Report No. FHWA-RD-73-11

URBAN TRAFFIC CONTROL AND BUS PRIORITY SYSTEM

Vol. III. Maintenance Manual

November 1972
Final Report

This document is available through the National Technical Information Service, Springfield, Virginia 22151.

Prepared for
FEDERAL HIGHWAY ADMINISTRATION
Offices of Research & Development
Washington, D.C. 20590

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TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-RD-73-11		

4. Title and Subtitle	5. Report Date
URBAN TRAFFIC CONTROL AND BUS PRIORITY SYSTEM. Vol. III. Maintenance Manual	December 1972
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No. GF-14-1001
9. Performing Organization Name and Address Sperry Systems Management Division Sperry Rand Corporation Great Neck, N.Y. 11020	10. Work Unit No. FCP 32B1 022 11. Contract or Grant No. FH-11-7605
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Highway Administration Washington, D.C. 20591	13. Type of Report and Period Covered Final Report 14. Sponsoring Agency Code

15. Supplementary Notes

The FHWA contract manager for this study is Juri Raus (HRS-33).

16. Abstract

An Urban Traffic Control and Bus Priority System has been implemented by the Sperry Systems Management Division in the District of Columbia under Federal Highway Administration contract No. FH-11-7605, Advanced Control Technology in Urban Traffic Control Systems - Installation. The system includes on-street surveillance and control elements and a central office data processing facility. This manual describes the procedures required to maintain and adjust the system.

This volume is one of a series of three comprising the complete final report on this R&D effort. The others are:

Report FHWA-RD-73-9. Vol. I. Design and Installation.
Report FHWA-RD-73-10. Vol. II. Operator's Manual.

17. Key Words	18. Distribution Statement
Networks Real Time Systems Traffic Control Systems Traffic Operations	No restriction. Copies of report are available from: National Technical Information Services Springfield, Virginia 22151

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	174	

Form DOT F 1700.7 (8-69)

FOREWORD

An Urban Traffic Control and Bus Priority System has been implemented by the Sperry Systems Management Division in the District of Columbia under Federal Highway Administration contract No. FH-11-7605, Advanced Control Technology in Urban Traffic Control Systems - Installation. The system includes on-street surveillance and control elements and a central office data processing facility. This manual describes the procedures required to maintain and adjust the system.

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SECTION 1

INTRODUCTION

This manual describes the procedures and detailed equipment documents required by a trained operator or technician to maintain the Urban Traffic Control System (UTCS)/ Bus Priority System (BPS) in proper operating condition. The UTCS/BPS computer program provides for the continuous detection and recording of system malfunctions. The operator is informed of a malfunction via three devices: the Control Panel, the CRT display and the Line Printer. The techniques described herein allow the operator or technician to analyze a system malfunction indication, isolate the malfunction to a particular piece of equipment and restore the system to normal operational status. In order to accomplish this expeditiously, the documents listed in Table 1-1 and paragraph 1.2 of this section should be readily available.

1.1 Summary

Section 1, Introduction, describes the purpose of this manual and lists the primary documents and drawings which should be referred to by the operator.

Section 2, Control Equipment, describes the layout of the UTCS/BPS Central Control Room, the power distributions, and system cable layout.

Section 3, Field Equipment, describes the two types of cabinets used in the UTCS/BPS System, equipment and layout within these cabinets and the documentation contained in each cabinet.

Section 4, Communications, contains a theory of operations of the communications techniques used by UTCS/BPS System, a description of the Central communications cabinets and how they are wired and a description of the communications chassis used in the field and how they are wired.

Section 5, Signal Description and Signal Flow, describes the various signals which are used in the system between the Field and Central or Central and the Field. In addition, a complete signal flow for the overall system is described.

Section 6, Malfunction Indication, describes the various malfunction indications on the Control Panel and what equipments could be responsible for each malfunction.

Section 7, Central Malfunction Isolation, describes how to isolate malfunctions to the Central equipment in a logical step-by-step procedure.

Section 8, Field Malfunction Isolation, describes how to isolate the problem to a particular piece of Field Equipment, knowning that the Central Equipment is functioning properly.

Section 9, Alignment Procedures, describes how the various pieces of equipment, both in Central and in the Field, must be aligned after being replaced due to a malfunction.

Section 10, Bus Mounted Transmitter and Depot Monitoring Equipment, describes the operation and maintenance of the bus mounted equipment and the function of the depot monitoring equipment.

Appendix A, Glossary, defines terms used in this manual which may be unfamiliar to the technician.

Appendix B, Special Test Fixtures, describes the Map display test fixture and the Communication Card extender.

Appendix C, Reference Tables, lists various tables for reference during troubleshooting.

1.2 Equipment Drawings

The following drawings are required for equipment troubleshooting:

1.2.1 Communication Equipment

RFL Dwg. No.	Description
CR-12,500 through 12,515	Wiring Connection Diagrams
CR-12, 516	Central Communications Cabinet Wire Lists
HD 35612	Power Supply Schematic
HE 35602	2F Receiver Schematic
HE 35607	3F Receiver Schematic
HD 35617	2F Transmitter Schematic
HD 35618	3F Transmitter Schematic
HD 35651	Chassis Assembly 5 Module, Type B

	RFL Dwg. No.	Description
	HE 35661	Chassis Assembly Type A, 11 Module
	HE 35631	Central Communications Cabinet Assembly

1.2.2 Control Panel

Artisan Dwg. No.	Description
5001653-1 through 006	Printed Circuit Boards Schematics
5001651	Panel Wiring Diagram
5001658	Card Cage Wiring Diagram

1.2.3 Map Electronics and Display

TEC Drawing No.	Description
006875-100	Washington Map Display Assembly
006875-120	Washington Map Logic Unit Assembly
006875-601	Logic Assembly Interface
006875-602	Basic Rack (Traffic Signal)
006875-603	Quarter Rack (Traffic Signal)
006875-604	Basic Rack (Sensor)
006875-605	Eighth Rack (Sensor)
006875-611	Power Supply
006875-900	Wiring Diagram, System
006875-901	Wiring Diagram, Interface Logic
006875-902	Wiring Diagram, Lamp Cable
006875-903	Customer Wiring
006875-905	Wiring Diagram - Traffic Signal and Sensor Basic Rack, Traffic Signal Quarter Rack and Sensor Eighth Rack
991834-003 through 006	Decoder Schematics
991836-008	Schematic, Quad 2 Nand
991841-008	Schematic, Lamp Drivers
991862-002	Schematic, Traffic Signal Card
991863-001	Schematic, Sensor Signal Card
991863-003	Schematic, Logic Memory
992321-011	Schematic, Line Receivers
992321-016	Schematic, Line Receivers
992398-004	Schematic, Flashers and One-Shots
Sperry Drawing No.	
1-004-2-0-4002	Map Display

1.2.4 Field Cabinet Equipment

(Wiring information included in each Field Cabinet)

Marbelite Drawing No.	Description
7006-700-935	Wiring, Timer - 19 circuit
7006-700-982	Wiring, Timer - 40 circuit
7019-1000-267	Layouts - 19 and 40 circuit back panels
7019-1000-271	Layout - Communications Back Panel
7019-1000-272	Layout - Back Panel for pole-mounted cabinet
9000-14	Wiring List, Controller Back Panel - 19 circuits
9000-15	Wiring List, Controller Back Panel - 40 circuits
9000-17	Wiring List Back Panel (For E.B.'s)
9000-18	Wiring List, Interconnect Harness, Type I
9000-19	Wiring List, Interconnect Harness, Type II
9000-20	Wiring List, Interconnect Harness, Type III
9000-21	Wiring List - Communications Back Panel Type I
9000-22	Wiring List - Communications Back Panel Type II
9000-23	Wiring List - Communications Back Panel Type III
9000-100-56	Schematic, Controller Back Panel - 19 circuit
9000-100-57	Schematic, Controller Back Panel - 40 circuit
9000-100-58	Schematic, Back Panel for EB's
TD 11557	Installation Assembly M30 Type Controller
EB 3123	Interface Internal Harness
SS 1082	Controller Interface

1.2.5 Vehicle Detector Electronics Unit

Decatur Drawing No.	Description
S 780-57-E	Schematic, Model LHA Loop Detector

1.2.6 Bus Detector Transmitters and Receivers

Sperry Drawing No.	Description
1-004-2-0-8221	Receiver Module
1-004-2-0-8222	Schematic Diagram
1-004-2-0-8224	Panel
1-004-2-0-8227	Bracket
1-004-2-0-8228	Printed Circuit Board #2 Assembly

Sperry Drawing No.	Description
1-004-2-0-8229	Printed Circuit Board #2
1-004-2-0-8230	Printed Circuit Board #1 Assembly
1-004-2-0-8231	Printed Circuit Board #1
1-004-2-0-8232	Bus Detector Receiver Enclosure
1-004-2-0-8234	Receiver Assembly
1-004-2-0-8240	Transmitter Assembly
1-004-2-0-8241	Schematic Diagram
1-004-2-0-8242	Outline and Installation Drawing
1-004-2-0-8244	Antenna Blocks
1-004-2-0-8245	Antenna Assembly
1-004-2-0-8246	Housing
1-004-2-0-8247	Transistor Mount
1-004-2-0-8248	Bus Transmitter Printed Circuit Board Assembly
1-004-2-0-8249	Bus Transmitter Printed Circuit Board
1-004-2-0-8255	Transmitter Control Unit Parts List
1-004-2-0-8256	Transmitter Control Unit

1.2.7 Miscellaneous Drawings

Sperry Drawing No.	Description
UTCS 4200 (35 sheets)	UTCS Installation Drawing

1.3 Reference Manuals

The operator or technician should have available, for reference, the documents listed in Table 1-1.

TABLE 1-1. REFERENCE MANUALS

Manual	Publication Number	Company
1. UTCS/BPS System Operators Manual	GF 15-1003	Sperry Systems Management Division
2. UTCS/BPS Traffic System Software Manual (3 Volumes)	GF-16-1003	Sperry Systems Management Division
3. UTCS/BPS Traffic Control Panel	Sperry Specification No. 1-004-0-0-3200	Sperry Systems Management Division
	Maintenance Procedure EPC-11088	Artisan Electronics Corp.
4. UTCS/BPS Map Display Graphics Unit	Sperry Specification No. 1-004-0-0-4000	Sperry Systems Management Division
5. UTCS/BPS Map Display Logic Unit	Sperry Specification No. 1-004-0-0-4003	Sperry Systems Management Division
6. Instruction Book for Map Display System	DPA-6875	TEC Inc.
7. Operation and Maintenance Manual for Frequency Shift Communication Equipment for the UTCS/BPS Traffic System	-	RFL Industries, Inc.
8. Manual for UTCS Controllers and Controller Adapters	-	The Marbelite Co., Inc.
9. XDS Sigma 5 Computer Reference Manual	900959	Xerox Data Systems
10. Real-Time Batch Monitor (RBM) Reference Manual, XDS Sigma 5/7 Computers	901581	Xerox Data Systems

Table 1-1. Reference Manuals (Continued)

Manual	Publication Number	Company
11. Operation and Maintenance Manual for UTCS/BPS Vehicle Detector Electronics, Model LHA	-	Decatur Electronics, Inc.
12. Bus Detector Transmitter and Receiver Installation and Maintenance Manual	-	EDO Aire
13. Central Site Signal Interface Table	SSMD Doc. No. 4-8-2000	Sperry Systems Management Division
14. Rolodex Cross-Reference Directory (Reference File Cards)	N.A.	Sperry Systems Management Division

1.4 Test Equipment and Special Tools

Table 1-2 lists the various types of standard test equipment recommended for use in servicing and maintaining the UTCS/BPS System.

In addition to standard hand tools, the special tools listed in Table 1-3 are required for servicing the UTCS/BPS System.

TABLE 1-2. STANDARD TEST EQUIPMENT

Item	Description	Type and Model Number
1.	Multimeter	Simpson Model 260 Series 5-P or equivalent
2.	Oscilloscope, Battery Operated	Tektronic Model 323 with Power Pack or equivalent
3.	Oscilloscope	Tektronic Model 585A or equivalent
4.	DBM Meter	Hewlett-Packard Model 400D or equivalent
5.	Electronic Counter	Hewlett-Packard Model 5321A or equivalent
6.	Digital Voltmeter	Hewlett-Packard Model 3439A or equivalent

Table 1-2. Standard Test Equipment (Continued)

Item	Description	Type and Model Number
7.	Stop Watch	Lafeyette Model 13E31016L or equivalent
8.	Strip Chart Recorder	Hewlett-Packard Model 680 or equivalent
9.	Signal Generator, Sine Wave	Hewlett-Packard Model 200CD or equivalent
10.	Loop Tester	Automatic Control Equipment Model LT-100 or equivalent
11.	Megohmer	Herman H. Sticht Co. Model B-5 or equivalent

TABLE 1-3. SPECIAL TOOLS

Item	Type and Part Number	Use
1.	Thomas & Betts - Crimping Tool No. WT-452A	With BT093GP Pins
2.	Thomas & Betts - Insertion - Extraction Tool No. WT-650	With BT093GP Pins
3.	Thomas & Bettes - Betts - Bus Strip Installing Tool No. WT-453A	With BC-06 and BC-010 Bus Connectors
4.	McMaster-Carr - Safety Fuse Puller No. 7074K1 or equivalent	Controller Cabinets

1.5 Replaceable Items

The maintenance philosophy of the UTCS/BPS System is based on the replacement of spared black boxes; that is, communication modules, Bus Detector receivers and transmitters, Vehicle Detectors, Map Electronics printed circuit boards, etc. However, there are failures that can be isolated to consumable items such as fuses and lamps. Table 1-4 lists the UTCS/BPS consumable items.

TABLE 1-4. CONSUMABLE ITEMS

UTCS/BPS Unit Name	Consumable Item	Type or Part Number	Total System Quantity
Map Display:			
Traffic & Link	Lamp	Type 387	577
Legends	Lamp	Type 757	224
Map Electronics:			
5v Power Supply	Lamp	Neon	1
Control Panel:			
Panel Switches	Lamp	Type 387	448
Central Communication Cabinets:			
Power Supply	Fuse	0.6 amp 250v Bussman Type HDL or equivalent	120
Power Supply	Lamp	14 Volt 0.08 amp	10
Field Communication:			
Power Supply	Fuse	3 AG 1/4 amp SLO BLO	213
	Lamp	Neon for Drake R118-323	
		Dome Ind. or equivalent	213
Vehicle Detector	Fuse	3 AG 1/2 amp	479
Controller Adapter	Fuse	3 AG 1-1/2 amp	111
Bus Test Equipment:			
Installation Fixture	Lamp	NE-51H	3
Operational Fixture:			
Signal	Lamp	67 watt Traffic Lamp	4
Power Supply	Fuse	3 AG .15 amp	4
Controller 40 Circuit	Fuse	5 amp cartridge - CEFCO-5 or equivalent	24
	Fuse	10 amp cartridge - ZELL-10 or equivalent	28
	Fuse	15 amp cartridge - ZELL-15 or equivalent	40
	Fuse	60 amp cartridge - SHAWMUT-OT60 or equivalent	4

Table 1-4. Consumable Items (Continued)

UTCS/BPS Unit Name	Consumable Item	Type or Part Number	Total System Quantity
Controller 19 Circuit	Fuse	5 amp cartridge - CEFCO-5 or equivalent	570
	Fuse	10 amp cartridge - ZELL-10 or equivalent	685
	Fuse	15 amp cartridge - ZELL-15 or equivalent	685
	Fuse	60 amp cartridge - SHAWMUT-OT60 or equivalent	95

1.6 Special Material

Table 1-5 lists special material that is used in the communications cabinets on the interface blocks.

TABLE 1-5. SPECIAL MATERIAL

Item	Name	Purpose
1	Thomas & Betts - Crimp Pins No. BT-093GP	Used in FS Communications Cabinets to interface with other equipment
2	Thomas & Betts - Bus Connectors No. BC-06 and No. BC-010	Used in FS Communications Cabinets

1.7 Equipment List

Table 1-6 lists the UTCS/BPS Equipment Complement.

Table 1-6. UTCS/BPS Equipment Complement

Equipment	Manufacturer	Type/Model Number	System Qty
Bus Detector Receiver	EDO-AIRE	11010	144
Bus Detector Transmitter	EDO-AIRE	11020	450
Bus Detector Transmitter Switch Control	Signal Stat	800 (Modified)	450
Vehicle Detector Electronic Unit	Decature	LHA	497
Controller Cabinet (Pad Mounted)	Marbelite	TBM 2416	116
Communications Back Panel	Marbelite	TBM 2469	116
Nineteen Circuit Controller	Marbelite	M30-19	95
Forty Circuit Controller	Marbelite	M30-40	12
Controller Adapter	Marbelite	TBM 2305	111
Equipment Cabinet (Pole Mounted)	District Supplied		36
Back Panel-Pole Mounted Cabinet	Marbelite	TBM-2510	36
Communications Chassis Type A	RFL	HE-35661	181
Communications Chassis Type B	RFL	HD-35651	24
Modular Power Supply	RFL	HB 35610	205
2 Fsk Receiver	RFL	HB 35600	631
2 Fsk Transmitter	RFL	HB 24335-5	631
3 Fsk Receiver	RFL	HB 35605	255
3 Fsk Transmitter	RFL	HB 24335-34	255
Dual Amplifiers	RFL	14717	30
Central Communications Cabinet Assembly	RFL	HE 35631	10
Sigma 5 CPU with/Integral IOP	Xerox	8201	1
Sigma 5 CPU without/Integral IOP	Xerox	8202	1
Power Fail Safe	Xerox	8213	2
Memory Protect	Xerox	8214	2
Additional Register Block	Xerox	8216	2
Floating Point Arithmetic	Xerox	8218	1
Interrupt Control Chassis	Xerox	8221	2
Priority Interrupt, 2 Levels	Xerox	8222	8
Memory Module (4096 Words)	Xerox	8251	4
Memory Increment (4096 Words)	Xerox	8252	12

Table 1-6. UTCS/BPS Equipment Complement (Continued)

Equipment	Manufacturer	Type/Model Number	System Qty
Two Way Access	Xerox	8255	4
Three Way Access	Xerox	8256	4
External Interface Feature	Xerox	8270	2
Multiplexer Input/Output Processor	Xerox	8273	1
Additional Eight Multiplexer Channels	Xerox	8276	1
Keyboard/Printer and Controller	Xerox	7012	2
Card Reader (400 CPM)	Xerox	7122	1
Card Punch (100 CPM)	Xerox	7165	1
Rad Controller	Xerox	7201	1
Rad Storage Unit 1.5 MB	Xerox	7203	1
Rad Storage Unit 3.0 MB	Xerox	7204	1
20 KC Magnetic Tape Control	Xerox	7361	2
20 KC Magnetic Tape Unit	Xerox	7362	3
BCD Option	Xerox	7365	2
Buffered Line Printer, 600 LPM	Xerox	7440	1
Interprocessor Interrupt Feature	Xerox	7700	1
Computer Interface Unit	Xerox	7901	1
IOP to DIO Adapter	Xerox	7929	1
Digital I/O Adapter	Xerox	7930	2
Digital I/O Expander	Xerox	7931	6
Stored Output Module (8 Bit)	Xerox	7950	36
Digital Input Module (16 Bit)	Xerox	7951	82
Frequency Control Unit	Xerox	7969	1
Frequency Source Unit	Xerox	7970	2
Communication Controller	Xerox	7612	1
Timing Module	Xerox	7612	1
Send Module	Xerox	7615	2
EIA Interface	Xerox	7621	2

Table 1-6. UTCS/BPS Equipment Complement (Continued)

Equipment	Manufacturer	Type/Model Number	System Qty
CRT Terminal	Hazeltine	H 2000	2
Control Panel	Artisan	UTCS Special	1
Map Logic Unit	TEC	UTCS Special	1
Map Graphics Unit	TEC	UTCS Special	1
Control Console	TAB	UTCS Special	1

SECTION 2

CENTRAL EQUIPMENT

2.1 General

The Central Equipment includes all the UTCS/BPS System equipment located in the Washington D. C., Control Center. The Central Equipment consists of the following major units:

(1) Traffic Control Console

(2) Map Display

(3) Communications Equipment

(4) Computers

(5) Computer Interface Unit (CIU)

In addition to the above major equipments, there are several minor equipments such as the Radio Link.

2.1.1 Equipment Location

Figure 2-1 presents a floor plan layout of the Washington, D.C., Control Center. The Traffic Control Console located directly in front of the Map Display supports the Traffic Control Panel two CRT Displays, the Cross Reference Director and a telephone. The Map Display consists of two units. They are the Map Display Unit mounted on the wall and the Map Electronics Unit adjacent to the CIU in the Communications Room. The Communications Equipment consists of ten equipment cabinets in the Communications Room. The Radio Link equipment consists of six decoder cabinets mounted on the wall in the Communications Room. The Traffic System Telephone Panel is one unit of a triple telephone line interconnect box mounted on the wall in the Communications Room. The dual computer consists of a UTCS Computer and a BPS Computer, associated core memory, three magnetic tape drives, a two cabinet Rapid Access Disc (RAD), two Teletypewriters (TTYs), A Line Printer, a Card Reader and a Card Punch. The Computer Interface Unit (CIU) is a dual cabinet unit located in the Communications Room.

2.1.2 Power Distribution

The UTCS/BPS building floor plan, Figure 2-1, shows the location of the Left and Right Power Distribution Panels. Figures 2-2 and 2-3 show the location, size and the equipment protected by the power distribution circuit breakers. Each circuit breaker is connected to a receptacle under the raised floor in the vicinity of the associated equipment. The circuit breakers marked (red) should be left in the ON position to prevent possible damage to equipment due to power turn on transients or, as in some cases, for convience because the equipment is turned on or off by its own local power control circuits.

2.1.3 System Cables

Several different types of cable are used in FS communication to interconnect the UTCS/BPS System. All FS Communication signals are carried on twisted pair cables. Six pair and twenty-seven pair are the two types of cables used. All CIU signals are carried on 10 wire shielded cables. Eight wires carry 8-bits of data and two wires are used for a ground. The shield drain is grounded at the transmitter end only.

Figure 2-4 shows a cable map of the interconnecting system cables and their identifing cable series number. The system cables are documented in the Central Site Signal Interface Table (SSMD Document No. 4-8-2000). A sample page of which is shown in Figure 2-5.

These wire-run lists must be used in order to trace a particular signal from the outgoing or incoming telephone lines through the Central communications equipment to the CIU. The run-list also shows all interconnections between the various pieces of prime equipment, exclusive of the computer and its peripherals. On each page, the left side is used to itemize signals coming into the unit, while the right side shows all signals going out of the unit. As shown in the Table index, all signals are identified. This document denotes the detailed connections between units, and all connections are cross-referenced. It should be noted that Communications Cabinet Blocks 100, 200 and 300 are referred to in this table as B1, B2 and B3, respectively.

There are 55 input telephone lines, designated TLI-01 through TLI-55. These lines bring in Vehicle Detection, Bus Detection and A-Phase Green signals. There are only 24 output telephone pairs, designated TLO-01 through TLO-24. These carry the Hold and Advance signals to the controllers. Page 3 of the Central Site Signal Interface Table shows to which one of the 10 cabinets (UD501-510) each telephone line input signal goes first and from which cabinet each output signal leaves.

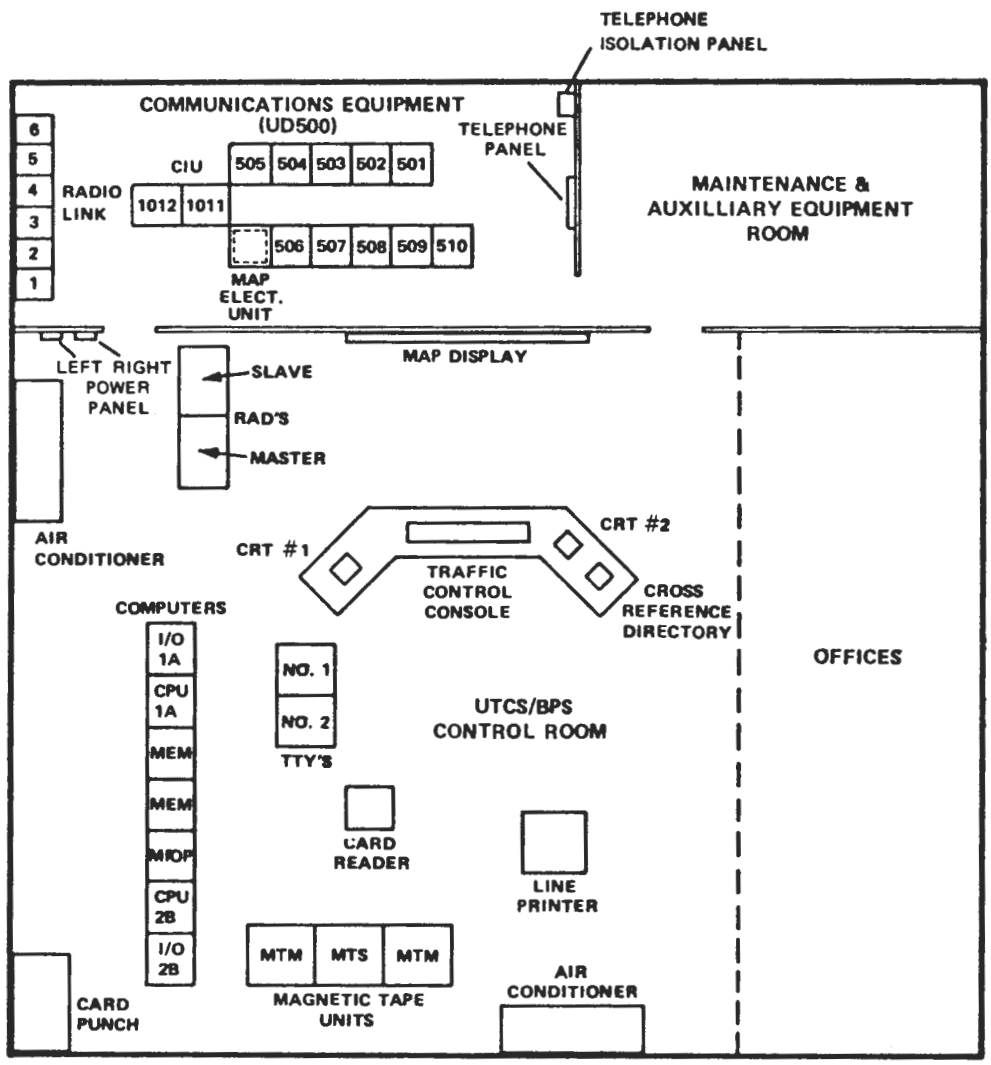


Figure 2-1. Floor Plan of UTCS/BPS Washington, D. C., Control Center

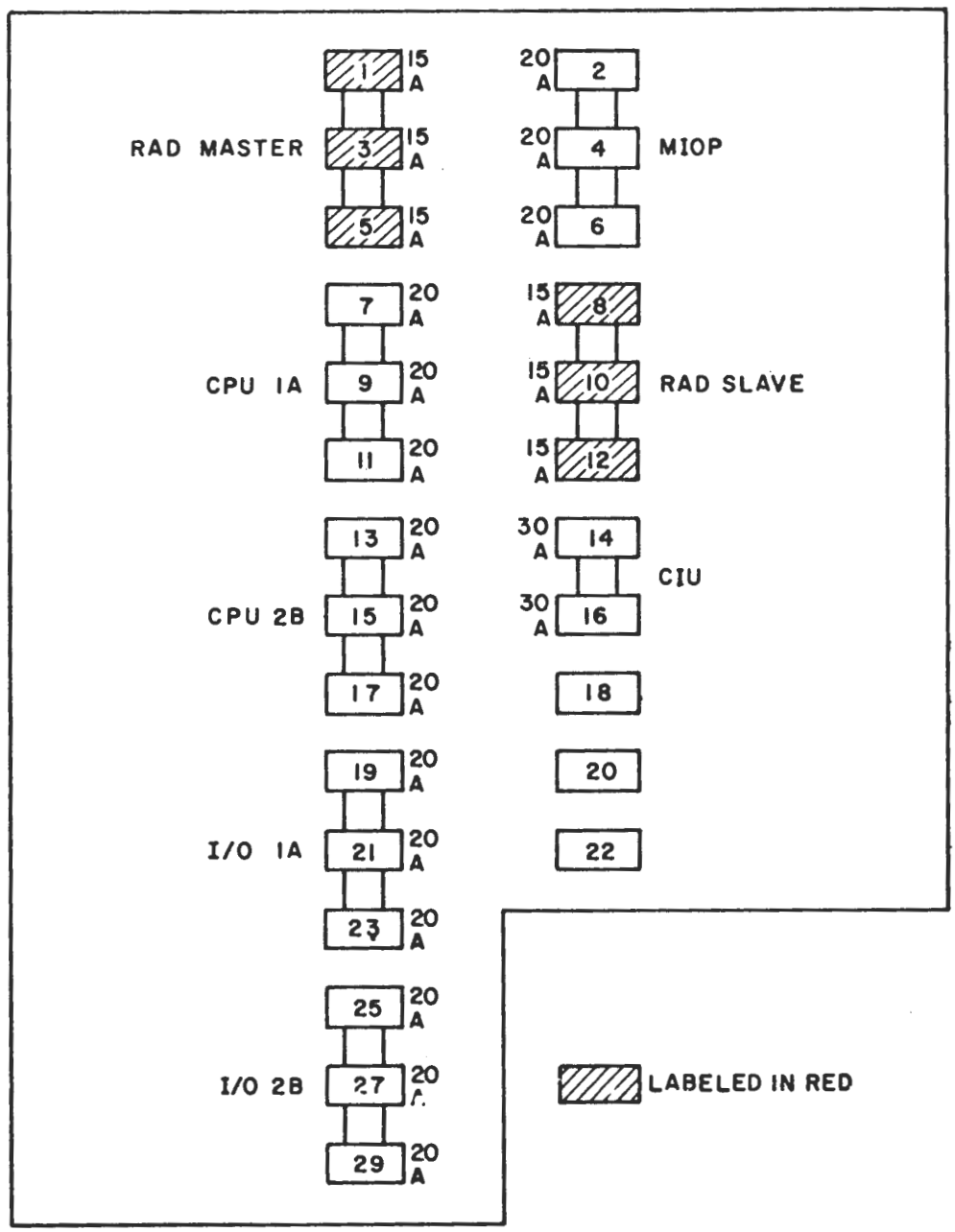


Figure 2-2. Left Power Distribution Panel

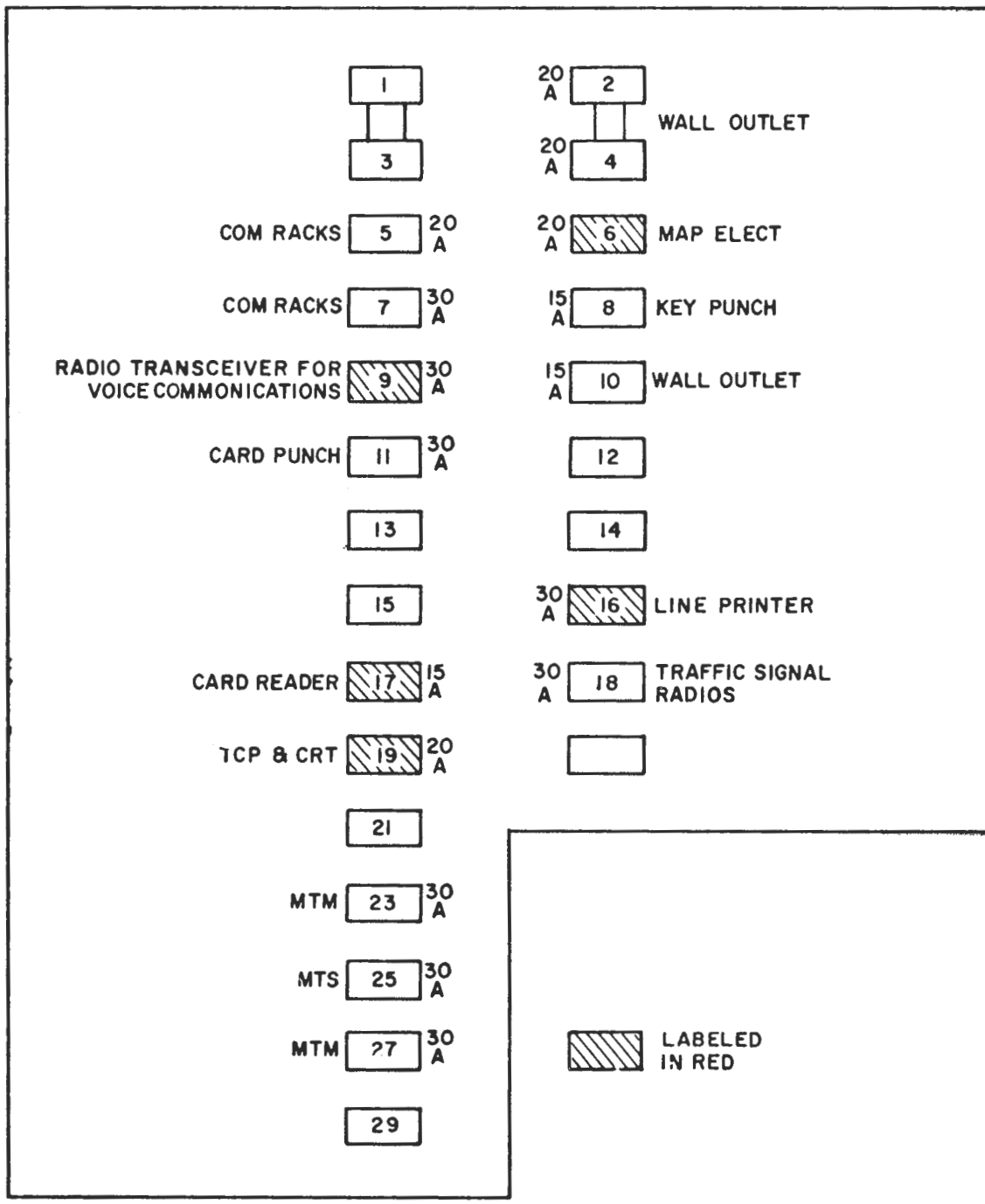


Figure 2-3. Right Power Distribution Panel

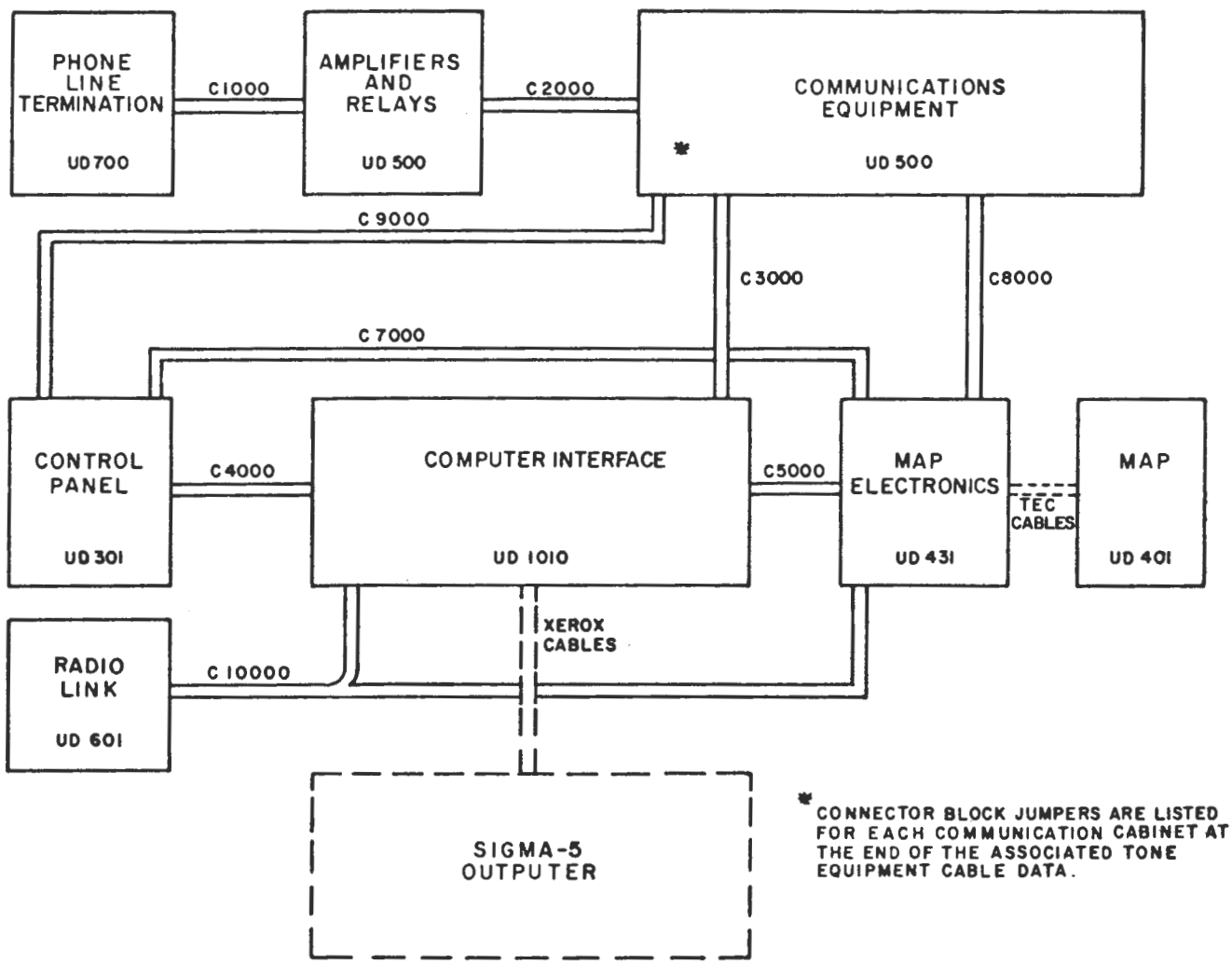


Figure 2-4. UTCS/BPS Cable Map

COMMUNICATIONS UNIT
UD 500

URBAN TRAFFIC CONTROL SYSTEM SIGNAL INTERFACE

PAGE 6D
DATE 09/18/72
REV A

(1) ASSY NAME NO.	(2) CABLE NO.	(3) SIGNAL ID	(4) INPUT PLUG/PIN NO. REC.	(5) ASSY NO.	(6) PLUG/PIN NO. TX	(7) WIRE TYPE	(8) LENGTH (FT.)	(9) SIGNAL ID	(10) OUTPUT PLUG/PIN NO. TX	(11) ASSY NO.	(12) PLUG/PIN NO. REC.	(13) WIRE TYPE	(14) LENGTH (FT.)
				FROM		SIGNAL INTERFACE				TO			
TONE 503	TJ2005	TLI-46	B3-C27	502	B3-A10	22TW-GRN	13.00	TLI-32	B3-A8	502	B3-C10	22TW-RED	13.00
		TLR-46	B3-C28	502	B3-A11	22TW-BLK	13.00	TLR-32	B3-A9	502	B3-C11	22TW-BLK	13.00
		TLI-47	B3-F17	502	B3-A8	22TW-BLU	13.00	TLI-45	B3-B19	502	B3-H8	22TW-WHT	13.00
		TLR-47	B3-F18	502	B3-A9	22TW-BLK	13.00	TLR-45	B3-B20	502	B3-H9	22TW-BLK	13.00
								TLI-48	B3-G15	502	B3-B8	22TW-YEL	13.00
			TO		FROM			TLR-48	B3-H15	502	B3-B9	22TW-BLK	13.00
								TLI-49	B3-F15	502	B3-K17	22TW-BRN	13.00
								TLR-49	B3-F16	502	B3-K18	22TW-BLK	13.00
TONE 503	TJ2006	TLI-52	B3-D17	502	B3-G29	22TW-GRN	13.00	TLI-50	B3-A19	502	B3-G8	22TW-RED	13.00
		TLR-52	B3-D18	502	B3-G30	22TW-BLK	13.00	TLR-50	B3-A20	502	B3-G9	22TW-BLK	13.00
								TLI-51	B3-J13	502	B3-F10	22TW-WHT	13.00
								TLR-51	B3-K13	502	B3-F11	22TW-BLK	13.00
								TLI-53	B3-J14	502	B3-C8	22TW-BLU	13.00
								TLR-53	B3-K14	502	B3-C9	22TW-BLK	13.00
								TLI-54	B3-J15	502	B3-B19	22TW-YEL	13.00
								TLR-54	B3-K15	502	B3-B20	22TW-BLK	13.00
								TLO-20	B3-E3	502	B3-D3	22TW-BRN	13.00
								TLR-20	B3-E4	502	B3-D4	22TW-BLK	13.00
TONE 503	TJ2009	TLI-17	B3-F10	504	B3-G13	22TW-RED	13.00	TLI-25	B3-G13	504	B3-J17	22TW-WHT	13.00
		TLR-17	B3-F11	504	B3-H13	22TW-BLK	13.00	TLR-25	B3-H13	504	B3-J18	22TW-BLK	13.00
		TLI-32	B3-R8	504	B3-D17	22TW-GRN	13.00	TLI-33	B3-G14	504	B3-E17	22TW-BLU	13.00
		TLR-32	B3-R9	504	B3-D18	22TW-BLK	13.00	TLR-33	B3-H14	504	B3-E18	22TW-BLK	13.00
		TLI-42	B3-D8	504	B3-E17	22TW-YEL	13.00						
		TLR-42	B3-D9	504	B3-F18	22TW-BLK	13.00						
		TLI-43	B3-K8	504	B3-H17	22TW-BRN	13.00						
		TLR-43	B3-K9	504	B3-H18	22TW-BLK	13.00						

INPUT

OUTPUT

NOTE: INPUT AND OUTPUTS NOT RELATED.

Figure 2-5. Sample Page (Wire Run List)

Referring to the sample page of Figure 2-5, the following procedure is used to read the data:

(a) Upper LH corner - Name of major assembly and UD number

(b) Upper RH corner - Page number, date and revision letter

(c) LH column 1 - Subassembly name and UD number

(d) LH column 2 - Cable number

(e) Input signal information is found in columns 1 through 8 only.

- Column 3 - Signal identification
- Column 4 - Receiver plug and pin number related to Column 1
- Column 5 - Subassembly number of transmitting unit
- Column 6 - Transmitter plug and pin number related to Column 5
- Column 7 - Wire type and color
- Column 8 - Cable length

(f) Output signal information is found in columns 1, 2 and 9 through 14 only.

- Column 9 - Signal identification
- Column 10 - Transmitter plug and pin number related to Column 1
- Column 11 - Subassembly number of receiving unit
- Column 12 - Receiver plug and pin number related to Column 11
- Column 13 - Wire type and color
- Column 14 - Cable length

2.1.4 Telephone Lines

The interface between the UTCS/BPS Central Equipment and the Field Equipment is by telephone lines. There are 79 active lines that enter and leave the Central via the input/output telephone line terminal blocks shown in Figures 2-6 and 2-7. From the terminal blocks mounted on the wall the line pairs run to the Communications Cabinets. See Figure 2-1.

The Central Site Signal Interface Table (SSMD Document No. 4-8-2000) lists the 55 input line pairs designated TLI-01 through TLI-55 and the 24 output line pairs designated TLO-1 through TLO-24. It also designates the Communications Cabinet termination point and the telephone block (Figure 2-6) termination point. TLR designates the return lead of a telphone pair either input or output.

2.1.5 Radio Link

The district's master clock and two one-way sign control signals are brought into Central via a Radio Link. The radio receiver is located external to the Central Site. The Radio Link is to be maintained by the District.

The synchronization and sign control tones are brought into Central on two wires into the Radio Link Cabinet No. 1 and then distributed to the other five cabinets. The output of each cabinet decoder is then sent to the Radio Link Interface Unit installed in the bottom of Cabinet No. 1.

From the Interface Unit the signals go to Connector J-1 mounted on the bottom of Radio Link Cabinet No. 1. A three wire cable carries the 15th Street One-Way North and the 17th Street One-Way South signals and a return to Connector P-13 at the Map Electronic Unit (UD 431). Two ten wire shielded cables carry the sync and sign signals to the Computer Interface Unit (Section 1012 of UD 1010).

2.1.6 CIU Configuration

The CIU configuration is shown in Figure 2-8. It consists of two units, UD 1011 and UD 1012 Ref. Figure 2-9 and 2-10. Unit UD 1011 contains only input modules while unit UD 1012 contains both input and output modules.

Each input section contains four plug-in card modules. Each plug-in card module accepts 16 data bits. Hence, each input section accomodates 64 data bits. When the computer addresses the particular section, it receives the 64 data bits in two 32 bit words. For instance, for the address 0/9 the words are V_4 and V_5, each word consisting of 32 individual vehicle detector inputs.

The pin connections on one side of the plug-in card module are labeled 1 through 8. The pins on the other side of the connector are labeled A through H. The 8 bits on one side (1-8) are part of one 32 bit word while the 8 bits on the other side (A-H) are part of the other 32 bit word. Hence, all four cards contribute to each of the two 32 bit words. Figure 2-11 shows the connector assembly.

In the output section, each section can accomodate four plug-in card modules. Each of these card modules can deliver only 8 bits. Hence, the 32 bit word comes out, in bit parallel on four cards. For instance, when the computer addresses the output word 1/7 the output is the H_1 word which is the Hold signal for 32 separate controllers.

Appendix C lists the data bit number and the associated card location and pin connection for all CIU inputs and outputs.

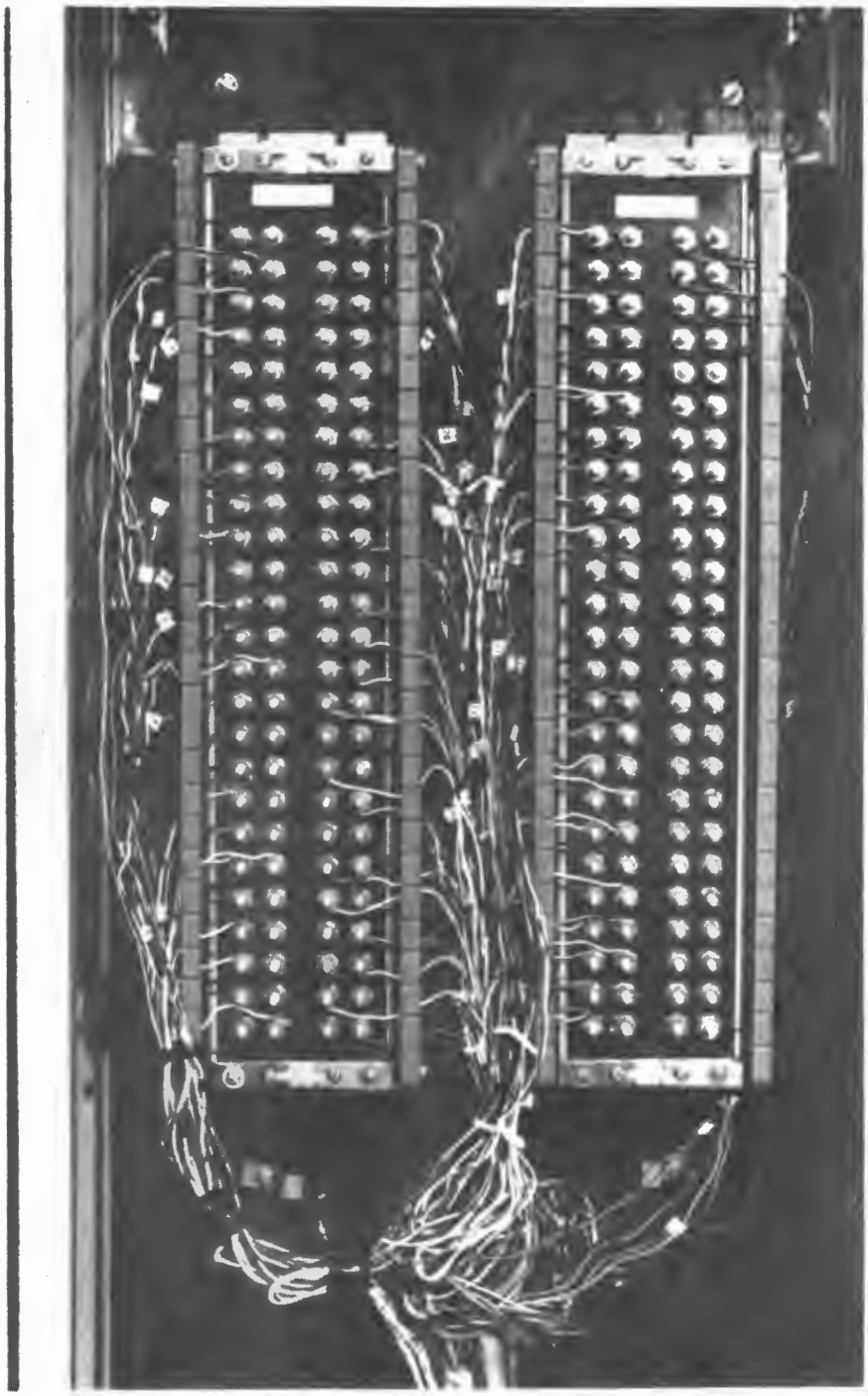


Figure 2-6. Telephone Panel

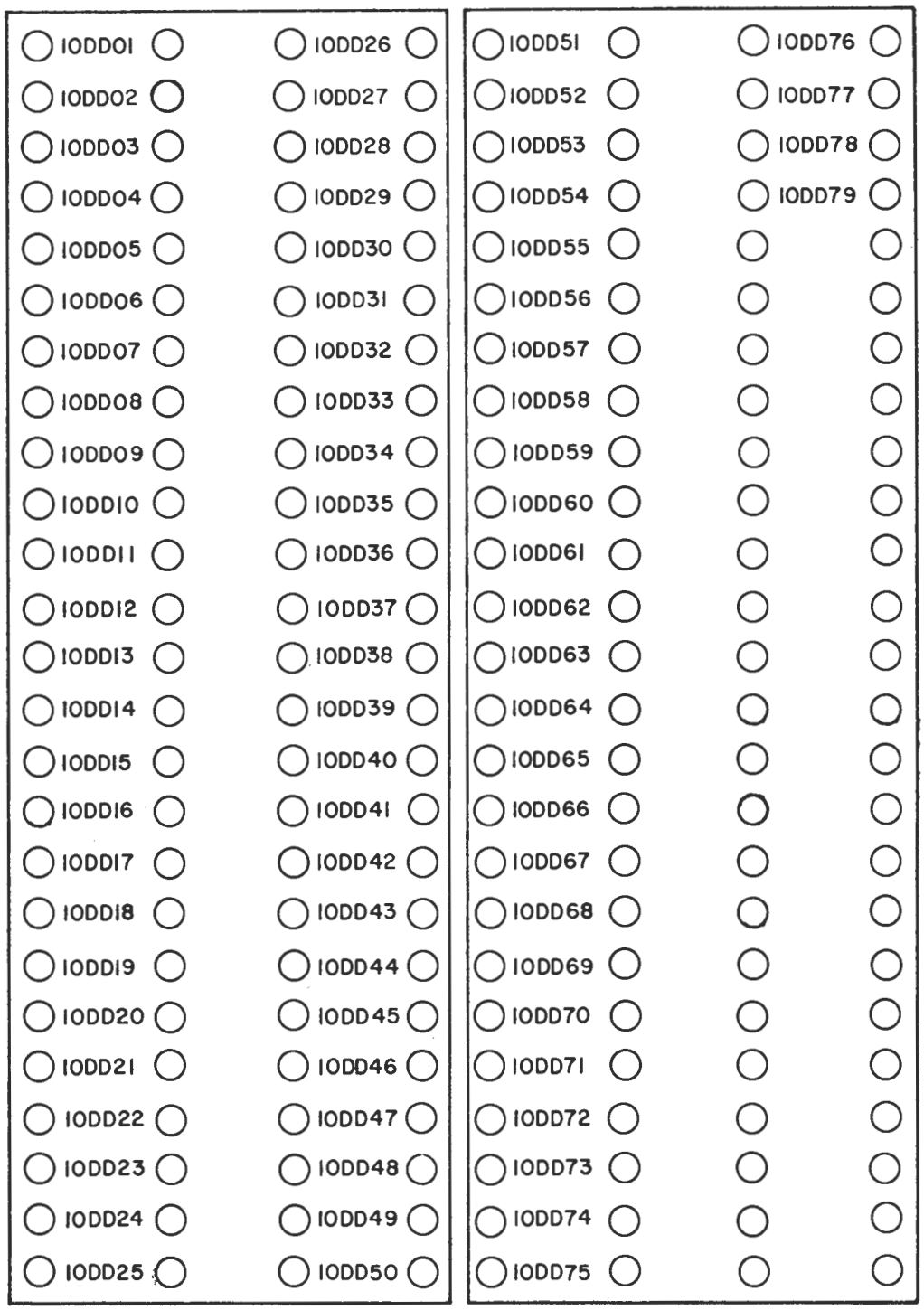
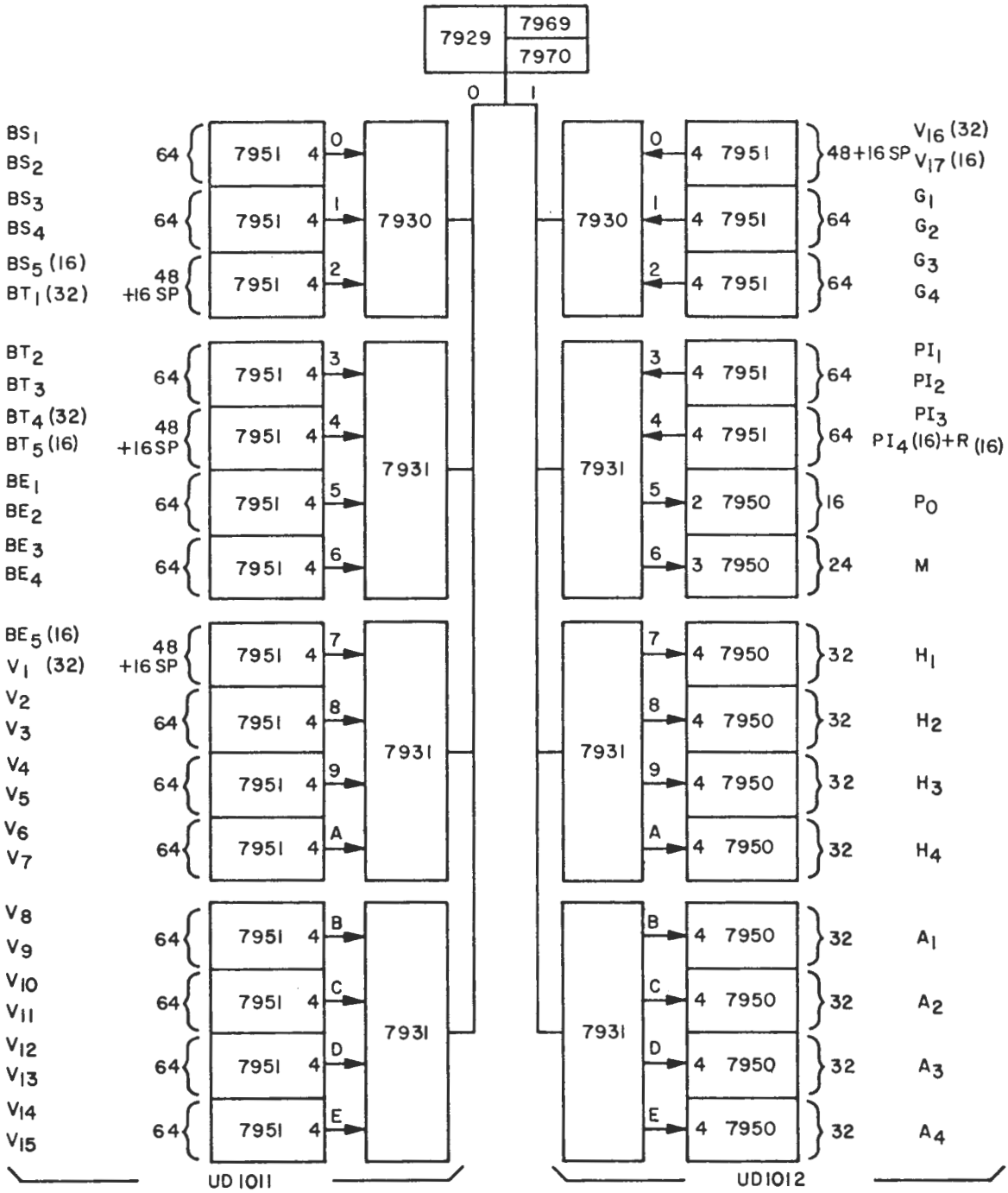


Figure 2-7. Input/Output Telephone Line Termination



WORD	DESCRIPTION	WORD	DESCRIPTION
BS	BUS STOP	R	RADIO LINK
BT	BUS THROUGH	PO	CONTROL PANEL OUTPUT
BE	BUS ERROR	M	MAP ELECTRONICS
V	VEHICLE DETECTOR	H	HOLD
G	GREEN RETURN	A	ADVANCE
PI	CONTROL PANEL INPUT	SP	SPARE

Figure 2-8 CIU Configuration

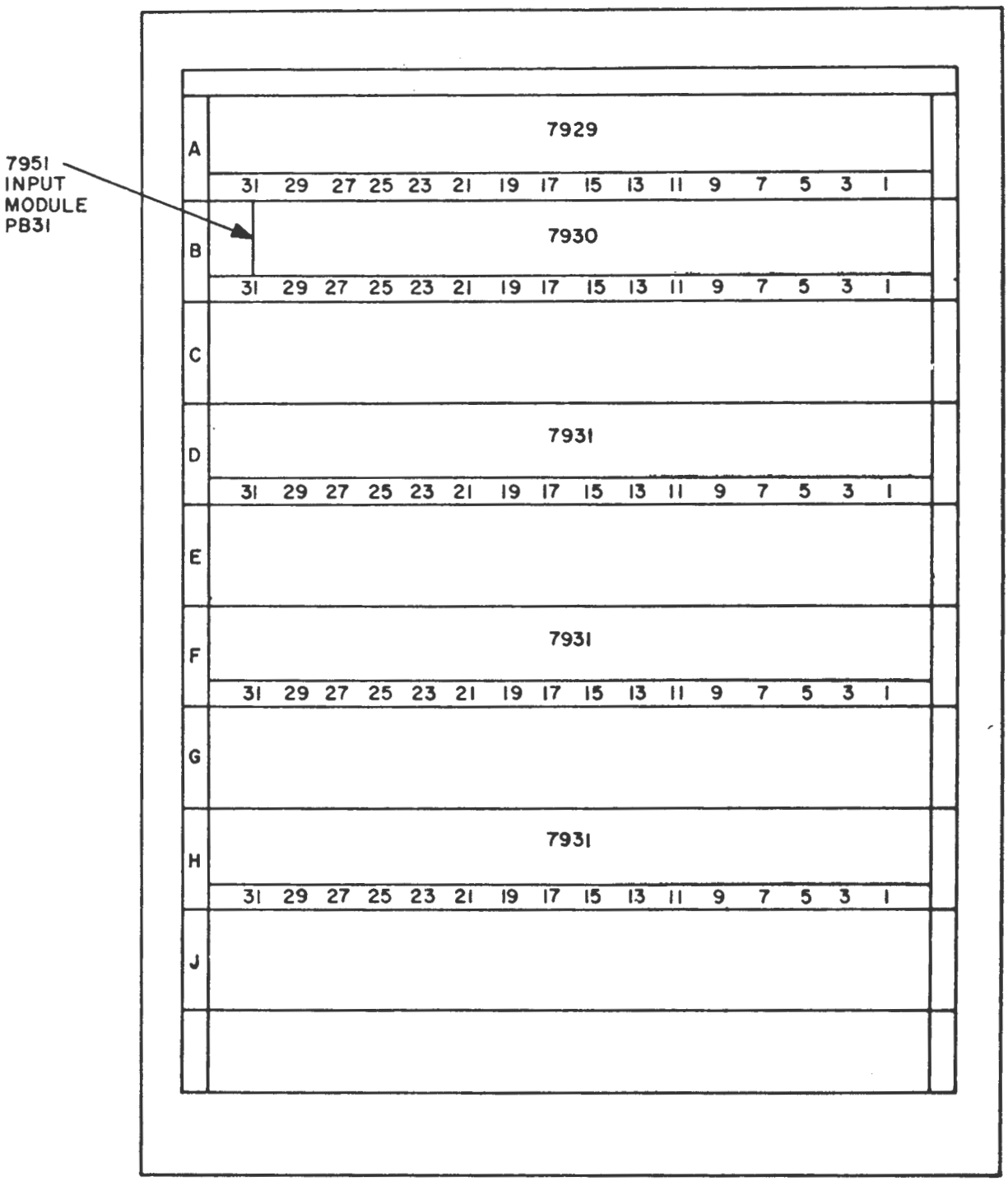


Figure 2-9 Computer Interface Unit Card Locations Rear UD 1011

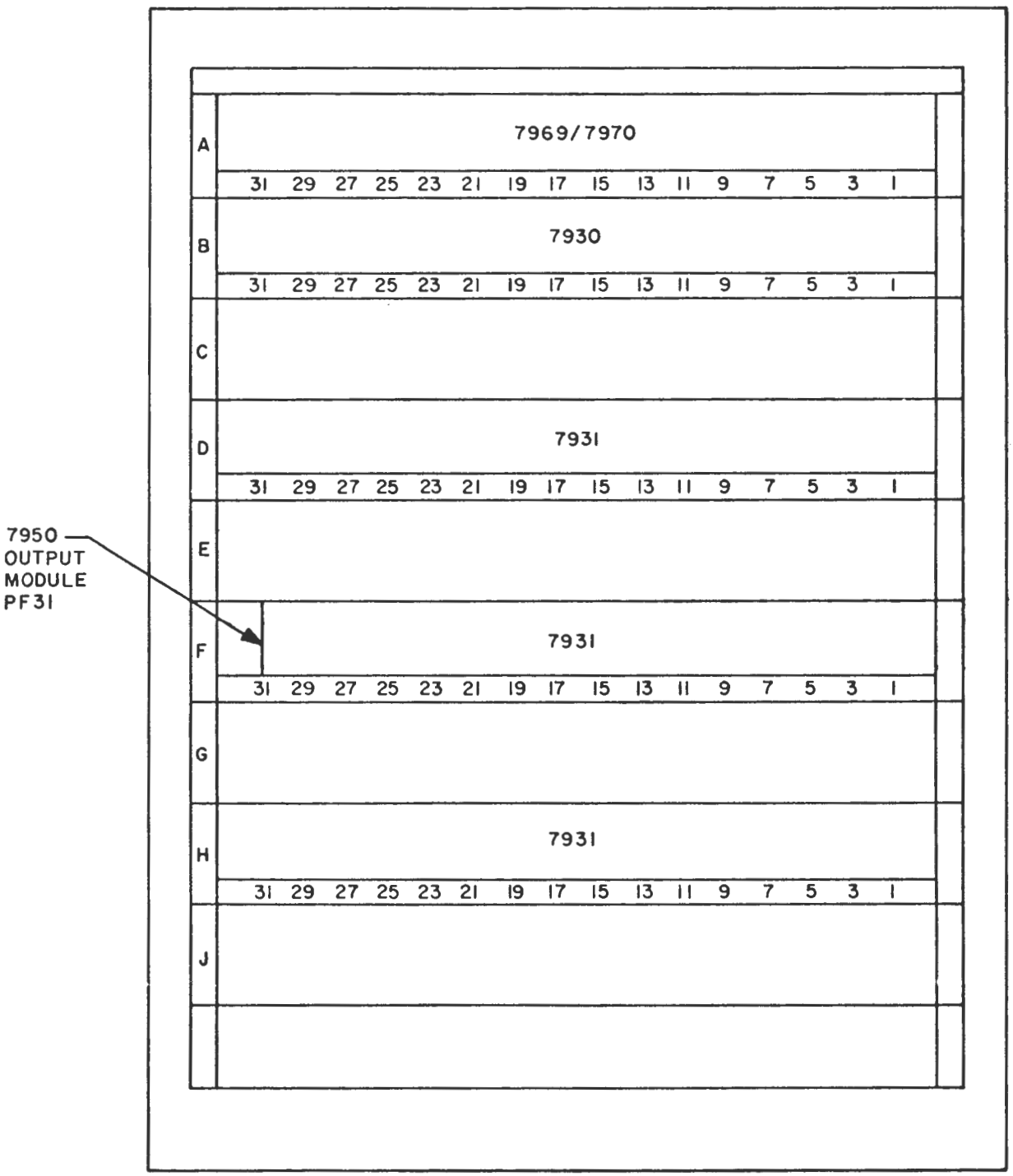


Figure 2-10 Computer Interface Unit Card Locations Rear UD 1012

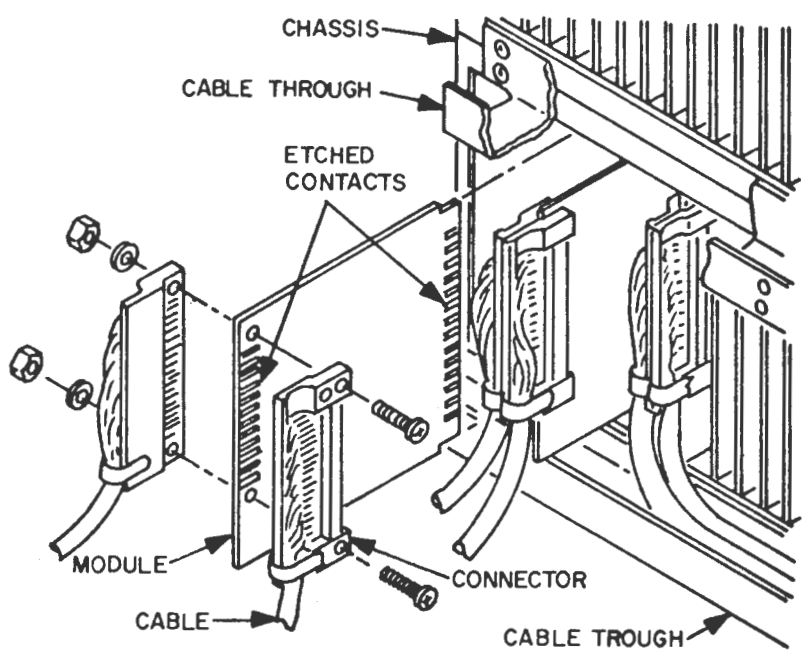


Figure 2-11 CIU Cable Assembly

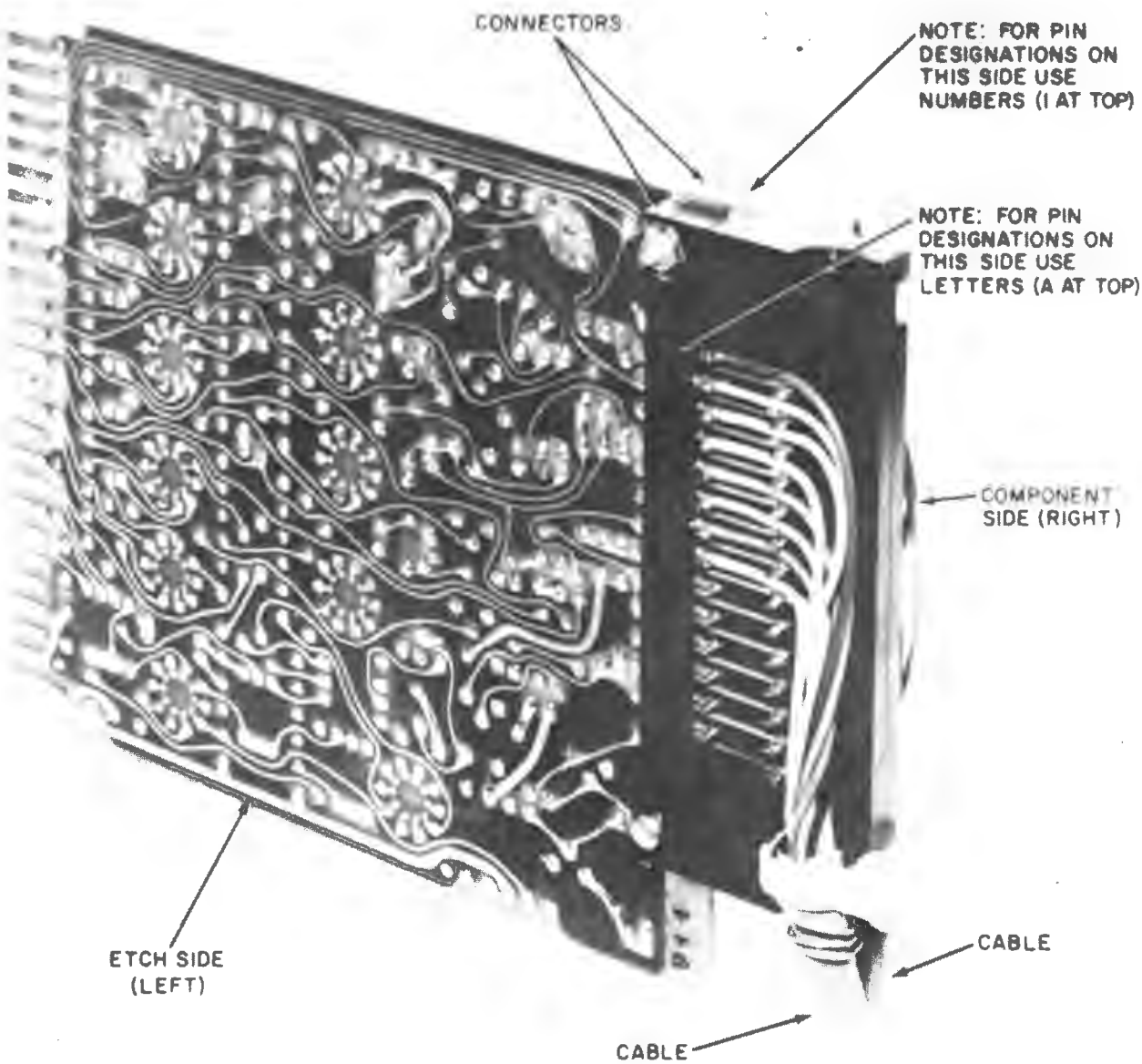


Figure 2-12 CIU Card and Connector

SECTION 3

FIELD EQUIPMENT

3.1 General

Two types of cabinets are used to house the field equipment in the UTCS/BPS System. They are pad mounted cabinets and pole mounted cabinets.

3.1.1 Equipment Location

The pad mounted cabinet, usually called a CB, is approximately 5 feet high x 3 feet wide x 2 feet deep. It houses the Timer Tray, Controller Back-Panel, Communications Back-Panel, Controller Adapter, Communications Modules and Vehicle and Bus Detectors. Figure 3-1 shows the location of these components and identifies other key maintenance points.

The communication trays and modules will vary from cabinet to cabinet depending upon the Vehicle and Bus Detector complement for the particular intersection in question. However, the Power Supply modules, Hold and Advance Receiver, and the A-Phase Green Transmitter will be located in the positions shown in Figures 3-1 and 3-2 in every controller cabinet.

The positions of the Vehicle Detectors and Communications Trays are shown in Figure 3-2. Vehicle Detector Position No. 1 and Communication Tray Position A are the first filled in each cabinet and additional detectors and trays are installed in increasing position numbers.

The pole mounted cabinet, usually called an EB, is approximately 2 feet high by 1 1/2 feet wide by 1 foot deep. It contains a small Communications Back-Panel, Vehicle Detectors and Bus Detector and Power Supplies Modules. The Bus Detector Modules and power supply are contained in a five module wrap-around that is shelf mounted. The Vehicle Detectors are also shelf mounted. See Figure 3-3.

3.1.2 Documentation

Each cabinet contains a documentation package. This package includes at least the following information:

(a) Cam Breakout and Dial Setup Sheet

(b) Timing Sheet - District

(c) Vehicle and Bus Detector Hookup CB

(d) Vehicle and Bus Detector Hookup EB

(e) Cabinet CB to Cabinet EB Hookup

(f) Color Sequence Chart

(g) Cabinet Wiring information

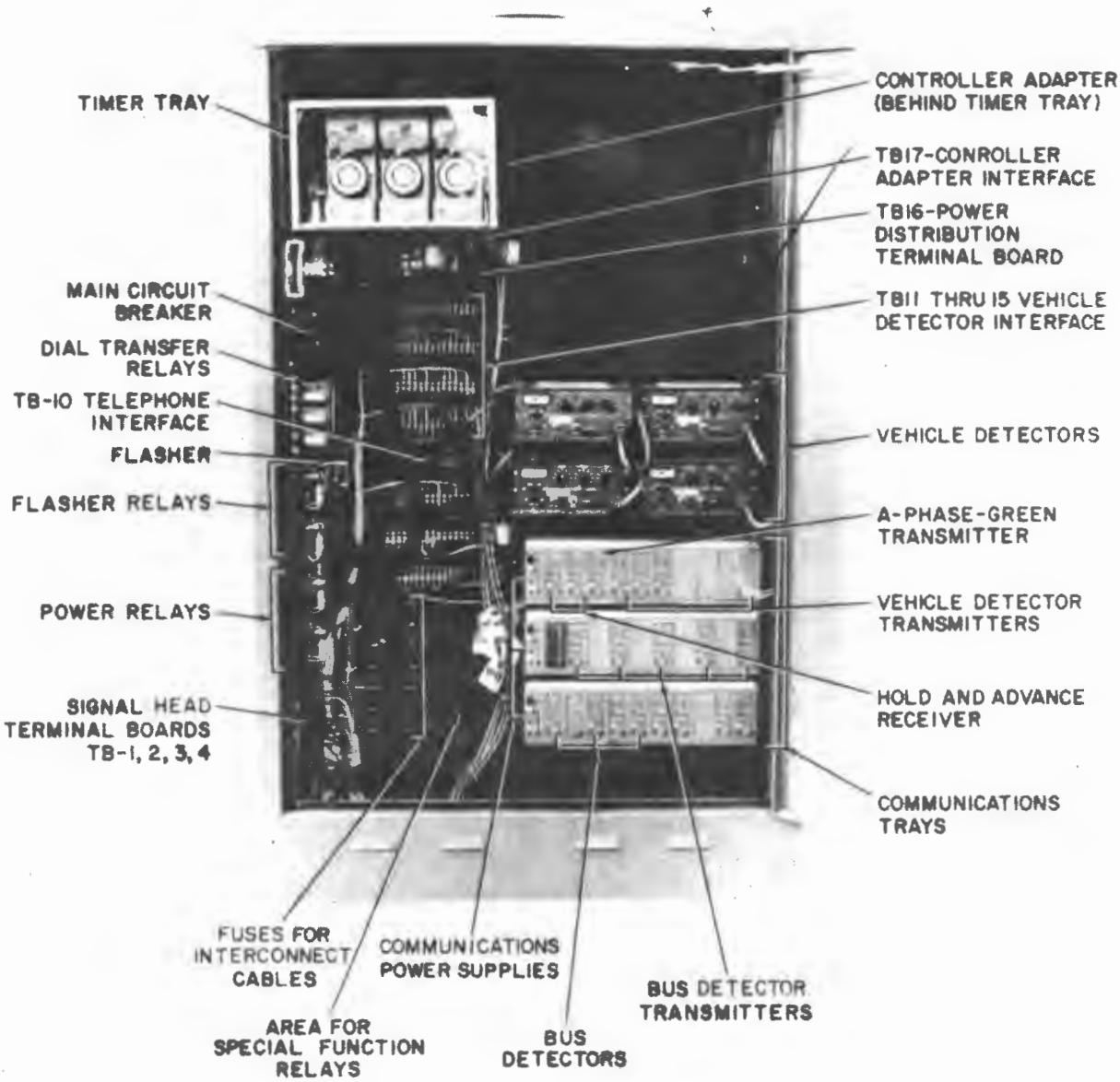


Figure 3-1. Pad Mounted Cabinet

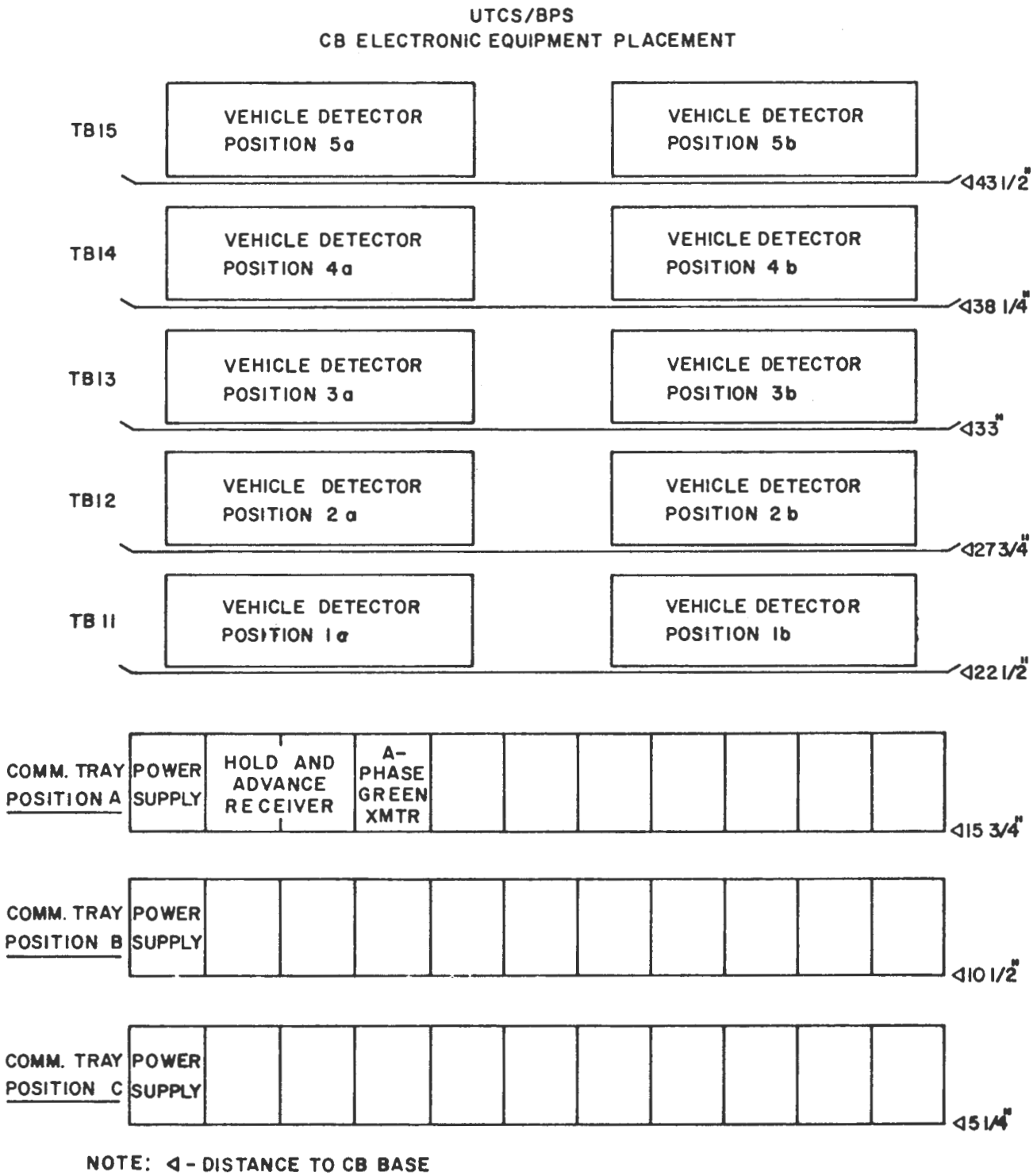


Figure 3-2. Detector and Communications Tray CB Position Assignment

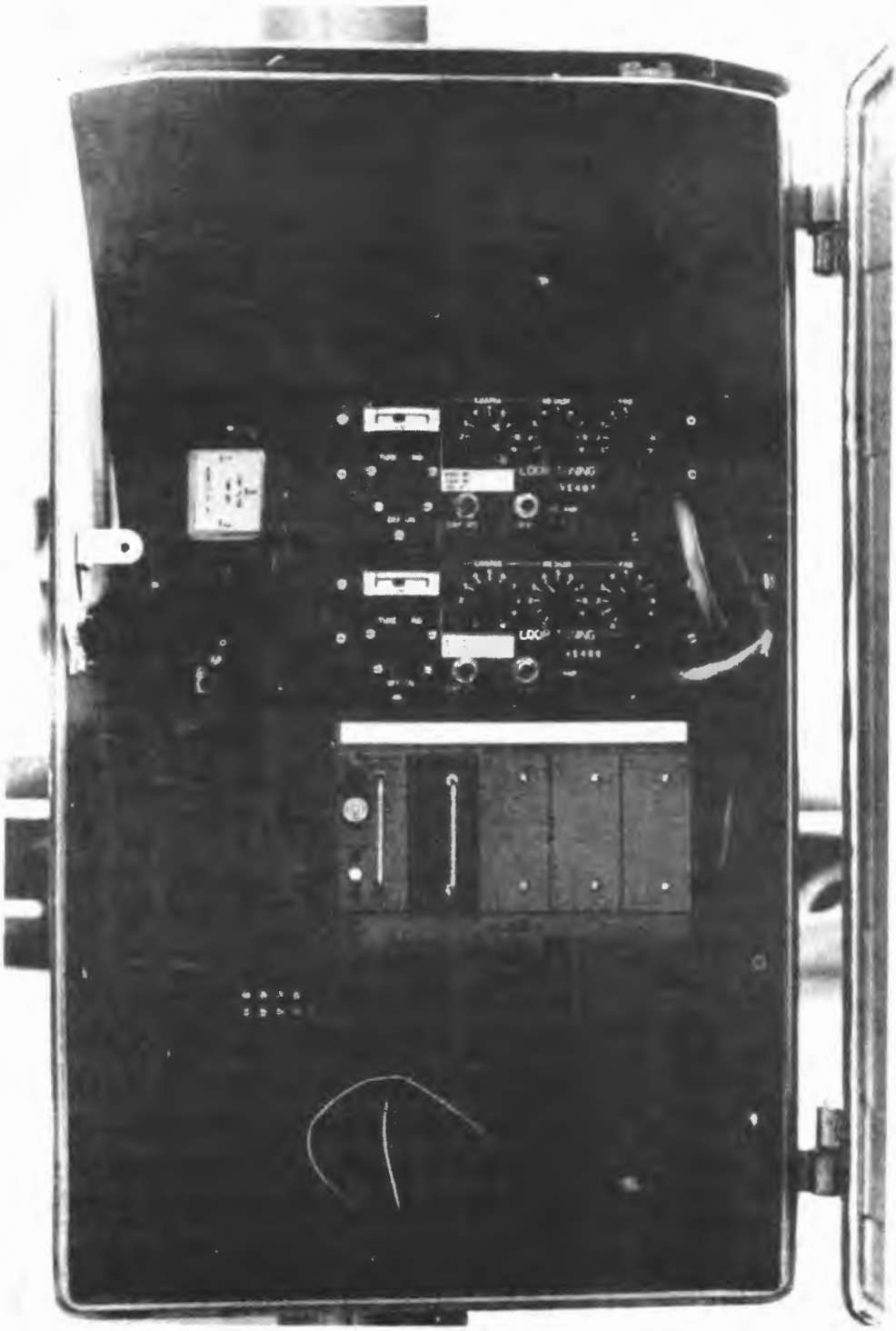


Figure 3-3. Pole Mounted Cabinet

SECTION 4

COMMUNICATIONS

4.1 General Theory

The UTCS/BPS communication techniques involve the use of frequency division multiplexing. This enables one telephone line to carry up to 20 signals simultaneously. The UTCS systems uses a maximum of 17 signals per line. Each signal occupies a separate 120 Hz bandwidth. The nominal or carrier frequency, f_o, of each signal is spaced 120 Hz away from the two adjacent carrier signals. Thus, 20 transmitters can combine their audio outputs into one telephone line and, at the other end, 20 separately tuned receivers can extract their corresponding signal from the telephone line. See Figure 4-1.

The UTCS/BPS System utilizes two different types of receivers and transmitters. These are called 2F and 3F.

4.1.1 2F Transmitters and Receivers

The 2F transmitter is always on, generating the Space frequency and the corresponding receiver output is a +6.5 vdc level. The application of a +12 vdc signal is required to key the Mark input of the 2F transmitter. The transmitter then shifts the frequency 60 Hz higher then the Space frequency. This higher frequency is referred to as Mark and causes the output of the corresponding receiver to drop to 0 volts.

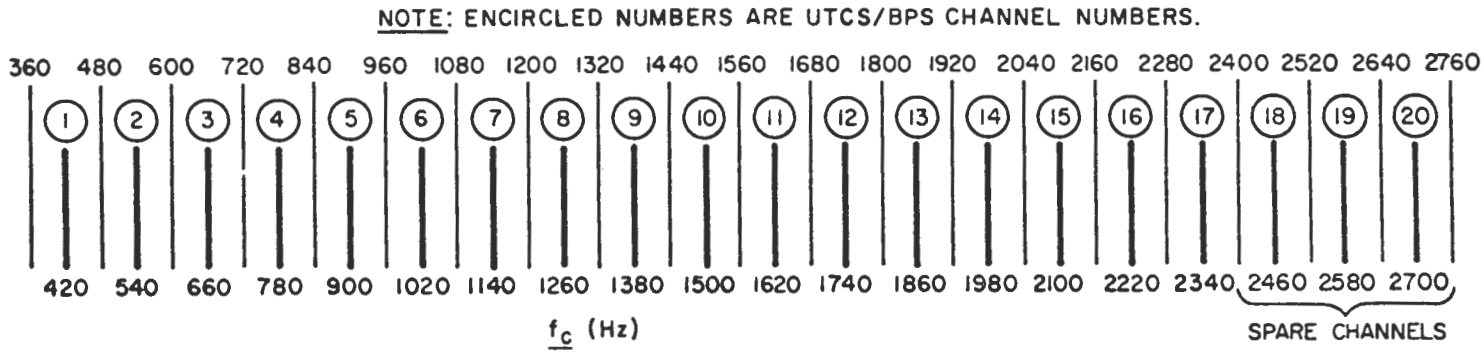
4.1.2 3F Transmitters and Receivers

The 3F transmitters have three keying points; Space, Mark, and Oscillator On.

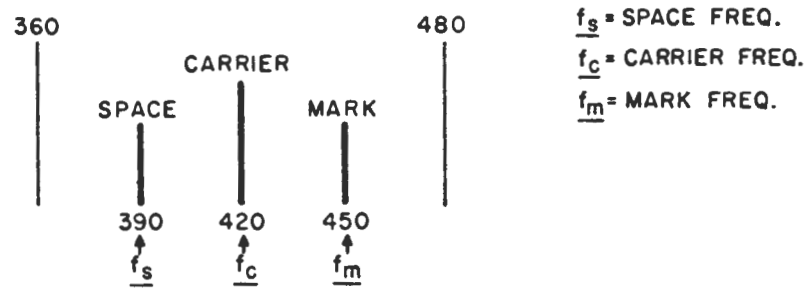
When the key Oscillator On is energized with a positive voltage the Oscillator puts out the carrier frequency, f_o. When the Space key and key Oscillator On are both positive, then the oscillator frequency shifts to the Space frequency, f_s. When the Mark key and key Oscillator On are both positive, then the oscillator frequency shifts to Mark frequency, f_m. The 3F receivers have three outputs; Carrier detect, Space, and Mark. If the corresponding transmitter is keyed to f_o, f_s or f_m, as described above, the following outputs will be obtained. See Figure 4-2.

(1) Keyed to f_o

The Space output is +12 vdc, the Mark output is +12 vdc and the Carrier Detector outputs is + 12 vdc.



(a) TELEPHONE LINE SPECTRUM



(b) SINGLE CHANNEL ANALYSIS

Figure 4-1. Frequency Division Multiplexing

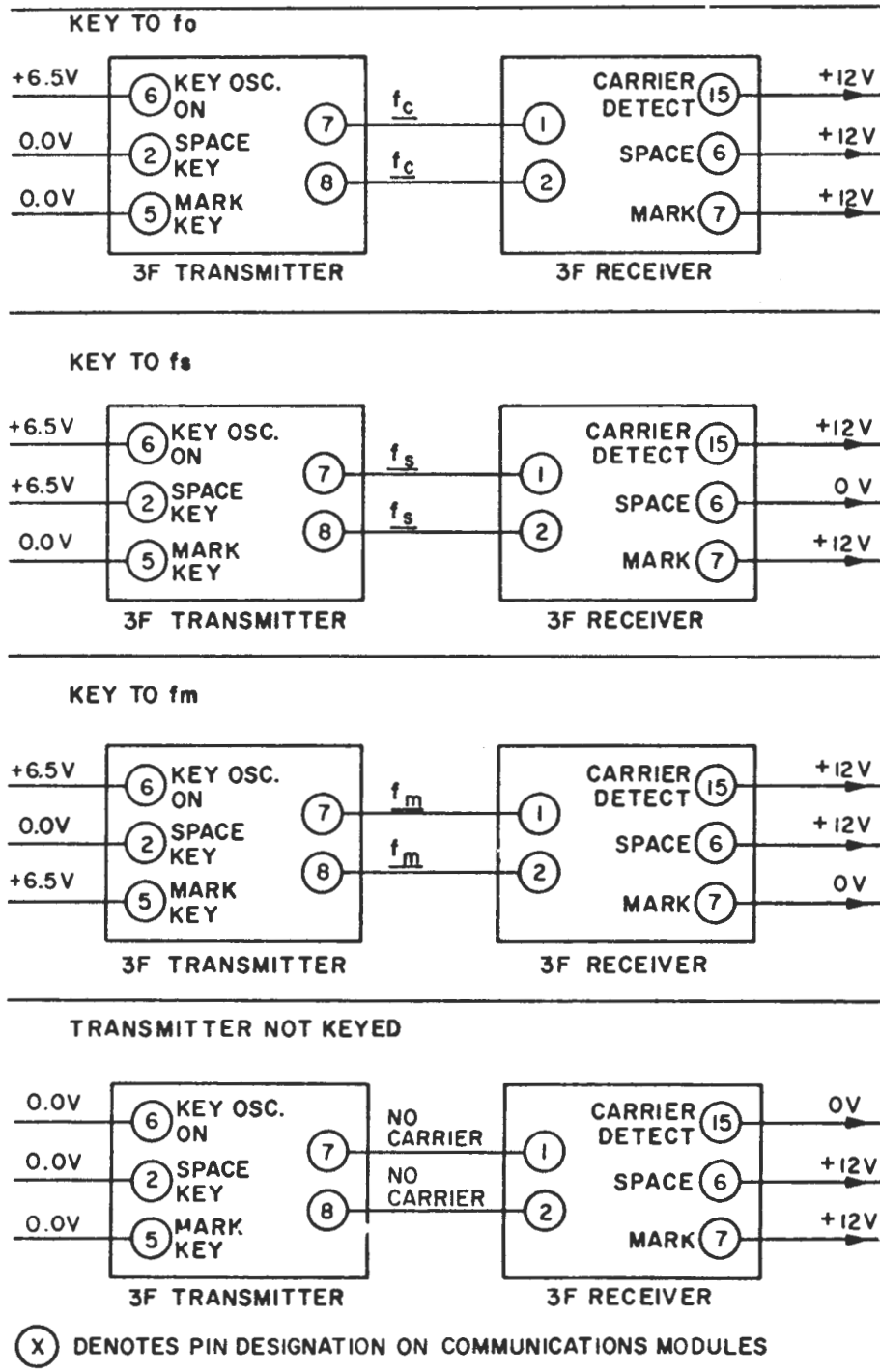


Figure 4-2. 3F Signal Logic

(2) Keyed to f_s

The Space output is 0 vdc, the Mark output is +12 vdc and the Carrier detect output is +12 vdc.

(3) Keyed to f_m

The Space output is +12 vdc, the Mark output is 0 vdc and the Carrier detect output is +12 vdc.

If the transmitter fails or the key Oscillator On is not keyed or the receive looses its input, then the Space output is + 12 vdc, the Mark output is + 12 vdc and the Carrier detect output is 0 vdc.

Figure 4-2 shows the above signal logic.

4.2 Central Communications Cabinets

4.2.1 General

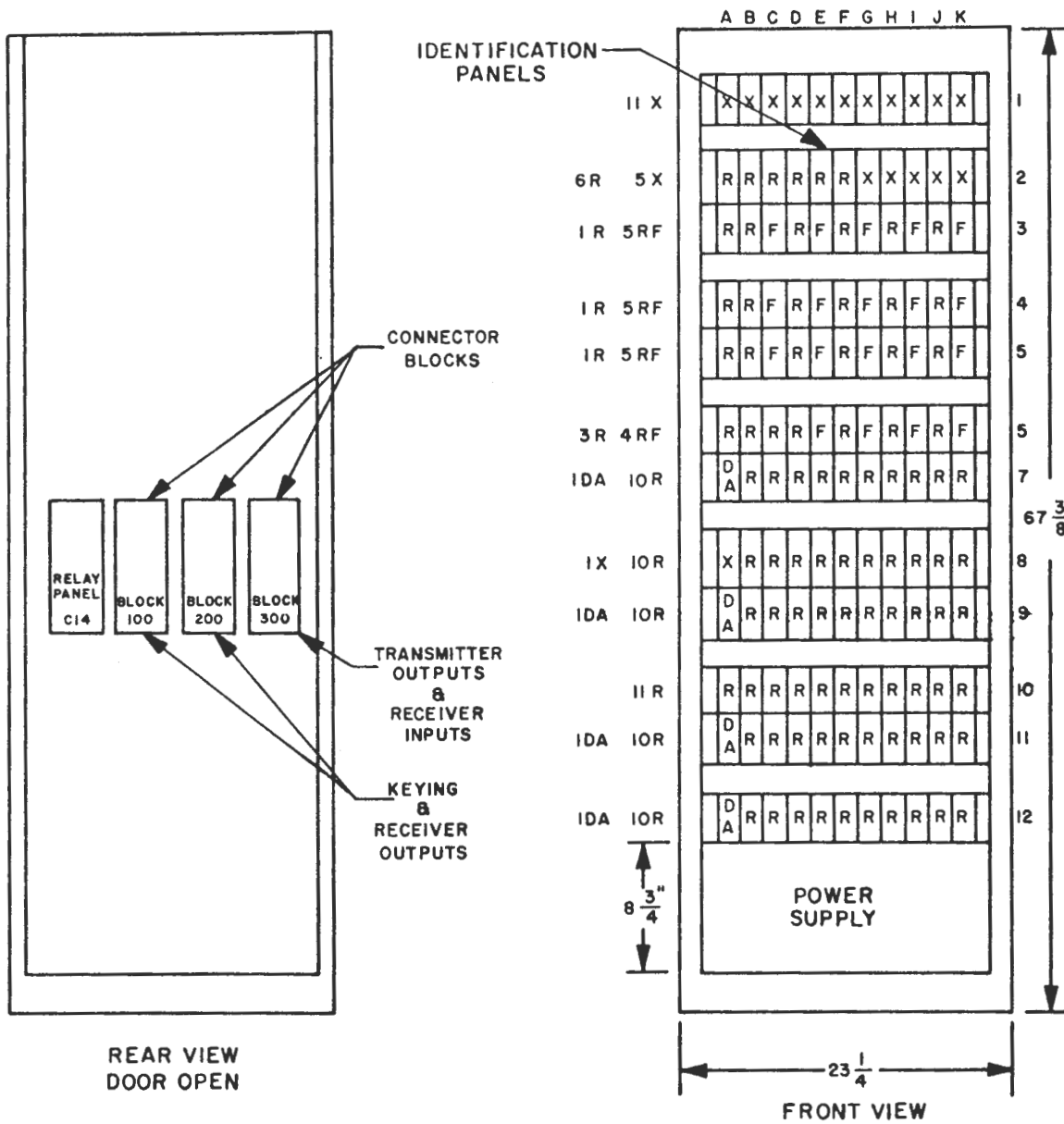
The Central Communications Equipment transmits Advance and Hold to the field and receives A-Phase Green, Vehicle Detector and Bus Detector signals from the field over leased telephone lines. It, in turn, converts these communication signals from the street to discrete dc levels suitable for input to the CIU and converts the digital discrete outputs of the CIU to communications signals.

4.2.2 Physical Description

The Communications Equipment consists of ten cabinets (UD 501 through UD 510) arranged on either side of the CIU in the Communications Room. Each cabinet is 67 3/8 inches high by 23 1/4 inches wide by 24 11/16 inches deep and houses 12 horizontal communications trays. Each tray is capable of holding 11 modules. A single power supply is at the bottom of each cabinet. Each cabinet is capable of housing 17 3F transmitters, 19 3F receivers, 73 2F receivers and 4 dual amplifiers. The actual equipment complement varies from cabinet to cabinet. Refer to RFL Drawing Number CR-12, 516A, Sheets 1 and 2 for the pictoral layout of each cabinet. The modules are inserted through the front of the cabinet. At the rear of each cabinet are three connector blocks and a Relay Panel. See Figure 4-3. Note, there are no 2F transmitters in Central.

4.2.3 Cabinet Wiring

All ten cabinets are wired indentically per RFL Drawing No. CR-12, 516A. (Sheet 3 is actually a wire-run list for each HD 35630 cabinet and consists of 24 pages.)



COMMUNICATION EQUIPMENT

X	3 FREQUENCY TRANSMITTER	(17)
RF	3 FREQUENCY RECEIVER	(19)
R	2 FREQUENCY RECEIVER	(73)
DA	DUAL AMPLIFIER	(4)

Figure 4-3 Central Communications Cabinet

Refer to Section 4.2.3.1. Each module tray has 11 connectors. Figure 4-4 shows the four different types of connectors.

A connector block consists of a matrix of pins, the back side of which is wire-wrapped to the pin connection of the various module connectors. The pins on the front of the block are either jumpered to other pins on the same block, tied to pins on an adjacent block, or connected via cable to another cabinet or piece of equipment. Wires are tied to the pins on the front of the block using push-on pins.

The three Connector blocks in the rear of each cabinet are wired up as follows:

Block		Signals
100 (B1)	Digital -	A-Phase Green and Vehicle Detectors
200 (B2)	Digital -	Bus Detectors, Advance and Hold
300 (B3)	Audio -	All

Block 100 contains 16 2F receiver outputs for A-Phase Green on columns A through H of rows 1 and 4 and 56 2F receiver outputs for vehicle detectors on columns A through H of rows 10, 13, 16, 19, 22, 25 and 28 as shown in Figure 4-5.

Block 200 contains 19 3F receiver outputs for bus detectors on column A through H of rows 1 through 4 and 6 through 8 and on columns A through C of rows 11 through 14. It also contains 16 3F transmitter inputs for Advance, Hold and Test on columns A through H of rows 19 through 22 and 24 through 27 as shown in Figure 4-6.

Block 300 contains all the audio signals as shown in Figure 4-7 as well as the input telephone line amplifiers and the output telephone line relays. It should be noted that all output telephone line signals go through a set of relay contacts before departing from central. Each Relay Panel can accommodate three signals. The relays are utilized in order to enable the operator to instantly drop a set of controllers from computer control. Pulling the relay out of its socket is also a useful test technique, allowing the operator to make checks on some Hold and Advance signals without transmitting these signals to the field controller. Paralleling up of communications equipment on a single telephone line is accomplished by the use of jumpers on Block 300 and jumper cables to other communications equipment cabinets as reflected in the Central Site Interface Table. Refer to SSMD Document No. 4-8-2000.

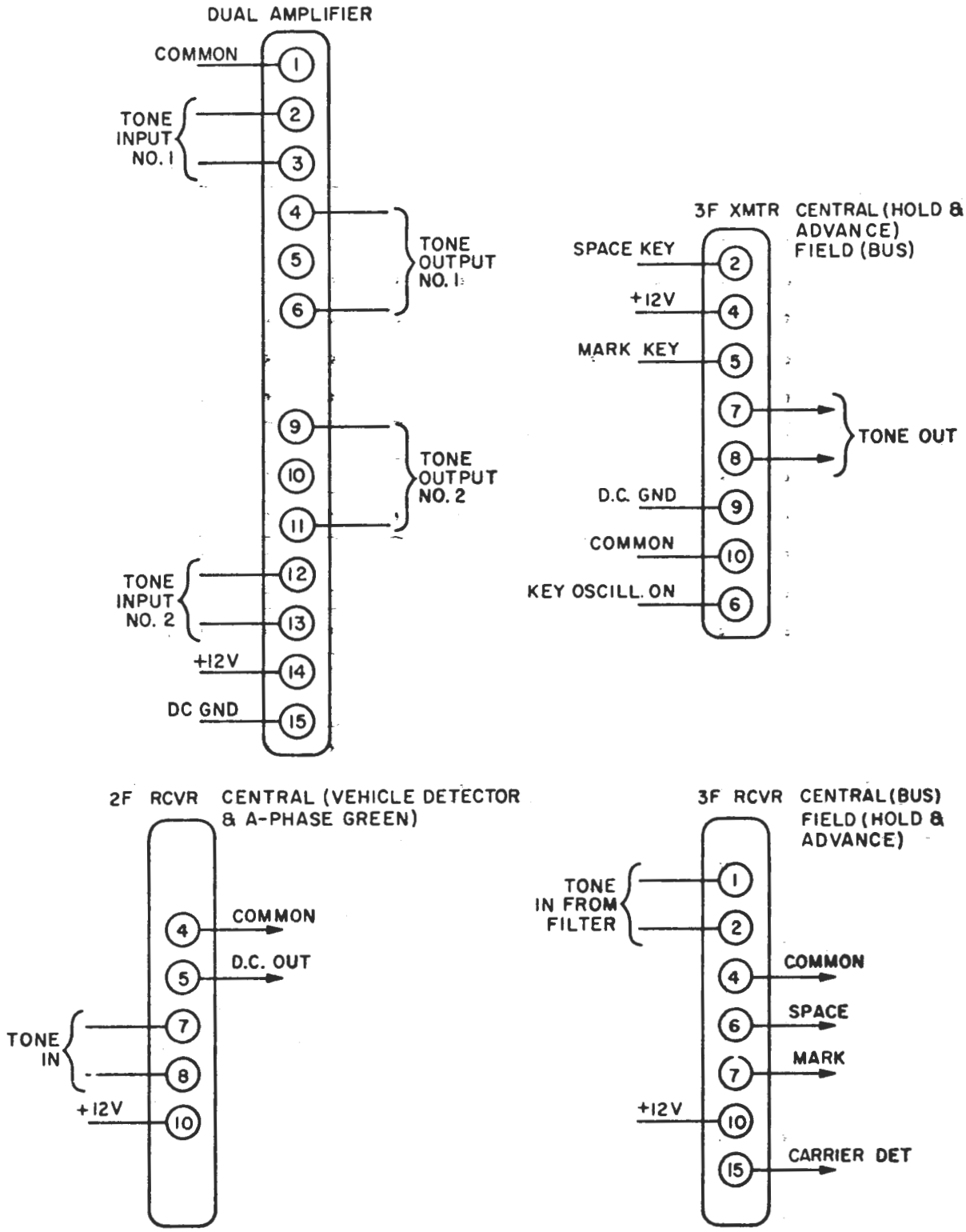


Figure 4-4. Communication Modules Pin Connections

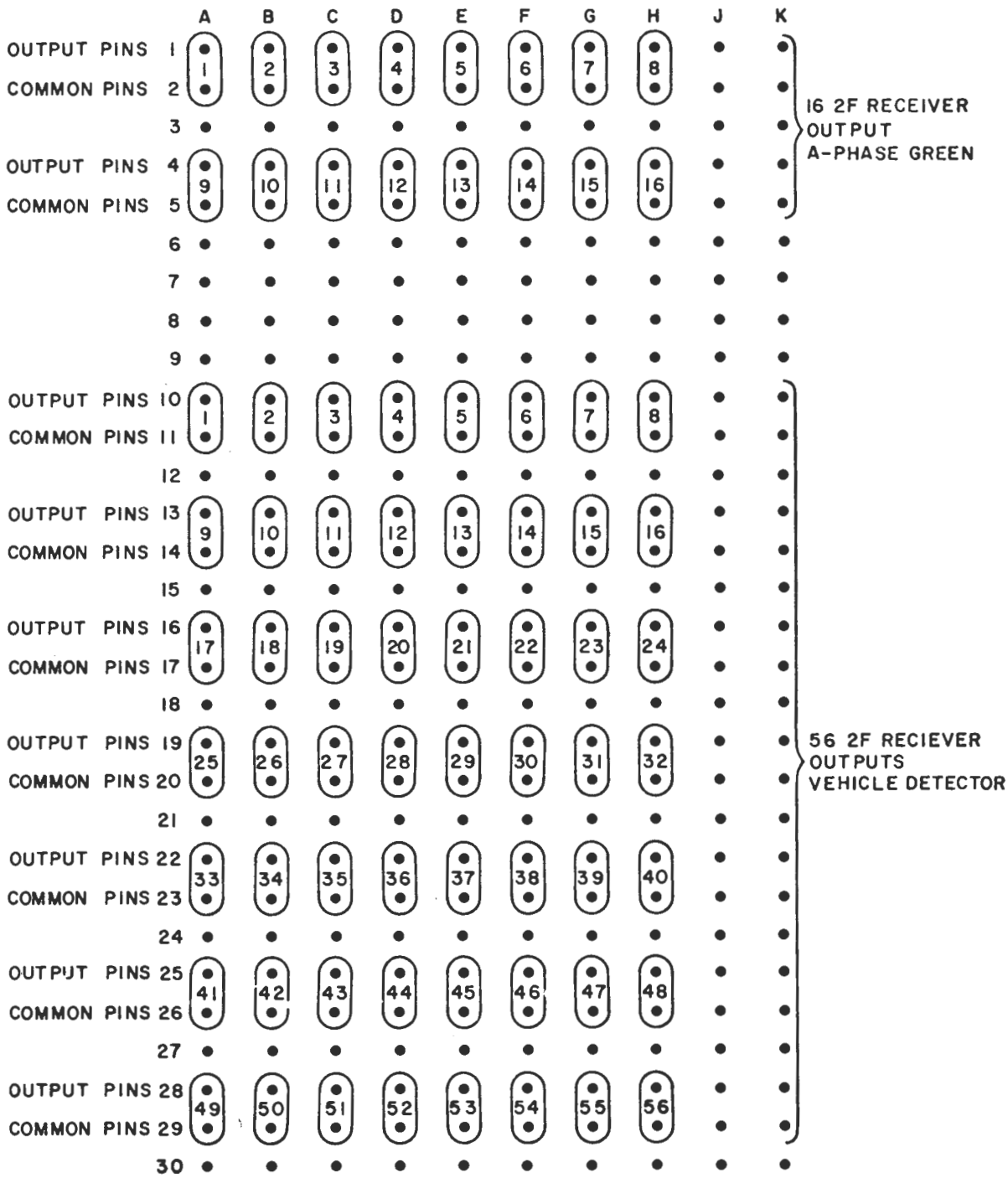


Figure 4-5. Digital Connector Block 100

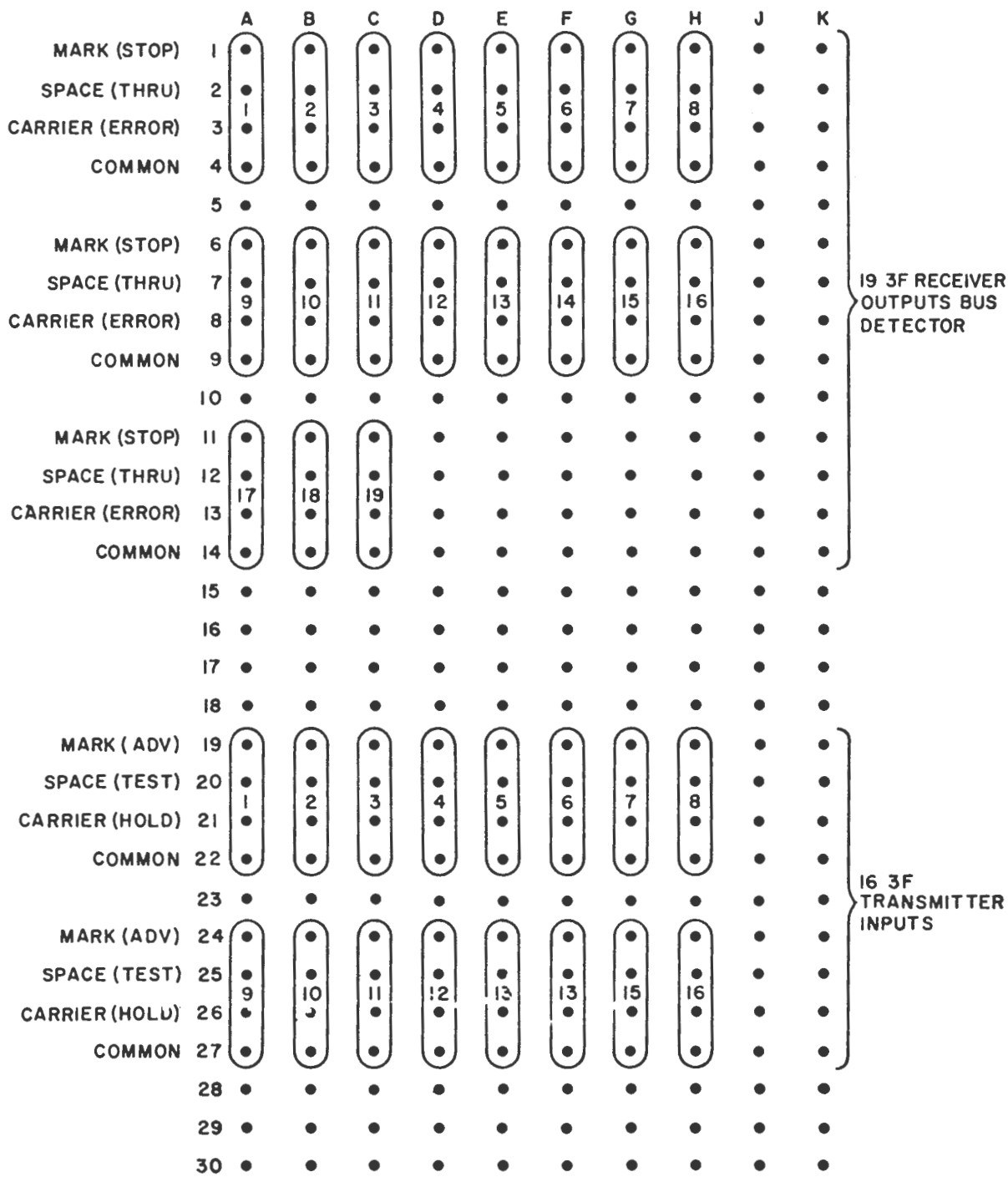


Figure 4-6. Digital Connector Block 200

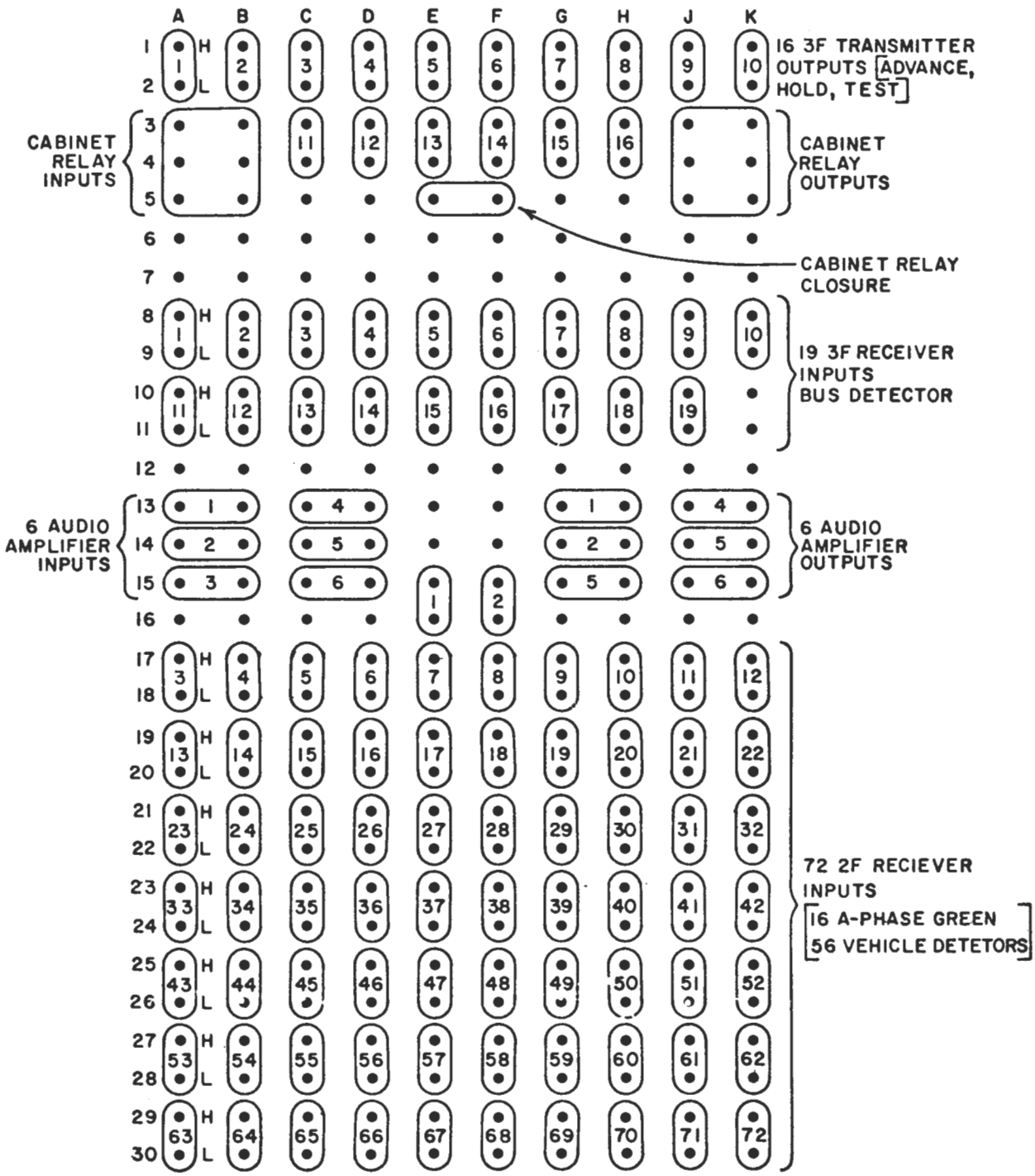


Figure 4-7. Audio Connector Block 300

4.2.3.1 Guide to Use of Internal Cabinet Wire-Run Lists

1. Internal Wire List, Sheet 3 of RFL Drawing Number CR-12516 - (24 pages)

   - Pages 1 and 2 detail the jumpers found on the wire-wrap side of the blocks. The pin matrix consists of columns A through H, reading from right to left and rows 1-29, from top to bottom. See Figure 4-8.

   - Pages 3 through 24 indicate the internal wiring, from the module pins to the rear pins of the block. The columns titled CHASSIS NO. and CON NO. refer to the location of a particular module, as viewed from the front of the cabinet. CHASSIS NO. refers to the vertical position of the module from 1 through 12, top to bottom, while CON NO. refers to the horizontal location, or slot position, from S1 through S11 of a module in a particular tray. See Figure 4-9 for a sample page.

It should be noted that in the Cross-Reference Directory module location is specified by a column (A through K) rather than a number. For example, the 2F receiver for Vehicle Detector 501 (Field Number) is in position K9 see Figure 4-3. For the wire run lists, the 9 indicates Chassis No. while the K is equivalent to S 11 (slot 11).

4.2.4 Power Supply

The central communications equipment power supply at the bottom of each cabinet supplies the +12 vdc power to all module trays in the cabinet. On the front panel of the power supply are mounted the following items:

(1) Guarded ON-OFF switch
(2) Indicator Lamp
(3) Ammeter
(4) Voltmeter
(5) 12 Fuses (one for each module tray)

The schematic for the +12 vdc power supply can be found in the Operation and Maintenance Manual for FS Communication Equipment (Table 1-1 No. 7).

4.3 Field Communications Chassis

4.3.1 General

There are two basic types of Field Communication Chassis. The first, Type A, is a large wall mounted chassis used in the pad mounted controller cabinets. There is, at least one Type A chassis in each of these cabinets and there can be up to three depending on

the number of Bus and Vehicle Detectors in the cabinet. The second type chassis, Type B, is used in the pole mounted cabinets (EB) to house Bus Detector receivers. It is approximately one-half the size of the Type A chassis and is shelf mounted.

4.3.2 Physical Description

The physical description of the Type A and Type B chassis are contained in Sections 4.3.2.1 and 4.3.2.2, respectively.

4.3.2.1 Type A Chassis

The Type A chassis is approximately 19 inches long by 12 3/8 inches wide by 5 1/4 inches high. It houses one power supply module and up to ten communication modules. The modules are inserted into the chassis from the front and plug into connectors mounted vertically at the back of the chassis. The number and types of modules can vary from cabinet to cabinet. Only the active module slots in the chassis have been wired. The type number stenciled on the side of each chassis and RFL drawings CR12500 through CR12514 define the number of slots wired and the type of module that goes into the slot. Blank panels have been provided for each unused slot to minimized module contamination. A marker strip has been provided on each chassis above the module opening for the purpose of identifying the module required for each slot.

4.3.2.2 Type B Chassis

The Type B chassis is approximately 9 3/4 inches long by 9 inches wide by 5 1/2 inches high. It houses one power supply module and up to four Bus Detector receivers. The modules are inserted in the same manner as the modules in the Type A chassis. The number stencilled on the side of the chassis and RFL drawing CR12514 define the number of slots wired. A marker strip is also provided on the Type B chassis for module identification purposes.

4.3.3 Chassis Wiring

Both types of chassis are supplied with a 4-foot extension cable for electrically connecting the communications equipment to the rest of the system via the terminal board panel mounted to the back of the cabinet. All circuit points required for fault isolation to the module level are brought out on these leads and are available on the cabinet back panel. These points are: the key for each transmitter, the output of each 3F receiver, +12 vdc from the power supply and the telephone line connection. The plug in modules obtain their power from the power supply via bus wiring at the back

of the chassis. Two pairs of telephone lines are used in each chassis containing a 3F receiver; one pair for the transmitter and one pair for the receiver. The telephone lines are bussed to the transmitters at the back of the chassis and brought out on a single pair.

FROM			TO			
BLOCK#	COI#	ROW#	BLOCK#	COI#	ROW#	WIRE SIZE
100	H	5	100	A	11	#26KYNAR
100	H	11	100	A	14	#26KYNAR
100	H	17	100	A	20	#26KYNAR
100	H	20	100	A	23	#26KYNAR
100	H	23	100	A	26	#26KYNAR
100	H	26	100	A	29	#26KYNAR
100	A	2	100	B	2	#26KYNAR
100	A	11	100	B	11	#26KYNAR
100	A	14	100	B	14	#26KYNAR
100	A	17	100	B	17	#26KYNAR
100	A	20	100	B	20	#26KYNAR
100	A	23	100	B	23	#26KYNAR
100	A	26	100	B	26	#26KYNAR
100	A	29	100	B	29	#26KYNAR
100	B	2	100	C	2	#26KYNAR
100	B	5	100	C	5	#26KYNAR
100	B	11	100	C	11	#26KYNAR
100	B	14	100	C	14	#26KYNAR
100	B	17	100	C	17	#26KYNAR
100	A	8	100	C	20	#26KYNAR
100	B	23	100	C	23	#26KYNAR
100	B	26	100	C	26	#26KYNAR
100	B	29	100	C	29	#26KYNAR
100	C	2	100	D	2	#26KYNAR
100	C	5	100	D	5	#26KYNAR
100	C	11	100	D	11	#26KYNAR
100	C	14	100	D	14	#26KYNAR
100	C	17	100	D	17	#26KYNAR
100	C	20	100	D	20	#26KYNAR
100	C	23	100	D	23	#26KYNAR
100	C	26	100	D	26	#26KYNAR
100	C	29	100	D	29	#26KYNAR
100	D	2	100	E	2	#26KYNAR
100	D	11	100	E	11	#26KYNAR
100	D	14	100	E	14	#26KYNAR
100	D	17	100	E	17	#26KYNAR
100	D	20	100	E	20	#26KYNAR
100	D	26	100	E	26	#26KYNAR
100	D	29	100	E	29	#26KYNAR
100	E	2	100	F	2	#26KYNAR
100	E	5	100	F	5	#26KYNAR
100	E	11	100	F	11	#26KYNAR
100	F	14	100	F	14	#26KYNAR
100	E	17	100	F	17	#26KYNAR
100	E	20	100	F	20	#26KYNAR
100	E	23	100	F	23	#26KYNAR
100	E	26	100	F	26	#26KYNAR
100	E	29	100	F	29	#26KYNAR
100	F	5	100	G	5	#26KYNAR
200	A	18	100	G	11	#26KYNAR
100	F	14	100	G	14	#26KYNAR

Figure 4-8. Sample Page 1-24 Internal Wire List

FROM			TO			
CHASSIS#	CON#	PIN#	BLOCK#	COL#	ROW#	WIRE SIZE
2	S1	5	100	A	1	#26KYNAR
5	S1	5	100	A	4	#26KYNAR
10	S1	5	100	A	7	#26KYNAR
7	S6	5	100	A	10	#26KYNAR
8	S4	5	100	A	13	#26KYNAR
9	S2	5	100	A	16	#26KYNAR
9	S10	5	100	A	19	#26KYNAR
10	S8	5	100	A	22	#26KYNAR
11	S6	5	100	A	25	#26KYNAR
12	S4	5	100	A	28	#26KYNAR
2	S2	5	100	B	1	#26KYNAR
6	S1	5	100	B	4	#26KYNAR
7	S7	5	100	B	10	#26KYNAR
8	S5	5	100	B	13	#26KYNAR
9	S3	5	100	B	16	#26KYNAR
9	S11	5	100	B	19	#26KYNAR
9	S11	5	100	B	20	#26KYNAR
10	S9	5	100	B	22	#26KYNAR
11	S7	5	100	B	25	#26KYNAR
12	S5	5	100	B	28	#26KYNAR
2	S3	5	100	C	1	#26KYNAR
6	S2	5	100	C	4	#26KYNAR
7	S8	5	100	C	10	#26KYNAR
8	S6	5	100	C	13	#26KYNAR
9	S4	5	100	C	16	#26KYNAR
10	S2	5	100	C	19	#26KYNAR
10	S10	5	100	C	22	#26KYNAR
11	S8	5	100	C	25	#26KYNAR
12	S6	5	100	C	28	#26KYNAR
2	S4	5	100	D	1	#26KYNAR
6	S3	5	100	D	4	#26KYNAR
7	S9	5	100	D	10	#26KYNAR
8	S7	5	100	D	13	#26KYNAR
9	S5	5	100	D	16	#26KYNAR
10	S3	5	100	D	19	#26KYNAR
10	S11	5	100	D	22	#26KYNAR
10	S11	4	100	D	23	#26KYNAR
11	S9	5	100	D	25	#26KYNAR
12	S7	5	100	D	28	#26KYNAR
2	S5	5	100	E	1	#26KYNAR
7	S2	5	100	E	4	#26KYNAR
7	S10	5	100	E	10	#26KYNAR
8	S8	5	100	E	13	#26KYNAR
9	S6	5	100	E	16	#26KYNAR
10	S4	5	100	E	19	#26KYNAR
11	S2	5	100	E	22	#26KYNAR
11	S10	5	100	E	25	#26KYNAR
12	S8	5	100	E	28	#26KYNAR
2	S6	5	100	F	1	#26KYNAR
7	S3	5	100	F	4	#26KYNAR
7	S11	5	100	F	10	#26KYNAR

Figure 4-9. Sample Page 3-24 Internal Wire List

SECTION 5

SIGNAL DESCRIPTION AND SIGNAL FLOW

5.1 Signal Description

There are five basic signals which flow between central and the field to convey the information necessary for the proper functioning of the UTCS/BPS System. These are:

(1) A-Phase Green
(2) Hold
(3) Advance
(4) Vehicle Detectors
(5) Bus Detectors

In addition, the districts master clock is brought in by a Radio Link.

5.1.1 A-Phase Green

When a particular controller falls into a particular green interval defined as A-Phase Green, it sends out a 115 vac signal which energizes a relay in the Controller Adapter causing a +12 vdc signal to be applied to the Mark key input of a 2F transmitter. The transmitter's output signal which was at f_s is shifted up in frequency 60 Hz to the f_m frequency and sent via telephone wire, to Central, where the signal is amplified and the signal shift subsequently sensed in the appropriate receiver. The receiver output level changes from +6.5 vdc to 0 vdc. This signal is then coupled to both the Map Display and the CIU. See Figure 5-1.

5.1.2 Hold and Advance

The Hold command is the means by which the controller is placed under Computer control. The Hold command removes the controller from local dial control to enable the presence of an Advance pulse from the Computer to step the Controller. See Figure 5-2.

The Hold command is a long-term signal, appearing as a +6.5 vdc level from the CIU. This signal is used to key the oscillator of a 3F transmitter on and to transmit over the telephone line the f_o frequency. Refer to Section 4.1.2. The 3F receiver in the field receives the f_o frequency and its carrier detector output changes from 0 vdc to +12 vdc which energizes a relay in the Controller Adaptor removing the Controller from local dial control

The Advance command is 0.5 seconds in duration and is sent out whenever the Controller must be stepped once. The +6.5 vdc Advance signal from the CIU is sent to the

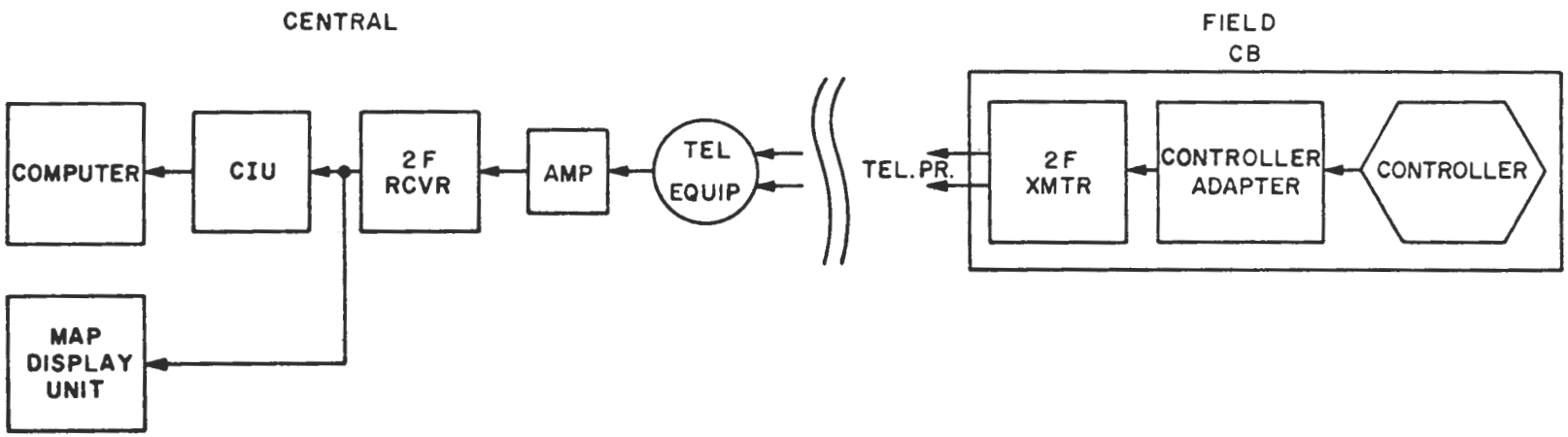


Figure 5-1. A-Phase Green Sign Flow Diagram

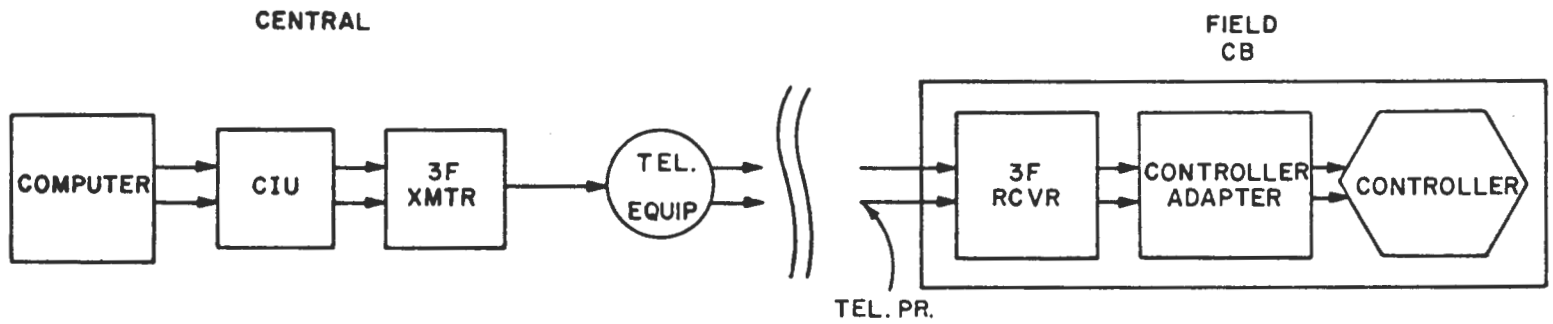


Figure 5-2. Hold and Advance Signal Flow Diagram

Mark key on the same 3F transmitter that the Hold command has keyed the Oscillator on. This causes the transmitter signal to shift 30 Hz higher in frequency and transmit over the telephone lines the f_m frequency. The 3F receiver in the field receives the f_m frequency and its Mark output changes from +12 vdc to 0 vdc while still holding the carrier detector output at +12 vdc. See Figure 4-2.

The change in Mark output keys a relay in the controller adaptor which allows a 115 vac signal to step the controller cam shaft once. See Figure 5-2.

5.1.3 Vehicle Detector

The signal flow diagram is shown in Figure 5-3. When a vehicle passes over the loop detector in the roadway, the Vehicle Detector Electronics unit senses this and deenergizes its output relay. This puts +12 vdc on the Mark key input of a 2F transmitter. The transmitters output signal which was at f_s is shifted up in frequency 60 Hz to the f_m frequency and is sent via telephone line to central. The signal shift is then amplified and subsequently sensed in the appropriate receiver. The receiver output level changes then from +6.5 vdc to 0 vdc. This signal is then sent to the CIU.

5.1.4. Bus Detector

The signal flow diagram is shown in Figure 5-4. The bus detector inputs inform the Computer that the bus has passed over the bus road loop antenna and is either going to stop at the bus stop or pass through it. The bus itself carries a Transmitter and a Control Device. Refer to Section 10. When the bus driver decides he wants to stop or pass through a particular bus stop, he sets the control unit in the appropriate position. When it is set in the stop position, the transmitter on the bus puts out a cw signal of 168KHz. When it is set in the through position, the transmitter puts out a cw signal of 182KHz.

These signals are picked up by the bus road loop antenna as the bus passes over it and are coupled into a Bus Receiver in the Field Cabinet. The receiver detects the input and depending on the frequency of the input puts out a +9.0 vdc, 50 milliseconds pulse at the Stop or Through output. This signal is then coupled to the keying inputs of the 3F transmitter.

The 3F transmitter has the Oscillator on terminal tied permanently to +12 vdc so that it is transmitting over the telephone the f_o frequency. The Stop output of the Bus Receiver is tied to the Mark key of the 3F transmitter and the Through output is tied to the Space key.

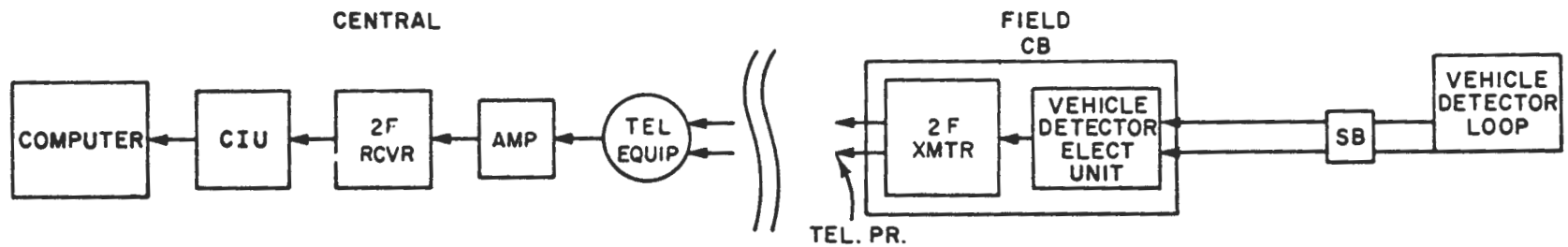


Figure 5-3. Vehicle Detection Signal Flow Diagram

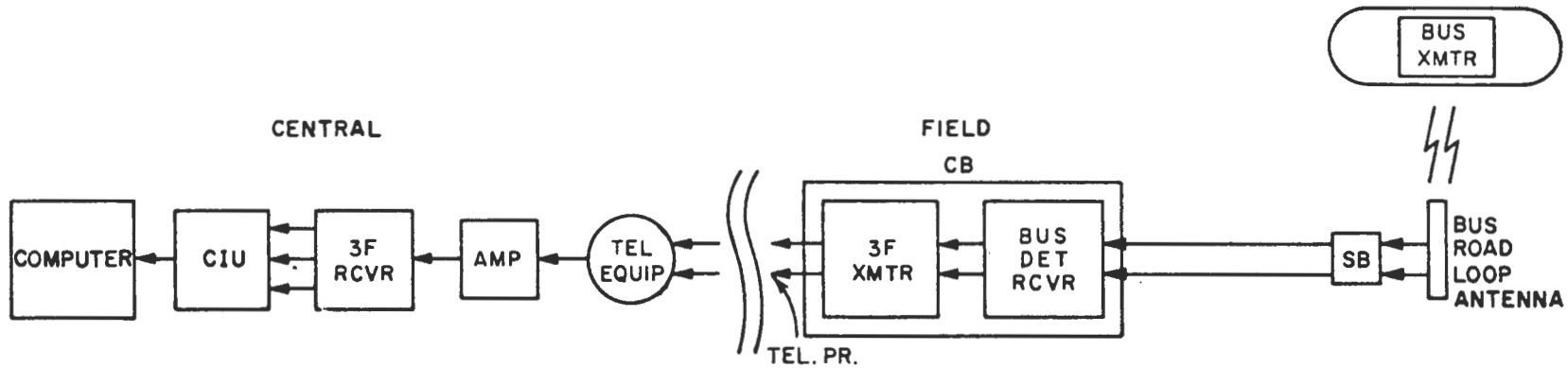


Figure 5-4. Bus Detection Signal Flow Diagram

The 3F transmitter then functions as described in Section 4.1.2; that is, with no bus signal present f_0 is transmitted; with the Stop signal present f_m is transmitted; and with the Through signal present f_s is transmitted. The signal is sent via the telephone line to Central where it is amplified and subsequently sensed in the appropriate receiver. The receiver Mark output level changes from +6.5 vdc to 0 vdc when f_m or Stop is received; the Space output changes from +6.5 vdc to 0 vdc when f_s or Through is received; and the Carrier detect output will stay at +6.5 vdc for f_m, f_s or f_0. However, if the 3F transmitter fails so that no signal is received at the receiver, the Carrier detect level changes from +6.5 vdc to 0 vdc informing the Computer of a communications failure. This signal is referred to as bus error.

5.1.5 Radio Link

The synchronization and sign control signals are brought into Central as coded audio tones. This signal is amplified and distributed to sign decoders whose output is 115 vac.

These signals are then processed in the Radio Link Interface Unit so that the presence of a synchronization signal is 0 vdc and the absence is +6.5 vdc. These signals are sent to the CIU.

The one-way sign control signals are 0 vdc for no sign and +6.5 vdc for the activation of the sign. These signals are sent to both the Map Display Unit and the CIU. See Figure 5-5.

5.2 System Signal Flow

An overall signal flow diagram showing the interface between all the UTCS/BPS equipments, both in Central and in the Field, is shown in Figure 5-6. Each of the signal group numbers in Figure 5-6 is related to the corresponding number in Table 5-1. Using Figure 5-6 and Table 5-1 the operator/technician can determine the correct signal level related to a signal state present at any equipment within the system. This information provides an overall view.

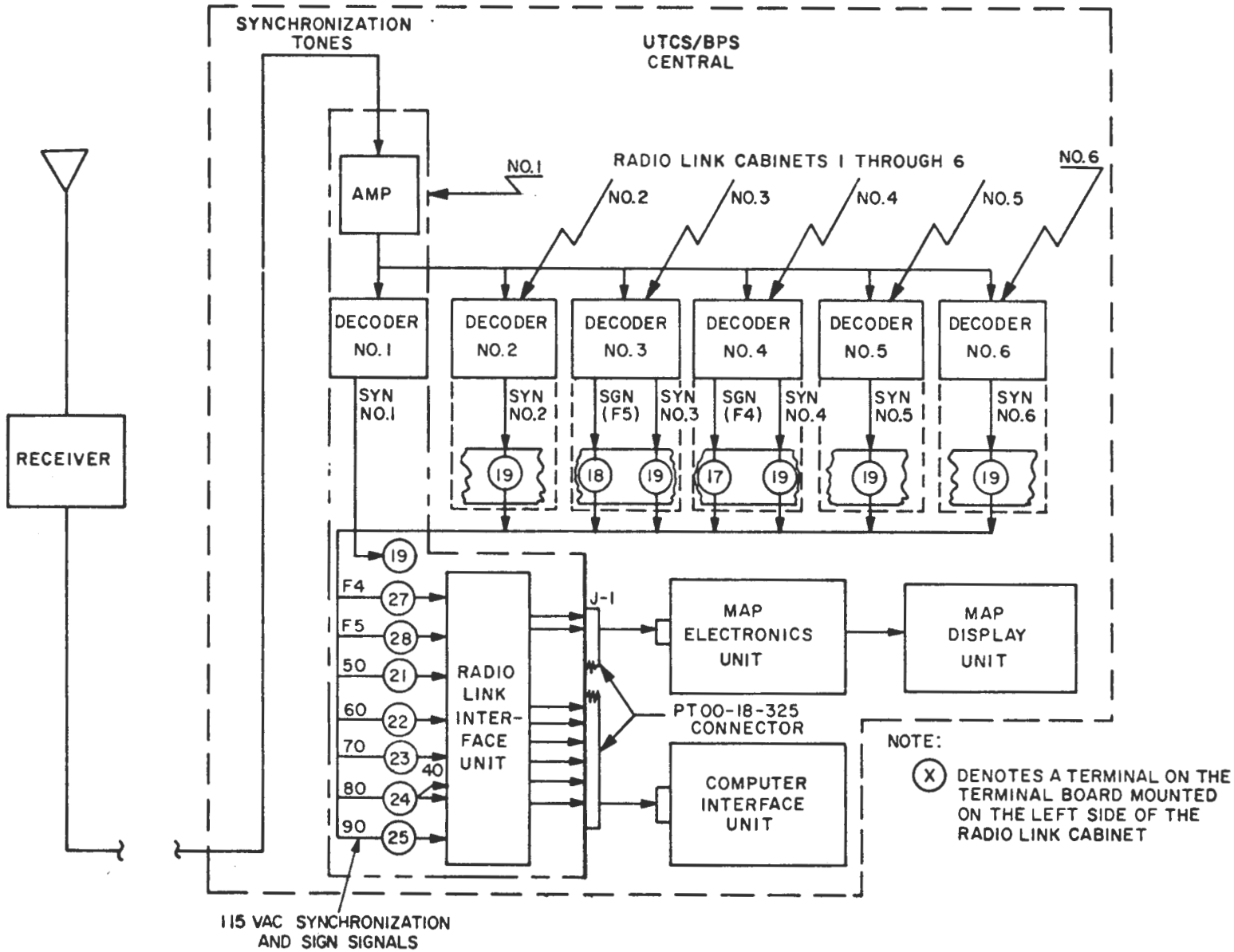


Figure 5-5. Radio Link Signal Flow Diagram

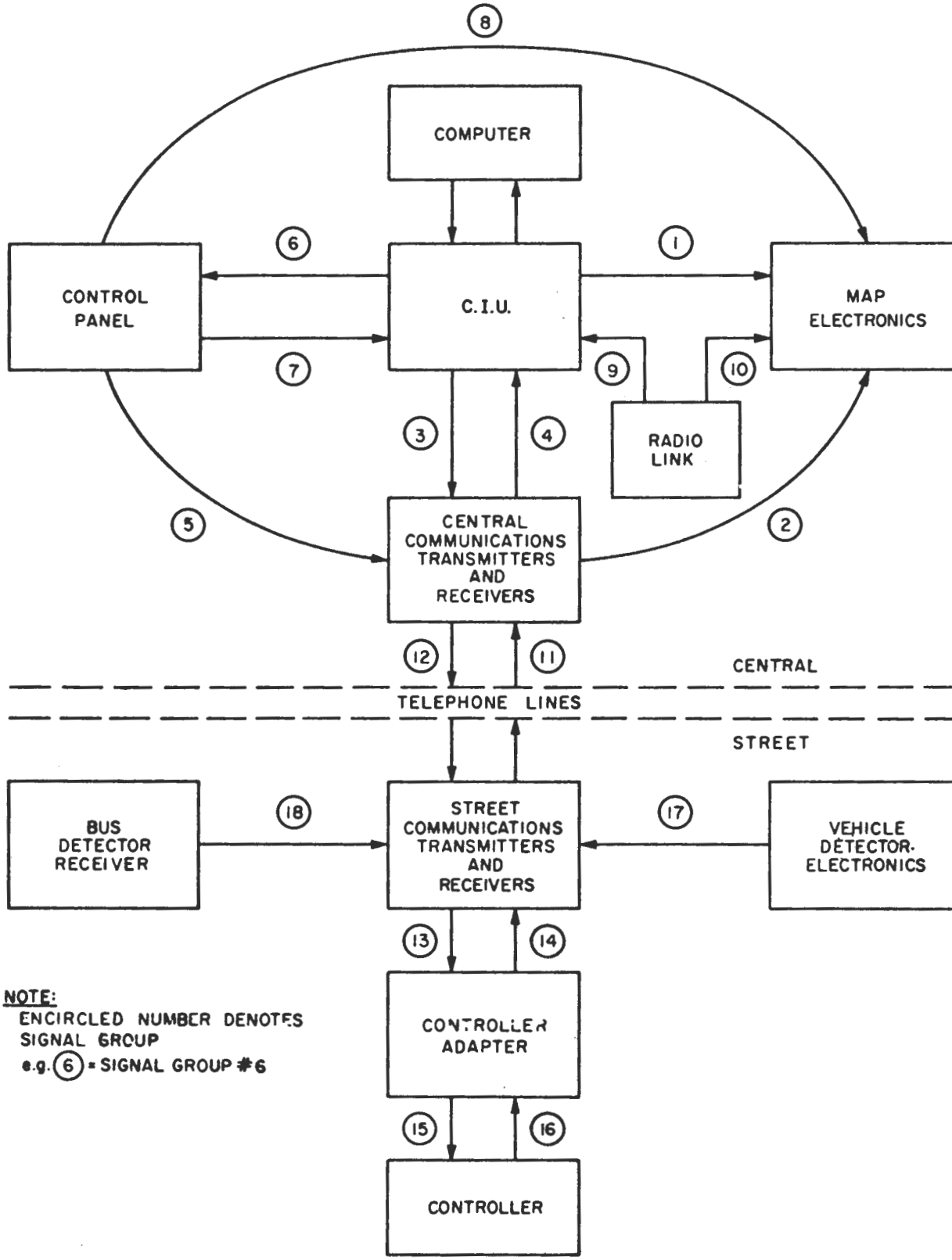


Figure 5-6. UTCS/BPS Signal Flow Diagram

TABLE 5-1. SYSTEM SIGNAL LEVELS

Signal Group	Function	Voltage/Signal for True Function	Voltage/Signal for False Function
1.	All CIU to Map Display signals	+6.5 ± 3.0 dc	+0.5 ± 0.5 dc
2.	A-Phase Green and minor returns	+0.5 ± 0.5 dc	+6.5 ± 3.0 dc
3.	Hold Advance	+6.5 ± 3.0 dc +6.5 ± 3.0 dc	+0.5 ± 0.5 dc +0.5 ± 0.5 dc
4.	A-Phase Green and minor returns Vehicle Detect Bus Stop Bus Through Bus Error	+0.5 ± 0.5 dc 0.5 ± 0.5 dc 0.5 ± 0.5 dc 0.5 ± 0.5 dc 0.5 ± 0.5 dc	+6.5 ± 3.0 dc +6.5 ± 3.0 dc +6.5 ± 3.0 dc +6.5 ± 3.0 dc +6.5 ± 3.0 dc
5.	Hold and Advance Release	(Switch Open)	(Switch Closure)
6.	All CIU to Control Panel signals	+6.5 ± 3.0 dc	+0.5 ± 0.5 dc
7.	All Control Panel to CIU signals	+0.5 ± 0.5 dc	+6.5 ± 3.0 dc
8.	Test 1 Test 2 Flash Display On-Off Fault Computer in Stand-by	+6.5 ± 3.0 dc +6.5 ± 3.0 dc (Switch Closure) +24.0 ± 4.0 dc +6.5 ± 3.0 dc	+0.5 ± 0.5 dc +0.5 ± 0.5 dc (Switch Open) +0.5 ± 0.5 dc +0.5 ± 0.5 dc
9.	Radio Sync Signals	+6.5 ± 3.0 dc	0
10.	One-Way Arrows	+6.5 ± 3.0 dc	0
11.	A-Phase Green Vehicle Detect Bus Stop Bus Through Bus Error	f_m f_m f_m f_s 0	f_o f_o f_o f_o f_o } Audio levels adjusted in accordance with Section 9
12.	Hold Advance	f_o f_m	No carrier f_o
13.	Hold Advance	+12.0 ± 2.0 dc +0.5 ± 0.5 dc	+0.5 ± 0.5 dc +12.0 ± 0.2 dc
14.	A-Phase Green or minor returns	+12.0 ± 2.0 dc	+0.5 ± 0.5 dc
15.	Advance	115v(rms)± 15 v	0

Table 5-1. System Signal Levels (Continued)

Signal Group	Function	Voltage/Signal for True Function	Voltage/Signal for False Function
16.	A-Phase green or minor returns	115v(rms)±15 v	0
17.	Vehicle Detector Electronics to 2F Transmitter	+9.0 ± 4.0 dc	+0.5 ± 0.5 dc
18.	Bus Stop to 3F Transmitter	+9.0 ± 4.0 dc	+0.5 ± 0.5 dc
	Bus Through to 3F Transmitter	+9.0 ± 4.0 dc	+0.5 ± 0.5 dc

SECTION 6

MALFUNCTION INDICATION

6.1 General

The UTCS/BPS System provides for the continuous detection and recording of system malfunctions. All repair maintenance action will be initiated by the various malfunction indicators.

6.2 Malfunction Indicators

The malfunction indicators and recordings of failures are described in Sections 6.2.1, 6.2.2 and 6.2.3.

6.2.1 Control Panel Malfunction Indicators

The first indication of a system malfunction is activation of the Audible Alarm and simultaneous illumination of a malfunction indicator. There are seven malfunction indicators, (Figure 6-1) each having a red background, which are located in the upper left hand section of the Control Panel. These indicators are as follows:

(1) CPU No. 1

(2) CPU No. 2

(3) Traffic System Controller

(4) Traffic System Detector

(5) Traffic System Communication

(6) BPS Detector

(7) BPS Communication

6.2.2 CRT Display

The CRT is capable of presenting the operator/technician with detailed information on a malfunction indicated by the Control Panel via the Failure Status page (Refer to Operator's Manual Figure C-1 CRT Failure Status Page). The Failure Status page is utilized to obtain the "computer number" of an indicated malfunction. The computer number can then be utilized in conjunction with the Cross Reference Directory in the fault isolation procedures.

6.2.3 Line Printer

The Line Printer furnishes a hard copy of the information displayed on the CRT should the operator/technician require such a copy. Unlike the CRT display whose data, of necessity, is truncated, the Line Printer records all malfunctions for a permanent record.

The Malfunction Indications, Table 6-1, lists the Control Panel malfunction indicator, the malfunction, the applicable CRT page and Map Display mode (Refer to Operator's Manual Table 3-1), and the location of the related malfunction isolation procedure.

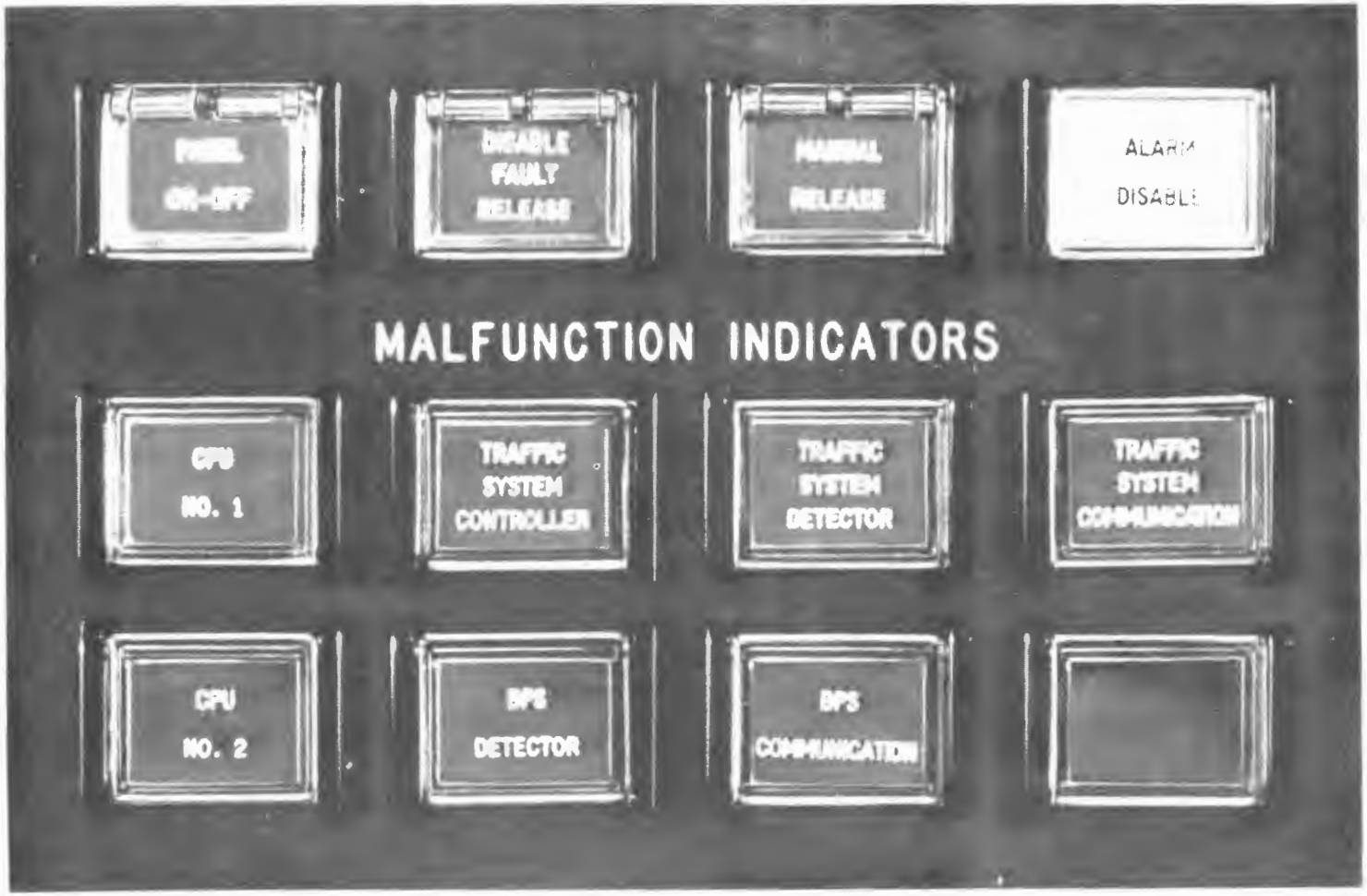


Figure 6-1. Malfunction Indicators

TABLE 6-1. MALFUNCTION INDICATIONS

Control Panel Indicator	Malfunction	CRT Page*	Map Display Mode	Procedure
1. CPU No. 1	UTCS Computer is not functioning normally	N.A.	Map indicates computer in Standby	Reinitiate Start-Up Procedure. Refer to Operator's Manual, paragraph 4.1.2 CPU Start-Up
2. CPU No. 2	BPS Computer is not functioning normally	N.A.	N.A.	Reinitiate Start-Up Procedure. Refer to Operator's Manual paragraph 4.1.2 CPU Start-Up
3. Traffic System Controller	Indicates a malfunction in the Controller Loop. Possibilities are: Controller failure, Controller Adapter failure, Communications failure, CIU failure, Interconnect failure	Failure Status (Controller No.)	Controllers Failed (Location)	Traffic Systems Controller. Refer to Section 7.8
4. Traffic System Detector	Indicates Detector Failure	Failure Status (Detector No.)	Surveillance Equipment Failed (Link Location)	Traffic Systems Detector. Refer to Section 7.9.
5. Traffic System Communications	Indicates Detector Communications Failure	Failure Status (Communications No.)	Surveillance Equipment Failed (Link Location)	Traffic Systems Communications. Refer to Section 7.10.
6. BPS Detector	Indicates Bus Detector Failure	Failure Status (BPS Detector No.)	BPS Surveillance Equipment Failed (Zone Location)	BPS Detector. Refer to Section 7.11
7. BPS Communication	Indicates Bus Detector Communications Failure	Failure Status (BPS Communications No.)	BPS Surveillance Equipment Failed (Zone Location)	BPS Communications. Refer to Section 7.12

*NOTE: Refer to Operator's Manual Figure C-1 for details of Failure Status page of CRT display.

SECTION 7

CENTRAL MALFUNCTION ISOLATION

7.1 General

The UTCS/BPS operational program continually monitors prime equipment in order to detect and record system malfunctions. After the operator/technician has familiarized himself with the Operator's Manual Section 2.7, he proceeds to determine the type of malfunction related to a particular Control Panel indication. Section 6 of this manual (Malfunction Indication) includes detailed information on system malfunction indicators and their related faults. Section 6 is intended as a guide towards locating the correct paragraph of this section. The operator/technician can then utilize the appropriate troubleshooting procedure.

In most cases, the replacement of a particular module, PC board, or lamp will result in an immediate return to normal system status. A log should be kept, recording all failures, their symptoms, causes and required corrective action.

7.2 Techniques

In order to isolate malfunctions properly the following ordered sequence should be followed.

(a) Telephone line failures

(b) Central Equipment failures

(c) Field Equipment failures

No technicians should be dispatched to the field until the telephone lines and Central Equipment have been found not to be at fault.

7.3 Telephone Lines

In any case of malfunction, it should be at once determined whether the fault is the result of the UTCS/BPS equipment or the leased telephone lines. There are twenty-four telephone pairs that carry information to the Field Equipment and fifty-five telephone pairs that bring information from the Field Equipment to Central.

7.3.1 Outgoing Lines

The control information, Hold (HOL) and Advance (ADV), are transmitted on the outgoing telephone pairs. In the event of several simultaneous Controller malfunctions the Cross Reference Directory should be checked to see if they are associated with the same telephone pair. If they are, the telephone line is malfunctioning and the telephone company should be notified immediately.

7.3.2 Incoming Lines

All vehicle detectors, bus detectors and communications failures should be checked in the Cross Reference Directory to see if they are associated with the same incoming telephone pair. If so, it can be either the telephone pair or the line amplifier for that telephone pair in Central.

To check the amplifier find its location in the Central Communications Cabinets by looking up the telephone line in Appendix C. Replace the amplifier with a spare unit. If the failures are still present, then the telephone line is malfunctioning and the telephone company should be notified immediately.

7.4 Computer

Figure 7-1 and figure 7-2 are fault diagrams for CPU No. 1 and CPU No. 2 failures.

Any system malfunction which is traceable to the Sigma 5 computer or any of its peripherals must be referred to the manufacturer's (Xerox Corp.) designated servicemen, under the terms of the maintenance arrangement. The sole exception to this rule is when it is suspected that the Computer Interface Unit (CIU), has failed. Then the procedure outlined in Section 7.5 should be followed.

Any malfunction in the CRTs should be referred to the manufacturer's (Hazeltine) designated servicemen under the terms of the maintenance arrangement.

7.5 Computer Interface Unit (CIU)

When the CIU is suspected to be the source of trouble, the maintenance should be limited to the replacement of input and output cards. This level of troubleshooting should normally be done when the system is off-line to prevent undesired perturbations to systems operation.

Figure 5-6 shows the input and output signal flow to the CIU and Table 5-1 lists the signal levels. If the proper signal level is not present, the output and/or input card should be changed.

Appendix C lists the data bit number and the associated card location and pin connection for all CIU inputs and outputs.

If card replacement fails to solve the problem, the manufacturer's designated service man should be called.

CAUTION

A CIU INPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

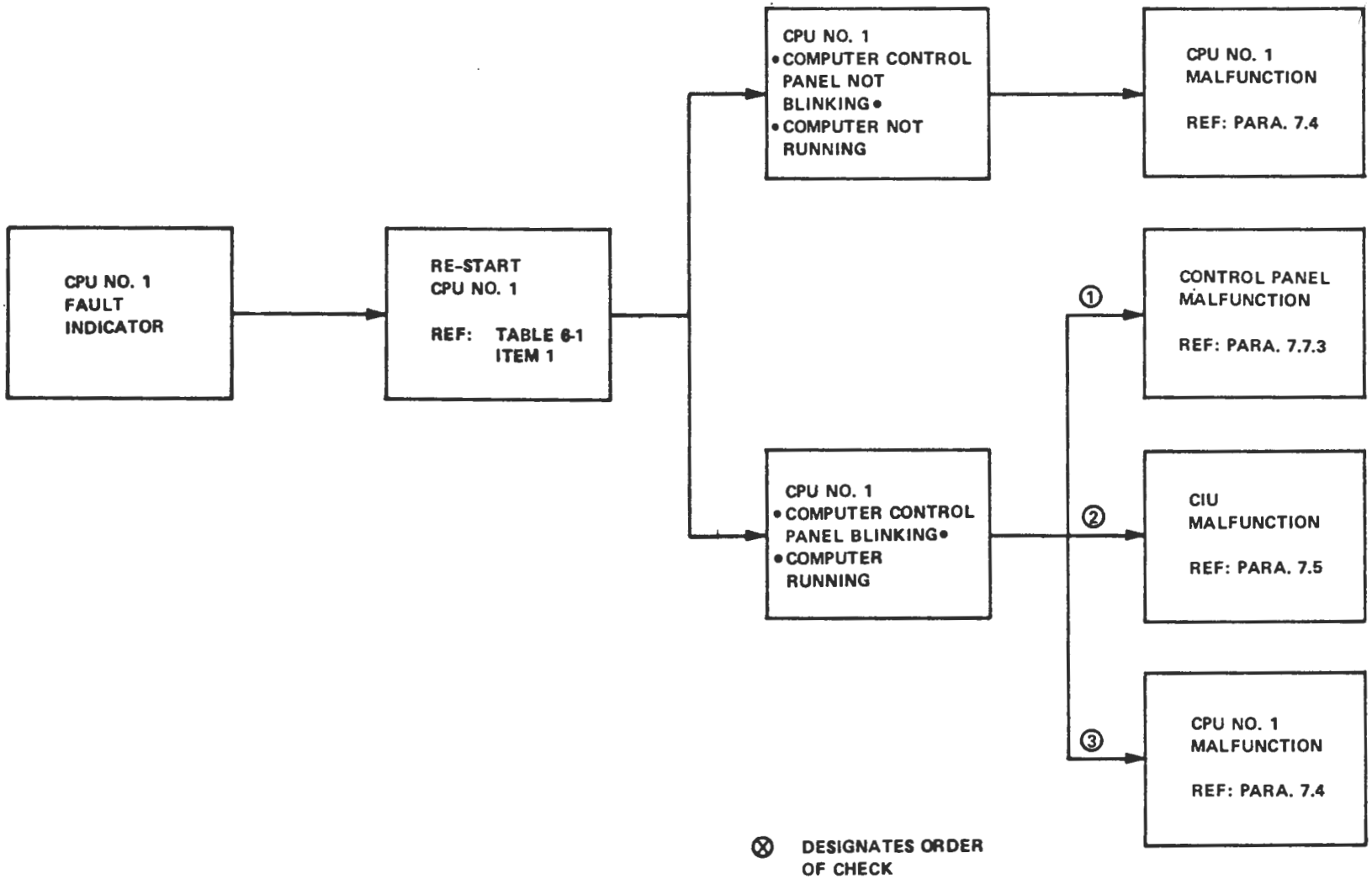


Figure 7-1. CPU No. 1 Fault Diagram

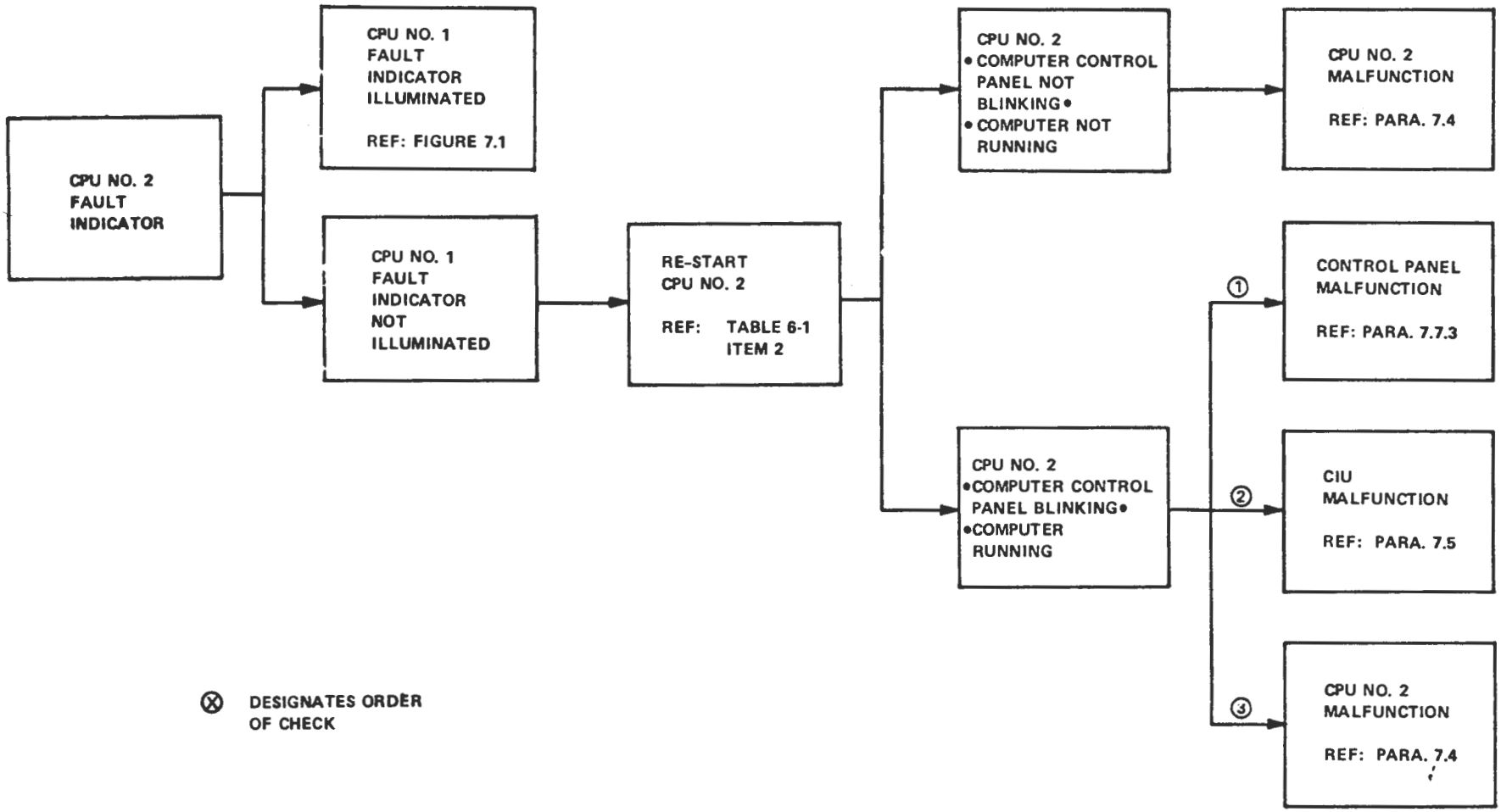


Figure 7-2. CPU No. 2 Fault Diagram

7.6 Map Display

When a malfunction occurs on the Map Display, check to see if the Map Display and the Map Display Electronic Unit are receiving the correct signals in the following manner:

(1) If the fault is the display of A-Phase Green or minor phase signals, check the signal levels present at the Connector block (B1) in the Map Display Electronic Unit (Ref. SSMD Doc. 4-8-2000).

(2) If the fault is in other inputs of the Electronic Unit, check the source (Control Panel, CIU, or Radio Link) for proper signal levels. This can be done at the following:

- Control Panel Terminal Board
  (Refer to Maintenance Procedures EPC-11088)
- CIU Output Circuit Card Connectors
  (Refer to SSMD Doc. 4-8-2000)
- Radio Link Output Connector
  (Refer to SSMD Doc. 4-8-2000).

If the fault is determined to be within the Map Display or Map Display Electronic Unit, the Map test fixture (Appendix B) enables troubleshooting to the module level.

7.7 Control Panel

A suspected Control Panel failure can be readily verified. As shown in Figure 5-6 the Control Panel interfaces with the Map Display Electronic Unit, the CIU, and the Communications Cabinets. The level of each of these signals can be measured at a terminal block located at the rear of the Control Panel. The location of each signal on the terminal block is specified in the Control Panel Maintenance Procedure EPC-11088.

7.7.1 Control Panel Switch Tests - Prior to investigating a particular signal level a check of the Control Panel switch operation should be accomplished by verifiying the intended switch action. Three types of switches are provided in the Control Panel switch assortment, and the action of these can be checked by depressing each switch or a sequence of switches. The three types of switch action are defined as follows:

- Alternate Action Switch - Depressing the front lens transfers the switch contacts and they remain transferred even after the actuation force is removed and the front lens has returned to its normal position. Depressing the front lens again returns the switch contacts to their normal position.
- Momentary Action - Depressing the front lens transfers the switch contacts until the actuating force is removed at which time the contacts return to their normal position and the front lens returns to its normal position.
- Momentary Action with Holding Coil - The numerous electrical interlock, lock-in and lock-out circuits provided with the system Control Panel are made possible with the inclusion of a magnetic holding coil to the momentary action switch. Once the holding coil is energized it will hold contacts in their actuated position. Removing power from the holding coil will cause the contacts to return to their normal position.

Once the switch operation has been verified Control Panel fault isolation can proceed by verification of the signal levels.

7.7.2 Control Panel to CIU Signals - Output signals from the Control Panel to the CIU are initiated upon operator actuation of Control Panel switches. A switch actuation provides a ground (0 volts) signal to the CIU. When a valid request is entered from the Control Panel and the system does not respond, the signal level should be verified at the Control Panel terminal block. If the signal level is correct, the fault is located in the CIU and the input card should be changed. If the signal level is not correct, then the Control Panel Maintenance Procedure EPC-11088 should be utilized to troubleshoot the Control Panel.

7.7.3 Control Panel From CIU - Input signals to the Control Panel are initiated from the CIU. These signals are either long term discretes, for operating the malfunction indicators and alarm, or pulsed inputs for operating the ENTER/READY, ERROR, and WAIT/ERROR indicators. The location and level of each input signal is specified in the

Control Panel Maintenance Manual. If the signal levels are correct, then the fault is located within the Control Panel and the Control Panel Maintenance Procedure EPC-11088 should be utilized to trouble-shoot the Control Panel.

If the signal levels are not correct, the CIU output card should be changed.

7.7.4 Control Panel to Map Display - The Control Panel provides the following discrete signals to the Map Display Electronic Unit:

(1) DISPLAY ON/OFF

(2) DISPLAY TEST NO. 1

(3) DISPLAY TEST NO. 2

(4) COMPUTER IN STANDBY

The level of each of these signals is specified in Table 5-1. If the signal level is correct, then follow the procedure of Section 7.6. An incorrect signal level isolates the fault to the Control Panel and the Control Panel Maintenance Procedure EPC-11088 should be utilized to troubleshoot the Control Panel.

7.7.5 Control Panel to Communications Cabinets

This signal terminates the transmission of output signals from the communications by opening a set of relays in the Communication Cabinets through which all output telephone lines pass. The output from the Control Panel is normally a switch closure which opens when a manual release has been initiated or the CPU-1 Malfunction Indicator comes on. When the switch opens it breaks the ground return of the relays and they drop out. Operation of this function is checked with a voltmeter across the terminals of the only two terminal block located at the rear of the Control Panel. When the manual release is initiated, the voltage will be 10 to 15 vdc. Under normal operation it will be 0 vdc.

7.8 Traffic System Controller

This fault indicator is a result of a system malfunction in the controller loop. The possible trouble areas are as follows:

(a) A-Phase Green failure

(b) Hold failure

(c) Advance failure

Figure 7-3 is a fault diagram for the traffic systems controller.

The operator should determine, as described in the Operator's Manual which controller is involved via the Failure Status page on the CRT and the location of the Controller Lamp Module on the Map Display by placing the Map in the Controller Status mode. The operator should then place the Map Display in the A-Phase Green mode and see if the affected traffic signal lamps are operating. If the red or the green lamp is illuminated constantly, the failure is in the A-Phase Green signal loop. The operator should then refer to the Cross Reference Directory, using the failed controller number from the CRT Failure Status page, for the location of the A-Phase Green receiver in Central. Replace the 2F receiver module with one of the same frequency. If the Map Display lamp module operates correctly, the failure has been repaired and the Controller can be brought back on line. If the red or green lamp is still illuminated continuously, the failure is in the Field Equipment.

Perform the communications link test of Section 7.8.1 and note the results to aid in field maintenance.

Fault Condition	Map lamp (A-Phase Green mode)	Communications line test	Fault in
1	Red or green lamp on continuously	Positive	Controller or Controller Adapter
2	Red lamp on continuously	Negative	Controller Adapter, A-Phase Green transmitter, Communications Power Supply

Refer to Section 8 for field malfunction isolation procedures.

If the Map Display lamp is operating correctly, bring the Controller back on line. If the Computer does not pick up the Controller, the A-Phase Green signal is not being received at the CIU.

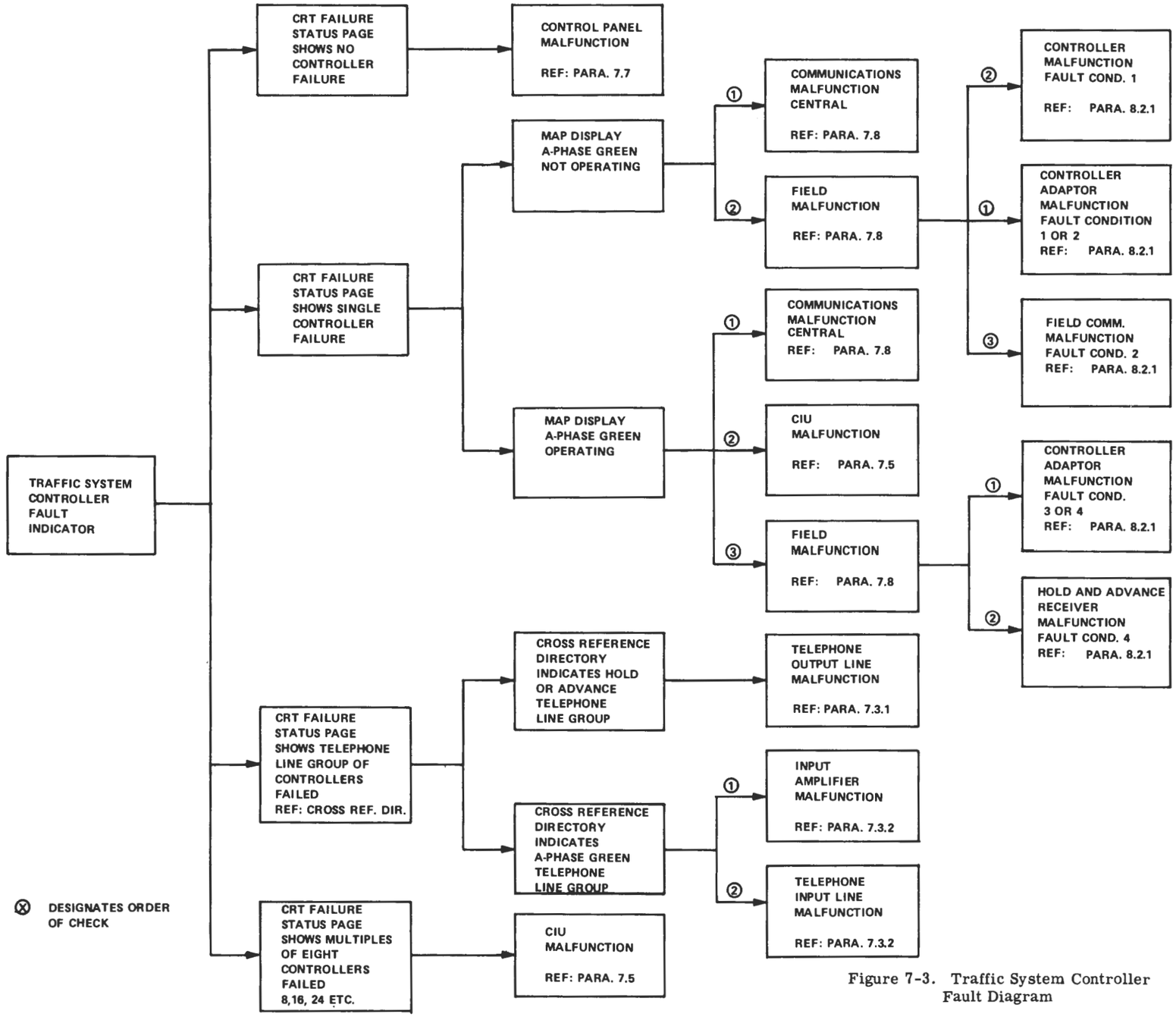


Figure 7-3. Traffic System Controller Fault Diagram

An off-line replacement of the associated CIU input card should be accomplished. Refer to the Central Site Signal Interface Table (SSMD Document No. 4-8-2000) for the connector and pin connection on the CIU input card. A sample of typical A-Phase Green signal tracing in Central is shown in Figure 7-4.

CAUTION

A CIU INPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

If the Map Display lamp module is operating correctly and the Computer picks up the failed Controller, then it is receiving the A-Phase Green signal and the fault is found in the Hold and Advance signal loop. A sample of a typical Hold and Advance signal tracing in Central is shown in Figure 7-5. Monitor the Hold and Advance signals from the CIU at the Communications Cabinets. Refer to the Central Site Signal Interface Table (SSMD Document No. 4-8-2000) for the Communication Cabinet block and pin data.

Note

The computer will not output the Hold and Advance signals after a Controller has failed. The Controller must be acknowledged as repaired and then brought back on-line. If an A-Phase Green signal is present, the Computer will attempt to pick up the Controller and will output the Hold and Advance signals until it fails again.

If either the Hold or the Advance signals are not present, then the CIU output card is most likely at fault and an off-line replacement of the CIU output card should be accomplished.

CAUTION

A CIU OUTPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

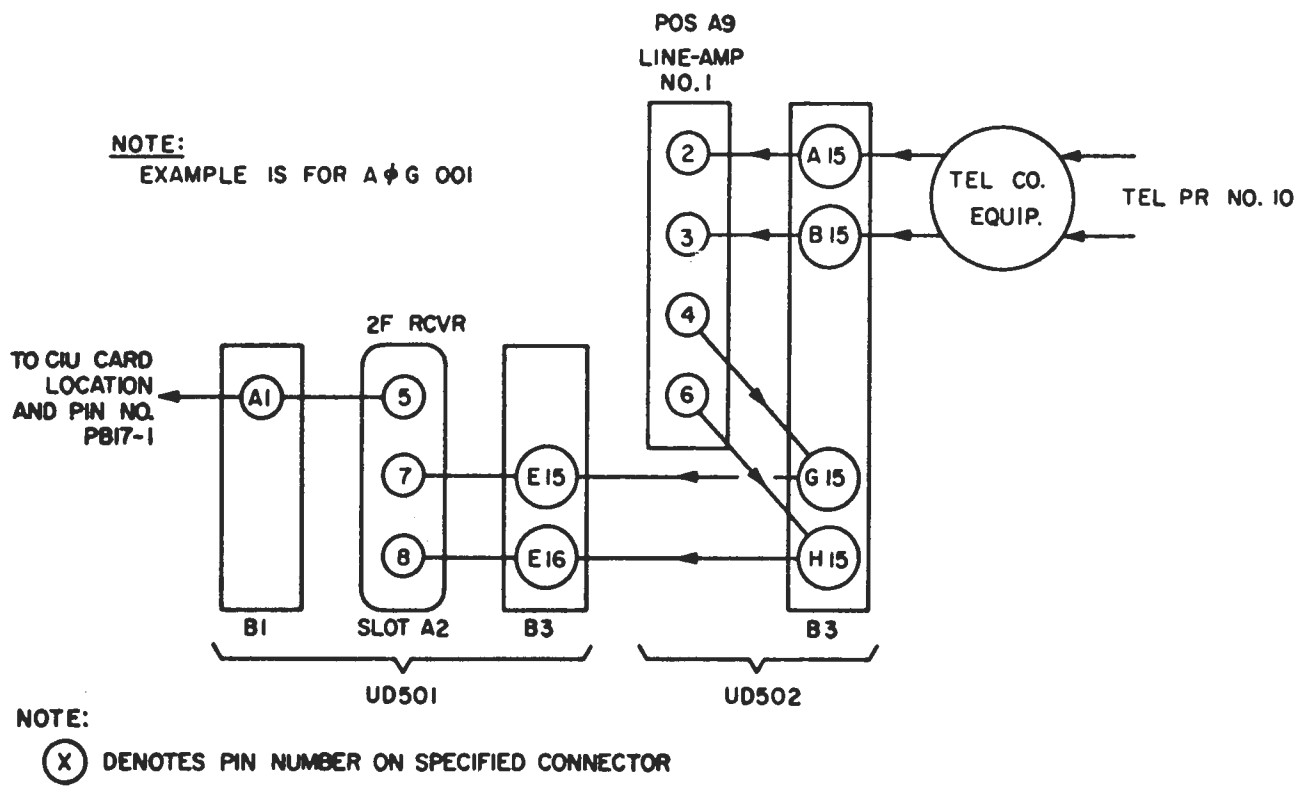
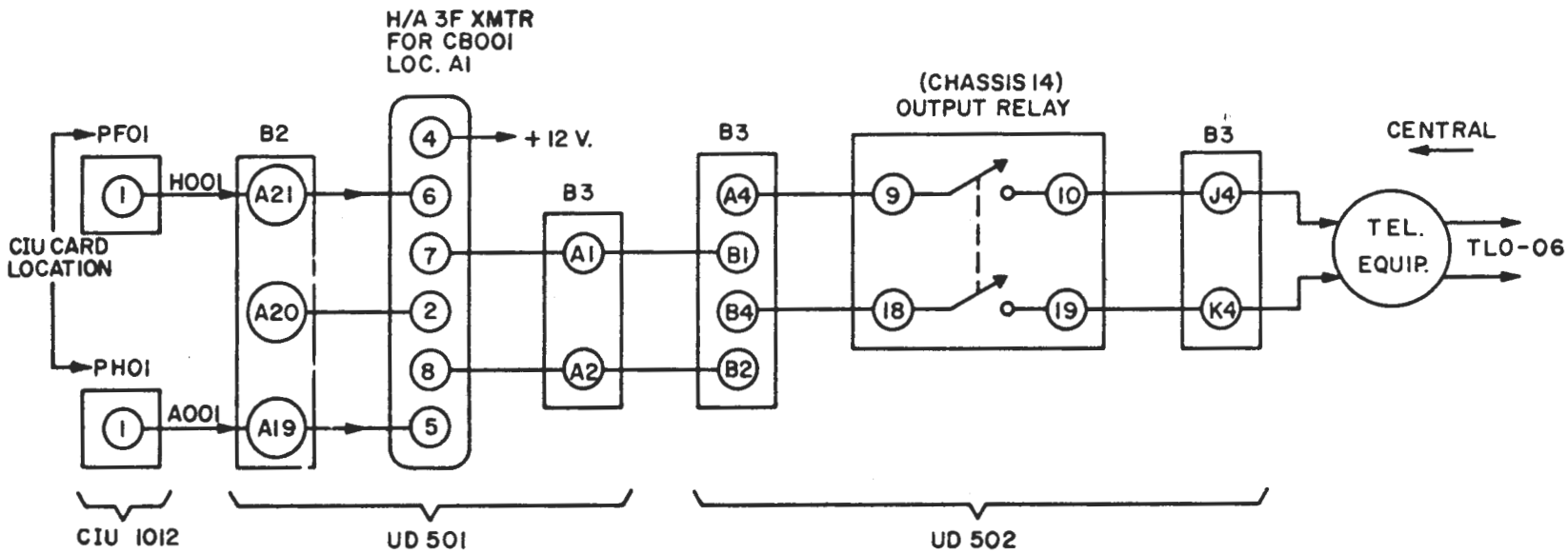


Figure 7-4. A-Phase Green Signal Tracing, Central (Sample)



NOTE:

(X) DENOTES PIN NUMBER ON SPECIFIED CONNECTOR

H001=HOLD SIGNAL FOR CONTROLLER NO.1

A001=ADVANCE SIGNAL FOR CONTROLLER NO.1

Figure 7-5. Hold and Advance Signal Tracing (Sample)

If the Hold and Advance signals are being outputed by the CIU, change the Hold and Advance 3F transmitter. Refer to the Cross Reference Directory for the location of the transmitter module in Central. Replace the transmitter with one of the same frequency. Adjust the transmitter output level per Section 9. Acknowledge that the Controller has been repaired and bring it back on-line. If the Controller does not fail again, the failure was in the Central 3F transmitter.

If the Controller fails again, the fault is found in the Field Equipment.

Perform the communications link test of Section 7.8.1 and note the results to aid in field maintenance.

Fault Condition	Map lamp (A-Phase Green mode)	Communications link test	Fault in
3	Operating correctly	Positive	Controller Adapter
4	Operating correctly	Negative	Hold and Advance receiver or Controller Adapter

Refer to Section 8 for Field Malfunction Isolation procedures.

7.8.1 Communications Link Test

When the communications link (Hold, Advance & A-Phase Green) for a particular Controller is under suspicion, perform the communication link test, utilizing the Card Extender described in Appendix B.

Placing the switch to TEST puts +6.5 vdc into the Transmitter on and Space key inputs of the Hold and Advance 3F transmitter. This sends a test signal out to the field which is returned as a pseudo A-Phase Green signal and tests out the entire communications link.

When the switch is placed in the TEST position the A-Phase Green receiver output should go from +6.5 vdc to 0 vdc. This is considered a positive result. If this does not happen, the results are considered negative.

7.9 Traffic System Detector

This fault indicator is a result of a system malfunction in the vehicle detector loop. The possible trouble areas are as follows:

(1) Vehicle detector failure

(2) Communications failure

(3) CIU failure

Figure 7-6 is a fault diagram for traffic systems detector.

The operator should determine, as described in the Operator's Manual which Vehicle Detector is at fault and its location.

After finding the location of the Central Communications receiver from the Cross Reference Directory, measure the signal of the Central Communications equipment for the presence of a vehicle (0.5 ± 0.5 vdc) or non-presence (6.5 ± 3.0 vdc) as outputted by the appropriate 2F receiver. If there are vehicle pulses in Central, the signal is not being received at the CIU.

An off-line replacement of the associated CIU input card should be accomplished. Refer to the Central Site Signal Interface Table (SSMD Document No. 4-8-2000) for the connector and pin connection on the CIU input card. A sample of typical vehicle detector signal tracing in Central is shown in Figure 7-7.

CAUTION

A CIU INPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

If permanent presence is detected (0 vdc) replace the Central 2F receiver with one of the same frequency and repeat the test. If permanent presence is still detected, the fault is in the Field Equipment.

Refer to Section 8 for Field Malfunction Isolation procedures

7.10 Traffic System Communication

This fault indicator is a result of a system malfunction in the vehicle detector communications loop. The possible trouble areas are as follows:

(1) Communications failure

(2) CIU failure

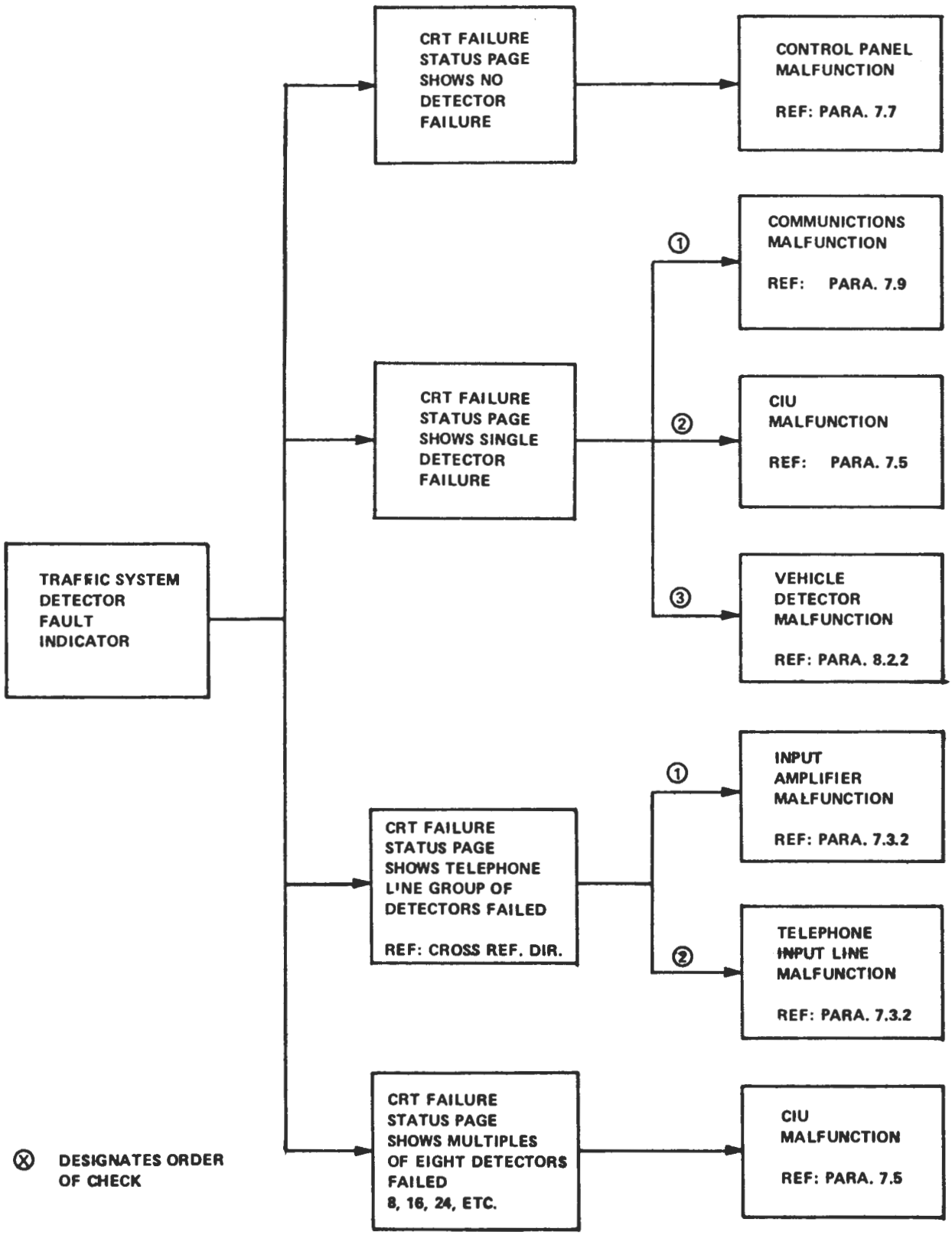
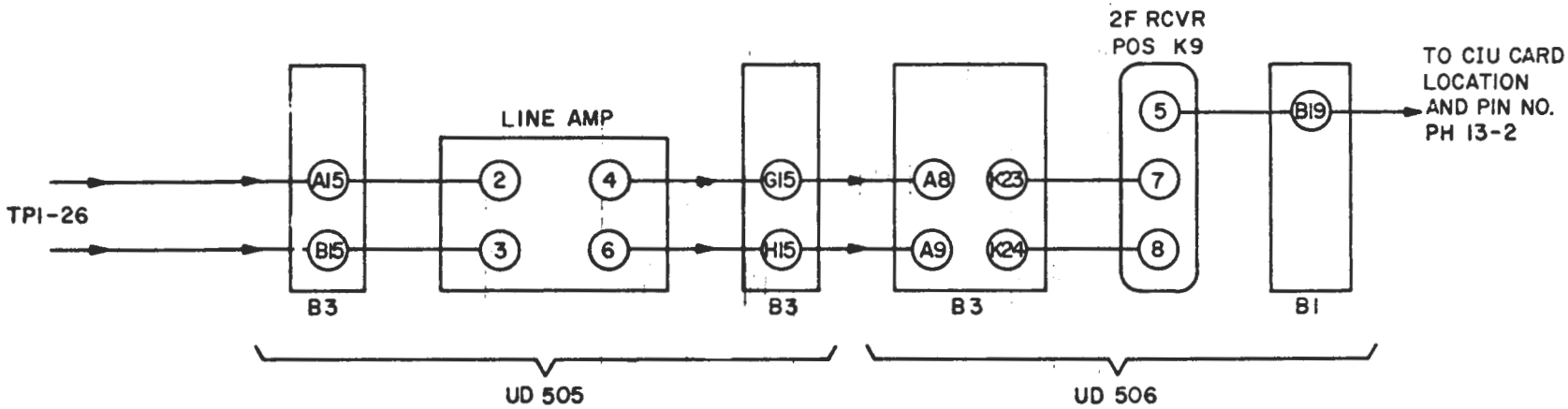


Figure 7-6. Traffic System Detector Fault Diagram



VE FIELD NO. 363
VE COMP. NO. 306
TEL. PR NO. 26

NOTE:

(X) DENOTES PIN NUMBER ON SPECIFIED CONNECTOR

Figure 7-7. Vehicle Detection Signal Tracing, Central (Sample)

Figure 7-8 is a fault diagram for traffic systems Communications.

The operator should determine, as described in the Operator's Manual, which Vehicle Detector communications receiver is at fault and its location.

After finding the location of the Central Communications receiver, from the Cross Reference Directory, measure the signal of the Central Communications equipment for the presence of a vehicle (0.5 ± 0.5 vdc) or non-presence (6.5 ± 3 vdc) as outputted by the appropriate 2F receiver. If there are vehicle pulses in Central, the signal is not being received at the CIU.

An off-line replacement of the associated CIU input card should be accomplished. Refer to the Central Site Signal Interface Table (SSMD Document No. 4-8-2000) for the connector and pin connection on the CIU input card. A sample of typical vehicle detection signal tracing is shown in Figure 7-7.

CAUTION

A CIU INPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

If no presence is detected, then replace the Central 2F receiver with one of the same frequency and repeat the test. If no presence is still detected, the fault is in the Field Equipment. Refer to Section 8 for Field Malfunction Isolation procedures.

7.11 BPS Detector

This fault indicator is a result of a system malfunction in the bus detector loop. The possible trouble areas are as follows:

(1) Bus detector failure

(2) Communications failure

(3) CIU failure

Figure 7-9 is a fault diagram for BPS Detectors.

The operator should determine, as described in the Operator's Manual, which Bus Detector is at fault and its location.

After finding the location of the Central Communications receiver, from the Cross Reference Directory, measure the Through (BT) and Stop (BS) signals from the appropriate 3F receiver. A presence signal is a 50 millisecond pulse. For a presence the receiver output level drops from +6.5 ± 3 vdc to 0.5 ± 0.5 vdc. The companion up

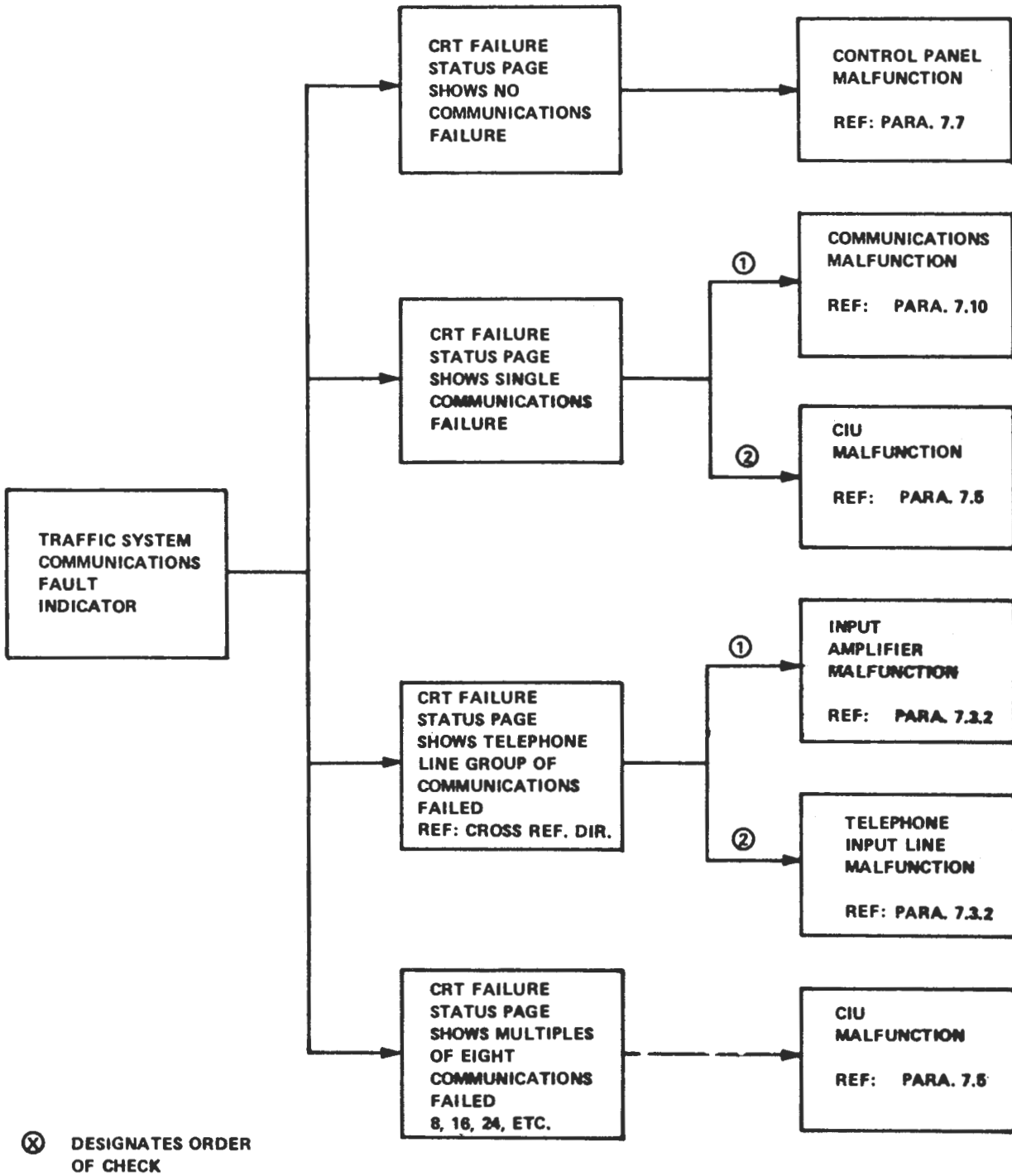


Figure 7-8. Traffic Systems Communications Fault Diagram

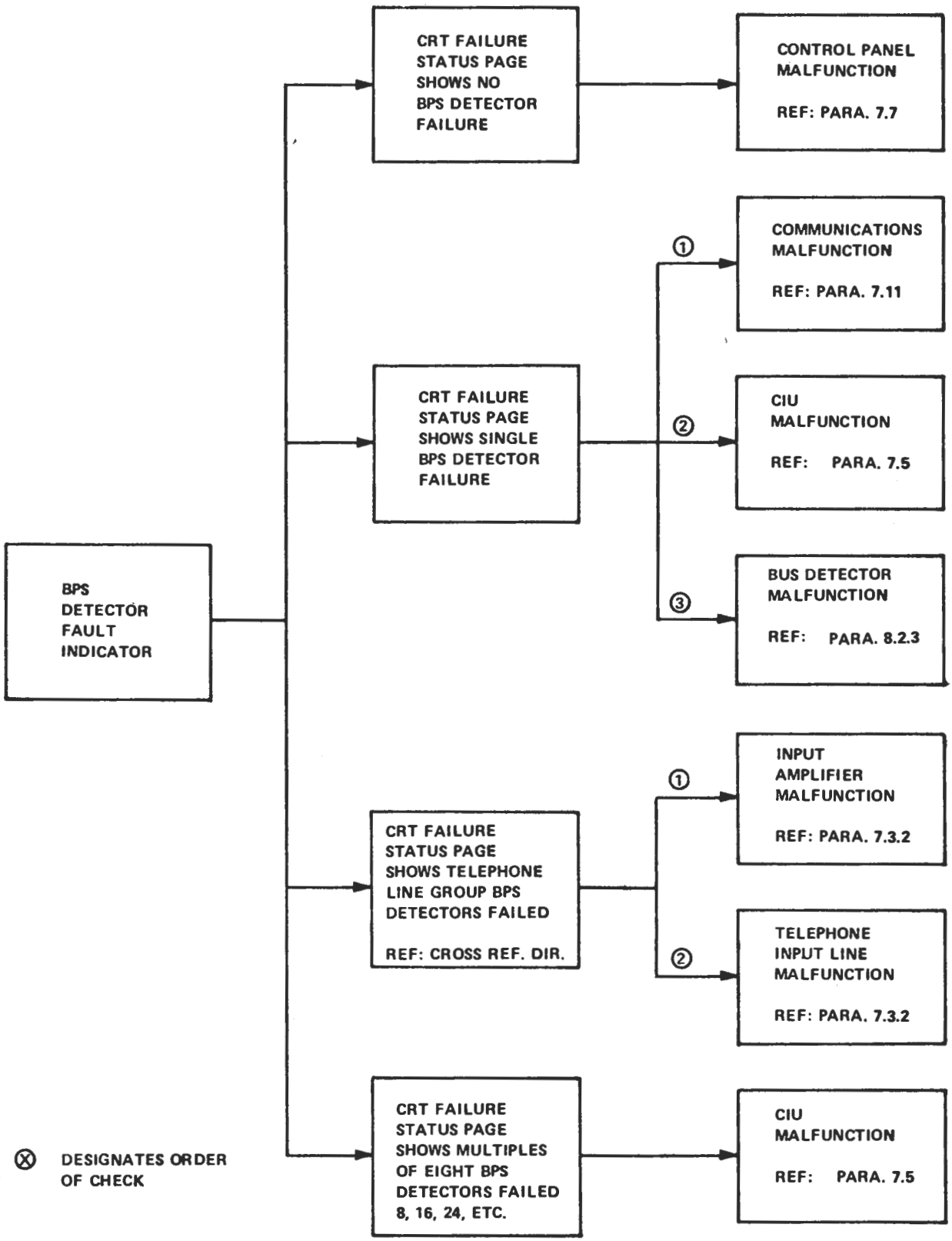


Figure 7-9. BPS Detector Fault Diagram

stream or down stream receiver output is monitored to determine when a bus is in the zone. If the 3F receiver output is correct, the signal is not being received at the CIU.

An off-line replacement of the associated CIU input card should be accomplished. Refer to the Central Site Signal Interface Table (SSMD Document No. 4-8-2000) for the connector and pin connection on the CIU input card. A sample of typical bus detection signal tracing is shown in Figure 7-10.

CAUTION

A CIU INPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

If the 3F receiver output is incorrect, replace the Central receiver and repeat the test. If the output is still incorrect, the fault is in the Field Equipment. Refer to Section 8 for Field Malfunction Isolation procedures.

7.12 BPS Communication

This fault indicator is a result of a system malfunction in the bus communications loop. The possible trouble areas are as follows:

(1) Communications failure

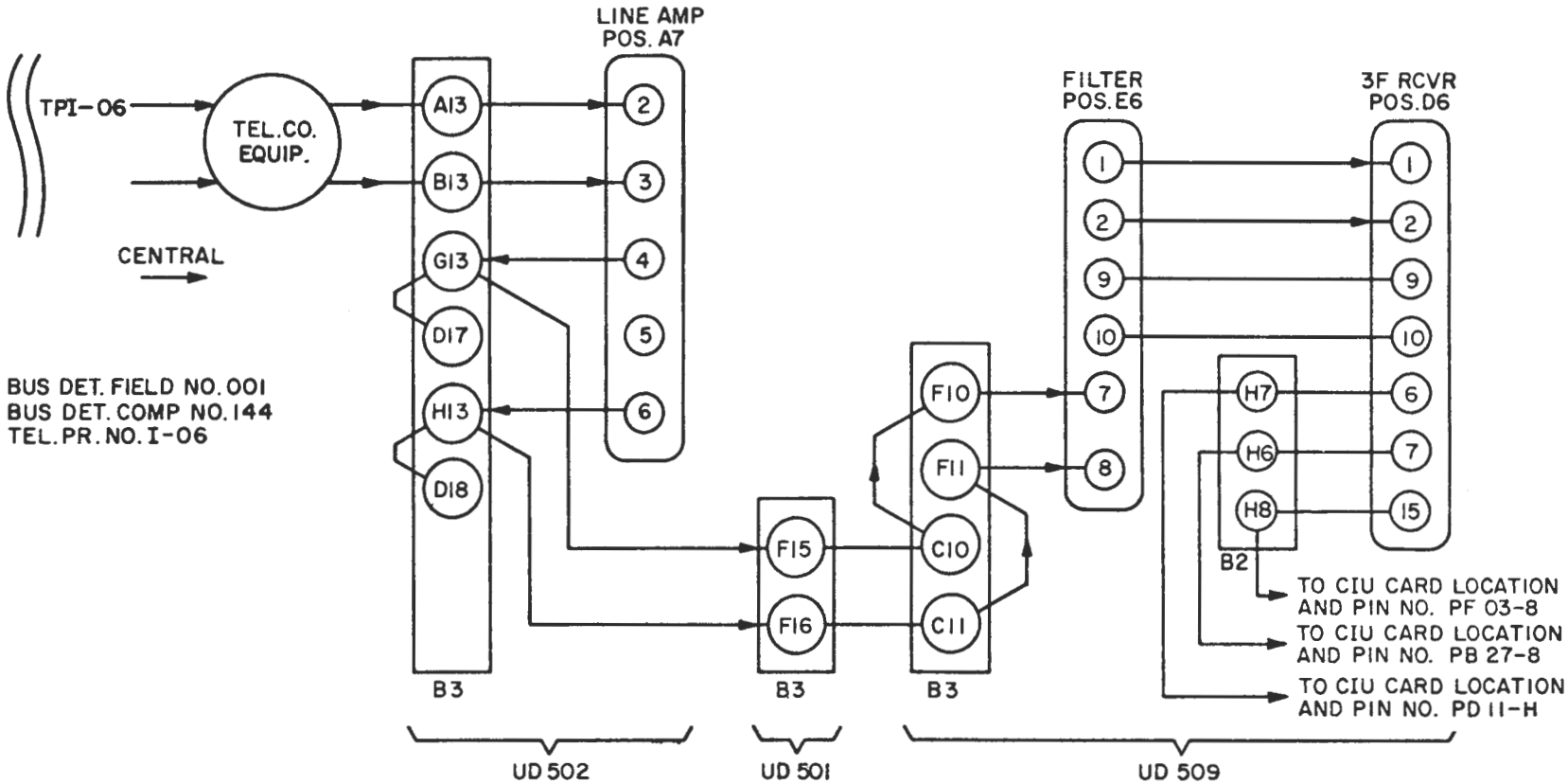
(2) CIU failure

Figure 7-11 is a fault diagram for BPS Communications.

The operator should determine, as described in the Operator's Manual, which bus communications channel is at fault and its location.

After finding the location of the Central Communications receiver, from the Cross Reference Directory, measure the Error (BE) signal at the communications connector block (Reference the Central Site Signal Interface Table (SSMD Document No. 4-8-2000). The presence of a Bus Error (BE) signal should be 0.5 ± 0.5 vdc. If there is not a Bus Error signal (that is, the communications loop is good), the signal is +6.5 ± 3.0 vdc. If the 3F reciever output is +6.5 ± 3.0 vdc, the signal is not being received at the CIU.

An off-line replacement of the associated CIU input card should be accomplished. Refer to the Central Site Signal Interface Table (SSMD Document No. 4-8-2000) for the connector and pin connection on the CIU input card. A sample of the typical bus detection signal tracing is shown in Figure 7-10.



NOTE:

(X) DENOTES PIN NUMBER ON SPECIFIED CONNECTOR

Figure 7-10. Local Bus Detection Signal Tracing (Sample)

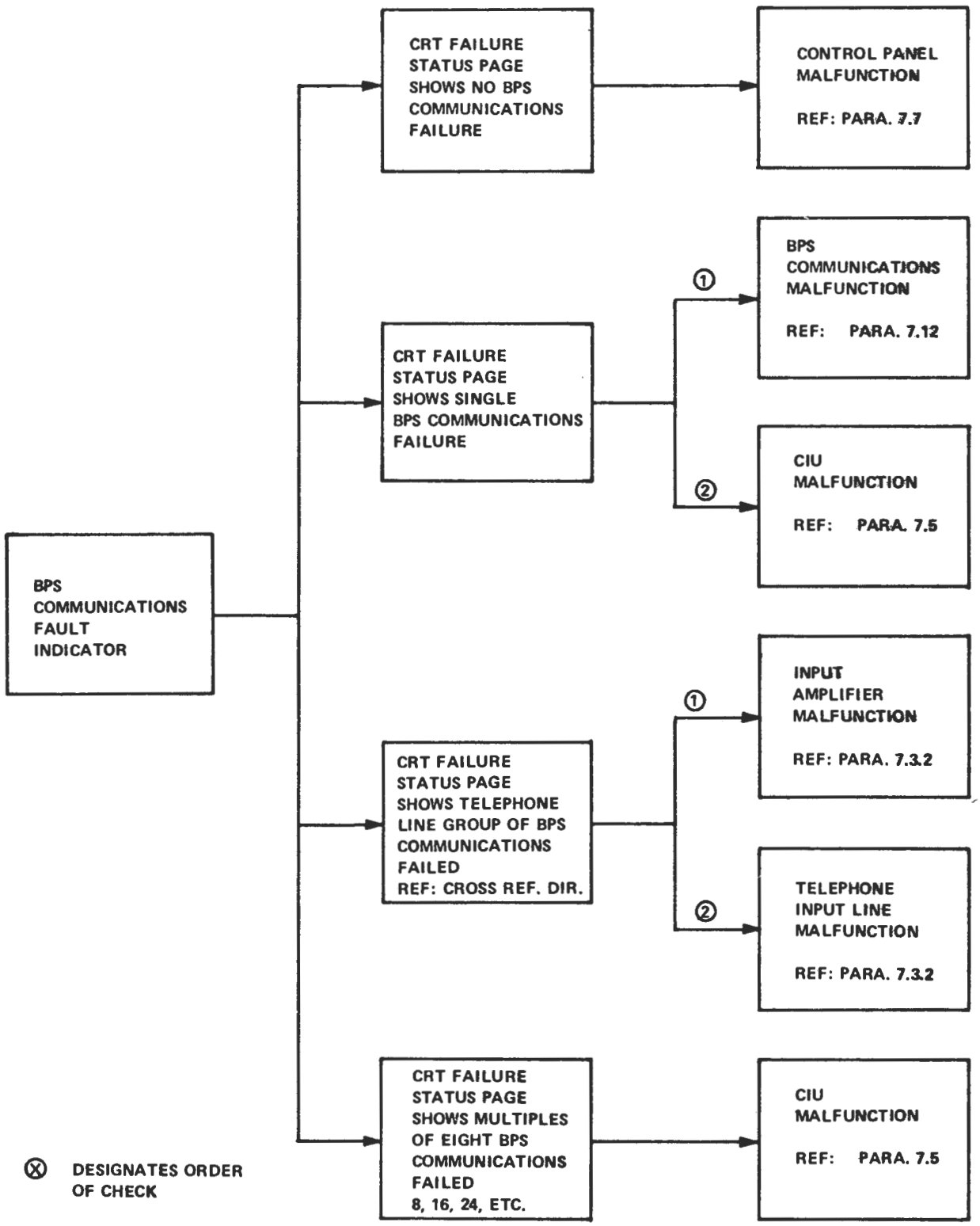


Figure 7-11. BPS Communications Fault Diagram

CAUTION

A CIU INPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

If the 3F receiver output is 0.5 ± 0.5 vdc, replace the Central receiver and repeat the test. If the output is still the same, the fault is in the Field Equipment. Refer to Section 8 for Field Malfunction Isolation procedures.

7.13 Radio Link

The Radio Link Interface Unit Schematic, Figures 7-12 and 7-13, show the connection of the 115 vac decoder outputs to the synchronization and sign relays. A 144 ohm resistor and the 1N754 zener diode provide +6.8 vdc from the 14 vdc source wired to the Radio Link Cabinet Terminal Board, Terminal Number 32. The presence of a synchronization (SYN) or sign (SGN) control signal is 115 vac. This presence activates its associated relay which, in turn, outputs a presence. The SYN and SGN outputs are +6.8 vdc for false SYN and SGN. For True SYN and True SGN (presence) the interface unit outputs a 0.5 ± 0.5 vdc.

7.13.1 Radio Link Malfunctions

When under Computer control if the synchronization degrades more than five seconds in either direction, a flag is set in the computer for all controllers using that cycle length. The flag is interepted by the Computer which, in turn, alerts the operator by changing the master Sync legend on the CRT Intersection Status Page from a Y (YES) to a N (NO) for any controller using that cycle length.

The 115 vac synchronization or sign signal can be measured at the terminal board on the left wall of the Radio Link Cabinet No. 1 Radio Link Signal Flow Diagram Figure 5-5. If the signal is not present, the fault is in the Radio Link and the Districts Maintenance Section should be notified. If 115 vac signal is present on the terminal board, refer to the Central Site Signal Interface Table (SSMD Document No. 4-8-2000) for the plug and pin information at the CIU.

If the signal is present at the CIU and the level is correct, then the CIU input card is suspect.

CAUTION

A CIU INPUT CONNECTOR OR CARD SHOULD BE REMOVED ONLY WHEN OFF-LINE.

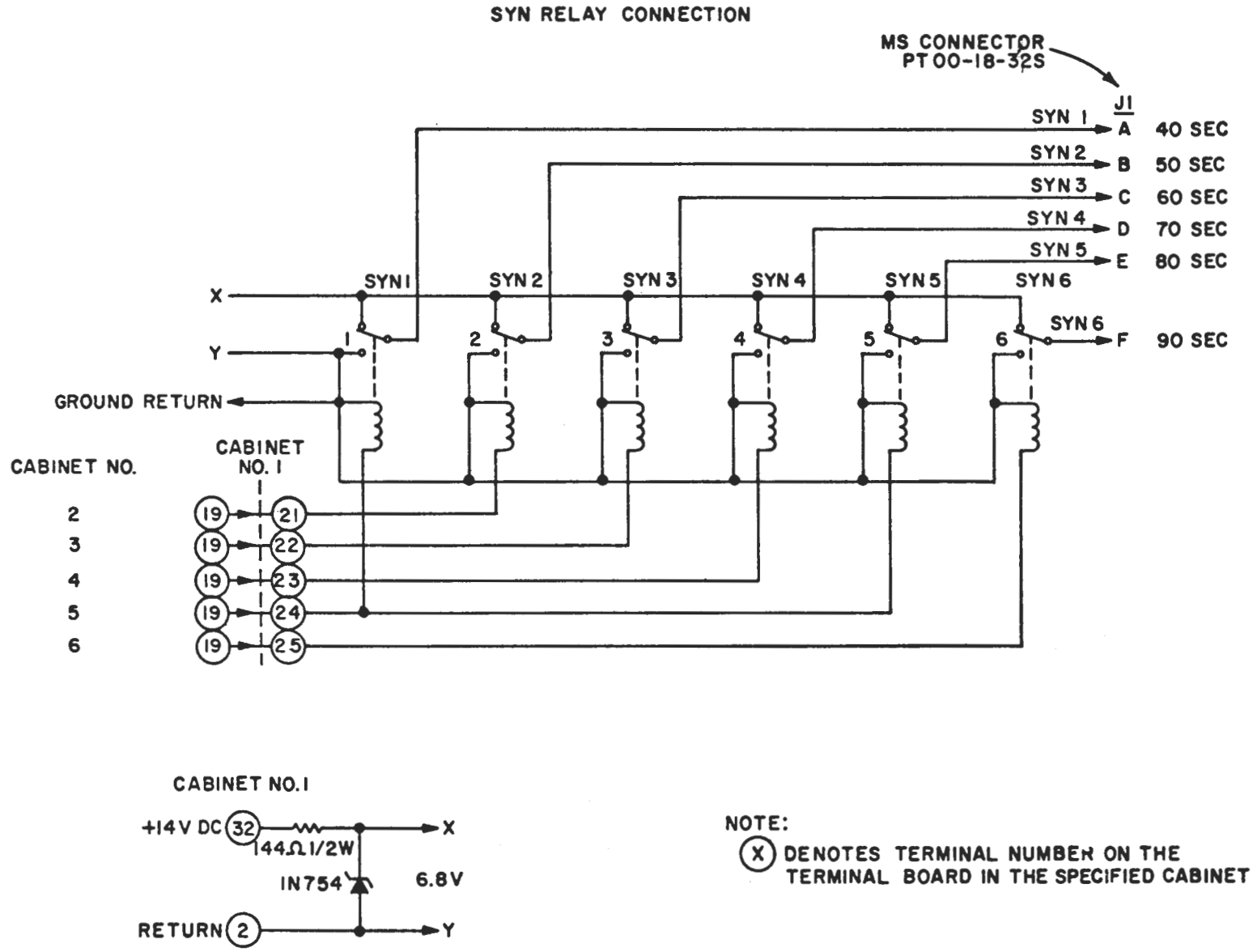


Figure 7-12. Radio Link Interface Unit Schematic SYN Relay Connections

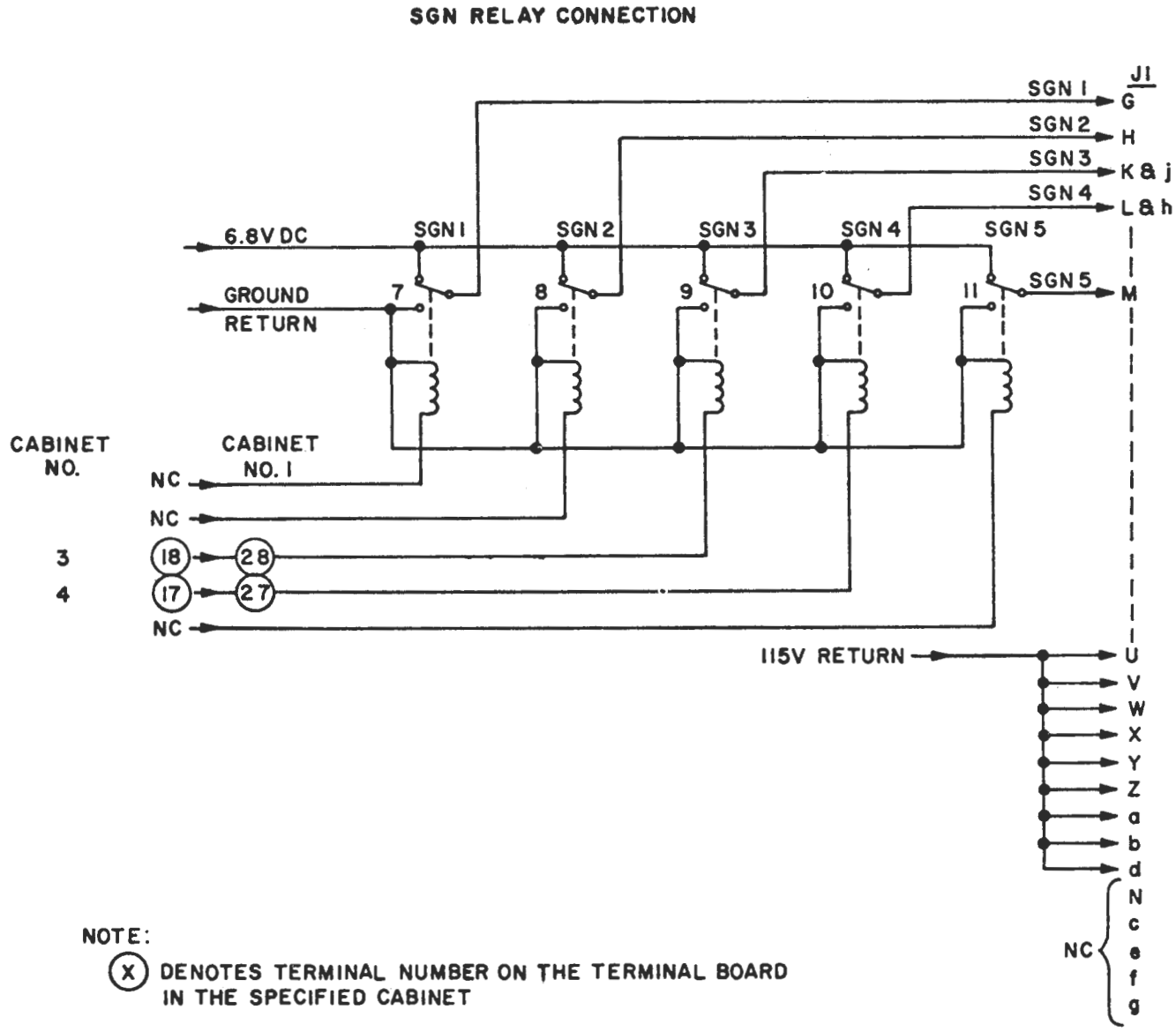


Figure 7-13. Radio Link Interface Unit Schematic SGN Relay Connections

If the synchronization signal is not present at the CIU input, then the fault is in the Radio Link Interface Unit. The first step is to replace the faulty relay. Refer to the Radio Link Interface Unit Synchronization Relay Connection Schematic Figure 7-12.

SECTION 8

FIELD MALFUNCTION ISOLATION

8.1 General:

Field Equipment malfunctions may occur while operating in either the stand by or computer mode of operation. Where Field Equipment is changed, it must be adjusted in accordance with the procedures of Section 9.

Failure isolation is based on a single malfunction and assumes that interconnection cabling is correct.

8.2 Computer Mode Failures

The procedures specified in the sections listed below of this manual should be carried out prior to going into the field for repairs since these procedures utilize Central Site equipment to provide fault isolation information for use in the field.

Section	Title
7.8	Traffic System Controller
7.9	Traffic System Detector
7.10	Traffic System Communications
7.11	BPS Detector
7.12	BPS Communications

8.2.1 Traffic System Controller

The fault conditions summarized in the following table and described in detail in Section 7.8 require field maintenance and further fault isolation as specified below:

Fault Condition	Map Lamp (A-Phase Green Mode)	Comm. Link Test	Fault in
1	Red or Green on Continuously	Positive	Controller or Controller Adapter
2	Red on continuously	Negative	A-Phase Green Transmitter or Comm. Power Supply
3	Operating Correctly	Positive	Controller Adapter
4	Operating Correctly	Negative	Hold and Advance Receiver or Controller Adapter

- Fault Condition 1

Check the Timing Tray for cam shaft rotation.

(a) If rotating,

(1) Check for 115 vac in A-Phase Green interval on Terminal Board 17 terminals 7 and 1

- If it is there, replace the Controller Adapter.
- If it is not there, replace Timing Tray.

(b) If not rotating,

(1) Check Terminal Board 17, terminals 19 and 1 for 115 vac each time an advance key passes under the stack switch.

- If the voltage is there, replace the Timing Tray.
- If the voltage is not there, check the fuse in the Controller Adapter. Replace, if blown and repeat b-1. If test is still negative, replace Controller Adapter.

- Fault Condition 2

Determine if communications power supply module is operating.

- Indicator lamp on
- Switch on
- + 12 vdc between terminals 3 (+) and 1 on Terminal Board 17

(1) If the power supply is not operating, replace the power supply.

(2) If it is operating, replace the A-Phase Green transmitter.

- Fault Condition 3

Replace Controller Adapter.

- Fault Condition 4

Remove and replace the two modules of the Hold and Advance receiver. If still unable to pick up the Controller, replace the Controller Adapter.

8.2.2 Traffic System Detector and Traffic System Communications

As a result of the tests performed at the Central Site in accordance with Section 7.9 and 7.10 of this manual, field fault isolation has been localized to the Vehicle Detector or associated communications transmitter.

Field check of the loop and detector can be accomplished at the Field Cabinet by placing the panel meter switch of the Vehicle Detector Electronics Unit to OPERATE and observing this meter when a vehicle passes over the loop. A deflection of the meter would indicate it is tuned and operating.

(a) If meter deflects -

Check the +12 vdc keying voltage to the 2F transmitter on the Communications Back-Panel. (terminal board number and terminal number associated with the particular vehicle detector will be found in the cabinet documentation package)

- If voltage is present, replace 2F transmitter.
- If voltage is not present, replace Vehicle Detector.

(b) If meter does not deflect -

Retune Vehicle Detector in accordance with Section 9.3.4.

- If unit can not be tuned, replace Vehicle Detector and repeat. If new unit can not be tuned, then the road loop has malfunctioned. Refer to Section 8.2.5.

8.2.3 BPS Detector

As a result of the tests performed in Section 7.11 the field fault isolation is localized to the Bus detector receiver. If changing the receiver fails to correct the the problem, then the bus road loop antenna has malfunctioned (Refer to Section 8.2.5.)

8.2.4 BPS Communications

As a result of the tests performed in Section 7.12 the field fault isolation is localized to the 3F transmitter and it should be replaced.

8.2.5 Loop Failures

If the vehicle loop or the bus road loop antenna are suspect, the maintenance man notifies the cognizant authority to check loop and lead in integrity.

8.3 Standby Mode Failures

When the equipment is in the Standby mode of operation, the fault must lie in the Controller or Controller Adapter since the Communications and Computer are not in

the loop. In the case of such a failure, a jumper is placed between terminals 7 and 8 of Terminal Board 5 or terminals 18 and 19 on Terminal Board 17. This removes the Controller Adapter from the loop.

If the fault persists, consult the Manual for UTCS Controllers and Controller Adapters for trouble shooting information.

If the fault is corrected, the Controller Adapter should be removed and replaced.

SECTION 9

ALIGNMENT PROCEDURES

9.1 General

The following alignment procedures should be followed whenever any changes or replacements are made to UTCS/BPS equipment.

9.2 Central Equipment Alignment Procedure

The only equipment requiring alignment in Central is the communications equipment. A communications equipment Card Extender should be used for all output and input signal level adjustments. The Card Extender initial setup is as follows:

(a) Select correct keyway adapter board (in plastic box).

(b) Spring-out adapter board clips, insert adapter board in edge connector and reinsert clips.

(c) Set Card Extender switches as follows:

MARK-CTR-SPACE switch to CTR
ON-TEST to ON
0 DB - 10 DB to 0 DB
LINE-OFF-LOAD to LINE

9.2.1 Transmitter Output Power

All Central transmitters are 3F, RFL Model HB-24335-34.

(a) Use Card Extender keyway 14 (Count from top).

(b) After initial set-up of Card Extender, remove module under test, insert Card Extender into module slot, insert module under test into Card Extender.

(c) Reset Card Extender switches as follows:

ON-TEST to TEST
LINE-OFF-LOAD to LOAD
MARK-CTR-SPACE to MARK

(d) Plug in high impedance power meter (HP Model 400D or equivalent) to J1 or J2 of Card Extender (meter ungrounded).

(e) Set each transmitter's output level to -7 dbm.

Note

1. Because the Card Extender board terminates each transmitter's output in 600 ohms when the LOAD-OFF-LINE switch is in LOAD, the HP 400D meter will read directly in DBM.

2. Each transmitter's output power should be set when the transmitter is keyed to Mark frequency (MARK CTR SPACE switch to MARK).

(f) Remove Card Extender and reinstall module under test.

9.2.2 Dual Amplifiers

Central amplifiers are RFL Model 14717.

(a) Insure that all transmitters on each input phone line are transmitting.

(b) Insert a HP Model 400D VTVM (or equivalent) into the OUT and COM test points of either amplifier 1 or 2 and set output power to -10 DBM.

9.2.3 Receiver Gain

Central receivers are either 3F, RFL Model HB-35605 (Dual module) or 2F, RFL Model HB 35600.

- For 3F receivers

(a) Use Card Extender keyway 3 (count from top).

(b) After initial set-up of Card Extender, remove the receiver Filter module (right-hand module of the receiver under test), insert the Card Extender into module slot, and install Filter module into Card Extender

(c) Reset Card Extender 0 DB - 10 DB switch to 10 DB.

(d) Insure that the street transmitter corresponding to the receiver is keyed to its MARK output.

(e) Insert 20,000 ohms/voltmeter (Simpson 260 or equivalent), set to read 12 vdc, into the MARK and COM test points of the receiver under test (left-hand module).

(f) Reduce receiver SENS control (ccw) until voltmeter reads +6.5 vdc ± vdc. Slowly increase SENS control (cw) until voltmeter just drops to 0 ± 1 vdc.

(g) Remove Card Extender, replace receiver filter module.

- 2F Receivers

(a) Use Card Extender keyway 12 (count from top).

(b) After initial set-up of Card Extender as detailed in Section 9.2 (c), remove the receiver module, insert the Card Extender into module slot and install module into Card Extender.

(c) Reset Card Extender 0 DB - 10 DB switch to 10 DB.

(d) Ensure that the street transmitter corresponding to the receiver under test is keyed to its MARK output. Corresponding transmitters are located using the Cross Reference Directory.

(e) Insert 20,000 ohms/volt voltmeter (Simpson 260 or equivalent), set to read 12 vdc, into the DC OUT and COM test points of the receiver under test.

(f) Reduce receiver SENS control (ccw) until voltmeter reads +12 vdc. Slowly increase SENS control (cw) until voltmeter just drops to 0 ± 1 vdc.

(g) Remove Card Extender, replace module.

9.3 Field Equipment Alignment Procedures

The replacement of certain types of Field Equipment requires the new equipment to be aligned to specific field conditions. The types of Field Equipment that require alignment are:

(1) Timing Tray
(2) 3F receivers
(3) 2F and 3F transmitter
(4) Vehicle Detectors
(5) Bus Detectors

The alignment procedures for the above equipments are described in the following paragraphs.

9.3.1 Timing Tray Alignment

When a Timing Tray is installed at an intersection, the cam breakout and timing dial key arrangement must be in accordance with the timing requirements for that intersection. This can be done in either of the following ways:

(a) Breakout cams and insert timing dial keys in accordance with the Cam Breakout and Dial Set-up sheet that is in the documentation package in the cabinet.

(b) Remove the camshaft and dial units (if operating) from the Timing Tray to be removed and install them in the new Timing Tray. If this course of action is followed, the procedure specified in the Manual For UTCS Controllers and Controller Adapters for removing and replacing camshaft should be followed.

9.3.2 Communications Equipment

Use a communications equipment Card Extender for all output and input signal level adjustments that are required in Sections 9.3.2.1 and 9.3.2.2.

The Card Extender initial set up for any street communications module is as follows:

(a) Select correct keyway adapter board (in plastic box).

(b) Spring-out keyway adapter clips, insert keyway adapter in edge connector and reinsert clips.

(c) Set Card Extender switches as follows:

MARK-CTR-SPACE to CTR

ON-TEST to ON

0 DB - 10 DB to 0 DB

LINE-OFF-LOAD to LINE

9.3.2.1 Hold and Advance Receiver

(a) Use Card Extender Keyway 3 (count from top).

(b) After initial set-up of Card Extender per Section 9.3.2, remove the receiver Filter module (right-hand module of the receiver under test), insert the Card Extender into module slot, and install Filter module into Card Extender

(c) Reset Card Extender 0 DB - 10 DB switch to 10 DB.

(d) Insure that the Central transmitter corresponding to the receiver-under test is keyed to its MARK output

(e) Insert 20,000 ohms/volt voltmeter (Simpson 260 or equivalent), set to read 12 vdc, into the MARK and COM test points of the receiver-under-test Receiver module (left-hand module).

(f) Reduce receiver SENS control (ccw) until voltmeter reads +12 volts d.c. Slowly increase SENS control (cw) until voltmeter just drops to 0 ± 1 vdc,

(g) Remove Card Extender and replace receiver Filter module.

9.3.2.2 A-Phase Green, Vehicle Detector and Bus Detector Transmitters

(a) Use keyway 14 (count from top).

(b) After initial set-up of Card Extender per Section 9.3.2, remove module under test, insert Card Extender into module slot, insert module under test into Card Extender.

(c) Reset Card Extender switches as follows:

- ON-TEST to TEST.
- LOAD-OFF-LINE to LOAD.
- MARK-CTR-SPACE to MARK.

(d) Plug in High impedance power meter (HP Model 400D or equivalent) to J1 and J2 of Card Extender (meter ungrounded).

(e) Set each transmitter's output level to value called for in the Cross Reference Directory.

NOTES

1. Because the Card Extender terminates each transmitter's output in 600 ohms when the LOAD-OFF-LINE switch is in LOAD, the HP 400D meter will read directly in DBM.

2. Each transmitter's output power should be set when the transmitter is keyed to MARK frequency ("MARK-CTR-SPACE" to MARK).

(f) Remove Card Extender and reinstall module under test.

9.3.3 Vehicle Detector

The detector is tuned in the field as follows. See Figure 9-1 for the front panel controls.

(a) 1. Put mode switch in the tune position.

2. Turn the sensitivity control to the full clockwise position.

(b) 1. Put No. 1 switch (coarse) tuning switch in position, fully clockwise.

2. Put No. 2 (medium) and No. 3 (fine) tuning switches in position, fully counter-clockwise.

3. The meter may read up scale, over 9 volts.

(c) If meter reads 9 volts or less leave No. 1 switch (coarse) in position fully clockwise. If meter reads over 9 volts rotate No. 1 switch (coarse) counter-clockwise to the first position that produces less than 9 volts on the meter. Leave No. 1 switch in this position.

(d) Rotate No. 2 switch (medium) clockwise to a position that causes the meter to read close to 9 volts but not over 9. Leave No. 2 switch at this position.

(e) Rotate No. 3 switch (fine) clockwise to a position that causes the meter to read approximately 9 volts. Leave No. 3 switch at this position.

NOTE

If above instructions are carefully followed, Detector should work satisfactorily at any voltage from 6 to 12 volts.

(f) Put the meter switch in indicate position and the meter may read up scale. If so, push the discharge button until the meter drops to zero. The unit is now ready to detect vehicles.

Figure 9-1. Vehicle Detector

NOTE

The Detector should now be tuned to the loop. The meter will swing up scale to indicate the presence of a vehicle. The meter swings down scale with no vehicle present.

(g) Wait a few minutes without pushing the discharge switch for the meter to drop to zero after the timing circuit has discharged itself.

(h) After detector is tuned, and meter reads zero, if a vehicle passes over the loop the meter should jump to approximately 3/4 scale. When vehicle leaves loop the voltage reading should drop to zero.

9.3.4 Bus Detector

Adjust the Bus Detector Receiver two front panel sensitivity controls (two) to maximum sensitivity by rotation to maximum clockwise position. The control is a twenty (20) turn variable resistor. Full end position occurs when an internal slip clutch operates audibly. A small (1/8" bladewidth) screwdriver is required.

(a) Bus Detector Transmitter Positioning

The calibration transmitter shall be positioned over the embedded roadway loop on a non-conductive support as follows:

Locate the transmitter over the roadway loop at least three (3) feet from the end of the loop.

Orient the transmitter such that its position is representative of its installed bus position in all respects except for roadway clearance height. The transmitter shall be positioned as follows:

- The mounting surface up.
- The plane of the mounting surface parallel to the roadway surface (roughly horizontal).
- The long central axis of the transmitter in the same plane as the two roadway loop wires.
- The bottom of the transmitter located 19 inches above the roadway.

(b) Threshold Adjustment

(1) Connect a direct current voltmeter to the front panel test points as follows:

Positive lead to the STOP test point.
Negative lead to the GRD test point.

The meter will indicate approximately 0 volts when a transmitter signal in the STOP mode exceeds the threshold level, and approximately 5 volts otherwise.

(2) Set the Transmitter Control switch continuously from the down (Stop) position to the up (Through) position and back while observing the voltmeter. Rotate STOP sensitivity control on the front panel in a counter-clockwise direction until the voltmeter reading remains at approximately 5 volts and then rotate the sensitivity control slowly clockwise until the meter again reads approximately 0 volts when the Transmitter Control switch is in the down (Stop) position. This setting is the STOP channel threshold adjustment setting.

(3) Remove the voltmeter connections from the test points.

(4) Connect a direct current voltmeter to the front panel test points as follows:

Positive lead to the THROUGH test point.
Negative lead to the GRD test point.

Set the Transmitter Control switch continuously from the down (Stop) position to the up (Through) position and back while observing the voltmeter. Rotate THROUGH sensitivity control on the front panel in the same way used to set the STOP channel threshold sensitivity setting. This is the THROUGH channel threshold adjustment setting.

Remove the voltmeter connections from the test points.

The threshold sensitivity control settings can be made if necessary with the Transmitter Control switch remaining in the down (Stop) position for the STOP channel setting and in the up (Through) position for the THROUGH channel setting. In this case the threshold sensitivity control is turned counter-clockwise until the voltmeter reads to approximately +5 volts, and then turned slowly clockwise just enough so that the voltmeter reads zero again.

The adjustments can be checked by observing the action of the voltmeter connected to the front panel test points when a normally mounted Bus Detector Transmitter passes slowly over the loop. When the sensitivity is properly adjusted, the meter should deflect to 0 volts when the transmitter is approximately one foot from the loop and should remain there until the transmitter is approximately one foot beyond the loop. The voltmeter reading should remain at about +5 volts whenever the transmitter is outside this region.

SECTION 10

BUS DETECTOR TRANSMITTER AND DEPOT MONITORING EQUIPMENT

10.1 General

The Bus Detector Transmitter and Transmitter Control Unit are mounted in the bus. The Control Unit is mounted on the steering column and the transmitter is mounted on the underside of the vehicle approximately 13 inches above the roadway.

10.2 Transmitter Control Unit

The Control Unit is a driver operated control mounted on the right hand side of the steering column. A covered three wire cable extention from the unit runs down the steering column to the floorboard and into a terminal board that is located on the right hand side of the instrument panel (by the door) in the circuit breaker section.

10.2.1 Operation

When the control lever is put in the down (Stop) position, a 12 volt return or ground signal is applied to terminal four of the terminal board in the bus. From there the signal goes to the Bus Detector Transmitter where it energizes the transmitter STOP channel. When the control lever is put in the up (Through) position, a +12 vdc signal is applied to terminal 4 of the bus terminal board. From there it goes to the transmitter where it energizes the THROUGH channel.

10.3 Bus Detector Transmitter

The Bus Detector Transmitter is a completely encapsulated unit that is approximately 13-1/2 inches long by 3-1/2 inches wide by 4 inches high. It has a covered four lead cable extention approximately 15 inches long that is terminated in a Molex No. 1653-P1 connector. It is mounted beneath the bus on the right side, forward of the rear axel near the rear door step. The connector mates with a similar connector on a covered four wire cable that runs to the bus terminal board in the front of the bus. The transmitter is oriented such that its long dimension is perpendicular to the side of the bus and the bottom edge is approximately 13 inches above the roadway. The transmitter obtains its power from the bus 12 volt supply via the extention cable and terminal board in the front of the bus.

10.3.1 Operation

Upon receipt of a Stop signal (ground), the Stop channel is energized and a magnetic field of 168 kHz is generated in a direction toward the roadway.

Upon receipt of a Through signal (+12 vdc), the Through channel is energized and a magnetic field of 182 kHz is generated.

10.4 Malfunctions

Each bus will undergo a daily go-no-go test routine. This test routine is described in Section 10.5.3. The assumption has been made that if the transmitter can operate in one of the modes, Stop or Through, it can also operate in the other mode.

If it is determined that the equipment on the bus is not operating, the following steps are to be followed in the order noted below:

(a) Turn the ignition switch on.

(b) Check for +12 vdc between terminals 1 (+) and 2 (Ret.) on the bus terminal board.

(1) If no voltage exists, check the bus circuit breaker. If still no voltage exists, the fault lies between the bus +12 volt power and the circuit breaker.

(2) If 12 vdc is on the terminal board, put the control lever in the down (Stop) position and check for 12 vdc between terminals 1(+) and 4 (Ret) on the terminal board. If no voltage exists, replace the Control Unit. If the +12 vdc is present, put the lever in the up (Through) position and check for +12 vdc between terminal 4 (+) and 2 (Ret) on the terminal board. If the voltage is not there, replace the Control Unit. If the voltage is there, the fault lies in the cable from the terminal board to the transmitter or in the transmitter.

(3) Underneath the bus, remove the electrical tape and disengage the Molex connectors. On the connector attached to the cable going to the bus terminal board the following voltages should appear:

- Pin A (+) to Pin B (Ret) +12 vdc continuously
- Pin A (+) to Pin D (Ret) +12 vdc with control lever down
- Pin D (+) to Pin B (Ret) +12 vdc with control lever up

If any of the above voltages are not there, the cable should be removed and replaced.

If all of the above voltages are there, the Bus Detector Transmitter should be removed and replaced. After installing the new transmitter the Molex connectors is engaged and electrical tape put around the connectors to effect a water tight seal.

10.5 Bus Detector Transmitter Test Fixtures

10.5.1 General

Two types of Bus Detector Transmitter Test Fixtures are available. One fixture is used to determine if the transmitter is working after it has been installed and while the bus is still up on the lift. The other fixture provides a daily check on the operation of the transmitter as the bus comes into the garage.

10.5.2 Installation Test Fixture

The installation test fixture is a go-no-go tester that is hand held. It is approximately 9 inches long, 4 inches wide and 1 inch high. It consists of a 35 turn coil of No. 18 AWG wire and a neon bulb. When in close proximity to the Bus Detector Transmitter, the radiated energy from the transmitter induces a voltage in the coil that is sufficient to light the neon bulb.

10.5.2.1 Operation

After the Bus Detector Transmitter has been installed and while the bus is still on the lift, the transmitter is turned on and the hand control is placed in either the Stop or Through position. The test fixture is brough up to the transmitter under the bus. If the neon bulb lights, the transmitter is considered to be working and the installation is complete.

10.5.2.2 Malfunction

While the test fixture contains a minimum number of parts and is very reliable, it should be checked periodically with a transmitter that is known to be operating properly. If the fixture fails to operate, replace the neon bulb (NE-51H).

10.5.3 Operational Test Fixture

The operational test fixture uses a Bus Detector Receiver, Bus Detector Loop and traffic signal head to test the Bus Detector Transmitters on a daily basis. The loop

is embedded in the road at a point near the bus terminal. The signal head is positioned such that the driver can see it as he passes over the loop. The Bus Detector Receiver is plugged into a single module communications wrap around that has a built in +12 vdc power supply. The wrap around and receiver are housed in a pole mounted cabinet which is installed at the side of the road near the loop. Because the normal output of the bus receiver is a 50 ms pulse, a pulse strecher has been added to the receiver to keep the signal head lamp lit long enough for the driver to see (approximately 3 seconds). The pulse strecher is made up of a sensitive mercury wetted relay that converts the Bus Detector Receiver dc output pulse to 115 vac. The ac pulse drives a time delay relay that controls the signal head lamp.

10.5.3.1 Operation

When the driver brings his bus into the garage, the hand control unit will be in either the Stop or Through position and the Bus Detector Transmitter energized. As the bus passes over the loop, a signal will be sent to the receiver which, in turn, illuminates the green light in the signal head. If the light is illuminated, the transmitter is considered to be working and no further action is taken. If the light fails to come on, the driver should notify the garage personnel and remedial action is then taken in accordance with the procedures put forth in Section 10.4 of this manual.

10.5.3.2 Malfunctions

If the signal head lamp fails to come on for a series of busses, the test fixture becomes suspect of failure. The installation fixture should be used on one of the busses to verify the failure. If required, the following steps should then be taken in the order specified:

(a) Check the bulb in the signal head.

(b) Check for 115 vac power in the cabinet.

(c) Put a high impedance (20, 000 ohms/volt) dc voltmeter between test points Stop (+) and ground and check for approximately five volts. If the five volts is not there, the fault is in either the dc power supply or receiver. Remove and replace the receiver. If the voltage is still not there, remove the receiver from the wrap around and replace the wrap around with its built in power supply.

If the voltage is there, the fault is in the pulse stretcher. The time delay relay may be energized, and the signal lamp lit, by shorting pins 5 and 6 of the time delay relay. If the lamp does not light, replace the time delay relay. If the lamp lights, replace the mercury wetted relay.

APPENDIX A

GLOSSARY

A.1 General

This glossary contains an explaination of the terms used in this manual. It is necessary that the technician understand these terms in order to perform the maintenance procedures outlined in this manual.

A.2 Explaination of Terms

A-Phase Green - The return discrete signal from a controller which is transmitted to the computer and map display. It is initiated at the start of the first controller timing interval, which represents the "main" street going green, and is present during the time that this phase is green. The chosen phase direction for each intersection corresponds to the direction of the "main" street traffic flow and is reflected in the intersection arrows on the map display.

Standby Mode (Off Line) - Computer control is relinquished to local dial system control for a controller, controllers in a section, or all controllers in the system. Surveillance of all detectors continues with respect to failure status and the Speed, Volume, and Occupancy.

Computer Control Mode (On Line) - When a controller, controllers in a section, or all controllers in the system are brought under computer control.

Presence - Detector "on state" or total detector pulse duration, in seconds, for a single vehicle.

Discrete - A long DC signal, as opposed to a pulse.

Radio Link - The radio receiver and associated electronics at Central providing discrete signals which are used to synchronize the UTCS generated controller cycles with those referenced by the district's master clock.

Cathode Ray Tube (CRT) Display Unit - A device using a cathode ray tube and associated electronics which provides an alphanumeric display of UTCS/BPS status and performance.

Central - The facility in Washington, D.C. which houses the UTCS/BPS computers, communications, display, and control equipment.

Central Processor Unit (CPU) - The portion of the UTCS Computer (CPU #1) or BPS Computer (CPU #2) which performs the logical and arithmetical functions. CPU #1 is dedicated to UTCS and all interface functions. CPU #2 is dedicated to BPS functions and UTCS/BPS raw history tape generation.

Communications (COM) - Refers to equipment at Central which provides the interface between the incoming and outgoing telephone lines and the Computer Interface Unit.

Computer Interface Unit (CIU) - The portion of the UTCS/BPS hardware which provides the interface between the UTCS Computer and external central equipments, and incoming and outgoing signals to central communications. It is also referred to as the I/O Multiplexer or MUX.

Rapid Access Disc (RAD) - Auxiliary storage device used for storing control patterns, the UTCS/BPS program, the UTCS/BPS configuration at shutdown, and the Real-Time Batch Monitor (RBM). The UTCS/BPS program and configuration are read into core memory during CPU start-up.

Teletypewriter (TTY) - A UTCS/BPS peripheral equipment used for two-way communications between the computers and the operator.

EB - A pole-mounted "electronics box", used to house remote vehicle detector electronic units and remote bus detector receivers.

CB - A large pad-mounted field cabinet, used to house local vehicle detector electronics, local bus detector receivers, communication equipment, controller adapter and controller.

f_o - The carrier frequency of a frequency shift transmitter.

f_s - The "SPACE" frequency, f_o minus 30 hertz, which results when an operating frequency shift transmitter has its SPACE Key input actuated.

f_m - The "MARK" frequency, f_o plus 30 hertz, which results when an operating frequency shift transmitter has its MARK Key input actuated. (Note: On a 3F transmitter, the MARK and SPACE Key inputs cannot be actuated simultaneously.)

BE - The "BUS ERROR" signal which results when the Carrier Detect output of the 3F receiver indicates that no signal, within the receiver bandwidth, has been detected.

BS - The "BUS STOP" signal, originated by the manual action of the bus driver, results in the detection of a MARK frequency signal by the 3F receiver.

BT - The "BUS THROUGH" signal, originated by the manual action of the bus driver, results in the detection of a SPACE frequency signal by the 3F receiver.

HOLD - A long duration pulse which is used to transfer field controllers from local dial control to Central Computer control.

ADVANCE - A 0.5 second pulse which will step the cam in a field controller, only if the HOLD signal has transferred the controller to Central Computer control.

FS - Frequency shift keying communication.

Traffic Control Panel (TCP) - The panel used by the operator to select the following;

System Control
Map Control
Malfunction Indicators
Status Display

Card Punch - Unit utilized by computer to punch computer cards.

Card Reader - Reads data from punch cards into computer.

Magnetic Tape Master (MTM) - Computer program storage for UTCS or BPS System.

Magnetic Tape Slave (MTS) - Computer tape unit for data storage using the electronics of a master. Used in the UTCS system.

Key Punch - Unit used to manually enter data on computer cards.

Line Printer - Unit to obtain hard copy of 15 minute reports as well as end of day report.

Multiplexer Input Output Processor (MIOP) - Unit that interfaces all computer peripherials including the CIU with the UTCS computer (CPU #1). This processor also has independent access to core memory to enable it to execute I/O tasks in parallel with other CPU operations.

APPENDIX B

SPECIAL TEST FIXTURES

Two special test fixtures are available for use on the UTCS/BPS equipment. They are:

(1) Map Display Test Fixture

(2) Communications Card Extender

B.1 Map Display Test Fixture

The Map Test Fixture is connected to the Map Display Electronics Unit connectors J11 and J12. 24 vdc power is required on P-11, Pin G to energize the DISPLAY ON relay of the Map Display via J-11, Pin F. See Figure B-3.

Figure B-1 shows the location of each switch on the front panel. To initialize the test fixture take the following steps.

(1) Place the controls in the position indicated below:

Switch	Position
POWER	ON
TEST 1	OFF
TEST 2	OFF
FAULT/$\overline{\text{FAULT}}$	$\overline{\text{FAULT}}$
DISPLAY	ON
FLASH	OFF
STATE + -	+
BIT SELECT A	ALL SWITCHES $\overline{\text{SEL}}$
BIT SELECT B	ALL SWITCHES $\overline{\text{SEL}}$
STATE 1	DOWN
STATE 2	DOWN

(2) Input the Communications Inhibit command in the following manner:

Set Word A (Bit Select A) equal to 1
Set Word B (Bit Select B) equal to 2
Set State Bit 1 up

Press the momentary TRANSMIT switch to initialize the Map Electronics Unit. The Map Electronics Unit will now accept addressing from the test fixture.

It should be noted that the Address word A (Bit Select A) and Address word B (Bit Select B) are in BCD format where switch 1 is the LSB of the A address and switch 5 is the LSB of the B address. See Figure B-1 for a value table.

Once the test fixture has been initialized Controller Addresses from Table B-1 or Link Addresses from Table B-2 can be entered via the Bit Select switches S1 through 9 and State switches S10 and 11. The address A and B in the tables is the BCD number.

The momentary TRANSMIT switch, when pressed will cause the Map to display the green light of the controller selected or illuminate the Link selected.

If the STATE switch (S10 or 11) specified in the tables is placed in the down position, then when the momentary TRANSMIT switch is pressed the Controller red light is illuminated or the Link indicator is extinguished.

The State switch (+, -) selects the polarity of the internal synchronizing signal and has no effect on the operation of the test fixture. The Map Display will function with either (+) or (-) synchronization.

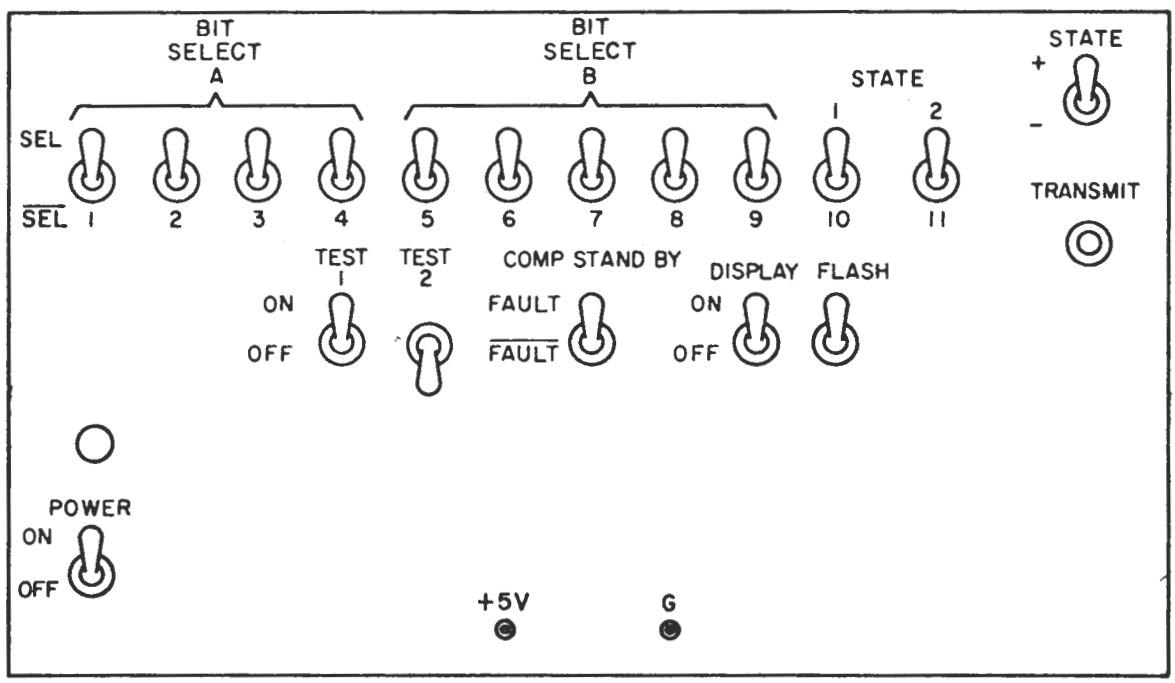
If the FAULT/$\overline{\text{FAULT}}$ switch is placed in the FAULT position, then the COMPUTER IN STAND-BY legend is illuminated.

If the TEST 1 switch is placed in the ON position, all intersections are illuminated red and half of the Link Arrows are illuminated. All legends which are green are illuminated.

If the TEST 2 switch is placed in the ON position, all intersections are illuminated green and the other half of the Link Arrows are illuminated. All legends are illuminated both red and green.

TEST switches 1 and 2 should not be placed in the ON position at the same time.

If the FLASH switch is placed in the ON position and one of the test switches is the ON position, then the Link Arrows illuminated will flash on and off.



	Word - A				Word - B				
Switch No.	1	2	3	4	5	6	7	8	9
BCD Value	1	2	4	8	1	2	4	8	16

Figure B-1. Map Fixture, Front Panel

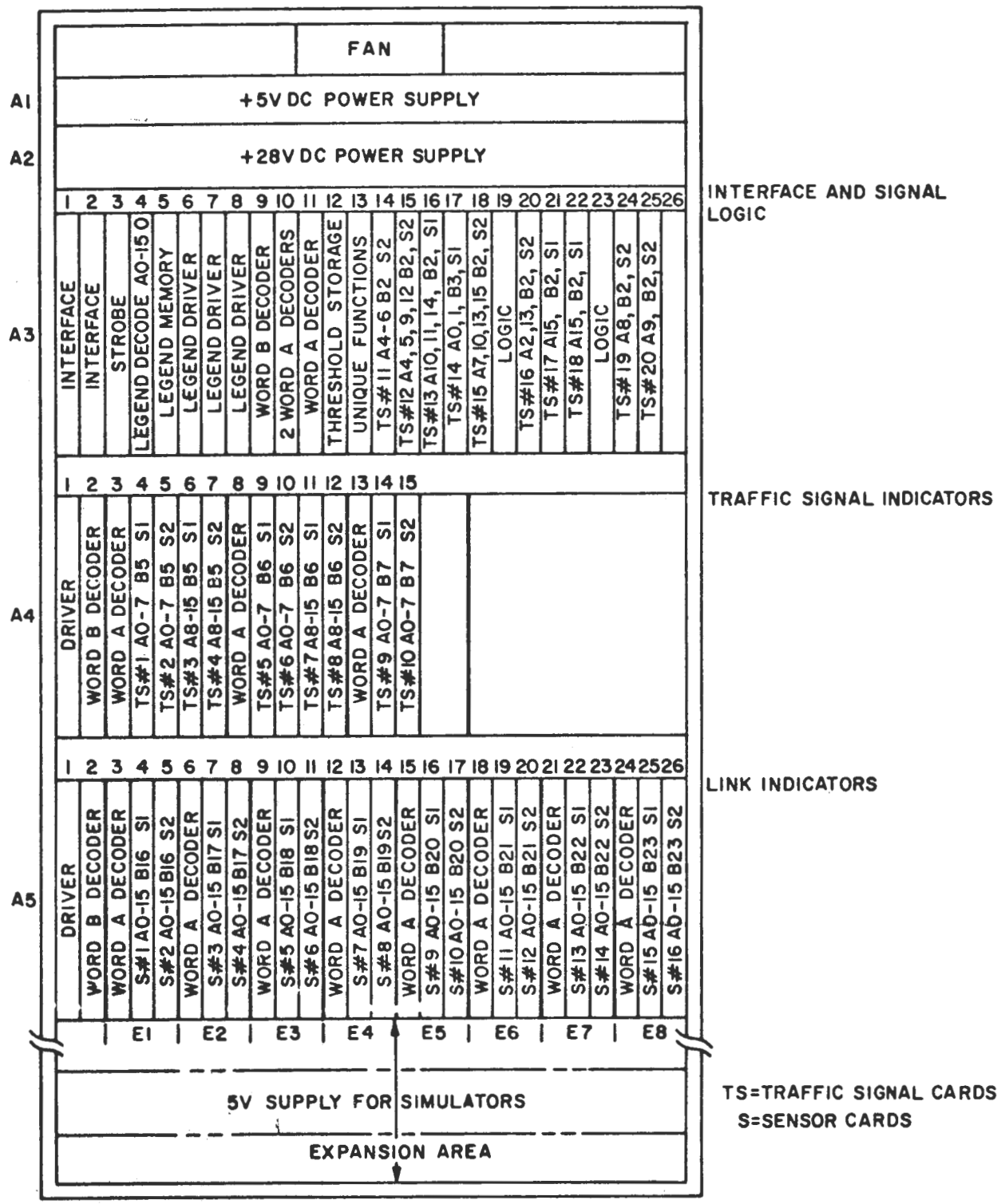


Figure B-2. Map Electronic Circuit Card Location

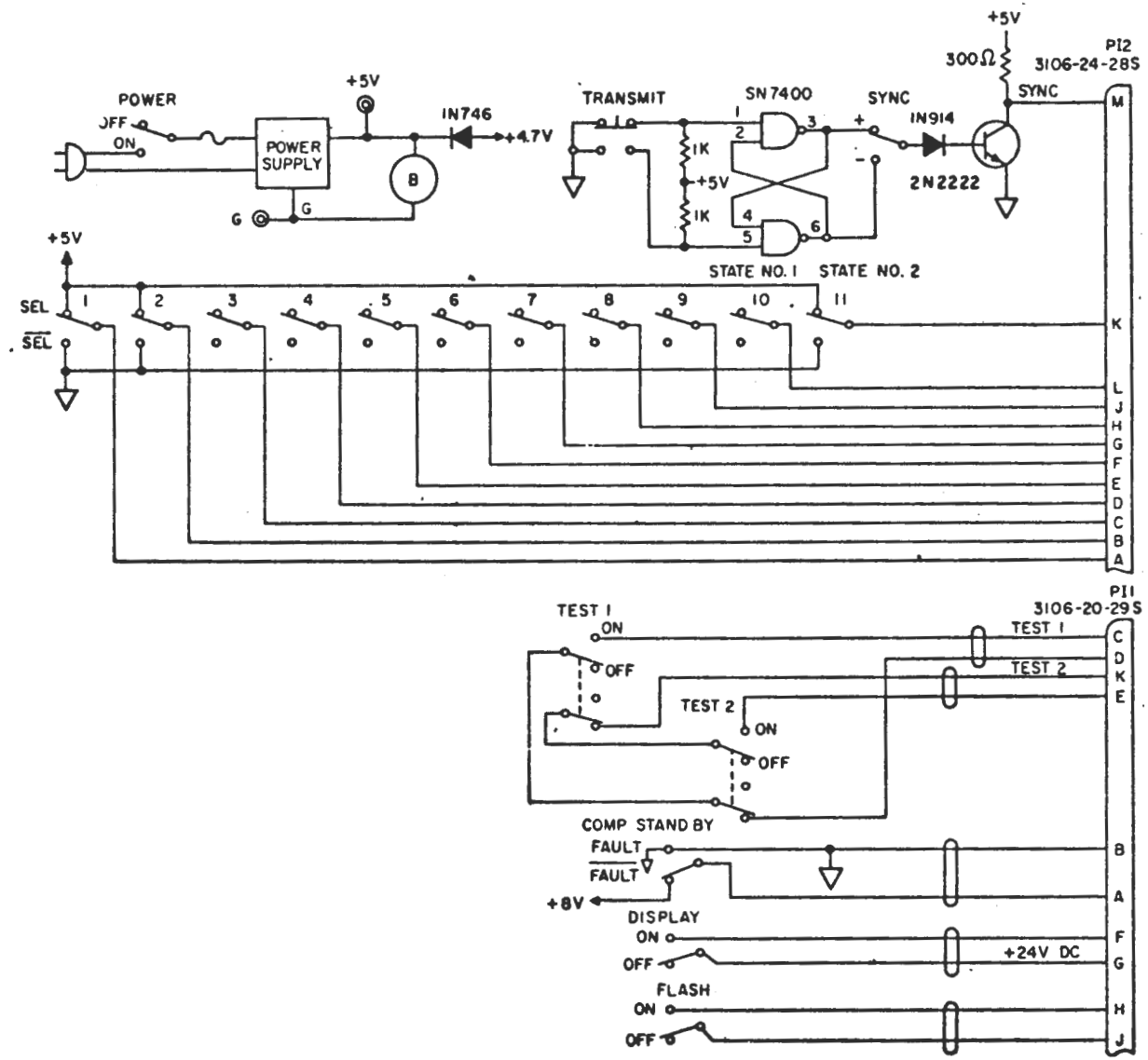


Figure B-3. Map Fixture, Schematic

TABLE B-1. MAP DISPLAY TEST FIXTURE, CONTROLLER ADDRESS/LOCATION

Contr. No.	Location	A-Phase Input Connector	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location Ref Fig. B-2 Tray	Card Location Ref Fig. B-2 Slot
001	M/30th	P16-A	0	5	1	A4	C4
002	Wisconsin/Whitehaven	P16-J	0	5	2	A4	C5
003	Wisconsin/34th.	P16-B	1	5	1	A4	C4
004	Wisconsin/Porter	P16-K	1	5	2	A4	C5
005	Wisconsin/Newark	P16-C	2	5	1	A4	C4
006	Wisconsin/Edmunds	P16-L	2	5	2	A4	C5
007	Wisconsin/Woodley	P16-D	3	5	1	A4	C4
008	Not Used	P16-M	3	5	2	A4	C5
009	Wisconsin/Mass.	P14-J	4	2	1	A3	C15
010	Wisconsin/Garfield	-	-	-	-	-	-
	A - Northbound	P14-A	4	2	2	A3	C14
	B - Southbound	P14-B	4	2	2	A3	C14
011	Mass./Garfield	P16-E	4	5	1	A4	C4
012	Wisconsin/R	P16-N	4	5	2	A4	C5
013	M/36th.	P14-K	5	2	1	A3	C15
014	M/33rd.	-	-	-	-	-	-
	A - Eastbound	P14-C	5	2	2	A3	C14
	B - Westbound	P14-D	5	2	2	A3	C14
015	M/Key Bridge	-	-	-	-	-	-
	A - Key Bridge Right Turn	P15-T	6	2	1	A3	C21
	B - M Left Turn	P15-U	6	2	1	A3	C21
	C - Key Bridge Left Turn	-	6	2	1	A3	C21
016	M/34th.	-	-	-	-	-	-
	A M/34th. Eastbound	P14-E	6	2	2	A3	C14
	B - M/34th. Westbound	P14-F	6	2	2	A3	C14
017	Wisconsin/M	-	-	-	-	-	-
	A - M Eastbound/Westbound	P14-T	7	2	1	A3	C16
	B - Wisconsin South	P14-U	7	2	1	A3	C16
018	M/31st.	P15-A	7	2	2	A3	C18
019	Penn./29th.	P14-L	8	2	1	A3	C15

Table B-1. Map Display Test Fixture, Controller Address/Location (Continued)

Contr. No.	Location	A-Phase Input Connector	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location Ref Fig. B-2 Tray	Card Location Ref Fig. B-2 Slot
020	Penn/28th./M	-	-	-	-	-	-
	A - M Westbound	P15-e	8	2	2	A3	24
	B - Penn. Eastbound	P15-f	8	2	2	A3	24
	C - Penn. Westbound	P15-d	8	2	2	A3	24
	D - 28th. Between Penn./M	-	8	2	2	A3	24
021	Penn./26th.	P16-F	5	5	1	A4	C4
022	Q/33rd.	P16-P	5	5	2	A4	C5
023	Penn/25th./L	P14-M	9	2	1	A3	C15
024	Penn/24th.	-	-	-	-	-	-
	A - Penn Eastbound	P15-g	9	2	2	A3	C25
	B - K Eastbound	P15-h	9	2	2	A3	C25
	C - K Westbound	-	9	2	2	A3	C25
	D - Penn Westbound	-	9	2	2	A3	C25
025	K/25th./Penn.	P16-G	6	5	1	A4	C4
026	Washington Circle SW	P16-R	6	5	2	A4	C5
027	Washington Circle NE	P16-H	7	5	1	A4	C4
028	23rd./E Westbound	P16-S	7	5	2	A4	C5
029	23rd./C	P16-T	8	5	1	A4	C6
030	21st./C	P16-c	8	5	2	A4	C7
031	Constitution/23rd.	-	-	-	-	-	-
	A - Constitution Eastbound	P14-V	10	2	1	A3	C16
	B - Constitution Westbound	P14-W	10	2	1	A3	C16
032	Constitution/22nd.	P15-B	10	2	2	A3	C18
033	Constitution./21st.	-		-	-	-	-
	A - Constitution Eastbound	P14-X	11	2	1	A3	C16
	B - Constitution Westbound	P14-Z	11	2	1	A3	C16
034	Virginia/E	P15-C	11	2	2	A3	C18
035	Virginia/21st.	P14-N	12	2	1	A3	C15
036	Virginia/20th.	-	-	-	-	-	-
	A - Virginia Westbound	P15-P	12	2	2	A3	C20
	B - Virginia Eastbound	P15-N	12	2	2	A3	C20
	C - Virginia Left Turn	-	12	2	2	A3	C20

Table B-1. Map Display Test Fixture, Controller Address/Location (Continued)

Contr. No.	Location	A-Phase Input Connector	Address (BCD)		State Bit (UP)	Card Location Ref Fig. B-2	
			A	B		Tray	Slot
037	Virginia/19th.	-	-	-	-	-	-
	A - Virginia	PI5-R	13	2	1	A3	C21
	B - C Eastbound	PI5-S	13	2	1	A3	C21
	C - C Westbound	-	13	2	1	A3	C21
038	Virginia/18th.	PI5-D	13	2	2	A3	C18
039	Constitution/20th.	-	-	-	-	-	-
	A - Constitution Eastbound	PI4-a	14	2	1	A3	C16
	B - Constitution Westbound	PI4-b	14	2	1	A3	C16
040	Constitution/19th.	PI5-E	14	2	2	A3	C18
041	Constitution/18th.	-	-	-	-	-	-
	A - Constitution Eastbound	PI5-V	15	2	1	A3	C21
	B - Constitution Westbound	PI5-W	15	2	1	A3	C21
	C - Constitution Eastbound, Left Turn	-	15	2	1	A3	C22
042	Constitution/17th.	PI5-F	15	2	2	A3	C18
043	E Westbound/20th.	PI6-U	9	5	1	A4	C6
044	E Westbound/21st.	PI6-d	9	5	2	A4	C7
045	E Westbound/19th.	PI6-V	10	5	1	A4	C6
046	E Westbound/18th.	PI6-e	10	5	2	A4	C7
047	E Eastbound/20th.	PI6-W	11	5	1	A4	C6
048	E Eastbound/19th.	PI6-f	11	5	2	A4	C7
049	E Eastbound/18th.	PI6-X	12	5	1	A4	C6
050	Constitution/Henry Bacon	PI6-g	12	5	2	A4	C7

Table B-1. Map Display Test Fixture, Controller Address/Location (Continued)

Contr. No.	Location	A-Phase Input Connector	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location Ref Fig. B-2 Tray	Card Location Ref Fig. B-2 Slot
051	17th./F	PI6-Z	13	5	1	A4	C6
052	17th./New York	PI6-h	13	5	2	A4	C7
053	E Eastbound/17th.	-	-	-	-	-	-
	A - 17th. Southbound/E	PI4-c	0	3	1	A3	C17
	B - 17th. Northbound/E	PI4-d	0	3	1	A3	C17
054	Penn./18th.	PI5-G	0	3	2	A3	C18
055	Penn./17th	PI6-a	14	5	1	A4	C6
056	Penn./Jackson	PI6-j	14	5	2	A4	C7
057	G/18th.	PI6-b	15	5	1	A4	C6
058	17th./Executive Building	PI6-k	15	5	2	A4	C7
059	K/19th.	PI7-A	0	6	1	A4	C9
060	K/18th.	PI7-J	0	6	2	A4	C10
061	17th./Conn./K	PI7-B	1	6	1	A4	C9
062	I/20th.	PI7-K	1	6	2	A4	C10
063	I/19th.	PI7-C	2	6	1	A4	C9
064	I/18th.	PI7-L	2	6	2	A4	C10
065	I/17th.	-	-	-	-	-	-
	A - I Southbound	PI4-e	1	3	1	A3	C17
	B - I Northbound	PI4-f	1	3	1	A3	C17
066	Penn./19th./H	-	-	-	-	-	-
	A - Penn. Westbound	PI4-G	1	3	2	A3	C14
	B - Penn. Eastbound	PI4-H	1	3	2	A3	C14
067	H/18th.	PI4-P	2	3	1	A3	C15

Table B-1. Map Display Test Fixture, Controller Address/Location (Continued)

Contr. No.	Location	A-Phase Input Connector	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location Ref Fig. B-3 Tray	Card Location Ref Fig. B-3 Slot
068	H/17th.	-	-	-	-	-	-
	A - H/Northbound	PI5-L	2	3	2	A3	C20
	B - H/Southbound	PI5-M	2	3	2	A3	C20
069	Penn./20th.	PI7-D	3	6	1	A4	C9
070	Penn./21st.	PI7-M	3	6	2	A4	C10
071	Penn./22nd.	-	-	-	-	-	-
	A - Penn. Westbound/ 22nd.	PI5-X	3	3	1	A3	C22
	B - Penn. Eastbound/ 22nd.	-	3	3	1	A3	C22
	C - K Eastbound/22nd.	PI5-Z	3	3	1	A3	C22
	D - K Westbound/22nd.	-	3	3	1	A3	C22
072	K/21st.	PI5-H	3	3	2	A3	C18
073	K/20th.	PI7-E	4	6	1	A4	C9
074	L/23rd.	PI7-N	4	6	2	A4	C10
075	L/New Hampshire	-	-	-	-	-	-
	A - L/22nd.	PI4-g	4	3	1	A3	C17
	B - New Hampshire	PI4-h	4	3	1	A3	C17
076	L/21st.	PI5-J	4	3	2	A3	C20
077	L/20th.	PI7-F	5	6	1	A4	C9
078	Not Used	PI7-S	5	6	2	A4	C10
079	Not Used	PI7-G	6	6	1	A4	C9
080	Not Used	PI7-R	6	6	2	A4	C10
081	L/17th.	PI7-H	7	6	1	A4	C9
082	L/16th.	PI7-S	7	6	2	A4	C10
083	L/15th.	PI7-T	8	6	1	A4	C11

Table B-1. Map Display Test Fixture, Controller Address/Location (Continued)

Conn. No.	Location	A-Phase Input Connector	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location Ref Fig. B-2 Tray	Card Location Ref Fig. B-2 Slot
084	L/19th.	PI7-c	8	6	2	A4	C12
085	L/18th.	PI7-U	9	6	1	A4	C11
086	L/Conn.	PI7-d	9	6	2	A4	C12
087	K/17th.	PI7-V	10	6	1	A4	C11
088	K/16th.	PI7-e	10	6	2	A4	C12
089	K/15th.	PI7-W	11	6	1	A4	C11
090	I/17th./Conn.	PI7-f	11	6	2	A4	C12
091	I/16th.	-	-	-	-	-	-
	A - I/16th. Southbound	PI4-j	5	3	1	A3	C17
	B - I/16th. Northbound	PI4-k	5	3	1	A3	C17
092	Not Used	Unassigned	5	3	2	A3	C20
093	H/Jackson/Conn.	PI7-X	12	6	1	A4	C11
094	H/16th.	PI7-g	12	6	2	A4	C12
095	Not Used	PI7-Z	13	6	1	A4	C11
096	L/Vermont	PI7-h	13	6	2	A4	C12
097	L/14th.	PI7-a	14	6	1	A4	C11
098	Not Used	PI7-j	14	6	2	A4	C12
099	K/14th.	PI7-b	15	6	1	A4	C11
100	K/15th./Vermont	PI7-k	15	6	2	A4	C12
101	Not Used	PI8-A	0	7	1	A4	C11
102	Not Used	PI8-J	0	7	2	A4	C12
103	Wisconsin/N	PI8-B	1	7	1	A4	C14
104	Wisconsin/O	PI8-K	1	7	2	A4	C15

Table B-1. Map Display Test Fixture, Controller Address/Location (Continued)

Contr. No.	Location	A-Phase Input Connector	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location Ref Fig. B-3 Tray	Card Location Ref Fig. B-3 Slot
105	Wisconsin/P	PI8-C	2	7	1	A4	C14
106	Wisconsin/Q	PI8-K	2	7	2	A4	C15
107	Not Used	PI8-D	3	7	1	A4	C14
108	Not Used	PI8-M	3	7	2	A4	C15
109	Virginia/23rd.	PI8-E	4	7	1	A4	C14
110	G/23rd.	PI8-N	4	7	2	A4	C15
111	G/22nd.	PI8-F	5	7	1	A4	C14
112	Not Used	PI8-P	5	7	2	A4	C15
113	I/23rd.	PI8-G	6	7	1	A4	C14
114	H/23rd.	PI8-R	6	7	2	A4	C15
115	18th./F.	PI8-H	7	7	1	A4	C14
116	20th./F	PI8-S	7	7	2	A4	C15
117	G/19th.	PI5-a	7	3	1	A3	C22
118	G/20th.	PI5-j	7	3	2	A3	C25
119	G/21st.	PI5-b	8	3	1	A3	C22
120	Wisconsin/Macomb	PI5-k	8	3	2	A3	C25
121	Wisconsin/Calvert	-	-	-	-	-	-
	A - Wisconsin Northbound	PI4-R	6	3	1	A3	C15
	B - Wisconsin Southbound	PI4-S	6	3	1	A3	C15
122	Wisconsin/Hall	PI5-K	6	3	2	A3	C20
123	Wisconsin/W Place	PI5-C	9	3	1	A3	C22

TABLE B-2. MAP DISPLAY TEST FIXTURE,
LINK TEST ADDRESS/LOCATION

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
009	Wisconsin/Mass.	S/B	8	16	1	A5	C4
		W/B	9	16	1	A5	C4
		N/B	0	16	1	A5	C4
		E/B	1	16	1	A5	C4
		E/B	2	16	1	A5	C4
010	Wisconsin/Garfield	S/B	10	16	1	A5	C4
		W/B	11	16	1	A5	C4
		N/B	3	16	1	A5	C4
		E/B	4	16	1	A5	C4
		S/B L.T.	12	16	1	A5	C4
011	Mass./Garfield	S/B	13	16	1	A5	C4
		W/B	14	16	1	A5	C4
		N/B	5	16	1	A5	C4
		E/B	6	16	1	A5	C4
012	Wisconsin/R	S/B	15	16	1	A5	C4
		W/B	8	16	2	A5	C5
		N/B	7	16	1	A5	C4
		E/B	0	16	2	A5	C5
015	M/Key Bridge	W/B L.T.	9	16	2	A5	C5
		N/B R.T.	1	16	2	A5	C5
		E/B	3	16	2	A5	C5
		E/B R.T.	4	16	2	A5	C5
		N/B L.T.	2	16	2	A5	C5
017	Wisconsin/M	S/B	10	16	2	A5	C5
		W/B	11	16	2	A5	C5
		N/B	5	16	2	A5	C5
		E/B	6	16	2	A5	C5

Note: N/B = Northbound, S/B = Southbound, E/B = Eastbound, W/B = Westbound, L.T. = Left turn, R.T. = Right turn.

Table B-2. Map Display Test Fixture,
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
018	M/31st.	W/B	12	16	2	A5	C5
		E/B	7	16	2	A5	C5
019	Penn./29th.	W/B	14	16	2	A5	C5
		E/B	1	17	1	A5	C7
		E/B	2	17	1	A5	C7
021	Penn./26th.	W/B	15	16	2	A5	C5
		E/B	3	17	1	A5	C7
		E/B	4	17	1	A5	C7
023	Penn./25th./L	S/B	8	17	1	A5	C7
		W/B	9	17	1	A5	C7
		N/B	5	17	1	A5	C7
		E/B	6	17	1	A5	C7
		W/B	10	17	1	A5	C7
024	Penn./24th.	S/B	11	17	1	A5	C7
		W/B	12	17	1	A5	C7
		N/B	7	17	1	A5	C7
		E/B	0	17	2	A5	C8
		W/B	13	17	1	A5	C7
		E/B	1	17	2	A5	C8
031	Constitution/23rd.	S/B	14	17	1	A5	C7
		W/B	15	17	1	A5	C7
		N/B	2	17	2	A5	C8
		E/B	3	17	2	A5	C8
032	Constitution/22nd.	W/B	8	17	2	A5	C8
033	Constitution/21st.	W/B	9	17	2	A5	C8
		E/B	5	17	2	A5	C8
		E/B L.T.	6	17	2	A5	C8

Table B-2. Map Display Test Fixture
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
037	Virginia/19th.	S/B	10	17	2	A5	C8
039	Constitution/20th.	W/B	11	17	2	A5	C8
		E/B	7	17	2	A5	C8
040	Constitution/19th.	S/B R.T.	12	17	2	A5	C8
		W/B	14	17	2	A5	C8
		E/B	0	18	1	A5	C10
		S/B L.T.	13	17	2	A5	C8
041	Constitution/18th.	W/B	15	17	2	A5	C8
		E/B	1	18	1	A5	C10
		E/B L.T.	2	18	1	A5	C10
		W/B R.T.	8	18	1	A5	C10
042	Constitution/17th.	S/B	9	18	1	A5	C10
		W/B	10	18	1	A5	C10
		N/B	3	18	1	A5	C10
		E/B	4	18	1	A5	C10
043	E (W/B)/20th.	W/B	11	18	1	A5	C10
		N/B	5	18	1	A5	C10
044	E (W/B)/21st.	S/B	12	18	1	A5	C10
045	E (W/B)/19th.	S/B	13	18	1	A5	C10
		W/B	14	18	1	A5	C10
046	E (W/B)/18th.	W/B	15	18	1	A5	C10
		N/B	6	18	1	A5	C10
047	E (E/B)/20th.	N/B	7	18	1	A5	C10
		E/B	0	18	2	A5	C11
048	E (E/B)/19th.	S/B	8	18	2	A5	C11
		E/B	1	18	2	A5	C11

Table B-2. Map Display Test Fixture,
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
049	E (E/B)/18th.	N/B	2	18	2	A5	C11
		E/B	3	18	2	A5	C11
050	Constitution/Henry Bacon Dr.	W/B	9	18	2	A5	C11
		N/B R.T.	4	18	2	A5	C11
		E/B	5	18	2	A5	C11
		W/B L.T.	10	18	2	A5	C11
051	17th./F	N/B	6	18	2	A5	C11
		E/B	7	18	2	A5	C11
052	17th./N.Y. Ave.	S/B	11	18	2	A5	C11
		N/B	0	19	1	A5	C13
053	E (E/B)/17th.	S/B	12	18	2	A5	C11
		N/B	1	19	1	A5	C13
		E/B	2	19	1	A5	C13
054	Penn./18th.	W/B	13	18	2	A5	C11
		N/B	3	19	1	A5	C13
		E/B	4	19	1	A5	C13
		E/B	5	19	1	A5	C13
055	Penn./17th.	S/B	14	18	2	A5	C11
		W/B	15	18	2	A5	C11
		N/B	6	19	1	A5	C13
		E/B	7	19	1	A5	C13
056	Penn./Jackson	S/B	8	19	1	A5	C13
		E/B	0	19	2	A5	C14
057	G/18th.	W/B	9	19	1	A5	C13
		N/B	1	19	2	A5	C14
058	17th./Executive	S/B	10	19	1	A5	C13

Table B-2. Map Display Test Fixture,
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
059	K/19th.	S/B	11	19	1	A5	C13
		W/B	12	19	1	A5	C13
		E/B	2	19	2	A5	C14
060	K/18th.	W/B	13	19	1	A5	C13
		N/B	3	19	2	A5	C14
		E/B	4	19	2	A5	C14
061	17th./Conn./K	S/B	14	19	1	A5	C13
		W/B	15	19	1	A5	C13
		N/B	5	19	2	A5	C14
		E/B	6	19	2	A5	C14
063	I/19th.	S/B	8	19	2	A5	C14
064	I/18th.	N/B	7	19	2	A5	C14
065	I/17th.	S/B	9	19	2	A5	C14
		N/B	0	20	1	A5	C16
		S/B L.T.	10	19	2	A5	C14
066	Penn./19th./H	S/B	11	19	2	A5	C14
		W/B	12	19	2	A5	C14
		E/B	1	20	1	A5	C16
		W/B L.T.	13	19	2	A5	C14
		W/B	14	19	2	A5	C14
067	H/18th.	W/B	15	19	2	A5	C14
		N/B	2	20	1	A5	C16
068	H/17th.	S/B	8	20	1	A5	C16
		W/B	9	20	1	A5	C16
		N/B	3	20	1	A5	C16

Table B-2. Map Display Test Fixture,
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
069	Penn./20th.	W/B	10	20	1	A5	C16
		N/B	4	20	1	A5	C16
		E/B	5	20	1	A5	C16
		E/B	6	20	1	A5	C16
070	Penn./21st.	S/B	11	20	1	A5	C16
		W/B	12	20	1	A5	C16
		E/B	7	20	1	A5	C16
		W/B	13	20	1	A5	C16
071	Penn./22nd.	N/B	0	20	2	A5	C17
		E/B	1	20	2	A5	C17
072	K/21st.	S/B	14	20	1	A5	C16
		W/B	15	20	1	A5	C16
		E/B	2	20	2	A5	C17
073	K/20th.	W/B	8	20	2	A5	C17
		N/B	3	20	2	A5	C17
		E/B	4	20	2	A5	C17
074	L/23rd.	S/B	9	20	2	A5	C17
	not used	W/B	10	20	2	A5	C17
		E/B	5	20	2	A5	C17
075	L/New Hampshire	N/B	6	20	2	A5	C17
	not used	S/B	11	20	2	A5	C17
	not used	W/B	12	20	2	A5	C17
		E/B	0	21	1	A5	C19
		N/B	7	20	2	A5	C17
076	L/21st.	S/B	13	20	2	A5	C17
	not used	W/B	14	20	2	A5	C17
		E/B	1	21	1	A5	C19

Table B-2. Map Display Test Fixture,
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
077	L/20th.	N/B	2	21	1	A5	C19
	not used	W/B	15	20	2	A5	C17
		E/B	3	21	1	A5	C19
081	L/17th.	S/B	12	21	1	A5	C19
	not used	W/B	13	21	1	A5	C19
		N/B	7	21	1	A5	C19
		E/B	0	21	2	A5	C20
082	L/16th.	S/B	14	21	1	A5	C19
	not used	W/B	15	21	1	A5	C19
		N/B	1	21	2	A5	C20
		E/B	2	21	2	A5	C20
083	L/15th.	S/B	8	21	2	A5	C20
	not used	W/B	9	21	2	A5	C20
		N/B	3	21	2	A5	C20
		E/B	4	21	2	A5	C20
084	L/19th.	S/B	10	21	2	A5	C20
	not used	W/B	11	21	2	A5	C20
		E/B	5	21	2	A5	C20
085	L/18th.	N/B	6	21	2	A5	C20
	not used	W/B	12	21	2	A5	C20
		E/B	7	21	2	A5	C20
086	L/Conn.	S/B	13	21	2	A5	C20
	not used	W/B	14	21	2	A5	C20
		N/B	0	22	1	A5	C22
		E/B	1	22	1	A5	C22
087	K/17th.	S/B	15	21	2	A5	C20
		W/B	8	22	1	A5	C22
		N/B	2	22	1	A5	C22
		E/B	3	22	1	A5	C22

Table B-2. Map Display Test Fixture,
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
088	K/16th.	S/B	9	22	1	A5	C22
		W/B	10	22	1	A5	C22
		N/B	4	22	1	A5	C22
		E/B	5	22	1	A5	C22
089	K/15th.	S/B	11	22	1	A5	C22
		W/B	12	22	1	A5	C22
		N/B	6	22	1	A5	C22
		E/B	7	22	1	A5	C22
090	I/17th./Conn.	S/B	13	22	1	A5	C22
		N/B	0	22	2	A5	C23
		E/B	1	22	2	A5	C23
091	I/16th.	S/B	14	22	1	A5	C22
		N/B	2	22	2	A5	C23
		S/B L.T.	15	22	1	A5	C22
093	H/Jackson/Conn.	S/B	8	22	2	A5	C23
		W/B	9	22	2	A5	C23
		N/B	3	22	2	A5	C23
094	H/16th.	S/B	10	22	2	A5	C23
		W/B	11	22	2	A5	C23
096	L/Vermont	S/B	12	22	2	A5	C23
	not used	W/B	13	22	2	A5	C23
		N/B	4	22	2	A5	C23
		E/B	5	22	2	A5	C23
097	L/14th.	S/B	14	22	2	A5	C23
	not used	W/B	15	22	2	A5	C23
		N/B	6	22	2	A5	C23
		E/B	7	22	2	A5	C23

Table B-2. Map Display Test Fixture,
Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
099	K/14th.	S/B	8	23	1	A5	C25
		W/B	9	23	1	A5	C25
		N/B	0	23	1	A5	C25
		E/B	1	23	1	A5	C25
		N/B L.T.	2	23	1	A5	C25
100	K/15th./Vermont	S/B	10	23	1	A5	C25
		W/B	11	23	1	A5	C25
		N/B	3	23	1	A5	C25
		E/B	4	23	1	A5	C25
101	K/10th.	W/B	12	23	1	A5	C25
		E/B	5	23	1	A5	C25
102	Independence/ 14th.	S/B	13	23	1	A5	C25
		W/B	14	23	1	A5	C25
		N/B	6	23	1	A5	C25
		E/B	7	23	1	A5	C25
115	18th./ F	N/B	0	23	2	A5	C26
		E/B	1	23	2	A5	C26
119	G/21st.	S/B	15	23	1	A5	C25
		W/B	8	23	2	A5	C26
120	Wisconsin/Macomb	S/B	9	23	2	A5	C26
		W/B	10	23	2	A5	C26
		N/B	2	23	2	A5	C26
		E/B	3	23	2	A5	C26
121	Wisconsin/Calvert	S/B	11	23	2	A5	C26
		W/B	12	23	2	A5	C26
		N/B	4	23	2	A5	C26
		E/B	5	23	2	A5	C26

Table B-2. Map Display Test Fixture, Link Test Address/Location (Continued)

Ref. Contr.	Intersection	Direction	Address (BCD) A	Address (BCD) B	State Bit (UP)*	Card Location (Ref. Fig. B-2) Tray	Card Location (Ref. Fig. B-2) Slot
123	Wisconsin/W Place	S/B	13	23	2	A5	C26
		N/B	6	23	2	A5	C26
		E/B	7	23	2	A5	C26
	Mass./22nd.	S/B	9	21	1	A5	C19
		W/B	8	21	1	A5	C19
		E/B	4	21	1	A5	C19
	Rhode Is./Conn.	S/B	6	21	1	A5	C19
		W/B	5	21	1	A5	C19
		E/B	10	21	1	A5	C19

B.2 UTCS FS Equipment Card Extender

The Model HB-35545 Card Extender shown in Figures B-4 and B-5 is used for system adjustment and maintenance of RFL tone equipment. The Card Extender includes an etched circuit board and a set of keyed inserts. Front panel mounted switches and jacks provide a convenient means by which audio and dc circuits may be switched or keyed.

B.2.1 Card Extender Types

There are three types of card extenders.

(1) Standard Card

(2) Reversed Panel Card

(3) Modified Card (marked with yellow band).

The Standard Card is described in the Operation and Maintenance Manual for FS Communication Equipment. Refer to Table 1-1 Manual 7.

Figure B-4. Extender Board, Front Panel

Figure B-5. Extender Board, P.C. View

The Reversed Panel Card is for use in the Field Cabinets in the extreme right module slot.

CAUTION

ONLY THE MODIFIED CARD (MARKED WITH THE YELLOW BAND) SHOULD BE USED IN CENTRAL IN THE ADVANCE AND HOLD TRANSMITTER SLOT TO PREVENT DAMAGE TO THE CIU. THE MODIFIED CARD WILL ONLY KEY SPACE WHEN THE TEST-ON SWITCH IS IN THE TEST POSITION. THE SPACE PIN IS NOT WIRED TO THE CIU. A CURRENT LIMITING RESISTOR HAS BEEN ADDED BETWEEN PIN 4 AND THE ARM OF THE MARK-CTR-SPACE SWITCH TO LIMIT THE VOLTAGE THE CIU OUTPUT CARD SEES.

APPENDIX C

REFERENCE TABLES

This appendix contains Reference Tables C-1 through C-10 which are to be used in the UTCS/BPS System.

All signal numbers in Tables C-1 through C-3 and C-8 are Computer numbers. The corresponding Field numbers are listed in the Central Site Signal Interface Table. See Figures 2-9, 2-10 and 2-12 for card and pin locations.

TABLE C-1. BPS SIGNAL CONNECTIONS TO CIU

	INPUT TO CIU (UD1011)								
	BUS STOP (BS)			BUS THROUGH (BT)			BUS ERROR (BE)		
BUS DETECTOR NUMBER	TRAY	SLOT	PINS	TRAY	SLOT	PINS	TRAY	SLOT	PINS
1- 8	PB	9	1-8	PB	25	A-H	PD	17	1-8
9- 16	PB	11	1-8	PB	27	A-H	PD	19	1-8
17- 24	PB	13	1-8	PB	29	A-H	PD	21	1-8
25- 32	PB	15	1-8	PB	31	A-H	PD	23	1-8
33- 40	PB	9	A-H	PD	1	1-8	PD	17	A-H
41- 48	PB	11	A-H	PD	3	1-8	PD	19	A-H
49- 56	PB	13	A-H	PD	5	1-8	PD	21	A-H
57- 64	PB	15	A-H	PD	7	1-8	PD	23	A-H
65- 72	PB	17	1-8	PD	1	A-H	PD	25	1-8
73- 80	PB	19	1-8	PD	3	A-H	PD	27	1-8
81- 88	PB	21	1-8	PD	5	A-H	PD	29	1-8
89- 96	PB	23	1-8	PD	7	A-H	PD	31	1-8
97-104	PB	17	A-H	PD	9	1-8	PD	25	A-H
105-112	PB	19	A-H	PD	11	1-8	PD	27	A-H
113-120	PB	21	A-H	PD	13	1-8	PD	29	A-H
121-128	PB	23	A-H	PD	15	1-8	PD	31	A-H
129-136	PB	25	1-8	PD	9	A-H	PF	1	1-8
137-144	PB	27	1-8	PD	11	A-H	PF	3	1-8
SPARES	PB	29	1-8	PD	13	A-H	PF	5	1-8
SPARES	PB	31	1-8	PD	15	A-H	PF	7	1-8

TABLE C-2. VEHICLE SIGNAL CONNECTIONS TO CIU

VEHICLE DETECTOR NUMBER	INPUT TO CIU VEHICLE DETECT (V) UD 1011		
	TRAY	SLOT	PINS
1- 8	PF	1	A-H
9- 16	PF	3	A-H
17- 24	PF	5	A-H
25- 32	PF	7	A-H
33- 40	PF	9	1-8
41- 48	PF	11	1-8
49- 56	PF	13	1-8
57- 64	PF	15	1-8
65- 72	PF	9	A-H
79- 80	PF	11	A-H
81- 88	PF	13	A-H
89- 96	PF	15	A-H
97-104	PF	17	1-8
105-112	PF	19	1-8
113-120	PF	21	1-8
121-128	PF	23	1-8
129-136	PF	17	A-H
137-144	PF	19	A-H
145-152	PF	21	A-H
159-160	PF	23	A-H
161-168	PF	25	1-8
169-176	PF	27	1-8
177-184	PF	29	1-8
185-192	PF	31	1-8
193-200	PF	25	A-H
201-208	PF	27	A-H
209-216	PF	29	A-H
217-224	PF	31	A-H
225-232	PH	1	1-8
233-240	PH	3	1-8

TABLE C-2. Vehicle Signal Connections To CIU (Continued)

VEHICLE DETECTOR NUMBER	INPUT TO CIU VEHICLE DETECT (V) UD 1011		
	TRAY	SLOT	PINS
241-248	PH	5	1-8
249-256	PH	7	1-8
257-264	PH	1	A-H
265-272	PH	3	A-H
273-280	PH	5	A-H
281-288	PH	7	A-H
289-296	PH	9	1-8
297-304	PH	11	1-8
305-312	PH	13	1-8
313-320	PH	15	1-8
321-328	PH	9	A-H
329-336	PH	11	A-H
337-344	PH	13	A-H
345-352	PH	15	A-H
353-360	PH	17	1-8
361-368	PH	19	1-8
369-376	PH	21	1-8
377-384	PH	23	1-8
385-392	PH	17	A-H
393-400	PH	19	A-H
401-408	PH	21	A-H
409-416	PH	23	A-H
417-424	PH	25	1-8
425-432	PH	27	1-8
433-440	PH	29	1-8
441-448	PH	31	1-8
449-456	PH	25	A-H
457-464	PH	27	A-H
465-472	PH	29	A-H
473-480	PH	31	A-H

TABLE C-2. Vehicle Signal Connections to CIU (Continued)

VEHICLE DETECTOR NUMBER	INPUT TO CIU VEHICLE DETECT (V) UD 1012		
	TRAY	SLOT	PINS
481-488	PB	9	1-8
489-496	PB	11	1-8
497-504	PB	13	1-8
503-512	PB	15	1-8
513-517	PB	9	A-E
Spare	PB	11	A-H
Spare	PB	13	A-H
Spare	PB	15	A-H

.TABLE C-3. COMMUNICATIONS SIGNAL CONNECTIONS TO CIU

A-PHASE GREEN NUMBER	INPUT TO CIU UD 1012 GREEN RETURN (G)		
	TRAY	SLOT	PINS
1- 8	PB	17	1-8
9- 16	PB	19	1-8
17- 24	PB	21	1-8
25- 32	PB	23	1-8
33- 40	PB	17	A-H
41- 48	PB	19	A-H
49- 56	PB	21	A-H
57- 64	PB	23	A-H
65- 72	PB	25	1-8
73- 80	PB	27	1-8
81- 88	PB	29	1-8
89- 96	PB	31	1-8
97-104	PB	25	A-H
105-112	PB	27	A-H
113-120	PB	29	A-H
121-128	PB	31	A-H

TABLE C-4. CONTROL PANEL SIGNAL CONNECTIONS TO CIU

CONTROL PANEL	INPUT TO CIU UD 1012 CONTROL PANEL (P) COMMANDS		
	TRAY	SLOT	PINS
1- 8	PD	1	1-8
9- 16	PD	3	1-8
17- 24	PD	5	1-8
25- 32	PD	7	1-8
33- 40	PD	1	A-H
41- 48	PD	3	A-H
49- 56	PD	5	A-H
57- 64	PD	7	A-H
65- 72	PD	9	1-8
73- 80	PD	11	1-8
81- 88	PD	13	1-8
89- 96	PD	15	1-8
97-104	PD	9	A-H
105-112	PD	11	A-H

TABLE C-5. RADIO LINK SIGNAL CONNECTIONS TO CIU

RADIO LINK	INPUT TO CIU UD 1012 RADIO LINK (R)		
	TRAY	SLOT	PINS
1- 8	PD	13	A-H
9- 16	PD	15	A-H

TABLE C-6. CONTROL PANEL SIGNAL CONNECTIONS FROM CIU

CONTROL PANEL	OUTPUT FROM CIU UD 1012 CONTROL PANEL (P) INSTRUCTIONS		
	TRAY	SLOT	PINS
1- 8	PD	17	1-8
9- 16	PD	19	1-8

TABLE C-7. MAP DISPLAY SIGNAL CONNECTIONS FROM CIU

MAP ELECTRONICS	OUTPUT FROM CIU UD 1012 MAP DISPLAY (M) INSTRUCTIONS		
	TRAY	SLOT	PINS
Strobe, State, Bit 1, and Spares	PD	25	1-8
Bits 2-9	PD	27	1-8
State 2-Spares	PD	29	1-8

TABLE C-8. COMMUNICATIONS SIGNAL CONNECTIONS FROM CIU

COMMUNICATIONS	OUTPUT FROM CIU UD 1012 HOLD (H) ADVANCE (A)		
	TRAY	SLOT	PINS
HOLD 1- 8	PF	1	1-8
HOLD 9- 16	PF	3	1-8
HOLD 17- 24	PF	5	1-8
HOLD 25- 32	PF	7	1-8
HOLD 33- 40	PF	9	1-8
HOLD 41- 48	PF	11	1-8
HOLD 49- 56	PF	13	1-8
HOLD 57- 64	PF	15	1-8
HOLD 65- 72	PF	17	1-8
HOLD 73- 80	PF	19	1-8

TABLE C-8. Communications Signal Connections From CIU (Continued)

COMMUNICATIONS	OUTPUT FROM CIU UD 1012 HOLD (H) ADVANCE (A)		
	TRAY	SLOT	PINS
HOLD 81- 88	PF	21	1-8
HOLD 89- 96	PF	23	1-8
HOLD 97-104	PF	25	1-8
HOLD 105-112	PF	27	1-8
HOLD 113-120	PF	29	1-8
HOLD 121-128	PF	31	1-8
ADVANCE 1- 8	PH	1	1-8
ADVANCE 9- 16	PH	3	1-8
ADVANCE 17- 24	PH	5	1-8
ADVANCE 25- 32	PH	7	1-8
ADVANCE 33- 40	PH	9	1-8
ADVANCE 41- 48	PH	11	1-8
ADVANCE 49- 46	PH	13	1-8
ADVANCE 57- 64	PH	15	1-8
ADVANCE 65- 72	PH	17	1-8
ADVANCE 73- 80	PH	19	1-8
ADVANCE 81- 88	PH	21	1-8
ADVANCE 89- 96	PH	23	1-8
ADVANCE 97-104	PH	25	1-8
ADVANCE 105-112	PH	27	1-8
ADVANCE 113-120	PH	29	1-8
ADVANCE 121-128	PH	31	1-8

TABLE C-9. INPUT TELEPHONE LINE vs AMPLIFIER MODULE LOCATION

INPUT TELEPHONE NUMBER (TL)	COMMUNICATIONS CABINET UD NUMBER, POSITION, and AMPLIFIER CHANNEL NUMBER
1	501-A7-1
2	501-A7-2
3	501-A9-1
4	501-A9-2
5	508-A7-1
6	502-A7-1
7	501-A11-1
8	502-A7-2
9	509-A7-1
10	502-A9-1
11	502-A9-2
12	502-A11-1
13	509-A7-2
14	505-A7-1
15	505-A7-2
16	506-A7-1
17	504-A7-1
18	506-A7-2
19	506-A9-1
20	507-A7-1
21	506-A11-2
22	507-A7-2
23	508-A7-2
24	506-A9-2
25	503-A7-1
26	505-A9-1
27	505-A9-2
28	506-A11-1
29	504-A7-2
30	504-A9-1

TABLE C-9. Input Telephone Line vs Amplifier Module Location (Continued)

INPUT TELEPHONE NUMBER (TL)	COMMUNICATIONS CABINET UD NUMBER, POSITION, and AMPLIFIER CHANNEL NUMBER
31	505-A11-1
32	505-A11-2
33	503-A7-2
34	504-A9-2
35	504-A11-1
36	509-A9-1
37	507-A9-1
38	508-A9-1
39	508-A9-2
40	508-A11-1
41	509-A9-2
42	507-A9-2
43	508-A11-2
44	509-A11-1
45	509-A11-2
46	504-A11-2
47	501-A11-2
48	503-A9-1
49	507-A11-1
50	507-A11-2
51	503-A9-2
52	510-A7-1
53	503-A11-1
54	503-A11-2
55	502-A11-2

TABLE C-10. CHASSIS TYPE vs RFL DRAWING NUMBER

CHASSIS TYPE	RFL DRAWING NUMBER
A1-1 through A1-8	12,500B
A2-1,2,4,5,6,8	12,501
A2-7	12,502
A2-9	12,503
A3-1,2,3	12,504
A3-4,5,6	12,505
A3-7,9	12,506
A3-10,11	12,507
A3-12	12,508
A4-1,2,4,6,7,8,9,11,12	12,509
A4-3,5,13	12,510
A4-10-1	12,511
A4-10-2	12,512
A5-1,2,4	12,513
A5-3	12,514

NOTE

Chassis type numbers as shown on the RFL Dwgs. are three digits, that is A-1-1-1. The last digit defines the frequency distribution of the plug-in modules.