data link TX
RPU	TB102	19	20	NC	RS-422 Encode/Decode Data Link	2D32406	Data link RX

Each of the above noise sources was energized through a 40-foot antenna wire which was adjacent to the 40-foot non-1E field signal wiring being tested. Refer to Tables 4-2 and 4-3 for each field wiring cable subjected to noise tests. The antenna was terminated to optimize coupled noise effects. A detailed description of the noise test implementation is given in the Noise Test Procedure section of Appendix D.

Identical simulated input signals and computer-entered values were used throughout all the phases of noise testing. Data obtained prior to, during, and following noise testing served as a point of reference and comparison for interpreting results.

4.1.1.2.1 Random Noise Test

This noise source was generated by a random noise generator [

]$_c$

The radiated random noise characteristics are as follows:

Peak value: 20 V
Frequency: 10 kHz - 10 MHz

Figure 4-1 shows the random noise test connections.

4.1.1.2.2 Crosstalk Noise - Chattering Relay Test

A dc and an ac relay were used to generate a radiated crosstalk noise. The relays were set in a "chattering" or "buzzer" mode by wiring the normally-closed relay contacts in series with the relay coil. The following types of relays were used during the crosstalk noise-chattering relay test:

1. Relay with a 118 Vac coil, 0.3 amp nominal
2. Relay with a maximum rating of 600 Vdc, 125 Vdc coil, 0.22 amp nominal

Figure 4-2a shows the dc crosstalk noise - chattering relay test connections. Figure 4-2b shows the ac crosstalk noise - chattering relay test connections.

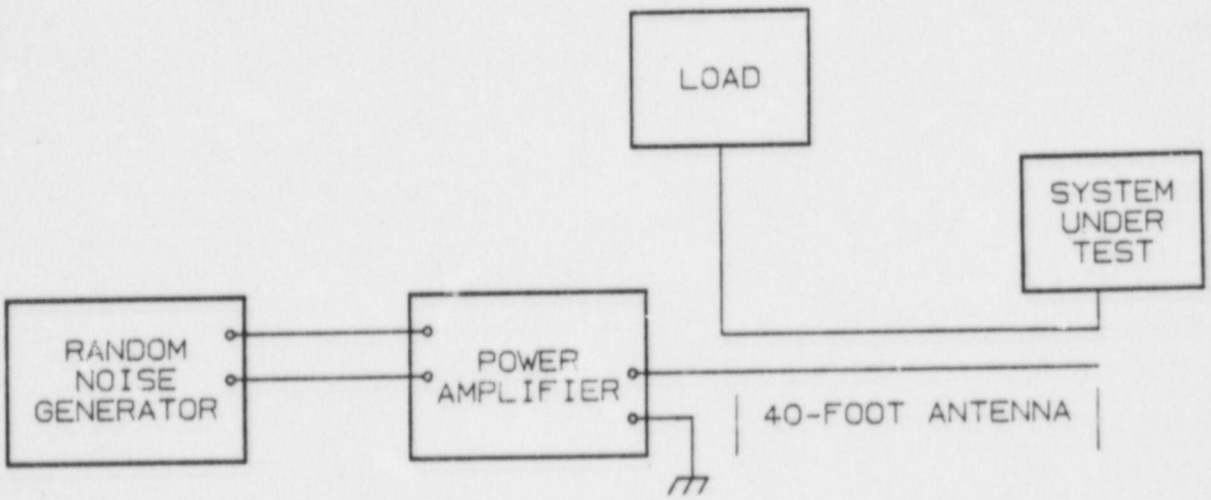
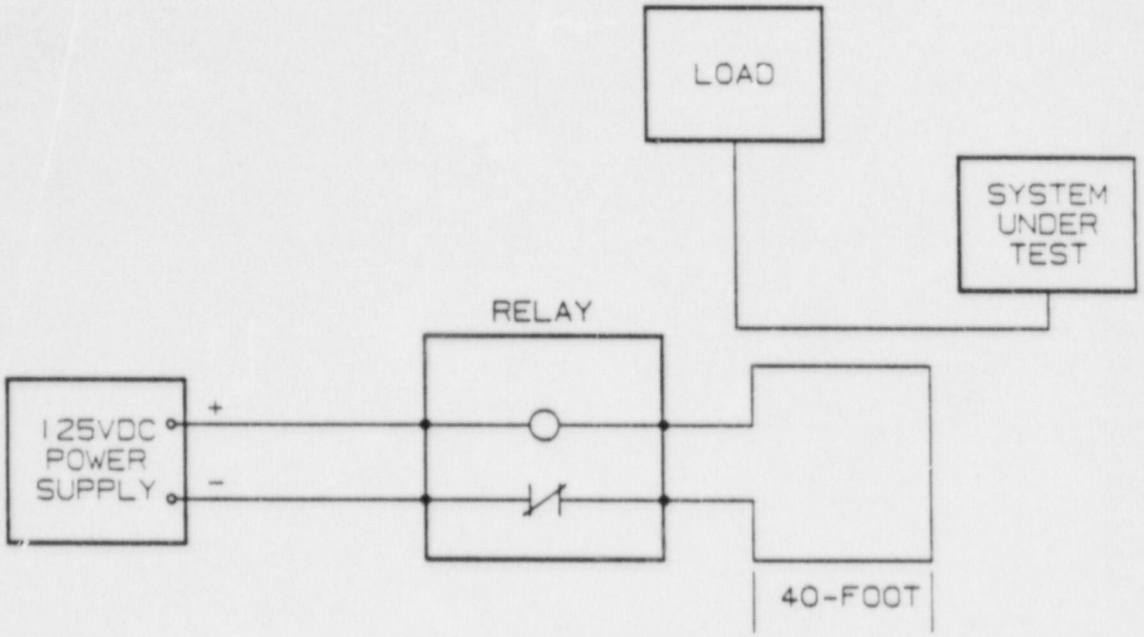


Figure 4.1 Random Noise Test Connections



4-2a. Crosstalk Noise - Chattering dc Relay Test Connections

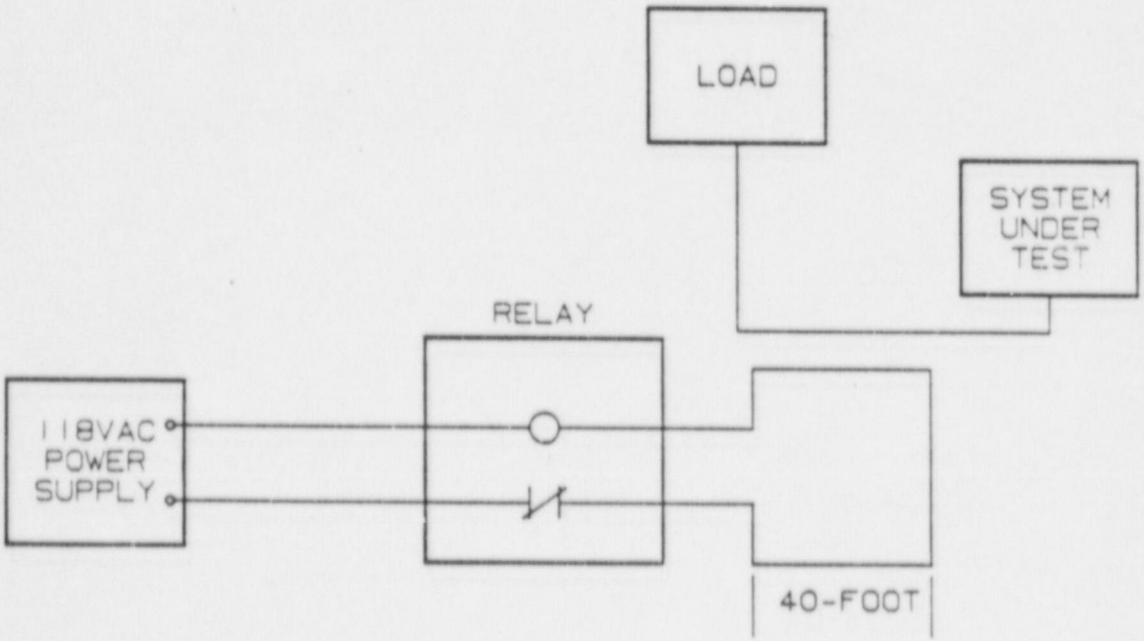


Figure 4-2b. Crosstalk Noise - Chattering ac Relay Test Connections

4.1.1.2.3 Military Specification Noise Test

Military specification noise testing was performed using switched cycling noise sources with the characteristics of Noise Sources No. 1 and No. 2 in Military Specification MIL-N-19900B.

The characteristics for Noise Source No. 1 were:

Voltage: 115 Vdc
Inductance: 3 H
Resistance: 500 ohm

The characteristics for Noise Source No. 2 were:

Voltage: 115 Vac
Inductance: 100 mH
Resistance: 2 ohm

Figure 4-3 shows the military specification noise sources.

4.1.1.2.4 High Voltage Transient Noise Test

This noise source was generated from a surge transient generator [

]$_c$ The

high voltage transient noise characteristics were as follows::

Peak value: 3.3 kV
Frequency: 1.25 MHz
Repetition rate: 120 Hz

Figure 4-4 shows the high voltage transient noise test connections.

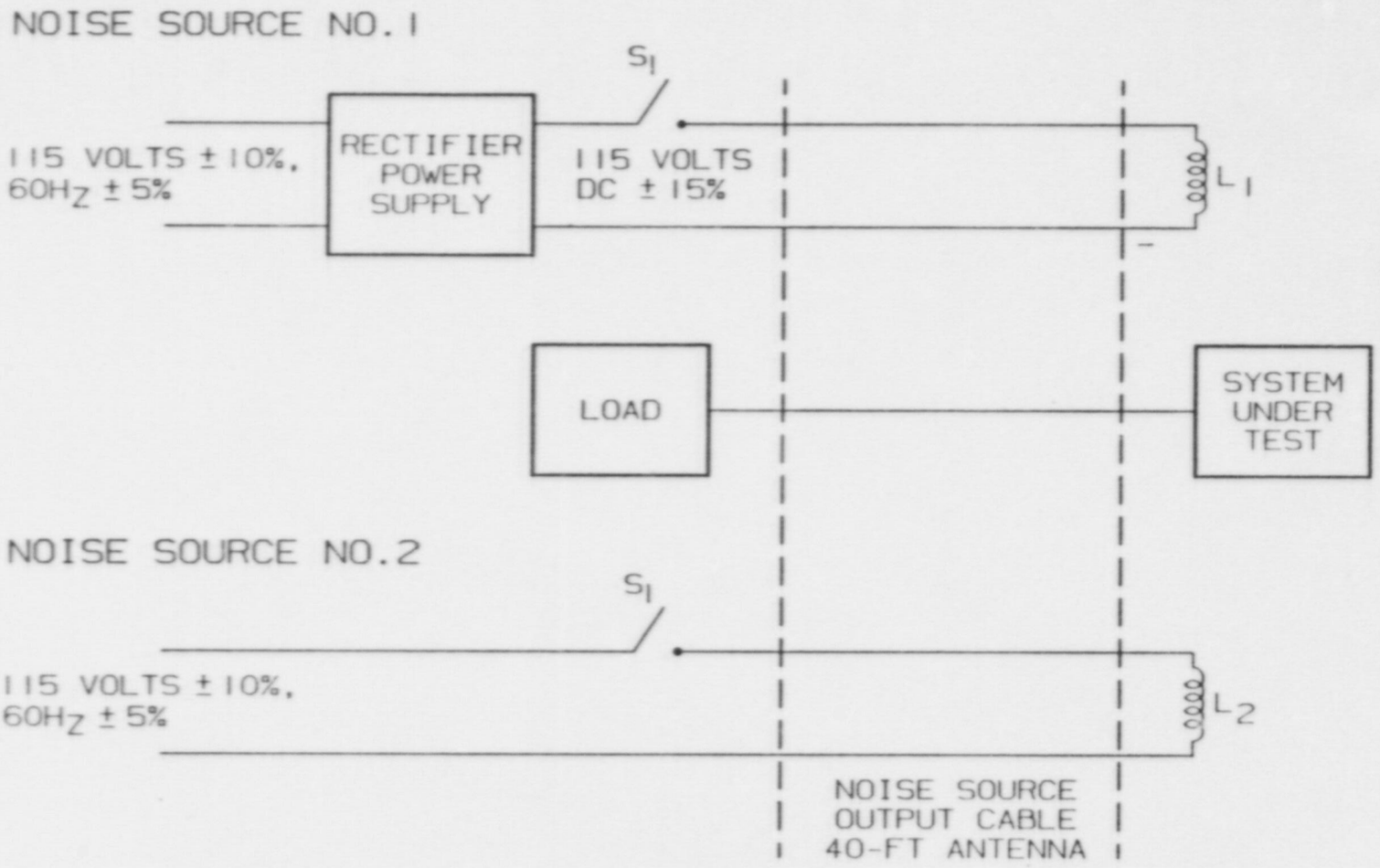


Figure 4.3. Military Specification Noise Sources

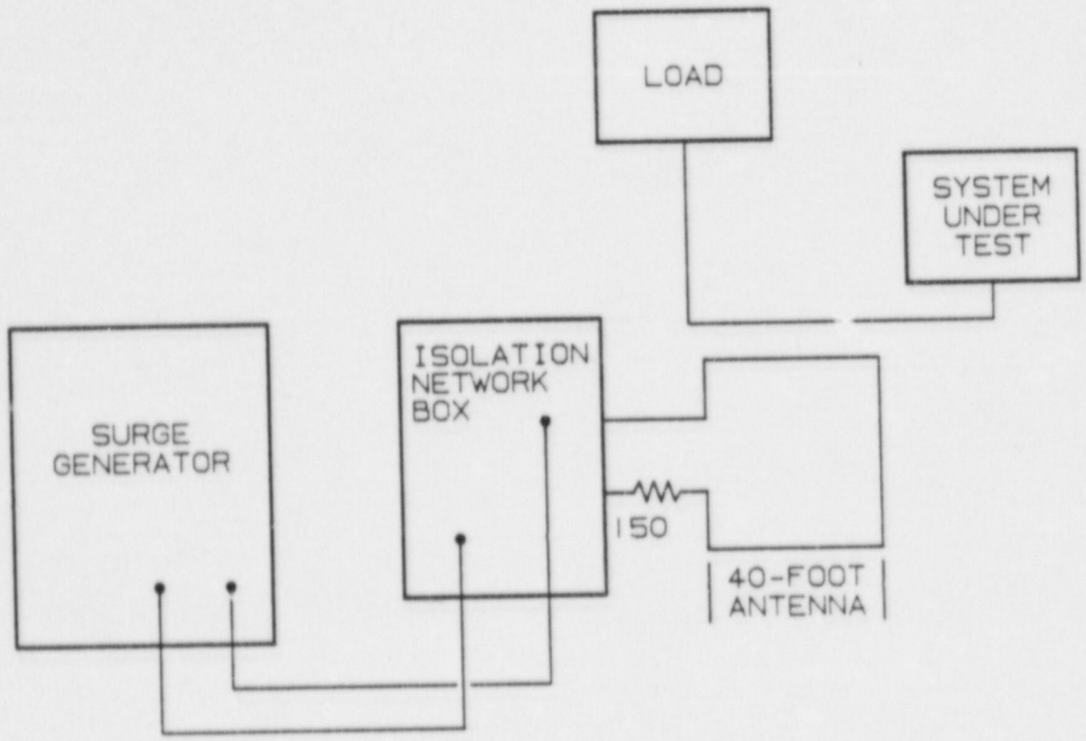


Figure 4-4. High Voltage Transient Noise Test Connections

4.1.2 Fault Tests

4.1.2.1 Description

To ensure that faults injected into non-1E field wiring did not propagate to the 1E system, credible faults were applied to each type of non-1E connection. Faults were applied to the respective terminals via non-1E isolated or else through the cabinet terminal junction box which passed the signal into the I/O component via flexible metal conduit. Refer to Tables 4-3 and 4-4 for each field wiring cable subjected to destructive and nondestructive fault tests. In addition to the field wiring listed in Tables 4-2 and 4-3, the test injection and test interlock of the RTD and current loop input Appendix R I/O boards were subjected to the same fault tests. Faults were individually applied for 2 minutes to each defined non-1E field wire listed in Table 4-3 and 4-4.

4.1.2.2 Test Outline

Types of faults included short circuits, representative applied common mode fault voltages, and representative line-to-line transverse mode fault voltages. Direct current voltages were applied in both positive and negative polarity. The fault voltages employed were 125 Vac, 60 Hz, 580 Vac, 60 Hz, 125 Vdc and 250 Vdc.

An exception to the general non-1E isolation test values was the case of fire protection buffering, in which a credible fault was defined to be 125 Vdc and 125 Vac by virtue of same-train 1E installation routing.

Faults were applied to all test terminals in the following sequence: first, short circuit, next, common mode (nondestructive) line-to-ground and finally, normal mode line-to-line fault (destructive) in order to minimize repairs and replacement. A detailed description of the fault tests implementation is given in the Fault Test Procedure section, Appendix D.

Normal pre-test conditions were ensured by monitoring the display and analog output signals. Data recorders were run 2 minutes prior to, during, and following each fault test. Repairs and replacement were performed and logged before proceeding to the next test in the fault test sequence.

TABLE 4-4
FAULT INJECTION FIELD CONNECTIONS

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB102	2	3	NC	RS-422 Encode/Decode Data Link	2D32406	Data link TX
RPU	TB101	19	20	NC	RS-422 Data Link	2334D63	Data link RX
	DISPLAY	Train C connector			SWDK-C RS-422 Encode/Decode Data Link	2D33403 2D33406	Data link Train C/display
DPU	TB204	5	6	N/A	High Level Voltage Output	2344D02	Output
RPU	TB103	11	12	NC	Appendix R Current Loop Input (nonrepeating)	2D33170	Output
	TB103	5	6	NC	Appendix R Current Loop Input (nonrepeating)	2D33170	Input
	TB103	8	9	NC	Appendix R Current Loop Input (nonrepeating)	2D33170	Input
RPU	TB104	12	13	NC	Appendix R RTD	2D33172	Output
	TB104	6	7	NC	Appendix R RTD	2D33172	Input
	TB104	8	9	NC	Appendix R RTD	2D33172	Input
	TB104	10	11	NC	Appendix R RTD	2D33172	Input
RPU	TB105	5	6	N/A	Digital Contact input (input closed)	2344D01	Input
RPU	TB106	5	6	NC	4-20 mA Current Loop Output (powered)	2D31856	Output
RPU	TB108	5	6	N/A	Digital Contact Output (NO)	23344D04	Output
RPU	TB108	5	7	N/A	Digital Contact Output (NC)	23344D04	Output
RPU	TB109	11	12	NC	Appendix R Current Loop Input (analog repeating)	2D31856	Output

4.1.2.2.1 Short Circuit

In the short circuit fault test, the high and low terminals of a signal were switched to earth ground at fault time. An event mark was recorded on channel 1 of the tape recorder indicating the beginning and end of the short circuit fault being applied to the test injection points. Refer to Tables 4-3 and 4-4 for test injection points. Refer to Figure 4-5 for the short circuit to ground test injection/recorder connection schematic.

4.1.2.2.2 Common Mode Fault Tests

4.1.2.2.2.1 250 Vdc Common Mode Fault Test

To the field connections of the I/O boards as shown in Tables 4-3 and 4-4, the common mode faults were applied to the test injection points as follows:

1. With the 250 V negative potential of the dc power supply applied to earth ground, the positive potential was applied to the high terminal of the test injection point. (Refer to Figure 4-6a.)

2. With the 250 V negative potential of the dc power supply applied to earth ground, the positive potential was applied to the low terminal of the test injection point. (Refer to Figure 4-6b.)

3. With the 250 V positive potential of the dc power supply applied to earth ground, the negative potential was applied to the high terminal of the test injection point. (Refer to Figure 4-6c.)

4. With the 250 V positive potential of the dc power supply applied to earth ground, the negative potential was applied to the low terminal of the test injection point. (Refer to Figure 4-6d.)

Figure 4-7 shows the dc power supply fault connections.

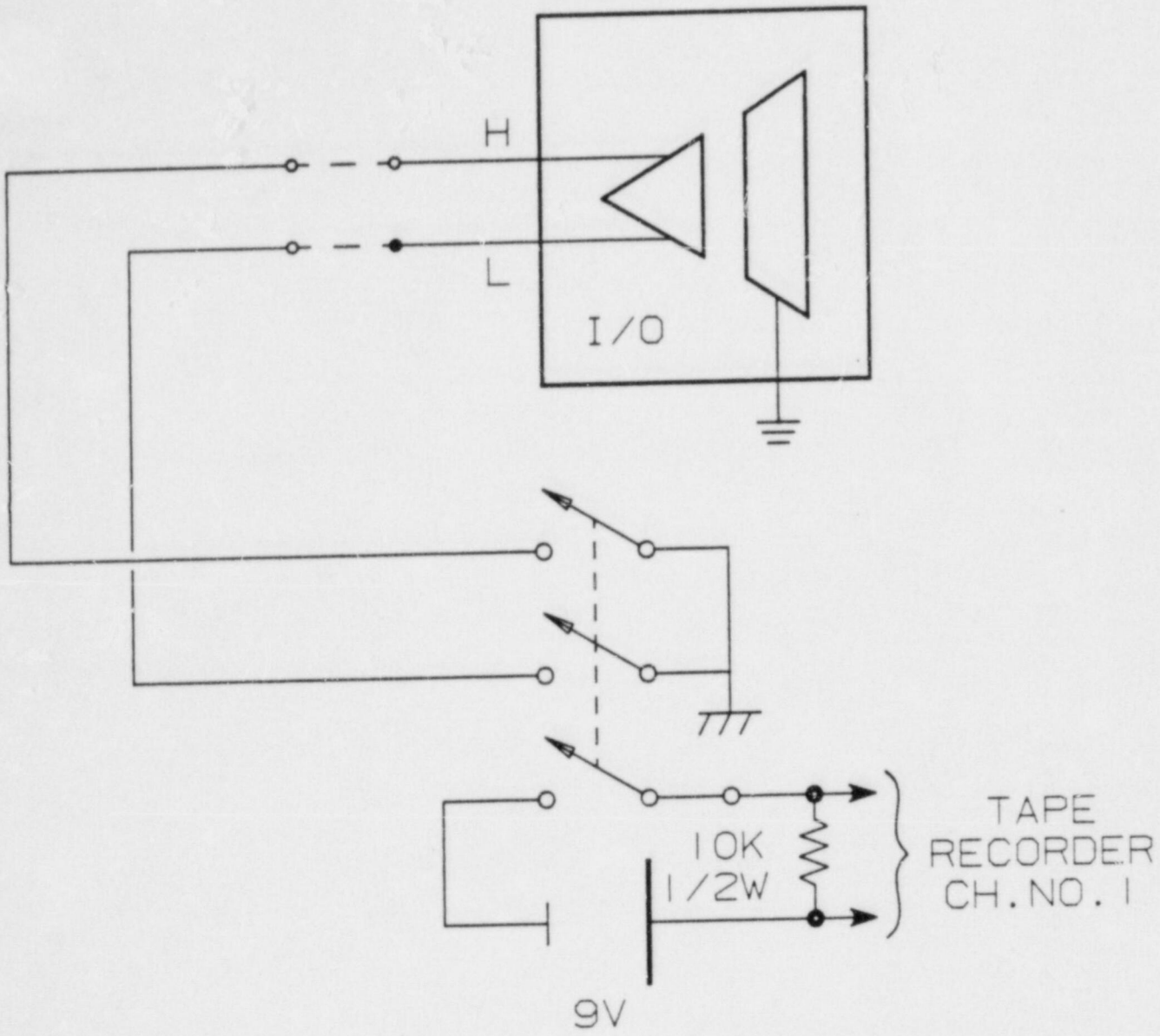


Figure 4-5. Short Circuit to Ground Test Injection/Recorder

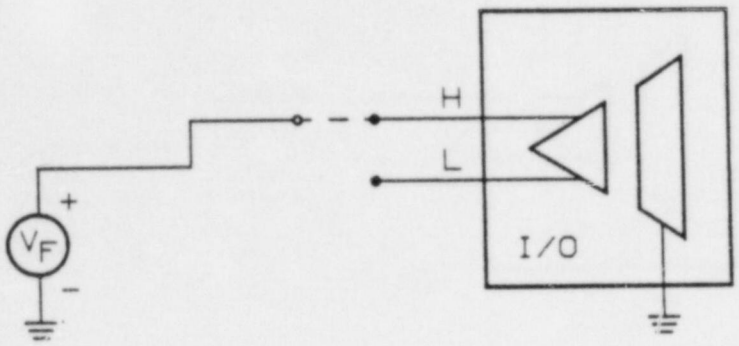


Figure 4-6a. 250 Vdc Common Mode Fault Test

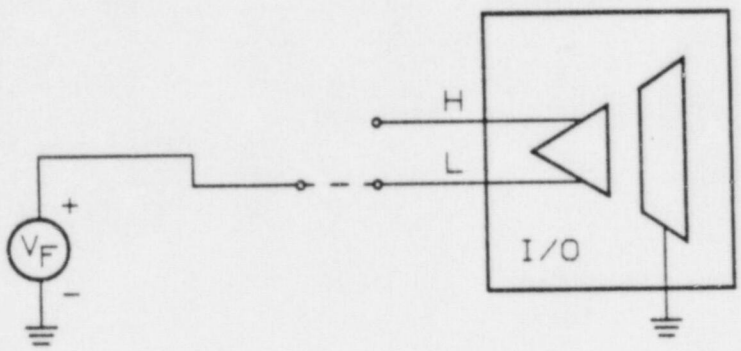


Figure 4-6b. 250 Vdc Common Mode Fault Test

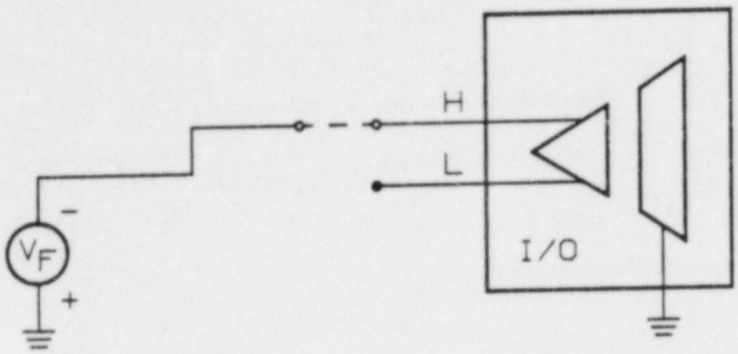


Figure 4-6c. 250 Vdc Common Mode Fault Test

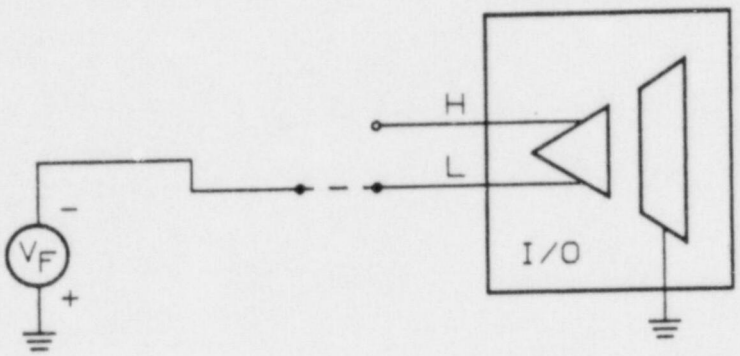


Figure 4-6d. 250 Vdc Common Mode Fault Test

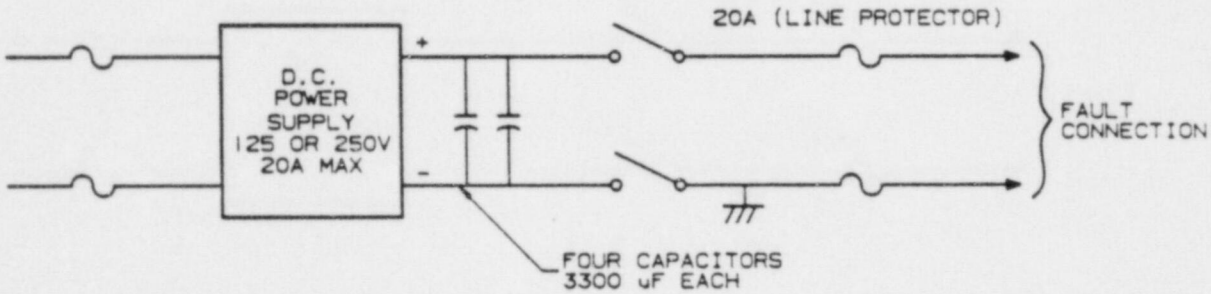


Figure 4-7. Dc Power Supply Fault Connections

4.1.2.2.2.2 580 Vac Common Mode Fault Tests

The 580 Vac common faults were applied to the test injection points as follows:

1. The neutral line of the 580 V fault source was connected to earth ground and the hot line was connected to the high terminal of the test injection point. (Refer to Figure 4-8a.)

2. The neutral line of the 580 V fault source was connected to earth ground and the hot line was connected to the low terminal of the test injection point. (Refer to Figure 4-8b.)

Figure 4-9 shows the ac fault connections. Figure 4-10 shows the transformer connection for the 580 Vac fault source.

4.1.2.2.3 Line-to-Line Fault Tests

Two types of line-to-line fault tests were conducted. The first type was implemented with the normal fuses internal to the I/O board circuitry installed according to design specifications. The second type was implemented with the fuses shorted by aluminum foil as a worst-case condition. Photographs in Appendix B show the I/O boards, types of faults and evidence of the fault effects while the fuses were shorted.

The components affected during the fuse shorted line-to-line fault tests are listed in the Test Effects column in Table A-13.

Note that during the dc fuse shorted test, earth ground was connected to the negative potential of the dc power supply. During the ac fuse shorted test, the ground was connected to the neutral line of the ac source. The dc power supply capability was 20 amp maximum continuous before current limiting took effect. Four 3300 μF capacitors were in parallel with the power supply output to ensure high initial current capacity.

4.1.2.2.3.1 125 Vac Line-to-Line Fault Tests

For this test, the neutral terminal of the 125 Vac source was connected to ground via a time delay 20 amp fuse. The faulted high and low terminals of the I/O boards listed in Tables 4-3 and 4-4 were switched via a circuit breaker to the "hot line" and earth ground. Figure 4-11 shows the ac fault connection. Figure 4-12 shows the transformer connection for the 125 Vac fault source.

4.1.2.2.3.2 125 Vdc Line-to-Line Fault Tests

The line-to-line faults were applied to the test injection points as follows:

1. The negative potential of the dc power supply was connected to earth ground. The line-to-line fault was injected into the high and low terminals of the test injection points. (Refer to Figure 4-13a).

2. The positive potential of the dc power supply was connected to earth ground. The line-to-line fault was injected into the high and low terminals of the test injection points. (Refer to Figure 4-13b).

4.1.2.2.3.3 250 Vdc Line-to Line Fault Tests

The line-to-line faults were applied to the test injection points as follows:

1. The negative potential of the dc power supply was connected to earth ground. The line-to-line fault was injected into the high and low terminals of the test injection point. (Refer to Figure 4-14a).

2. The positive potential of the dc power supply was connected to earth ground. The line-to-line fault was injected into the high and low terminals of the test injection point. (Refer to Figure 4-14b).

4.1.2.2.3.4 580 Vac Line-to-Line Fault Tests

For this test, the neutral terminal of 580 Vac source was connected to ground via a 20 amp fuse. The faulted high and low terminals of the I/O boards listed in Tables 4-3 and 4-4 were switched via circuit breaker to the "hot line" and earth ground. Figure 4-15 shows the ac fault connection. Figure 4-10 shows the transformer connection for the 580 Vac fault source.

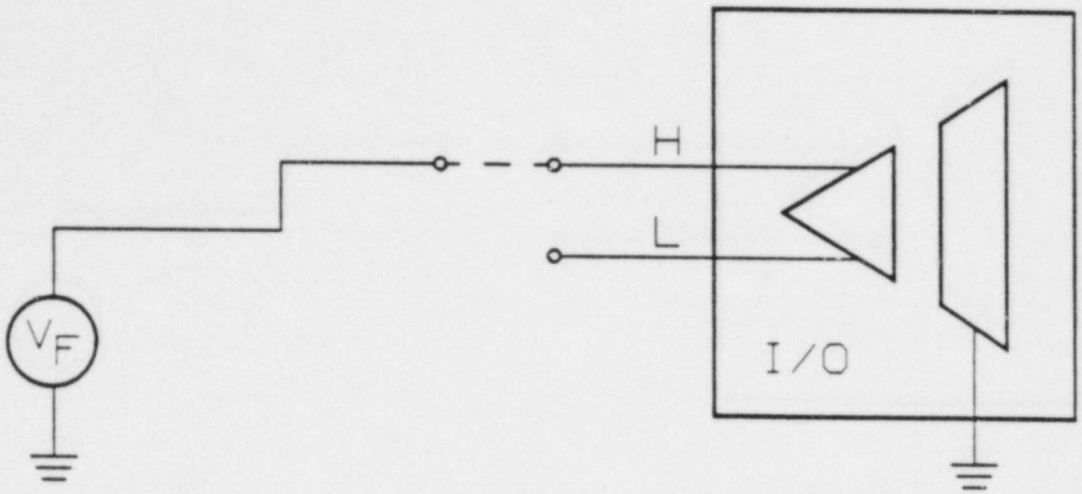


Figure 4-8a. 580 Vac Common Mode Fault Test

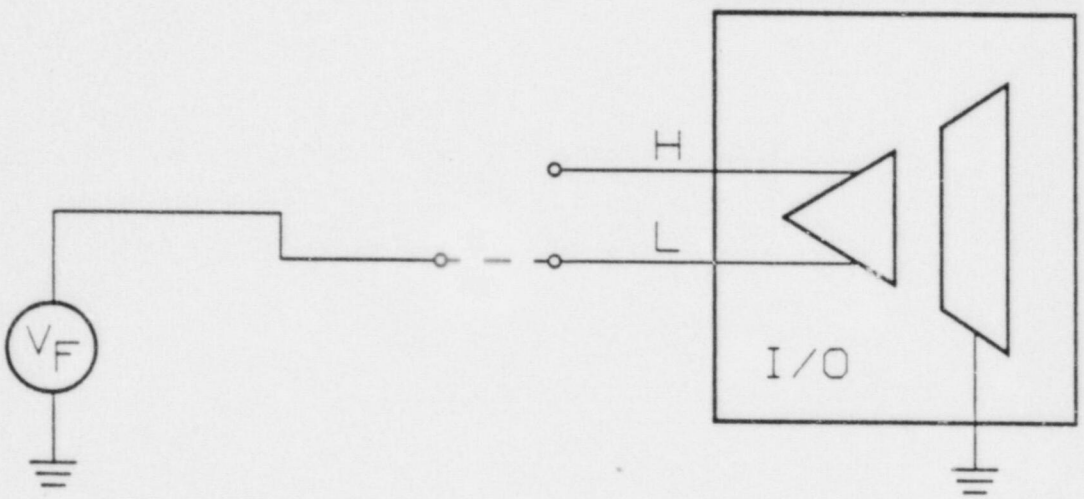


Figure 4-8b. 580 Vac Common Mode Fault Test

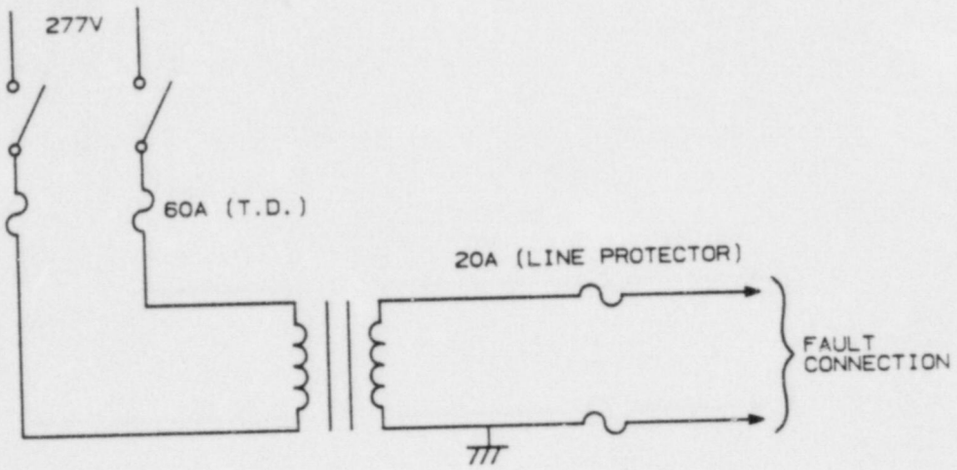


Figure 4-9. Ac Fault Connections

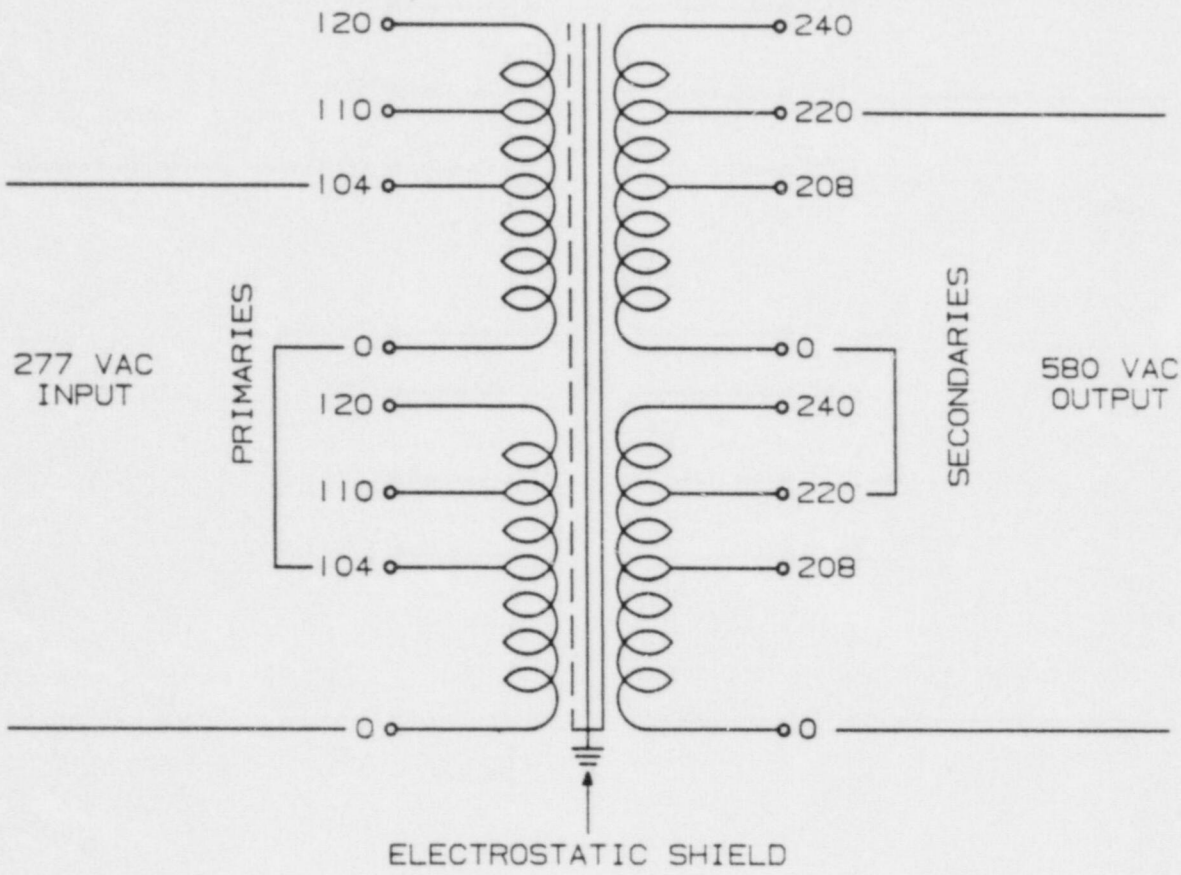


Figure 4-10. Transformer Connection for the 580 Vac Fault Source

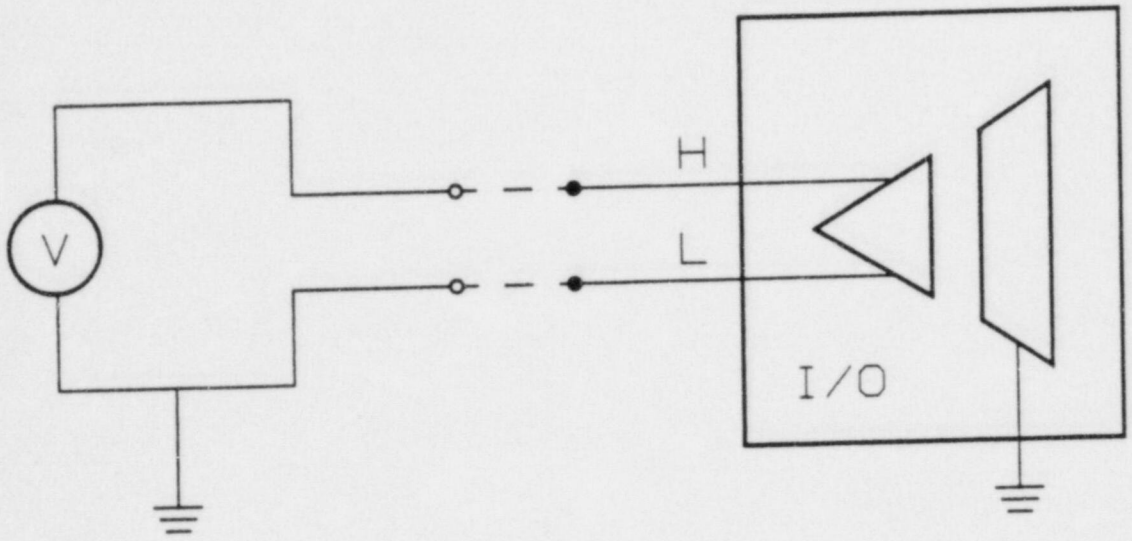


Figure 4-11. 125 Vac Line-to-Line Fault Test

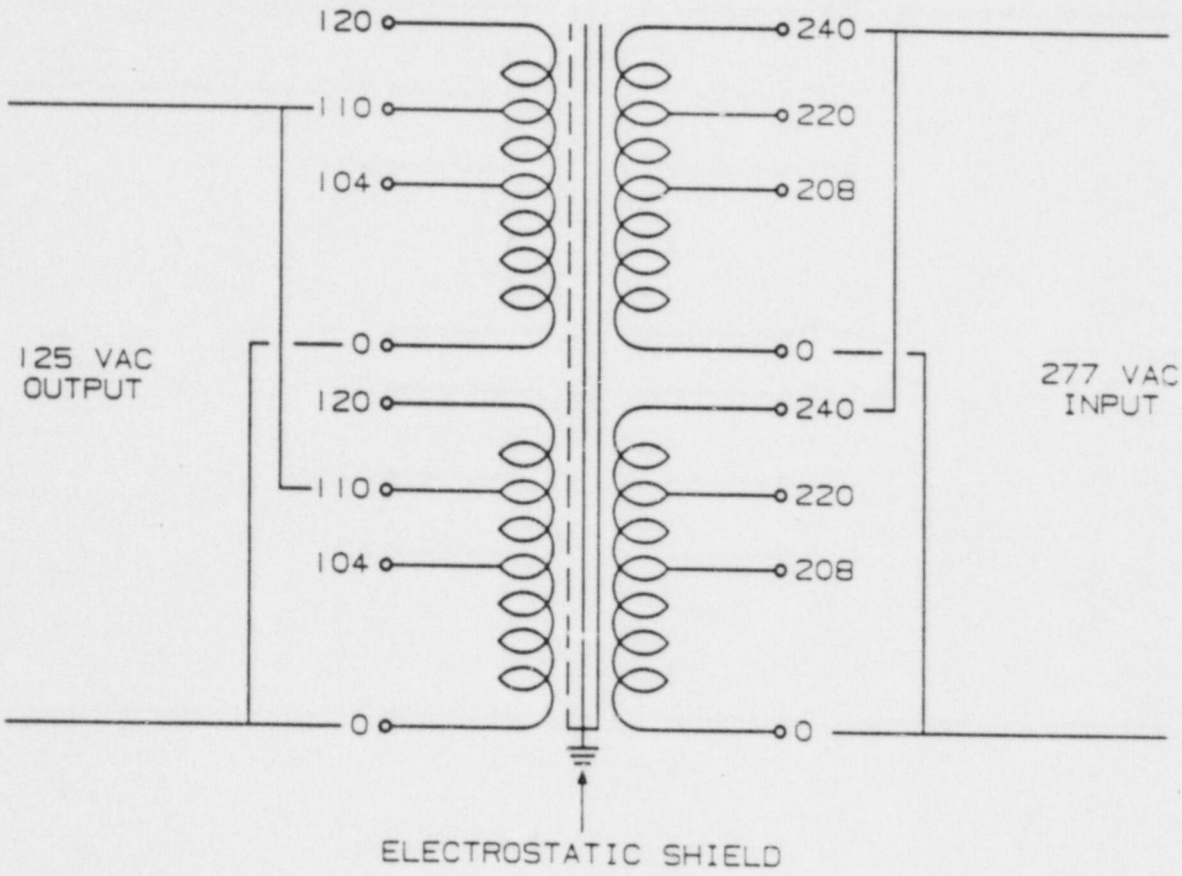


Figure 4-12. Transformer Connection for the 125 Vac Fault Source

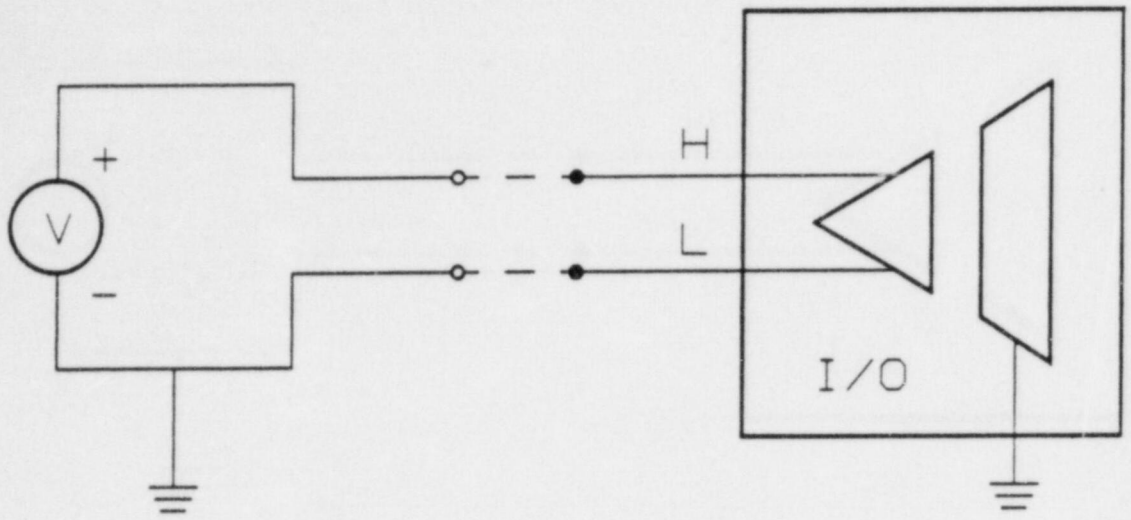


Figure 4-13a. 125 Vdc Line-to-Line Fault Test

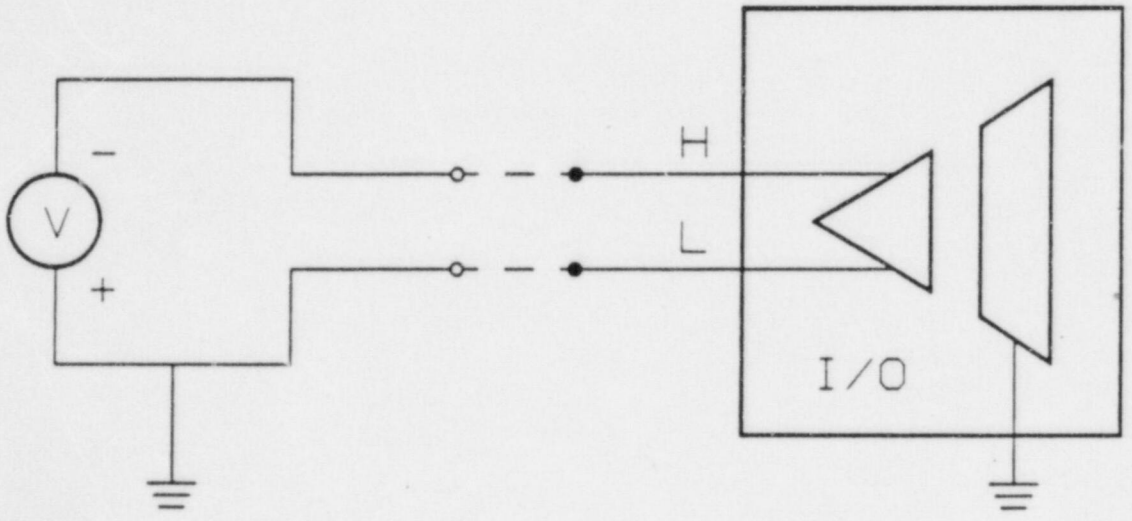


Figure 4-13b. 125 Vdc Line-to-Line Fault Test

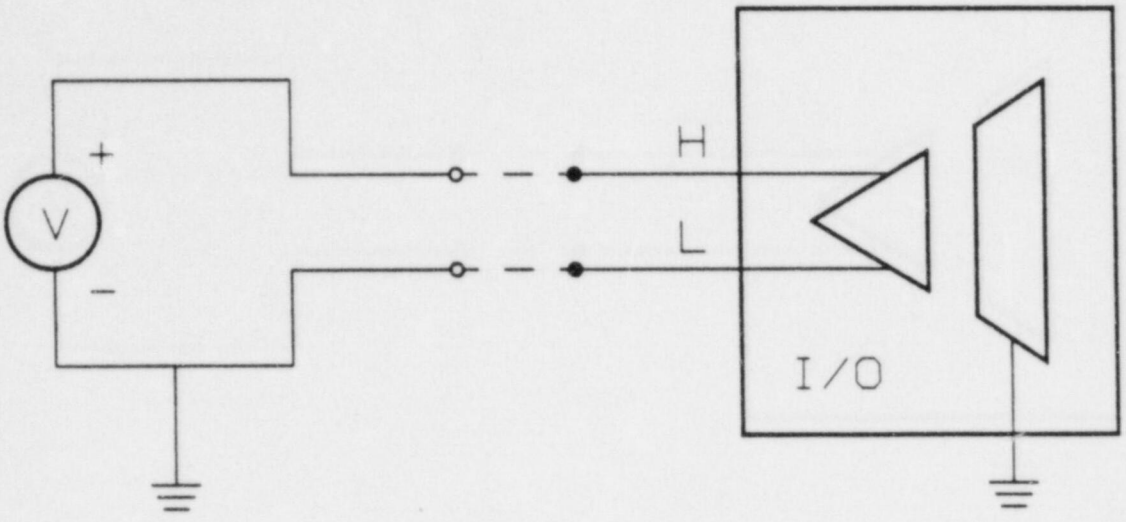


Figure 4-14a. 250 Vdc Line-to-Line Fault Test

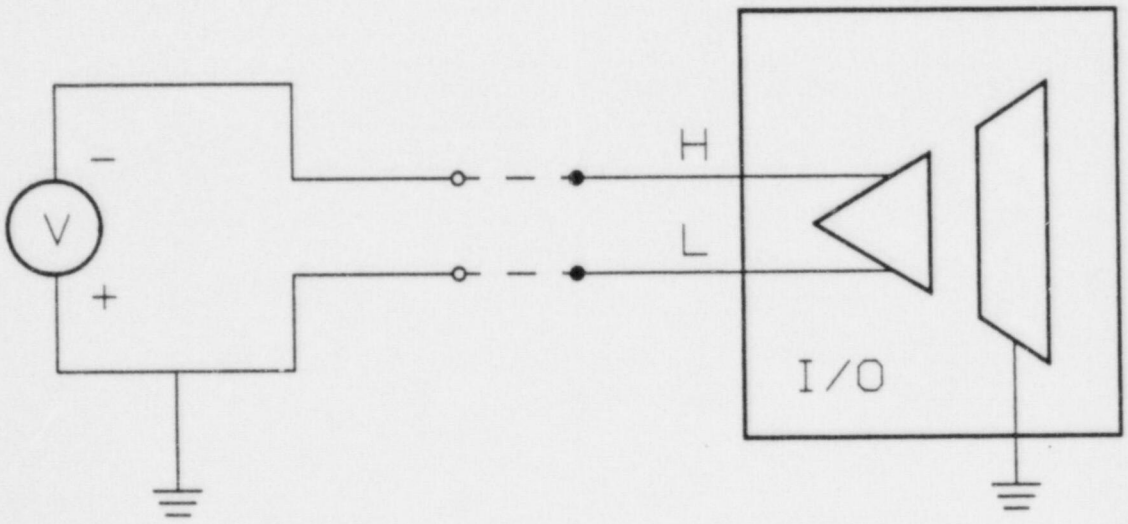


Figure 4-14b. 250 Vdc Line-to-Line Fault Test

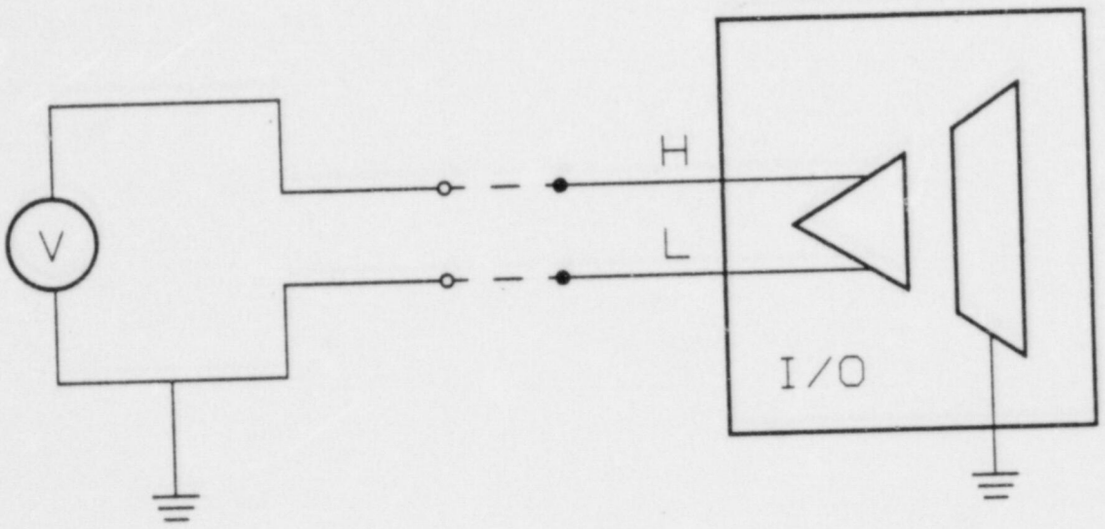


Figure 4-15. 580 Vac Line-to-Line Fault Test

4.2 SURGE WITHSTAND CAPABILITY (SWC) TEST

4.2.1 Description

The SWC tests were conducted under normal operating conditions of the system in accordance with IEEE 472-1974. The purpose of this test was to determine: (1) that no component failures occurred, and (2) that no input/output was affected except the data link when the surge was directly applied to it.

4.2.2 Test Outline

The surge was input in common mode and transverse mode into the termination of the inputs/outputs. The duration was 2 seconds at a 120 Hz repetition rate. Circuits were surge tested at 125 percent of the standard surge voltage (3.3 kV instead of 2.5 kV).

Each of the following seven groups of circuitry was tested within the specified conditions:

1. Data communication (RS-422 Data Link, Encode/Decode data link)
2. Input current circuits (Appendix R RTD and current loop input)
3. Input voltage circuits (Appendix R RTD)
4. Digital contact (digital contact input/output)
5. Output current circuits (current loop output)
6. Output voltage circuits (high level voltage output)
7. Ac power line (cabinet, display)

Tables 4-3 and 4-4 define each field wire subjected to the surge tests. The test injection and test interlock of the RTD and current loop input Appendix R I/O boards were subjected to the same surge tests.

A detailed description of the SWC test implementation is given in the Surge Withstand Test Procedure section of Appendix D.

4.2.2.1 Common Mode Test

For this test, one terminal of the test generator was connected to each input or output connection of the I/O board. The other terminal of the test generator was connected to the ground of the surge generator. An isolating inductor (for example, an RF choke rated at 10 amp, 2000 V, 370 μH) was inserted in each cable lead to the normal signal source or load.

4.2.2.2 Transverse Mode Test

For this test, the terminals of the test generator were connected to the high and low of of the I/O board terminal connection. An isolating inductor (10 amps, 2000 V, 370 μH) was inserted in each lead to the normal signal source or load.

4.2.3 Implementation of Test Procedures

The surge withstand capability test was carried out by using a surge generator [ ]$_c$ The output voltage of the surge generator was set to 3.3 kV at an impedance of 150 ohm.

Figure 4.16A shows common mode surge withstand capability test connection, and Figure 4.16B shows transverse mode surge withstand capability test connection. The isolation network box was used to set common mode or a transverse mode.

Figure 4-16C shows a block diagram of the equipment connections which were implemented during the SWC test. Refer to Appendix D for the surge test procedure which shows all the test injection points that were subjected to the surge.

The duration of the surge on the test injection point was continuous for 2 seconds. Each test was carried out in the common mode and in the transverse mode. The monitored output of the surge generator was fed to channel number one of the tape recorder.

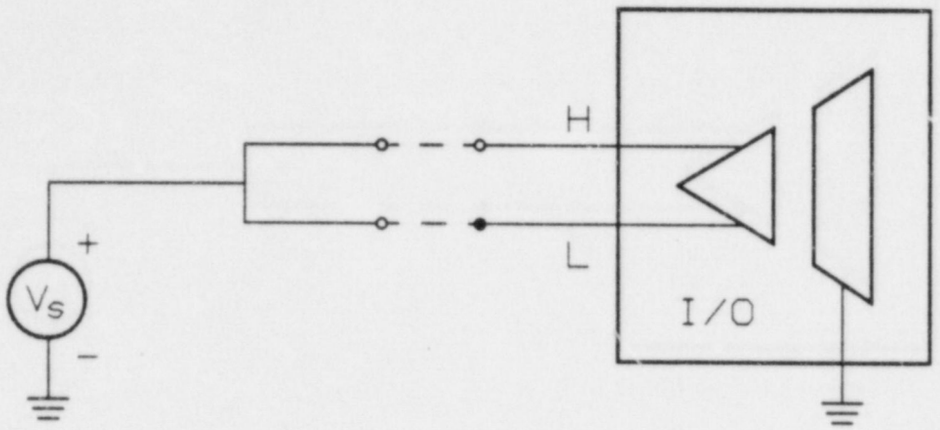


Figure 4-16A. Common Mode Surge Withstand Capability Test Connection.

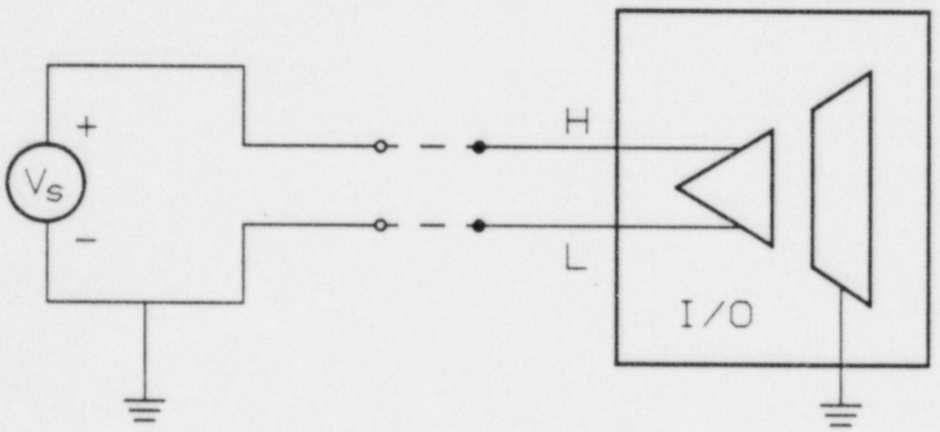


Figure 4.16B. Transverse Mode Surge Withstand Capability Test Connection.



Figure 4-16C. Block Diagram of Surge Withstand Capability (SWC) Test

4.3 RADIO FREQUENCY INTERFERENCE (RFI) SUSCEPTIBILITY TEST

The purpose of the RFI susceptibility this test was to evaluate the performance of the system when subjected to electromagnetic fields such as generated from portable radio transceivers or any other devices that generate continuous wave radiated electromagnetic energy.

4.3.1 Test Methodology

The RFI susceptibility tests were conducted in accordance with SAMA Standard PMC 33.1-1978. The classes of field strengths the system was subjected to were 3 V/m and 10 V/m over the entire frequency range of 20 MHz to 1 GHz, and 20 V/m over the frequency range of 20 MHz to 500 MHz.

Two types of tests were performed. In the first, referred to as a "modulation" test, a computer controlled sweep of the signal generator was utilized, [

]$_{b,c}$ In the second test, referred to as a "keying" test, the signal generator output was turned on and off at one-second intervals and with very short rise and fall times to simulate the keying of a transceiver. [

]$_{b,c}$

4.3.2 Test Location

The tests were carried out in a shielded enclosure (anechoic chamber) [

]$_{c}$

4.3.3 Test Equipment

Two types of antennae were used during the testing. A biconical antenna covered frequencies ranging from 20 MHz to 160 MHz, and a log periodic antenna covered frequencies ranging from 160 MHz to 1 GHz.

Two power amplifiers were used to cover the whole frequency range. The first amplifier covered 20 MHz to 500 MHz; the second amplifier covered 500 MHz to 1 GHz.

[ ] D.C

4.3.4 Test Procedure

Calibration testing was conducted to generate a calibration data file for the control computer for the signal generator. Once calibration testing was completed, modulation and keying tests were performed on the system cabinet and on the system display.

A detailed description of the radio frequency interference test implementation is given in the Radio Frequency Interference Test Procedure section of Appendix D.

Refer to Appendix D for the test procedures for the RFI susceptibility tests.

4.3.5 Calibration Test

The calibration data files were generated for 3 V/m, 10 V/m, and 20 V/m over the entire frequency band (20 MHz to 1 GHz), for both vertical and horizontal polarizations, for use in implementing the modulation and keying tests. Figure 4-18 is a photo of the anechoic chamber showing the iog periodic antenna in the horizontal polarization calibration [

]$_c$



Figure 4-17. Radio Frequency Interference Equipment Test Setup



Figure 4-18. Radio Frequency Field Calibration



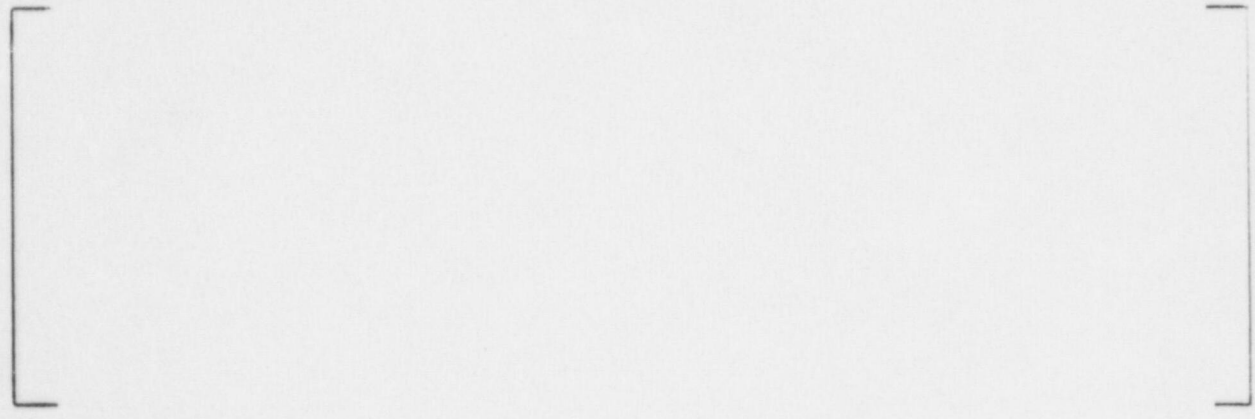
D.C

Figure 4-19 is a block diagram which illustrates all the interconnections between equipment used in the RFI calibration tests for generating the calibration data file.



D.C

4.3.6 Modulation Test



D.C

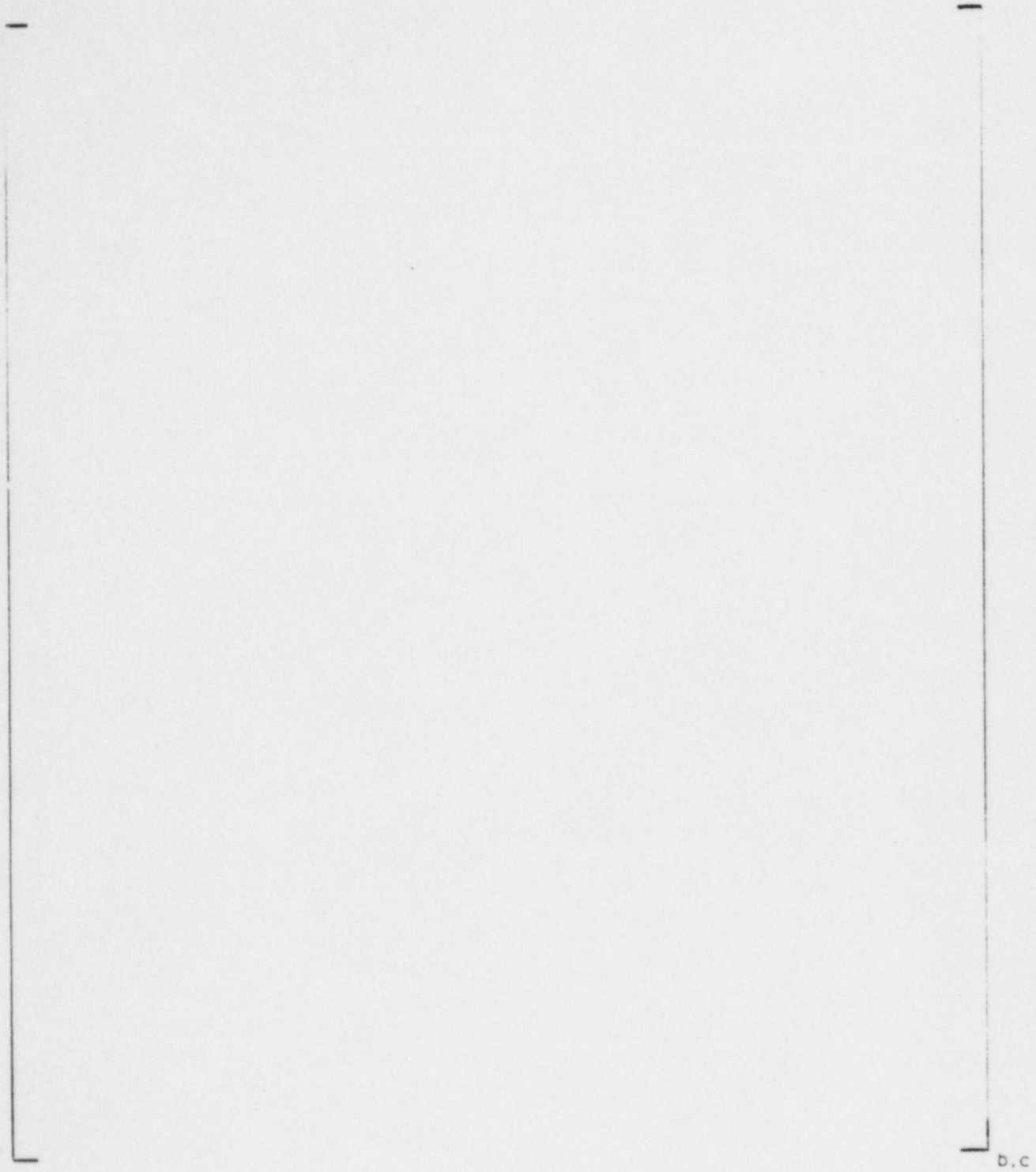


Figure 4-19. Block Diagram of Radio Frequency Interference Calibration Tests



Figure 4-20. Cabinet Subject to Radio Frequency Field

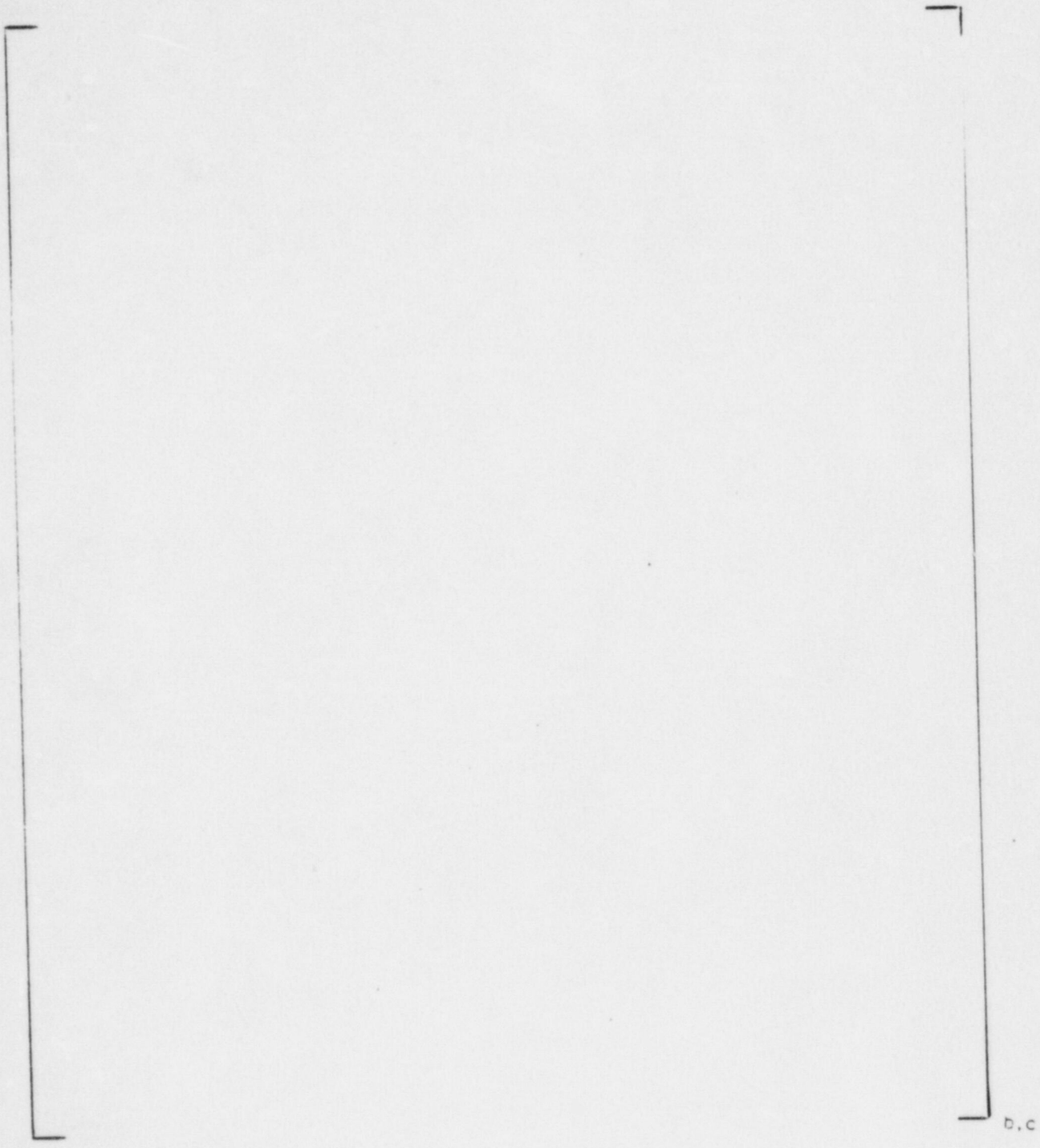


Figure 4-21. Block Diagram of Radio Frequency Interference Modulation Tests



b,c

The system display was used to monitor system performance and the simulated input when targeting the cabinet. A tape recorder was used to record the analog data, and a data logger was used to obtain a printout for pre-test and post-test data. Refer to Table 5-2, Analog Output Tables, for the recorded channels.

Following the cabinet test, the system display was subjected, in the vertical and horizontal polarizations, to the same RF fields to which the cabinet had been subjected. The display was subjected to the RF field on both the front and back sides. Table 5-2 shows the modulation tests performed on the display.

While targeting the display, it was monitored with a video camera and observed on a TV monitor. During the test, the analog outputs of the cabinet I/O were recorded on a tape recorder.

4.3.7 Keying Test

[redacted]

b.c

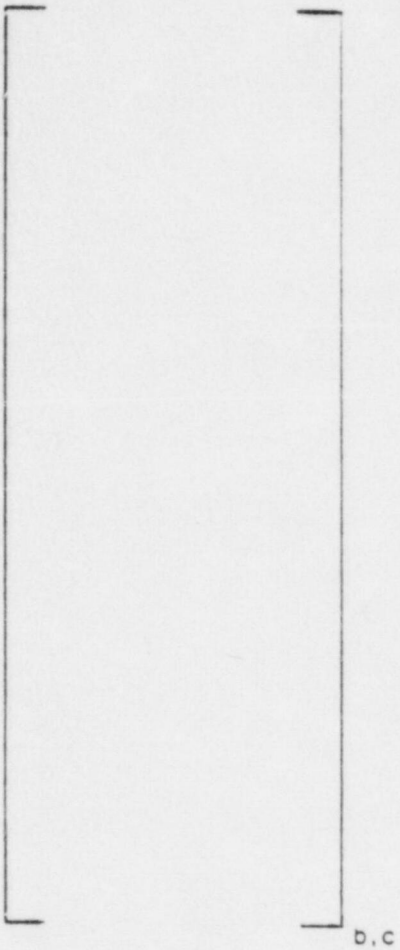
Figure 4-22 is a block diagram which shows the interconnections between equipment used for the RFI keying tests.

[redacted]

b.c

TABLE 4-5

KEYING TEST FREQUENCIES



D.C

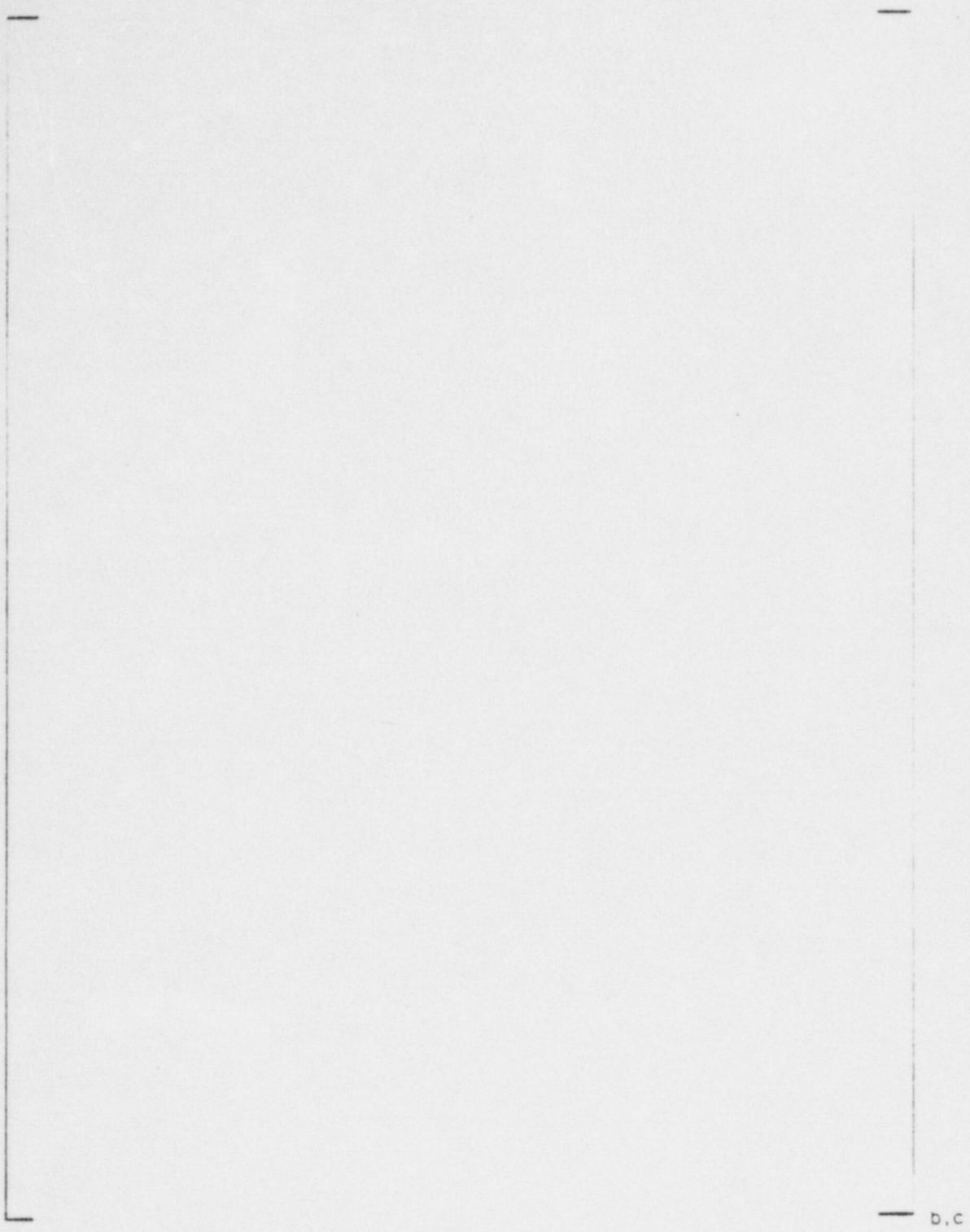


Figure 4-22. Block Diagram of Radio Frequency Interference Keying Tests

SECTION 5

TEST SETUP AND MONITORING

5.1 TEST SETUP

The test setup consisted of a Remote Processing Unit (RPU) and a Database Processing Unit (DPU) housed in a split-bay cabinet. Field cables (bundled) were routed to a patch panel. The analog signals were taken from the patch panel and fed into a digital data logger, and through a buffer amplifier to a tape recorder. Figure 5-1 shows the cabinet and field cable setup. Figure 5-2 shows the test equipment setup (patch panel, tape recorder, data logger and noise sources). Refer also to Figure 2-3 in Section 2, which shows system hardware and field cable connections, including the data acquisition and monitoring system.

5.1.1 System Connections

System connections throughout the test were implemented via the patch panel. Some of the input/output signals from the system I/O boards were routed normally; those that were always considered to be isolated were routed through flexible metal conduits inside the cabinet to junction boxes. The RPU/DPU field connections to the I/O terminations are shown in detail in Appendix E.

The routing configuration and the separation of the field connection cables were implemented according to standard nuclear power plant practices.

Two alternative configurations of the data link boards were used. An RS-422 data link board was installed in TB101, while an RS-422 Encode/Decode data link was installed in TB102. Both boards stayed in place, but the connection to the processor was changed to allow each board to be tested for transmitting and receiving. The rest of the I/O connections remained in place, as described in Section 2, System Configuration.

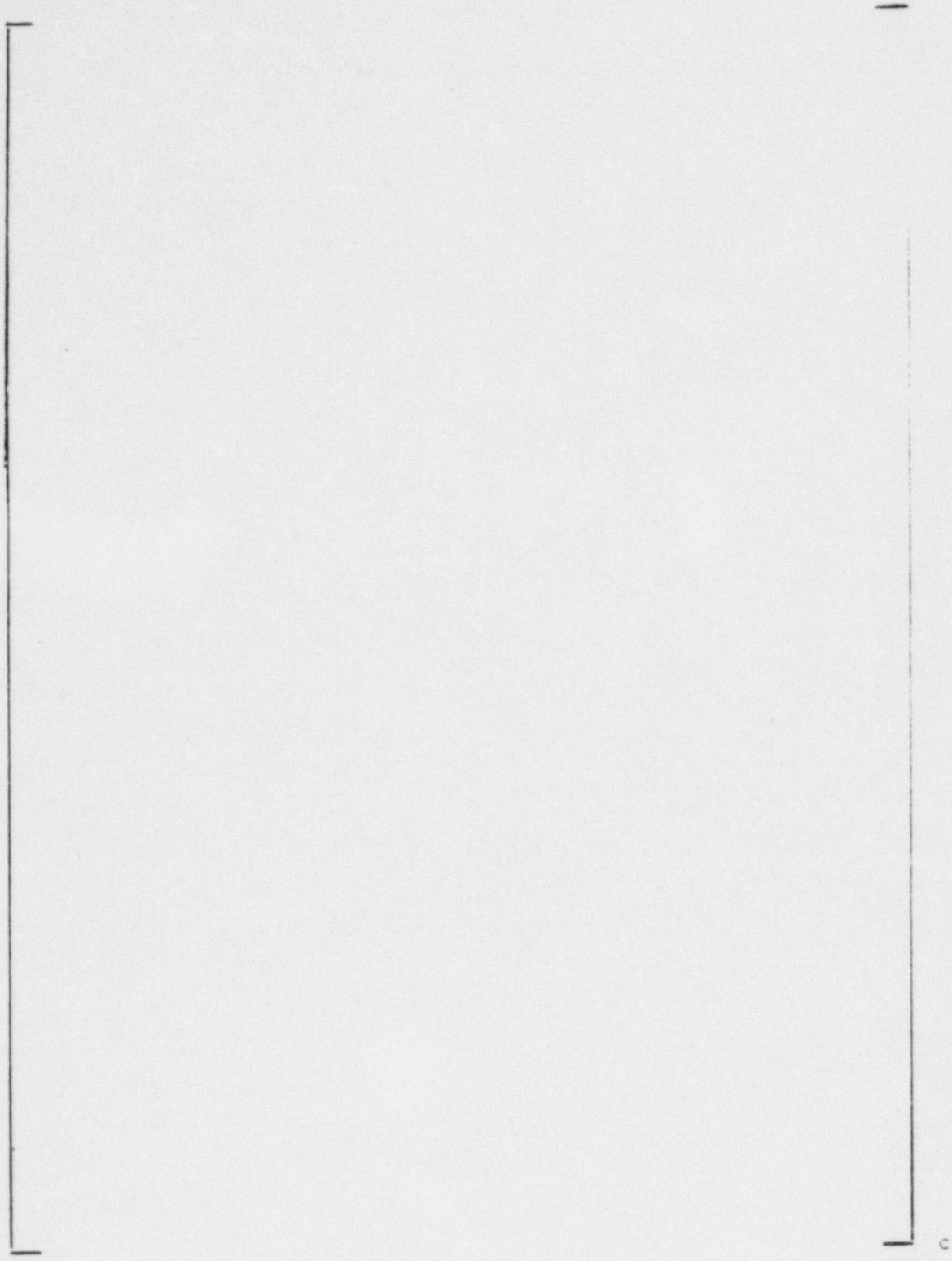


Figure 5-1. Cabinet and Field Cable Setup



Figure 5-2. Noise, Fault, and Surge Test Equipment Setup

5.1.2 Simulated Input Signals

In order to replicate normal system operation, signals representing temperature, pressurizer level, and RHR flow were simulated and input to the RPU. Table 5-1 shows the simulated parameter values. Potentiometers were used to set temperature values; other values were set by fixed resistors. The potentiometers and fixed resistors were mounted on the patch panel. Simulated sensor inputs were adjusted to "normal" milliampere or resistance values for sensors and RTDs, respectively. Contact inputs were single-pole, double-throw switches set to "normal" status. Simulated inputs were retained throughout testing except when that specific field cable was a line-to-line fault injection point. Forty-foot cables connected the patch panel to the I/O terminal connections of the RPU/DPU.

Figure 5-3 shows a simulated sensor input signal for a resistance temperature detector (RTD). Figure 5-4 shows a 4-20 mA transmitter simulator.

5.1.3 Data Acquisition System and Analog Outputs

The data acquisition system provided a record of all analog outputs during each test. The data acquistion system consisted of a tape recorder and a digital data logger. The tape recorder was interfaced to the patch panel through buffer amplifiers. The data logger was connected directly to the panel.

Figure 5-5, 5-6, and 5-7 show the technique used for monitoring analog current loop output, analog output, and digital contact input/output signals.

5.1.3.1 Tape Recorder

A [ ]$_{b,c}$ tape recorder was used to record the outputs of the system. The noise or fault signal was recorded on channel 1; the other channels were used for the system analog I/O (refer to Table 5-2). [

]$_{b,c}$

TABLE 5-1
SIMULATION OF NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB204	FI-417A	100%	0-120%	N/A	8.33 V	Computer set value
TB204	FI-437A	100%	0-120%	N/A	8.33 V	Computer set value
TB205	System alarms	N/A		N/A	N/A	Normally open
TB103 (2, 3)	LT-467 Pressurizer level	56%	0-100%	Fixed resistor	N/A	
TB103 (11, 12)	TE434				4.09 V	
TB103 (16, 17)	PT-406 RCS Wide range pressure	1981 psig	0-3000 psig	Fixed resistor	N/A	16.26 mA
TB103 (26, 27)	TE444				4.09 V	
TB104	TE414 RCS T_c Loop 1	540°F	0-700°F	Potentiometer	4.09 V	411.4 ohm
TB104	TE424 RCS T_c Loop 2	540°F	0-700°F	Potentiometer	4.09V	411.4 ohm
TB105 (2, 3)	LSH7803 Pump 1B Sump H	N/A		Closed contact	N/A	
TB105 (5, 6)	LSHH7803A Pump 1B Sump H.H.	N/A		Closed contact	N/A	
	P4-B Reactor trip switchgear TRN-S	N/A		Closed contact	N/A	

TABLE 5-1 (Cont)
SIMULATION OF NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB106 (2, 3)	PMY-868 RHR temperature	130°F	50° to 400°F	N/A	1.91 V	Computer set value
TB106 (5, 6)	PMY-862 RHR pressure	100 psig	0-700 psig	N/A	1.57 V	Computer set value
TB107	TE434 RCS T_c Loop 3	540°F	0-700°F	Potentiometer	TB103 (11, 12)	411.4 ohm
TB107	TE444 RCS T_c Loop 4	540°F	0-700°F	Potentiometer	TB103 (25, 26)	411.4 ohm
TB108	EN1, 2 and 3	N/A		N/A	Normally open	N/A
TB109	FT868 RHR Pump B flow	464	0-4000	Fixed resistor	1.0 V	4.0 mA

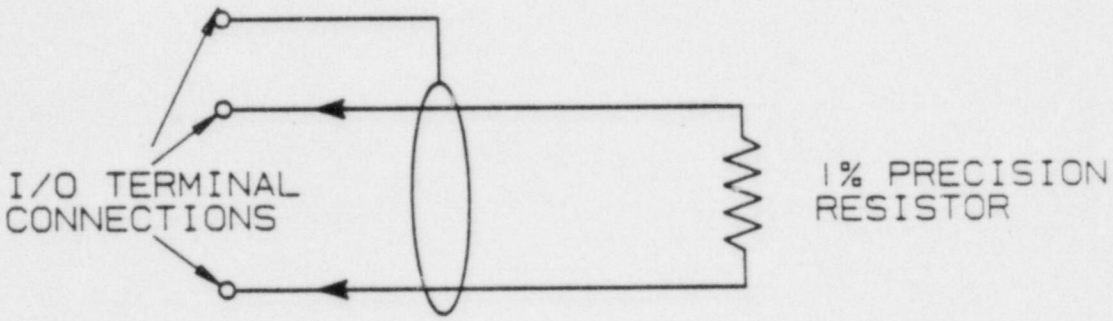


Figure 5-3. 4-20 mA Transmitter Simulator

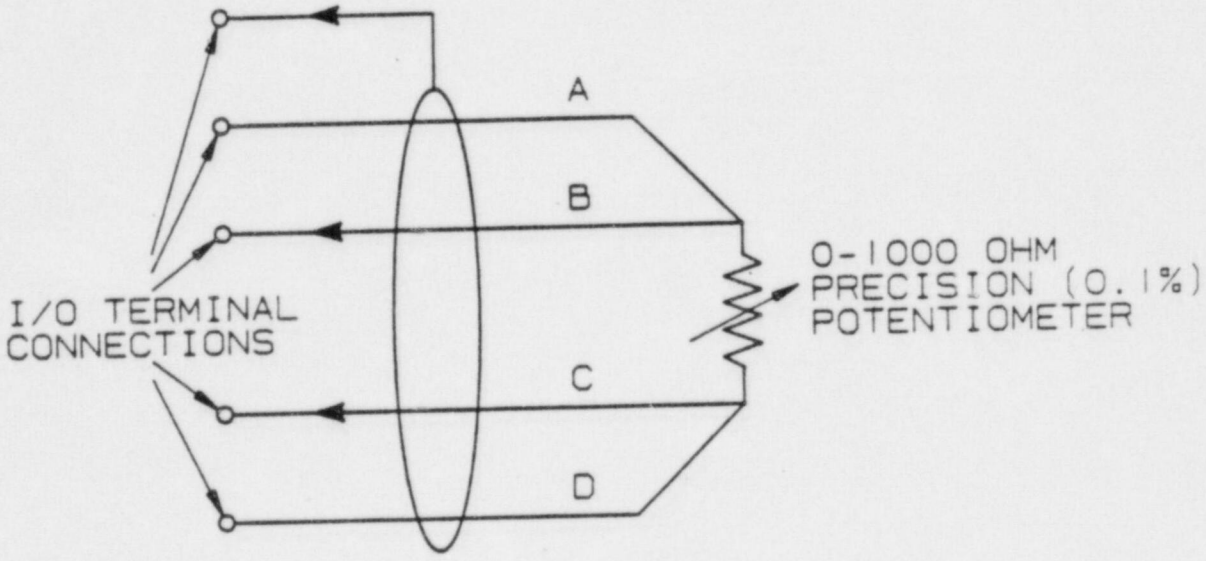


Figure 5-4. Resistance Temperature Detector (RTD)

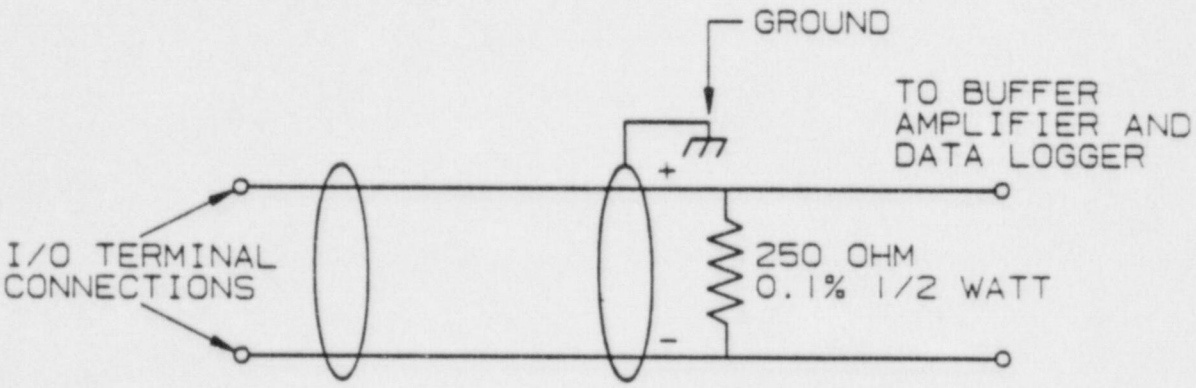


Figure 5-5. 4-20 mA Current Loop Output

TABLE 5-2
TAPE RECORDED DATA

Tape Recorder Channel	Reference I/O Function	TB Connection
1	Noise/source	N/A
[redacted]		

D.C

The differential outputs of the system were fed through buffer amplifiers, which also converted the signals from differential to single ended. Each signal was fed through one buffer amplifier, except the contact input, which was fed through two buffer amplifiers in series for attenuation purposes. Figure 5-6 shows a typical connection for an analog output channel. Figure 5-7 shows the contact output connection to the buffer amplifier.

5.1.3.2 Data Logger

The digital data logger was used for pre-test and post-test verification of analog output status. Prior to each test, it was used to generate a printout for all $[\ ]_{D.C}$ channels to verify that the analog output values were normal. After each test, another printout of the data for all $[\ ]_{D.C}$ channels was generated to verify that the analog signal levels had not changed during testing. These printouts were then attached to the backs of the data sheets. The data logger was not connected during testing.

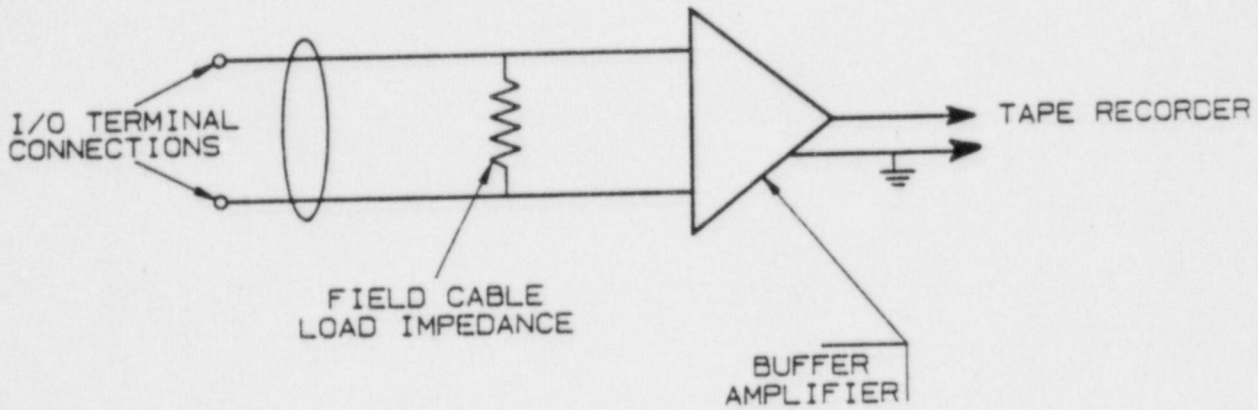


Figure 5-6. Analog Output Channel Recording

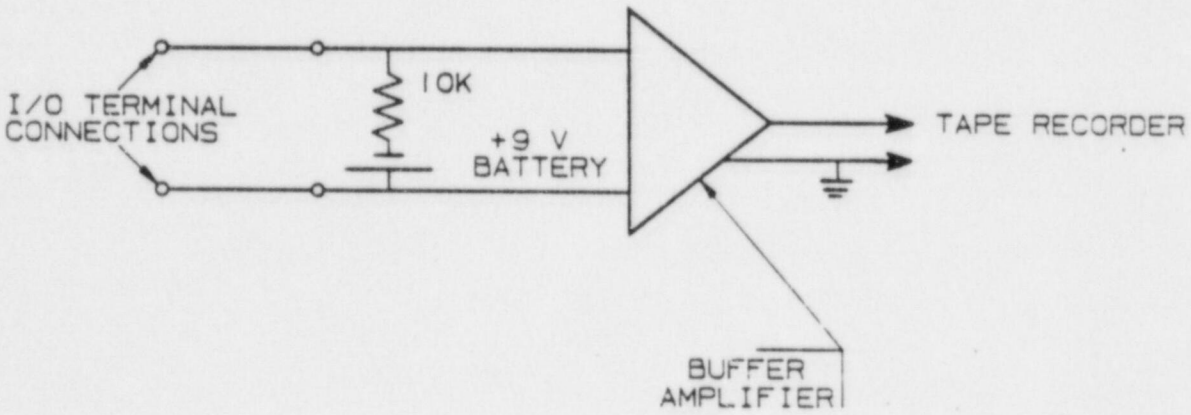


Figure 5-7. Contact Output Connection

5.2 TEST MONITORING

The tests were monitored in accordance with the acceptance criteria outlined in Section 6. The system display, data link tester and analog ouput signals were monitored to ensure that the system and its input/ouput remained functional and accurate throughout the noise, fault, surge and radio frequency interference testing.

The tape recorder was run 2 minutes prior to testing, 2 minutes during noise or fault, application, and 2 minutes after testing. The recorded outputs were monitored and all observed effects were noted on data sheets. Information specified on the data sheets included the type of test performed, the beginning and end of the recording footage, where the noise or fault was applied, and remarks and test observations. Figure 5-8 shows a sample noise test data sheet; Figure 5-9 shows a sample fault test data sheet; Figure 5-9A shows a sample surge test data sheet.

Log sheets were also kept during testing. The log sheets showed the test set, date, and time; the beginning and end of the recording footage; and the gain and frequency setting for each buffer amplifier. Figure 5-10 shows a sample log sheet. The data sheets and log sheets were compared to ensure the accuracy of the record keeping.

5.2.1 Display Monitoring

The system display module was used to monitor all simulated signals, the status of the RPU and the DPU, and the status of the RPU/DPU and DPU/display data links. The display pages were checked before and after testing to ensure that the noise, fault, surge and radio frequency interference did not affect the simulated input or propagate through the system.

The actual values of the simulator signals appeared on the following display pages selected from the Detail Data Menu:

- PAGE 1 PRIMARY DATA -- This display showed PT406 wide range pressure; TE414 wide range temperature loop 1; TE424 wide range temperature loop 2, TE434 wide range temperature loop 3; and TE444 wide range temperature loop 4 (Figure 5-11).

- PAGE 3 PRIMARY DATA -- This display showed LT467 pressurizer level (Figure 5-12).

- PAGE 8 CCW, RHR DATA -- This display showed FT868 Residual Heat Removal flow (Figure 5-13).

The status of the RPU and DPU appeared on the following display pages selected from the Diagnostic Summary Menu:

- PAGE 2 DPU STATUS -- This display showed the hardware and software status of the DPU (Figure 5-14).

- PAGE 3 APC-1 STATUS -- This display showed the hardware and software status of the RPU (Figure 5-15).

The status of the RPU/DPU and the DPU/display data links appeared on the bottom of each page of the display.

5.2.2 Data Link Tester

The data link tester was used to monitor the RPU/DPU data link and the RPU/ERF (Emergency Response Facility) data link. The data link tester also provided the capability to monitor the real time clock link between the RPU and DPU and to monitor the contact input simulated signal. These capabilities were not available on the system display.

5.2.3 Analog Output

The analog output signals were monitored during the entire test using a digital voltmeter. This ensured that the accuracy of the output had not degraded during testing.

Procedure Rev. _____
Date _____
Test # _____

TYPE

SHORT CIRCUIT _____, AC _____, DC _____

COMMON MODE _____ GROUND CONNECTED TO VOLTS PLUS _____ MINUS _____ GROUND

LINE TO LINE _____ VOLTS (+) TO (+) _____ (+) TO (-) _____
VOLTS (-) TO (+) _____ (-) TO (-) _____

I/O MODULES TB _____ TYPE _____ POINT _____

PRE-TEST

DATA LOGGER CALIBRATION VERIFICATION

REMARKS _____

_____

DISCONNECT DATA LOGGER _____

TAPE RECORDER FOOTAGE BEGIN _____ END _____ SET # _____

DISPLAY PAGE _____

RTC BYTE _____ CONTACT #1 IN BYTE _____ #2 _____

CRT OBSERVATION POINTS _____

TEST OBSERVATIONS:

_____

_____

_____

POST-TEST OBSERVATIONS (DISPLAY AND STATUS):

_____

_____

_____

POST-TEST DATA LOGGER CALIBRATION VERIFICATION:

_____

_____

_____

_____

PERFORMED _____ VERIFIED _____

Figura 5-8. Fault Test Data Sheet

Procedure Rev. _____
Date: _____
Test #: _____

TYPE

RANDOM NOISE _____ MIL N10099 #1 _____
CROSSTALK NOISE _____ MIL N19900 #2 _____
SURGE TRANSIENT _____
TEST INJECTION POINT TB# _____ TYPE _____ POINT # _____ DRAWING _____
CONFIGURATION TABLE A1 _____ A2 _____

PRE-TEST

DATA LOGGER DATA VERIFICATION* PRINT OUTPUT # _____
SYSTEM STATUS: DPU _____ RPU _____ DISPLAY _____ DATA LINK _____
DISPLAY TYPE VALUE PAGE 1 PT406 ___ TE414 ___ TE424 ___ TE434 ___ TE444 ___
PAGE 3 LT467 ___ PAGE 8 FT868 ___
DATA LINK DATA BYTE RTC _____ CONTACT #1 _____ & #2 _____
REMARKS AND TEST OBSERVATION _____

DISCONNECT DATA LOGGER _____

TEST

TAPE RECORDER FOOTAGE BEGIN _____ END _____ SET # _____
SPEED _____ TIME _____
SYSTEM STATUS: DPU _____ RPU _____ DISPLAY _____ DATA LINK _____
DISPLAY TYPE VALUE PAGE 1 PT406 ___ TE414 ___ TE424 ___ TE434 ___ TE444 ___
PAGE 3 LT467 ___ PAGE 8 FT868 ___
DATA LINK DATA BYTE RTC _____ CONTACT #1 _____ & #2 _____
REMARKS AND TEST OBSERVATION _____

POST-TEST

DATA LOGGER DATA VERIFICATION* PRINT OUTPUT # _____
SYSTEM STATUS: DPU _____ RPU _____ DISPLAY _____ DATA LINK _____
DISPLAY TYPE VALUE PAGE 1 PT406 ___ TE414 ___ TE424 ___ TE434 ___ TE444 ___
PAGE 3 LT467 ___ PAGE 8 FT868 ___
DATA LINK DATA BYTE RTC _____ CONTACT #1 _____ & #2 _____
REMARKS AND TEST OBSERVATION _____

PERFORMER _____ VERIFIER _____

NOTE:

Figure 5-9. Noise Test Data Sheet

Procedure Rev. ____

TYPE

NORMAL MODE _____

COMMON MODE _____ I/O CARD TYPE _____ P/N _____

TB CONNECTION _____

PRE TEST

DATA LOGGER VERIFICATION

REMARKS _____

_____

_____

DISCONNECT DATA LOGGER _____

TAPE RECORDER FOOTAGE BEGIN _____ END _____

DISPLAY PAGE _____

RTC BYTE _____ CONTACT #1 IN BYTE _____ #2 _____

CRT OBSERVATION POINTS _____

TEST OBSERVATIONS:

_____

_____

_____

_____

POST TEST OBSERVATIONS (DISPLAY AND STATUS):

_____

_____

_____

POST TEST DATA LOGGER VERIFICATION:

_____

_____

_____

_____

PERFORMER _____ VERIFIER _____

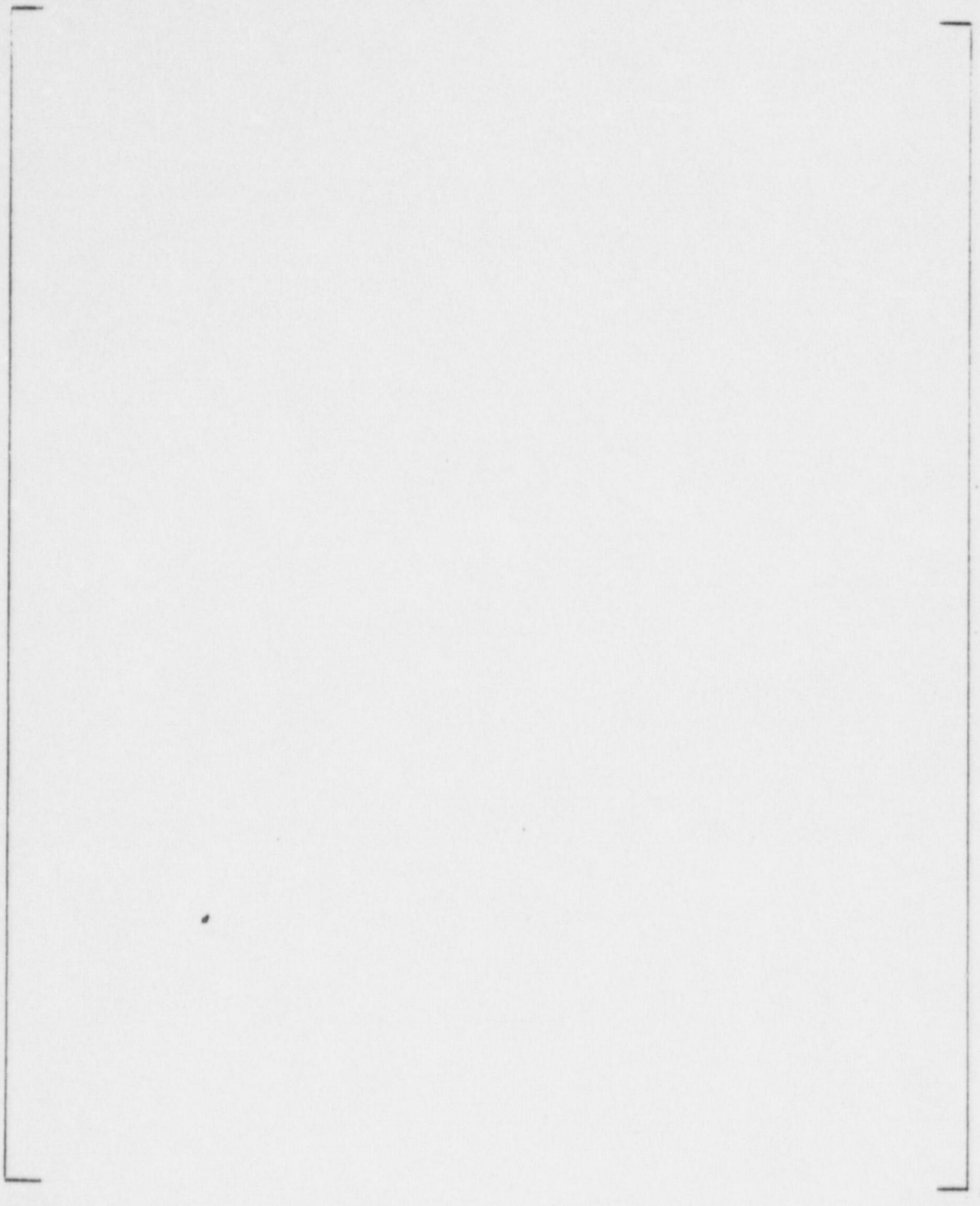
Figure 5-9A. Surge Test Data Sheet



Figure 5-10. Tape Recorder Log Sheet



Figure 5-11. Page 1 Primary Data

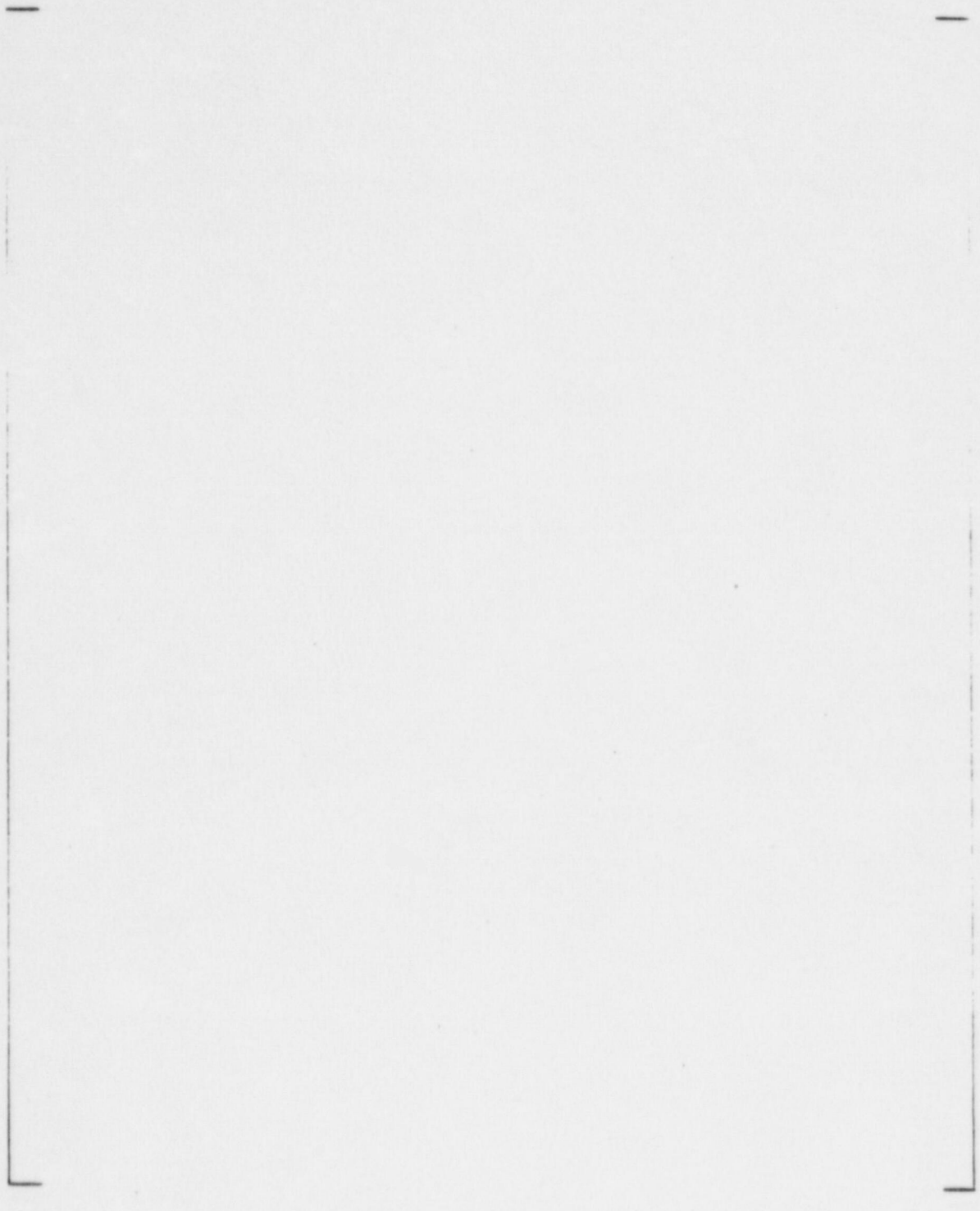


a,b,c

Figure 5-12. Page 3 Primary Data



Figure 5-13. Page 8 CCW and RHR Data



a.b.c

Figure 5-14. Page 2 DPU Status



Figure 5-15. Page 3 RPU Status

SECTION 6

ACCEPTANCE CRITERIA

6.1 DESCRIPTION

The general acceptance criterion for the 1E safety-related system is that the system shall remain operational in the event of credible noise or fault injected from the non-1E isolated wiring or to the terminal connection of the I/O board. Specific acceptance criteria for the noise and fault, surge withstand and radio frequency interference tests are defined in the following paragraphs.

6.1.1 Noise and Fault Acceptance Criteria

The system shall continue to operate with proper data transfer and within the specified accuracy during noise and fault testing. No channels in trains other than the train in which the noise or fault is injected shall be affected. For example, when applying the test signal to an isolated output, the 1E input shall not be affected. When applying the test signal to a non-1E input, the 1E inputs and outputs of the system shall not be affected.

6.1.2 Surge Withstand Acceptance Criteria

The system shall continue to operate with the proper data transfer and within the specified accuracy during surge withstand testing. No channel in the same or other train, including the channel being surged, shall be affected, with the exception of surge application to a data link channel, in which case the data flow may stop until the surge is removed.

6.1.3 Radio Frequency Interference Acceptance Criteria

The system shall continue to operate with proper data transfer and within the specified accuracy at an RF field of 3 V/m over the frequency band of 20 MHz to 1 GHz with cabinet doors closed.

SECTION 7
TEST RESULTS

7.1 DESCRIPTION

The results of the system noise and fault tests are based on the acceptance criteria defined in Section 6. The observations of the display, the data link tester, and the analog signal recording before, during, and after each noise and fault test showed no effect on the continuous operation of the RPU, DPU, display or input/output signals (analog/digital). Tables 7-1 through 7-5 show the results for each type of I/O and display subjected to the tests. The following is a detailed description of the noise and fault test results.

7.2 NOISE AND FAULT TEST RESULTS

7.2.1 Noise Test Results

7.2.1.1 Random Noise Test Results

No effects were observed on the system performance during the test. Refer to Table 7-1 for compliance to passed/failed criteria and to Table A-1 for test effects.

7.2.1.2 Crosstalk Noise -- Chattering Relays

7.2.1.2.1 Ac Chattering Relay

No effects were observed on the system performance during the test. Refer to Table 7-1 for compliance to passed/failed criteria and to Table A-2 for test effects.

7.2.1.2.2 Dc Chattering Relay

No effects were observed on the performance of the system I/O and processors during the test. [ ]$_{D.C}$ Refer to Table 7-1 for compliance to passed/failed criteria and to Table A-3 for test effects.

7.2.1.3 Military Specification Noise

7.2.1.3.1 Noise Source No. 1

No effects were observed on the system performance during the test. Refer to Table 7-1 for compliance to passed/failed criteria and to Table A-4 for test effects.

7.2.1.3.2 Noise Source No. 2

No effects were observed on the system performance during the test. Refer to Table 7-1 for compliance to passed/failed criteria and to Table A-5 for test effects.

7.2.1.4 High Voltage Transient Noise

No effects were observed on the performance of the system I/O and processors during the test. [ ]$_{D.C}$ Refer to Table 7-1 for compliance to passed/failed criteria and to Table A-6 for test effects.

7.2.2 Fault Test Results

7.2.2.1 Short Circuit Fault

No effects were observed on the system performance during the test. Refer to Table 7-3 for compliance to passed/failed criteria and to Table A-10 for test effects.

7.2.2.2 Common Mode Fault

7.2.2.2.1 250 Vdc

No effects were observed on the system performance during the test. Refer to Table 7-3 for compliance to passed/failed criteria and to Table A-11 for test effects.

7.2.2.2.2 580 Vac

No effects were observed on the system performance during the test. Refer to Table 7-3 for compliance to passed/failed criteria and to Table A-11 for test effects.

7.2.2.3 Line-to-Line Fault

7.2.2.3.1 Internal Fuse Installed

7.2.2.3.1.1 125 Vac Fault

No effects were observed on the system performance during the test. Refer to Table 7-4 for compliance to passed/failed criteria and to Table A-12 for test effects.

7.2.2.3.1.2 125 Vdc Fault

No effects were observed on the system performance during the test. Refer to Table 7-4 for compliance to passed/failed criteria and to Table A-12 for test effects.

7.2.2.3.1.3 250 Vdc Fault

No effects were observed on the system performance during the test. Refer to Table 7-4 for compliance to passed/failed criteria and to Table A-12 for test effects.

7.2.2.3.1.4 580 Vac Fault

No effects were observed on the system performance during the test. Refer to Table 7-4 for compliance to passed/failed criteria and to Table A-12 for test effects.

7.2.2.3.2 Internal Fuse Shorted

7.2.2.3.2.1 125 Vac Fault

No effects were observed on the system performance during the test. Refer to Table 7-5 for compliance to passed/failed criteria and to Table A-13 for test effects.

7.2.2.3.2.2 125 Vdc Fault

No effects were observed on the system performance during the test. Refer to Table 7-5 for compliance to passed/failed criteria and to Table A-13 for test effects.

7.2.2.3.2.3 250 Vdc Fault

No effects were observed on the system performance during the test. Refer to Table 7-5 for compliance to passed/failed criteria and to Table A-13 for test effects.

7.2.2.3.2.4 580 Vac Fault

No effects were observed on the system performance during the test. Refer to Table 7-5 for compliance to passed/failed criteria and to Table A-13 for test effects.

7.3 SURGE WITHSTAND FAULT TEST RESULTS

7.3.1 Common Mode

No effects were observed on the performance of the system I/O and processors during the test. [

]$_{b,c}$ Refer to Table 7-3 for compliance to passed/failed criteria and to Table A-9 for test effects.

7.3.2 Transverse Mode

No effects were observed on the system performance during the test. Refer to Table 7-3 for passed/failed criteria and to Table A-9 for test effects.

7.4 RADIO FREQUENCY INTERFERENCE TEST RESULTS

7.4.1 Modulation Tests

7.4.1.1 3 V/m Field Strength

7.4.1.1.1 Vertical Polarization

No effects were observed on the system performance during the test. Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-7 for test effects.

7.4.1.1.2 Horizontal Polarization

No effects were observed on the system performance during the test. Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-7 for test effects.

7.4.1.2 10 V/m Field Strength

7.4.1.2.1 Vertical Polarization

The RPU/DPU performed properly during the test except in the range [ ]$_{D,C}$ Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-7 for test implementation and effects.

7.4.1.2.2 Horizontal Polarization

The RPU/DPU performed properly during the test except in the range [ ]$_{D,C}$ The display module performed properly except in the range [ ]$_{D,C}$ Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-7 for test effects.

7.4.1.3 20 V/m Field Strength

7.4.1.3.1 Vertical Polarization

The RPU/DPU performed properly during the test except in the range [ ]$_{D,C}$ Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-7 for test implementation and effects.

7.4.1.3.2 Horizontal Polarization

The RPU/DPU performed properly during the test except in the range [ ]$_{D,C}$ Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-7 for test implementation and effects.

7.4.2 Keying Test

7.4.2.1 3 V/m Field Strength

7.4.2.1.1 Vertical Polarization

No effects were observed on the system performance during the test. Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-8 for test effects.

7.4.2.1.2 Horizontal Polarization

No effects were observed on the system performance during the test. Refer to Table 7-2 for compliance to passed/failed criteria and to Table A-8 for test effects.

7.4.2.2 10 V/m Field Strength

7.4.2.2.1 Vertical Polarization

No effects were observed on the system performance during the test. Refer to Table 7-2 for passed/failed criteria and to Table A-8 for test effects.

7.4.2.2.2 Horizontal Polarization

No effects were observed on the system performance during the test. Refer to Table 7-2 for passed/failed criteria and to Table A-8 for test effects.

TABLE 7-1
NOISE TESTS

I/O Board Description	Random Noise	TST#	Crosstalk Noise AC	TST#	Crosstalk Noise DC	TST#	Military Specification Noise Source #1	TST#	Military Specification Noise Source #2	TST#	High Voltage Transient Noise	TST#
1. RS422 Data link (transmit)	Passed	N104	Passed	N102	Passed	N101	Passed	N57	Passed	N42	Passed	N103
2. RS422 Data link (receive)	Passed	N34	Passed	N17	Passed	N75	Passed	N66	Passed	N50	Passed	N95
3. Encode/Decode RS422 Data link (transmit)												
3a. baud rate 19.2 K	Passed	N32	Passed	N12	Passed	N79	Passed	N65	Passed	N49	Passed	N92
3b. baud rate 800 K	Passed	N29	Passed	N13	Passed	N77	Passed	N62	Passed	N46	Passed	N89
4. Encode/Decode RS422 Data link (receive)												
4a. baud rate 19.2 K	Passed	N100	Passed	N98	Passed	N97	Passed	N58	Passed	N43	Passed	N99
4b. baud rate 800 K	Passed	N30	Passed	N14	Passed	N76	Passed	N63	Passed	N47	Passed	N90
5. Appendix R current loop input	Passed	N19	Passed	N2	Passed	N67	Passed	N51	Passed	N35	Passed	N81
6. Appendix R RTD	Passed	N20	Passed	N3	Passed	N69	Passed	N52	Passed	N36	Passed	N82
7. Digital contact input	Passed	N21	Passed	N4	Passed	N73	Passed	N53	Passed	N37	Passed	N87
8. 4-20 mA current loop output	Passed	N22	Passed	N5	Passed	N70	Passed	N54	Passed	N38	Passed	N83
9. Digital contact output												
9a. Normally closed	Passed	N24	Passed	N6	Passed	N71	Passed	N55	Passed	N39	Passed	N85
9b. Normally open	Passed	N25	Passed	N7	Passed	N72	Passed	N56	Passed	N40	Passed	N86
10. Appendix R current loop input (repeater)	Passed	N23	Passed	N16	Passed	N68	Passed	N59	Passed	N41	Passed	N84
11. High voltage level output	Passed	N28	Passed	N15	Passed	N74	Passed	N60	Passed	N44	Passed	N94
12. *[												] b,c

* = Special Nonrequired Test
NOTE: 1.[
2.[ ] b,c

TABLE 7-2
RADIO FREQUENCY INTERFERENCE
NOISE TEST

		Modulation Test						Keying Test					
		Vertical Polarization			Horizontal Polarization			Vertical Polarization			Horizontal Polarization		
		Frequency Band			Frequency Band			Frequency Band			Frequency Band		
		a	b	c	a	b	c	a	b	c	a	b	c
Class 1 3 V/m	Cabinet processor and I/O	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed
	System display module	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed	Passed
Class 2 10 V/m	Cabinet processor and I/O	OK	OK/ Except [ ] b,c	OK	OK	OK/ Except [ ] b,c	OK	OK	OK	OK	OK	OK	OK
	System display module	OK/ Except [ ] b,c	OK	OK	OK	OK/ Except [ ] b,c	OK	OK	OK	OK	OK	OK	OK
Class 3 20 V/m	Cabinet processor and I/O	N/T	OK 160-300 MHz	OK 300-500 MHz	OK	OK/ except [ ] b,c	OK 300-500 MHz	N/T	N/T	N/T	N/T	N/T	N/T
	System display module	N/T	N/T	N/T	N/T	N/T	N/T	N/T	N/T	N/T	N/T	N/T	N/T

Frequency band

a = 20 MHz - 50 MHz
b = 50 MHz - 300 MHz
c = 300 MHz - 1 GHz

N/T = Not Tested

TABLE 7-3
FAULT TESTS

Description	Surge Withstand: Common Mode TST#	Surge Withstand: Transverse Mode TST#	Short Circuit TST#	250 dc Common Mode: - PS to GND, + PS to I/O: Into H TST#	250 dc Common Mode: - PS to GND, + PS to I/O: Into L TST#	250 dc Common Mode: + PS to GND, - PS to I/O: Into H TST#	250 dc Common Mode: + PS to GND, - PS to I/O: Into L TST#	580 Vac Common Mode: Neutral to GND, Hot to I/O: Into H TST#	580 Vac Common Mode: Neutral to GND, Hot to I/O: Into L TST#
1. RS422 Data link output (transmit)	Passed S42	Passed S41	Passed SH10	Passed C42	Passed C43	Passed C44	Passed C45	Passed C68	Passed C69
2. RS422 Data link (receive)	Passed S39	Passed S40	Passed SH10A	Passed C246	Passed C247	Passed C248	Passed C249	Passed C74	Passed C75
3. Encode/Decode RS422 Data link (transmit)	Passed S38	Passed S37	Passed SH9	Passed C244	Passed C245	Passed C242	Passed C243	Passed C72	Passed C73
4. Encode/Decode RS422 Data link (receive)	Passed S43	Passed S44	Passed SH9	Passed C46	Passed C47	Passed C48	Passed C49	Passed C70	Passed C71
5. Appendix R current loop input									
5a - (output)	Passed S10	Passed S9	Passed SH2	Passed C15	Passed C16	Passed C17	Passed C18	Passed C55	Passed C56
5b - (output)	Passed S11	Passed S112	N/R	N/R	N/R	N/R	N/R	N/R	N/R
6. Appendix R RTD									
6a - output	Passed S3	Passed S4	Passed SH3	Passed C20	Passed C21	Passed C22	Passed C23	Passed C57	Passed C58
6b - exitation	Passed S6	Passed S5	N/R	N/R	N/R	N/R	N/R	N/R	N/R
6c - sense	Passed S7	Passed S8	N/R	N/R	N/R	N/R	N/R	N/R	N/R
7. Digital contact input	Passed S14	Passed S13	Passed SH8	Passed C24	Passed C25	Passed C26	Passed C27	Passed C59	Passed C60
8. 4-20 mA current loop output	Passed S2	Passed S1	Passed SH4	Passed C28	Passed C29	Passed C30	Passed C31	Passed C61	Passed C62
9. Digital contact output									
9a - Normally closed	Passed S15	Passed S16	Passed SH6	Passed C32	Passed C33	Passed C34	Passed C35	Passed C63	Passed C65
9b - Normally open	Passed S18	Passed S17	Passed SH7	Passed C36	Passed C37	Passed C38	passed C39	Passed C64	Passed C65
10. Appendix R current loop input (repeater)									
10a - output	Passed S19	Passed S20	Passed SH5	Passed C40	Passed C41	Passed C38	Passed C39	Passed C66	Passed C67
10b - input	Passed S22	Passed S21	N/R	N/R	N/R	N/R	N/R	N/R	N/R

N/R = Not Required

TABLE 7-3 (CONT)
FAULT TESTS

Description	Surge Withstand: Common Mode	TST#	Surge Withstand: Transverse Mode	TST#	Short Circuit	TST#	250 dc Common Mode: - PS to GND / + PS to I/O: Into H	TST#	Into L	TST#	250 dc Common Mode: + PS to GND / - PS to I/O: Into H	TST#	Into L	TST#	580 Vac Common Mode: Neutral to GND / Hot to I/O: Into H	TST#	Into L	TST#
11. High level voltage output	Passed	S24	Passed	S25	Passed	SH1	Passed	C11	Passed	C12	Passed	C13	Passed	C4	Passed	C53	Passed	C54
12. • [																	] b,c	
13. Appendix R current loop input (test injection)	Passed	S27	Passed	S28	Passed	SH78	Passed	C81	Passed	C82	Passed	C79	Passed	C80	Passed	C76	Passed	C77
14. Appendix R current loop input (test interlock)	Passed	S30	Passed	S29	Passed	S89	Passed	C85	Passed	C86	Passed	C83	Passed	C84	Passed	C87	Passed	C88
15. Appendix R RTD (Test injection)																		
15a - exitation	Passed	S31	Passed	S32	Passed	SH90	Passed	C100	Passed	C101	Passed	C96	Passed	C97	Passed	C92	Passed	C93
15b - sense	Passed	S34	Passed	S33	Passed	SH91	Passed	C102	Passed	C103	Passed	C98	Passed	C99	Passed	C94	Passed	C95
16. Appendix R RTD (test interlock)	Passed	S35	Passed	S36	Passed	SH110	Passed	C106	Passed	C107	Passed	C104	Passed	C105	Passed	C108	Passed	C109
17. Ac power line																		
17a - cabinet	Passed	S48	Passed	S47	N/R		N/R		N/R		N/R		N/R		N/R		N/R	
17b - display	Passed	S50	Passed	S49	N/R		N/R		N/R		N/R		N/R		N/R		N/R	

• = Special Nonrequired Test
N/R = Not Required

NOTE: 1 [ ]b,c

TABLE 7-4
LINE-TO-LINE FAULT FUSE INSTALLED

Description	125 ac	TST #	125 Vdc GND Connected to P.S. Positive	TST #	125 Vdc GND Connected to P.S. Negative	TST #	250 Vdc GND Connected to P.S. Positive	TST #	250 Vdc GND Connected to P.S. Negative	TST #	580 Vac GND Connected to Neutral	TST #
1. RS422 Data link (transmit)	Passed	L175	Passed	L173	Passed	L171	Passed	L188	Passed	L186	Passed	L190
2. RS422 Data link (receive)	Passed	L120	Passed	L136	Passed	L137	Passed	L156	Passed	L157	Passed	L169
3. Encode/Decode RS422 Data link (transmit)	Passed	L119	Passed	L135	Passed	L138	Passed	L155	Passed	L158	Passed	L168
4 Encode/Decode RS422 Data link (receive)	Passed	L176	Passed	L174	Passed	L172	Passed	L189	Passed	L187	Passed	L191
5. Appendix R Current loop input	Passed	L112	Passed	L160	Passed	L122	Passed	L141	Passed	L142	Passed	L162
6. Appendix R RTD	Passed	L113	Passed	L124	Passed	L123	Passed	L144	Passed	L143	Passed	L163
7. Digital contact input	Passed	L114	Passed	L125	Passed	L126	Passed	L145	Passed	L146	Passed	L164
8. 4-20 mA current loop output	Passed	L115	Passed	L128	Passed	L127	Passed	L148	Passed	L147	Passed	L165
9. Digital contact output												
9a-Normally closed	Passed	L116	Passed	L129	Passed	L131	Passed	L150	Passed	L151	Passed	L167
9b-Normally opened	Passed	L117	Passed	L130	Passed	L132	Passed	L149	Passed	L152	Passed	L166
10. Appendix R current loop input (repeater)	Passed	L118	Passed	L134	Passed	L133	Passed	L154	Passed	L153	Passed	L170

TABLE 7-4 (CONT)
LINE-TO-LINE FAULT FUSE INSTALLED

Description	125 ac	TST #	125 Vdc GND Connect to P.S. Positive	TST #	Negative	TST #	250 Vdc GND Connect to P.S. Positive	TST #	Negative	TST #	580 Vac GND Connected to Neutral	TST #
11. High level voltage output	Passed	L111	Passed	L159	Passed	L121	Passed	L140	Passed	L139	Passed	L161
12A. Encode/Decode RS422 Data Link** (I/O BOARD)	Passed	L233	Passed	L241	Passed	L234	N/R*		N/R		N/R	
13. Appendix R current loop input (test injection)	Passed	L235	Passed	L178	Passed	L177	N/R		N/R		N/R	
14. Appendix R current loop input (test interlock)	Passed	L236	Passed	L179	Passed	L180	N/R		N/R		N/R	
15. Appendix RTD (test injection)												
15a-excitation	Passed	L238	Passed	L182	Passed	L182	N/R		N/R		N/R	
15b-sense	Passed	L239	Passed	L185	Passed	L183	N/R		N/R		N/R	
16. Appendix R RTD (test interlock)	Passed	L237	Passed	L240	Passed	L181	N/R		N/R		N/R	

*N/R = Not Required

**These fault tests were performed on a separate data link board transmit channel connected as Train C to the display module. Faults from a postulated source inside the Train C DPU were tested. Maximum credible fault voltages of 125 Vac and 125 Vdc were assumed. The faults were applied directly to the isolation barrier components (optical isolators) for worst case conditions.

TABLE 7-5
LINE-TO-LINE FAULT FUSE SHORTED

I/O Board Description	125 Vdc	TST #	125 Vac	TST #	250 Vdc	TST #	580 Vac	TST #
1. RS422 Data link transmit	Passed	L201	Passed	L209	Passed	L216	Passed	L223
2. RS422 Data link receive	Passed	L228	Passed	L226	Passed	L230	Passed	L232
3. Encode/Decode RS422 Data link (transmit)	Passed	L227	Passed	L225	Passed	L229	Passed	L231
4. Encode/Decode RS422 Data link (receive)	Passed	L200	Passed	L210	Passed	L217	Passed	L224
5. Appendix R current loop input	Passed	L198	Passed	L206	N/R*		N/R	
6. Appendix R RTD	Passed	L199	Passed	L207	N/R		N/R	
7. Digital contact input	Passed	L193	Passed	L203	Passed	L212	Passed	L219
8. 4-20 mA Current loop output	Passed	L197	Passed	L204	Passed	L213	Passed	L220
9. Digital contact output								
9a-Normally closed	Passed	L195	Passed	L208	Passed	L215	Passed	L222
9b-Normally open	Passed	L196	Passed	L205	Passed	L214	Passed	L221
10. Appendix R current loop input	N/R		N/R		N/R		N/R	
11. High voltage level output	Passed	L192	Passed	L202	Passed	L211	Passed	L218
12A. Encode/Decode RS422 Data link (I/O BOARD)	N/R		N/R		N/R		N/R	

*N/R = Not Required

NOTE: The negative line of the dc power supply was connected to the negative terminal during the line-to-line fuse shorted test.

TABLE 7-5 (CONT)
LINE-TO-LINE FAULT FUSE SHORTED

I/O Board Description	125 Vdc TST #	125 Vac TST #	250 Vdc TST #	580 Vac TST #
13. Appendix R current loop input (test injection)	N/R	N/R	N/R	N/R
14. Appendix R current loop input (test interlock)	N/R	N/R	N/R	N/R
15. Appendix RTD (test injection)				
15a-excitation	N/R	N/R	N/R	N/R
15b-sense	N/R	N/R	N/R	N/R
16. Appendix R RTD (test interlock)	N/R	N/R	N/R	N/R

SECTION 8
CONCLUSION

The evidence in this report shows that the system remained functional within its specified accuracy, and met the acceptance criteria of isolation between the Class 1E safety instrumentation and Non-Class 1E instrumentation.

The test conclusively demonstrated that the system continued to operate when subjected to the following:

- Maximum credible fault voltage of 250 Vdc and 580 Vac
- Maximum continuous fault current of 20 amperes
- Maximum surge withstand capability of 3.3 kV
- Radio frequency interference of 3 V/m field strength in the frequency band 20 MHz to 1 GHz and 10 V/m field strength above 76 MHz to 1 GHz, and 20 V/m field strength above 76 MHz to 500 MHz
- Random noise
- Crosstalk noise - chattering relays
- Military specification noise
- High voltage transient noise

In no case was the performance of the system degraded by abnormal electrical conditions imposed on the isolated input/output field wiring. No changes in the design are necessary. In particular:

- The processors of the RPU, DPU and display continued to operate undisturbed.

- The output to the operator display was continuous and accurate.

- The noise, fault, and surge transients were not propagated through the isolation circuitry or picked up wire to wire.

- The analog and digital (contact input/output) signals to other 1E systems were continuous and accurate.

In summary, the noise, fault, surge, and radio frequency interference test program convincingly demonstrated that the system performance did not degrade even when subjected to abnormal electrical conditions which far exceed those that can be reasonably postulated.

APPENDIX A

LIST OF NOISE, FAULT, SURGE, AND RADIO FREQUENCY INTERFERENCE TESTS

This appendix contains the following tables:

Table	Title
A-1	Random Noise Tests
A-2	AC Crosstalk Noise Tests -- Chattering Relays
A-3	DC Crosstalk Noise Tests -- Chattering Relays
A-4	Military Specification Noise Source #1 Tests
A-5	Military Specification Noise Source #2 Tests
A-6	High Voltage Noise Test
A-7	Radio Frequency Modulation Test
A-8	Radio Frequency Keying Test
A-9	Surge Withstand Fault Tests
A-10	Short Circuit Fault Test
A-11	Common Mode Fault Test
A-12	Line-To-Line Fault Test Fuse Installed
A-13	Line-To-Line Fault Test Fuse Shorted

TABLE A 1
RANDOM NOISE TESTS

TEST NUMBER	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
N19	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
N20	APPENDIX R RTD	TB104-12,13	NO EFFECT
N21	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
N22	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
N23	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
N24	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
N25	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
N26	DIGITAL CONTACT OUTPUT	TB205-8,10	NO EFFECT
N27	DIGITAL CONTACT OUTPUT	TB205-8,9	NO EFFECT
N28	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
N29	RS-422 ENCODE/DECODE DATA LINK	TB203-2,3	NO EFFECT
N30	RS-422 ENCODE/DECODE DATA LINK	TB203-5,6	NO EFFECT
N31	RS-422 ENCODE/DECODE DATA LINK	TB203-16,17	NO EFFECT
N32	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
*N33	DISPLAY	SDWK-C	NO EFFECT
N34	RS-422 DATA LINK	TB101-19,20	NO EFFECT
N34	RS-422 ENCODE/DECODE DATA LINK	TB201-2,3	NO EFFECT
N100	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
N104	RS-422 DATA LINK	TB101-2,3	NO EFFECT

* = Special Nonrequired Test

TABLE A 2

AC CROSSTALK NOISE TESTS - CHATTERING RELAYS

TEST NUMBER	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
N1	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
N2	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
N3	APPENDIX R RTD	TB104-12,13	NO EFFECT
N4	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
N5	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
N6	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
N7	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
N8	DIGITAL CONTACT OUTPUT	TB205-8,10	NO EFFECT
N9	DIGITAL CONTACT OUTPUT	TB205-8,9	NO EFFECT
N10	RS-422 ENCODE/DECODE DATA LINK	TB203-16,17	NO EFFECT
N11	RS-422 ENCODE/DECODE DATA LINK	TB203-16,17	NO EFFECT
N12	RS-422 ENCODE/DECODE	TB102-2,3	NO EFFECT
N13	RS-422 ENCODE/DECODE DATA LINK	TB203-2,3	NO EFFECT
N14	RS-422 ENCODE/DECODE DATA LINK	TB203-5,6	NO EFFECT
N15	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
N16	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
N17	RS-422 DATA LINK	TB101-19,20	NO EFFECT
N17	RS-422 ENCODE/DECODE DATA LINK	TB201-2,3	NO EFFECT
*N18	DISPLAY	SWDK-C	NO EFFECT
N98	RS-422 DATA LINK	TB102-19,20	NO EFFECT
N102	RS-422 DATA LINK	TB101-2,3	NO EFFECT

* = Special Nonrequired Test

TABLE A 3

DC CROSSTALK NOISE TESTS - CHATTERING RELAYS

TEST NUMBER	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
N67	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
N68	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
N69	APPENDIX R RTD	TB104-12,13	NO EFFECT
N70	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
N71	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
N72	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
N73	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
N74	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
N75	RS-422 DATA LINK	TB101-19,20	NO EFFECT
N75	RS-422 ENCODE/DECODE DATA LINK	TB201-2,3	NO EFFECT
N76	RS-422 ENCODE/DECODE DATA LINK	TB203-5,6	NO EFFECT
N77	RS-422 ENCODE/DECODE DATA LINK	TB203-16,17	NO EFFECT
N78	RS-422 ENCODE/DECODE DATA LINK	TB203-2,3	NO EFFECT
N79	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
•[			]
			D,C
N96	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
N97	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
N101	RS-422 DATA LINK	TB101-2,3	NO EFFECT

• = Special Nonrequired Test

TABLE A 4
MILITARY SPECIFICATION
NOISE SOURCE #1 TESTS

TEST NUMBER	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
N51	APPENDIX R CURRENT LOOP INPUT	TB103-11,13	NO EFFECT
N52	APPENDIX R RTD	TB104-12,13	NO EFFECT
N53	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
N54	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
N55	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
N56	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
N57	RS-422 DATA LINK	TB101-2,3	NO EFFECT
N58	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
N59	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
N60	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
*N61	DISPLAY	SWDK-C	NO EFFECT
N62	RS-422 ENCODE/DECODE DATA LINK	TB203-2,3	NO EFFECT
N63	RS-422 ENCODE/DECODE DATA LINK	TB203-5,6	NO EFFECT
N64	RS-422 DATA LINK	TB101-19,20	NO EFFECT
N65	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
N66	RS-422 DATA LINK	TB101-19,20	NO EFFECT
N66	RS-422 ENCODE/DECODE DATA LINK	TB201-2,3	NO EFFECT

* = Special Nonrequired Test

TABLE A 5
MILITARY SPECIFICATION
NOISE SOURCE #2 TESTS

TEST NUMBER	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
N35	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
N36	APPENDIX R RTD	TB104-12,13	NO EFFECT
N37	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
N38	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
N39	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
N40	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
N41	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
N42	RS-422 DATA LINK	TB101-2,3	NO EFFECT
N43	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
N44	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
*N45	DISPLAY	SWDK-C	NO EFFECT
N46	RS-422 ENCODE/DECODE DATA LINK	TB203-2,3	NO EFFECT
N47	RS-422 ENCODE/DECODE DATA LINK	TB203-5,6	NO EFFECT
N48	RS-422 ENCODE/DECODE DATA LINK	TB203-16,17	NO EFFECT
N49	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
N50	RS-422 DATA LINK	TB101-19,20	NO EFFECT
N50	RS-422 ENCODE/DECODE DATA LINK	TB201-2,3	NO EFFECT

* = Special Nonrequired Test

TABLE A-6
HIGH VOLTAGE TRANSIENT NOISE TESTS

TEST NUMBER	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
N81	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
N82	APPENDIX R RTD	TB104-11,12	NO EFFECT
N83	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
N84	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
N85	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
N86	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
N87	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
N88	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
N89	RS-422 ENCODE/DECODE DATA LINK	TB203-2,3	NO EFFECT
N90	RS-422 ENCODE/DECODE DATA LINK	TB203-5,6	NO EFFECT
N91	RS-422 ENCODE/DECODE DATA LINK	TB203-16,17	NO EFFECT
N92	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
* [			] b,c
N94	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
N95	RS-422 DATA LINK	TB101-19,20	NO EFFECT
N95	RS-422 ENCODE/DECODE DATA LINK	TB201-2,3	NO EFFECT
N99	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
N103	RS-422 DATA LINK	TB101-2,3	NO EFFECT

* = Special Nonrequired Test

TABLE A-7
RADIO FREQUENCY MODULATION TESTS

TEST #	FIELD	FREQUENCY BAND	ANTENNA	POLARIZATION	TARGET	TEST EFFECT
RF 1	3 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 2	3 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 3	3 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 4	3 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 5	3 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 6	3 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 7	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET FRONT, DOORS CLOSED	NO EFFECT
RF 8	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RF 9	10 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET FRONT, DOORS CLOSED	NO EFFECT
RF 10	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RF 11	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET SIDE A, DOORS CLOSED	[ ] b,c
RF 12	10 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET SIDE A, DOORS CLOSED	NO EFFECT
RF 13	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET SIDE A, DOORS CLOSED	NO EFFECT
RF 14	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET SIDE A, DOORS CLOSED	NO EFFECT
RF 15	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET SIDE A, DOORS CLOSED	NO EFFECT
RF 16	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET SIDE A, DOORS CLOSED	NO EFFECT
RF 17	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET BACK, DOORS CLOSED	NO EFFECT
RF 18	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET BACK, DOORS CLOSED	NO EFFECT
RF 19	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET BACK, DOORS CLOSED	NO EFFECT
RF 20	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET BACK, DOORS CLOSED	NO EFFECT
RF 21	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET BACK, DOORS CLOSED	[ ] b,c
RF 22	10 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET BACK, DOORS CLOSED	
RF 23	3 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET BACK, DOORS OPEN	NO EFFECT
RF 24	3 V/m	20 - 16C MHZ	BICONICAL	HORZ	CABINET BACK, DOORS OPEN	NO EFFECT
RF 25	3 V/m	160 - 500 MH	LOG PERIODIC	HORZ	CABINET BACK, DOORS OPEN	NO EFFECT
RF 26	3 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET BACK, DOORS OPEN	NO EFFECT
RF 27	3 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET BACK, DOORS OPEN	NO EFFECT
RF 28	3 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET BACK, DOORS OPEN	NO EFFECT
RF 29	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET SIDE B, DOORS CLOSED	NO EFFECT
RF 30	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET SIDE B, DOORS CLOSED	NO EFFECT
RF 31	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET SIDE B, DOORS CLOSED	NO EFFECT
RF 32	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET SIDE B, DOORS CLOSED	NO EFFECT
RF 33	10 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET SIDE B, DOORS CLOSED	[ ] b,c
RF 34	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET SIDE B, DOORS CLOSED	
RF 35	10 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET SIDE B, DOORS OPEN	
RF 36	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET SIDE B, DOORS OPEN	NO EFFECT
RF 37	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET SIDE B, DOORS OPEN	NO EFFECT
RF 38	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET SIDE B, DOORS OPEN	NO EFFECT

TABLE A-7
RADIO FREQUENCY MODULATION TESTS (CONTINUED)

TEST #	FIELD	FREQUENCY BAND	ANTENNA	POLARIZATION	TARGET	TEST EFFECT
RF 39	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET SIDE B, DOORS OPEN	NO EFFECT
RF 40	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET SIDE B, DOORS OPEN	NO EFFECT
RF 41	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 42	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 43	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 44	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 45	10 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET FRONT, DOORS OPEN	[ ] b,c
RF 46	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RF 47	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RF 48	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET FRONT, DOORS CLOSED	NO EFFECT
RF 49	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	CABINET BACK, DOORS OPEN	NO EFFECT
RF 50	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET BACK, DOORS OPEN	NO EFFECT
RF 51	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET BACK, DOORS OPEN	NO EFFECT
RF 52	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET BACK, DOORS OPEN	NO EFFECT
RF 53	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET BACK, DOORS OPEN	NO EFFECT
RF 54	10 V/m	20 - 160 MHZ	BICONICAL	VERT	CABINET BACK, DOORS OPEN	[ ] b,c
RF 55	3 V/m	20 - 160 MHZ	BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RF 56	3 V/m	20 - 160 MHZ	BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RF 57	3 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RF 58	3 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RF 59	3 V/m	500 - 1GHZ	LOG PERIODIC	VERT	DISPLAY, FRONT	NO EFFECT
RF 60	3 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	DISPLAY, FRONT	NO EFFECT
RF 61	3 V/m	500 - 1GHZ	LOG PERIODIC	VERT	DISPLAY, BACK	NO EFFECT
RF 62	3 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	DISPLAY, BACK	NO EFFECT
RF 63	3 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	DISPLAY, BACK	NO EFFECT
RF 64	3 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	DISPLAY, BACK	NO EFFECT
RF 65	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	DISPLAY, BACK	NO EFFECT
RF 66	10 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	DISPLAY, BACK	NO EFFECT
RF 67	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	DISPLAY, BACK	NO EFFECT
RF 68	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	DISPLAY, BACK	NO EFFECT
RF 69	3 V/m	20 - 160 MHZ	BICONICAL	VERT	DISPLAY, BACK	NO EFFECT
RF 70	3 V/m	20 - 160 MHZ	BICONICAL	HORZ	DISPLAY, BACK	NO EFFECT
RF 71	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	DISPLAY, BACK	[ ] b,c
RF 72	10 V/m	20 - 160 MHZ	BICONICAL	VERT	DISPLAY, BACK	

TABLE A-7
RADIO FREQUENCY MODULATION TESTS (CONTINUED)

TEST #	FIELD	FREQUENCY BAND	ANTENNA	POLARIZATION	TARGET	TEST EFFECT	
RF 73	10 V/m	20 - 160 MHZ	BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT	
RF 74	10 V/m	20 - 160 MHZ	BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT	
RF 75	10 V/m	160 - 500 MHz	LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT	
RF 76	10 V/m	500 - 1GHZ	LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT	
RF 77	10 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	DISPLAY, FRONT	[	] b,c
RF 78	10 V/m	500 - 1GHZ	LOG PERIODIC	VERT	DISPLAY, FRONT	NO EFFECT	
RF 79	20 V/m	160 - 500 MHz	LOG PERIODIC	VERT	DISPLAY, FRONT	[	] b,c
RF 81	20 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET, FRONT, DOORS CLOSED	NO EFFECT	
RF 82	20 V/m	160 - 500 MHZ	LOG PERIODIC	VERT	CABINET, FRONT, DOORS OPEN	NO EFFECT	
RF 83	20 V/m	160 - 500 MHZ	LOG PERIODIC	HORZ	CABINET, FRONT, DOORS OPEN	NO EFFECT	
RF 84	20 V/m	20 - 160 MHZ	BICONICAL	HORZ	CABINET, FRONT, DOORS CLOSED	NO EFFECT	

TABLE A-8
RADIO FREQUENCY KEYING TEST

TEST #	FIELD	BAND	ANTENNA	POLARIZATION	TARGET	TEST EFFECT
RFK 1	3 V/m	D.C	LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 2	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 3	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 4	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 5	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 6	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 7	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RFK 8	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RFK 9	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RFK 10	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RFK 11	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RFK 12	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS CLOSED	NO EFFECT
RFK 13	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 14	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 15	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 16	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 17	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 18	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 19	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 19	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 20	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 21	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 22	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 23	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 24	3 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 25	3 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 26	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 27	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 28	3 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 29	3 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 30	3 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 31	3 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 32	3 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 33	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 34	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 35	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 36	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 37	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 38	10 V/m		LOG PERIODIC	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 39	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 40	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 41	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 42	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 43	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT

TABLE A-8
RADIO FREQUENCY KEYING TEST (CONTINUED)

TEST #	FIELD	BAND	ANTENNA	POLARIZATION	TARGET	TEST EFFECT
RFK 44	3 V/m	b,c	LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 45	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 46	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 47	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 48	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 49	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 50	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 51	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 52	3 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 53	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 54	10 V/m		LOG PERIODIC	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 55	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 56	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 57	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 58	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 59	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 60	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 61	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 62	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 63	3 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 64	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 65	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 66	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 67	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 68	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 69	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 70	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 71	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 72	10 V/m		BICONICAL	VERT	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 73	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 74	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 75	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 76	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 77	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 78	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 79	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 80	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 81	3 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 82	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 83	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 84	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 85	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 86	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 87	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT

TABLE A-8
RADIO FREQUENCY KEYING TEST (CONTINUED)

TEST #	FIELD	BAND	ANTENNA	POLARIZATION	TARGET	TEST EFFECT
RFK 88	10 V/m	D.C	BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 89	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 90	10 V/m		BICONICAL	HORZ	CABINET FRONT, DOORS OPEN	NO EFFECT
RFK 91	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 92	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 93	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 94	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 95	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 96	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 97	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 98	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 99	3 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 100	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 101	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 102	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 103	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 104	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 105	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 106	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 107	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 108	10 V/m		BICONICAL	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 109	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 110	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 111	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 112	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 113	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 114	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 115	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 116	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 117	3 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 118	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 119	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 120	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 121	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 122	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 123	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 124	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 125	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 126	10 V/m		BICONICAL	VERT	DISPLAY, FRONT	NO EFFECT
RFK 127	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 128	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 129	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 130	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 131	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT

TABLE A-8
RADIO FREQUENCY KEYING TEST (CONTINUED)

TEST #	FIELD	BAND	ANTENNA	POLARIZATION	TARGET	TEST EFFECT
RFK 132	3 V/m	[	LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 133	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 134	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 135	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 136	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 137	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 138	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 139	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 140	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 141	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 142	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 143	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 144	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 145	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 146	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 147	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 148	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 149	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 150	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 151	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 153	3 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 153	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 154	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 155	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 156	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 157	10 V/m		LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT
RFK 158	10 V/m	] b,c	LOG PERIODIC	HORZ	DISPLAY, FRONT	NO EFFECT

TABLE A-9
SURGE WITHSTAND FAULT TESTS

TEST #	TEST MODE	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
S 1	TRANS	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
S 2	COM	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
S 3	COM	APPENDIX R RTD	TB104-11,12	NO EFFECT
S 4	TRANS	APPENDIX R RTD	TB104-11,12	NO EFFECT
S 5	TRANS	APPENDIX R RTD	TB104-4,5	NO EFFECT
S 6	COM	APPENDIX R RTD	TB104-4,5	NO EFFECT
S 7	COM	APPENDIX R RTD	TB104-2,3	NO EFFECT
S 8	TRANS	APPENDIX R RTD	TB104-2,3	NO EFFECT
S 9	TRANS	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
S10	COM	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
S11	COM	APPENDIX R CURRENT LOOP INPUT	TB103-2,3	NO EFFECT
S12	TRANS	APPENDIX R CURRENT LOOP INPUT	TB103-2,3	NO EFFECT
S13	TRANS	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
S14	COM	DIGITAL CONTACT INPUT	TB105 5,6	NO EFFECT
S15	COM	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
S16	TRANS	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
S17	TRANS	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
S18	COM	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
S19	COM	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
S20	TRANS	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
S21	TRANS	APPENDIX R CURRENT LOOP INPUT	TB109-2,3	NO EFFECT
S22	COM	APPENDIX R CURRENT LOOP INPUT	TB109-2,3	NO EFFECT
S23	COM	APPENDIX R CURRENT LOOP INPUT	TB109-16,17	NO EFFECT
S24	TRANS	APPENDIX R CURRENT LOOP INPUT	TB109-16,17	NO EFFECT
S25	TRANS	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
S26	COM	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
S27	COM	APPENDIX R CURRENT LOOP INPUT	TB109-5,6	NO EFFECT
S28	TRANS	APPENDIX R CURRENT LOOP INPUT	TB109-5,6	NO EFFECT
S29	TRANS	APPENDIX R CURRENT LOOP INPUT	TB109-8,9	NO EFFECT
S30	COM	APPENDIX R CURRENT LOOP INPUT	TB109-8,9	NO EFFECT
S31	COM	APPENDIX R RTD	TB104-6,7	NO EFFECT
S32	TRANS	APPENDIX R RTD	TB104-6,7	NO EFFECT
S33	TRANS	APPENDIX R RTD	TB104-8,9	NO EFFECT
S34	COM	APPENDIX R RTD	TB104-8,9	NO EFFECT
S35	COM	APPENDIX R RTD	TB104-10,11	NO EFFECT
S36	TRANS	RS 422 ENCODE/DECODE DATA LINK	TB104-10,11	NO EFFECT
S37	TRANS	RS 422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
S38	COM	RS-422 DATA LINK	TB102-2,3	NO EFFECT
S39	COM	RS 422 DATA LINK	TB101-19,20	NO EFFECT
S40	TRANS	RS 422 DATA LINK	TB101-19,20	NO EFFECT
S41	TRANS	RS-422 DATA LINK	TB101-2,3	NO EFFECT
S42	COM	RS-422 ENCODE/DECODE DATA LINK	TB101-2,3	NO EFFECT
S43	COM	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
S44	TRANS	DISPLAY	TB102-19,20	NO EFFECT
*S45	TRANS		SWDK-C	NO EFFECT

* = Special Nonrequired Test

TABLE A-9
SURGE WITHSTAND FAULT TESTS (CONTINUED)

TEST #	TEST MODE	TYPE OF I/O BOARD	TEST INJECTION POINT		TEST EFFECT	
•[						] b,c
47	TRANS	CABINET POWER LINE	BLK	WH	NO EFFECT	
S48	COM	CABINET POWER LINE	BLK	WH	NO EFFECT	
S49	TRANS	DISPLAY POWER LINE	BLK	WH	NO EFFECT	
S50	COM	DISPLAY POWER LINE	BLK	WH	NO EFFECT	

• = Special Nonrequired Test

TABLE A-10
SHORT CIRCUIT FAULT TEST

TEST #	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
SH1	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
SH2	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
SH3	APPENDIX R RTD	TB104-12,13	NO EFFECT
SH4	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
SH5	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
SH6	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
SH7	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
SH8	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
SH9	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
SH9	RS-422 ENCODE/DECODE DATA LINK	TB201-2,3	NO EFFECT
SH10	RS-422 DATA LINK	TB101-2,3	NO EFFECT
SH10A	RS-422 DATA LINK	TB101-19,20	NO EFFECT
•SH19	DISPLAY	SWDK-C	NO EFFECT
SH78	APPENDIX R CURRENT LOOP INPUT	TB103 19,20	NO EFFECT
SH89	APPENDIX R CURRENT LOOP INPUT	TB103-22,23	NO EFFECT
SH90	APPENDIX R RTD	TB104-6,7	NO EFFECT
SH91	APPENDIX R RTD	TB104-8,9	NO EFFECT
SH110	APPENDIX R RTD	TB104-10,11	NO EFFECT

• = Special Nonrequired Test

TABLE A-11
COMMON MODE FAULT TEST

TEST #	VOLTAGE LEVEL	GROUND CONN TO	LINE-TO-LINE CONNECTION	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
C11	250 DC	-	+ to H	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
C12	250 DC	-	+ to L	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
C13	250 DC	+	- to H	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
C14	250 DC	+	- to L	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
C15	250 DC	-	+ to H	APPENDIX R CURRENT LOOP IN	TB103-11,12	NO EFFECT
C16	250 DC	-	+ to L	APPENDIX R CURRENT LOOP IN	TB103-11,12	NO EFFECT
C17	250 DC	+	- to H	APPENDIX R CURRENT LOOP IN	TB103-11,12	NO EFFECT
C18	250 DC	+	- to L	APPENDIX R CURRENT LOOP IN	TB103-11,12	NO EFFECT
C20	250 DC	-	+ to H	APPENDIX R RTD	TB104-12,13	NO EFFECT
C21	250 DC	-	+ to L	APPENDIX R RTD	TB104-12,13	NO EFFECT
C22	250 DC	+	to H	APPENDIX R RTD	TB104 12,13	NO EFFECT
C23	250 DC	+	- to L	APPENDIX R RTD	TB104-12,13	NO EFFECT
C24	250 DC	-	+ to H	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
C25	250 DC	-	+ to L	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
C26	250 DC	+	- to H	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
C27	250 DC	+	- to L	DIGITAL CONTACT INPUT	TB105-5,6	NO EFFECT
C28	250 DC	-	+ to H	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
C29	250 DC	-	+ to L	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
C30	250 DC	+	- to H	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
C31	250 DC	+	- to L	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
C32	250 DC	-	+ to H	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
C33	250 DC	+	+ to L	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
C34	250 DC	+	- to H	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
C35	250 DC	+	- to L	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
C36	250 DC	-	+ to L	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
C37	250 DC	+	- to L	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
C38	250 DC	-	+ to H	APPENDIX R CURRENT LOOP INPUT	TB109 11,12	NO EFFECT
C39	250 DC	-	+ to L	APPENDIX R CURRENT LOOP INPUT	TB109 11,12	NO EFFECT
C40	250 DC	+	- to H	APPENDIX R CURRENT LOOP INPUT	TB109 11,12	NO EFFECT
C41	250 DC	+	- to L	APPENDIX R CURRENT LOOP INPUT	TB109 11,12	NO EFFECT
C42	250 DC	-	+ to H	RS-422 DATA LINK	TB101 2,3	NO EFFECT
C43	250 DC	-	+ to L	RS-422 DATA LINK	TB101 2,3	NO EFFECT
C44	250 DC	+	- to H	RS-422 DATA LINK	TB101 2,3	NO EFFECT
C45	250 DC	+	- to L	RS-422 DATA LINK	TB101 2,3	NO EFFECT

TABLE A-11
COMMON MODE FAULT TEST (CONTINUED)

TEST #	VOLTAGE LEVEL	GROUND CONN TO	LINE-TO-LINE CONNECTION	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
C46	250 DC	-	+ to H	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
C47	250 DC	-	+ to L	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
C48	250 DC	+	- to H	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
C49	250 DC	+	- to L	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
*C50	250 DC	-	+ to H	DISPLAY	SWDK-C	FUSE BLOWN
*C51	250 DC	-	+ to L	DISPLAY	SWDK-C	FUSE BLOWN
*C51	250 DC	+	- to H	DISPLAY	SWDK-C	NO EFFECT
*C52	250 DC	+	- to L	DISPLAY	SWDK-C	NO EFFECT
C53	580 AC	NEUTRAL	+ to H	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
C54	580 AC	NEUTRAL	+ to L	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NO EFFECT
C55	580 AC	NEUTRAL	+ to H	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
C56	580 AC	NEUTRAL	+ to L	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NO EFFECT
C57	580 AC	NEUTRAL	+ to H	APPENDIX R RTD	TB104-12,13	NO EFFECT
C58	580 AC	NEUTRAL	+ to L	APPENDIX R RTD	TB104-12,13	NO EFFECT
C59	580 AC	NEUTRAL	+ to H	DIGITAL CONTACT	TB105-5,6	NO EFFECT
C60	580 AC	NEUTRAL	+ to L	DIGITAL CONTACT	TB105-5,6	NO EFFECT
C61	580 AC	NEUTRAL	+ to H	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
C62	580 AC	NEUTRAL	+ to L	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NO EFFECT
C63	580 AC	NEUTRAL	+ to H	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
C64	580 AC	NEUTRAL	+ to L	DIGITAL CONTACT OUTPUT	TB108-5,6	NO EFFECT
C65	580 AC	NEUTRAL	+ to L	DIGITAL CONTACT OUTPUT	TB108-5,7	NO EFFECT
C66	580 AC	NEUTRAL	+ to H	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
C67	580 AC	NEUTRAL	+ to L	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NO EFFECT
C68	580 AC	NEUTRAL	+ to H	RS-422 DATA LINK	TB101-2,3	NO EFFECT
C69	580 AC	NEUTRAL	+ to L	RS-422 DATA LINK	TB101-2,3	NO EFFECT
C70	580 AC	NEUTRAL	+ to H	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
C71	580 AC	NEUTRAL	+ to L	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NO EFFECT
C72	580 AC	NEUTRAL	+ to H	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
C73	580 AC	NEUTRAL	+ to L	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NO EFFECT
C74	580 AC	NEUTRAL	+ to H	RS-422 DATA LINK	TB101-19,20	NO EFFECT
C75	580 AC	NEUTRAL	+ to L	RS-422 DATA LINK	TB101-19,20	NO EFFECT

TABLE A-11
COMMON MODE FAULT TEST (CONTINUED)

TEST #	VOLTAGE LEVEL	GROUND CONN TO	LINE-TO-LINE CONNECTION	TYPE OF I/O BOARD	TEST INJECTION POINT	TEST EFFECT
*C75A	580 AC	NEUTRAL	+ to H	--- DISPLAY	SWDK-C	FUSE BLOWN
C75B	580 AC	NEUTRAL	+ to L	--- DISPLAY	SWDK-C	FUSE BLOWN
C76	580 AC	NEUTRAL	+ to H	APPENDIX R CURRENT LOOP INPUT	TB103-19,20	NO EFFECT
C77	580 AC	NEUTRAL	+ to L	APPENDIX R CURRENT LOOP INPUT	TB103-19,20	NO EFFECT
C78	250 DC	-	+ to L	APPENDIX R CURRENT LOOP INPUT	TB103-19,20	NO EFFECT
C79	250 DC	-	+ to H	APPENDIX R CURRENT LOOP INPUT	TB103-19,20	NO EFFECT
C80	250 DC	-	+ to L	APPENDIX R CURRENT LOOP INPUT	TB103-19,20	NO EFFECT
C81	250 DC	+	- to H	APPENDIX R CURRENT LOOP INPUT	TB103-19,20	NO EFFECT
C82	250 DC	+	- to L	APPENDIX R CURRENT LOOP INPUT	TB103-19,20	NO EFFECT
C83	250 DC	-	+ to H	APPENDIX R CURRENT LOOP INPUT	TB103-22,23	NO EFFECT
C84	250 DC	-	+ to L	APPENDIX R CURRENT LOOP INPUT	TB103 22,23	NO EFFECT
C85	250 DC	+	- to H	APPENDIX R CURRENT LOOP INPUT	TB103-22,23	NO EFFECT
C86	250 DC	+	- to L	APPENDIX R CURRENT LOOP INPUT	TB103-22,23	NO EFFECT
C87	580 AC	NEUTRAL	+ to H	APPENDIX R CURRENT LOOP INPUT	TB103-22,23	NO EFFECT
C88	580 AC	NEUTRAL	+ to L	APPENDIX R CURRENT LOOP INPUT	TB103-22,23	NO EFFECT
C92	580 AC	NEUTRAL	+ to H	APPENDIX R RTD	TB104-6,7	NO EFFECT
C93	580 AC	NEUTRAL	+ to L	APPENDIX R RTD	TB104-6,7	NO EFFECT
C94	580 AC	NEUTRAL	+ to H	APPENDIX R RTD	TB104-8,9	NO EFFECT
C95	580 AC	NEUTRAL	+ to L	APPENDIX R RTD	TB104-8,9	NO EFFECT
C96	250 DC	-	+ to H	APPENDIX R RTD	TB104-6,7	NO EFFECT
C97	250 DC	-	+ to L	APPENDIX R RTD	TB104-6,7	NO EFFECT
C98	250 DC	-	+ to H	APPENDIX R RTD	TB104-8,9	NO EFFECT
C99	250 DC	-	+ to L	APPENDIX R RTD	TB104-8,9	NO EFFECT
C100	250 DC	+	- to H	APPENDIX R RTD	TB104-6,7	NO EFFECT
C101	250 DC	+	- to L	APPENDIX R RTD	TB104-6,7	NO EFFECT
C102	250 DC	+	- to H	APPENDIX R RTD	TB104-8,9	NO EFFECT
C103	250 DC	+	- to L	APPENDIX R RTD	TB104-8,9	NO EFFECT
C104	250 DC	-	+ to H	APPENDIX R RTD	TB104-10,11	NO EFFECT
C105	250 DC	-	+ to L	APPENDIX R RTD	TB104-10,11	NO EFFECT
C106	250 DC	+	- to H	APPENDIX R RTD	TB104-10,11	NO EFFECT
C107	250 DC	+	- to L	APPENDIX R RTD	TB104-10,11	NO EFFECT
C108	580 AC	NEUTRAL	+ to H	APPENDIX R RTD	TB104-10,11	NO EFFECT
C109	580 AC	NEUTRAL	+ to L	APPENDIX R RTD	TB104-10,11	NO EFFECT
C242	250 DC	+	- to H	RS422 ENCODE/DECODE DATA INPUT	TB102-2,3	NO EFFECT
C243	250 DC	+	- to L	RS422 ENCODE/DECODE DATA INPUT	TB102-2,3	NO EFFECT
C244	250 DC	-	+ to H	RS422 ENCODE/DECODE DATA INPUT	TB102-2,3	NO EFFECT
C245	250 DC	-	+ to L	RS422 ENCODE/DECODE DATA INPUT	TB102-2,3	NO EFFECT
C246	250 DC	-	+ to H	RS422 ENCODE/DECODE DATA INPUT	TB101-19,20	NO EFFECT
C247	250 DC	-	+ to L	RS422 ENCODE/DECODE DATA INPUT	TB101-19,20	NO EFFECT
C248	250 DC	+	- to H	RS422 ENCODE/DECODE DATA INPUT	TB101-19,20	NO EFFECT
C249	250 DC	+	- to L	RS422 ENCODE/DECODE DATA INPUT	TB101-19,20	NO EFFECT

TABLE A-12
LINE-TO-LINE FAULT TEST
FUSE INSTALLED

TEST #	VOLTAGE LEVEL	TYPE OF I/O BOARD	TEST INJECTION/POINT	GROUND CONNECTED TO	TEST EFFECT
L111	125 AC	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NEUTRAL	
L112	125 AC	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NEUTRAL	
L113	125 AC	APPENDIX R RTD	TB104-12,13	NEUTRAL	
L114	125 AC	DIGITAL CONTACT INPUT	TB105-5,6	NEUTRAL	
L115	125 AC	4-20 MA CURRENT LOOP OUTPUT	TB106-5,6	NEUTRAL	
L116	125 AC	DIGITAL CONTACT OUTPUT	TB108-5,7	NEUTRAL	
L117	125 AC	DIGITAL CONTACT OUTPUT	TB108-5,6	NEUTRAL	
L118	125 AC	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NEUTRAL	
L119	125 AC	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NEUTRAL	
L120	125 AC	RS-422 DATA LINK	TB101-19,20	NEUTRAL	
L121	125 DC	HIGH LEVEL VOLTAGE OUTPUT	TB204 5,6	OF PS	
L122	125 DC	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	- OF PS	
L123	125 DC	APPENDIX R RTD	TB104-12,13	- OF PS	
L124	125 DC	APPENDIX R RTD	TB104-12,13	+ OF PS	
L125	125 DC	DIGITAL CONTACT INPUT	TB105-5,6	+ OF PS	
L126	125 DC	DIGITAL CONTACT INPUT	TB105-5,6	- OF PS	
L127	125 DC	4-20 MA CURRENT LOOP OUTPUT	TB106-5,6	- OF PS	
L128	125 DC	4-20 MA CURRENT LOOP OUTPUT	TB106-5,6	+ OF PS	
L129	125 DC	DIGITAL CONTACT OUTPUT	TB108-5,7	+ OF PS	
L130	125 DC	DIGITAL CONTACT OUTPUT	TB108-5,6	+ OF PS	
L131	125 DC	DIGITAL CONTACT OUTPUT	TB108-2,4	- OF PS	
L132	125 DC	DIGITAL CONTACT OUTPUT	TB108-2,3	- OF PS	
L133	125 DC	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	- OF PS	
L134	125 DC	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	+ OF PS	
L135	125 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	+ OF PS	
L136	125 DC	RS-422 DATA LINK	TB101-19,20	+ OF PS	
L137	125 DC	RS-422 DATA LINK	TB101-19,20	- OF PS	
L138	125 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	- OF PS	
L139	250 DC	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	- OF PS	
L140	250 DC	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	+ OF PS	
L141	250 DC	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	+ OF PS	
L142	250 DC	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	- OF PS	
L143	250 DC	APPENDIX R RTD	TB104-12,13	- OF PS	
L144	250 DC	APPENDIX R RTD	TB104-12,13	+ OF PS	
L145	250 DC	DIGITAL CONTACT INPUT	TB105-5,6	+ OF PS	
L146	250 DC	DIGITAL CONTACT INPUT	TB105-5,6	- OF PS	
L147	250 DC	4-20 MA CURRENT LOOP OUTPUT	TB106-5,6	- OF PS	
L148	250 DC	4-20 MA CURRENT LOOP OUTPUT	TB106-5,6	+ OF PS	

D.C

TABLE A-12
LINE-TO-LINE FAULT TEST
FUSE INSTALLED (CONTINUED)

TEST #	VOLTAGE LEVEL	TYPE OF I/O BOARD	TEST INJECTION/POINT	GROUND CONNECTED TO	TEST EFFECT
L149	250 DC	DIGITAL CONTACT OUTPUT	TB108-5,6	+ OF PS	
L150	250 DC	DIGITAL CONTACT OUTPUT	TB108-2,4	+ OF PS	
L151	250 DC	DIGITAL CONTACT OUTPUT	TB108-8,10	- OF PS	
L152	250 DC	DIGITAL CONTACT OUTPUT	TB108-11,12	- OF PS	
L153	250 DC	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	- OF PS	
L154	250 DC	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	+ OF PS	
L155	250 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	+ OF PS	
L156	250 DC	RS-422 DATA LINK	TB101-19,20	+ OF PS	
L157	250 DC	RS-422 DATA LINK	TB101-19,20	- OF PS	
L158	250 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	- OF PS	
L159	250 DC	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	+ OF PS	
L160	125 DC	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	+ OF PS	
L161	580 AC	HIGH LEVEL VOLTAGE OUTPUT	TB204-5,6	NEUTRAL	
L162	580 AC	APPENDIX R CURRENT LOOP INPUT	TB103-11,12	NEUTRAL	
L163	580 AC	APPENDIX R RTD	TB104-12,13	NEUTRAL	
L164	580 AC	DIGITAL CONTACT INPUT	TB105-5,6	NEUTRAL	
L165	580 AC	4-20 mA CURRENT LOOP OUTPUT	TB106-5,6	NEUTRAL	
L166	580 AC	DIGITAL CONTACT OUTPUT	TB108-5,6	NEUTRAL	
L167	580 AC	DIGITAL CONTACT OUTPUT	TB108-5,7	NEUTRAL	
L168	580 AC	RS-422 ENCODE/DECODE DATA LINK	TB102-2,3	NEUTRAL	
L169	580 AC	RS-422 DATA LINK	TB101-19,20	NEUTRAL	
L170	580 AC	APPENDIX R CURRENT LOOP INPUT	TB109-11,12	NEUTRAL	
L171	125 DC	RS-422 DATA LINK	TB101-2, 3	- OF PS	
L172	125 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	- OF PS	
L173	125 DC	RS-422 DATA LINK	TB101-2,3	+ OF PS	
L174	125 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	+ OF PS	
L175	125 AC	RS-422 DATA LINK	TB101-2,3	NEUTRAL	
L176	125 AC	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NEUTRAL	
L177	125 DC	APPENDIX R CURRENT LOOP INPUT	TB103-5,6	- OF PS	
L178	125 DC	APPENDIX R CURRENT LOOP INPUT	TB103-5,6	+ OF PS	

b,c

TABLE A-12
LINE-TO-LINE FAULT TEST
FUSE INSTALLED (CONTINUED)

TEST #	VOLTAGE LEVEL	TYPE OF I/O BOARD	TEST INJECTION/POINT	GROUND CONNECTED TO	TEST EFFECT
L179	125 DC	APPENDIX R CURRENT LOOP INPUT	TB103-8,9	+ OF PS	
L180	125 DC	APPENDIX R CURRENT LOOP INPUT	TB103-8,9	- OF PS	
L181	125 DC	APPENDIX R RTD	TB104-10,11	- OF PS	
L182	125 DC	APPENDIX R RTD	TB104-6,7	- OF PS	
L183	125 DC	APPENDIX R RTD	TB104-8,9	- OF PS	
L184	125 DC	APPENDIX R RTD	TB104-6,7	+ OF PS	
L185	125 DC	APPENDIX R RTD	TB104-8,9	+ OF PS	
L186	250 DC	RS-422 DATA LINK	TB101-2,3	- OF PS	
L187	250 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	- OF PS	
L188	250 DC	RS-422 DATA LINK	TB101-2,3	+ OF PS	
L189	250 DC	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	+ OF PS	
L190	580 AC	RS-422 DATA LINK	TB101 2,3	NEUTRAL	
L191	580 AC	RS-422 ENCODE/DECODE DATA LINK	TB102-19,20	NEUTRAL	
L194	125 DC	RS-422 ENCODE/DECODE DATA LINK	TX CHANNEL, OPTICAL ISOLATOR PIN 2 AND 3 IN SERIES WITH RESISTOR	- OF PS	
L233	125 AC	RS-422 ENCODE/DECODE DATA LINK	TX CHANNEL, OPTICAL ISOLATOR PIN 2 AND 3	- OF PS	
L234	125 DC	RS-422 ENCODE/DECODE DATA LINK	TX CHANNEL, OPTICAL ISOLATOR PIN 2 AND 3	- OF PS	
L235	125 AC	APPENDIX R CURRENT LOOP INPUT	TB103-5,6	NEUTRAL	
L236	125 AC	APPENDIX R CURRENT LOOP INPUT	TB103-8,9	NEUTRAL	
L237	125 AC	APPENDIX R RTD	TB104-10,11	NEUTRAL	
L238	125 AC	APPENDIX R RTD	TB104-6,7	NEUTRAL	
L239	125 AC	APPENDIX R RTD	TB104-8,9	NEUTRAL	
L240	125 DC	APPENDIX R RTD	TB104-10,11	+ OF PS	
L241	125 DC	RS-422 ENCODE/DECODE DATA LINK	TX CHANNEL, OPTICAL ISOLATOR PIN 2 AND 3	+ OF PS	

D,C

TABLE A-13
LINE-TO-LINE FAULT TEST
FUSE SHORTED

TEST #	VOLTAGE LEVEL	TYPE OF I/O BOARD	TEST INJECTION/POINT	GROUND CONNECTED TO	TEST EFFECT
L192	125 DC	HIGH LEVEL VOLTAGE OUTPUT	TB 204-5,6	- OF PS	[
L193	125 DC	DIGITAL CONTACT INPUT	TB 105-5,6	- OF PS	
L195	125 DC	DIGITAL CONTACT OUTPUT	TB 108-5,6	- OF PS	
L196	125 DC	DIGITAL CONTACT OUTPUT	TB 108-8,10	- OF PS	
L197	125 DC	4-20 mA CURRENT LOOP OUTPUT	TB 106-5,6	- OF PS	
L198	125 DC	APPENDIX R CURRENT LOOP INPUT	TB 103 11,12	OF PS	
L199	125 DC	APPENDIX R RTD	TB 104-12,13	- OF PS	
L200	125 DC	RS-422 ENCODE/DECODE DATA LINK	TB 102-19,20	- OF PS	
L201	125 DC	RS-422 DATA LINK	TB 101-2,3	- OF PS	
L202	125 AC	HIGH LEVEL VOLTAGE OUTPUT	TB 204-5,6	NEUTRAL	
L203	125 AC	DIGITAL CONTACT INPUT	TB 105-5,6	NEUTRAL	
L204	125 AC	4-20 mA CURRENT LOOP OUTPUT	TB 106-5,6	NEUTRAL	
L205	125 AC	DIGITAL CONTACT OUTPUT	TB 108-5,6	NEUTRAL	
L206	125 AC	APPENDIX R CURRENT LOOP INPUT	TB 103-11,12	NEUTRAL	
L207	125 AC	APPENDIX R RTD	TB 104-12,13	NEUTRAL	
L208	125 AC	DIGITAL CONTACT OUTPUT	TB 108-11,13	NEUTRAL	
L209	125 AC	RS-422 DATA LINK	TB 101-2,3	NEUTRAL	
L210	125 AC	RS-422 ENCODE/DECODE DATA LINK	TB 102-19,20	NEUTRAL	
L211	250 DC	HIGH LEVEL VOLTAGE OUTPUT	TB 204-5,6	- OF PS	] b,c

TABLE A-13 (CONT)
LINE-TO-LINE FAULT TEST
FUSE SHORTED

TEST #	VOLTAGE LEVEL	TYPE OF I/O BOARD	TEST INJECTION/POINT	GROUND CONNECTED TO	TEST EFFECT
L212	250 DC	DIGITAL CONTACT INPUT	TB 105-5,6	- OF PS	[
L213	250 DC	4-20 mA CURRENT LOOP OUTPUT	TB 106-2,3	- OF PS	
L214	250 DC	DIGITAL CONTACT OUTPUT	TB 108-16,17	- OF PS	
L215	250 DC	DIGITAL CONTACT OUTPUT	TB 108-19,21	- OF PS	
L216	250 DC	RS-422 DATA LINK	TB 101-16,17	- OF PS	
L217	250 DC	RS-422 ENCODE/DECODE DATA LINK	TB 102-19,20	- OF PS	
L218	580 AC	HIGH LEVEL VOLTAGE OUTPUT	TB 204-5,6	NEUTRAL	
L219	580 AC	DIGITAL CONTACT INPUT	TB 105-11,12	NEUTRAL	
L220	580 AC	4-20 mA CURRENT LOOP OUTPUT	TB 106-5,6	NEUTRAL	
L221	580 AC	DIGITAL CONTACT OUTPUT	TB 108-19,20	NEUTRAL	
L222	580 AC	DIGITAL CONTACT OUTPUT	TB 108-25,27	NEUTRAL	
L223	580 AC	RS-422 DATA LINK	TB 101-2,3	NEUTRAL	
L224	580 AC	RS-422 ENCODE/DECODE DATA LINK	TB 102-5,6	NEUTRAL	
L225	125 AC	RS-422 ENCODE/DECODE DATA LINK	TB 102-16,17	NEUTRAL	
L226	125 AC	RS-422 DATA LINK	TB 101-19,20	NEUTRAL	
L227	125 DC	RS-422 ENCODE/DECODE DATA LINK	TB 102-2,3	- OF PS	
L228	125 DC	RS-422 DATA LINK	TB 101-5,6	- OF PS	]

b,c

TABLE A-13 (CONT)
LINE-TO-LINE FAULT TEST
FUSE SHORTED

TEST #	VOLTAGE LEVEL	TYPE OF I/O BOARD	TEST INJECTION/POINT	GROUND CONNECTED TO	TEST EFFECT
L229	250 DC	RS-422 ENCODE/DECODE DATA LINK	TB 102-2,3	- OF PS	[ ] b,c
L230	250 DC	RS-422 DATA LINK	TB 101-5,6	- OF PS	
L231	580 AC	RS-422 ENCODE/DECODE DATA LINK	TB 102-16,17	NEUTRAL	
L232	580 AC	RS-422 DATA LINK	TB 101-19,20	NEUTRAL	

APPENDIX B

FAULT TESTS, FUSE SHORTED PHOTOGRAPHS

This appendix contains the following figures:

Figure B-1a. Fault Test, Fuse Shorted: 580 Vac Fault Into RS-422 Encode/Decode Data Link Receive Channel (Front, S/N 87)

Figure B-1b. Fault Test, Fuse Shorted: 580 Vac Fault Into RS-422 Encode/Decode Data Link Receive Channel (Back, S/N 87)

Figure B-2a. Fault Test, Fuse Shorted: 580 Vac Fault Into RS-422 Data Link Transmit Channel (Front, S/N 102)

Figure B-2b. Fault Test, Fuse Shorted: 580 Vac Fault Into RS-422 Data Link Transmit Channel (Back, S/N 102)

Figure B-3a. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Input (Front, S/N 253)

Figure B-3b.. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Input (Back, S/N 253)

Figure B-4a. Fault Test, Fuse Shorted: 250 Vac Fault Into Current Loop Output (Front, S/N 40)

Figure B-4b. Fault Test, Fuse Shorted: 250 Vac Fault Into Current Loop Output (Back, S/N 40)

Figure B-5a. Fault Test, Fuse Shorted: 580 Vac Fault Into High Level Voltage Output (Front, S/N 42)

Figure B-5b. Fault Test, Fuse Shorted: 580 Vac Fault Into High Level Voltage Output (Back, S/N 42)

Figure B-6a. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Output (Front, S/N 39)

Figure B-6b. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Output (Back, S/N 39)



Figure B-1a. Fault Test, Fuse Shorted: 580 Vac Fault Into RS-422 Encode/Decode Data Link Receive Channel (Front, S/N 87)



b,c

Figure B-1b. Fault Test, Fuse Shorted: 580 Vac Fault Into RS-422 Encode/Decode Data Link Receive Channel (Back, S/N 87)



b,c

Figure B-2a. Fault Test, Fuse Shorted: 580 Vac Fault Into
RS-422 Data Link Transmit Channel (Front, S/N 102)



b,c

Figure B-2b. Fault Test, Fuse Shorted: 580 Vac Fault Into RS-422 Data Link Transmit Channel (Back, S/N 102)



b,c

Figure B-3a. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Input (Front, S/N 253)



b,c

Figure B-3b.. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Input (Back, S/N 253)



b,c

Figure B-4a. Fault Test, Fuse Shorted: 250 Vac Fault Into Current Loop Output (Front, S/N 40)



b,c

Figure B-4b. Fault Test, Fuse Shorted: 250 Vac Fault Into Current Loop Output (Back, S/N 40)



b,c

Figure B-5a. Fault Test, Fuse Shorted: 580 Vac Fault Into High Level Voltage Output (Front, S/N 42)



b,c

Figure B-5b. Fault Test, Fuse Shorted: 580 Vac Fault Into High Level Voltage Output (Back, S/N 42)



b,c

Figure B-6a. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Output (Front, S/N 39)



b,c

Figure B-6b. Fault Test, Fuse Shorted: 580 Vac Fault Into Digital Contact Output (Back, S/N 39)

APPENDIX C

MICROPROCESSORS AND I/O BOARDS DESCRIPTION

This appendix contains the following information:

- Input/Output I/O Board Description
  - High voltage level output
  - Appendix R Current-loop input
  - Appendix R RTD
  - 4 to 20 mA current-loop output
  - Digital contact input
  - Digital contact output
  - RS 422 Encode/Decode Datalink
  - RS 422 Datalink
- Microprocessor Board Description

[ ]

[ ]

b.c

SIGNAL CONDITIONING BOARD DESCRIPTIONS

Appendix R Current Loop Signal Conditioning Board

The Westinghouse Appendix R current loop input (CLI) board (2D33170G01) is capable of receiving up to two analog signals as inputs. The signal from the board, to the processor chassis, is scaled to the 0 to +5 volt range.

This type of board provides analog signal conditioning sufficient to meet the fire separation criteria of 10CFR50, Appendix R for parameters essential for safe cold shutdown.

Each current loop input of each board has a matching field side current loop output which provides the isolation for the 7300 series process cabinets. This "repeater" function is a hard-wired jumper selectable feature of the Appendix R CLI board.

Appendix R RTD Signal Conditioning Board

The Westinghouse Appendix R RTD input board (2D33172G01) is capable of receiving up to two four-wire RTD inputs. The signal from the board to the processor chassis is scaled to the 0 to +5 volt range.

This type of board provides analog signal conditioning sufficient to meet the fire separation criteria of 10CFR50, Appendix R for parameters essential for safe cold shutdown.

Each RTD input has a matching current loop output which is used to provide the isolation for the 7300 series process cabinets. Because of the nonlinear nature of RTD signals, the repeater function is not a hard-wired feature of the board. The input signal is digitized and converted to engineering units by the APC processor. The linear temperature scale is then converted to an analog 0 to 10 volt signal which is used to drive the current loop output channel of the Appendix R RTD board.

The Appendix R RTD board has two jumper configurable ranges. Either a 100 or 200 ohm RTD can be used as an input. When a 100 ohm platinum RTD is selected as the input, the nominal current excitation source is set to 1.95 mA, and for a 200 ohm RTD is set to 0.95 mA. The board also provides the selection of the type of low pass filtering for inputs, either 0.5 Hz or 5.0 Hz.

Adjustable trim pots are provided on the field side outputs for selecting the appropriate gain and offset.

Digital Contact Input Board

Each Westinghouse digital contact input board receives eight digital input signals and outputs logic-level (0 or 1) reproductions of these signals. Two models are available: Model 2344D01/G01 is a passive circuit receiving externally powered contact closure inputs; Model 2344D01/G02 is an active circuit generating an isolated energizing voltage of 48 Vdc for each channel.

High Level Voltage Output Board

The Westinghouse voltage output board (2344D02G01) is capable of providing four 0 to 10 V voltage outputs. The nominal input range of this board, from the computer side, is 0 to 10 volts.

4 to 20 mA Current Loop Output Board

The Westinghouse current loop output board (2D31856G01) is capable of delivering four current loop outputs. The nominal input range of this board, from the computer side, is 1.92 to 9.6 volts which corresponds to an output of 4 to 20 mA.

The output of the CLO board is jumper configurable and can be used as an active or passive output.

Digital Contact Output Board

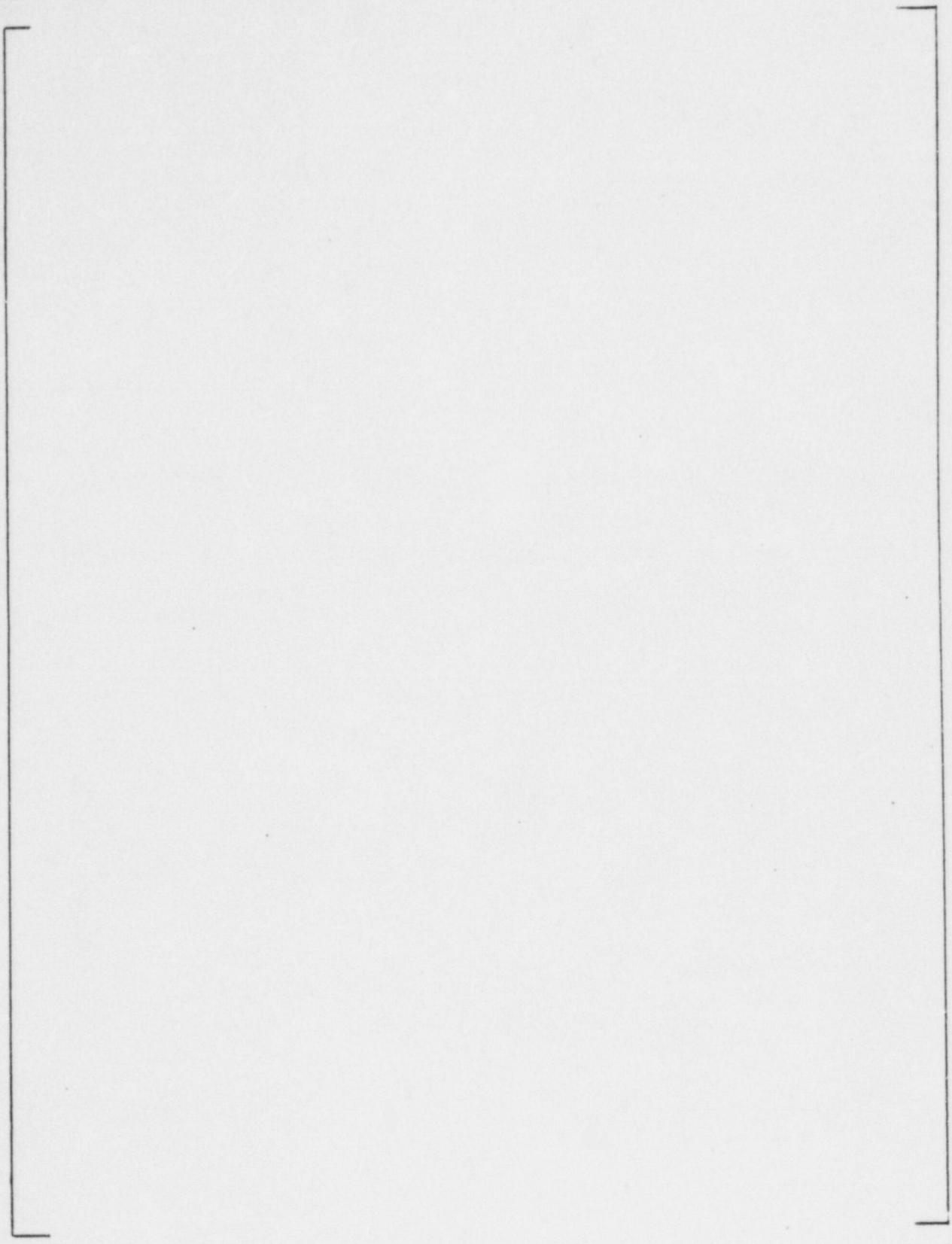
Each Westinghouse 2344D04 series digital contact output board converts eight digital signals (0 volt and 5 volt) to provide eight form C contact outputs to the associated field wiring.

RS-422 Encode/Decode Data Link

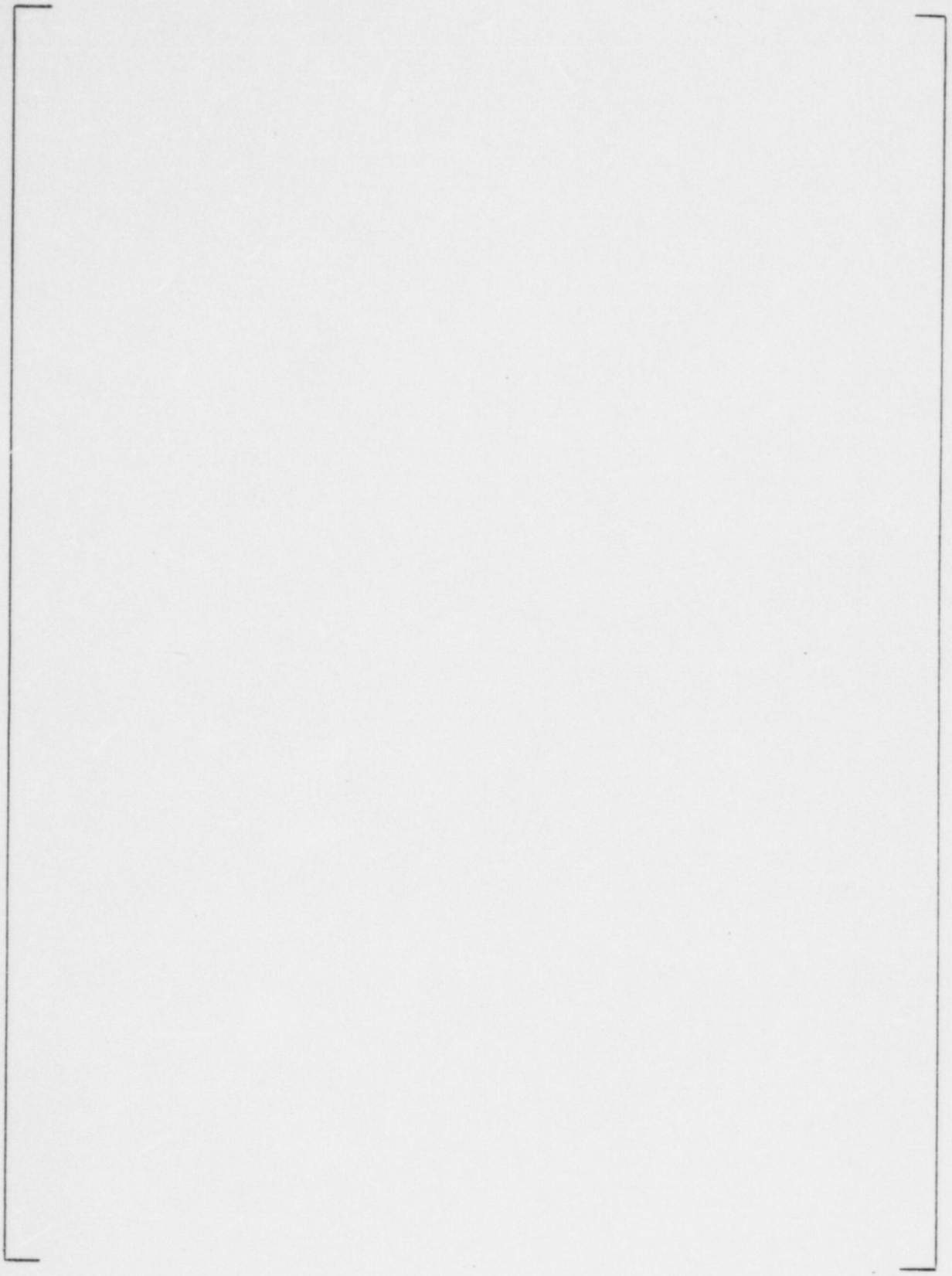
Each Westinghouse 2D32406 series RS-422 Encode/Decode data link board provides two transmit and two receive channels for synchronous or asynchronous operation. Each channel is electrically isolated through optical isolators.

RS-422 Data Link

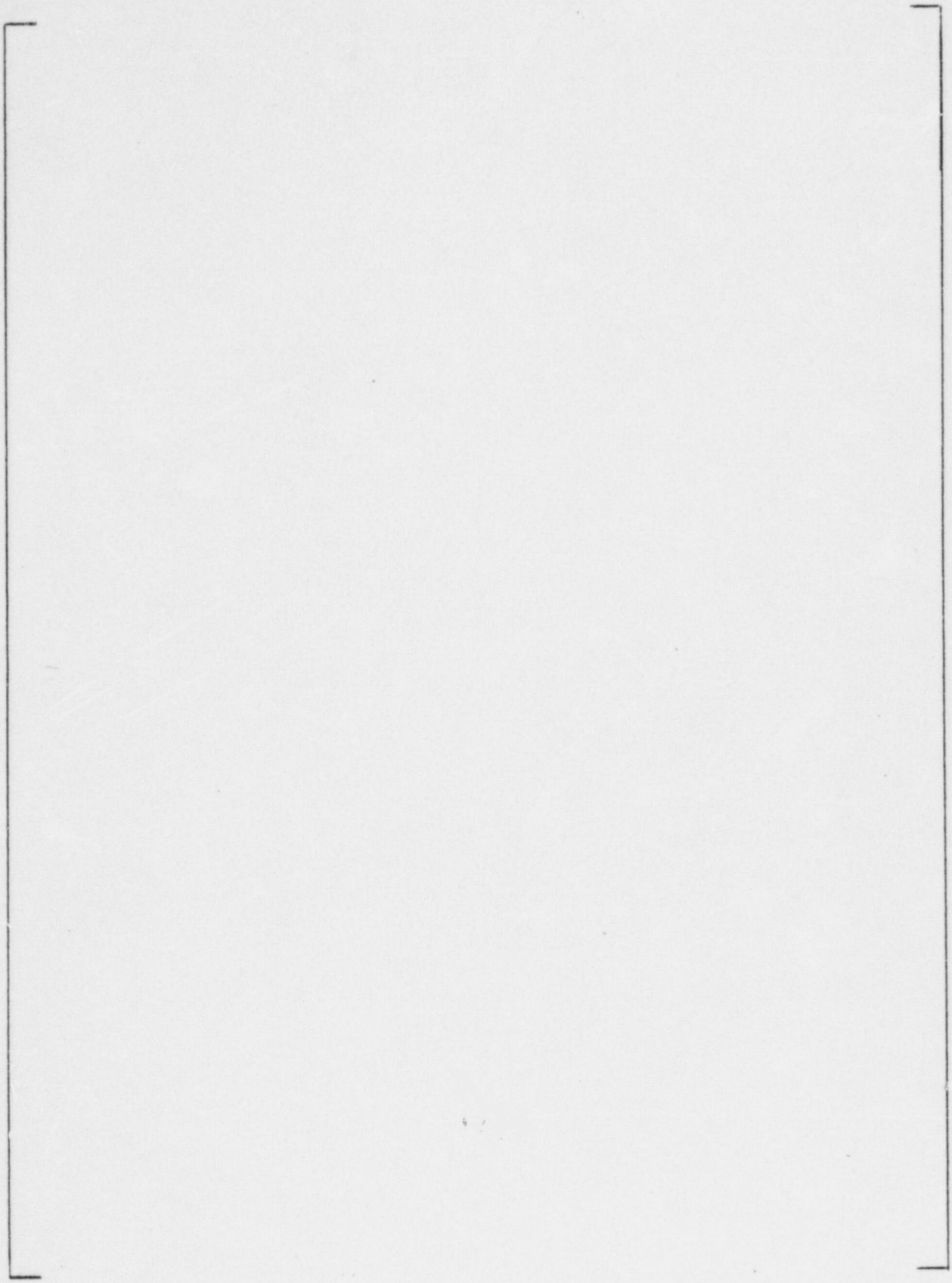
The RS-422 data link board provides two input and two output RS 422 communication channels to the processor and makes the data in the controller side available as RS-232. Each input and output signal is isolated from the other input and output signals to the board, from the cabinet power supply, and from the output signals.



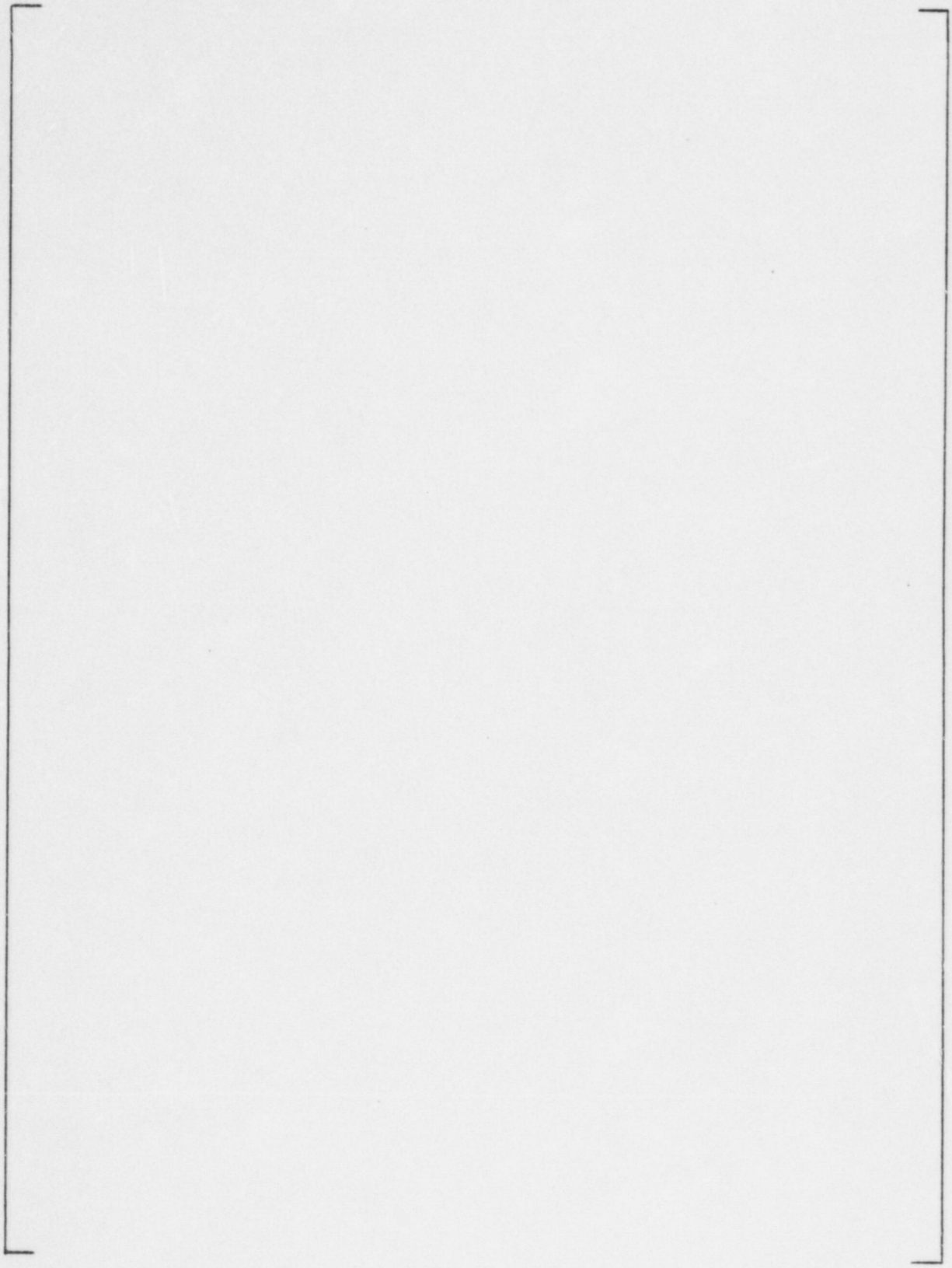
a.c



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APPENDIX D

TEST PROCEDURES

This appendix contains the following test procedures:

- Part D1 -- Noise Test Procedure
- Part D2 -- Fault Test Procedure
  (The shielding test in the fault test procedure was not performed.)
- Part D3 -- Surge Withstand Test Procedure
- Part D4 -- Radio Frequency Interference Test Procedure

PART D1

NOISE TEST PROCEDURE

CNN 050586-0	DATE 7/17/86	REVISION NO. 0

NOISE TEST PROCEDURE

FOR

PSMS, QDPS, RVLIS-86

AND ICC-86

APPROVALS

	ORIGINAL	REV. 0	REV. 1	REV. 2
AUTHOR	C. N. Nasrallah			
REVIEWED	J. R. Smith			
MANAGER	W. Ciaramitaro			
QUALITY ASSURANCE	R. Saupe			

1.0 INTRODUCTION

This procedure details the electrical interference "noise" tests to be applied to a test configuration representative of a variety of plant equipment arrangements as described in References 1 and 2.

The test configuration is documented in sketches CNN61086, CNN62086, and CNN62286, Sheets 1 and 2, which become part of these test records as modified by this procedure and the references above.

2.0 PREPARATION FOR TEST

2.1 Prepare configuration record sheet per Table 3-4, Page 17, Reference 1, for each P.C. board in the configuration. Identify QA records files. Record all test observations in a "Permanent Record Book."

2.2 Connect the field cabling to sensor simulation, load simulation, contact input (SPDT) simulation, contact output loads, and remote interlock/test injection per Attachment B.

2.3 Perform calibration of the system as follows:

2.3.1 Load plant software to DPU and RPU. Obtain printout of "PROM" operating software for test records.

2.3.2 a. Perform, verify, and record "self cal" values.

b. Input analog (voltage and current) and resistance values corresponding to 0 - 100% of scale in 20% increments and record.

2.3.3 Perform and verify calibration of analog repeater function module slot TB109. Record values 0, 20, 40, 60, 80, and 100% FS.

2.3.4 Set up "normal" operate simulation parameter per Table D1-1.

2.3.5 Verify that analog output parameters and display values agree with Table D1-1.

a. Make a printer plot output record of all display pages per above.

b. Connect digital data logger and record "normal" analog output values. Per Table D1-1, disconnect digital data logger. (Note: Digital data logger is to be pretest and post-test verification of system status only. It will be disconnected during noise tests.)

c. Connect tape recorder per Attachment C and record for six (6) minutes.

d. Play back above data on Visicorder and verify calibration of record/playback data system. (Compare with data logged values (b) above.)

e. Recalibrate, if necessary, and make a "reference" cross calibration of (b), (c), and (d) above.

2.3.6 Make a six (6) minute tape record of above, except turn off RPU at two (2) minutes into the run (monitor switch) and turn back on at four (4) minutes into the run. Record observations.

2.3.7 Repeat the above except turn off DPU (monitor switch) at +2 minutes and restore at +4 minutes. Record observations.

2.3.8 Reconnect the digital data logger and display plotter and record values. Values should agree $\pm$ 0.5% FS with 2.3.5(b) above.

3.0 NOISE TEST PROCEDURE SEQUENCE

3.1 Pretest

Using digital data logger and display observation, verify "normal" condition of systems per calibration values of 2.3.8 above, and Table D1-1.

3.2 Disconnect data logger and verify "antenna" connections and configuration for each injection point of Attachment A.

3.3 Connect noise source; verify readiness of tape recorder data logger system. Enter identifying records in tape recorder log.

3.4 Set the display unit to observe the page indicating the respective parameter subject to noise injection (where applicable), and record any change in the error message in the APC status block during each test.

3.5 Run the tape recorder for two (2) minutes for pretest data, apply the noise source for two (2) minutes, and stop the recorder after a two (2) minute post-test period. Record all observed effects if any on system display, monitoring oscilloscope and digital CRT. (TB202 16-17 "buffered" data link).

3.6 Observing the display, oscilloscope, and CRT data monitor for system continuity, note and record observations.

NOTE: Continuity of System Functionality of I/O such as "RTC" not addressed by analog or display page outputs to be software addressed and observations recorded via using "buffer" connected CRT monitor. Record the address function and operating status observed.

3.7 If observation indicates an anomaly during the test, tape recorded data should be played back on the Visicorder and observations recorded before proceeding.

3.8 Reconnect the data logger and confirm that the calibrations are retained ± 0.5%. Verify display data supports the calibration data. Record any discrepancies.

3.9 With the system confirmed to be in the pretest condition, proceed to the next test.

4.0 RANDOM NOISE TEST

4.1 Connect the [ ]$_{D.C}$ (20V peak, 10 kHz to 10M Hz) and antenna assembly cable to first terminal of Table D1-2, and test per sequence 3.0 above.

4.2 Repeat above for each TB designation of Table D1-2.

5.0 CROSSTALK NOISE TEST

5.1 Connect the 118 volt AC chattering relay and antenna assembly cable to the first terminal of Table D1-2, and test per sequence 3.0 above.

5.2 Repeat the above for each TB designation of Table D1-2.

5.3 Repeat 5.1 and 5.2 above except use 125V DC chattering relay.

6.0 MIL N19900 NOISE TEST

6.1 Connect the "noise source 1" and antenna assembly cable to the first terminal of Table D1-2 and test per sequence 3.0 above.

6.2 Repeat above for each TB designation of Table D1-2.

6.3 Repeat 6.1 and 6.2 above except use "noise source 2."

7.0 SURGE TRANSIENT GENERATOR

7.1 Connect the [ ]$_{B,C}$ surge generator (3.3 kV peak, 1.25M Hz at 120/sec. rep. rate) and antenna assembly cable to first terminal of Table D1-2 and test per sequence 3.0 above.

7.2 Repeat above for each TB designation of Table D1-2.

8.0 ALTERNATE DATA LINK I/O CONFIGURATION

8.1 Reconfigure RPU data links I/O boards per "alternate" Attachment B and field connections per Attachment A, Table D1-2.

9.0 TEST ALTERNATE CONFIGURATION

9.1 Repeat tests 4.0 through 7.0 above, except test connections and sequence per Attachment A, Table D1-2.

10.0 POST TEST

10.1 Repeat system calibration per Section 2.3. Note comparison.

10.2 Play back tape-recorded results on a Visicorder and record all observed anomalies.

TABLE D1-1
SIMULATION NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB204	FI-417A	100%	0-120%	N/A	8.33 V	Computer set value
TB204	FI-437A	100%	0-120%	N/A	8.33 V	Computer set value
TB205	System alarms	N/A		N/A	N/A	Normally open
TB103 (2, 3)	LT-467 Pressurizer level	56%	0-100%	Fixed resistor	N/A	
TB103 (11, 12)	TE434				4.09 V	
TB103 (16, 17)	PT-406 RCS Wide range pressure	1981 psig	0-3000 psig	Fixed resistor	N/A	16.26 mA
TB103 (26, 27)	TE444				4.09 V	
TB104	TE414 RCS T_c Loop 1	540°F	0-700°F	Potentiometer	4.09 V	411.4 ohm
TB104	TE424 RCS T_c Loop 2	540°F	0-700°F	Potentiometer	4.09V	411.4 ohm
TB105 (2, 3)	LSH7803 Pump 1B Sump H	N/A		Closed contact	N/A	
TB105 (5, 6)	LSHH7803A Pump 1B Sump H.H.	N/A		Closed contact	N/A	
	P4-B Reactor trip switchgear TRN-S	N/A		Closed contact	N/A	
TB106 (2, 3)	PMY-868 RHR temperature	130°F	50° to 400°F	N/A	1.91 V	Computer set value
TB106 (5, 6)	PMY-862 RHR pressure	100 psig	0-700 psig	N/A	1.57 V	Computer set value

TABLE D1-1 (Cont)
SIMULATION NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB107	TE434 RCS T_c Loop 3	540°F	0-700°F	Potentiometer	TB103 (11, 12)	411.4 ohm
TB107	TE444 RCS T_c Loop 4	540°F	0-700°F	Potentiometer	TB103 (25, 26)	411.4 ohm
TB108	EN1, 2 and 3	N/A		N/A	Normally open	N/A
TB109	FT868 RHR Pump B flow	464	0-4000	Fixed resistor	1.0 V	4.0 mA

Procedure Rev. _____
Date: _____
Test #: _____

TYPE

RANDOM NOISE _____ MIL N10099 #1 _____
CROSSTALK NOISE _____ MIL N19900 #2 _____
SURGE TRANSIENT _____
TEST INJECTION POINT TB# _____ TYPE _____ POINT # _____ DRAWING _____
CONFIGURATION TABLE A1 _____ A2 _____

PRE-TEST

DATA LOGGER DATA VERIFICATION* PRINT OUTPUT # _____
SYSTEM STATUS: DPU _____ RPU _____ DISPLAY _____ DATA LINK _____
DISPLAY TYPE VALUE PAGE 1 PT406 ___ TE414 ___ TE424 ___ TE434 ___ TE444 ___
PAGE 3 LT467 ___ PAGE 8 FT868 ___
DATA LINK DATA BYTE RTC _____ CONTACT #1 _____ & #2 _____
REMARKS AND TEST OBSERVATION _____
_____
DISCONNECT DATA LOGGER _____

TEST

TAPE RECORDER FOOTAGE BEGIN _____ END _____ SET # _____
SPEED _____ TIME _____
SYSTEM STATUS: DPU _____ RPU _____ DISPLAY _____ DATA LINK _____
DISPLAY TYPE VALUE PAGE 1 PT406 ___ TE414 ___ TE424 ___ TE434 ___ TE444 ___
PAGE 3 LT467 ___ PAGE 8 FT868 ___
DATA LINK DATA BYTE RTC _____ CONTACT #1 _____ & #2 _____
REMARKS AND TEST OBSERVATION _____
_____
_____

POST-TEST

DATA LOGGER DATA VERIFICATION* PRINT OUTPUT # _____
SYSTEM STATUS: DPU _____ RPU _____ DISPLAY _____ DATA LINK _____
DISPLAY TYPE VALUE PAGE 1 PT406 ___ TE414 ___ TE424 ___ TE434 ___ TE444 ___
PAGE 3 LT467 ___ PAGE 8 FT868 ___
DATA LINK DATA BYTE RTC _____ CONTACT #1 _____ & #2 _____
REMARKS AND TEST OBSERVATION _____
_____
_____

PERFORMER _____ VERIFIER _____

NOTE:

Figure D1-1. Noise Test Data Sheet

REFERENCES

1. I&CDE/SID(86)-099, "Preliminary Test Plan Reference Document QDPS Noise and Fault Testing," dated June 20, 1986.

2. I&CDE/SID(86)-108, "Noise and Fault Testing Digital Data Link Isolators (QDPS)," dated June 27, 1986.

ATTACHMENT A

NOISE INJECTION "ANTENNA" CONNECTIONS

NOTE: "Antenna"* for noise injection is to be 40 foot of unshielded single conductor cable routed adjacent to external field cable terminated at the identified test field terminals. The "antenna" and test cable is to be separated from balance of simulated field cabling for effect analysis purposes. The test cable connection within the cabinet is to be conduit routed consistent with "isolated" installation design (Reference 1).

This attachment contains the following tables:

- Table D1-2 Noise Injection Field Connections
- Table D1-3 Alternate Configuration RPU TB101 and 102

* Antenna to be source impedance terminated or shorted to earth ground

TABLE D1-2
NOISE INJECTION FIELD CONNECTIONS

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB102	2	3	NC	RS-422 Encode/Decode Data Link	2D32406	Data link TX
DPU	TB201	2	3	NC	RS-422 Encode/Decode Data Link	2D33406	Data link TX
RPU	TB101	19	20	NC	RS-422 data link	2334D63	Data link RX
DPU	TB203	16	17	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train C display
DPU	TB203	2	3	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train A/Train C
DPU	TB203	5	6	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train C/Train A
DPU	DISPLAY	Train C connector			SWDK	2D33403	Data link Train C/display
DPU	TB204	5	6	N/A	High Level Voltage Output	2344D02	Output
DPU	TB205	8	9	N/A	Digital Contact Output (open)	2344D04	Output
DPU	TB205	8	10	N/A	Digital Contact Output (closed)	2344D04	Output
RPU	TB103	11	12	NC	Appendix R current loop input (nonrepeating)	2D33170	Output
RPU	TB104	12	13	NC	Appendix R RTD	2D33172	Output
RPU	TB105	5	6	N/A	Digital Contact Input (input open)	2344D01	Input
RPU	TB105	5	6	N/A	Digital Contact Input (input closed)	2344D01	Input
RPU	TB106	5	6	NC	4-20 mA Current Loop Output (powered)	2D31856	Output
RPU	TB108	5	6	N/A	Digital Contact Output (NO)	23344D04	Output
RPU	TB108	5	7	N/A	Digital Contact Output (NC)	23344D04	Output
RPU	TB109	11	12	NC	Appendix R Current Loop Input (analog repeating)	2D31856	Output

TABLE D1-3
ALTERNATE CONFIGURATION RPU TB101 AND 102

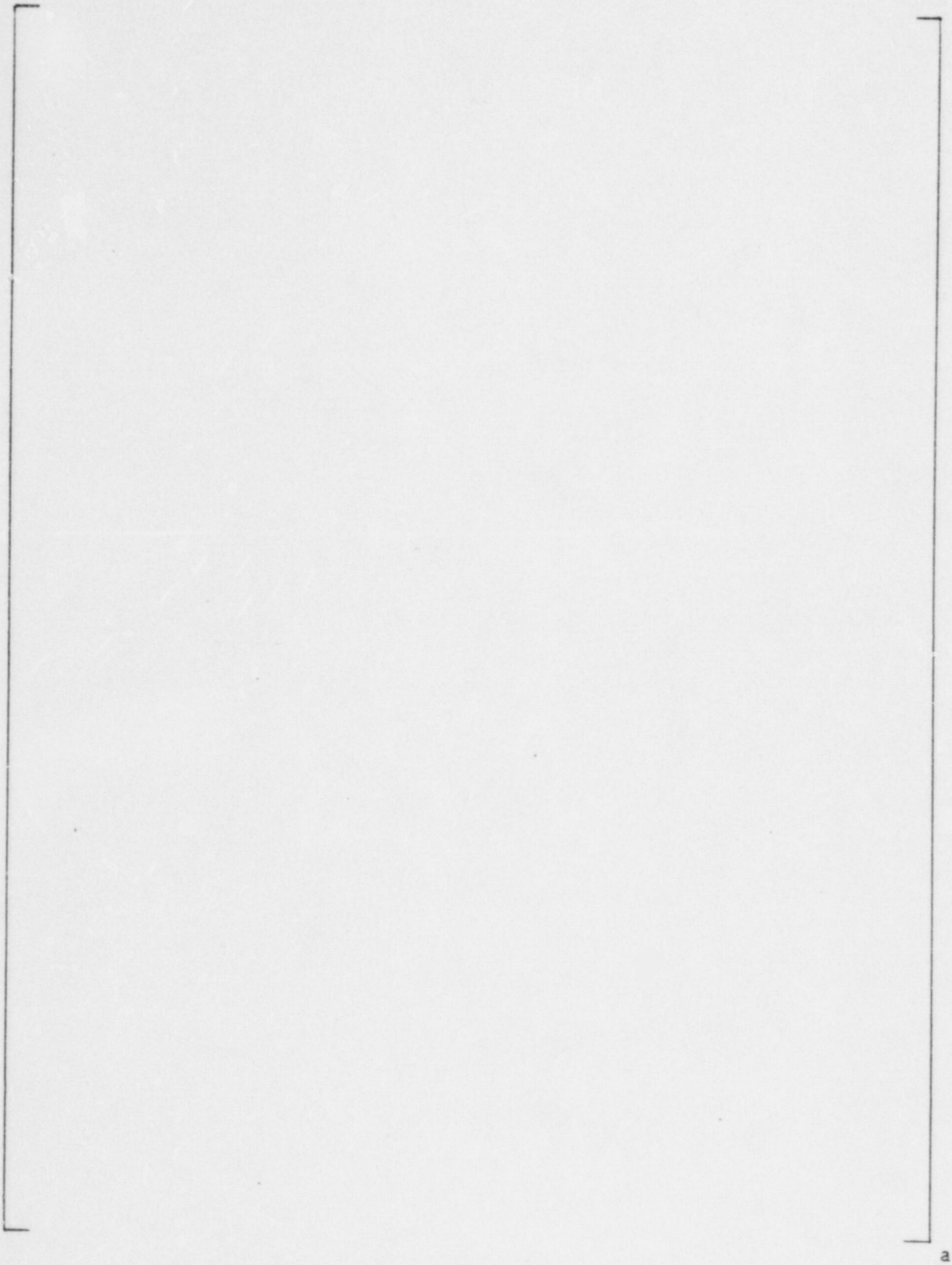
Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB101	2	3	NC	RS-422 Data Link	2334D63	Data link TX
RPU	TB102	19	20	NC	RS-422 Encode/Decode Data Link	2D32406	Data link RX

ATTACHMENT B

FIELD CONNECTIONS AND SIMULATION

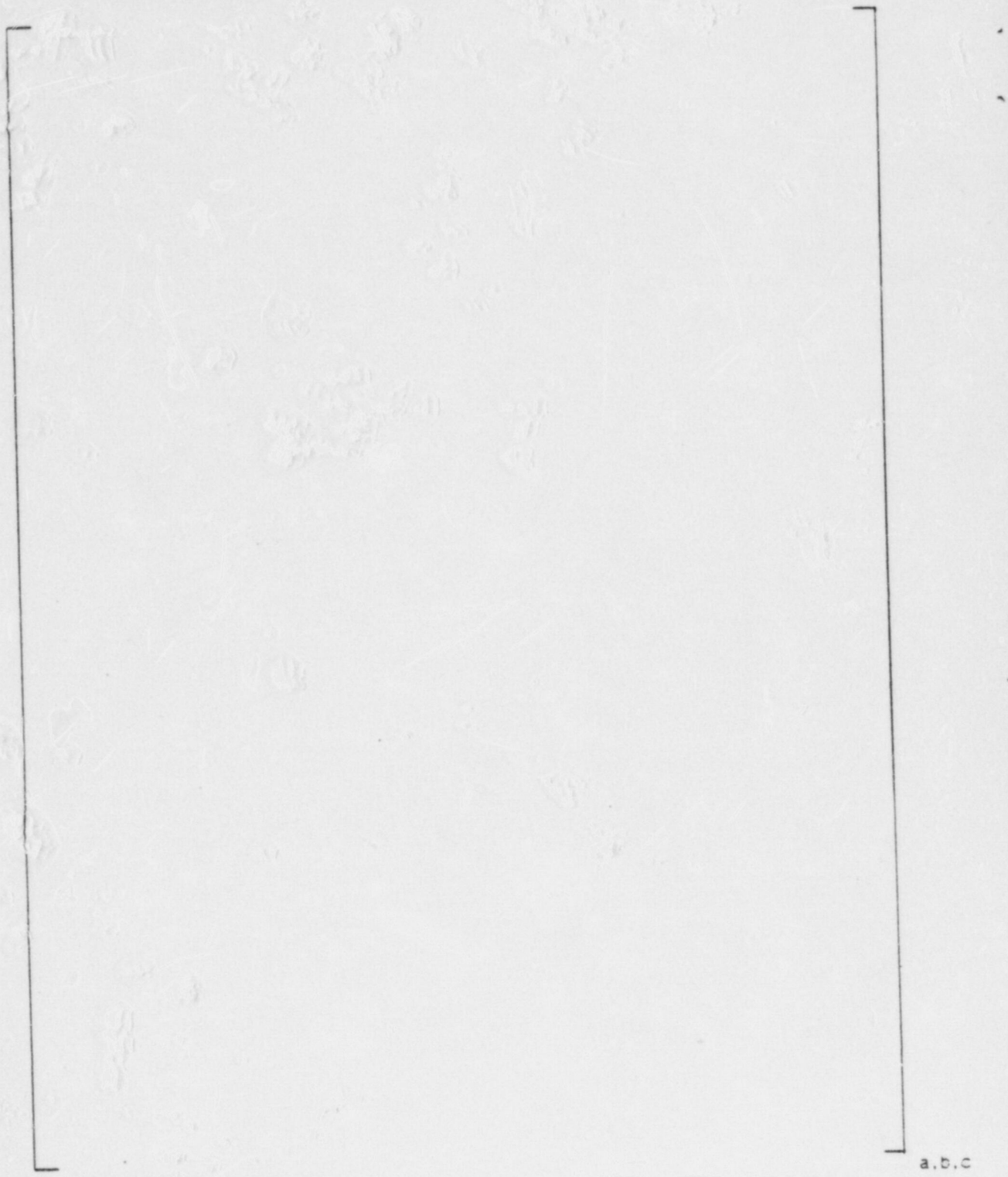
This attachment contains the following figures:

- Figure D1-2 Legends and Symbols for Field Connections Diagrams
- Figure D1-3 RPU Field Connections (2 sheets)
- Figure D1-4 RPU Alternate Field Connections, RPU Data Links
- Figure D1-5 DPU Field Connections
- Figure D1-6 4-20 mA Transmitter Simulator
- Figure D1-7 4-20 mA Current Loop Output
- Figure D1-8 Resistance Temperature Detector (RTD)
- Figure D1-9 Analog Output Channel Recording
- Figure D1-10 Contact Output Connection
- Figure D1-11 Dummy Load Termination, RS-422 Data Links
- Figure D1-12 "Appendix R" Cards, Remote Calibrate Simulation



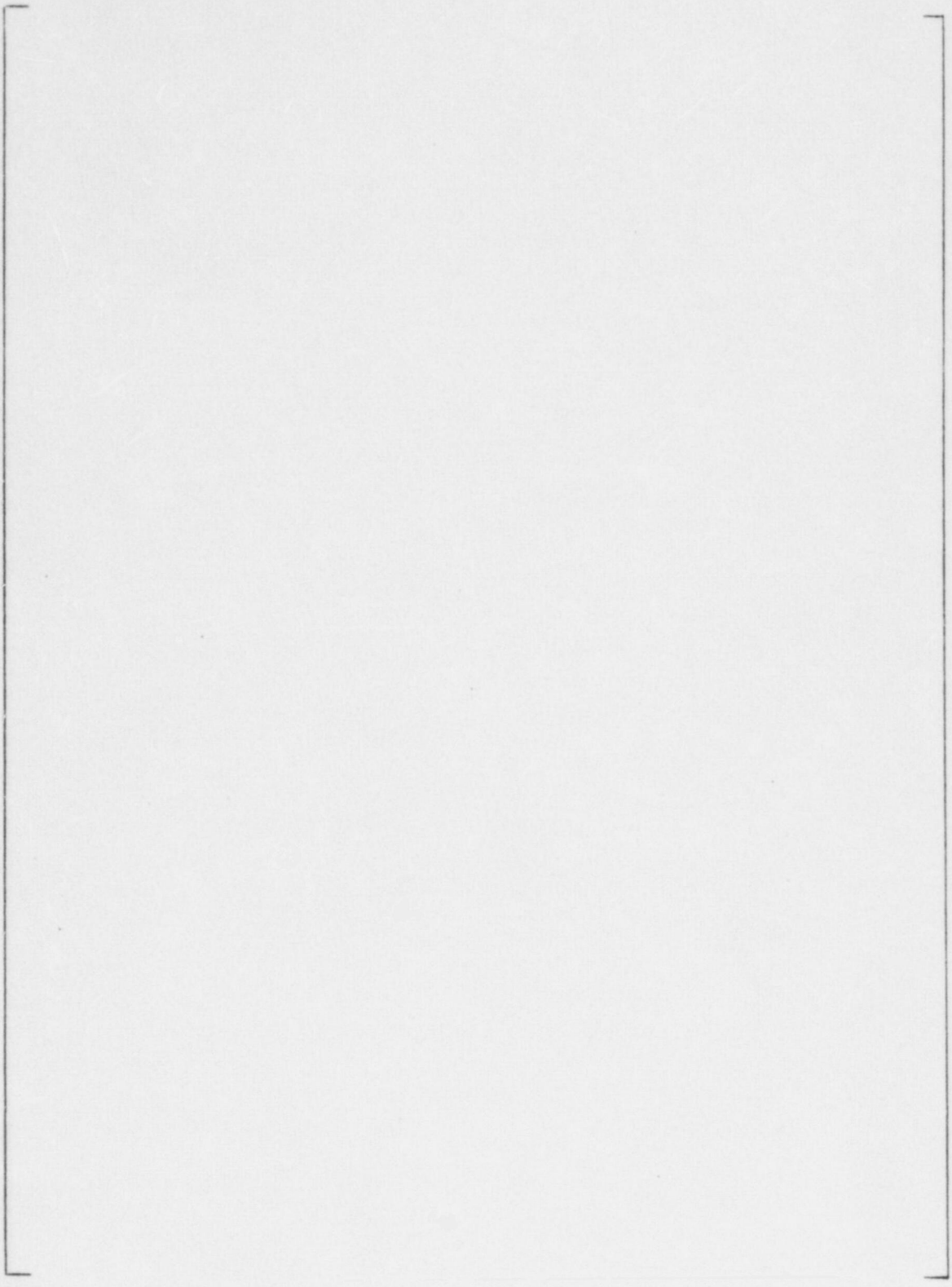
a,b,c

Figure D1-2. Legends and Symbols for Field Connections Diagram



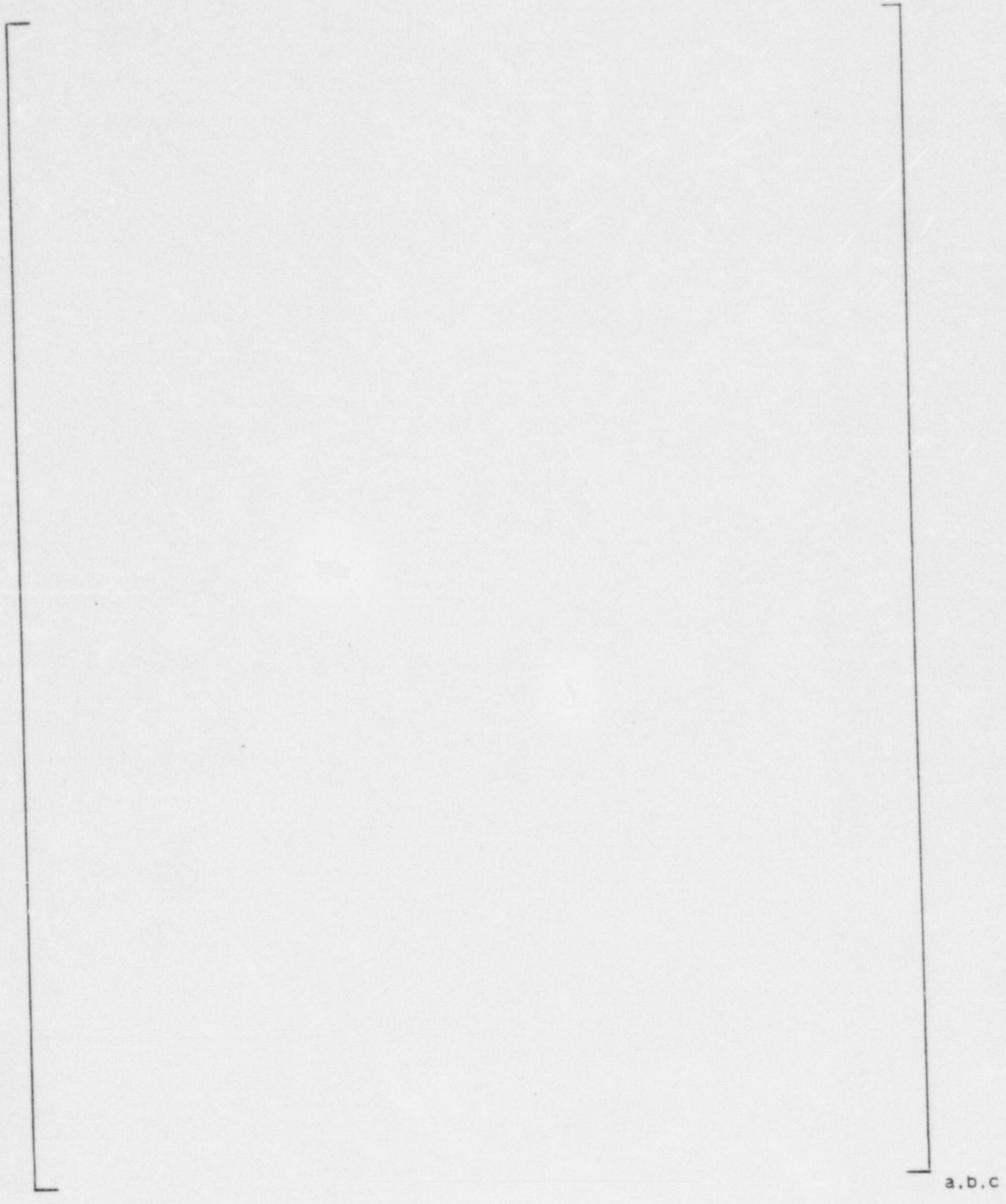
a,b,c

Figure D1-3. RPU Field Connections (sheet 1 of 2)



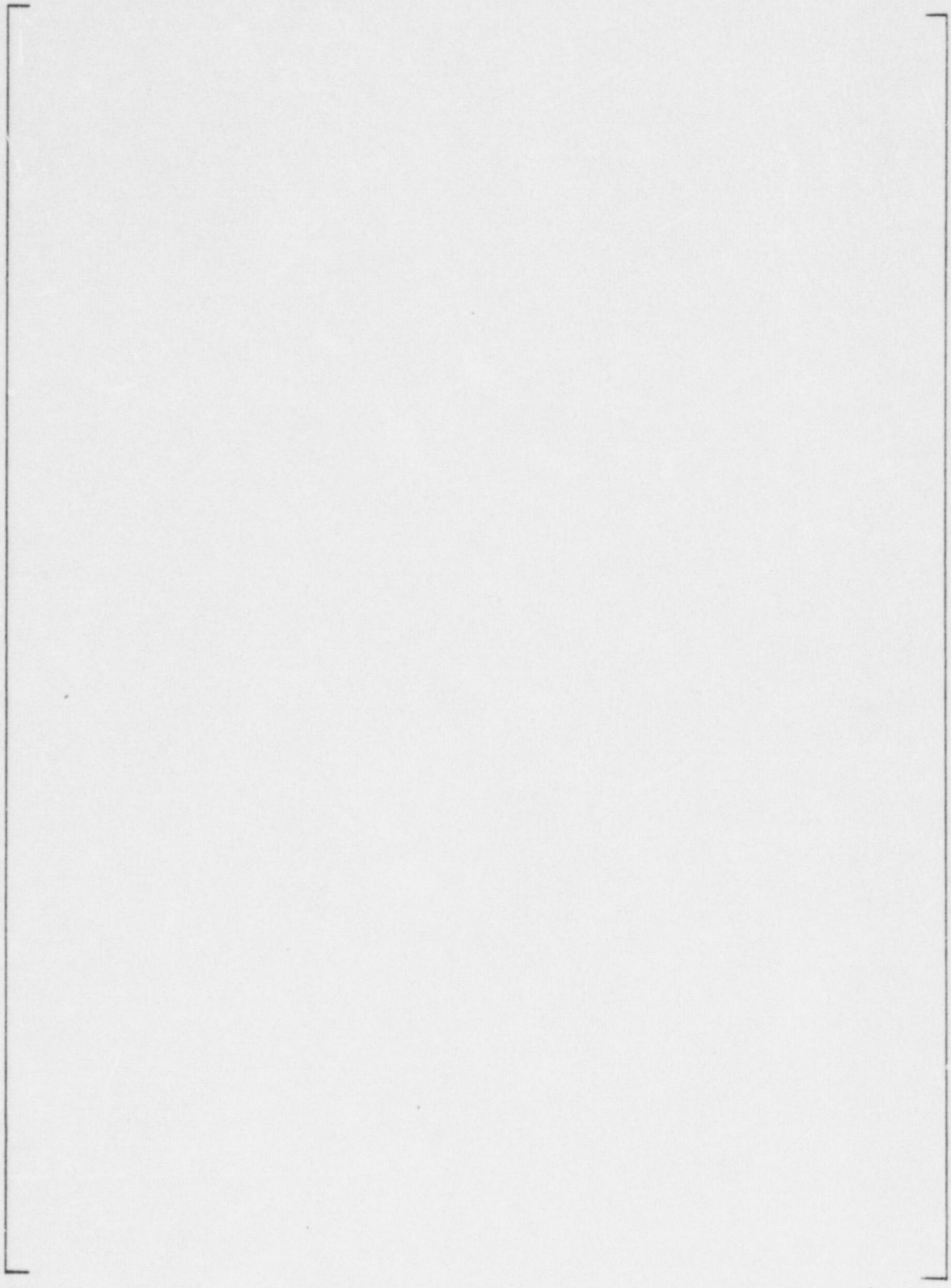
a,b,c

Figure D1-3. RPU Field Connections (sheet 2 of 2)



a,b,c

Figure D1-4. RPU Alternate Field Connections, RPU Data Links
(TB101 and 102 Only)



a,b,c

Figure D1-5. DPU Field Connections

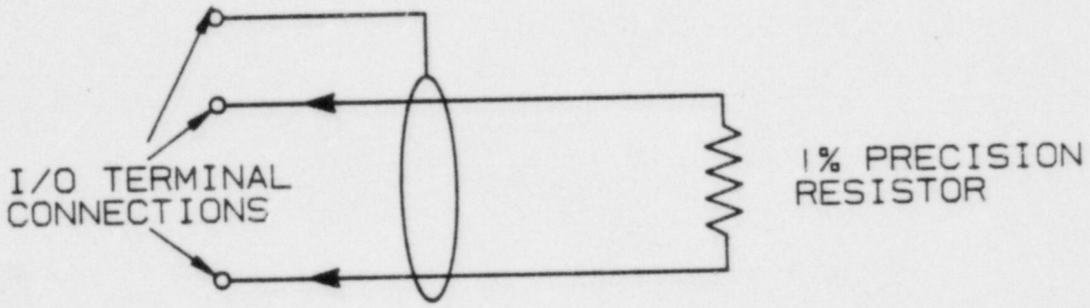


Figure D1-6. 4-20 mA Transmitter Simulator

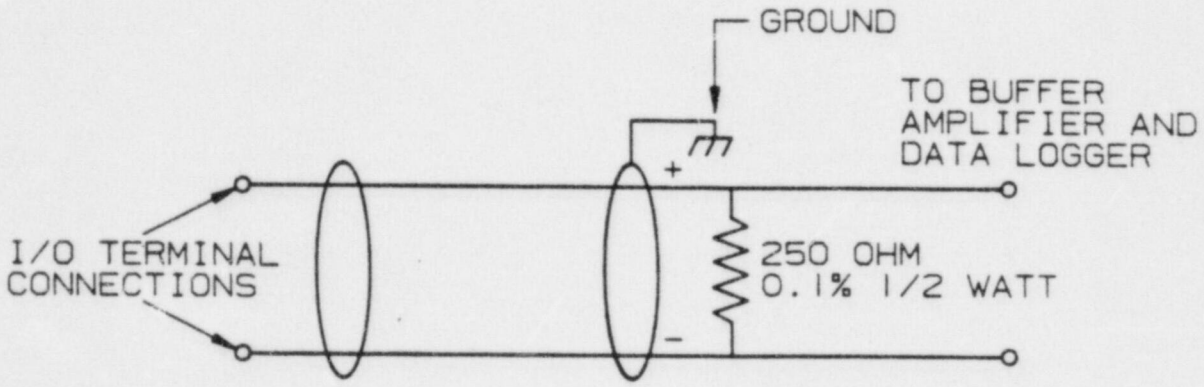


Figure D1-7. 4-20 mA Current Loop Output

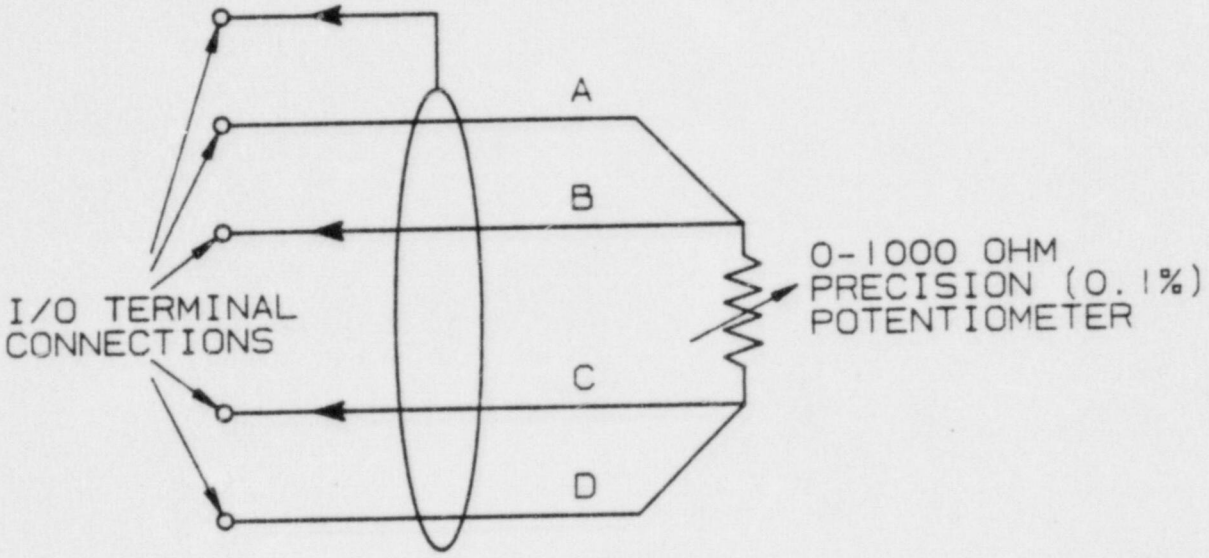


Figure D1-8. Resistance Temperature Detector (RTD)

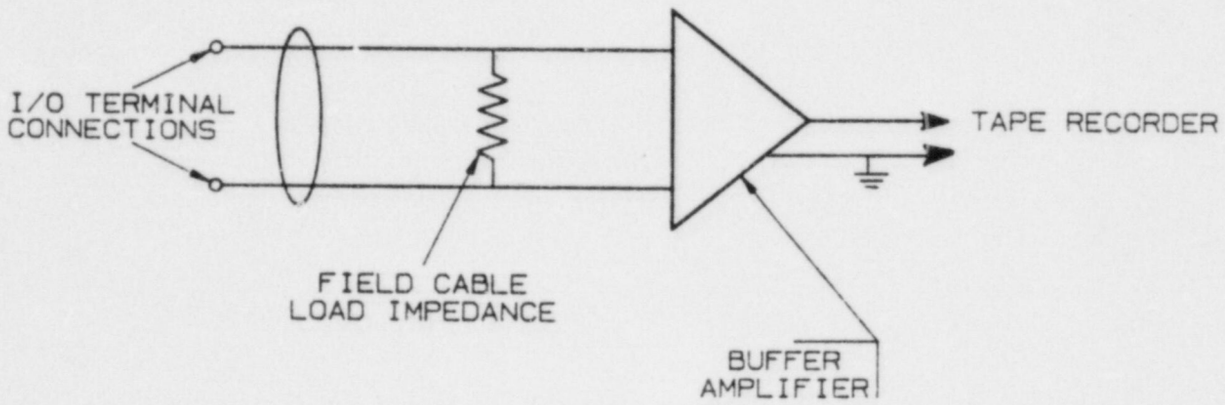


Figure D1-9. Analog Output Channel Recording

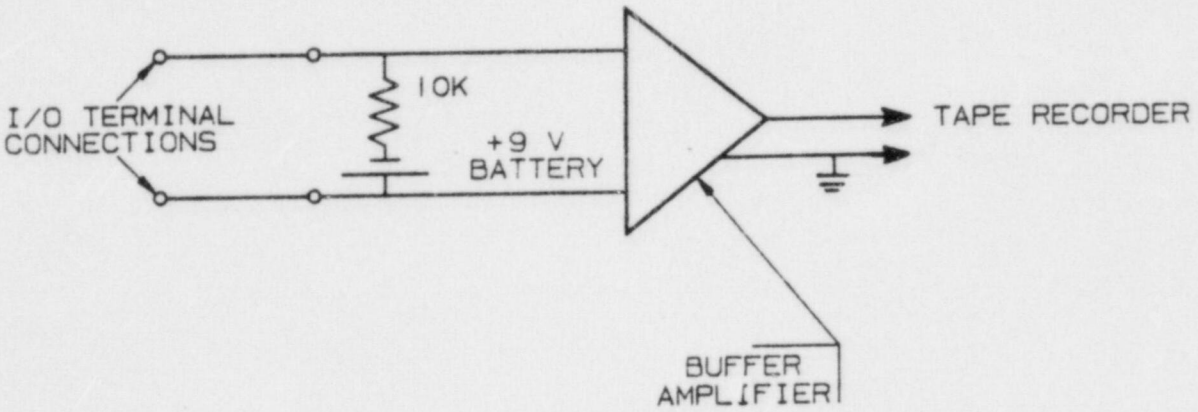
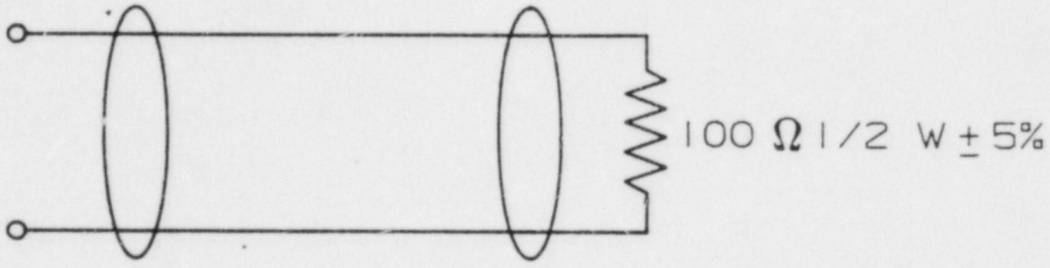


Figure D1-10. Contact Output Connection



APPLIED TO DATA LINKS
EXCEPT THOSE EFFECTING
INTER CONNECTIONS IN
TEST CONFIGURATION

Figure D1-11. Dummy Load Termination, RS-422 Data Links

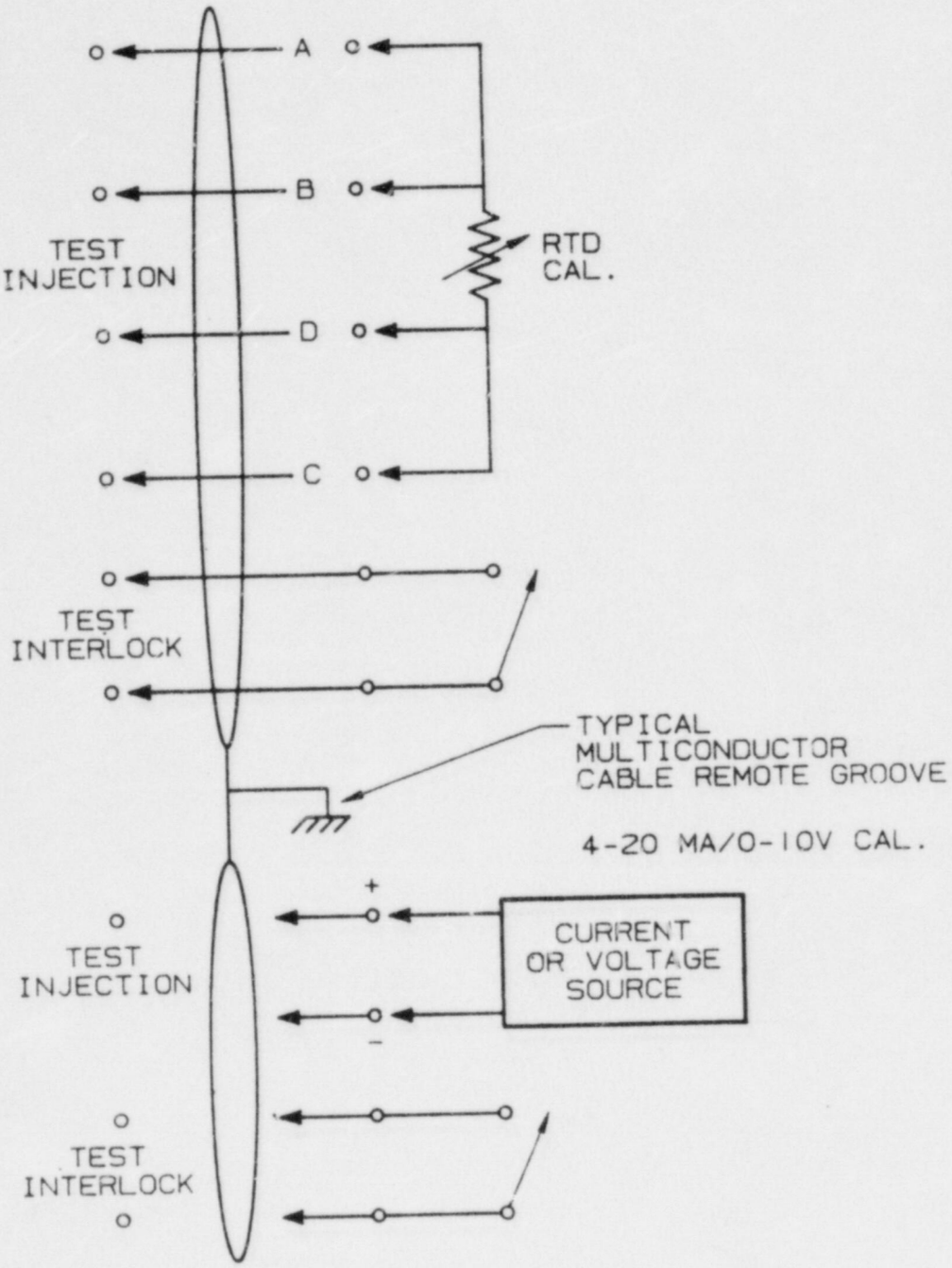


Figure D1-12. "Appendix R" Cards, Remote Calibrate Simulation

ATTACHMENT C

TRANSIENT DATA RECORDING SYSTEM CONNECTIONS AND SCALING

This attachment contains the following:

- Table D1-4 Tape-Recorded Data

TABLE D1-4
TAPE-RECORDED DATA

Tape Recorder Channel	Reference I/O Function	TB Connection
1	Noise/source	N/A
[redacted]		

b,c

PART D2

FAULT TEST PROCEDURE

(The shielding test in the fault test procedure was not performed.)

DATE
7/30/86

REVISION NO.
0

FAULT TEST PROCEDURE

FOR

PSMS, QDPS, RVLIS-86

AND ICC-86

APPROVALS

	ORIGINAL	REV. 0	REV. 1	REV. 2
AUTHOR	C. N. Nasrallah			
REVIEWED	J. R. Smith			
MANAGER	W. Ciaramitaro			
QUALITY ASSURANCE	R. Saupe			

1.0 INTRODUCTION

This procedure details the electrical fault tests to be applied to a test configuration representative of a variety of plant equipment arrangements as described in References 1 and 2.

The test configuration is documented in sketches CNN61086, CNN62086, and CNN62286, Sheets 1 and 2, which become part of these test records as modified by this procedure and references above.

2.0 PREPARATION FOR TEST

2.1 Verify record sheet per Table 3-4, Page 17, References 1 and 3, for each P.C. board in the configuration. Identify QA records files. Record all test observations in a "Permanent Record Book."

2.2 Connect the field cabling to sensor simulation, load simulation, contact input (SPDT) simulation, contact output loads, and remote interlock/test injection per Reference 3.

2.3 Perform calibration of the system as follows:

2.3.1 Load plant software to DPU and RPU. Obtain printout of "PROM" operating software for test records.

2.3.2 a. Perform, verify, and record "self cal" values.

b. Input analog (voltage and current) and resistance values corresponding to 0 - 100% of scale in 20% increments and record.

2.3.3 Perform and verify calibration of analog repeater function module slot TB109. Record values 0, 20, 40, 60, 80, and 100% FS.

2.3.4 Set up "normal" operate simulation parameter per Table D2-1.

2.3.5 Verify that the analog output parameters and display values agree with Table D2-1.

a. Make a printer plot output record of all display pages per above.

b. Connect digital data logger and record "normal" analog output values. Per Table D2-1, disconnect the digital data logger. (Note: Digital data logger to be pretest and post test verification of system status only. It shall be disconnected during fault tests.)

c. Connect tape recorder per Table D2-2 and record for six (6) minutes.

d. Play back the above data on Visicorder and verify calibration of record/playback data system. (Compare with data logged values (b) above.)

e. Recalibrate, if necessary, and make a "reference" cross calibration of (b), (c), and (d) above.

2.3.6 Make a six (6) minute tape record of above except turn off RPU at two (2) minutes into the run (monitor switch) and turn back on at four (4) minutes into the run. Record observations.

2.3.7 Repeat the above except turn off DPU (monitor switch) at +2 minutes and restore at +4 minutes. Record observations.

TABLE D2-1
SIMULATION NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB204	FI-417A	100%	0-120%	N/A	8.33 V	Computer set value
TB204	FI-437A	100%	0-120%	N/A	8.33 V	Computer set value
TB205	System alarms	N/A		N/A	N/A	Normally open
TB103 (2, 3)	LT-467 Pressurizer level	56%	0-100%	Fixed resistor	N/A	
TB103 (11, 12)	TE434				4.09 V	
TB103 (16, 17)	PT-406 RCS Wide range pressure	1981 psig	0-3000 psig	Fixed resistor	N/A	16.26 mA
TB103 (26, 27)	TE444				4.09 V	
TB104	TE414 RCS T_c Loop 1	540°F	0-700°F	Potentiometer	4.09 V	411.4 ohm
TB104	TE424 RCS T_c Loop 2	540°F	0-700°F	Potentiometer	4.09V	411.4 ohm
TB105 (2, 3)	LSH7803 Pump 1B Sump H	N/A		Closed contact	N/A	
TB105 (5, 6)	LSHH7803A Pump 1B Sump H.H.	N/A		Closed contact	N/A	
	P4-B Reactor trip switchgear TRN-S	N/A		Closed contact	N/A	
TB106 (2, 3)	PMY-868 RHR temperature	130°F	50° to 400°F	N/A	1.91 V	Computer set value

TABLE D2-1
SIMULATION NORMAL PARAMETER VALUES (CONT)

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB106 (5, 6)	PMY-862 RHR pressure	100 psig	0-700 psig	N/A	1.57 V	Computer set value
TB107	TE434 RCS T_c Loop 3	540°F	0-700°F	Potentiometer	TB103 (11, 12)	411.4 ohm
TB107	TE444 RCS T_c Loop 4	540°F	0-700°F	Potentiometer	TB103 (25, 26)	411.4 ohm
TB108	EN1, 2 and 3	N/A		N/A	Normally open	N/A
TB109	FT868 RHR Pump B flow	464	0-4000	Fixed resistor	1.0 V	4.0 mA

TABLE D2-2
TAPE-RECORDED DATA

Tape Recorder Channel	Reference I/O Function	TB Connection
1	Fault/source	N/A
[redacted]		

b,c

2.3.8 Reconnect digital data logger and display plotter and record values. Values should agree ± 0.5% FS with 2.3.5(b) above.

2.3.9 Using a shorted cable, verify maximum fault current and time duration per Attachment B. Verify that "line" protector fuses blow. Refer to Figures D2-4 and D2-5.

3.0 FAULT TEST PROCEDURE SEQUENCE

3.1 Pretest

Using digital data logger and display observation, verify "normal" condition of systems per calibration values of 2.3.8 above, and Table D2-1.

3.2 Disconnect the data logger and verify "fault" connections and configuration for each injection point of Attachment A.

3.3 Connect fault source; verify connection of recorder per Table D2-3 and readiness of tape recorder data logger system. Enter identifying records in tape recorder log.

3.4 Set the display unit to observe the page indicating the respective parameter subject to fault injection (where applicable), and record any change in the error message in the APC status block during each test.

3.5 Run the tape recorder for two (2) minutes for pretest data, apply fault source for two (2) minutes, and stop recorder after a two (2) minute post test period. Record all observed effects if any on system display, monitoring oscilloscope and digital CRT (TB202 16-17 "buffered" data link).

3.6 Observing the display, oscilloscope, and CRT data monitor for system continuity, note and record observations.

Note: Continuity of System Functionality of I/O such as "RTC" not addressed by analog or display page outputs to be software addressed and observations recorded using "buffer" connected CRT monitor. Record address function and operating status observed.

3.7 If observation indicates an anomaly during the test, tape recorded data should be played back on the Visicorder and observations recorded before proceeding.

3.8 Reconnect the data logger and confirm calibrations are retained + 0.5%. Verify that the display data supports the calibration data. Record any discrepancies.

3.9 With system confirmed to be in pretest condition, proceed to the next test.

4.0 Go to 5.0 Short Circuit.

5.0 SHORT CIRCUIT

5.1 The (+) "high" (-) "low" terminals of TB102 Table A-1 to be switched to earth ground at fault time and switched event marked on recorder channel number 1 (Figure D2-1).

(NOTE: The normal load or input simulator on analog channels will be retained in place for this testing to record recovery following short circuit time interval.)

5.2 Repeat above for each TB designation of Table D2-4.

CAUTION: CONNECTIONS IN PLANT COULD USE EARTH CONNECTION ON REMOTE EQUIPMENT. FOR PURPOSES OF THESE TESTS (6 AND 7) SIMULATED LOADING SHALL BE FLOATING. (DISCONNECT 4-20 mA EARTH GROUND).

TABLE D2-3
TAPE RECORDER CONNECTION AND RELOCATION DURING FAULT TESTS

Tape Recorder Channel	Reference I/O Function	T.B. Connection	Connections Remarks
1	Fault Source		Test Reference
[redacted]			

D.C

* Relocation only when fault injection is applied to these terminals

6.0 250 VOLT DC COMMON MODE

The following tests are to be applied to field connections connected to I/O modules per Table D2-4 to each (+) high and (-) low term and 250-volt fault voltage source and test per sequence 3.0 above as follows:

6.1 With 250-volt negative potential applied to earth ground, switch (+) fault voltage to (+) higher terminal (TB102 Table D2-4).

6.2 Repeat 6.1 above except switch fault to (-) low terminal (TB102).

6.3 With 250 volt positive potential applied to earth ground switch (-) fault voltage to (+) high terminal. TB102.

6.4 Repeat 6.3 above except fault voltage switched to (-) low terminal. TB102.

6.5 Repeat 6.1 to 6.4 above for each TB designation of Table D2-4.

7.0 580V AC COMMON MODE FAULT TEST

7.1 With a 580 volt fault source lead connected to earth ground and test sequence per 3.0 above, switch 580 volt fault source to the (+) high terminal of Table D2-4 (TB102).

7.2 Repeat 7.1 above, except switch fault source to (-) low terminal per Table D2-4.

LINE-TO-LINE FAULTS

CAUTION: The following tests are destructive of isolation components, wiring, and circuitry. Simulated inputs or load terminations are to be disconnected and recorder channels relocated and restored from fault terminals to alternate terminals per Table D2-3. Wire size from fault source to be 16 awg min. with a length of 40 feet.

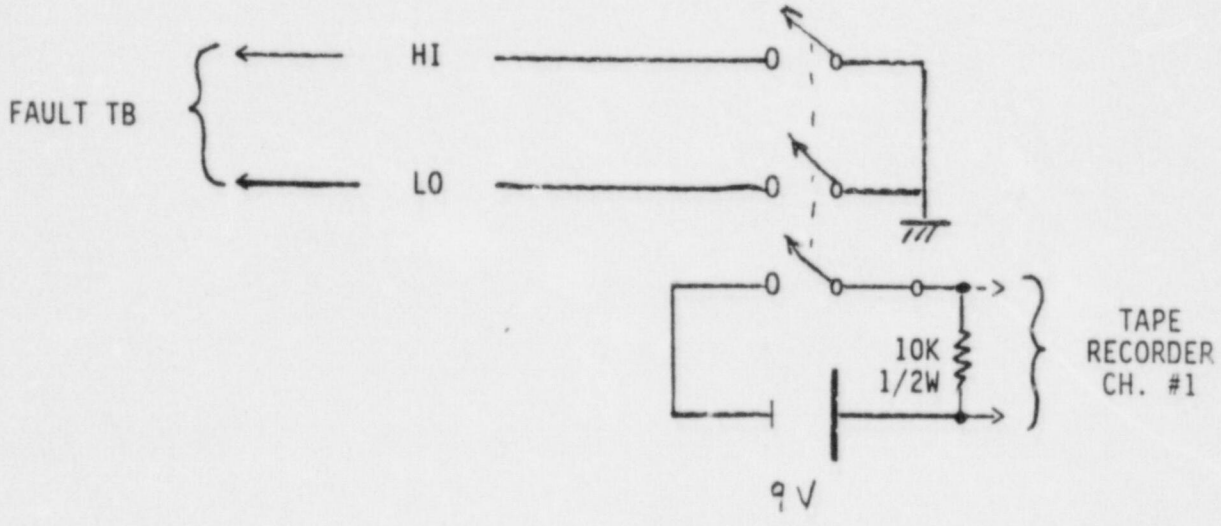


Figure D2-1. Short Test Tape Recorder Event Marker

Tests are to be conducted twice. The initial tests of Section 8 through 15 will be fuse-protected as per original design configuration (Test Series A).

Following the above fault test series, I.O. board fuses interfacing respective fault terminals of Tables D2-4 to D2-7 to be shorted out at I/O board fuse holders. Fault interruption in this case will be either due to I/O board circuit/component failures and/or the fault source protective fuse (20 amp).

Repeat testing Section 8 through 15 (Series B) with the reduced I/O board protection.

Following each test repair or replace boards as required to restore to original condition before proceeding to the next test.

8.0 125 VOLT DC LINE-TO-LINE FAULT TEST

8.1 Connect the (-) negative lead wire of the 125 volt dc 20 amp fused fault source to earth ground and with the test sequence 3.0 above, switch fault voltage plus (+) to (+) high and minus (-) to (-) low terminals (source line to isolator lines).

8.2 Repeat 8.1 above except reverse fault source polarities.

8.3 Repeat 8.1 and 8.2 for each TB of Table D2-4.

9.0 125V AC LINE-TO-LINE FAULT

9.1 For this test, one terminal of the 125 volt AC source to be connected to earth ground. The (+) high and (-) low terminals of Table D2-4 are switched to the "hot line" and earth ground respectively, observing the test sequence 3.0 above, beginning with TB102.

9.2 Repeat above for each TB designated in Table D2-4.

MAXIMUM CREDIBLE FAULTS

CAUTION: THE FOLLOWING TESTS APPLY ONLY TO A FEW SELECTED TERMINALS (Tables D2-6 and D2-7).

10.0 250 VOLT DC LINE TO LINE FAULT TEST

10.1 Connect the (-) negative lead wire of the 250 volt DC 20 amp fused source fault to earth ground and with the test sequesnce 3.0 above, switch fault voltage plus (+) to (+) high and minus (-) to (-) low terminals (source line to isolator lines).

10.2 Repeat 10.1 above except reverse fault source polarities.

10.3 Repeat 10.1 and 10.2 for each TB of Table D2-6.

11.0 580V AC LINE-TO-LINE FAULT

11.1 For this test, one terminal of the 580 volt AC source is to be connected to earth ground. The fault (+) high and (-) low terminals of Table D2-6 are switched to the "hot line" and earth ground, respectively, observing the test sequence 3.0 above, with TB102.

11.2 Repeat above for each TB designated in Table D2-6.

12.0 ALTERNATE CONFIGURATION RPU

12.1 Reconfigure RPU data link modules and interconnections per Table D2-5 and repeat fault tests 5.0 through 9.0 except apply to TB test points of Table D2-5.

13.0 ALTERNATE CONFIGURATION MAXIMUM, CREDIBLE FAULTS

13.1 With equipment arrangement in alternate configuration per 12.0 above, repeat fault tests 10.0 and 11.0 except apply to TB test points of Table D2-7.

14.0 "CLI" APPENDIX R BOARD TEST INJECTION MODE

14.1 Set test permissive switches remote (TB109, 5 and 6) and location (J3, 3 and 4 shorted) to test position.

14.2 Perform remote calibration check to verify that "on test" conditions are established.

14.3 Perform common mode and line fault tests per Section 5 through 8 with connections to TB103-19 (+) and TB103-20 (-).

14.4 Restore above test permissive switch to off (normal).

14.5 Repeat tests Section 5 through 8 above except apply to TB103-22 (+) and TB103-23 (-).

14.6 Replace fuses on CLI I/O board installed in TB109 with shorted fuses per above (F5 and F8), and repeat tests 14.3 through 14.5 (Series B tests).

15.0 RTD APPENDIX R BOARD TEST INJECTION MODE

15.1 Set test permissive switches remote (TB104, 10 and 11) and local (J3, 3 and 4) to test position.

15.2 Verify channel 1 "on test" status by remote calibration check.

15.3 Apply common mode and fault tests Section 5.0 through 8.0 to TB104-8 (+) and TB104-9 (-).

15.4 Repeat 15.3 above except apply to TB104-6 (+) and TB104-7 (-).

15.5 Restore the above test permissive switch to normal.

15.6 Apply common mode and fault tests Section 5 through 8 to TB104-10 (+) and TB104-11 (-).

15.7 Replace design fuses with shorted fuses on RTD I/O board (F5, F8 and F10) in TB104 position and repeat tests 15.3 through 15.6.

16.0 SHIELD FAULT TESTS

Note: This testing, Sections 16 through 22, is dependent on the manner in which field cable shields are terminated on respective field terminations. Shields must be reconnected from the manner defined in the reference test configuration (pigtail to the ground bus) to that which may be employed in other plants for these tests. That is, the adjacent terminal block screw connection associated with respective analog signals rather than "pigtailed" to cabinet ground bus.

Field connections affected in the above manner are routed to earth ground via copper clad traces on the respective P.C. boards. Testing is required to demonstrate that cabinets field wired in this manner retain isolation in the event of an accidental fault applied to the insulated shield wiring. For this case, the accident is assumed to occur with a single contact of the shield to the "hot line" of a grounded fault source.

16.1 Reconnect field cable shields to respective adjacent TB screw connection on:

DPU: TB201-4, TB201-21, TB-202-4, TB203-4, TB203-7, TB203-18, TB-204-4, TB204-7

RPU: TB101-4, TB102-4, TB102-21
TB103-1, TB103-14, TB103-15, TB103-28*
TB104-1, TB104-14, TB104-15, TB104-28, TB106-4, TB106-7*
TB107-1, TB107-14, TB107-15, TB107-28, TB109-4, TB109-13*

*Note: Cabinet wiring calls for direct connection to cabinet ground bus in all cases for these boards.

With the alternate termination of field shield wiring per above proceed with testing as follows:

17.0 125 VOLT DC SHIELD FAULT TEST

17.1 Connect the negative lead wire of the 125 volt dc 20A fused fault source to earth ground at cabinet bus bar (with display unit ground similarly connected). Following test sequence of 3.0 above, switch the +125 volt dc fault to the insulated shield wire connected to TB102-21 of Table D2-8.

17.2 Repeat 17.1 above for each shield terminal of Table D2-8.

18.0 125 VOLT AC SHIELD FAULT TEST

18.1 Repeat 17.1 and 17.2 above except use 125 volt ac grounded 20A fused fault source and "hot line" connected to shield terminals of Table D2-8.

19.0 SHIELD FAULTS, ALTERNATE RPU CONFIGURATION

19.1 With RPU reconfigured per Table D2-9, repeat shield fault testing 17 and 18 above except apply to shield terminals of Table D2-9.

20.0 250 VOLT DC SHIELD FAULTS

20.1 Connect the negative lead wire of the 250 Volt dc 20A fused fault source to earth ground per 17.1 above and per test sequence 3.0 switch 250V dc fault to shield terminal TB102-21 per Table D2-10.

20.2 Repeat 20.1 above for each TB designation of Table D2-10.

21.0 580 VOLT AC, SHIELD FAULTS

Repeat fault tests 20.0 above except using 580 volt ac 20A fused fault source ground and hot line switched fault respectively applied to terminals of Table D2-10 in test sequence 3.0.

22.0 250V DC/580V AC SHIELD FAULTS; ALTERNATE CONFIGURATION

22.1 Reconfigure RPU datalink per Table D2-11 and repeat shield fault tests 20 and 21 above, except apply to shield TB designations of Table D2-11.

Procedure Rev. _____
Date _____
Test # _____

I/O Module _____

TYPE

SHORT CIRCUIT _____, AC _____, DC _____

COMMON MODE _____ GROUND CONNECTED TO VOLTS PLUS _____ MINUS _____ GROUND

LINE TO LINE _____ VOLTS (+) TO (+) _____ (+) TO (-) _____
VOLTS (-) TO (+) _____ (-) TO (-) _____

I/O MODULES TB _____ TYPE _____ POINT _____

PRE-TEST

DATA LOGGER CALIBRATION VERIFICATION

REMARKS _____

_____

DISCONNECT DATA LOGGER _____

TAPE RECORDER FOOTAGE BEGIN _____ END _____ SET # _____

DISPLAY PAGE _____

RTC BYTE _____ CONTACT #1 IN BYTE _____ #2 _____

CRT OBSERVATION POINTS _____

TEST OBSERVATIONS:

_____

_____

_____

POST-TEST OBSERVATIONS (DISPLAY AND STATUS):

_____

_____

_____

POST-TEST DATA LOGGER CALIBRATION VERIFICATION:

_____

_____

_____

_____

PERFORMED _____ VERIFIED _____

Figure D2-2. Fault Test Data Sheet

REFERENCES

1. I&CDE/SID(86)-099, "Preliminary Test Plan Reference Document QDPS Noise and Fault Testing," dated June 20, 1986.

2. I&CDE/SID(86)-108, "Noise and Fault Testing Digital Data Link Isolators (QDPS)," dated June 27, 1986.

3. Noise Test Procedure for PSMS, QDPS, RVLIS-86 and ICC-86, I&CDE/SID(86)-112.

ATTACHMENT A
FAULT CONNECTIONS

This attachment contains the following tables and figures:

- Table D2-4 Field Connections Fault Testing
- Table D2-5 Alternate Configuration RPU TB101 and 102
- Table D2-6 Field Connections for 250 VDC and 580 VAC Faults
- Table D2-7 Alternate Configuration RPU TB101 and 102
- Figure D2-3 Typical Block Diagram of RPU and DPU Subsystems
- Figure D2-4 dc Power Supply Fault Connections
- Figure D2-5 ac Fault Connections

TABLE D2-4
FIELD CONNECTIONS FAULT TESTING

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB102	2	3	NC	RS-422 Encode/Decode Data Link	2D32406	Data link TX
DPU	TB201	2	3	NC	RS-422 Encode/Decode Data Link	2D33406	Data link TX
RPU	TB101	19	20	NC	RS-422 data link	2334D63	Data link RX
DPU	TB203	16	17	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train C display
DPU	TB203	2	3	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train A/Train C
DPU	TB203	5	6	NC	RS-422 Encode/Decode Data Link	2D33406	Data link Train C/Train A
DPU	DISPLAY	Train C connector			SWDK	2D33403	Data link Train C/display
DPU	TB204	5	6	N/A	High Level Voltage Output	2344D02	Output
DPU	TB205	8	9	N/A	Digital Contact Output (open)	2344D04	Output
DPU	TB205	8	10	N/A	Digital Contact Output (closed)	2344D04	Output
RPU	TB103	11	12	NC	Appendix R current loop input (nonrepeating)	2D33170	Output
RPU	TB104	12	13	NC	Appendix R RTD	2D33172	Output
RPU	TB105	5	6	N/A	Digital Contact Input (input open)	2344D01	Input
RPU	TB105	5	6	N/A	Digital Contact Input (input closed)	2344D01	Input
RPU	TB106	5	6	NC	4-20 mA Current Loop Output (powered)	2D31856	Output
RPU	TB108	5	6	N/A	Digital Contact Output (NO)	23344D04	Output
RPU	TB108	5	7	N/A	Digital Contact Output (NC)	23344D04	Output
RPU	TB109	11	12	NC	Appendix R Current Loop Input (analog repeating)	2D31856	Output

TABLE D2-5
ALTERNATE RPU TB101 AND 102

Section	Terminal Block Reference	Connections Hi	Connections Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB101	2	3	NC	RS-422 Data Link	2334D63	Data link TX
RPU	TB102	19	20	NC	RS-422 Encode/Decode Data Link	2D32406	Data link RX

TABLE D2-6
FIELD CONNECTIONS FOR 250 VDC and 580 VAC FAULTS

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Non 1E/App. R Function
RPU	TB102	2	3	NC	RS-422 Encode/Decode Data Link	2D32406	Data Link TX/RTC
RPU	TB101	19	20	NC	RS-422 Data Link	2334D63	Data Link ERF
DPU	TB204	5	6	N/A	0-10V Output	2344D02	Output
RPU	TB105	5	6	N/A	Digital Contact Input (Input Open)	2344D01	Input
RPU	TB106	5	6	NC	4-20 mA Output (Powered)	2D31856	Output
RPU	TB108	5	6	N/A	Digital Contact Output (NO)	23344D04	Output
RPU	TB108	5	7	N/A	Digital Contact Output (NC)	23344D04	Output

TABLE D2-7
ALTERNATE CONFIGURATION RPU TB101 AND 102

Section	Terminal Block Reference	Connections H1	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Non 1E/APP. R Function
RPU	TB101	2	3	NC	RS-422 Data Link	2334D63	Data Link TX
RPU	TB102	19	20	NC	RS-422 Encode/Decode Data Link	2D32406	Data Link RX

Note: Caution: For line-to-line faults, disconnect from DPU.

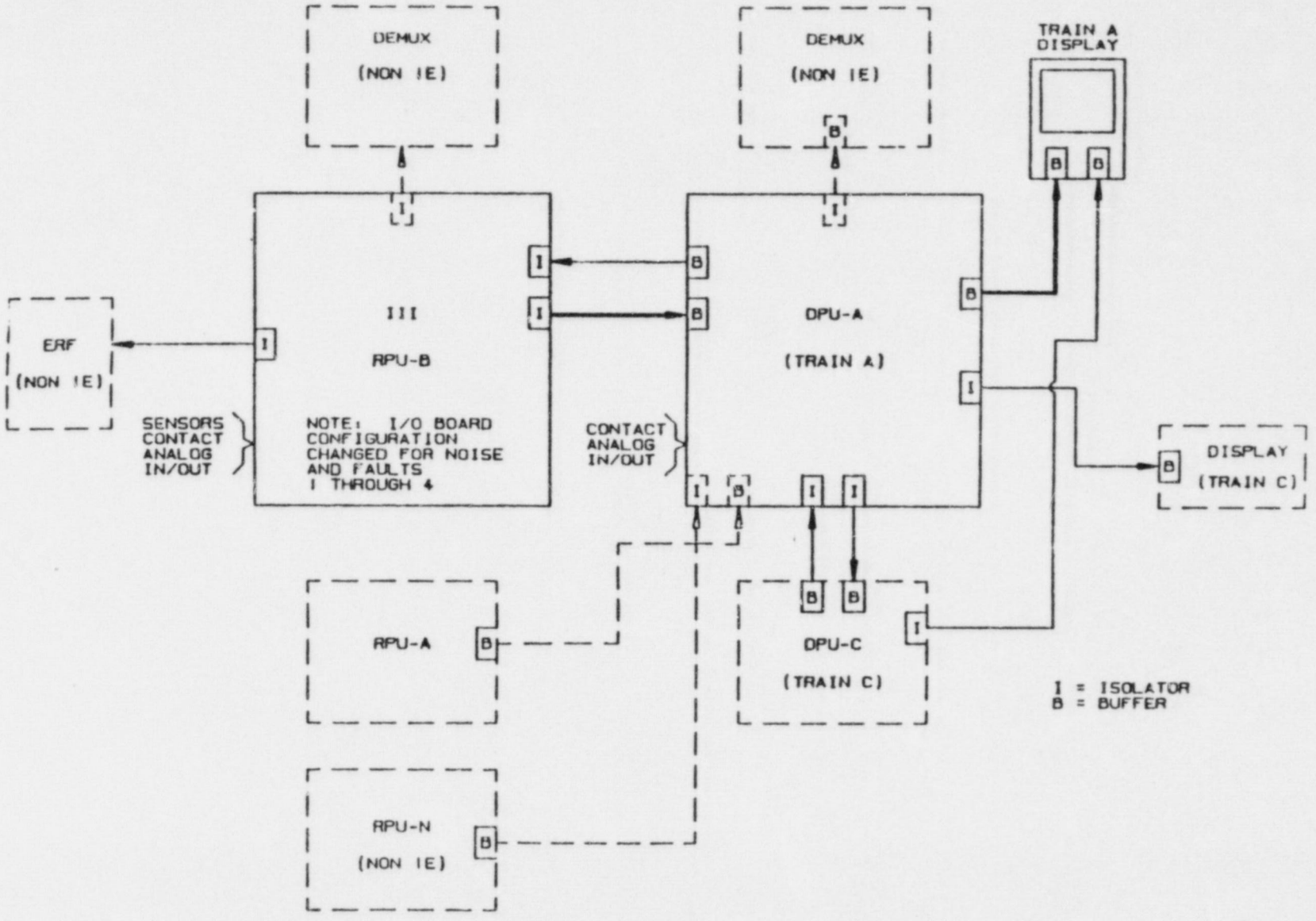


Figure D2-3. Typical Block Diagram of RPU and DPU Subsytems

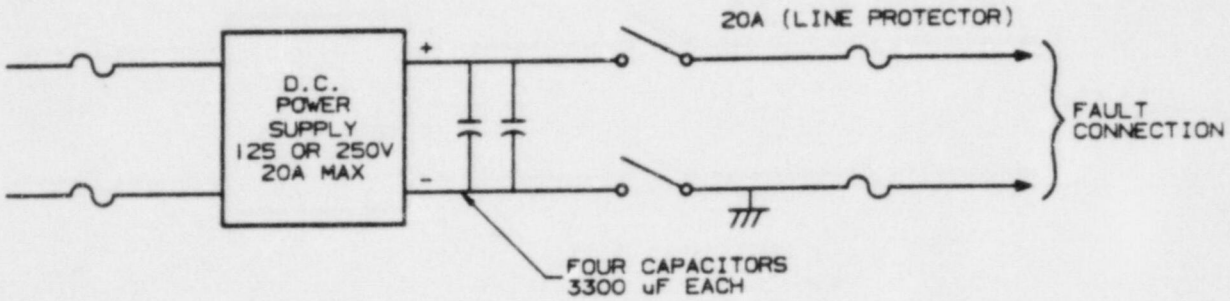


Figure D2-4. dc Power Supply Fault Connections

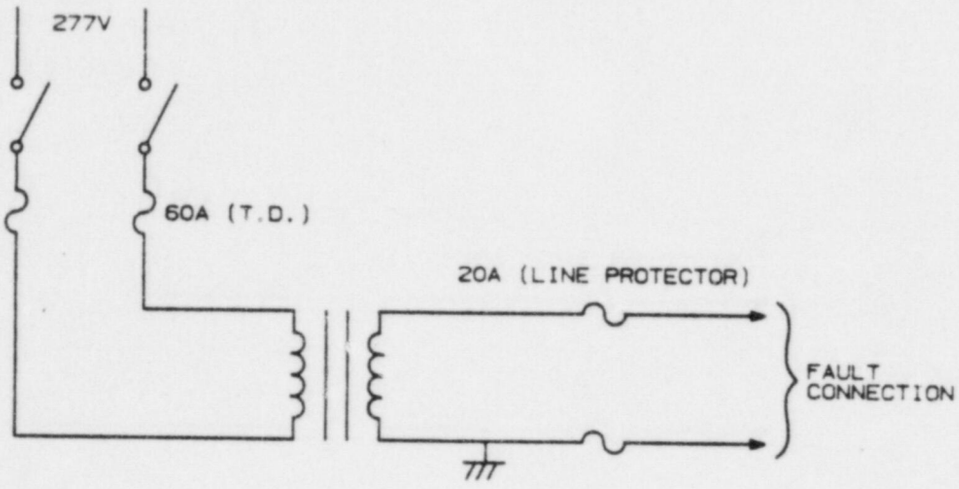


Figure D2-5. ac Fault Connections

ATTACHMENT B

DESCRIPTION OF FAULT SOURCE POWER SUPPLIES -- AC FAULT

The ac fault will be generated using a [ ]$_{b,c}$ kva transformer. The primary voltage used will be 277 V ac from a 480 V Y-connected facilities transformer source applied to the test transformer primary or secondary for respective test voltages. The short circuit impedance of the transducer will permit 7 to 10 times rated current delivery to a short circuit (75,000 volt amperes nominally).

Dual primaries each tapped at 104, 110, and 120 volts, along with dual secondaries with corresponding 208, 220, and 240 volt tops, provide the desired range adjustments. Applied voltages may exceed ratings by 10 percent without saturation effects.

The dc fault source is a variable voltage 300 V filtered power supply [ ]$_{b,c}$ Peak fault currents will be delivered from electrolytic filter capacitors and further energy makeup will be maintained by 3-phase full-wave SCRs regulated at the set current limit (20 amperes). A short circuit fault current of several hundred amperes and time duration is determined by the 3300 of filter capacitors equivalent series resistance (ESR rating).

Note: Employing a shorted 40-foot length of two conductor cable, measure and record maximum deliverable currents and time duration with 20 ampere line protection.

Caution: Line protection fuse must blow to proceed with test.

ATTACHMENT C

FAULT APPLICATION TO SHIELDS

This attachment contains the following tables:

- Table D2-8 Field Connections Fault Testing of Shields
- Table D2-9 Alternate Configuration RPU TB101 and 102
- Table D2-10 Field Connections for 250 VDC and 580 VAC Faults of Shields
- Table D2-11 Alternate Configuration RPU TB101 and 102

TABLE D2-8
FIELD CONNECTIONS FAULT TESTING OF SHIELDS

Section	Terminal Block Reference	Connections H1	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Non 1E/App. R Function
RPU (1) (NOTE)	TB102	19	20	21	Encode/Decode	2D33406	Data Link RX/RTC
RPU	TB101	2	3	4	RS-422 Data Link	2334D63	Data Link ERF
DPU	DISPLAY	Train C Shield Connector			Encode/Decode	2D33406	Data Link Train C/ Display
DPU	TB204	5	6	7	0-10V Output	2344D02	H.V. Output
DPU	TB103	11	12	1	APP. R. 4-20 mA Out (Nonrepeating)	2D33170	Output
RPU	TB104	12	13	1	APP. R RTD	2D33172	Output
RPU	TB106	5	6	7	4-20 mA Output (Powered)	2D31856	Output
RPU	TB109	11	12	13	APP. R 4-20 mA (Analog Repeating)	2D31856	Output

Note: Caution: For line-to-line faults, disconnect from DPU.

*Ground Fault Injection Terminal

TABLE D2-9
ALTERNATE CONFIGURATION RPU TB101 AND 102

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Non 1E/App. R Function
*RPU	TB101	19	20	21	RS-422 Data Link	2334D63	Data Link RX
RPU	TB102	2	3	4	RS-422 Encode/Decode Data Link	2D32406	Data Link TX

Note: Caution: For line-to-line faults, disconnect from DPU.

*Ground Fault Injection Terminal

TABLE D2-10
FIELD CONNECTIONS FOR 250 VDC AND 580 VAC FAULTS OF SHIELDS

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Non 1E/App. R Function
RPU (1) (NOTE)	TB102	19	20	21	RS-422 Encode/DecodeData Link	2D33406	Data Link RX/RTC
RPU	TB101	2	3	4	RS-422 Data Link	2334D63	Data Link ERF
DPU	TB204	5	6	7	0-10V Output	2344D02	H.V. Output
DPU	TB106	5	6	7	4-20 mA Output (Powered)	2D31856	Output

Note: Caution: For shield faults, disconnect from DPU.

Caution: For line-to-line faults, disconnect from DPU.

*Ground Fault Injection Terminal

TABLE D2-11
ALTERNATE CONFIGURATION RPU TB101 AND 102

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Non 1E/App. R Function
*RPU/DPU	TB101	19	20	21	RS-422 Data Link	2334D63	Data Link RX
RPU (2)	TB102	2	3	4	Encode/Decode	2D32406	Data Link TX

Note: Caution: For ground faults, disconnect from DPU.

*Ground Fault Injection Terminal

PART D3
SURGE WITHSTAND TEST PROCEDURE

DATE	REVISION NO.
7/25/86	0

SURGE WITHSTAND TEST PROCEDURE

FOR

PSMS, QDPS, RVLIS-86

AND ICC-86

APPROVALS

	ORIGINAL	REV. 0	REV. 1	REV. 2
AUTHOR	C. N. Nasrallah			
REVIEWED	J. R. Smith			
MANAGER	W. Ciaramitaro			
QUALITY ASSURANCE	R. Saupe			

1.0 INTRODUCTION

This procedure details the electrical IEEE-472 surge withstand tests to be applied to a test configuration representative of a variety of plant equipment arrangements as described in References 1 and 2.

A representative sample of field terminations only are to be tested owing to similarity and prior testing both in bench test and qualification system configurations.

The test configuration is documented in sketches CNN61086, CNN62086, and CNN62286, Sheets 1 and 2, which become part of these test records as modified by this procedure and references above.

2.0 PREPARATION FOR TEST

2.1 Connect the field cabling to sensor simulation, load simulation, contact input (SPDT) simulation, contact output loads, and remote interlock/test injection per Reference 3.

2.2 Perform calibration of the system as follows:

2.2.1 Load plant software to DPU and RPU. Obtain printout of "PROM" operating software for test records.

2.2.2 a. Perform, verify, and record "self cal" values.

b. Input analog (voltage and current) and resistance values corresponding to 0 - 100% of scale in 20% increments and record.

2.2.3 Perform and verify calibration of analog repeater function module slot TB109. Record values 0, 20, 40, 60, 80, and 100% FS.

2.2.4 Set up "normal" operate simulation parameter per Table D3-1.

2.2.5 Verify that the analog output parameters and display values agree with Table D3-1.

a. Make a printer plot output record of all display pages per above.

b. Connect digital data logger and record "normal" analog output values. Per Table D3-1, disconnect digital data logger. (Note: Digital data logger to be pretest and post-test verification of system status only. It shall be disconnected during surge tests.)

c. Connect tape recorder per Table D3-2 and record for six (6) minutes.

d. Play back the above data on Visicorder and verify calibration of record/playback data system. (Compare with data logged values (b) above.)

e. Recalibrate, if necessary, and make a "reference" cross calibration of (b), (c), and (d) above.

2.2.6 Make a six (6) minute tape record of above except turn off RPU at two (2) minutes into the run (monitor switch) and turn back on at four (4) minutes into the run. Record observations.

2.2.7 Repeat above except turn off DPU (monitor switch) at +2 minutes and restore at +4 minutes. Record observations.

2.2.8 Reconnect digital data logger and display plotter and record values. Values should agree ± 0.5% FS with 2.3.5(b) above.

3.0 SURGE TEST PROCEDURE SEQUENCE

3.1 Pretest

Using digital data logger and display observation, verify "normal" condition of systems per calibration values of 2.3.8 above, and Table D3-1.

3.2 Disconnect data logger and verify surge generator connections and configuration for each injection point of Attachment A.

3.3 Connect surge generator source, verify connection of recorder per Table D3-1 and readiness of tape recorder data logger system. Enter identifying records in tape recorder log. CAUTION: Observe alternate recorder connection for surge application to respective record terminals (Table D3-3).

3.4 Set the display unit to observe the page indicating the respective parameter subject to fault injection (where applicable), and record any change in the error message in the APC status block during each test.

3.5 Run the tape recorder for two (2) minutes for pretest data, apply the surge source for two (2) seconds, and stop the recorder after a two (2) minute post-test period. Record all observed effects if any on system display, monitoring oscilloscope and digital CRT, (TB202 16-17 "buffered" data link).

3.6 Observing the display, oscilloscope, and CRT data monitor for system continuity, note and record observations.

Note: Continuity of System Functionality of I/O such as "RTC" not addresse by analog or display page outputs to be software addressed and observations recorded using "buffer" connected CRT monitor. Record the address function and operating status observed.

3.7 If observation indicates an anomaly during the test, tape-recorded data should be played back on the Visicorder and observations recorded before proceeding.

3.8 Reconnect the data logger and confirm calibrations are retained + 0.5%. Verify display data supports the calibration data. Record any discrepancies.

3.9 With system confirmed to be in pretest condition, proceed to the next test.

3.10 For surge tests applied to data links terminated in "dummy loads," verify post test operability by reconnecting to CRT display and observe transmitted format and/or reconfigure system to verify operability of tested receive channel.

4.0 SURGE WITHSTAND TEST

CAUTION: Observe all precautions against high voltage hazards per the [ ]$_{b,c}$ Instruction Manual.

4.1 Adjust the [ ]$_{b,c}$ surge generator for 150 ohm source impedance, line frequency repetition rate, and 2.0-second timed cycle operation at a crest value between 2.5 and 3.3 kv. Connect a oscilloscope to J-102 "output monitor" (one volt/kv) for observation during test.

4.2 Connect the high and low [.]$_{b,c}$ Connect both chasses to earth ground.

4.3 Using a dummy load of approximately 1,000 ohm (10 each 100 ohm carbon resistor x 1 watt in series) connecied to "equipment under test" terminations 1 and 2, run two cycles set for "normal mode" to verify approximate impulse amplitude and time durations.

4.4 Locate surge generator and isolation network to access cabinet terminal blocks with isolation network test cables. Connect both chassis grounds to the cabinet ground bus (near earth connecting cable) using short straight connecting wires (Reference Figure D3-2).

4.5 Remove hi (+) and lo (-) cable connections from TB204, 5 and 6 and connect to "power" terminations [,]$_{D.C}$ respectively. Connect [ ]$_{D.C}$ to terminal block connections 5 and 6, respectively.

4.6 [ ]$_{D.C}$ run test per sequence 3.0 above.

4.7 Repeat 4.6 except [.]$_{D.C}$

4.8 Remove test cable connections and reconnect field cable to test terminals. Repeat connections and test each TB terminal pair of Table D3-4 per 4.5 through 4.7 above.

5.0 RTD APPENDIX R BOARD TEST INJECTION MODE

5.1 Set test permissive switches remote (TB104, 10 and 11) and local (J3, 3 and 4) to test position.

5.2 Verify channel 1 "on test" status by remote calibration check.

5.3 Apply common mode and surge tests Paragraph 4.6 and 4.7 to TB104-8 (+) and TB104-9 (-).

5.4 Repeat 5.3 above except apply to TB104-6 (+) and TB104-7 (-).

5.5 Restore above test permissive switches to normal and repeat testing Paragraphs 4.6 and 4.7 except apply to TB104-10 (+) and TB104-11 (-).

6.0 "CLI" APPENDIX R BOARD TEST INJECTION MODE

6.1 Set test permissive switches remote (TB109, 5 and 6) and location J3, 3 and 4 shorted) to test position.

6.2 Perform remote calibration check to verify that "on test" conditions are established.

6.3 Perform common mode and line surge tests per Paragraphs 4.6 and 4.7 with connections to TB109-5 (+) and TB109-6 (-).

6.4 Restore above test permissive switch to off (normal).

6.5 Repeat tests Paragraph 4.6 and 4.7 above except apply to TB109-8 (+) and TB109-9 (-).

7.0 DATA LINK SURGE TESTS

Application of surge testing to data links requires an alternate procedure in that data communications must be interrupted for test injection [

]$_{B,C}$

7.1 Disconnect field cables of TB102, 16 and 17 per Table D3-5 and connect [ ]$_{B,C}$ [respective TB connections. [

]$_{B,C}$ test per 4.6 above (reference Figure D3-2).

7.2 Reconnect [ ]b,c
repeat test per 4.7 above.

7.3 Reconfigure RPU data link I/O boards per Table D3-5 and repeat 7.1 and 7.2 for designated TB connectors of Table D3-5.

Procedure Rev. _____

TYPE

TRANSVERSE MODE _____ DATE _____

COMMON MODE _____ TEST NUMBER _____

TB CONNECTION _____ I/O CARD TYPE _____ P/N _____

PRE_TEST

DATA LOGGER VERIFICATION

REMARKS _____

_____

_____

DISCONNECT DATA LOGGER _____

TAPE RECORDER FOOTAGE BEGIN _____ END _____ SCT # _____

DISPLAY PAGE _____

RTC BYTE _____ CONTACT #1 IN BYTE _____ #2 _____

CRT OBSERVATION POINTS _____

TEST OBSERVATIONS:

_____

_____

_____

_____

POST TEST OBSERVATIONS (DISPLAY AND STATUS):

_____

_____

_____

POST TEST DATA LOGGER VERIFICATION:

_____

_____

_____

_____

PERFORMER _____ VERIFIER _____

Figure D3-1. Surge Test Data Sheet

REFERENCES

1. I&CDE/SID(86)-099, "Preliminary Test Plan Reference Document QDPS Noise and Fault Testing," dated June 20, 1986.

2. I&CDE/SID(86)-108, "Noise and Fault Testing Digital Data Link Isolators (QDPS)," dated June 27, 1986.

3. Noise Test Procedure for PSMS, QDPS, RVLIS-86 and ICC-86, I&CDE/SID(86)-112.

4. ANSI/IEEE C37.90-1974 (IEEE STD. 472-1974) "Guide for Surge Withstand Capability (SWC) Tests."

TABLE D3-1
SIMULATION NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB204	FI-417A	100%	0-120%	N/A	8.33 V	Computer set value
TB204	FI-437A	100%	0-120%	N/A	8.33 V	Computer set value
TB205	System alarms	N/A		N/A	N/A	Normally open
TB103 (2, 3)	LT-467 Pressurizer level	56%	0-100%	Fixed resistor	N/A	
TB103 (11, 12)	TE434				4.09 V	
TB103 (16, 17)	PT-406 RCS Wide range pressure	1981 psig	0-3000 psig	Fixed resistor	N/A	16.26 mA
TB103 (26, 27)	TE444				4.09 V	
TB104	TE414 RCS T_c Loop 1	540°F	0-700°F	Potentiometer	4.09 V	411.4 ohm
TB104	TE424 RCS T_c Loop 2	540°F	0-700°F	Potentiometer	4.09V	411.4 ohm
TB105 (2, 3)	LSH7803 Pump 1B Sump H	N/A		Closed contact	N/A	
TB105 (5, 6)	LSHH7803A Pump 1B Sump H.H.	N/A		Closed contact	N/A	
	P4-B Reactor trip switchgear TRN-S	N/A		Closed contact	N/A	
TB106 (2, 3)	PMY-868 RHR temperature	130°F	50° to 400°F	N/A	1.91 V	Computer set value
TB106 (5, 6)	PMY-862 RHR pressure	100 psig	0-700 psig	N/A	1.57 V	Computer set value

TABLE D3-1 (Cont)
SIMULATION NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB107	TE434 RCS T_c Loop 3	540°F	0-700°F	Potentiometer	TB103 (11, 12)	411.4 ohm
TB107	TE444 RCS T_c Loop 4	540°F	0-700°F	Potentiometer	TB103 (25, 26)	411.4 ohm
TB108	EN1, 2 and 3	N/A		N/A	Normally open	N/A
TB109	FT868 RHR Pump B flow	464	0-4000	Fixed resistor	1.0 V	4.0 mA

TABLE D3-2
TAPE-RECORDED DATA

Tape Recorder Channel	Reference I/O Function	TB Connection
1	Noise/source	N/A
[redacted]		

b.c

TABLE D3-3
TAPE RECORDER AND RELOCATION SURGE TEST

Tape Recorder Channel	Reference I/O Function	T.B. Connection	Connections Remarks
1	Surge Generator	*	Test Reference
[redacted]			

b,c

*Relocation only when surge injection is applied to these terminals

ATTACHMENT A
SURGE CONNECTIONS

This attachment contains the following:

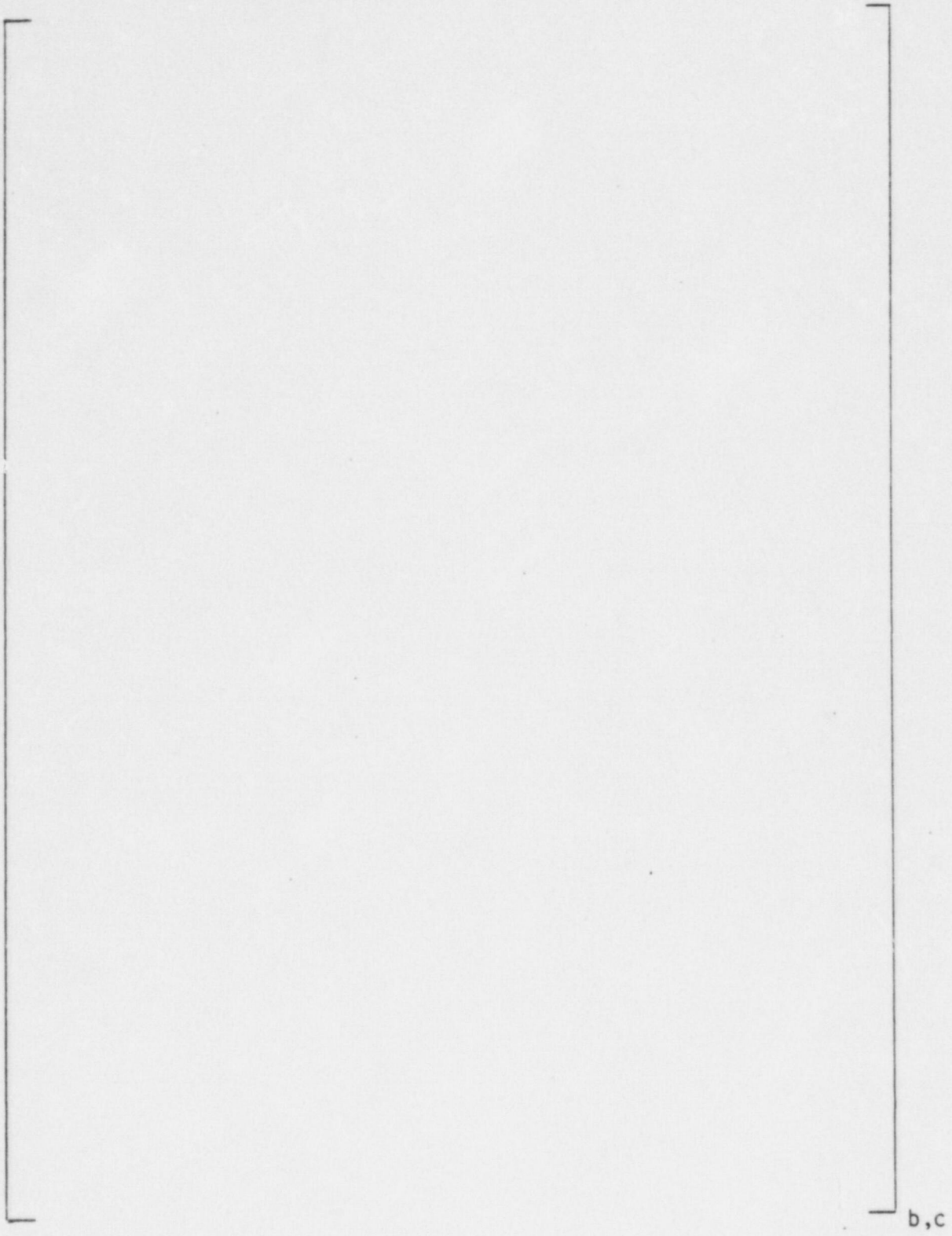
- Table D3-4 Field Connections Surge Testing
- Table D3-5 Field Connections Surge Testing of Data Links
- Table D3-6 Alternate Configuration RPU TB101 and 102
- Figure D3-2 Block Diagram of Surge Withstand Capability (SWC) Test
- Figure D3-3 Typical Block Diagram of RPU and DPU Subsystems

TABLE D3-4
FIELD CONNECTIONS SURGE TESTING

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB102	2	3	NC	RS-422 Encode/Decode Data Link	2D32406	Data link TX
RPU	TB101	19	20	NC	RS-422 Encode/Decode Data Link	2334D63	Data link RX
DPU	DISPLAY	Train C connector			SWDK RS-422 Encode/Decode Data Link	2D33403 2D33406	Data link Train C/display
DPU	TB204	5	6	N/A	0-10V Output	2344D02	Output
RPU	TB103	11	12	NC	Appendix R 4-20 mA Output (nonrepeating)	2D33170	Output
RPU	TB103	5	6	NC	Appendix R 4-20 mA Output (nonrepeating)	2D33170	Input
RPU	TB103	8	9	NC	Appendix R 4-20 mA Output (nonrepeating)	2D33170	Input
RPU	TB104	12	13	NC	Appendix R RTD	2D33172	Output
RPU	TB104	6	7	NC	Appendix R RTD	2D33172	Input
RPU	TB104	8	9	NC	Appendix R RTD	2D33172	Input
RPU	TB104	10	11	NC	Appendix R RTD	2D33172	Input
RPU	TB105	5	6	N/A	Digital Contact input (input open)	2344D01	Input
RPU	TB106	5	6	NC	4-20 mA Current Loop Output (powered)	2D31856	Output
RPU	TB108	5	6	N/A	Digital Contact output (NO)	23344D04	Output
RPU	TB108	5	7	N/A	Digital Contact output (NC)	23344D04	Output
RPU	TB109	11	12	NC	Appendix R 4-20 mA (analog repeating)	2D31856	Output

TABLE D3-5
FIELD CONNECTIONS SURGE TESTING OF DATA LINKS

Section	Terminal Block Reference	Connections Hi	Lo	Sh.	I/O Isolator Type	Isolation I/O Board	Function
RPU	TB101	2	3	NC	RS-422 Data Link	2334D63	Data link TX
RPU	TB102	19	20	NC	RS-422 Encode/Decode Data Link	2D32406	Data link RX



b,c

Figure D3-2. Block Diagram of Surge Withstand Capability (SWC) Test

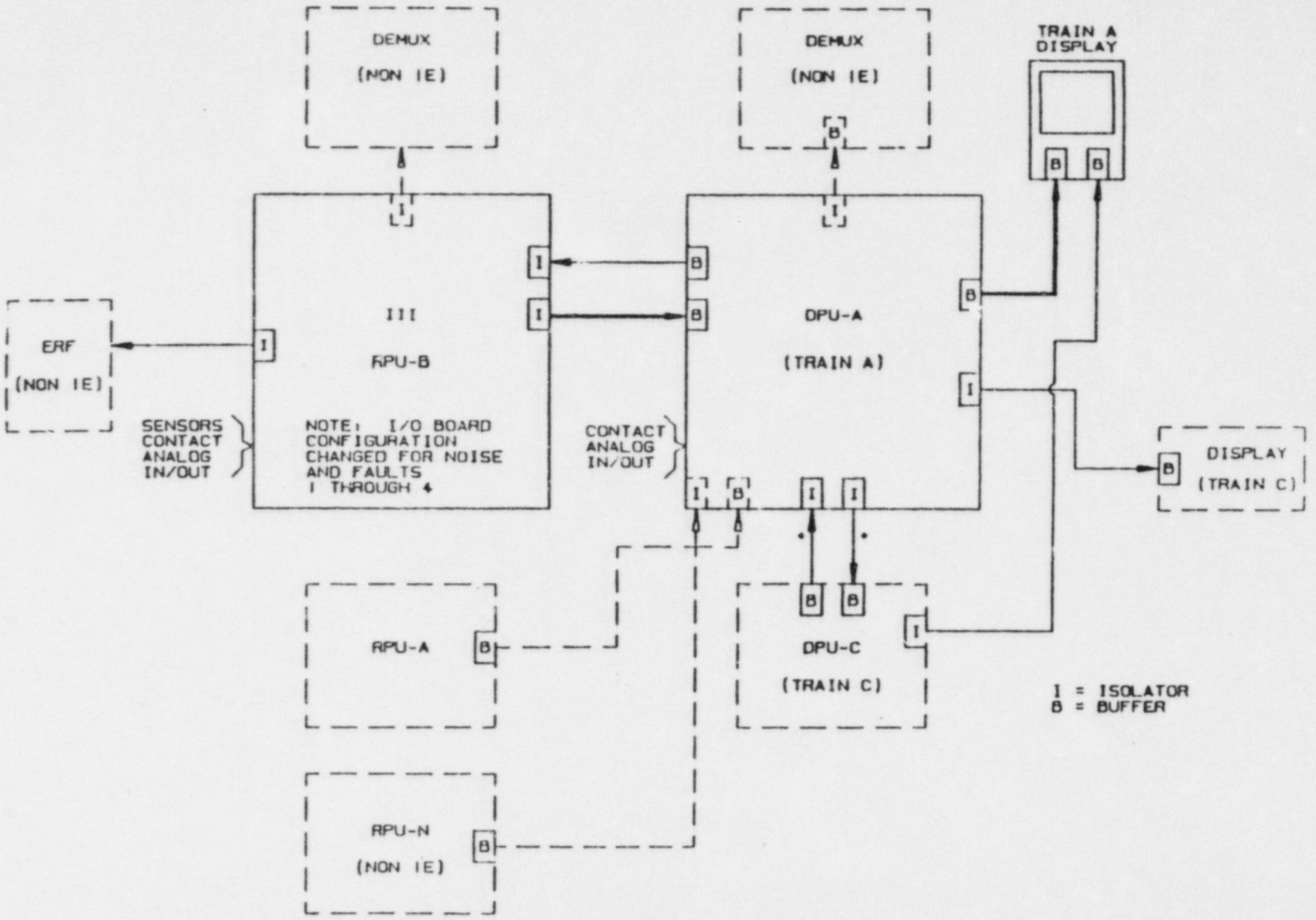


Figure D3-3 Typical Block Diagram of RPU and DPU Subsystems

PART D4

RADIO FREQUENCY INTERFERENCE TEST PROCEDURE

DATE	REVISION NO.
8/5/86	0

RADIO FREQUENCY INTERFERENCE TEST PROCEDURE

FOR

PSMS, QDPS, RVLIS-86

AND ICC-86

APPROVALS

	ORIGINAL	REV. 0	REV. 1	REV. 2
AUTHOR	C. N. Nasrallah			
REVIEWED	J. R. Smith			
MANAGER	W. Ciaramitaro			
QUALITY ASSURANCE	R. Saupe			

1.0 INTRODUCTION

This procedure details the Radio Frequency Interference (RFI) tests to be applied to a test configuration representative of a variety of plant equipment arrangements as described in References 1 and 2. Tests are to be conducted per the intent of SAMA Standard PMC 33.1-1978 level a, b, and c and bands a, b, and c.

The test configuration is documented in sketches CNN61086, CNN62086, and CNN62286, Sheets 1 and 2, which become part of these test records as modified by this procedure and references above.

Caution:

Test facility regulations are to be followed with regard to personnel safety in radiation fields.

2.0 PREPARATION FOR TEST

2.1 Prepare test configuration simulation connections per Reference 1. Record all supportive test observations, including test equipment, description, calibration date, and calibration due date in a "Permanent Record Book."

2.2 Locate the test cabinet and display unit in RFI screen room and route field cabling to simulation and test monitor/recording. Simulation and contact input equipment are located outside the screen room. Verify system operability per Reference 1 and as follows:

When the RPU/DPU cabinet is the test target, the keyboard may be cabled for remote control of the display unit paging and remote video camera observation/recording during testing. The keyboard will be relocated to the proximity of the display unit with nominal connecting cable (approximately 15 feet) when the field is targeting the display unit.

Cabinet ground bus and display chassis are to be connected to the facility ground plane via short bonding cables (routed in conduit if necessary). Power line earth grounds should be included in ground plane connections. Equipment ac power will be routed below the ground plane and/or flex conduit shielded to the respective equipment under test.

2.2.1 Load modified software to DPU and RPU.

2.2.2 Set up "normal" operate simulation parameter per Table D4-1.

2.2.3 Verify that the analog output parameters and display values agree with Table D4-1.

a. Make a printer plot output photograph or video record of all display output pages per above.

b. Connect the digital data logger and record "normal" analog output values. Per Table D4-1, disconnect the digital data logger. (Note: Digital data logger is to be pretest and post-test verification of system status only. It shall be disconnected during tests).

c. Connect the tape recorder per Attachment A and record for six (6) minutes.

d. Play back the above data on the Visicorder and verify calibration of record/playback data system. (Compare with data logged values (b) above.)

e. Recalibrate, if necessary, and make a "reference" cross calibration.

TABLE D4-1
SIMULATION NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB204	FI-417A	100%	0-120%	N/A	8.33 V	Computer set value
TB204	FI-437A	100%	0-120%	N/A	8.33 V	Computer set value
TB205	System alarms	N/A		N/A	N/A	Normally open
TB103 (2, 3)	LT-467 Pressurizer level	56%	0-100%	Fixed resistor	N/A	
TB103 (11, 12)	TE434				4.09 V	
TB103 (16, 17)	PT-406 RCS Wide range pressure	1981 psig	0-3000 psig	Fixed resistor	N/A	16.26 mA
TB103 (26, 27)	TE444				4.09 V	
TB104	TE414 RCS T_c Loop 1	540°F	0-700°F	Potentiometer	4.09 V	411.4 ohm
TB104	TE424 RCS T_c Loop 2	540°F	0-700°F	Potentiometer	4.09V	411.4 ohm
TB105 (2, 3)	LSH7803 Pump 1B Sump H	N/A		Closed contact	N/A	
TB105 (5, 6)	LSHH7803A Pump 1B Sump H.H.	N/A		Closed contact	N/A	
	P4-B Reactor trip switchgear TRN-S	N/A		Closed contact	N/A	
TB106 (2, 3)	PMY-868 RHR temperature	130°F	50° to 400°F	N/A	1.91 V	Computer set value
TB106 (5, 6)	PMY-862 RHR pressure	100 psig	0-700 psig	N/A	1.57 V	Computer set value

TABLE D4-1 (Cont)
SIMULATION NORMAL PARAMETER VALUES

Reference Connection	Parameter Identification	Display Units	Range	Simulation	Output	Sensor Set
TB107	TE434 RCS T_c Loop 3	540°F	0-700°F	Potentiometer	TB103 (11, 12)	411.4 ohm
TB107	TE444 RCS T_c Loop 4	540°F	0-700°F	Potentiometer	TB103 (25, 26)	411.4 ohm
TB108	EN1, 2 and 3	N/A		N/A	Normally open	N/A
TB109	FT868 RHR Pump B flow	464	0-4000	Fixed resistor	1.0 V	4.0 mA

2.2.4 Make a six (6) minute tape record of above, except turn off RPU at (2) minutes into the run (monitor switch) and turn back on at four (4) minutes into the run. Record observations.

2.2.5 Repeat the above except turn off DPU (monitor switch) at +2 minutes to restore at +4 minutes. Record observations.

2.2.6 Reconnect the digital data logger and display plotter and record values. Values should agree ± 0.5% FS with 2.2.3 above.

2.2.7 With the equipment in normal operating condition, measure radiated field strength and spectrum emanating from equipment cabinet and display at 1 meter all four sides and above.

3.0 RFI TEST PROCEDURE SEQUENCE

3.1 Pretest

With RPU, DPU, and display unit in the screen room and simulated field connections and recorders outside, and using, digital data logger and display observation, verify "normal" condition of systems per calibration values of 2.2.6 above and Table D1-1.

3.2 Disconnect the data logger and verify tape recorder connections.

3.3 Connect RFI antenna source; verify readiness of tape recorder data system. Enter identifying records in the tape recorder log.

3.4 Set the display unit to observe a page indicating a key parameter subject to RFI injection disturbance, and record any change in the error message in the APC status block during each test. Locate field monitors at "non-targeted" assemblies RPU, DPU, or display units and observe during testing. Record observed readings.

3.5 Run the tape recorder for two (2) minutes for pretest data, apply the noise source for the time duration of the field level and frequency sweep, and stop the recorder after a two (2) minute post test period. Record all observed effects if any on system display, monitoring oscilloscope, and digital CRT (TB202 16-17 "buffered" data link).

3.6 Observing the display, oscilloscope, and CRT data monitor for system continuity, note and record observations.

Note: Continuity of System Functionality of I/O such as "RTC" not addressed by analog or display page outputs is to be software addressed and observations recorded using externally mounted "buffer" connected CRT monitor. Record address function and operating status observed.

3.7 If observation indicates an anomaly during the test, tape-recorded data should be played back on the Visicorder and observations recorded before proceeding.

3.8 Reconnect the data logger and confirm that pretest calibrations are retained $\pm$ 0.5%. Verify that the display data supports the calibration data. Record any discrepancies.

3.9 With the system confirmed to be in pretest condition, proceed to the next test.

4.0 RFI TEST CLASS 1

4.1 With the RPU section front of the cabinet as the target of the test facility antenna, test per sequence 3.0 above at 3V/meter horizontal field over the frequency band "a" 20 to 50 MHz.

4.2 Repeat 4.1 above, except band "b" 50 to 300 MHz.

4.3 Repeat 4.1 above, except band "c" 300 to 1000 MHz.

4.4 Repeat 4.1 through 4.3, except doors front and rear open. If there is no observable effect, go to 5.0 "Class 2" test.

4.5 Repeat 4.1 through 4.3, except vertical field.

5.0 RFI TEST CLASS 2

5.1 With the RPU section front of the cabinet as the target of the test facility antenna, test per sequence 3.0 above at 10V/meter horizontal field over the frequency band "a" 20 to 50 MHz.

5.2 Repeat 5.1 above, except band "b" 50 to 300 MHz.

5.3 Repeat 5.1 above, except band "c" 300 to 1000 MHz.

5.4 Repeat 5.1 through 5.3, except vertical field.

6.0 Repeat 5.0, except with cabinet doors front and rear in the open position.

7.0 Repeat 5.0 through 6.0, except cabinet rotated 90° from initial orientation above.

8.0 Repeat 5.0 through 6.0, except cabinet rotated 180° from initial orientation.

9.0 Repeat 5.0 through 6.0, except cabinet rotated 270° from initial orientation.

9.1 Repeat 9.0, except target antenna to top cable entry.

10.0 RFI Test, Display Unit

10.1 Rearrange the antenna and cabinet to target the test field upon the front of the Display Unit chassis, and repeat respective test fields and spectrums 4.0 through 9.0 above (including skip to 5.0 Class 2 level if "no effect" per 4.4 above).

10.2 Repeat above except:

a. Rotate 90°
b. Rotate 180°
c. Rotate 270°
d. Target antenna from above display unit

11.0 RFI CLASS 3 (OPTIONAL)

Note: This testing is to be conducted based on having completed tests at Class 2 field levels with minimal effect on system performance (doors closed) to determine operating margins.

11.1 Repeat the testing of the cabinet and Display Unit with field and equipment orientations above, except the field strength is to be 20V/meter.

11.2 If equipment performance is affected under any door closed condition, reduce the field level to determine effect threshold level between 10 and 20V/meter.

12.0 MODIFICATIONS

In the event of unacceptable performance effects at level 1 or 2 field exposures, experimental effort will be undertaken to isolate and/or shield the affected component or components. If possible, duplicate the observed effect with a communication transceiver for subsequent factory testing of production equipment, including possible modifications thereof to minimize such effects.

REFERENCES

1. I&CDE/SID(86)-112, "Noise Test Procedure for PSMS, QDPS, RVLIS-86, and ICC-86," dated July 2, 1986.

2. I&CDE/SID(86)-099, "Preliminary Test Plan Reference Document QDPS Noise and Fault Testing," dated June 20, 1986.

3. I&CDE/SID(86)-108, "Noise and Fault Testing Digital Data Link Isolators (QDPS)," dated June 27, 1986.

ATTACHMENT A

TRANSIENT DATA RECORDING

SYSTEM CONNECTIONS

AND SCALING

This attachment contains the following:

- Table D4-2 Tape-Recorded Data
- Figure D4-1 Analog Output Channel Recording
- Figure D4-2 Contact Output Connection

TABLE D4-2
TAPE RECORDED DATA

Tape Recorder Channel	Reference I/O Function	TB Connection
1	Noise/source	N/A
[redacted]		

D.C

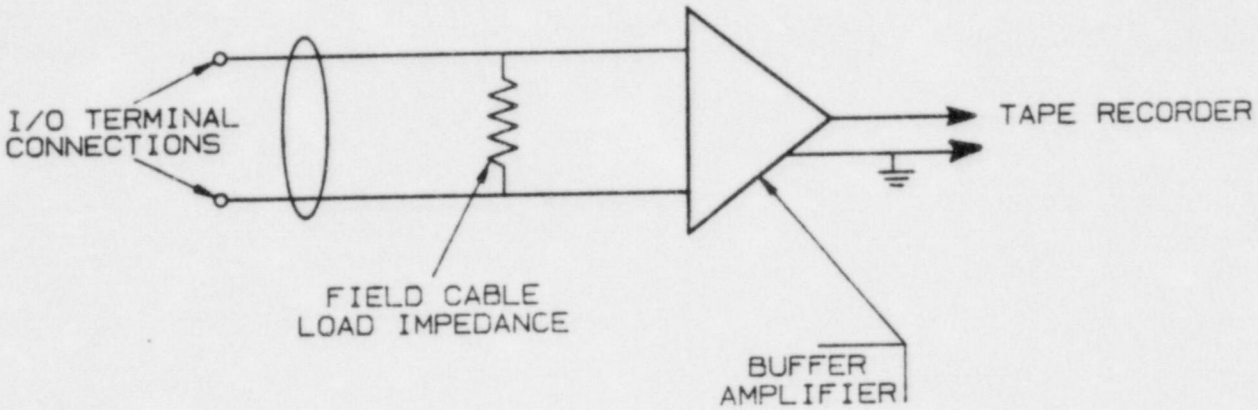


Figure D4-1. Analog Output Channel Recording

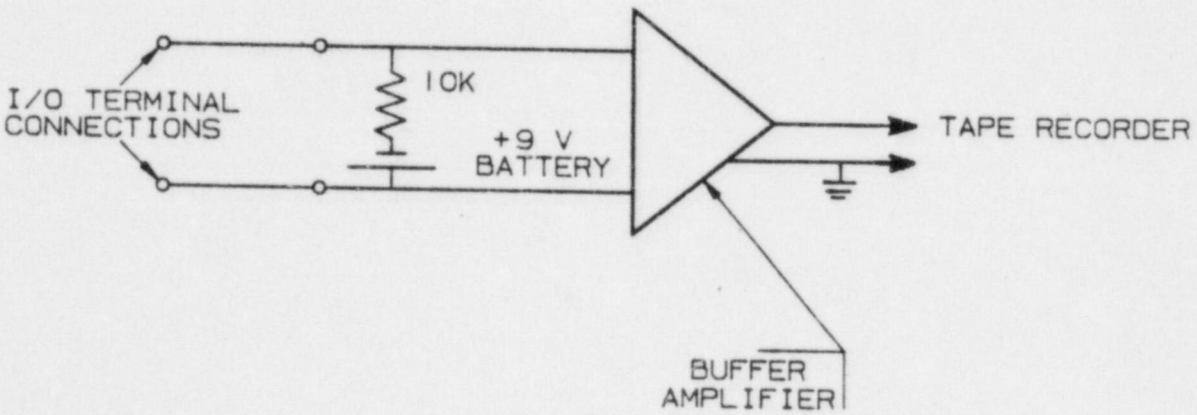


Figure D4-2. Contact Output Connection

APPENDIX E

SYSTEM CONFIGURATION DRAWINGS

Appencix E contains the following figures:

Figure E-1 Noise and Fault Test RPU Configuration Drawing

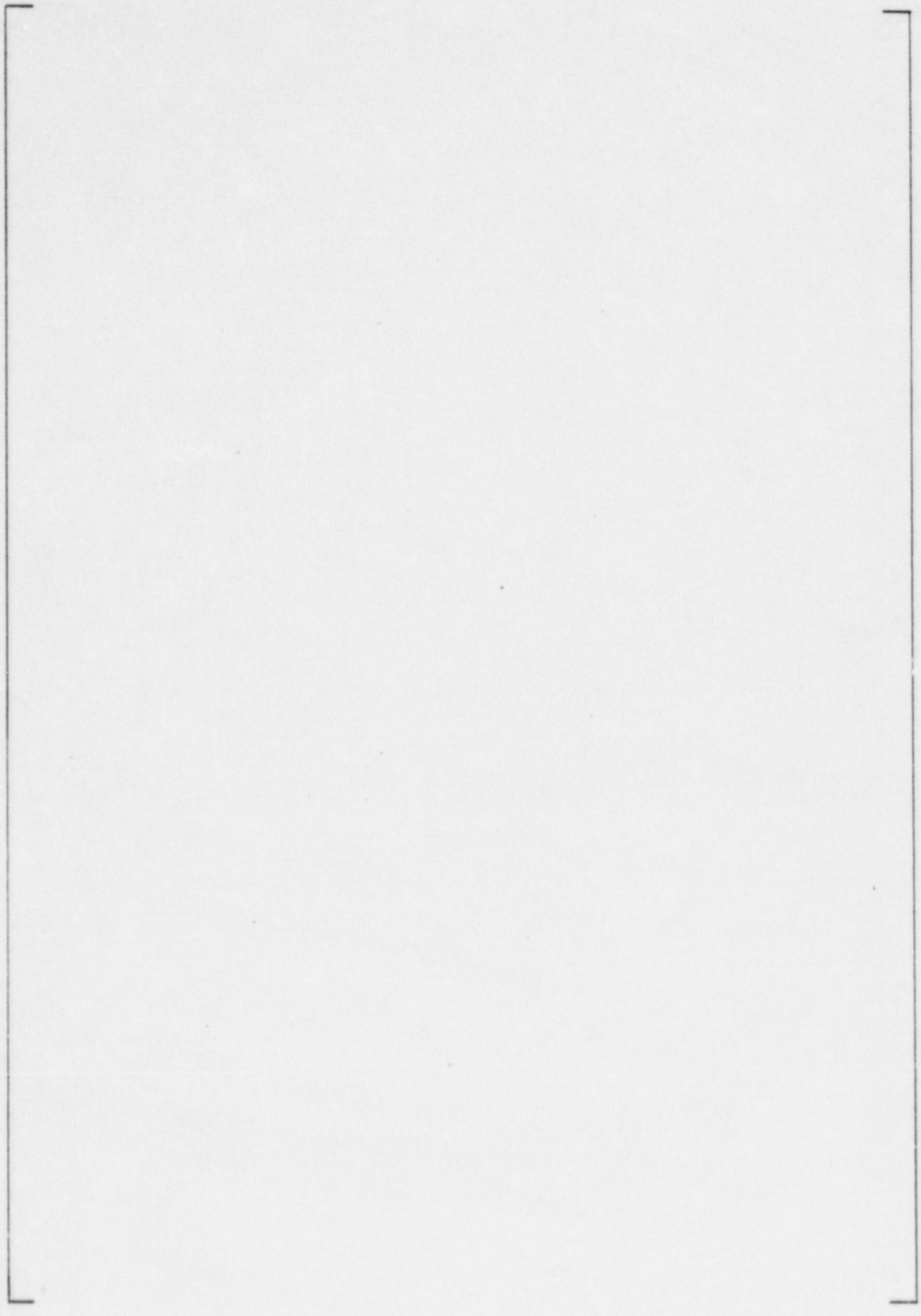
Figure E-2 Noise and Fault Test DPU Configuration Drawing

Figure E-3 Legends and Symbols for Field Connections Diagram

Figure E-4 RPU Field Connections, Sheet 1 of 2
RPU Field Connections, Sheet 2 of 2

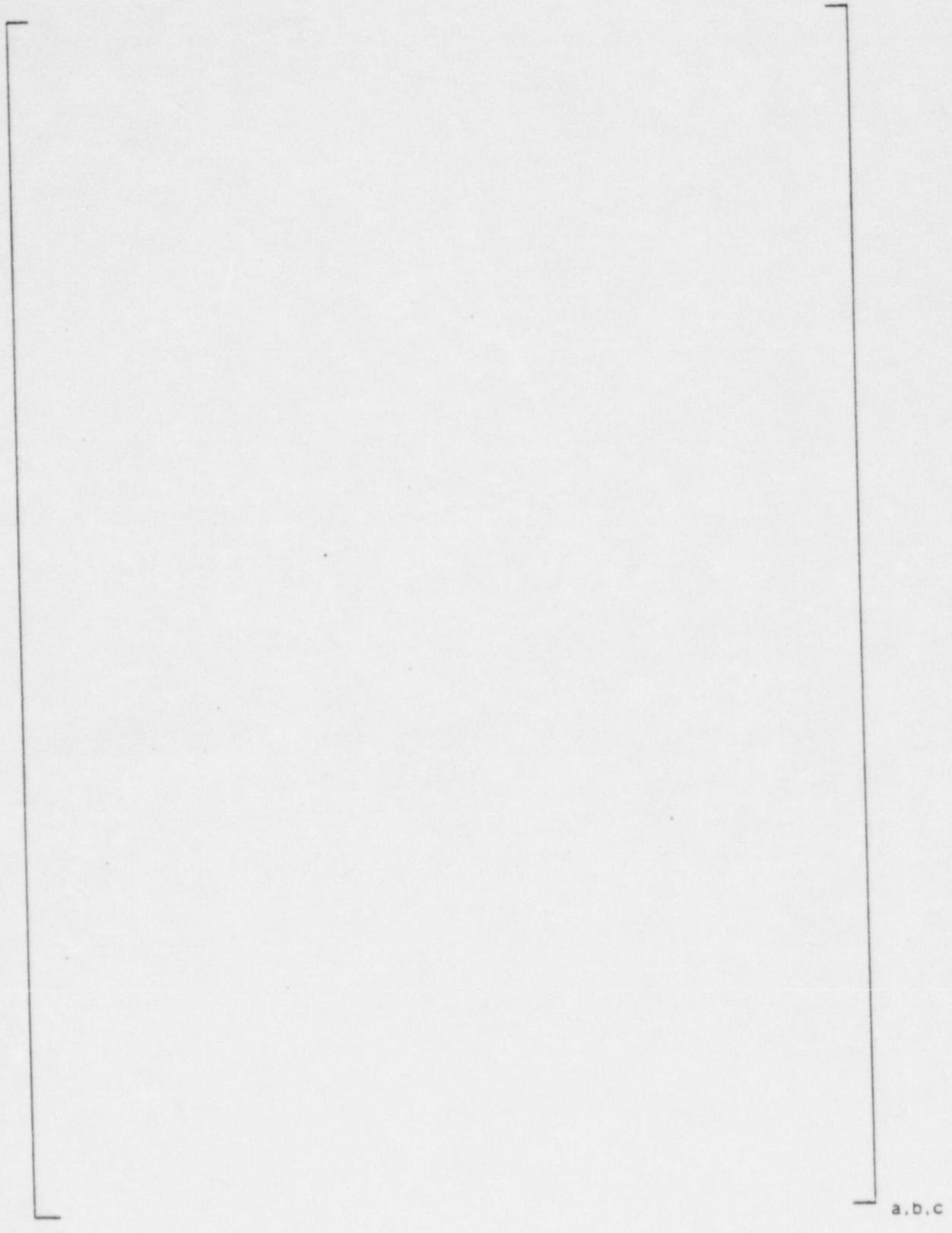
Figure E-5 RPU Alternate Field Connections, RPU Data Links (TB101 and 102 Only)

Figure E-6 DPU Field Connections



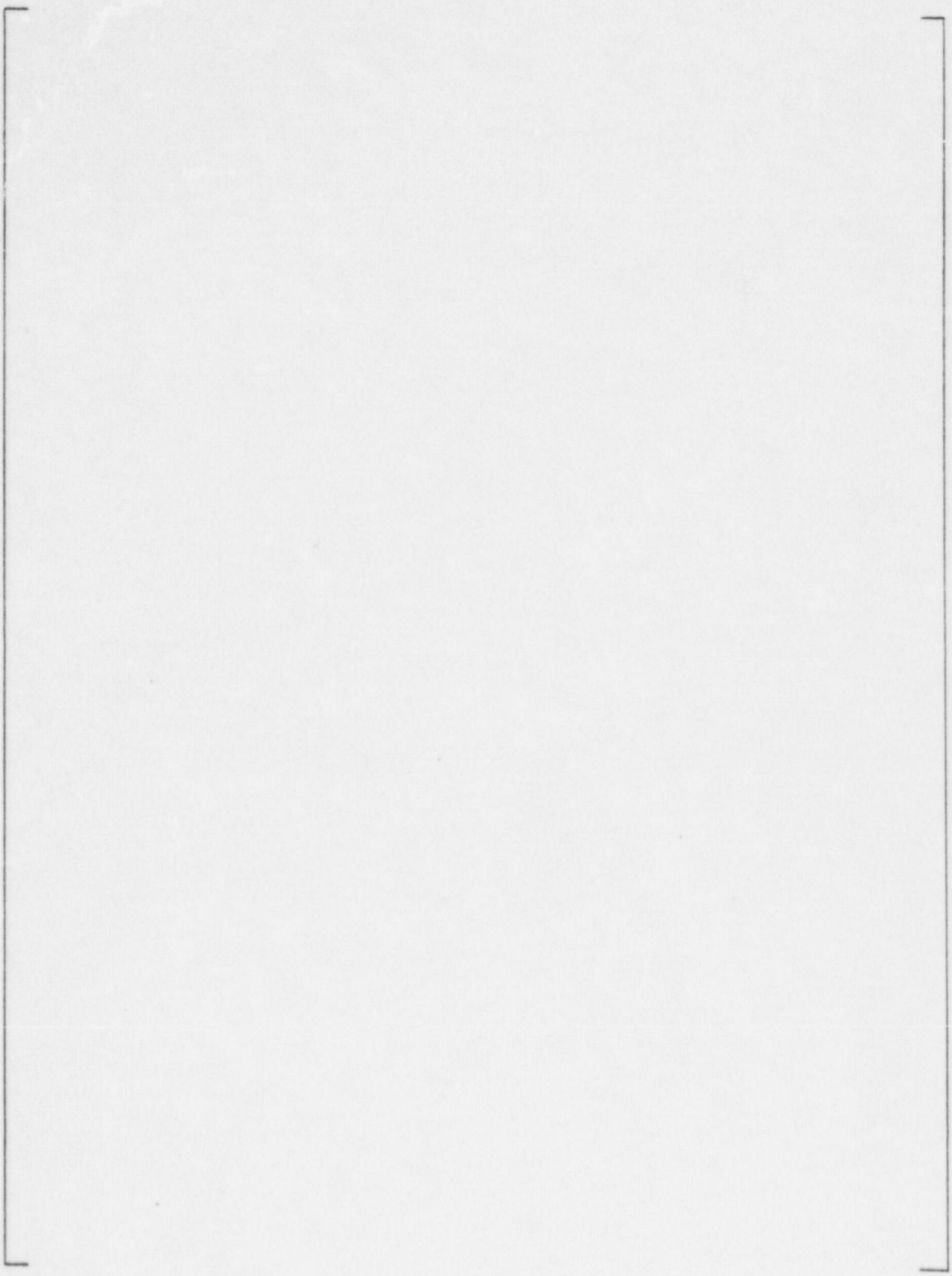
a,b,c

Figure E-1. Noise and Fault Test RPU Configuration Drawing



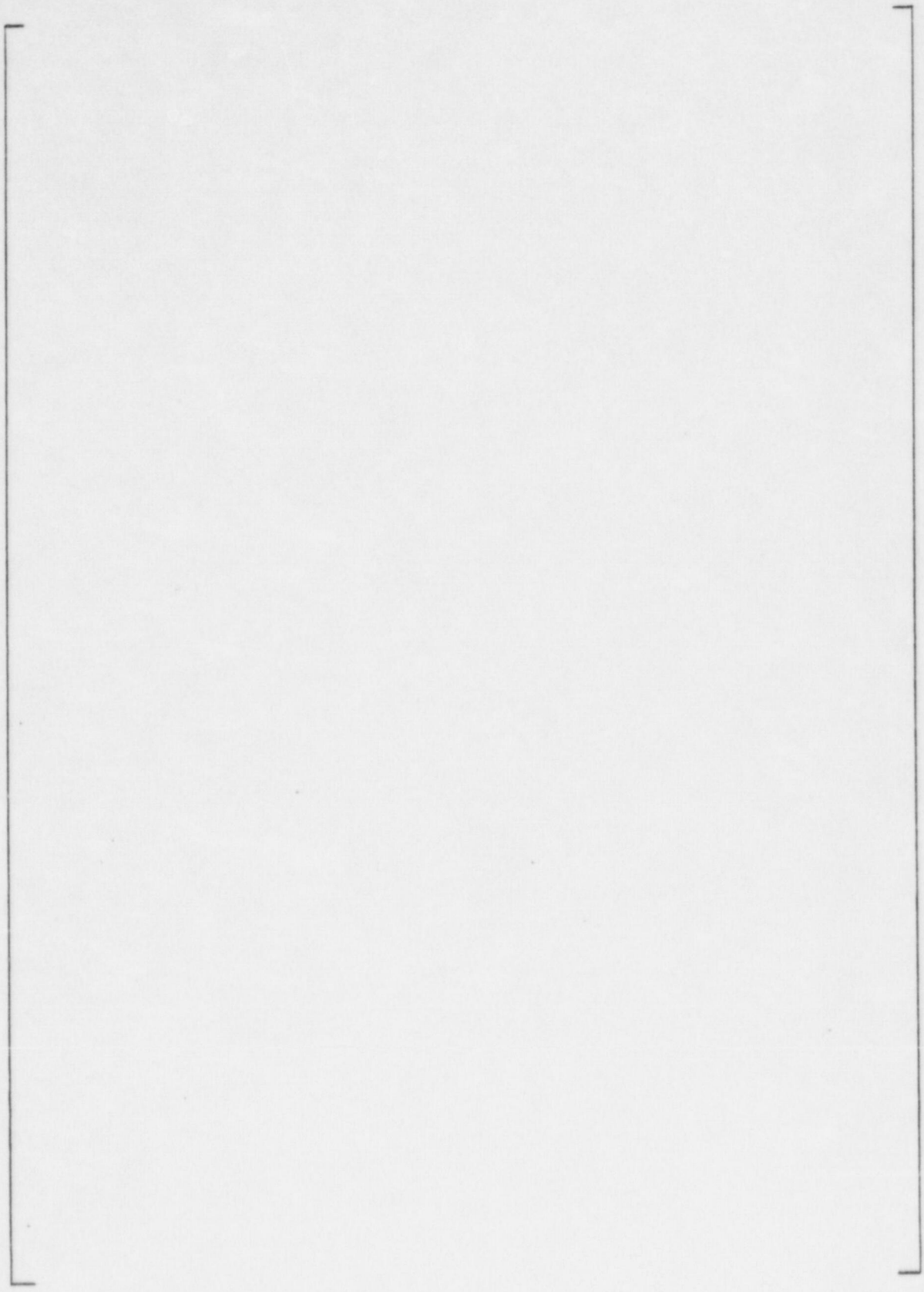
a,b,c

Figure E-2. Noise and Fault Test DPU Configuration Drawing



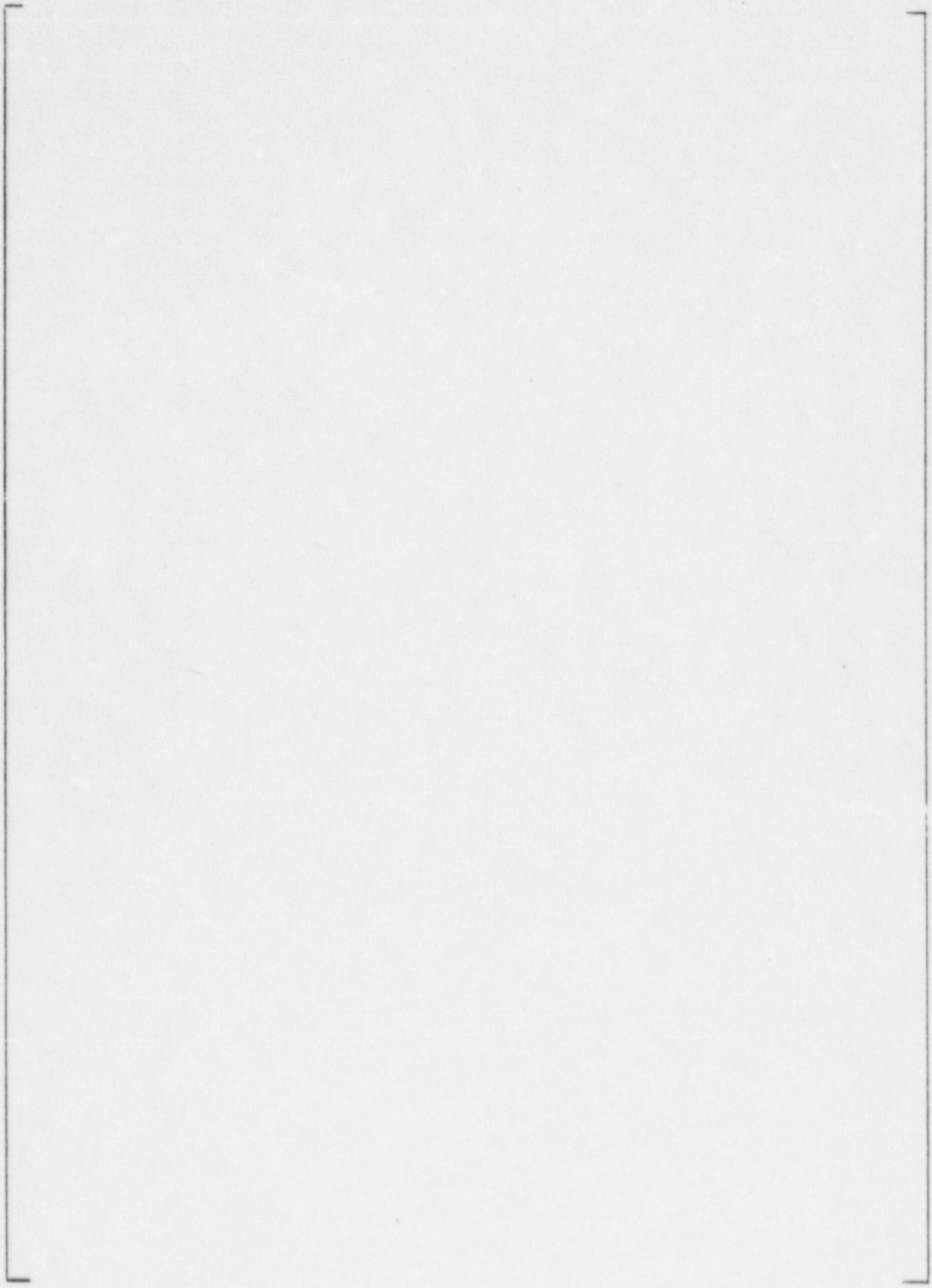
a,b,c

Figure E-3. Legends and Symbols for Field Connections Diagram



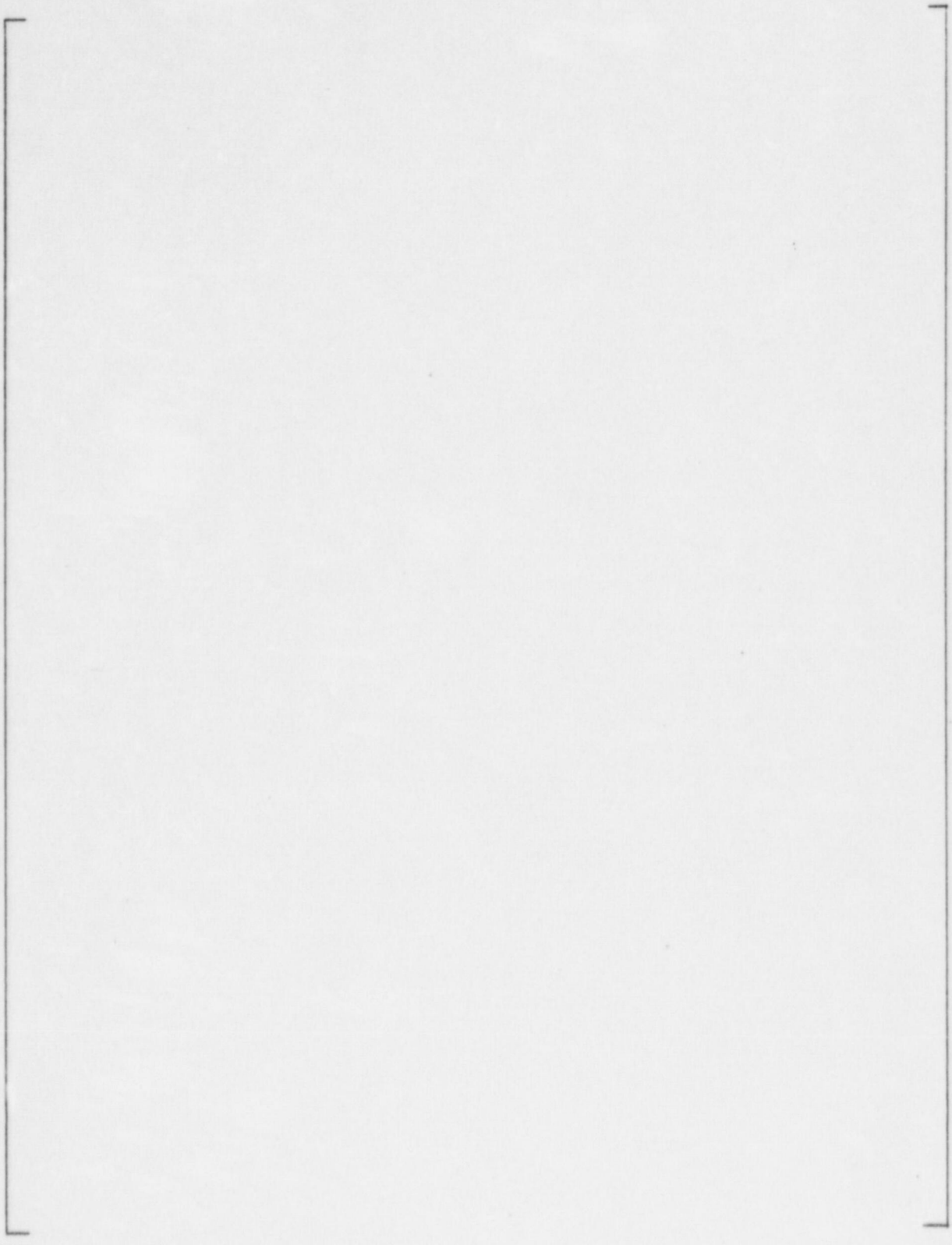
a,b,c

Figure E-4. RPU Field Connections, Sheet 1 of 2



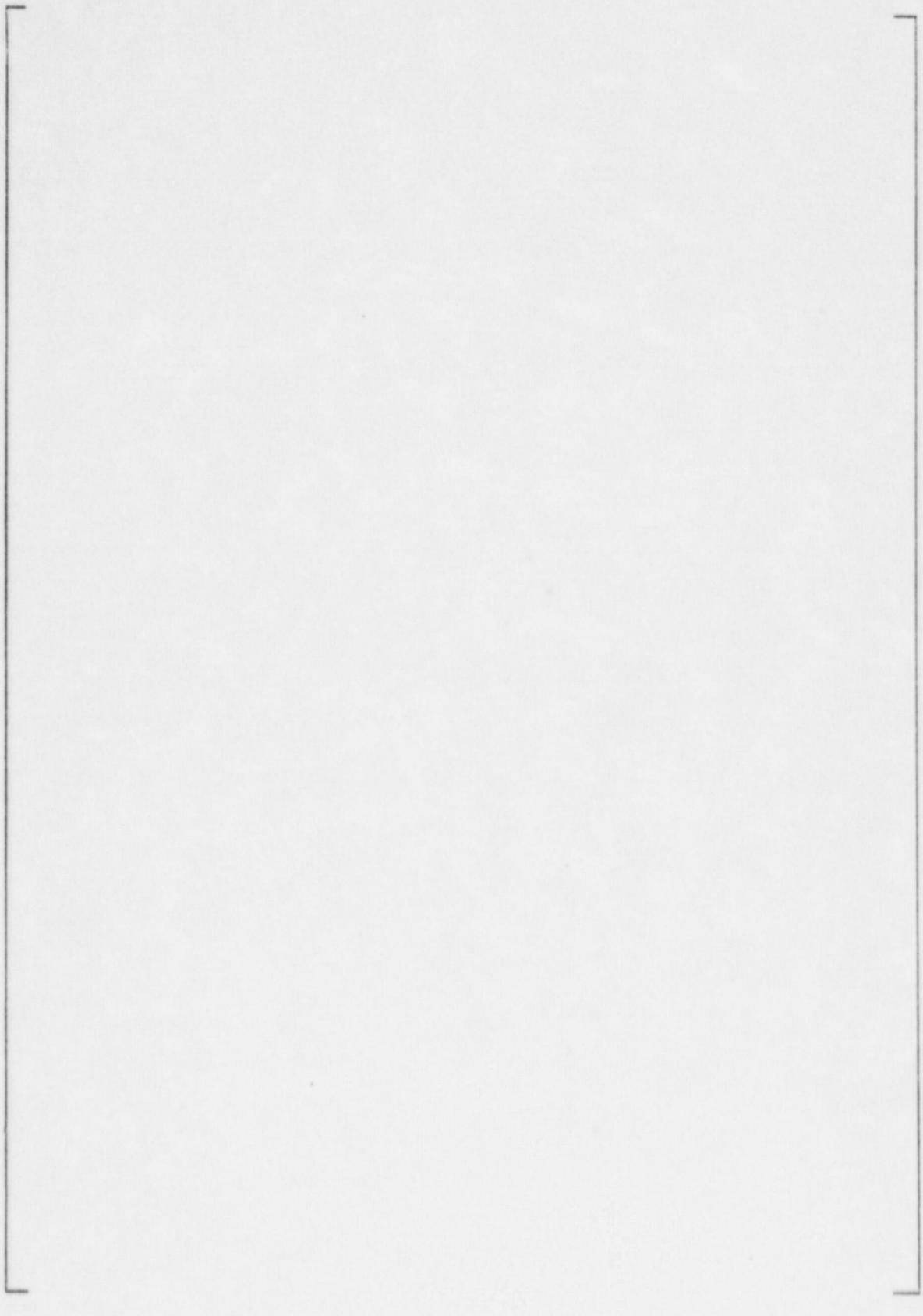
a,b,c

Figure E-4. RPU Field Connections, Sheet 2 of 2



a,b,c

Figure E-5. RPU Alternate Field Connections, RPU Data Links (TB101 and 102 Only)



a,b,c

Figure E-6. DPU Field Connections

APPENDIX F

TEST EQUIPMENT LIST

Table F-1 describes the test equipment.

TABLE F-1
TEST EQUIPMENT LIST

Description	Equipment/Model No.	Test Use

[redacted]

D.C

TABLE F-1
TEST EQUIPMENT LIST (CONT)

Description	Equipment/Model No.	Test Use
[redacted]		

D.C