TM 11-5820-570-14

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT

AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

MAINTENANCE CONTROL GROUP AN/GSA-99(V)1 (NSN 5895-00-930-0132)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)2 (NSN 5895-00-930-0172)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)3 (NSN 5895-00-930-0171)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)4 (NSN 5895-00-930-0170)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)5 (NSN 5895-00-930-0173)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)6 (NSN 5895-00-930-0169)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)7 (NSN 5895-00-930-0133)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)8 (NSN 5895-00-930-0168)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)9 (NSN 5895-00-930-0163)

MAINTENANCE CONTROL **GROUP AN/GSA-99(V)lO (NSN 5895-00-930-5578)**

MAINTENANCE CONTROL GROUP AN/GSA-99(V)11 (NSN 5895-00-930-5579)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)12 (NSN 5895-00-930-0134)

(NUS 6283)

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1976

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 24-volt dc power supply circuits, or on the ll5-volt ac line connections. Serious injury or death may result from contact with these points.

DON'T TAKE CHANCES!

TECHNICAL MANUAL
No. 11-5820-570-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON DC, 11 JUNE 1976

Operator's, Operational, Direct Support and General Support Maintenance Manual

F o r

MAINTENANCE CONTROL GROUP AN/GSA-99(V)1 (NSN 5895-00-930-0132)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)2 (NSN 5895-00-930-0172)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)3 (NSN 5895-00-930-0171)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)4 (NSN 5985-00-930-0170)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)5 (NSN 5895-00-930-0173)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)6 (NSN 5895-00-930-0169)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)7 (NSN 5895-00-930-0133)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)8 (NSN 5895-00-930-0168)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)9 (NSN 5895-00-930-0163)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)10 (NSN 5895-00-930-5578)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)11 (NSN 5895-00-930-5579)

MAINTENANCE CONTROL GROUP AN/GSA-99(V)12 (NSN 5895-00-930-5590)
(NUS 6283)

CONTENTS

PART 1. OVERALL EQUIPMENT

			Paragraph	Page
CHAPTER	1.	INTRODUCTION		
Section	I.			
		General	1	1
		Forms and records	2	1
Section	II.	Description and data		
		Purpose and use	3	3
		Technical characterstics	4	3
		Major assemblies	5	3
		Modular subassemblies	6	3
		Nomenclature	7	7
		Equipment description	8	9
Chapter	2.	INSTALLATION		
		Equipment inspection	9	11
		Connecting associated equipment	10	11
		Initial application of power	11	11

*This technical manual is an authentification of the manufacturer's commercial literature and does not confirm with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

CONTENTS (Cont)

			Paragraph	Page
CHAPTER	3.	OPERATING INSTRUCTIONS		
Section	I.	Controls, connectors, and indicators		
		Cabinet, controls and indicators	12	13
		Circuit breaker panel, controls and indicators	13	14
		Fault indicator and switching panel, controls and indicators	14	15
		Select panel, controls and indicators	15	16
		Tone receiver module, controls, connectors, and indicators	16	18
		Tone generator module, connectors	17	19
		Amplifier-hybrid module, controls	18	19
		4-wire telephone unit, controls and connectors	19	20
		Power supply, controls and indicators	20	21
Section	II.	Operating procedures		
		Answering incoming calls from shelters, vans, and remote mainline maintenance control centers	21	22
		Terminating calls from shelters, vans, and remote mainline maintenance control centers	22	22
		Initiating calls to shelters, vans, and remote mainline maintenance control centers	23	22
		Answering incoming calls from remote tributary maintenance control centers	24	22
		Terminating calls from remote tributary maintenance control centers	25	22
		Initializing calls to remote tributary maintenance control centers	26	22
		Establishing conference calls	27	23
		Monitoring fault indicators	28	23
CHAPTER	4.	**THEORY OF OPERATION**		
Section	I.	General		
		System application	29	25
		Site arrangement	30	25
Section	II.	Functional description		
		Local communications	31	27
		Call routing	32	31
		Communication between mainline sites	33	33
		Communication between mainline and tributary sites	34	35
		Fault indications	35	37
CHAPTER	5.	MAINTENANCE INSTRUCTIONS		
Section	I.	Preventive maintenance		
		General	36	41
		Maintenance materials	37	41
		General cleaning and inspection	38	41
		Weekly cleaning and inspection	39	41
Section	II.	Corrective maintenance		
		Troubleshooting	40	41
Section	III.	Alignment		
		General	41	58
		Test equipment required	42	58
		Test setup	43	58
		Alignment procedure	44	58

LIST OF ILLUSTRATIONS

Figure No.	*Title*
1	**Maintenance Control Center NUS 6283 (Mainline Sites)**
2	**Maintenance Control Center (Mainline Sites), Front View**
3	**Fault Indicator and Switching Panel and Select Panel, Controls and Indicators**
4	**Typical Site Arrangement, Block Diagram**
5	**Local Communication, Shelter or Van to Maintenance Control Center, Block Diagram**
6	**Local Communication, Maintenance Control Center to Shelter or Van, Block Diagram**
7	**Call Routing, Block Diagram**
8	**Communication Between Mainline Sites, Block Diagram**
9	**Communication Between Mainline and Tributary Sites, Block Diagram**
10	**Fault Indications, Block Diagram**
11	**Tone Receiver Adjustment, Test Setup**
12	**4-Wire Telephone Transmit Level Adjustment, Test Setup**
13	**Tone Generator Adjustment, Test Setup**
14	**Amplifier-Hybrid Adjustment, Test Setup**
15	**4-Wire Telephone Receive Level Adjustment, Test Setup**
16	**Maintenance Control Center (Mainline), Schematic Diagram (2 Parts)**
17	**Maintenance Control Center (Mainline), Wiring Diagram (4 Parts)**

LIST OF TABLES

Table No.	*Title*	*Page*
1	Module and Panel Complement	6

PART II. MODULES

4-wire telephone NUS 5165-8 and NUS 5165-45
1600 cps tone generator NUS 5165-30G1
1600 cps tone receiver NUS 5l65-37Gl
Relay logic NUS 5165-41Gl
Amplifier-hybrid NUS 5165-42G1
Ground interrupter NUS 5165-43Gl
Fault indicatior and switching panel NUS 6294-l
Select panel NUS 6295-2

PREFACE

This Manual describes the maintenance control center NUS 6283 installed at mainlinesites of the ET-A communications system. Part I provides installation instructions, operating procedures, theory of operation, and information. Theory of operation is described at the equipment level, and emphasis is placed on the interrelation of the modules rather than on circuitdetails. The modules are described in Part II, except for Lambda Power Supply LE 102 FM-1735-1. Refer to the power supply manufacturer's instruction manual for power supply operation and maintenance.

The maintenance control center conforms to a modular concept and is maintained to the direct support (3rd echelon) level. Maintenance to this level of support is concerned with localizing trouble to a particular module. When trouble is localized, replace the defective module. Refer to Instruction Manual for Test Facilities Kit MK-884/FRC-81(V), TM 11-5820-570-14/1 and -14/2 for maintenance information on the modules.

The maintenance control center is a component equipment in the ET-A communications system. The follow is a list of publications pertaining to the ET-A communications system component equipments.

Manual Title	Manual Number
Maintenance Control Group AN/GSA-99(V)1 through AN/GSA-99(V)12 (NUS 6283)	11-5820-570-14
Operator's Manual for Center, Communications Operations AN/MSQ-76(V)1 through AN/MSQ-76(V)3 and AN/GSQ-106(V)1 through AN/CSQ-106(V)3 (Console Local Equipment)	11-5820-571-10
Radio Set AN/FRC-113(V)1 through AN/FRC-113(V)11 (NUS 6060)	11-5820-572-14
Multiplexer Set AN/FCC-40 through AN/FCC-54	11-5820-573-15
Nodal Point Receiver (NUS 8021/8024)	11-5820-574-14
Console, Communication Control OZ-8149/MRC-114(V) through OA-8154/MRC-114(V) (NUS 5972-5, -6)	11-5820-575-14
Console Training Facility (NUS 8423)	11-5820-576-14
Switching Set, Communications AN/MSQ-74(V)1 through AN/MSQ-74(V)lO and AN/MSQ-74(V)12 (Console Remote Equipment) (NUS 7640)	ll-5820-577-14
Center, Communications Operations AN/MSQ-76(V)l through AN/MSQ-76(V)3 and AN/GSQ-106(V)1 through AN/GSQ-106(V)3 (Console Local EQuipment)	11-5820-578-24
Communication Group OA-8319/MSM (NUS 6052-23G1)	11-5820-578-14-1
Power Amplifier Group AN/MRA-15 (NUS 7561)	11-5820-579-15
Electronic Tube Cooler, ET-A Type 15-27-32.5	11-5820-579-15-1
Amplifier-Power Supply AM-4632/FRC-113(V) (NUS 6061-3)	11-5820-580-14
Transmitter (NUS **5951)**	11-5820-581-14
Console, Communication Control OA-7695/GRC and OA-7696/GRC (NUS 5972-3, -7)	11-5820-582-14
Dual Receiver (NUS 5961)	11-5820-583-14
Maintenance Control Group AN/GSA-100 (NUS 6264)	11-5820-585-14
Tributary Terminal Set AN/FSC-34 (NUS **7957)**	11-5820-587-15
Amplifier-Power Supply AM-4419/GRC (NUS 8013-2)	ll-5820-603-14
ET-A Mainline Site Manual	11-5895-376-14-l
ET-A Tributary Site Manual	11-5895-376-14-2
ET-A Site Equipment, Towers and Antennas	11-5895-376-14-3
Test Facilities Kit MK-884/FRC-81	11-6625-647-14

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope of Manual

This manual describes Maintenance Control Center NUS 6283 (Mainline Sites) (fig. 1) and covers its installation, operation, theory and maintenance. It includes cleaning and inspection of the equipment and field level maintenance.

2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. **Use equipment forms and records in accordance with instructions in TM 38-750.**

b. Report of Packaging and Handling Deficiencies. **Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DSAR 4145.8.**

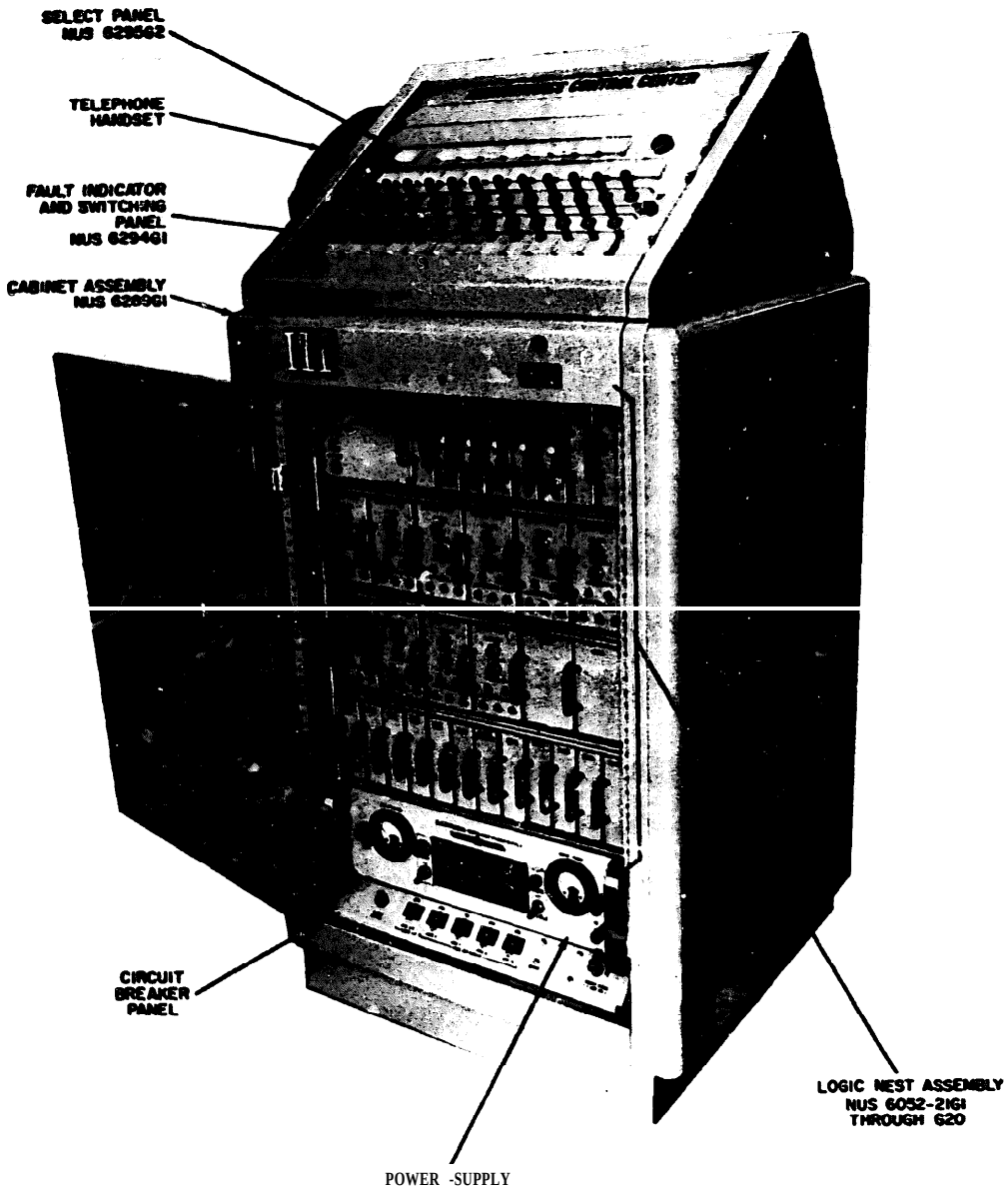


Figure 1. Maintenance control center NUS 6283 (mainline sites).

c. Reporting of Equipment Publication Improvements. The reporting of errors, omissions, and recommendations for improving this manual by the indivual is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 (Test) located in the back of the manual, and forwarded direct US Army Electronics Command, ATTN: AMSEL-MA-Q, Fort Monmouth, NJ 07703. To use the form in the back of the manual, cut it out, fill it out as shown on the sample figure, fold it where shown, and drop it in the mail. A reply will be furnished direct to you.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Maintenance Control Center NUS 6283 (Mainline Sites) provides the facilities for communicating and selectivity signaling mainline shelters and vans. These facilities are extended via regular order-wire circuits, so that distant shelters, vans, and maintenance control centers can be interconnected. In addition, the maintenance control center provides fault indications for each on-site radio-equipment shelter or van, multiplex center, and console remote equipment van.

4. Technical Characteristics

Line voltage	**115 vac**
Line current	**4.0 amp**
Operating ambient temperature	**−29°C to +55°C (−20°F to 121°F)**
Nonoperating ambient temperature	**−62°C to +71°C (−80°F to 160°F)**
Ambient relative humidity (external)	**100 percent**
Operating barometric pressure	**Sea level to 10,000 feet**
Nonoperating barometric pressure	**Sea level to 40,000 feet**

5.Major Assemblies

The major assemblies of Maintenance Control Center NUS6283(Mainline Sites) are listed below. The location of the major components are shown in figure 1 .

Component	*Height (in.)*	*Depth (in.)*	*Width (in.)*
Fault Indicator and Switching Panel NUS 6294G1	**7**	**7**	**19**
Select Panel NUS 6295G2	**1¾**	**9**	**19**
Logic Nest Assembly NUS 6052-21	**21**	**14**	**19**
Power Supply	**5¼**	**16**	**19**
Circuit Breaker Panel	**2½**	**2½**	**19**

6. Modular Subassemblies (fig. 2)

Maintenance Control Center NUS 6283 (mainline sites)are arranged in a configuration such that common modules can be inserted or removed from a maintenance control center cabinet to meet the requirements of any individual site complex (table I). Terminal wiring in all mainline maintenance control centers is identical and has been wired for the maximum module complement. The modular subassemblies.

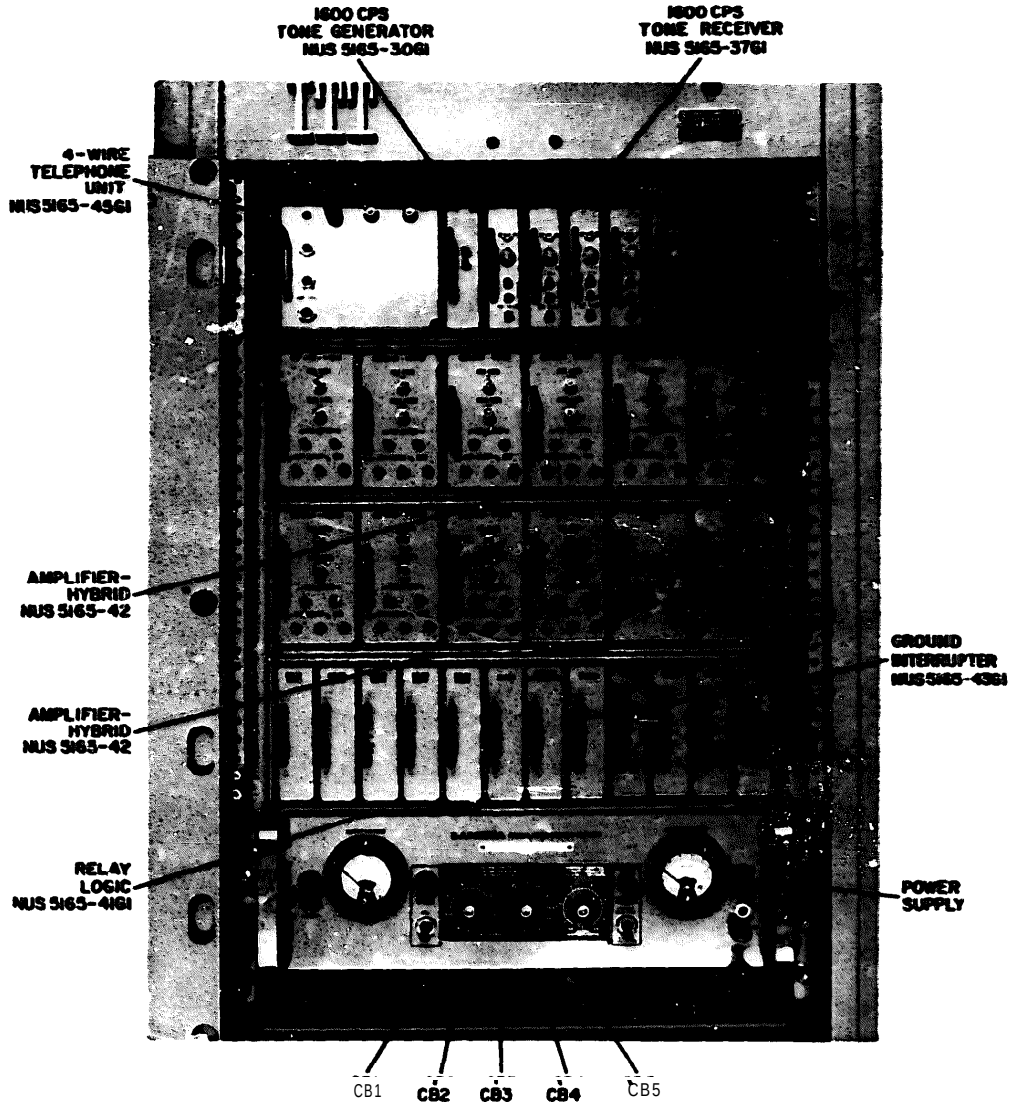


Figure 2. Maintenance control center (mainline sites), front view.

are contained within the cabinet assembly and are part of Logic **Nest Assembly** NUS 6052-21, Gl through G20. The modular subassemblies **and their functions are listed below.**

Modular subassembly	Function
Amplitier-Hybrid NUS 5165-42Gl	Provides two-to-four-wire conversion and amplification of incoming and outgoing signals.
1600 CPS Tone Receiver NUS 5165-37G1	Detects **1600 cps** tone on the line and provides an open circuit or continuity to an external circuit.
1600 CPS Tone Generator NUS 5165-30G1	Provides 1600 cps tone for remote site signaling.
Relay Logic **NUS 5165-4lGl**	Provides operating paths for call indicators and remote alarms.
4-Wire Telephone NUS 5165-45Gl	Provides four-wire communications between maintenance control center and remote sites.
Ground Interrupter NUS 5165-43G1	Provides intermittent ground to relay logic module.

TABLE 1. MODULE AND PANEL COMPLEMENT

Modules or panel	NUS number	Maintenance control center NUS 6283											
		G1	G2	G3	G5	G6	G8	G9	G13	G14	G16	G18	G20
Fault Indicator and Switching Panel	**6294G1**	1	1	**1**	1	1	1	**1**	**1**	1	1	1	**1**
Select Panel	**6295G2**			**-**					**1**	1	**1**	1	2
Power Supply		1	1	**1**	1	1	1	1	**1**	1	**1**	1	1
Ground Interrupter	**5165-43Gl**	1	1	**1**	1	1	1	1	**1**	1	1	1	1
Amplifier-Hybrid	**5165-42Gl**	2	2	**3**	3	4	5	6	**3**	4	6	**9**	6
1600 CPS Tone Generator	**5165-30G1**	1	1	**1**	1	1	1	1	**1**	1	**1**	**1**	1
Relay Logic	**5165-4lGl**	1	1	**2**	2	2	3	3	**2**	3	3	**5**	3
1600 CPS Tone Receiver	**5165-37G1**	1	2	**1**	2	2	3	3	**1**	1	2	**5**	2
4-wire Telephone Unit	**5165-45G1**	1	1	**1**	1	1	1	1	**1**	1	**1**	**1**	**1**

7. Nomenclature

A list of nomenclature and manufacturer's designations for Maintenance Control Center NUS 6283 (mainline sites) and its major components and modular subassemblies is given below, A common name is provided for each listed item.

Nomenclature	Manufacturers designation	Common name
Indicator, Fault Locating ID-1353/ GSA-99(V)	Fault Indicator and Switching Panel NUS 6294G1	Fault indicator and switching panel
Cabinet, Electrical Equipment CY-4874/GSA-99(V)	Cabinet Assembly NUS 6289G1	Cabinet
Power Supply PP-4513/GSA-99(V)	Power Supply - (Lambda LE102FM-1735-1)	Power supply
	Circuit Breaker Panel ITTFL D2386695	Circuit breaker pane
Drawer, Electrical Equipment, Rack Mounted CH-554/FCC	Frame Assembly NUS 5165-1Gl	Frame
Interrupter, Ground PL-1118/GSA-99(V)	Ground Interrupter NUS 5165-43Gl	Ground interrupter module
Amplifier Audio Frequency AM-4515/GSA-99(V)	Amplifier-Hybrid NUS 5165-42Gl	Amplifier-hybrid module

7. Nomenclature (cont)

Nomenclature	Manufacturers designation	Common name
Oscillator, Audio Frequency 0-13231/G	1600 CPS Tone Generator NUS 5165-30G1	Tone generator module
Control, Alarm C-6945/GSA-99(V)	Relay Logic NUS 5165-4lGl	Relay logic module
Monitor, Audio Frequency ID-1354/G	1600 CPS Tone Receiver NUS 5165-37G1	Tone receiver module
Four Wire Telephone Unit, Order Wire TA-683/GSA-99(V)	4-Wire Telephone unit NUS 5165-45Gl	4-wire telephone unit
Panel, Indicator-Interconnecting ID-1369/GSA-99(V)	Select Panel NUS 6295G2	Select panel
Maintenance Control Group	Maintenance Control Center (Mainline)	Maintenance control center
AN/GSA-99(V)l	NUS 6283G1	
AN/GSA-99(V)2	NUS 6283G2	
AN/GSA-99(V)3	NUS 6283G3	
AN/GSA-99(V)4	NUS 6283G5	
AN/GSA-99(V)5	NUS 6283G6	
AN/GSA-99(V)6	NUS 6283G8	
AN/GSA-99(V)7	NUS 6283G9	
AN/GSA-99(V)8	NUS 6283G13	
AN/GSA-99(V)9	NUS 6283G14	
AN/GSA-99(V)lO	NUS 6283G16	
AN/GSA-99(V)ll	NUS 6283G18	
AN/GSA-99(V)12	NUS 6283G20	

7. Nomenclature (cont)

Nomenclature	Manufacturers designation	Common name
Communication Control Group	Logic Nest Assembly	Logic nest
OA-7934(V)l/ GSA-99(V)	NUS 60520-21Gl	
OA-7934(V)2/ GSA-99(V)	NUS 6052-21G2	
OA-7934(V)3/ GSA-99(V)	NUS 6052-21G3	
OA-7934(V)4/ GSA-99(V)	NUS 6052-21G5	
OA-7934(V)5/ GSA-99(V)	NUS 6052-21G6	
OA-7934(V)6/ GSA-99(V)	NUS 6052-21G8	
OA-7934(V)7/ GSA-99(V)	NUS 6052-21G9	
OA-7934(V)3/ GSA-99(V)	NUS 6052-21G13	
OA-7934(V)8/ GSA-99(V)	NUS 6052-21G14	
OA-7934(V)9/ GSA-99(V)	NUS 6052-21G16	
OA-7934(V)lO/ GSA-99(V)	NUS 6052-21G18	
OA-7934(V)11/ GSA-99(V)	NUS 6052-21G20	

8. Equipment Description

(fig. 1)

a. The maintenance control center consists of a floor cabinet with a turret assembly placed on the top. The turret assembly contains a

telephone handset, select panels, and a fault indicator and switching panel. Space is provided in the turret assembly for up to three select panels. One select panel is required for each sector or nodal point radio van.

b. The lower portion of the cabinet contains a logic nest and associated modules, a power supply, and a circuit breaker panel.

c. At the lower rear of the cabinet, a signal entrance panel containing 17 connectors is used to connect incoming power and signal cables.

CHAPTER 2

INSTALLATION

9. Equipment Inspection

a. Inspect cabinet, assemblies, panels and modules for damage incurred during shipment; report ant damage on DD Form 6 (para2). In the logic nest, check that all modules are properly seated in their receptacles.

b.Determine that the equipment complement is complete, as listed on the packing slip.

10. Connecting Associated Equipment

When shipped, all cabling witbin the maintenance control center is properly connected. Incoming signal and power cables must be connected. Make all connections at the signal entrance panel (located at the bottom rear of the cabinet). Refer to the as-built ***site drawings for*** interconnection data.

11. Initial Application of Power (fig. 2)

Apply power to the maintenance control center by turning on the power supply. Distribute power to all modules and panels by setting circuit breakers CB1 through CB5 to the reset state. Observe that the TRIPPED CKT BKR indicator goes out as the last circuit breaker is reset.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROL, CONNECTORS, AND INDICATORS

12. Cabinet, Controls and Indicators

(fig. 2)

Control or indicator	Reference designation	Function
TRIPPED CKT BKR	DS1	Lights red to indicate that one or more of circuit breakers CBl through CB5 on circuit breaker panel has tripped.
Bell	DS2	Sounds to indicate incoming calls and alarm indications.
Handset	HS1	Used for two-way voice communications.

13. Circuit Breaker Panel, Controls and Indicators

(fig. 2)

Control or indicator	Reference designation	Function
TURRET LEVEL A-D	CB1	Controls application of power to fault indicator, and switching panel and all select panels.
FRAME AND MODULES LEVEL E circuit breaker	**CB2**	Controls application of power to 4-wire telephone unit, tone generator module and all tone receiver modules.
LEVEL F circuit breaker	CB3	Controls application of power to amplifier-hybrid modules in cabinet location F.
LEVEL G circuit breaker	CB4	Controls application of power to amplifier-hybrid modules in cabinet location G.
LEVEL H circuit breaker	CB5	Controls application of power to ground interrupter module and all relay logic modules
TRIPPED CKT BKR	DS1	Lights red to indicate that one or more of circuit breakers CB1 through CB5 has tripped.

14. Fault Indicator and Switching Panel, Controls and Indicators (fig. 3)

Control or indicator	Reference designation	Function
Telephone lever switches	Sl through **S12**	Select conference circuit #l when set to the up position and conference circuit #2 when set to the down position.
Telephone lever switches	S13 through S24	Select conference circuit #3 when set to the up position and conference circuit #4 when set to the down position.
Operator's call pushbutton and associated indicators	S25 and DS1 through DS4	When depressed, connects operator to conference line and lights steady white. Flashes when a call is acknowledged on any line. Returns to steady white after call pushbutton is pressed at conclusion of call.
Call push-buttons and associated indicators (4 indicators per circuit)	S26 through S36 and DS5 through DS48	Connect on-site shelters or vans to operators phone. Flash white to signal operator and light **steady** white when operator presses switch associated with calling party to acknowledge call. Flash blue when calling party sends end of call signal and go off when operator presses operator’s pushbutton to cancel call.
SIGNAL push-button	S37	Used to signal calling station. When pressed, connects 1600 cps tone to desired station.

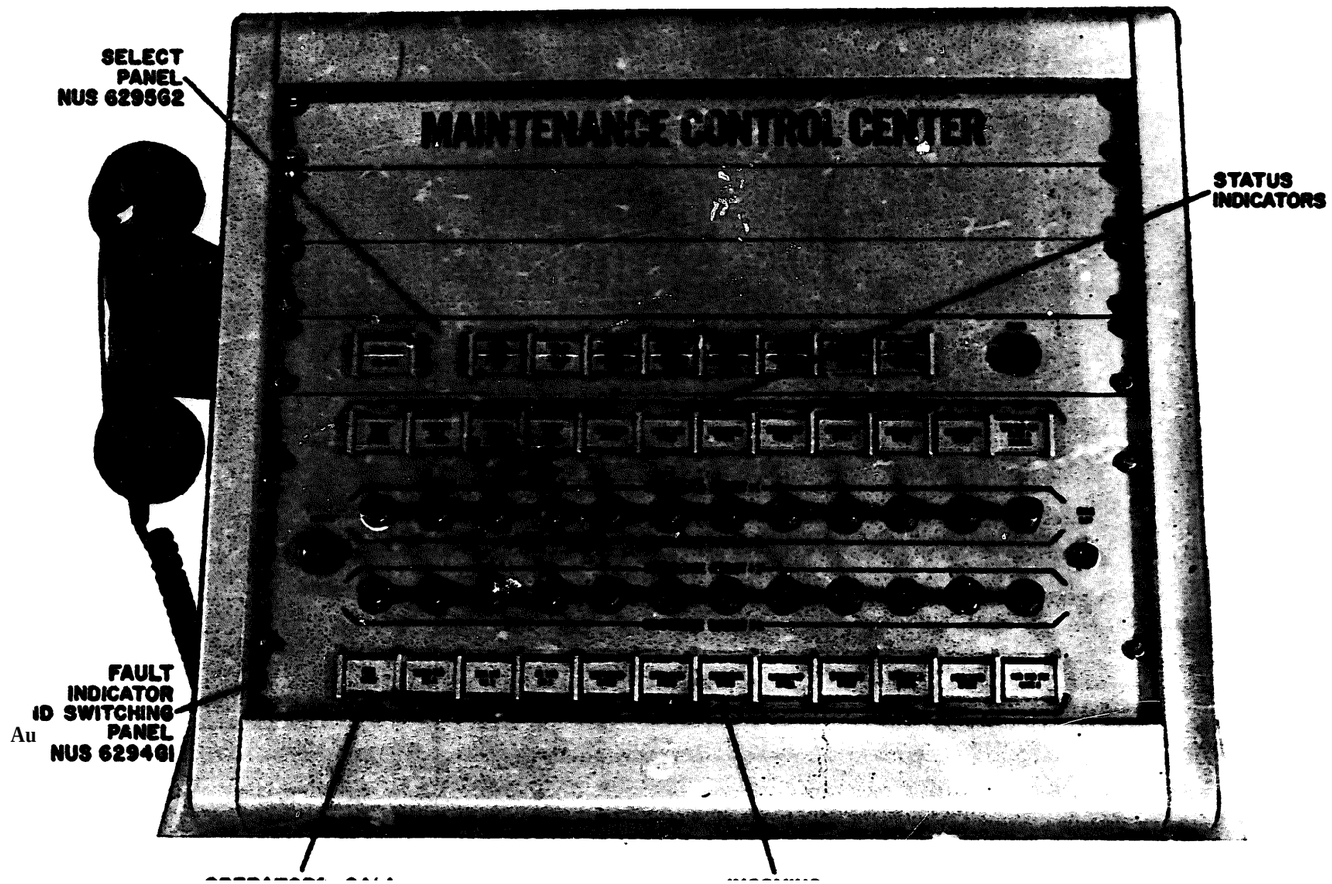
14. Fault Indicator and Switching Panel, Controls and Indicators (cont)

Control or indicator	Reference designation	Function
RING OFF pushbutton	S38	Simulates an end of call signal.
Fault indicator pushbuttons and associated indicators (4 indicators per circuit	S39 through S50 and DS49 through DS96	Provide continuous alarm monitoring of tower lights and site shelters. Light steady green during normal conditions. Flash red when fault develops and change to steady red when pushbutton is operated to acknowledge fault. Flash green when fault is repaired and change back to steady green when pushbutton is pressed again.

15. Select Panel, Controls and Indicators

(fig. 3)

Control or indicator	Reference designation	Function
Select pushbuttons and associated indicators (4 indicators per circuit	Sl through S8 and DS1 through DS32	Select tributary order-wire circuit. Light white when operator is being called and change to blue when operator pressed pushbutton to acknowledge call.
RESET pushbutton	S9	Releases select pushbuttons when pressed at conclusion of call.



Au

Figure 3. Fault indicator and switching panel and select panel, controls and indicators.

15. Select Panel, Controls and Indicators (cont)

Control or indicator	Reference designation	Function
Control indicators	DS33 through DS36	Indicate order-wire control station. Light amber when remote station has control. Light blue when local maintenance control center is controlling station.

16. Tone Receiver Module, Controls, Connectors, and Indicators (fig. 2)

Control or indicator	Reference designation	Function
INCOMING CALL indicator	DS1	Not used.
Incoming call buzzer	DS2	Not used.
SENSITIVITY ADJUST potentiometer	R2	Adjusts sensitivity of received tone level.
IN test jacks	J1 and J2	Provide connection for input signal measurements.
DC TEST jack	J3	Provides connection for dc voltage measurements.

17. Tone Generator Module, Connectors

(fig. 2)

The only front panel controls on the tone generator module are OUTPUT jacks J1 and J2. These jacks are used to measure the tone generator output signal level.

18. Amplifier-Hybrid Module, Controls

(fig. 2)

Control	Reference designation	Function
REC AMPL potentiometer	R9	Adjusts level of received signal.
XMIT AMPL potentiometer	R22	Adjusts level of transmitted signal.
REC OUTPUT jacks	Jl and J2	Provide connections for receive output measurements.
XMIT OUTPUT jacks	J3 and J4	Provide connections for transmit output measurements.
GRD jack	J5	Provides ground connection for testing.

19. 4-Wire Telephone Unit, Controls and Connectors

(fig. 2)

Control or connector	Reference designation	Function
HDST LEVEL potentiometer	R9	Adjusts signal level to handset.
REC LEVEL potentiometer	R3	Adjusts signal input level to module.
XMT LEVEL potentiometer	R20	Adjusts signal output level from module.
RFC 4W jack	J1	Provides connection for incoming signal measurements.
REC HDST jack	J2	Provides connection for receive handset signal measurements.
XMT 4W jack	J3	Provides connection for outgoing signal measurements.
XMT HDST jack	J4	Provides connection for transmit handset signal measurements.

20. Power Supply, Controls and Indicators

(fig. 2)

Control	Reference designation	Function
INDICATOR SELECTOR switch	S1	Not used.
POWER ON switch	S2	Controls application of input power to supply.

20. Power Supply, Controls and Indications (cont)

Control	Reference designation	Function
LOAD FAULT ON indicator	I1	Monitors current regulated or voltage regulated mode of operation.
THERMAL OVERLOAD indicator	I2	When lit, indicates that temperature of supply has exceeded maximum safe value.
POWER ON indicator	I3	When lit, indicates that power is on.
OUPUT VOLTAGE meter	M1	Monitors voltage of metered units.
OUTPUT CURRENT meter	M2	Monitors current of metered units.
(delta)V potentiometer	R1	Varies dc voltage over l-volt range
V potentiometer	R2	Varies dc voltage over a range 0-35 volts.
CURRENT LIMITER potentiometer	R3	Set at 6.6 amperes of overload.

Section II. **OPERATING PROCEDURES**

21. Answerlug Incoming Calls from Shelters, Vans, and Remote Mainline Maintenance Control Centcrs

To answer incoming calls, proceed as foIlows:

a. Observe the condition of call pushbuttons S26 through S36. The incoming call pushbutton will flash white, and bell DS2 will sound momentarily on an incoming call.

b. Press the flashing white call pushbutton.

c. Observe that the depressed pushbutton light changes to steady white and the operator's call pushbutton light changes to flashing white.

d. Remove handset HS1 from the cradle and communicate with the calling party.

22. Terminating Calls from Shelters, Vans, and Remote Mainline Maintenance Control Centers

To terminate a call, proceed as follows:

a At the conclusion of conversation, request that the calling party send an end of call signal.

b. Observe that the steady white call pushbutton changes to flashing blue and that bell DS2 sounds momentarily.

c. Press the flashing white operator's call push-button.

d. Observe that the incoming call pushbutton blue light go off and the operator's call pushbutton changes from flashing to steady white.

e. Replace the handset HS1 on the cradle.

f. If the end of call signal has not been received within a reasonable period of time, press the RING OFF pushbutton to simulate an end of call from a remote station.

23. Initiating Calls to Shelters, Vans, and Remote Mainline Maintenance Control Centers

To initiate a call, proceed as follows:

a. Select the desired party and press the associated call pushbutton, S26 through S36.

b. Observe that the selected call pushbutton becomes steady white and operator's call pushbutton changes to flashing white.

c. Remove handset HS1 from the cradle.

d. Press SIGNAL pushbutton S37, and com-municate with called party.

e. At end of communication, remote station must send an end of call signal.

24. Answering Incoming Calls from Remote Tributary Maintenance Control Centers

To answer incoming calls, proceed as follows:

a. Observe the condition of all select pushbuttons, S1 through S8, on select panel. The pushbutton associated with calling party will light steady white and bell DS2 will sound momentarily.

b. Observe the condition of call pushbuttons S25 through S36 on the fault **indicator and switching** panel. The nodal van call pushbutton associated with the calling party will flash white and the operator's call pushbutton will light steady white

c. Press the steady white pushbutton on the select panel.

d. Observe that the depressed **pushbuttton** changes to steady blue and that MCC ACK control indicator lights blue.

e. Press the flashing white call pushbutton on the fault indicator and switching panel.

f. Observe that the flashing white call pushbutton changes to steady white and the operator's call pushbutton changes to flashing white.

g. Remove handset HS1 from cradle and com municate with the calling party.

25. Terminating Calls from Remote Tributary Maintenance Control Centers

To terminate a call, proceed as follows:

a. At the conciusion of conversation, depress the RESET pushbutton on the select panel.

b. Observe that the steady white call pushbutton S34 through S36, changes to flashing blue and bell DS2 sounds momentarily. Observe that all in dicators on select panel go out.

c. Press operator's call pushbutton.

d. Observe that the flashing blue pushbutton goes off and that the operator's call pushbutton changes from flashing to steady white.

e. Replace handset HS1 on the cradle.

26. Initiating calls to Remote Maintenance control centers

To initiate a call, proceed as follows:

a. Select the nodal van associated with the desire tributary maintenance control center and press the nodal van call pushbutton, S26 through S36.

b. Observe that the selected pushbutton **becomes** steady white and the operator's call pushbutton changes to flashing white.

c. On the select panel, press the select button, S1 through S8, associated with the desired tributary maintenance control center.

d. Observe that both the pushbutton and control indicator DS1 light steady blue.

e. Remove the handset HS1 from the cradle.

f. Press SIGNAL pushbutton S37 and communicate with the called party.

27. Establishing Conference Calls

To establish a conference call at the maintenance control center, proceed as follows:

a. Answer the incoming call (para 21) and communicate with the calling party.

b. Initiate a call to the desired conference (para 23).

c. Depress operator's call pushbutton.

d. Set telephone lever switch S1 to the up or down postion to select conference circuit #l or #2, respectively; or set telephone lever switch S13 to the up or down position to select conference circuit #3 or #4, respectively.

e. Set the telephone lever switch associated with the cailing party to the conference circuit selected in step c or d above.

f. Set the telephone lever switch associated with the desired conferee (step b) to the selected conference circuit.

g. Conferees and the operator can now communicate with each other.

h. To remove the operator from the conference circuit, set telephone lever switch S1 or S13 to the center position.

i. At the conclusion of the conference, each conferee will send an end of call signal to the maintenance control canter, causing the associated call pushbuttons to flash blue. (Alarm will sound momentarily.)

j. Release the conference by setting ail telephone lever switches to the center position. (Fiashing blue lights will go out.)

k. Replace handset HS1 on the cradle.

28. Monitoring Fault Indicators

To monitor the 12 status indicator pushbuttons located on the fault indicator and switching panel proceed as follows:

a. Observe that ail status indicator pushbuttons, S39 through S50, are lit steady green and the audible aiarm is silenced.

b. When a fault develops, the associated status indicator pushbutton changes from steady green to flashing red and bell DS2 sounds.

c. Press the flashing red status indicator push-button, S39 through S50, as required, to acknowledge the alarm condition and silence the bell.

d. Observe that the depressed status indicator pushbutton changes to steady red and that bell DS2 is silenced.

e. When the fault is corrected, observe that the depressed status indicator pushbutton changes to flashing green and that bell DS2 sounds.

f. Press the flashing green status indicator push-button to acknowledge the end of alarm condition and silence the bell.

g. Observe that the status indicator pushbutton changes to steady green and that bell DS2 is silenced, restoring the status indicators to normal.

CHAPTER 4

THEORY OF OPERATION

Section I. GENERAL

29. System Application

The mainline maintenance control center provides signaling and communication facilities between mainline shelters and vans. These facilities are extended through regular order-wire circuits so that distance shelters, vans and maintenance control centers can be interconnected.

30. Site Arrangement

The arrangement of an individual site complex is dependent upon the shelter and van requirements at the particular location. Various combinations of eight basic modules and panels are used in varying quantities in the maintenance control center to provide 20 different site arrangements. A maintenance control center at a mainline site, can accommodate a maximum of 11 channels. Alarm indications from individual shelters and vans are monitored at the maintenance control center. Figure 4 shows a maximum site arrangement with 11 fault and communication lines interconnected within a site complex. Communication to distant sites is provided by radio shelters and radio vans.

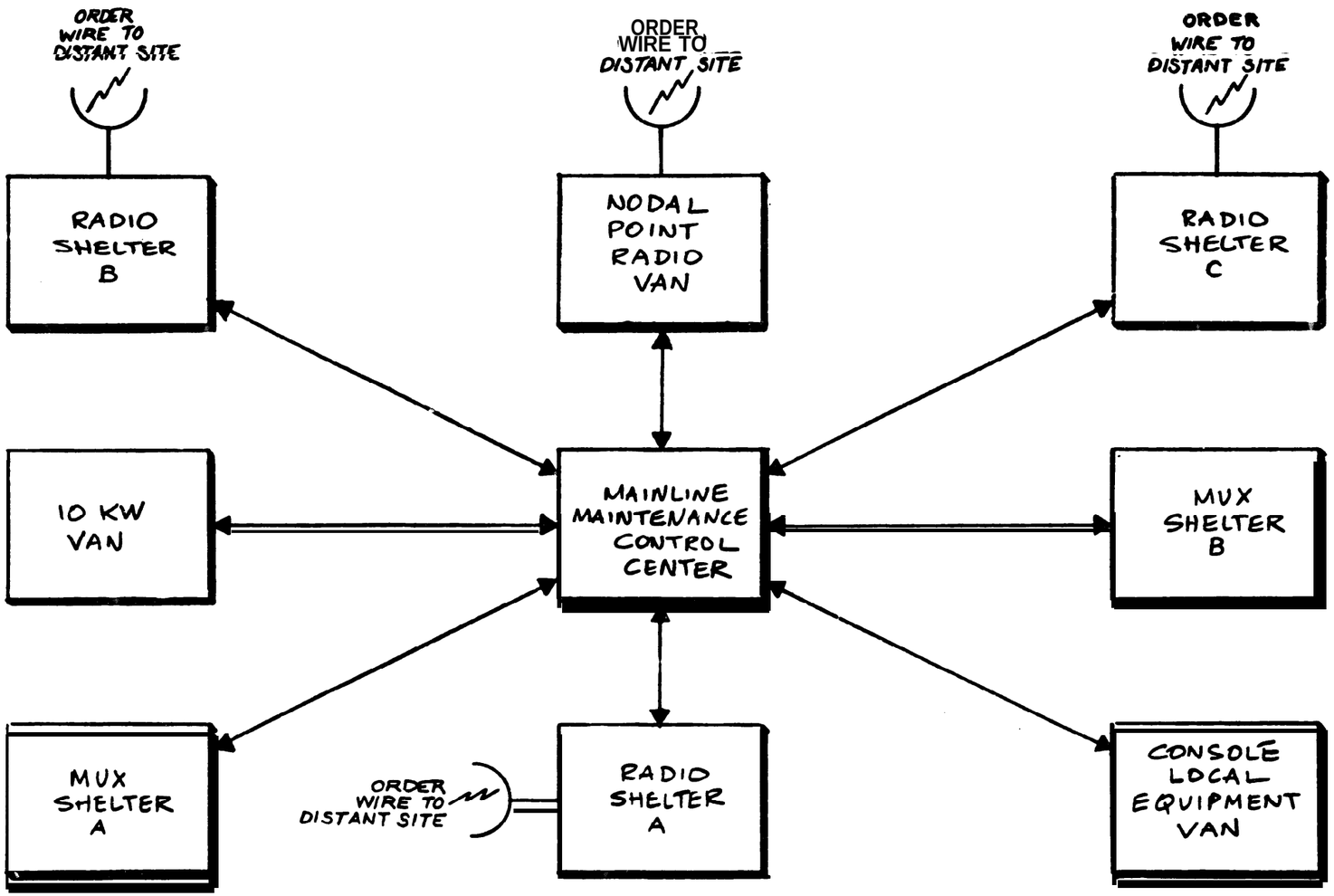


Figure 4. Typical site arrangement, block diagram.

Section II. FUNCTIONAL DESCRIPTION

31. Local Communications

Local communications at a main line site between the local maintenance control center and local shelters or vans utilize two methods of signaling. Simplex ground signaling is used from the local shelter or van to the bad maintenance control center. Tone signaling is utilized from the local maintenance control center to the local shelter or van. Figure 5 shows the major equipment relationship between the maintenance control center and a local shelter or van. The operation of a typical circuit is described in the following paragraphs.

a From Local Shelter or Van to Local Maintenance Control Center (fig 6). When a user at a local shelter or van removes the handset and presses a signal pushbutton, a ground circuit is completed to the maintenance control center This results in an audible alarm and the flashing of an appropriate call indicator.

(1) The incoming fault and commmunication line from the local shelter or van connects to the local maintenance control center at the signal entrance panel (fig.5). The grounded line activates the relay logic module which connects interrupted ground from the ground interrupter module to the white indicator lamp and pushbutton in the fault indicator and switching panel. The white lamp associated with the incoming line starts flashing, signifying an incoming call. The relay logic module also connects steady ground to the alarm bell causing it to ring. As long as the calling party keeps the signal pushbutton operated, the bell will continue to sound. The flashing white lamp continues to flash after its initial activation.

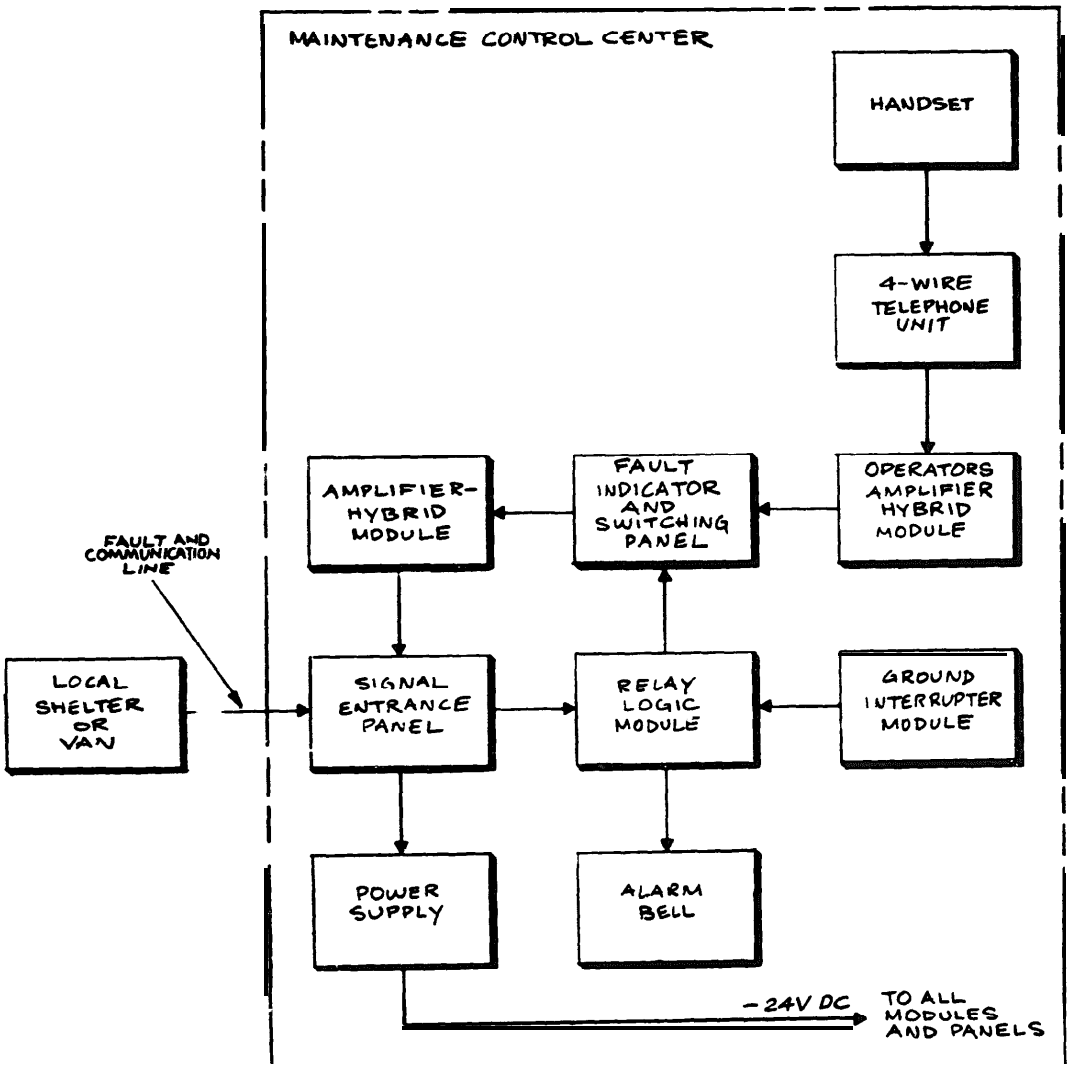


Figure 5. Local communication, shelter or van to maintenance control center, block diagram.

(2) The operator at the local maintenance control center (fig. 16) acknowledges the incoming call by pressing the pushbutton containing the flashing **white** lamp. This changes the state of the white indicator from flashing white to steady **white.** Operation of the pushbutton causes relay logic module operation, which removes the interrupted ground from the white lamp and applies steady ground to the white indicator.

(3) The talking path through the maintenance control center originates at the handset. It continues through the 4-wire telephone unit to the operators amplifier-hybrid module. The path is then connected through operated pushbutton contacts on the fault indicator and switching panel to another amplifier-hybrid module. The talking path is finally established through the signal entrance panel to the incoming line.

(4) One amplifier-hybrid module at each maintenance control center is associated with the 4-wire telephone unit. This arrangement converts the four-wire telephone circuit to two wires for connection through the bus arrangement of pushbuttons on the fault indicator and switching panel. The two-wire circuit is converted back to four wires by a second amplifier-hybrid module for connection to the line. Thus, signals come into the maintenance control center on a four-wire basis, are converted to two wires for switching purposes and, once switched, are again converted back to four wires for talking.

(5) At the conclusion of the conversation, the calling party presses the signal pushbutton again. This changes the associated indicator from steady white to flashing blue. The reoperation of the signal pushbutton at the local shelter causes relay operation in the relay logic module which removes the steady ground from the white indicator lamp and applies interrupted ground to the associated blue indicator lamp. The ground interrupter module is connected to the fault indicator and switching panel through the operation of the relay logic module.

(6) The operator at the local maintenance control center acknowledges the end of the call by pressing the operator's call pushbutton. This changes the indication from flashing blue to **off,** and the operator's call pushbutton lights steady white. The operator at the maintenance control center can now generate or accept additional calls on the same line.

b. From Local Maintenance Control Center to Local Shelter or Van (fig. 16). When the maintenance supervisor or operator at the local maintenance control center originates a call to a local shelter or van, the desired station is first selected. The required call pushbutton on the fault indicator and switching panel is pressed to complete the path between the operator's circuit and the desired line. A SIGNAL pushbutton on the same panel is then depressed, causing signaling tone to be transmitted to the local shelter or van.

(1) The operator at the maintenance control center removes the handset from its cradle and presses the call pushbutton of the desired station. The operated pushbutton causes relay operation in the ground interrupter module which removes the steady ground from the operator's call pushbutton and replaces it with interupted ground. This causes the indicators to change from steady to flashing white.

(2) The depressed station pushbutton also causes relay operation in the relay logic module. Ground connected from the relay logic module to the operated pushbutton causes it to light steady white.

(3) A talking path is established from the handset (fig. 6) through the four-wire telephone unit and operator's amplifier-hybrid module to the fault indicator and switching panel and amplifier-hybrid module associated with the called party. A four-wire path is then extended through the signal entrance panel to the local shelter over the site line facilities.

(4) When the SIGNAL pushbutton on the fault indicator and switching panel is depressed (fig. 16), -24 vdc battery is connected to the input of the 1600 cps tone generator module. As long as the SIGNAL pushbutton is held depressed, the 1600 cps tone is transmitted through the maintenance control center to the desired shelter or van. The signal path is identical to the talking path described previously.

(5) The incoming 1600 cps tone at the called shelter or van is detected by a 1600 cps tone receiver or a speaker amplifier module. A signal buzzer and lamp are activated in the tone receiver, indicating an incoming call. The maintenance man at the local shelter removes the handset and proceeds to converse with the maintenance control center operator.

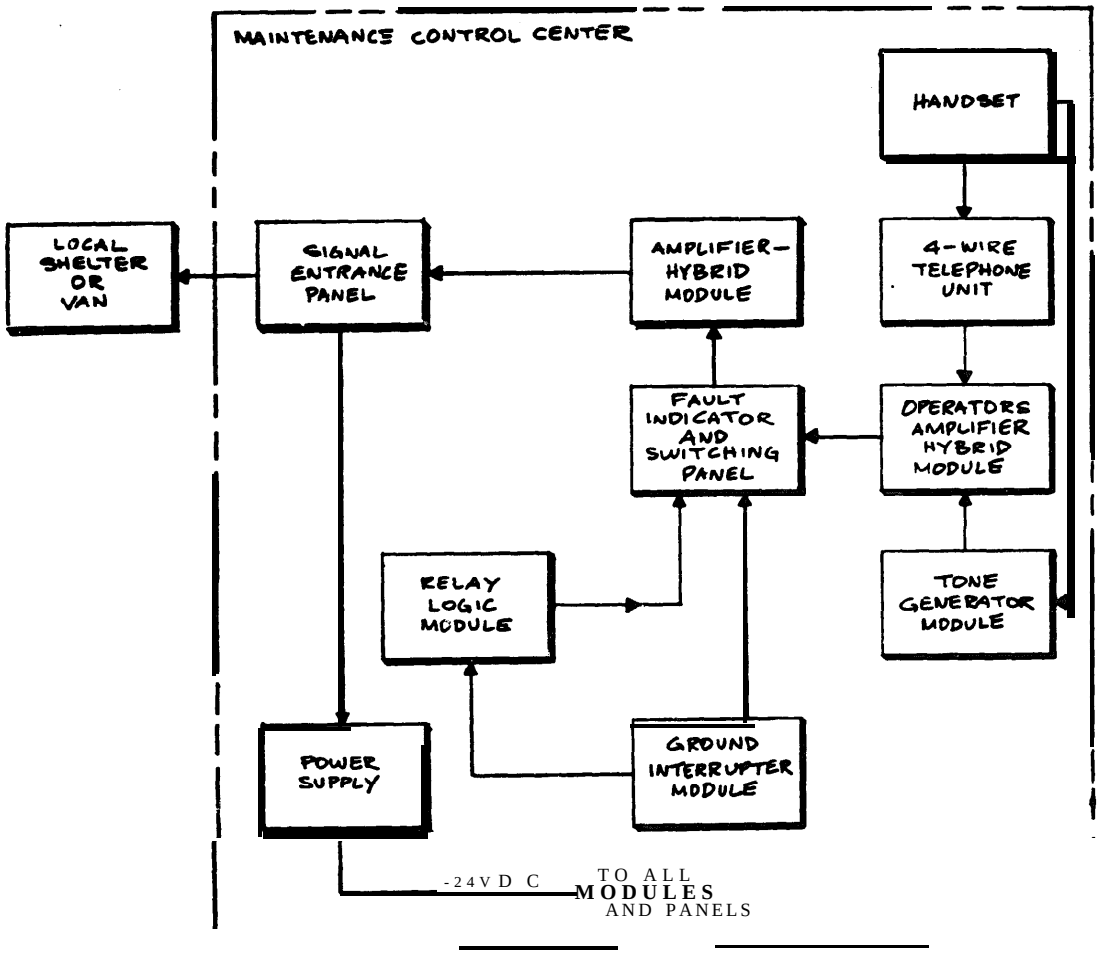


Figure 6. Local communication, maintenance Control center to shelter or van, block diagram.

32. Call Routing (fig. 16)

When an incoming call is acknowledged at the maintenance control center and a request is made to route the call to another shelter, a conference circuit must be selected. Figure 7 illustrates the route that a call takes through the maintenance control center from shelter 1 to shelter 2. Each maintenance control center has four conference circuits available for call routing. Operation is as follows:

a. The incoming call is answered and acknowledged as previously described in paragraph 31a (1) through (5).

b. The operator at the maintenance control center then initiates a call to the desired conference in an identical manner to that described in paragraph 31b, and depresses the operator's call pushbutton.

c. The operator sets the telephone lever switches on the fault indicator and switching panel to the desired conference circuit (fig. 16). Conference circuit #1 is selected by setting S1 through S12 to the up position. The second conference circuit is selected by setting S1 through S12 to the down position. Conference circuit #3 is selected by setting S13 through S24 to the up position. The fourth conference circuit is selected by setting S13 through S24 to the down position. Telephone lever switches and S13 are used to connect the operators circuit into the conference.

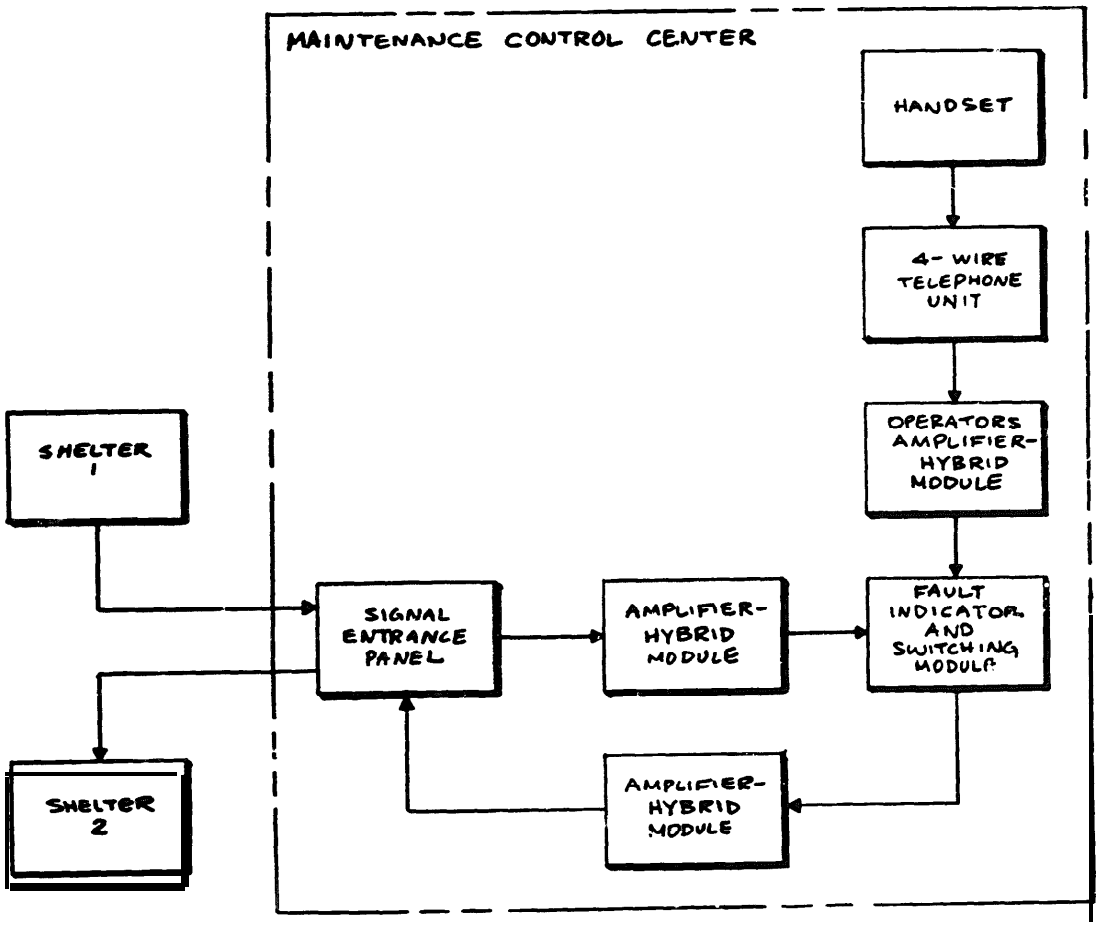


Figure 7. Call routing, block diagram.

d. Assuming shelter 1 desires to talk to shelter 2, the operator initiates a call to shelter 2 in the normal manner, described in paragraph 31*b*. If conference circuit #1 is selected, the operator sets S1 and the telephone lever switches assigned to shelters 1 and 2 to the up position. The operator, shelter 1 and shelter 2 are now tied together in conference. If the operator wishes to leave the conference, S1 is set to the center position.

e. As many as 12 conferees can be interconnected on the same conference circuit. A second, third or fourth conference can be established on the remaining circuits in a manner identical to that described above. Operation of the telephone lever switches extends the talking path from call pushbuttons S36 to the bus arrangement of telephone lever switches.

f. At the conclusion of a conference, all conferees send an end of call signal to inform the operator that the conference is complete. If a conferee fails to send the end of call signal, the operator can monitor the conference circuit and, if it is not in use, the pushbutton associated with the line to be disconnected and the RING OFF pushbutton are depressed, restoring the circuit to normal. After all the end of call signals have been received, the operator terminating the call as described in paragraph 31a (5) and (6).

33. Communication Between Mainline Sites (fig. 8)

Communication between mainline sites is similar to local communications. In-band 1600 cps tone is used for signaling. Audible and visual indications of incoming calls from remote sites are present at the local maintenance control center. The pushbutton and indicator sequence of events is the same as for local calls. Typical circuit operation is described in the following paragraphs.

a. When an operator at a distant mainline maintenance control center initiates a call, 1600 cps tone is transmitted to the local radio shelter at the distant site. The tone is then retransmitted over radio facilities to the local radio shelter at the local site. The local radio shelter sends the tone to the local maintenance control center.

b. The signaling tone sent from the distant maintenance control center causes audible indications at all three locations: local radio shelter, local maintenance control center, and distant radio shelter. The incoming call at the local maintenance control center is received on the 1600 cps tone receiver module and routed to the relay logic module through a simplex ground circuit. The operator acknowledges the call as previously described in paragraph 31a.

Figure 8. Communication between mainline sites, block diagram.

which is used to adjust the audio level. The incoming 1,600-cps signaling tone bypasses this network and is fed directly to the 1,500/1, 600-cps tone receiver. The audio signals from potentiometer R9 are again amplified externally and sent through TB1 and hookswitch XHS1 to the receiver portion of handset HS1. Resistor R16 terminates the incoming signal line when the handset is cradled.

Signals to be transmitted are sent from the transmitter portion of handset HS1 through hookswitch XHS1, terminal board TB1, and dc blocking capacitor Cl to terminals 6 and 7 of transformer T2. Capacitor C2 blocks the dc voltage, and resistor R17 serves as a termination when the handset is cradled. The output from terminals 1 and 5 of the secondary of T2 passes through closed-circuit XMT HDST jack J4 and 2-kc or 3-kc low-pass filter FL2 to hybrid R14 and R15. The hybrid attenuates the signal approximately 6 db. The output of the hybrid is applied across a network consisting of resistors R18 and R19 and XMT LEVEL potentiometer R20, which is used to adjust the transmitting level of the module. The output of the hybrid also is applied to 20-db sidetone pad R10 through R13. These signals pass through hybrid R4, R5, and R6 and provide a sidetone level at about -32 db to the receiving portion of the unit. The sidetone level provides a natural background to the operator who is speaking. In addition, the R14, R15 hybrid is used as the point of entry for the 1,600-cps signaling tone. This tone is keyed on over BD1-10 by a pushbutton on the handset, and enters the module from the external tone generator over BD1-12 and 13. The signal from XMT LEVEL potentiometer R20 is applied to primary terminals 4 and 6 of transformer T1. (In central equipment cabinets NUS 5972-3 and -7, pins 1 and 2 of BD2 are strapped to pins 4 and 3, respectively.) The secondary of T1 is tapped to permit matching the transmitted signals to a 150-ohm or 600-ohm load. These signals pass through closed-circuit XMT 4W jack J3 and leave the module on BD1 terminals 1 and 2.

Jacks Jl through J4 (REC 4W, REC HDST, XMT 4W, and XMT HDST, respectively) permit measurements of the inputs to, and the outputs from, the four-wire telephone module.

Operation of the NUS 5165-45 module is similar to that of the NUS 5165-8 module. The NUS 5165-45 configuration does not include the jackbox and hookswitch XHS1. Also, the handset does not include the signaling key.

34. Communication Between Mainline and Tributary Sites
(fig. 9)

Communication between a remote tributary maintenance control center and a local mainline maintenance control center utilizes a two-step siganling sequence. Tone signaling is used from the remote tributary to a nodal van at the local site. The tone is detected by the nodal van receiver which completes a ground circuit to the local maintenance control center. At the local maintenance control center and the nodal van, pushbutton indicators on select panels indicate the incoming call. Audible indications are also present. Operation is as follows:

a. The incoming tone from the remote tributary maintenance control center (fig. 16), detected by the nodal van receiver, causes the select pushbutton in the nodal van to light steady white. Momentary ground is extended from the nodal van to the signal entrance panel at the local maintenance control center. This momentary ground is further extended from the signal entrance panel to the maintenance control center select panel. The select pushbutton lights, and bell DS2 sounds momentarily, indicating an incoming call. The nodal van call indicator flashes white. Thus, the select panels in the nodal van and the maintenance control center are activated by a call from a remote tributary maintenance control center.

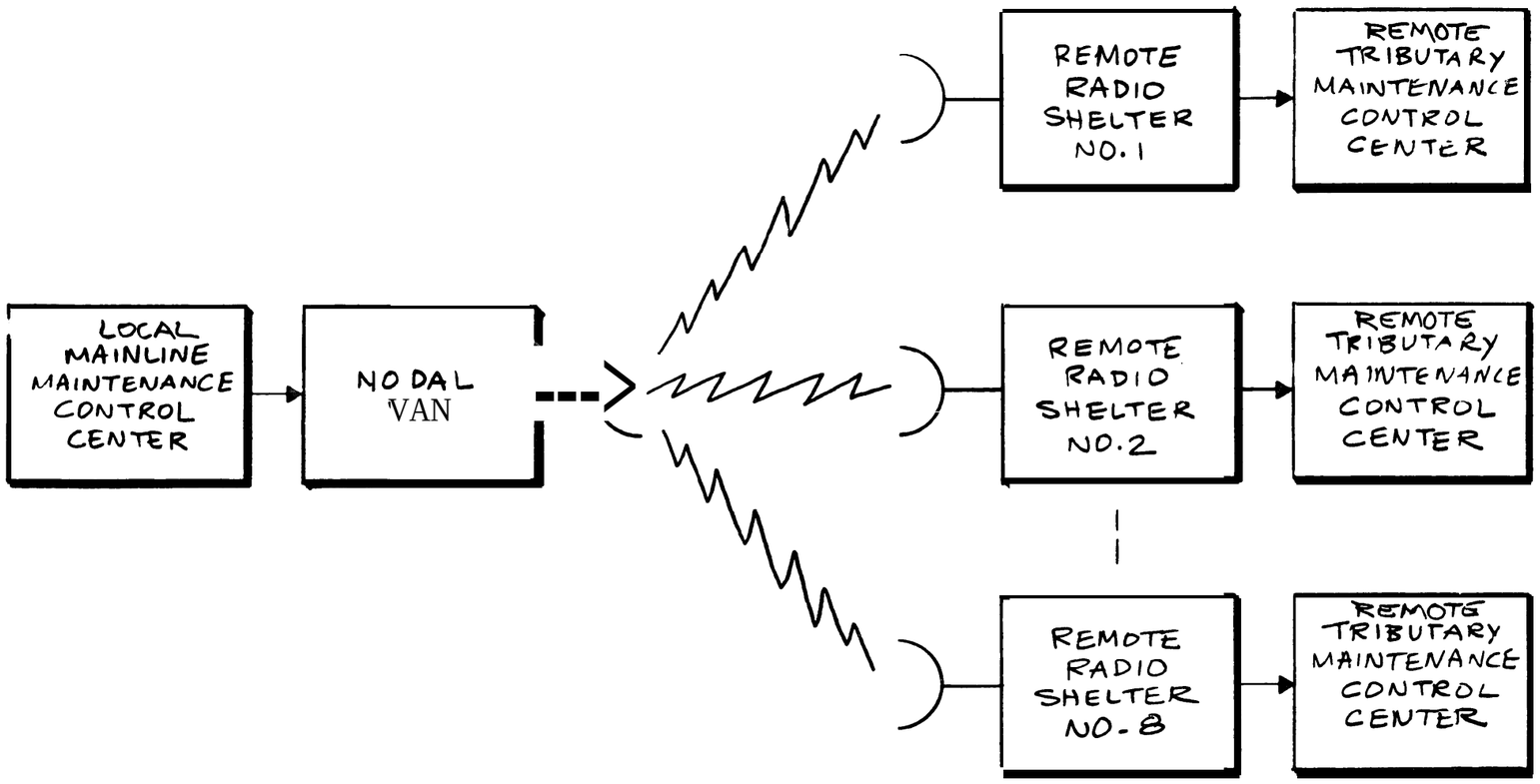


Figure 9. Communication between mainline and tributary sites, block diagram.

b. If the operator **at the maintenance control center acknowledges the incoming call, a blue in use** indicator **on the** select panel will light. **At** the nodal **van, an amber in use indicator lights informing maintenance personnel that the maintenance control center has control. If the call is acknowledged at the nodal van, the in use indicators would reverse in color.**

c. A maximum of eight tributary maintenance control centers can be handled by one select panel. Each tributary is assigned to a particular select pushbutton. When the incoming call is acknowledged, the calling tributary select push-button is depressed. This causes indicates to **change from white to blue. A ground path is completed from the select panel to the nodal van, activating the path for communications from the tributary.**

d. The nodal van call indicator pushbutton is now depressed, changing from flashing to steady white. The operator's call pushbutton indicator changes from steady to flashing white. Thus, a talking path is established from the local maintenance control center to the remote tributary maintenance control center.

e. The termination of a call is similar to that previously described in paragraph 31a. The RESET pushbutton on either select panel must be depressed **to release the select pushbutton on both select panels (MCC and nodal van) from the circuit.**

35. Fault Indications (fig. 10)

Status indicator lights, displayed on the fault indicator and switching panel, are used so that one central **point at a mainline site can monitor the status and condition of equipment at va shelters and vans. A maximum of 12 equipment be monitored by the fault indicator and switch panel. The operation of a typical circuit is described in the following paragraphs.**

a. In the normal condition, with all equipment functioning properly, a continuity is provided by monitored equipment to the signal entrance p This loop circuit is connected directly to a relay the fault indicator and switching panel, holding relay in an operated condition (fig. 16). The open relay transfers ground through its own contacts contacts of a released status indicator pushbutton to keep a green status light on. Thus, in the no state, with no fault conditions existing, all s lights remain steady green.

b. **When a fault develops at a shelter or van green light goes off, an associated light starts flashing red, and bell DS2 sounds. The loop c present under normal conditions, which held relay operated, is opened at the shelter during or trouble conditions. The released relay removes the ground from the green lamp, transfers interrupted ground through its own contacts, and nor closed contacts of the associated status ind pushbutton, to red lamps. The red lamps flashing, indicating the alarm condition. The interrupted ground is provided by the ground interrupter module, which connects directly t fault indicator and switching panel. At the time that the red lamp starts flashing an alarm sounds, indicating the alarm condition. The bell operation is controlled by the release associated relay and the released status ind pushbutton.**

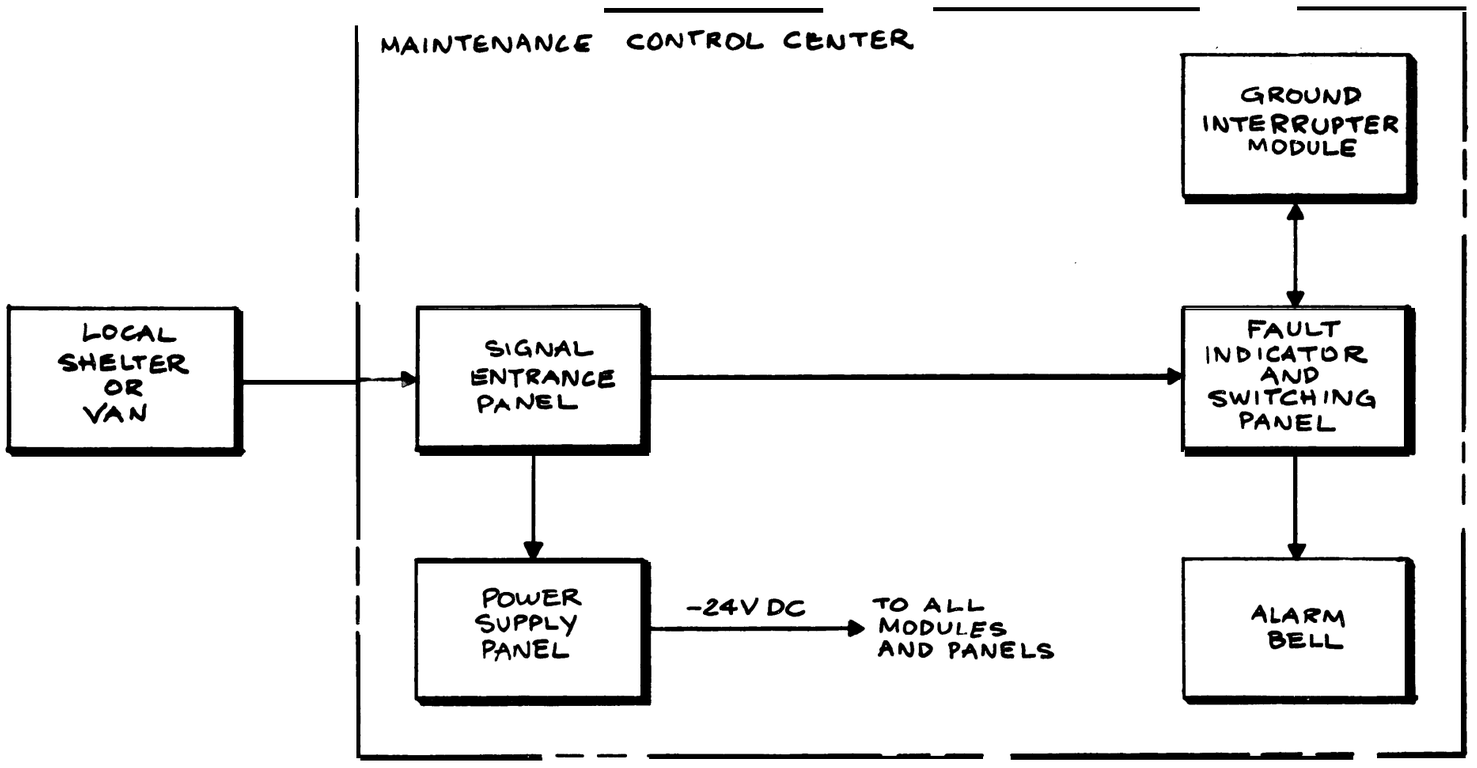


Figure 10. Fault indications, block diagram.

c. The operator at the maintenance control center acknowledges the alarm condition by pressing the status indicator pushbutton containing the flashing red light. Operation of the pushbutton opens the alarm bell circuit, silencing the bell and removing the interrupted ground from the flashing red light. A steady ground is then connected to the red light through the now-operated status indicator pushbutton contacts and the still-released relay.

d. As long as the alarm condition exists at the shelter, the status lamp will remain steady red. When the fault at the shelter is corrected, the red lamp goes out, the green status lamp (par. 35a) starts flashing green, and the alarm bell rings. This, is caused by the return of the continuity circuit from the shelter, reoperating the associated relay. Interrupted ground is couuected through operated contacts of both the relay and status indicator pushbutton, flashing the green lamp.A new path through operated contacts of the relay and pushbutton completes the alarm bell circuit, causing it to ring.

e. The operator acknowledges the return to normal at the shelter by reoperating, the status indicator pushbutton. The flashing green light changes to a steady green and the bell stops ringing. The interrupted ground appliesd to the green lamp is transferred through operated relay contacts and normally closed contacts of the now released status indicator pushbutton to a steady state ground. The alarm circuit is opened by the operation of the status indicator pushbutton, returning the fault indicator monitor circuit to normal.

CHAPTER 5

MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE

36. General

Preventative maintenance procedures for the maintenance control center consists of general and weekly cleaning and inspection procedures.

37. Maintenance Materials

Item	Federal Stock Number
Abrasive, sheet: sandpaper #0000; 9 by 12-in.	627500-0000
Cloth, textile: cheesecloth: lint-free;	408-2701
36 in. Orangestick Tape TL-83	5120-408-4036
Cleaning compound	5970-184-2003
Abrasive, sheet: crocus, 9- by 11-in.	7930-395-9542
Alcohol or nonleaded gasoline	(Orda) [a]
Polish, metal: paste	6Gl5l6 [b]

a. Ordnance Corps item

b. Signal Corps stock number

c. Interim Federal stock number

38. General Cleaning and Inspection

Clean and inspect the equipment using the following procedures:

a. Use a clean, dry, lint-free cloth for dusting.

b.If necessary, moisten a cloth or brush with cleaning compound (Federal Stock No. 7930-395-9542); after cleaning, wipe area dry with clean cloth.

WARNING

Prolonged breathing of cleaning compound is dangerous. Cleaning compound is flammable; do not use near open flame.

CAUTION

Do not use cleaning compound on electrical parts.

c. If available, use a vacuum cleaner to remove dust from inaccessible areas.

39. Weekly Cleaning **and Inspection**

Perform the following procedure each week.

a. Clean and tighten equipment mounting hardware, cables and connectors.

b. Inspect electrical and mechanical parts, mounting hardware, and exposed metal surfaces for rust, corrosion, or moisture . Clean or dry items, as required.

c. Inspect cables and wiring for kinks, strains, moisture, and frayed, cut, or damaged insulation.

d. Check switches, cable assemblies, and indicator lamps for looseness of accessible items. Tighten items as required.

Section II. CORRECTIVE MAINTENANCE

40. Troubleshooting

a Troubleshooting of a maintenance control enter consists of duplicating normal operating conditions to isolate the trouble to a defective module or panel. It is very important that the maintenance control center is operational at all times and that down time is kept to a minimum. Modular substitution is the most efficient method of rapid service restoration. Substitute properly adjusted and working spare modules in an attempt to locate the trouble. Since the maintenance control center is entirely modularized, a trouble condition will usually be within one or more modules. The maintenance technician should only resort to point-to-point circuit checks when modular substitution has failed to locate the trouble.

b. The following charts cover common troubles that might occur during the operation of the equipment. Since all possible troubles **cannot** be covered, use the procedures given in the charts as a guide in isolating a trouble to a defective module or modules. After the defective module has **been** replaced, repeat the procedures given to insure **that** the trouble has been corrected. Refer to TM 11-6625-647-14/l and 2 for module maintenance proced**ures.**

(2) Unable to answer incoming call from shelter, van, or remote maintenance control centers

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
1	Request the origination of a call from a local shelter or van.	Call pushbutton associated with calling line flashes white and bell sounds.	Proceed to step 2.	Check indicators and pushbutton associated with calling line. Check bell DS2, Proceed to step 4.
2	Press flashing white call pushbutton.	Call pushbutton changes to steady white and operator's call pushbutton flashes white,	Proceed to step 3.	Check operators call pushbutton S25 and associated indicators. Proceed to step 4.
3	Remove handset HS1 from cradle and communicate with calling party.	Conversation shall be at a comfortable level.	End of test.	Proceed to step 6.
4	Substitute spare relay logic module and repeat step 1.	Same as step 1.	Repeat step 2.	Proceed to step 5.

(2) Unable to answer incoming call from shelter, van, or remote maintenance control centers (cont)

Step	Procedure	Normal indication	If indicat ion is normal	If ‘indication is abnormal
5	Substitute spare ground interrupter module and repeat step 1.	Same as step 1.	Repeat step 2.	Perform point-to-point circuit check. Refer to figure 16.
6	Substitute spare amplifier-hybrid module in operators circuit.	Conversation shall be at a comfortable level.	End of test.	Proceed to step 7.
7	Substitute spare 4-wire telephone unit.	Conversation shall be at a comfortable level.	End of test.	Proceed to step 8.
8	Substitute spare amplifier-hybrid module associated with calling party circuit.	Conversation shall be at a comfortable level.	End of test.	Proceed to step 9.
9	Substitute spare handset .	Conversation shall be at a comfortable level.	End of test.	Perform point-to-point circuit check. Refer to figure 16,

(3)Unable to terminate call from shelter, van, or remote maintenance control center

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
1	Initiate a call on a trunk to a shelter, van or remote maintenance control center. Request that called trunk send end of call signal.	Call pushbutton associated with called trunk changes to flashing blue and bell sounds.	Proceed to step 2.	Check call pushbutton indicators and contacts. Check bell DS2. Proceed to step 3.
2	Press operator's call pushbutton.	Call pushbutton lights go off and operator's call pushbutton becomes steady white.	End of test.	Proceed to step 3.
3	Substitute spare tone receiver module and repeat steps 1 and 2.	Same as step 1.	Repeat step 2.	Proceed to step 4.
4	Substitute spare relay logic module and repeat steps 1 and 2.	Same as step l.	Repeat step 2.	Proceed to step 5.

(3) Unable to terminate call from shelter, van or remote maintenance control center (cont)

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
5	Substitute spare ground interrupter module and repeat step 1.	Same as step l.	Repeat step 2.	Perform point-to-point circuit check. Refer to figure 16.

(4) Unable to initiate call to shelter, van, or remote mainline maintenance control center

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
1	Press call push-button of selected station.	Call pushbutton becomes steady white and operator’s’ call pushbutton flashes white.	Proceed to step 2.	Check station and operator's call pushbutton indicators and contacts. Proceed to step 3.
2	Remove handset HS1 from cradle and press SIGNAL pushbutton S9,	Called station answers.	End of test.	Check SIGNAL push-button S9 contacts. Proceed to step 3.

(4) Unable to initiate call to shelter, van, or remote mainline maintenance control center (cont)

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
3	Substitute spare relay logic module and repeat step 1.	Same as step l.	Repeat step 2.	Proceed to step 4.
4	Substitute spare ground interrupter module and repeat step 1.	Same as step 1.	Repeat step 2.	Proceed to step 5.
5	Substitute spare tone generator module and repeat step 1.	Same as step 1.	Repeat step 2.	Perform point-to-point circuit check, Refer to figure 16.

(5) Unable to answer incoming call from remote tributary maintenance control center

Step	Proc edure	Normal indication	If indication is normal	If indication is abnormal
1	Request the origination of a call from a remote tributary maintenance control center.	Select pushbutton associated with calling line lights steady white and bell sounds.	Proceed to step 2.	Check select pushbutton indicators and contacts associated with calling line. Check DS2. Proceed to step 6.
2	Observe call pushbuttons S26 through S36 on fault indicator and switching panel.	Nodal van call pushbutton associated with calling line flashes white and operator's pushbutton is steady white.	Proceed to step 3.	Check call pushbutton indicators and contacts associated with calling line. Proceed to step 6.
3	Press steady white pushbutton on select panel,	Select pushbutton changes to steady blue and control indicator lights blue,	Proceed to step 4.	Check control indicator DS1 and relay Kl0. Proceed to step 6.

(5) Unable to answer incoming call from remote tributary maintenance control center (cont)

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
4	Press flashing white call pushbutton.	Call pushbutton changes to steady white and operators pushbutton changes to flashing white.	Proceed to step 5.	Proceed to step 6.
5	Remove handset HS1 from cradle and communicate with calling party.	Conversation shall be at a comfortable level.	End of text.	Proceed to step 8.
6	Substitute spare ground interrupter module and repeat step 1.	Same as step 1.	Repeat step 2.	Proceed to step 7.
7	Substitute spare relay logic module and repeat step 1.	Same as step 1.	Repeat step 2.	Perform point-to-point circuit check. Refer to figure 16.
8	Substitute spare amplifier-hybrid module in operators circuit.	Conversation shall be at a comfortable level.	End of test.	Proceed to step 9.

(7) Unable to initiate call to a remote tributary maintenance control center (cont)

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
5	Substitute spare ground interrupter module and repeat step 1.	Same as step 1.	Repeat step 2.	Proceed to step 6.
6	Substitute spare tone generator module and repeat step 1.	Same as step 1.	Repeat step 2.	Perform point-to-point circuit check. Refer to figure 16.

(8) **Unable** to establish conference calls

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
1	Select a local shelter or van and initiate a call.	Called party answers.	Proceed to step 2.	Troubleshoot call initiation as described in paragraph 4Ob(4).

(8) Unable to establish conference calls (cont)

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
2	Select another local shelter or van and initiate a call.	Called party answers.	Proceed to step 3.	Troubleshoot call initiation as described in paragraph 40b(4).
3	Set operator and called station telephone lever switches to conference circuit #1.	Communication established between all three parties.	Proceed to step 4.	Check telephone lever switch contacts in conference circuit #l position. Refer to fault indicator -and switching panel module manual (Part II).
4	Set operator and called station telephone lever switches to conference circuit #2.	Communication established between all three parties.	Proceed to step 5.	Check telephone lever switch contacts in conference circuit X2 position. Refer to fault indicator and switching panel module manual (Part II).

(8) **Unable to** establish conference **calls** (cont)

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
5	Set operator and called station telephone lever switches to conference circuit #3.	Communication established between all three parties.	Proceed to step 6.	Check telephone lever switch contacts in conference circuit #3 position. Refer to fault indicator and switching panel module manual (Part II).
6	Set operator and called station telephone lever switches to conference circuit #4.	Communication established between all three parties.	End of test,	Check telephone lever switch contacts **in** conference circuit #4 position. Refer to fault indicator and switching panel module manual **(Part II).**

(9) Unable to monitor fault indications

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
1	Observe the status of all fault indicator pushbuttons S39 through S5O.	All pushbuttons light steady green.	Proceed to step 2.	Check pushbutton indicators, associated relays and incoming line circuits.
2	Contact local shelter or van and have maintenance man simulate trouble condition. Note: Be sure maintenance man remains at shelter in case actual trouble condition develops.	Fault indicator pushbutton changes to flashing red and bell DS2 sounds.	Proceed to step 4.	Check bell DS2. Proceed to step 3.
3	Substitute spare ground interrupter module.	Fault indicator pushbutton changes to flashing red.	Proceed to step 4.	Check associated relay and fault indicator pushbutton contacts.

(9) Unable to monitor fault indications (cont)

Step	Procedure	Normal indication	If indication is normal	If indication is abnormal
4	Press flashing red fault indicator pushbutton.	Fault indicator changes to steady red and bell DS2 goes off.	Proceed to step 5.	Check fault indicator hold coil and contacts on relay K1.
5	Remove simulated trouble condition at local shelter or van.	Fault indicator pushbutton changes to flashing green and bell DS2 sounds.	Proceed to step 6.	Troubleshoot fault indicator and switching panel. Refer to fault indicator and switching panel module manual (Part II).
6	Press flashing green fault indicator pushbutton.	Fault indicator pushbutton changes to steady green.	Proceed to step 7.	Perform point-to-point circuit check. Refer to figure 16.
7	Repeat steps 1 through 6 for any other shelters or vans suspected of trouble.	Same as steps 1 through 6.	End of test.	Same as steps 1 through 6.

Section III. ALIGNMENT

41. **General**

This section presents procedures for adjusting the power supply and the tone receiver, 4-wire telephone, tone generator, and amplifier hybrid modules. The alignment of the maintenance control center is performed after installation of the equipment, at scheduled intervals as directed by site maintenance policies, and after extensive repairs. Individual adjustments are performed when a particular module has been repaired or replaced.

42. **Test Equipment Required**

Electronic Counter, Hewlett-Packard 5243L (AN/USM-26)
Multimeter, Simpson 260 (TS-352)
Test Oscillator, Hewlett-Packard 650A (AN/FRM-25)
VTVM, Hewlett-Packard 400D (ME-30/U)
Module extender card ITTFL NUS 5165-19
Test Cables and Adapters (figs. 11 through 15)

43. **Test Setup**

a. Set POWER switch on maintenance control center power supply to ON. Allow a one-minute warmup period.

b. Press all fault indicators. All fault indicators should light red.

c. Set all CONFERENCE CIRCUIT toggle switches to the center position.

d. Depress operator's call indicator pushbutton. Indicator should light steady white and alarm bell should be silent.

44. **Alignment Procedure**

NOTE

Before performing any of the following alignment procedures, take the maintenance control center off line to prevent test signals from being transmitted to other sites. Perform the alignment as quickly as possible.

a. Tone Receiver Adjustment

(1) Set SENSITIVITY ADJUST potentiometer R2 (fig. 2) on each tone receiver module fully counterclockwise.

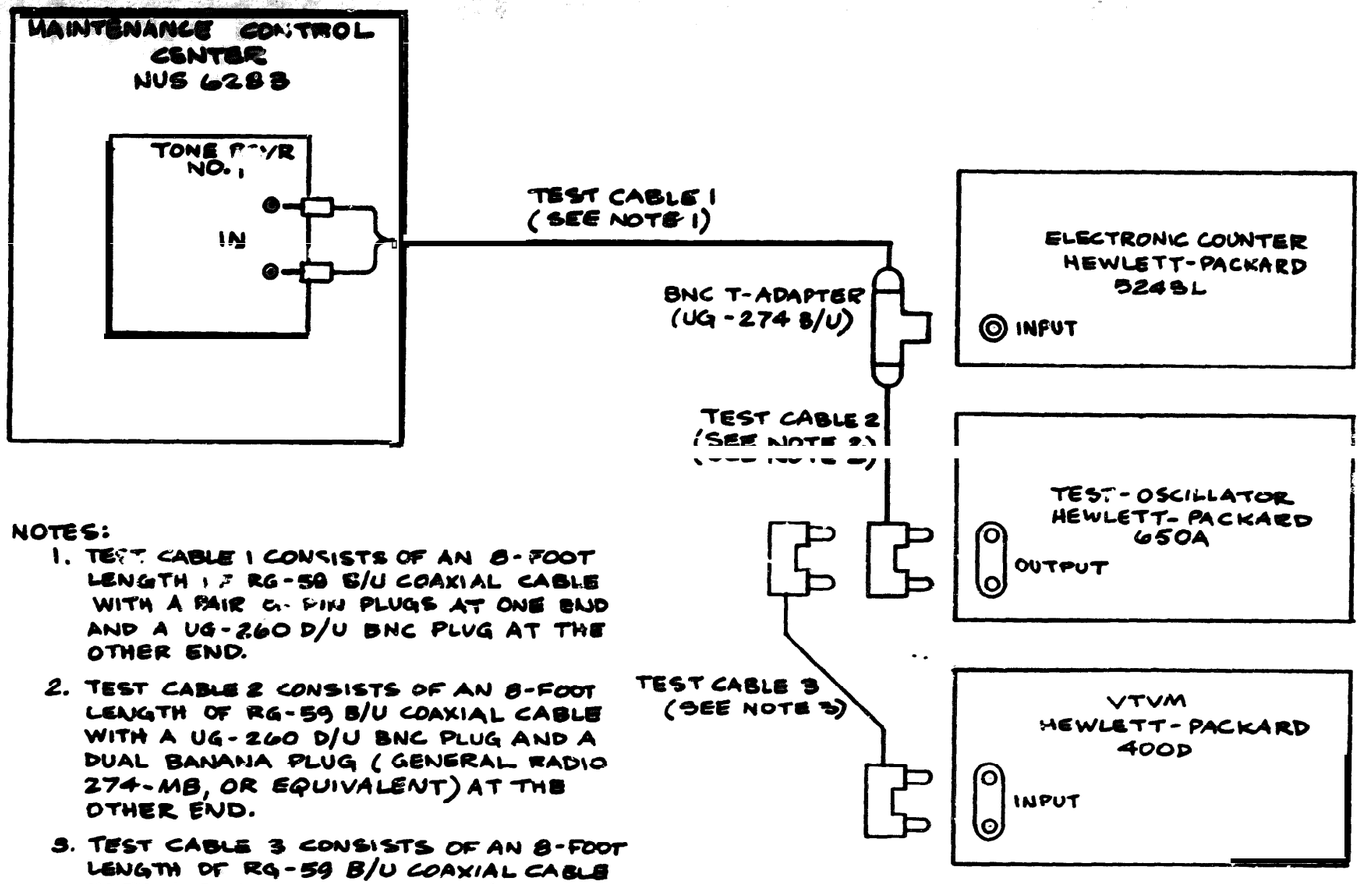
(2) Connect test oscillator to IN test jacks J1 and J2 of tone receiver No. 1 module as shown in figure 11.

(3) Set test oscillator for an output of 1600 (±5) cps at a level of −16 dbm as indicated on vtvm.

(4) Slowly rotate SENSITIVITY ADJUST potentiometer R2 clockwise until alarm bell sounds and channel 1 call indicator flashes.

(5) Set test oscillator output level to −24dbm, as indicated on vtvm. Alarm bell should be silenced; call indicator should continue to flash.

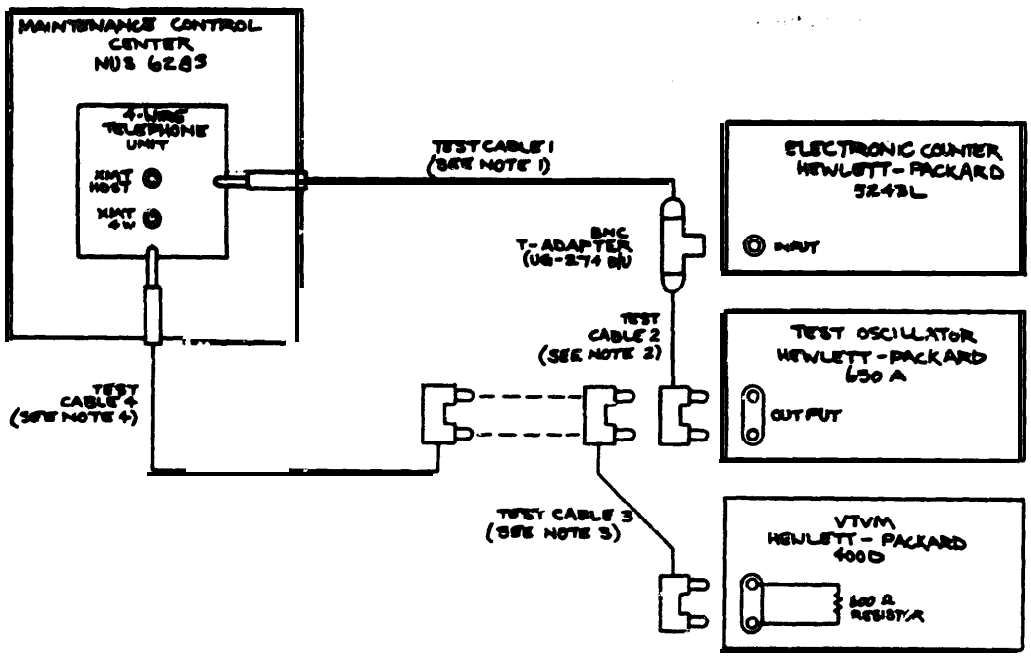
(6) Depress flashing call indicator button. Call indicator should light steady white and operator's call pushbutton indicator should flash white.



NOTES:

1. TEST CABLE 1 CONSISTS OF AN 8-FOOT LENGTH OF RG-58 B/U COAXIAL CABLE WITH A PAIR OF PIN PLUGS AT ONE END AND A UG-260 D/U BNC PLUG AT THE OTHER END.
2. TEST CABLE 2 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A UG-260 D/U BNC PLUG AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT THE OTHER END.
3. TEST CABLE 3 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT BOTH ENDS.

Figure 11. **Tone receiver adjustment, test setup.**



NOTES:

1. TEST CABLE 1 CONSISTS OF AN 8-FOOT LENGTH OF RG-59B/U COAXIAL CABLE WITH A FJ-055B TELEPHONE PLUG AT ONE END, AND A UG-260 D/U BNC PLUG AT THE OTHER END.
2. TEST CABLE 2 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A UG-260 D/U BNC PLUG AT ONE END AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT THE OTHER END.
3. TEST CABLE 3 CONSISTS OF AN 8-FOOT LENGTH OF RG-59B/U COAXIAL CABLE WITH A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT BOTH ENDS.
4. TEST CABLE 4 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A FJ-055B TELEPHONE PLUG AT ONE END AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT AT THE OTHER END.

Figure 12. **4-wire telephone transmit level adjustment, test setup.**

(3) Depress SIGNAL pushbutton (fig. 3) on fault indicator and switching panel and hold depressed.

(4) Adjust potentiometer R15 (fig. 2) on the tone generator module for an indication of −13 dbm on vtvm. Release SIGNAL pushbutton.

(5) Disconnect vtvm and connect electronic counter to OUTPUT test jacks J1 and J2 on tone generator module, as shown in B, figure 13.

(6) Depress SIGNAL pushbutton on fault indicator and switching panel. Electronic counter should indicate 1600 (±25) cps while SIGNAL pushbutton is held depressed. Release pushbutton and disconnect test equipment.

d. Amplifier-Hybrid and 4-Wire Telephone Receive Level Adjustments.

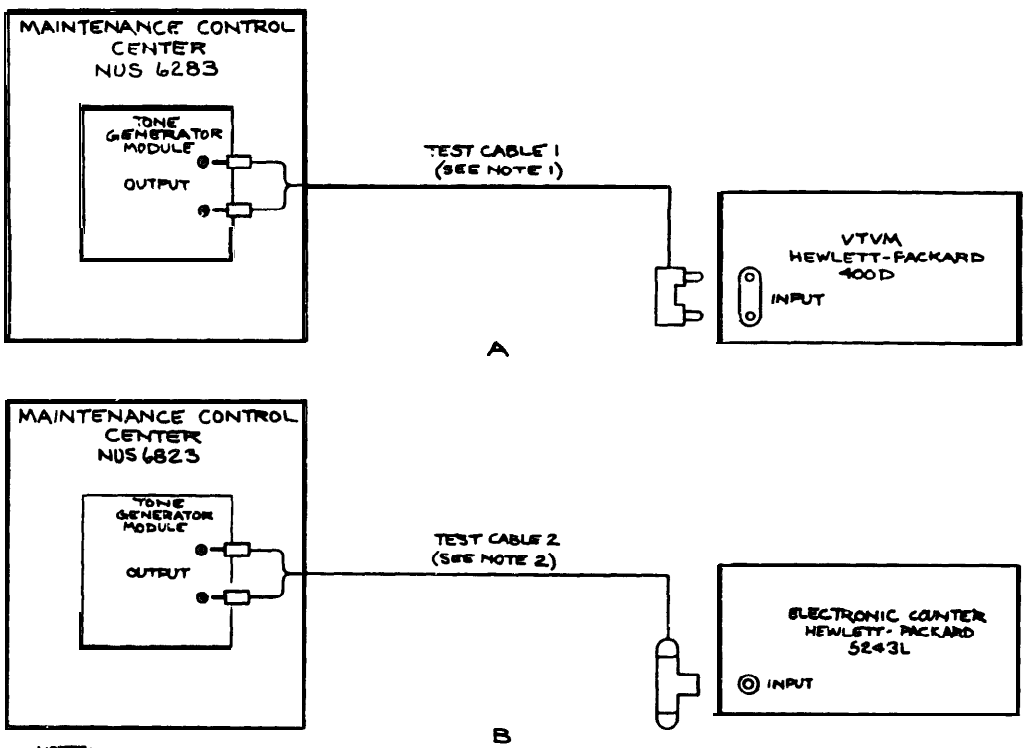
(1) Connect test oscillator and vtvm to XMT HDST jack J4 (fig. 2) on 4-wire telephone unit, as shown in figure 12.

(2) Set test oscillator for an output of 1000 (±5) cps at a level of 0 dbm as indicated on vtvm. Disconnect vtvm.

(3) Connect vtvm to REC OUTPUT jacks J1 and J2 (fig. 2) of amplifier hybrid No. 1 module in level F, as shown in A, figure 14.

(4) Adjust REC AMPL potentiometer R9 on amplifier hybrid No. 1 for a vtvm indication of +2 dbm. Disconnect vtvm.

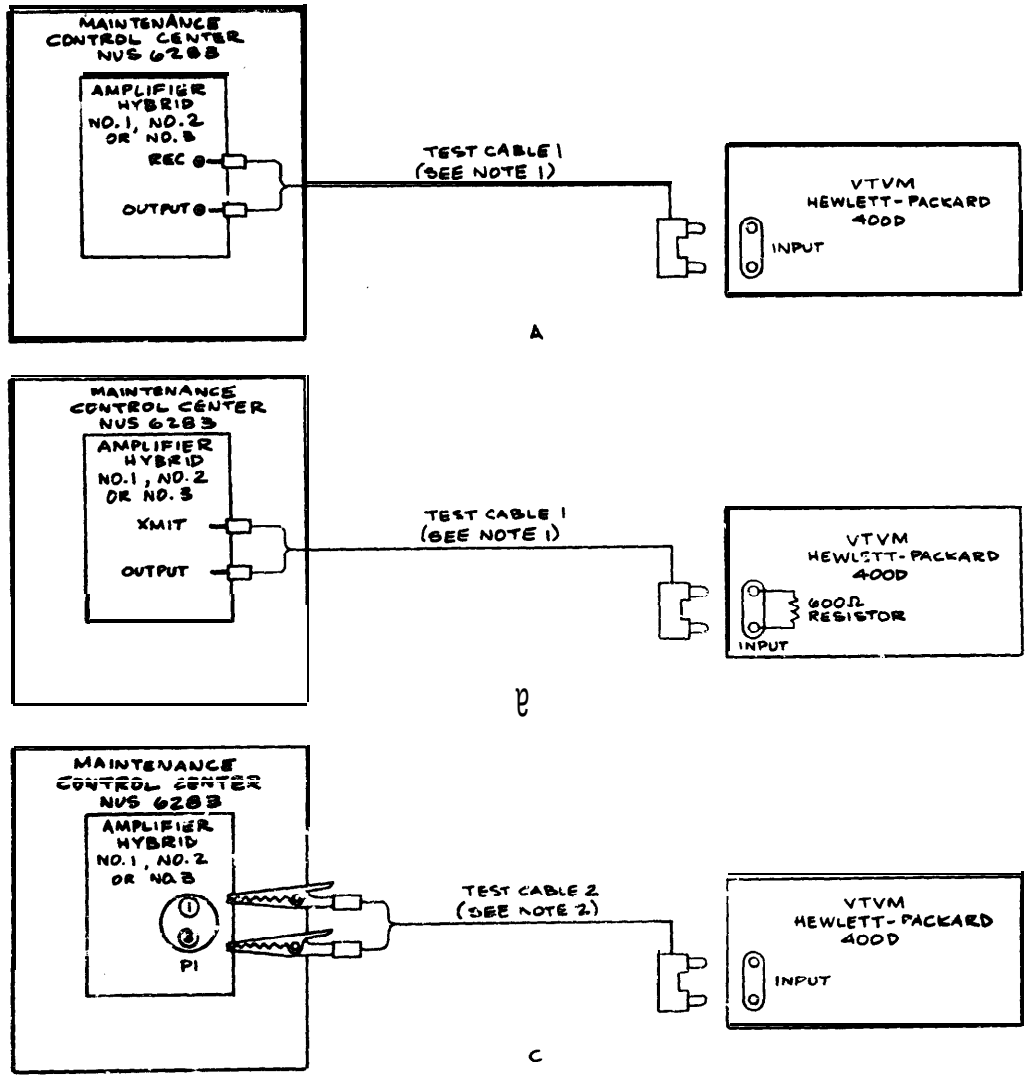
(5) Connect vtvm to XMIT OUTPUT jacks J3 and J4 of amplifier hybrid No. 2, as shown in B, figure 14.



NOTES:

1. TEST CABLE 1 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A PAIR OF PIN PLUGS AT ONE END AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT AT THE OTHER END.
2. TEST CABLE 2 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A PAIR OF PIN PLUGS AT ONE END AND A UG-260D/U BNC PLUG AT THE OTHER END.

Figure 13. **Tone generator adjustment, test setup.**



NOTES:

1. TEST CABLE 1 CONSISTS OF AN 8-FOOT LENGTH OF RG-58B/U COAXIAL CABLE WITH A PAIR OF PIN PLUGS AT ONE END AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT THE OTHER END.
2. TEST CABLE 2 CONSISTS OF AN 8-FOOT LENGTH OF RG-58B/U COAXIAL CABLE WITH A PAIR OF ALLIGATOR CLIPS AT ONE END AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT THE OTHER END.

Figure 14. **Amplifier-hybrid adjustment, test setup.**

(6) Depress channel 1 call pushbutton on fault indicator and switching panel.

(7) Adjust XMIT AMPL potentiometer R22 for a vtvm indication of −7 dbm. Operator's call pushbutton indicator should flash white and call indicator should be steady white. Disconnect vtvm.

(8) Depress RING OFF button. Alarm bell should ring momentarily and call indicator should flash blue.

(9) Depress operator's call pushbutton. Call indicator should go out and operator's call pushbutton indicator should be steady white.

(10) Connect vtvm to XMIT OUTPUT jacks J3 and J4 of amplifier hybrid No. 3, as shown in B, figure 14.

(11) Repeat steps (6) through (9).

NOTE

Depress the next call indicator button.

(12) Repeat steps (5) through (9) for each of the remaining hybrid amplifiers. Remove test equipment.

(13) Connect test oscillator and vtvm to pins 1 and 3 of connector P1 on amplifier hybrid No. 2, as shown in C, figure 14.

(14) Set test oscillator for an output of 1000 (±5) cps at a level of −7 dbm as indicated on vtvm. Disconnect vtvm.

(15) Connect vtvm to REC OUT jacks J1 and J2 of amplifier hybrid No. 2 in level F, as shown in A, figure 14.

(16) Adjust REC AMPL potentiometer R9 on amplifier hybrid No. 2 for a vtvm indication of +2 dbm.

(17) Depress channel 1 call indicator button. Disconnect vtvm.

(18) Connect vtvm to XMIT OUTPUT jacks J3 and J4 of amplifier hybrid No. 1, as shown in A, figure 14.

(19) Adjust XMIT AMPL potentiometer R22 on amplifier No. 1 for a vtvm indication of +4 dbm. Operator's call pushbutton indicator should flash white and call indicator associated with the channel under test should light steady white. Disconnect vtvm.

(20) Depress RING OFF button. Alarm bell should ring momentarily and call indicator should flash blue.

(21) Depress operator's call pushbutton. Call indicator should go out and operator's indicator should light steady white.

(22) Connect test oscillator and vtvm to pins 1 and 3 of connector P1 on amplifier hybrid No. 3, as shown in C, figure 14.

(23) Set test oscillator for an output of 1000 (±5) cps at a level of −7 dbm as indicated on vtvm. Disconnect vtvm.

(24) Connect vtvm to XMIT OUTPUT jacks J3 and J4 of amplifier hybrid No. 3, as shown in B, figure 14.

(25) Depress channel 2 call indicator button.

(26) Adjust REC AMPL potentiometer R9 of amplifier hybrid No. 3 for a vtvm indication of +2 dbm. Operator's call pushbutton indicator should flash white and call indicator associated with channel under test should be steady white. Disconnect vtvm.

(27) Repeat steps (20) through (26) for each of the remaining amplifier hybrid modules. Disconnect test equipment.

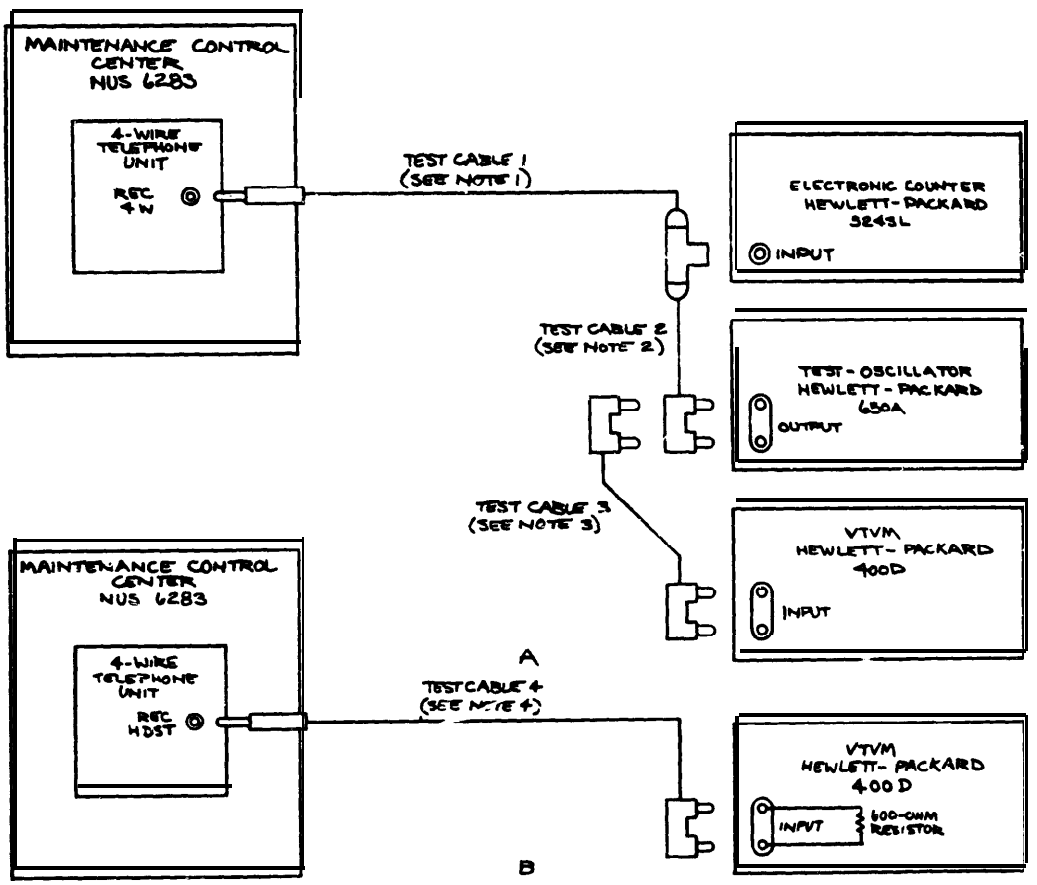
(28) Connect test oscillator and vtvm to REC 4W jack J1 on 4-wire telephone unit, as shown in A, figure 15.

(29) Set test oscillator for an output of 1000 (±5) cps at a level of +4 dbm as indicated on vtvm. Disconnect vtvm.

(30) Connect 600-ohm resistor across vtvm INPUT terminals and connect vtvm to REC HDST jack J2 on 4-wire telephone unit, as shown in B, figure 15.

(31) Set REC LEVEL potentiometer R3 on 4-wire telephone unit fully clockwise. Vtvm should indicate between −5 and −2 dbm. Disconnect vtvm.

(32) Adjust HDST LEVEL gain control knob on 4-wire telephone unit for a convenient hearing level on hand set receiver. Disconnect test equipment.



NOTES:

1. TEST CABLE 1 CONSISTS OF AN 8-FOOT LENGTH OF RG-59B/U COAXIAL CABLE WITH A PJ-055B TELEPHONE PLUG AT ONE END, AND A UG-260 D/U BNC PLUG AT THE OTHER END.
2. TEST CABLE 2 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A UG-260 D/U BNC PLUG AT ONE END AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT THE OTHER END.
3. TEST CABLE 3 CONSISTS OF AN 8-FOOT LENGTH OF RG-59B/U COAXIAL CABLE WITH A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT) AT BOTH ENDS.
4. TEST CABLE 4 CONSISTS OF AN 8-FOOT LENGTH OF RG-59 B/U COAXIAL CABLE WITH A PJ-055B TELEPHONE PLUG AT ONE END AND A DUAL BANANA PLUG (GENERAL RADIO 274-MB, OR EQUIVALENT AT THE OTHER END.

Figure 15. **4-wire telephone receive level adjustment, test setup.**

e. Power Supply Adjustment

(1) Connect multimeter across the minus terminal and the white and red terminal of power supply.

(2) Adjust power supply VOLTAGE CONTROLS potentiometers (fig. 2) for voltmeter indication of −24 (±1) vdc.

(3) Set all circuit breakers on circuit breaker panel to the tripped state. TRIPPED CKT BKR indicator should light.

(4) Turn off the power supply.

(5) Connect a 3.7-ohm, 500-watt load resistor across the power supply voltage output terminals.

(6) Turn on power supply and allow one minute warmup. Ensure that all circuit breakers are in the tripped state.

(7) Adjust power supply CURRENT CONTROL adjustment for an indication of 6.6 amperes on the power supply OUTPUT CURRENT meter. The THERMAL OVERLOAD indicator should light.

(8) Adjust the external resistor to 4 ohms (ammeter indicating 6 amperes). The THERMAL OVERLOAD indicator should go out.

(9) Remove load resistor and reset circuit breakers. TRIPPED CKT BKR indicator should go out.

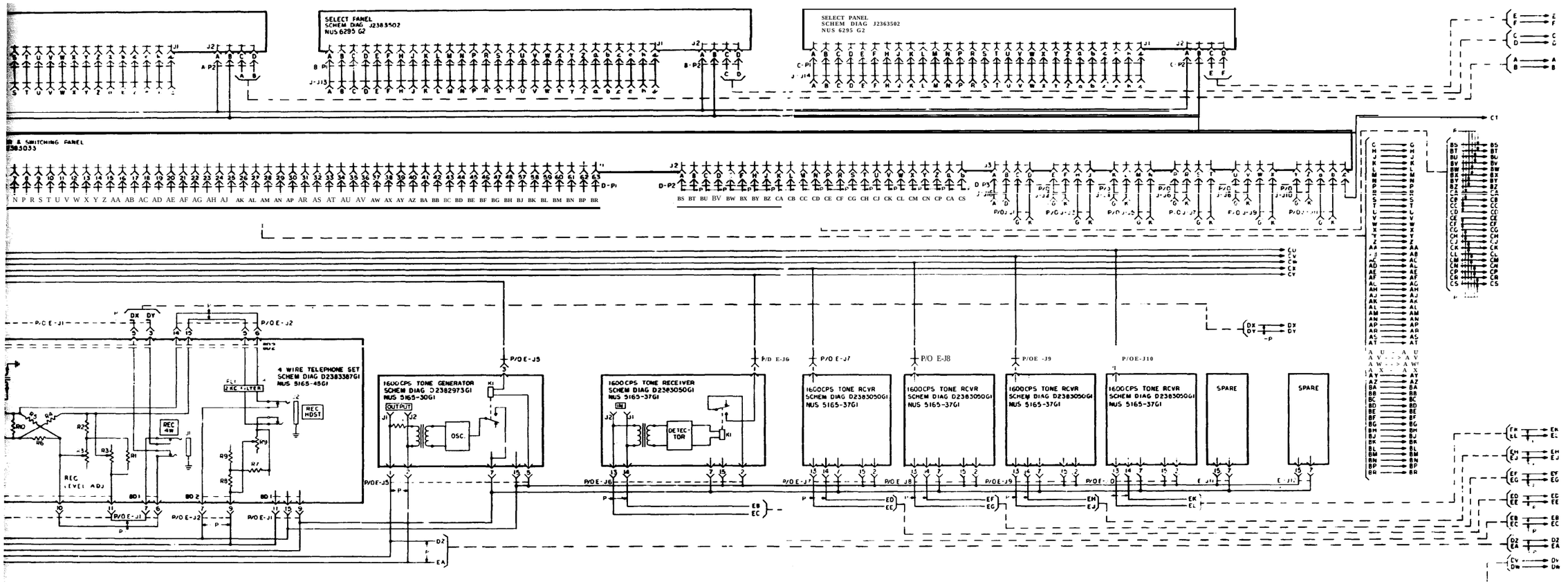


Figure 16. Maintenance control center (mainline), schematic diagram (part 1 of 2).

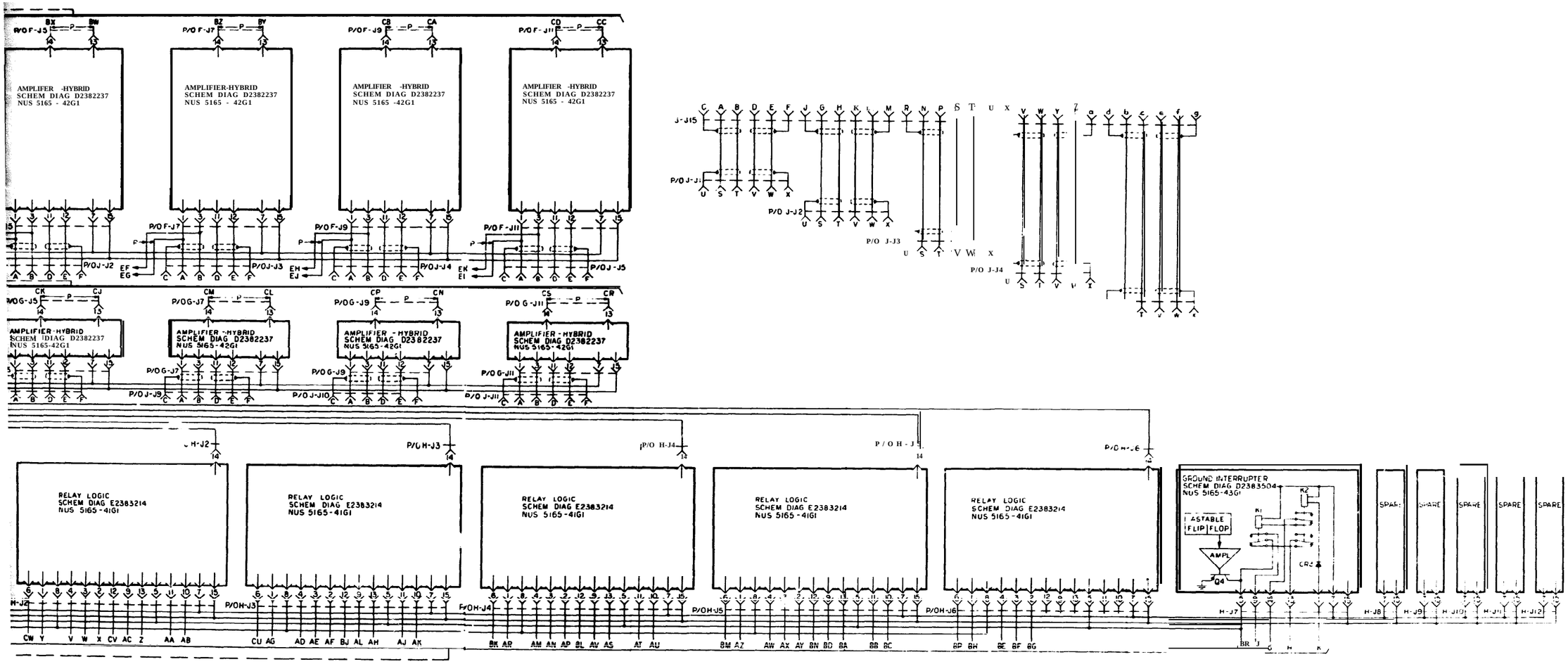


Figure 16. Maintenance control center (mainline), schematic diagram (part 2 of 2).

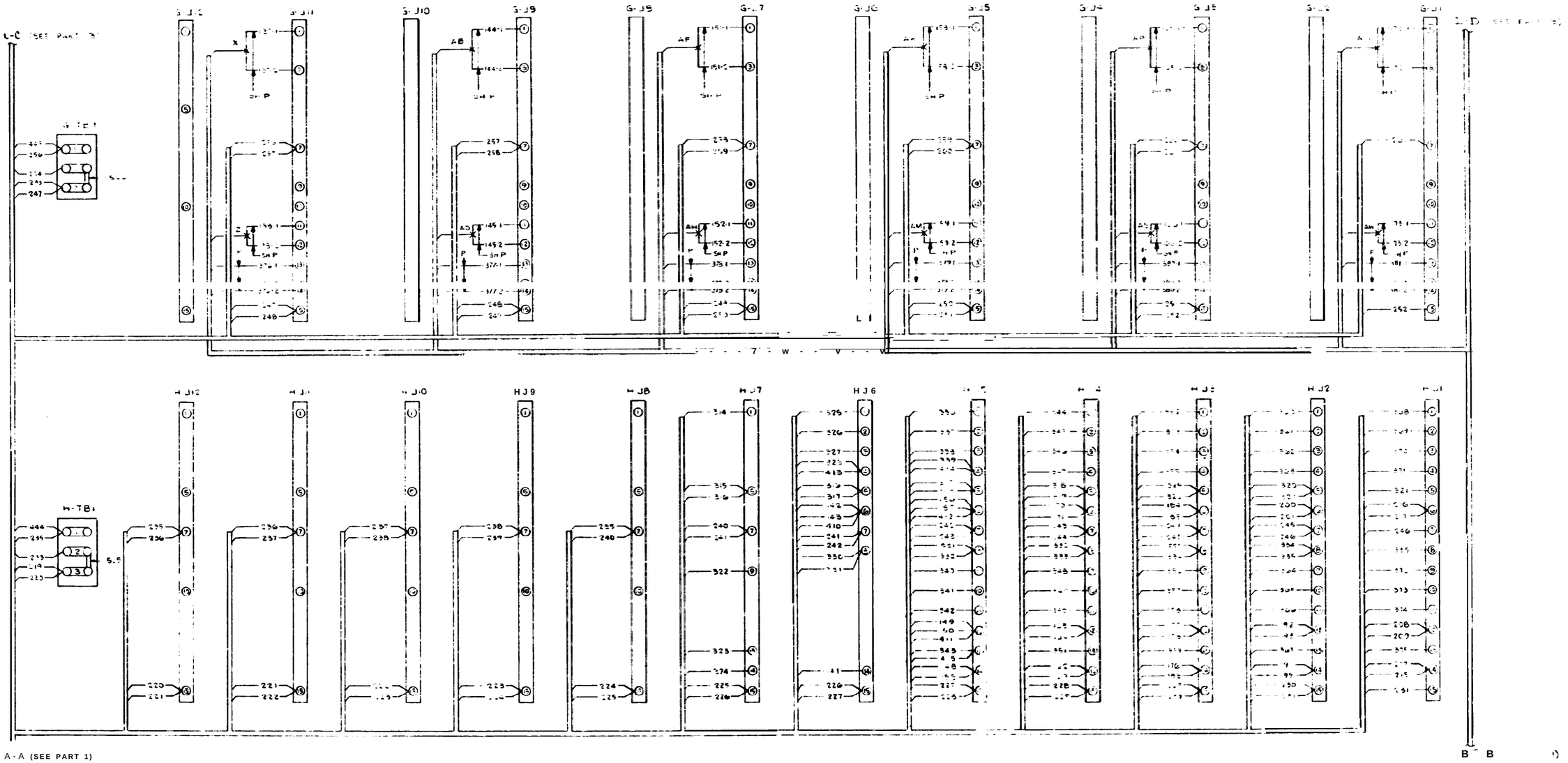


Figure 17. Maintenance control center (mainline), wiring diagram (part 2 of 4).

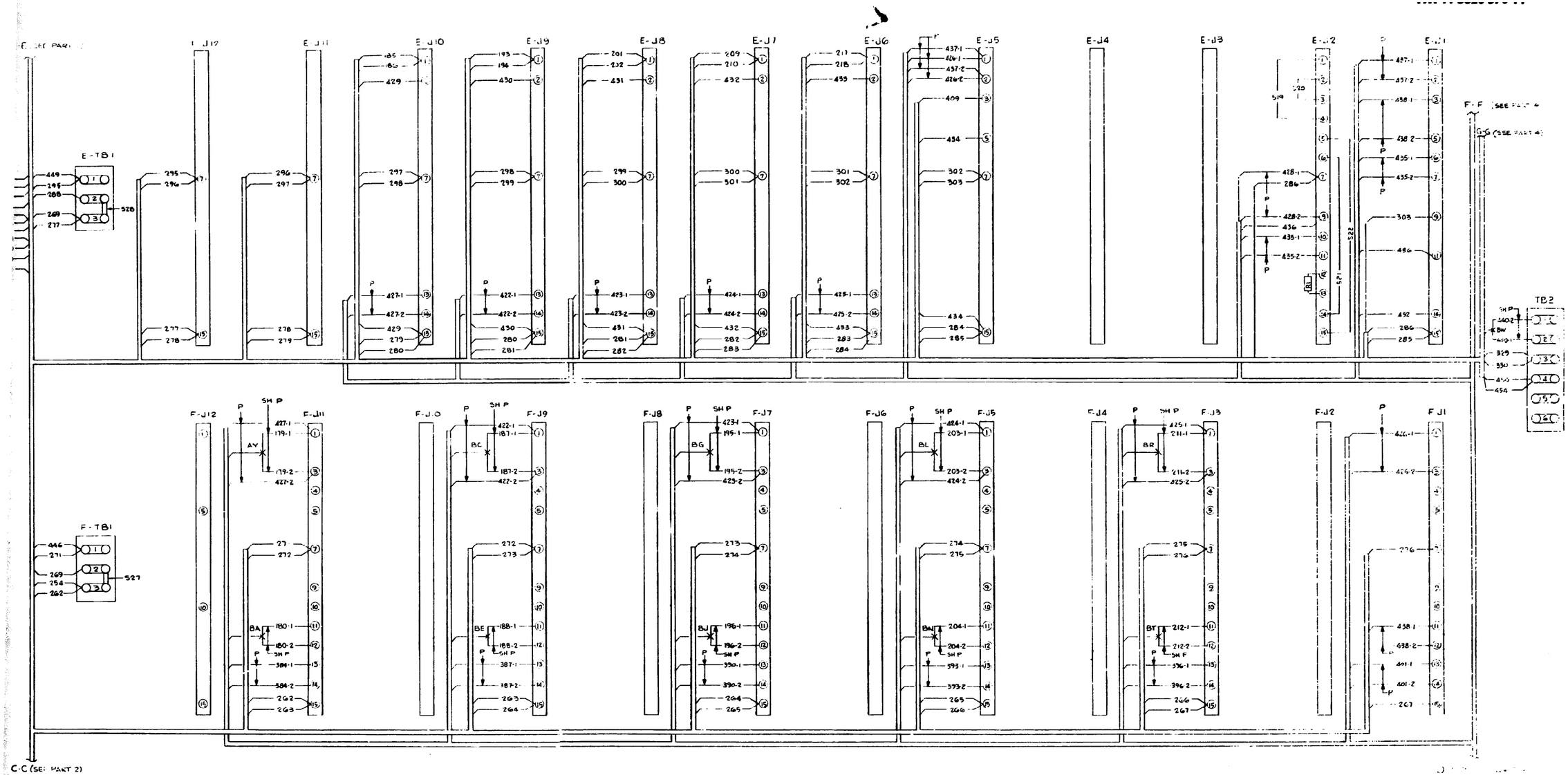


Figure 17. Maintenance control center (mainline), wiring diagram (part 3 of 4).

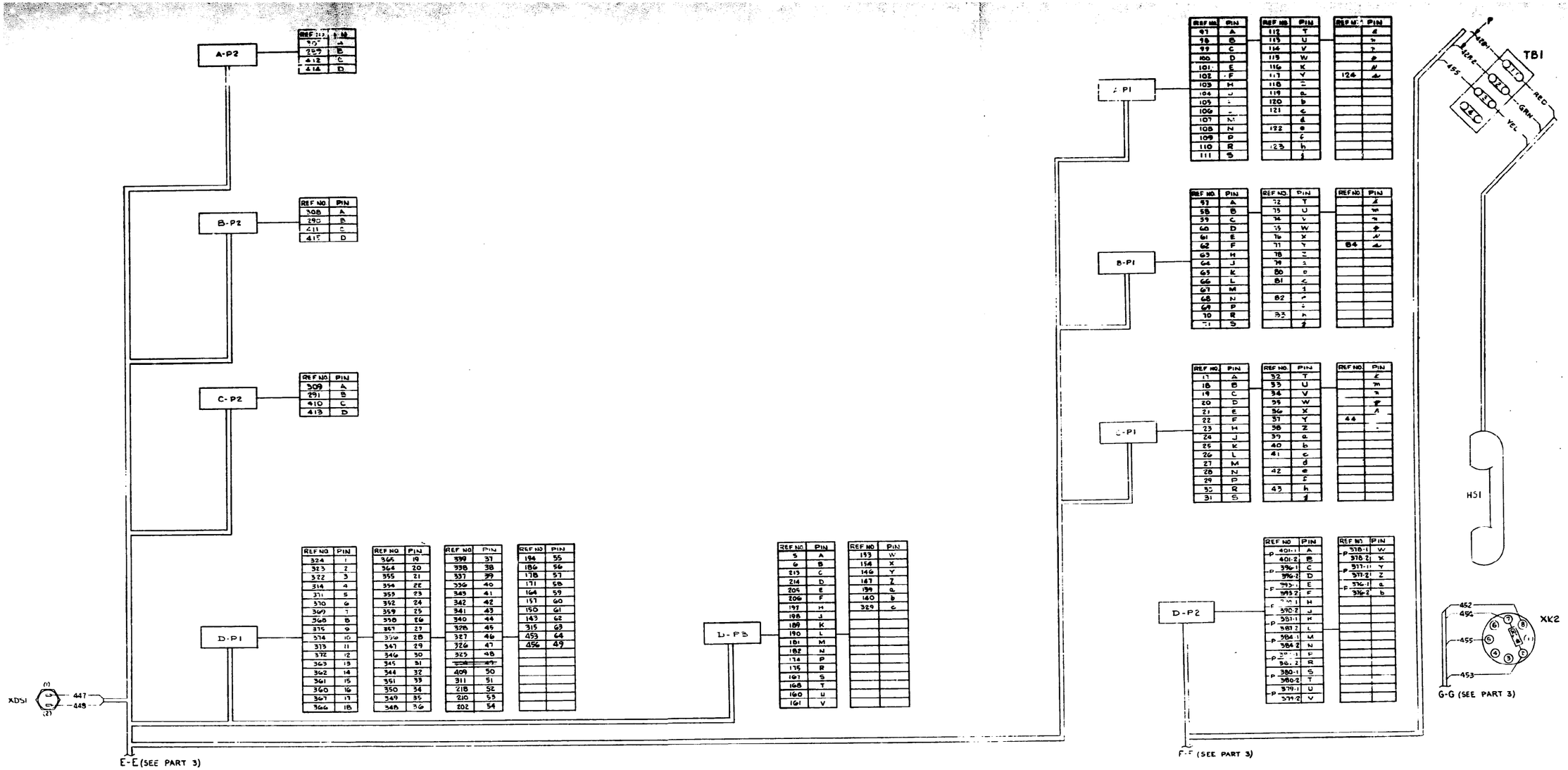


Figure 17. Maintenance control center (mainline), wiring diagram (part 4 of 4).

4-WlRE TELEPHONE
NUS 5165-8 and NUS 5165-45

DESCRIPTION

The 4-wire telephone NUS 5165-8 or NUS 5165-45 permits order-wire speech communication between remote sites, It operates on a party-line basis and utilizes telephone headsets. The module consists of two printed circuit boards fastened to a single front panel. One printed circuit board is hinged at the front panel end to provide access to the second board. The two printed circuit boards are held together at the end away from the front panel by captive screws that can be released to free the hinged board. These captive screws must be secured before plugging in the module to ensure good electrical contact. On the NUS 5165-8 module, the telephone handset is mounted on the front panel, which also is equipped with phone jacks to permit monitoring and the insertion **of** test tones. The unit slides into a compartment of the frame and module assembly of the central equipment cabinet or the tributary maintenance control center. When transmission is desired, a key on the handset is depressed to actuate a 1,600-cps tone generator in the central equipment cabinet, This applies the ringing signal through the four-wire telephone unit to other sites to notify the operators that speech communication is about to begin. Both the ringing and speech signals are superimposed on a baseband signal used in transmitting all messages from one site to another. A sidetone level of the transmitted speech is applied to the receiver to provide a natural background to the operator, who hears his own voice. On the NUS 5165-45 module, the handset is mounted remotely and does not include the signaling key. The hookswitch is not included on this module. Pertinent characteristics of the four-wire telephone module follow:

Input impedance	150 or 600 ohms
Input. frequency range	300cps to 4 kc
Order-wire frequency range	300 cps to 3 kc
Signaling frequency	1,600 cps
Output impedance	150 or 600 ohms
Sidetone level	-32 db (ref to 0 dbm)
Power requirement	-48 vdc

CIRCUIT DESCRIPTION (Figures 1 and 2)

Order-wire signals enter the NUS 5165-8 module *&rough pins 3 and 5 of plug BD1, pass through closed circuit REC 4W jack JI, are amplified externally, and then returned to the module, They are applied across a network consisting of resistors Rl and R2 and REC LEVEL potentiometer R3, which is used to adjust the sensitivity of the unit to order-wire input signals. The signals developed across this network are applied to hybrid R4, R5, and R6, which attenuates incoming signals approximately 6 db, From the hybrid, they are applied to pins 14 and 15 of BD2 and to 20-db pad R1O, through R13, The cross-conversion from the 20-db pad is used in the transmitting portion of the four-wire telephone module as a sidetone path. The signals applied to pins 14 and 15 of BD2 are amplified externally and sent back to the unit through pins 5 and 6 of BD2, (In central equipment cabinets NUS 5972-3 and -7, pins 14 and 15 of BD2 are strapped internally to pins 6 and 5, respectively,) The signals are sent through 2-kc or 3-kc low-pass filter FLP to prevent the 4-kc pilot tone from entering the handset. The filtered signals pass through closed-circuit REC HDST jack J2 and are applied across a network consisting of resistors R7 and R8 and HDST LEVEL potentiometer R9,

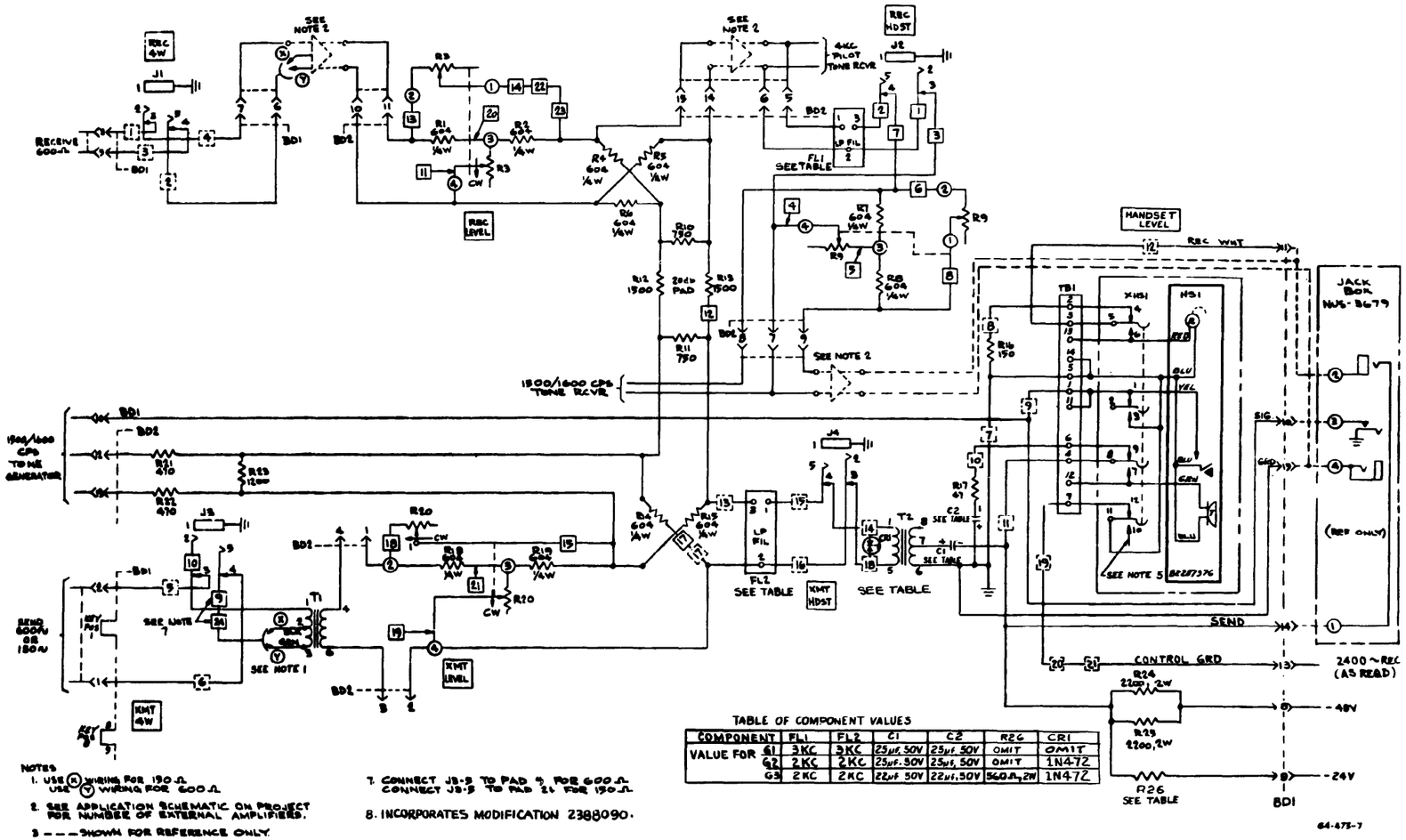
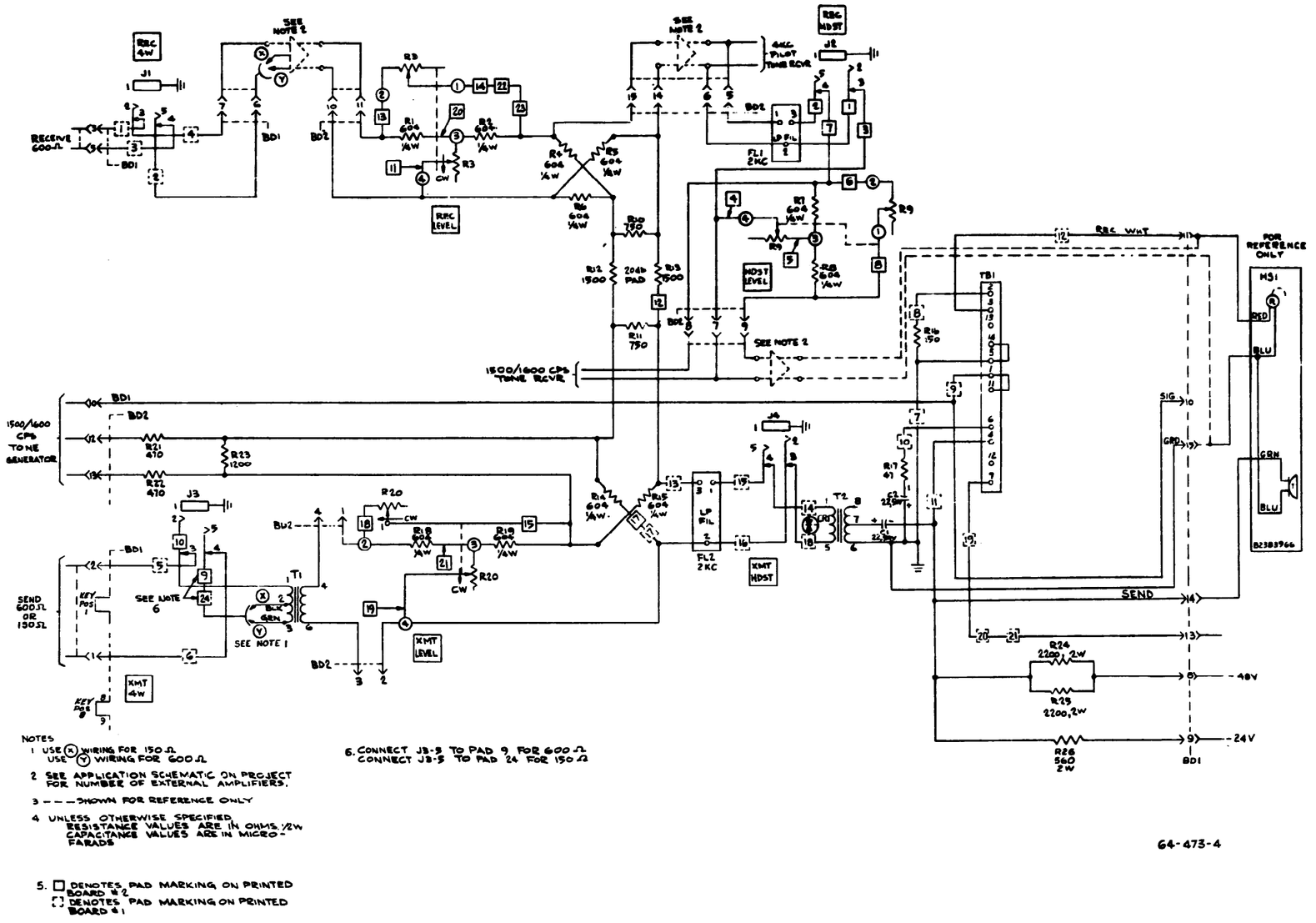


TABLE OF COMPONENT VALUES

COMPONENT	FL1	FL2	C1	C2	R26	CR1
VALUE FOR G1	3KC	3KC	25μf, 50V	25μf, 50V	OMIT	OMIT
G2	2KC	2KC	25μf, 50V	25μf, 50V	OMIT	1N472
G3	2KC	2KC	22μf, 50V	560Ω, 2W		1N472

NOTES
1. USE (R) WIRING FOR 150Ω. USE (Y) WIRING FOR 600Ω.
2. SEE APPLICATION SCHEMATIC ON PROJECT FOR NUMBER OF EXTERNAL AMPLIFIERS.
3. - - - SHOWN FOR REFERENCE ONLY.
4. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, ½W CAPACITANCE VALUES ARE IN MICRO-FARADS.
5. HOOK SWITCH CONTACTS SHOWN WHEN PHONE IS ON HOOK.
6. □ DENOTES PAD MARKING ON PRINTED BOARD #2. ⬚ DENOTES PAD MARKING ON PRINTED BOARD #1.
7. CONNECT J3-3 TO PAD 4 FOR 600Ω. CONNECT J3-5 TO PAD 21 FOR 150Ω.
8. INCORPORATES MODIFICATION 2388090.

Figrue 1. 4-Wire Telephone NUS 5165-8, Schematic Diagram



NOTES

1 USE (X) WIRING FOR 150 Ω
USE (Y) WIRING FOR 600 Ω

2 SEE APPLICATION SCHEMATIC ON PROJECT FOR NUMBER OF EXTERNAL AMPLIFIERS.

3 - - - SHOWN FOR REFERENCE ONLY

4 UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, ½W CAPACITANCE VALUES ARE IN MICRO-FARADS

5. ☐ DENOTES PAD MARKING ON PRINTED BOARD # 2
[ ] DENOTES PAD MARKING ON PRINTED BOARD # 1

6. CONNECT J3-5 TO PAD 9 FOR 600 Ω
CONNECT J3-5 TO PAD 24 FOR 150 Ω

64-473-4

Figure 2. 4-Wire Telephone NUS 5165-45, Schematic Diagram

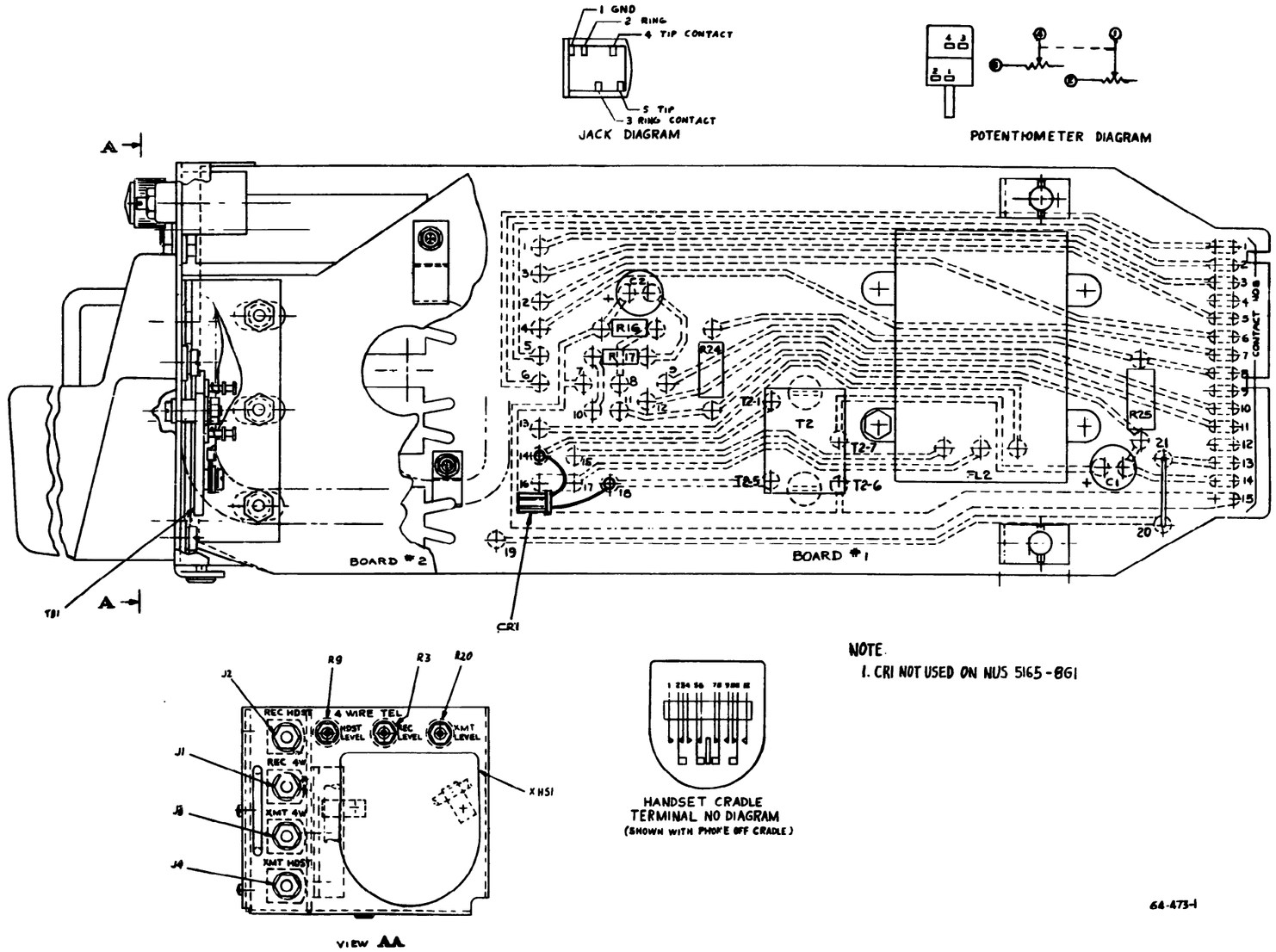


Figure 3. 4-Wire Telephone NUS 5165-8G1, G2 Parts Location (Sheet 1 of 3)

1600 CPS TONE GENERATOR
NUS 5165-30G1

DECRIPTION

The 1600 cps tone generator provides an order-wire signaling frequency to contact a remote site. The tone generator consists of a shunt-fed oscillator, amplifier, output impedance matching network, and relay. The module characteristics are as follows:

Input power requirement	-24 vdc
Output frequency	1600 ±25cps
output level	-16 dbm

Circuit description (Figures 1 and 2)

Oscillator. The signal is generated by transistor Q1 and tuned circuit Z1. The output from the collector of Q1 is coupled to the tuned circuit by resistor R11 and capacitor C1. The grounded tap (3) of Z1 provides an in-phase feedback through C2 to the base of Q1. The voltage-divider resistors R2 and R3 provide the proper dc bias for the base of Q1. Similarly, R7 and R8 provide emitter bias. Resistor R7 in the emitter circuit is a means for degeneration to improve oscillator stability.

Amplifier. A portion of the output of the oscillator is coupled to the base of amplifier Q2 by capacitor C4. The bias for the base of Q2 and, thereby, the gain of this transistor stage is controlled by relay Kl. When K1 is deenergized the bias for Q2 is developed across R9, CR1, and R11, making the base more positive than the emitter whose fixed bias is taken from the junction of Rl2 and R16. This back biasing of Q2 reduces the output to a minimum. Maximum output from the module is produced when K1 is energized. At this time CR1 is back biased by the -24 VDC applied to it by the closing of relay contacts B2 and B1. With CR1 back biased, the base of Q1 becomes more negative due to the voltage division across R9 and R10. Under this condition Q2 conducts, providing maximum signal to the output. The output level of the amplifier is set to the desired value by use of potentiometer R15. The primary winding of the tuned transformer network Z2 (tuned to 1600 cps) provides a load for transistor Q2. The output of the module is conveyed from the secondary of Z2 to pins 1 and 2 of plug P1. Front-panel jacks J1 and J2 also afford access to the output of the tone generator.

1600 CPS TONE RECEIVER
NUS 5165-37Gl

DESCRIPTION

The 1600 cps tone receiver provides an audible and a visual indication, by means of a buzzer and a lamp, when a 1600 cps tone signal is applied to the receiver. The receiver's front panel contains input (IN) test jacks, an output test (DC TEST) jack, a potentiometer control (SENSITIVITY ADJUST), and an indicator lamp (INCOMING CALL). Pertinent characteristics of this receiver are as follows:

Input impedance	10 kilohms (minimum)
Operating frequency	**1600 cps**
Input sensitivity for relay operation	Adjusted for -20 dbm
Output	Continuity or open circuit for external circuit
Power requirement	-24 vdc

CIRCUIT DESCRIPTION (Figures 1 and 2)

The input signal is coupled through impedance-matching transformer T1 to the base of transistor Q1. SENSITIVITY ADJUST potentiometer R2 is provided to control the amplitude of the input signal. The signal is amplified by two common-emitter amplifier stages (Q1 and Q2)and coupled through transformer T2 to tuned circuits Z1 and Z2. The circuits, each consisting of an inductance and capacitance in series , are **tuned to** resonate at 1600 cps and offer a relatively high impedance to frequencies to frequencies other than 1600 cps. Tuned circuit Z1 is connected in series with the top bridge rectifier circuit (diodes CR1 thru CR4) and tuned circuit Z2 is connected in parallel with the bottom bridge rectifier circuit (diodes CR5 thru CR8). The two bridge rectifier circuits develop a net dc voltage that is applied to the base of transistor Q3. The value of voltage developed is dependent upon the frequency of the signals entering the receiver. When this net voltage is negative, and of sufficient level, it will cause transistor Q3 to conduct enough to energize relay K1. When the net voltage becomes less negative, or positive, Q3 will not conduct sufficiently to energize relay K1.

If a pure 1600 cps tone signal (even in the presence of voice-frequency signals) enters the receiver, more current flows into the top bridge rectifier circuit than into the bottom bridge rectifier circuit. A negative voltage of sufficient level appears at the base of Q3 so that Q3 conducts enough to energize relay K1. Consequently, the buzzer and INCOMING CALL lamp are activated.

Speech and other voice-frequency range signals have components which are predominatly at **other** than 1600 cps, even though some may lie close to this frequency. When such signals enter the receiver, more current flows in the bottom bridge rectifier circuit than in the top bridge with the result that there is dc voltage in the output of the bottom bridge. Thus, the net voltage at the base of Q3 becomes less negative or even positive (depending upon the frequency content of the input signal) and Q3 does not conduct heavily enough to energize relay H1. Consequently, the buzzer and the INCOMING CALL lamp are not activated.

RELAY LOGIC

NUS 5165-41Gl

DESCRIPTION

The relay logic module 5165-41G1 is used in the mainline site maintenance control center and preventive operating paths for the call indcators and audible alarm associated with two voice enhancers. The quality of relay logic modules at a maintenance control center depends upon the nature of voice channels required. Pertinent characteristics of the relay logic module are as follows:

Voltage Requirement:	-24 vdc
Output:	Continuity or open circuit for external lamps and audible alarm.

CIRCUIT DESCRIPTION (Figures 1 and 2)

The relay logic module contains eight relays which provide operating paths for the audible alarm, the white indicators, and the blue indicators. Relays K1 through K4 provide operating paths for the white No. 1 and blue No. 1 indicators. Relays K5 through K8 provide operating paths for the white No. 2 and blue No. 2 indicators. Since the operation of either group of relays is similar, only the operation of relays Kl through K4 is described.

Initially, assume that only -24 vdc is present on P1-7 and that ground is applied to P1-15. When SIG GRD is applied to P1-6, relay K1 operates and the operating circuit to the **AUD** ALM (P1-8) is closed. Also, an operating ground is applied to relay (K2) through "break" contacts of relay **K4** and "make" contacts of relay K1. Relay K2 operates and locks up through "make" contacts of K2 and "break" contacts of **K4.** With relay K2 operated, the circuit from INTERRUPTED GRD (P1-5) to WHITE No. 1 (P1-3) is closed via "make" contacts of K2 and "break" contacts of K3. When SIG GRD is removed from P1-6, relay K1 releases and the AUD ALM circuit is opened. Relay K2 remains energized and the INTERRUPTER GRD to WHITE No. 1 circuit remains closed.

When BUS GRD No. 1 is applied to P1-4, an operating ground is applied to relay K3 through "break" contacts of relay K1 and K4. Relay K3 operates causing the INTERRUPT GRD to WHITE No. 1 circuit to open and the GRD (Pl-15) to WHITE No. 1 circuit to close. When SIG GRD is again applied to P1-6, relay K1 operates, closing the circuit to AUD ALM. Also, relay K4 operates and locks up through "make" contacts of K4 to BUS GRD No. 1. With relay **K4** operated, relays K2 and K3 release. At this point, the GRD to WHITE No. 1 circuit is opened and the INTERRUPTER GRD to BLUE No. 1 (P1-2) circuit is closed. When SIG GRD is removed from P1-6, relay Kl releases and the AUD ALM circuit is opened. When BUS GRD No. 1 is removed, relay K4 releases causing the INTERRUPT GROUND to BLUE No. 1 circuit to open. At this point, the relay logic circuit is restored to the initial state.

The diodes connected across the relay coils suppress arcing.

AMPLIFIER-HYBRID

NUS 5165-42G1

DESCRIPTION

The amplifier-hybrid module converts a 4-wire telephone circuit to a 2-wire circuit for switching purposes, and converts a 2-wire line back to a 4-wire line. Voice and audio signaling frequencies are amplified in separate amplifiers and coupled to a common path through the hybrid transformer. Pertinent characteristics of this module are as follows:

Input impedances	600 Ohms
Output impedances	600 Ohms
Frequency	0 - 4000 cps
Input power requirements	-24 vdc at 35 ma

* CIRCUIT DESCRIPTION (Figures 1 and 2)

Receive Path. Terminals 1 and 3 of transformer T1 receive a 1600-cps signal from a tone generator or voice frequencies from the transmit circuit of a four-wire telephone unit. These signals are coupled to the base of Ql by transformer T1 and capacitor C2. The audio frequencies are amplified by the common emitter circuit of Q1 and coupled to the base of Q2 for farther amplification. The output level of the receive path is controlled by potentiometer R9. The primary winding of T2 and resistor Rl2 form the load for transistor Q2 while the secondary is connected to the hybrid. Pins 4 and 5 of plug P1 are not used. The path continues from pins 12 and 13 on the hybrid to output pins 13 and 14 of connector P1.

Hybrid Transformer. The hybrid transformer is a four-wire terminating set in the form of a bridge circuit. The circuit is arranged so that the two-wire line from P1, pins 13 and 14, and the balancing network of R604 and the grounded center tap winding form one pair of bridge arms. The four-wire input and output circuits at terminals 6 and 7 and 4 and 5 of the hybrid form the other pair of conjugate arms. Maximum coupling between the input and output circuits is determined by the impedance of the balancing network and the two-wire termination.

Transmit Path. Audio signals received at pins 13 and 14 of connector P1 are coupled to the hybrid winding through resistors of R14 and R15. The signal is then transferred to the winding across terminals 4 and 5 and on to the primary of transformer T4. The voice or signaling frequencies are amplified in transistor circuits Q3 and Q4 and coupled to the receive circuit of a remote four-wire telephone unit through transformer T5. The level of the output across the secondary of T5 is controlled by potentiometer R22. Circuits Q3 and Q4 are also the side tone path for the transmitted signal.

GROUND INTERRUPTER

NUS 5165-43Gl

DESCRIPTION

The ground interrupter supplies an intermittent ground to the telephone order-wire circuits with a frequency of approximately one half cycle per second. T&e interrupter consists of a free running multivibrator and two stage power amplifier. The module also contains two relays which control two remote indicating lamps. The module characteristics are as follows:

Output level	-24 vdc or ground
Output frequency:	1 cycle per second
Power Requirements	125 ma dc

CIRCUIT DESCRIPTION (Figures 1 and 2)

Multivibrator. The frequency to operate the ground interrupter module is generated in the basic free running multivibrator circuit of Ql and Q2. The frequency of the flip flop is approximately one half cycle per second and is a result of the charge time of capacitor Cl and resistor R3 and capacitor C2 and resistor R1. The symmetrical output of the flip flop is coupled through capacitor C4 to the base of transistor Q3.

Amplifier. When the base of Q3 is positive the transistor conducts, applying a negative potential to the base of Q4. Transistor Q4, a power transistor, conducts heavily to supply ground to external circuits connected to P1-5. The collector source voltage and load resistor are located in a separate module. When the flip flop changes state, Q3 cuts off removing the forward bias from Q4. Transistor Q4 cuts off, returning its collector to -24 volts dc.

Lamp Relays. With BUS GRD applied, relay K1 is energized, relay K2 is de-energized, and a path is provided for an intermittently-flashing blue lamp. When the switched ground is **applied** to P1-1, relay K2 energizes, providing a path for a steadily-glowing white lamp and an open path for the blue lamp. When BUS GRD and switch GRD are both removed, a path is completed for an intermittently-flashing white lamp.

FAULT INDICATOR AND SWITCHING PANEL

NUS 6294G1

DECRIPTION

The fault indicator and switching panel displays summary failure indications of monitored equipment, displays incoming call indications, and provides switching facilities for maintenance communications. The panel consists of two rows of pushbutton-indicator switches and two rows of telephone toggle switches. The top row of pushbutton-indicator switches displays the status of external monitored equipments. The switches are equipped with red and green **indicator lamps which provide the status** indications. The pushbutton-indicator switches in **the bottom row light to indicate incoming calls.**

CIRCUIT DESCRIPTION (Figures 1 and 2)

of the monitored equipments. With no faults present, the pushbutton-indicators light steady green. If a fault occurs in a monitored equipment, the associated indicator flashes red and an external audible alarm circuit is actuated. Depressing the flashing red pushbutton-indicator deactuates the external alarm circuit, and the flashing indicator changes to steady red. When the fault is corrected, the red indicator changes to flashing green, and the external alarm circuit is actuated. Momentarily depressing the flashing pushbutton-indicator deactuates the alarm circuit and changes the indication to steady green. Since operation of each fault circuit is identical, only circuit 13 is discussed in detail. In the absence of a fault, relay K1 (fig. 1) remains energized by a ground applied to pin A of connector J3. The ground path through closed contacts K1 (2-4) and S39 (2C-2NC) lights green indicators DS50 and DS51. If a fault occurs, the ground is removed from pin A of J3, deenergizing relay K1. The green indicators go out as the ground path is opened. Interrupted ground is applied to red indicators DS49 and DS52 through closed contacts K1 (6-8) and S39 (1C-1NC), causing the red indicators to flash. The ground path provided through closed contacts K1 (2-4), S39 (3C-3NC), and OR gate diode CR14 to pin C of J3 actuates the external alarm. When pushbutton-indicator S39 is depressed, the alarm circuit is disabled by open contacts S39 (3C-3NC), and flashing indicators DS49 and DS52 change to steady red by the ground applied through closed contacts K1 (2-4) and S39 (1C-1NO). Correction of the fault will cause relay K1 to energize, applying interrupted ground to green indicators DS50 and DS51 through closed contacts (K1 (1-6) and S39 (2C-2NO). The green indicators flash, and the alarm circuit is actuated through closed contacts K1 (2-5) and S39 (3C-3NO). Depressing pushbutton-indicator S39 disables the alarm and removes interrupted ground from the green indicators as contacts S39 (3C-3NO) and S39 (2C-2NO), respectively, open. Ground applied through closed contacts S39 (2C-2NC) restores indicators DS50 and DS51 to the normal steady-green condition.

Incoming Call Indicators. Pushbutton-indicators S25 through S36 provide indications of **incoming calls, calls in progress**, and hang-up signals. Pushbutton-indicator S25 is used as **the operator's call indicator; the remaining pushbutton**-indicators are connected to external **telephone circuits. When a call comes in on circuit 2,** and interrupted ground is applied to **pin 6 of connector J1, causing white indicators DS5 and DS8 to flash. When the flashing pushbutton-indicator switch (S25) is depressed, ground is applied to pin 6 of connector J1, changing the flashing indication to steady white, and the incoming signal (pins C and D of connector J1) is routed to the operator's circuit (pins A and B of connector J1) through closed contacts S26 (1C-1NO) (2C-2NO) and S25 (1C-1NC) (2C-2NC). A completion of call signal (interrupted ground on pin 7 of connector J1) causes blue indicators DS6 and DS7 to flash.** This indication **is cancelled by depressing pushbutton-indicator switch S25, which releases S26, disabling the flashing indicator.**

Conference Circuit Switches. Switches S1 through S24 are conference circuit selector switches. The switches provide connections between any of the input circuits to the panel. Four audio channels (trunks) are wired to the two rows of 12 telephone toggle switches. The upper row of switches is for conference circuit8 1 and 2; the bottom row connects conference circuits 3 and 4. Four conferences may be in progress at one time. Two or more circuits may be connected together by operating the toggle switch above their respective pushbutton-indicators to the same conference circuit position. For example, circuits 2 and 12 can be connected to conference circuit 1 by operating conference switches S2 and S12 to the up position. Circuits 3, 4, and 5 can be connected to conference circuit 4 by operating conference switches Sl5, Sl6, and S17 to the down position. Similarly, two more conferences may be established by utilizing the down position of switches in the upper row (conference circuit 2) and the up position of the switches in the bottom row (conference circuit 3).

SELECT PANEL
NUS 6295-2

DESCRIPTION

Select panel NUS 6295-2 is located at main line Maintenance Control Centers NUS 6283-11 through NUS 6283-20. Space is provided at a maintenance control center (MCC) for up to three select panels. One MCC select panel is required for each nodal van at a main line site. A similar select panel (NUS 6295-1) is required at each nodal van. The MCC select panel and the nodal van select panel are connected in parallel and provide the capability to monitor eight tributary order wire circuits and to select any one of the circuits for two-way communication. Selection can be accomplished from either the MCC select panel or the nodal van select panel. When one panel is used for selecting a tributary order wire circuit, the select capability of the other panel is inhibited. Pertinent characteristics of select panel 6295-2 are as follows:

Operating Voltages	-48 vdc (relays)
	-24 vdc (pushbutton holding coils and indicators)
Output	Continuity or open to an external circuit.

CIRCUIT DESCRIPTION (Figures 1 and 2)

Select panel NUS 6295-2 contains eight pushbutton-indicators (S1 through S8). Each pushbutton-indicator is associated with a tributary order-wire circuit and consists of a pushbutton (with holding coil) and four indicator lamps (two white and two blue). Control relays K1 through K8 are associated with pushbutton-indicators S1 through S8, respectively, The select panel also contains RESET pushbutton S9, control relays K9 through K12 and indicator XDS1(two amber lamps and two blue lamps). Since the operation of all eight pushbutton-indicator circuits is identical, only one circuit is described.

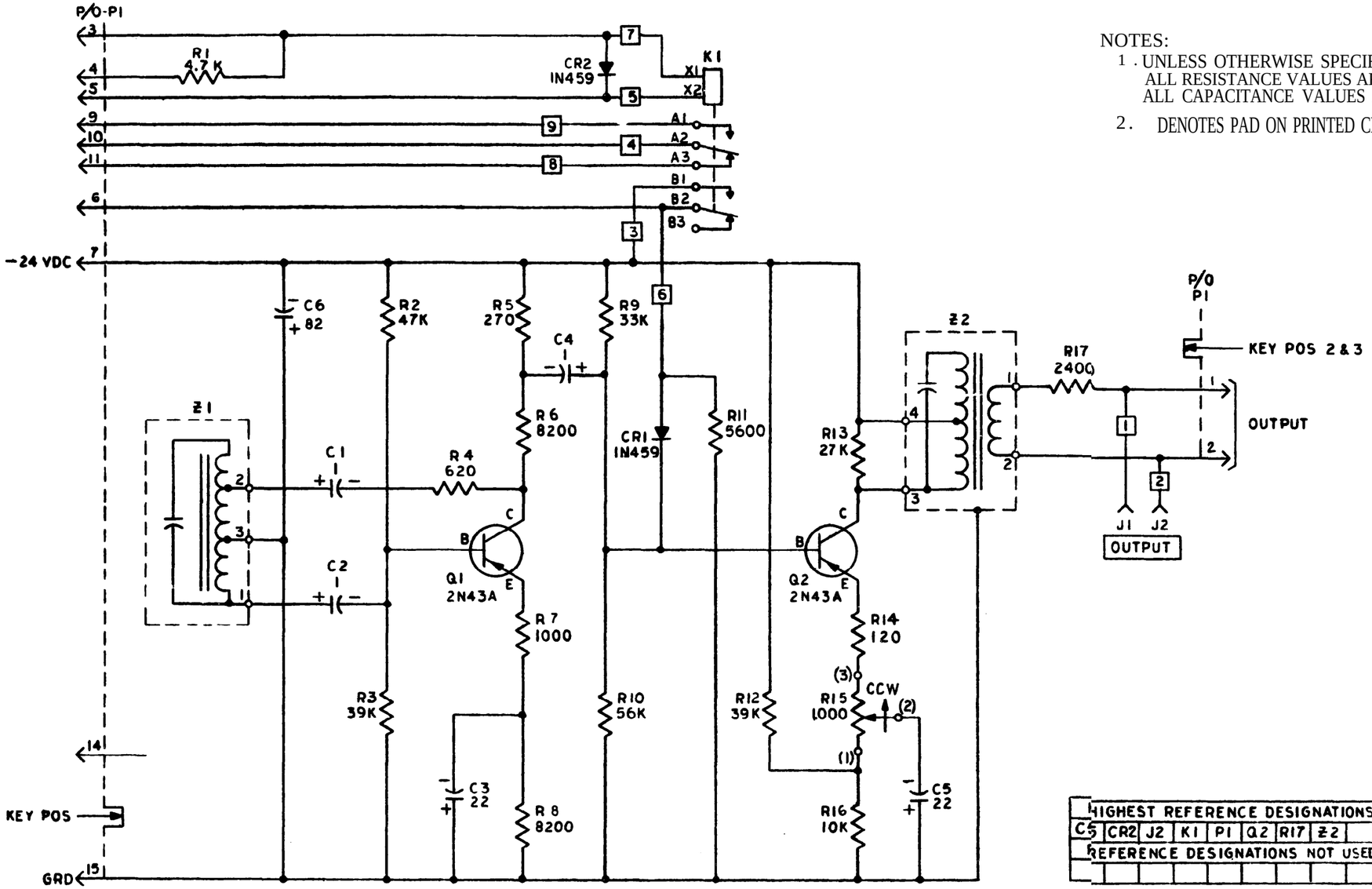
Initially, all pushbuttons are released, all indicators are off, relays K1 through K9 and K12 are de-energized, and relays K10 and K11 are energized. When tone receiver 1 is activated, relays K1 and K9 are energized and lock-up. The lock-up ground for relays K1 and K9 is applied through RESET switch S9. At this point the S1 indicator is steady white and ground is applied to J2-c (RELAY LOGIC INPUT). Depressing the S1 pushbutton causes the S1 indicator to change from steady white to steady blue. Pushbutton S1 is held in the "operate" or "in" position by the associated holding coil With pushbutton S1 held in the "operate" position, the S1 indicator and the MCC ACK indicator remain steady blue, a ground is applied to J1-K (REMOTE SEL 1) and the operating ground for relay K10 is removed. The ground at J1-K causes order wire circuit No. 1 to be connected to the order wire bridge amplifier through the remote select panel (select panel at nodal van).

With relay K10 de-energized, the XDS1 indicator on this select panel is steady blue and the XDS1 indicator on the remote select panel is steady amber. The blue indication on this panel (at MCC) and the amber indication at the remote panel (at nodal van) inform the maintenance men that the MCC select panel has control.

The RESET pushbutton at the MCC select panel or the RESET pushbutton at the nodal van select panel may be used to return the circuit to the initial state. Depressing either RESET pushbutton causes the S1 pushbutton to release, the S1 indicator to go off, relays

K1, K9, and K11 to de-energize, and relay K10 to energize. Relay K11 will be de-energized only while the RESET pushbutton is depressed. Relay K12 is controlled from an external circuit (RELAY LOGIC BUS SWITCH).

The diodes connected across each relay coil and **pushbutton** holding coil prevent high voltage buildup when the operating voltage is removed. The remaining diodes isolate the pushbutton-indicator circuits from each other.



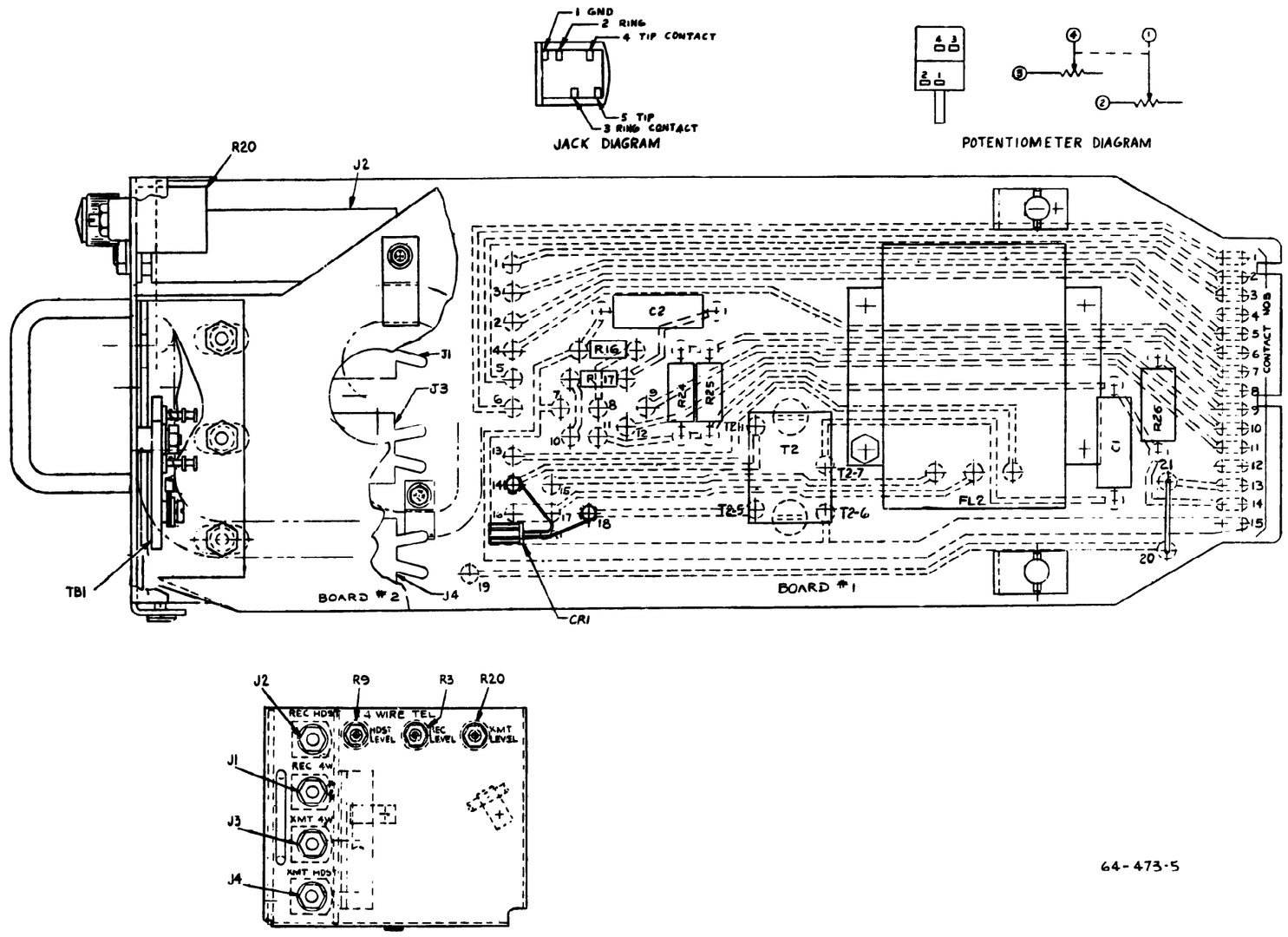
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT.
   ALL CAPACITANCE VALUES ARE IN MICROFARADS.
2. DENOTES PAD ON PRINTED CIRCUIT BOARD

HIGHEST REFERENCE DESIGNATIONS								
C5	CR2	J2	K1	P1	Q2	R17	Z2	
REFERENCE DESIGNATIONS NOT USED								

64-594-1

Figure 1. 1600 CPS Tone Generator NUS 5165-30G1, Schematic Diagrtam



64-473-5

Figure 4. 4-Wire Telephone NUS 5165-45, Parts Location (Sheet 1 of 2)

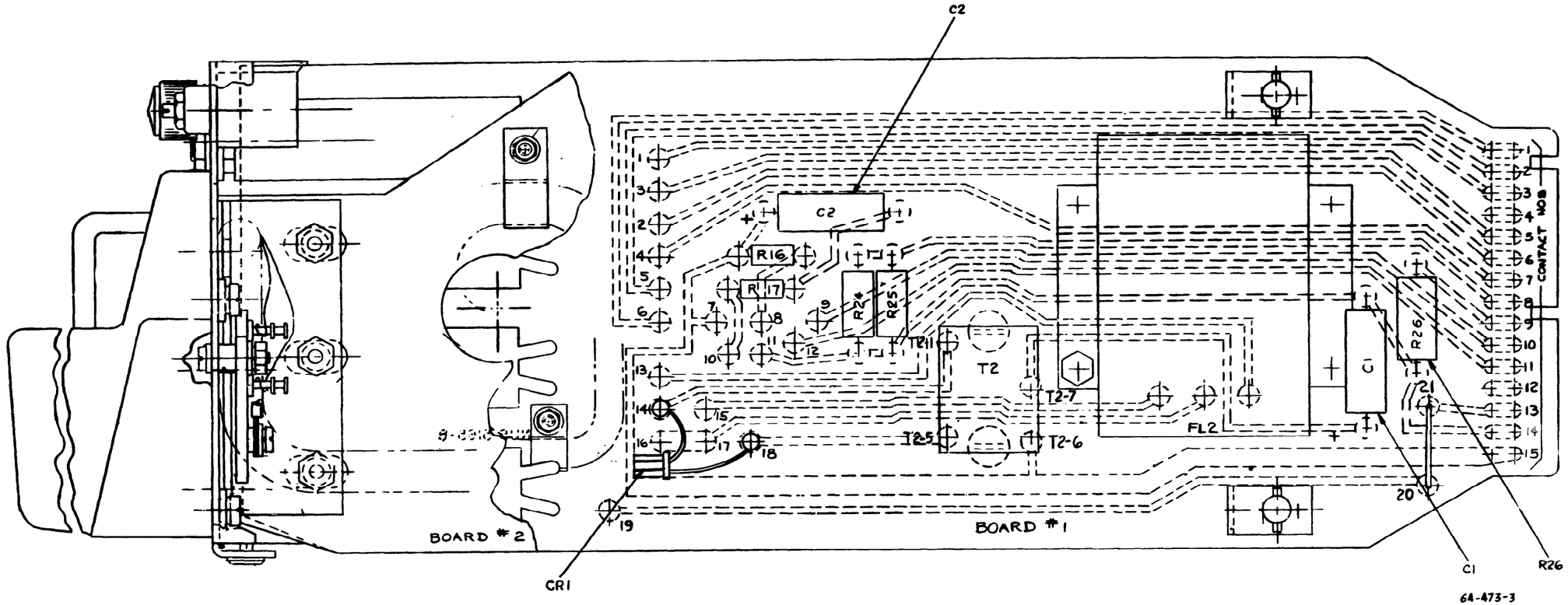


Figure 3. 4-Wire Telephone NUS 5165-8G3, Parts Location (Sheet 3 of 3)

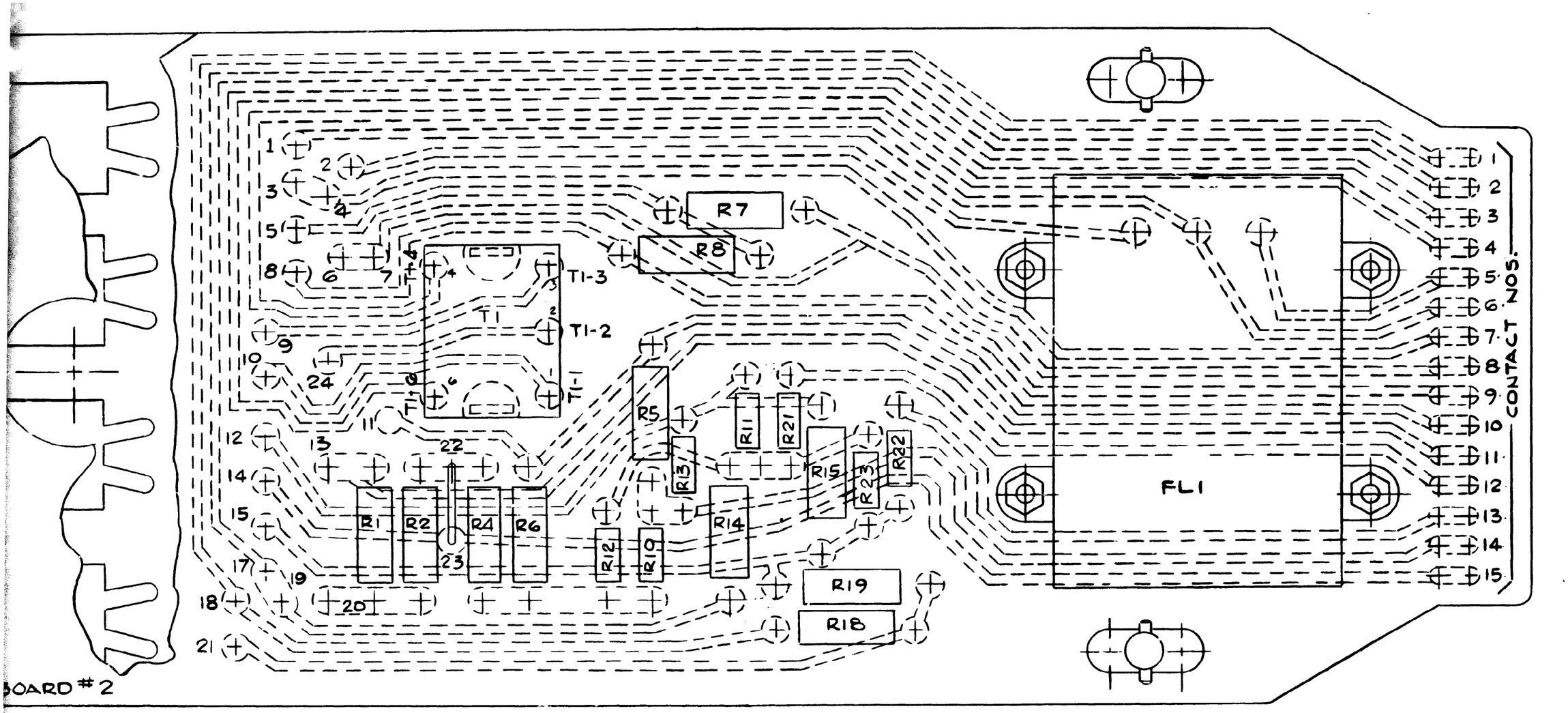


Figure 3. 4-Wire Telephone
NUS 5165-8
Parts Location
(Sheet 2 of 3)

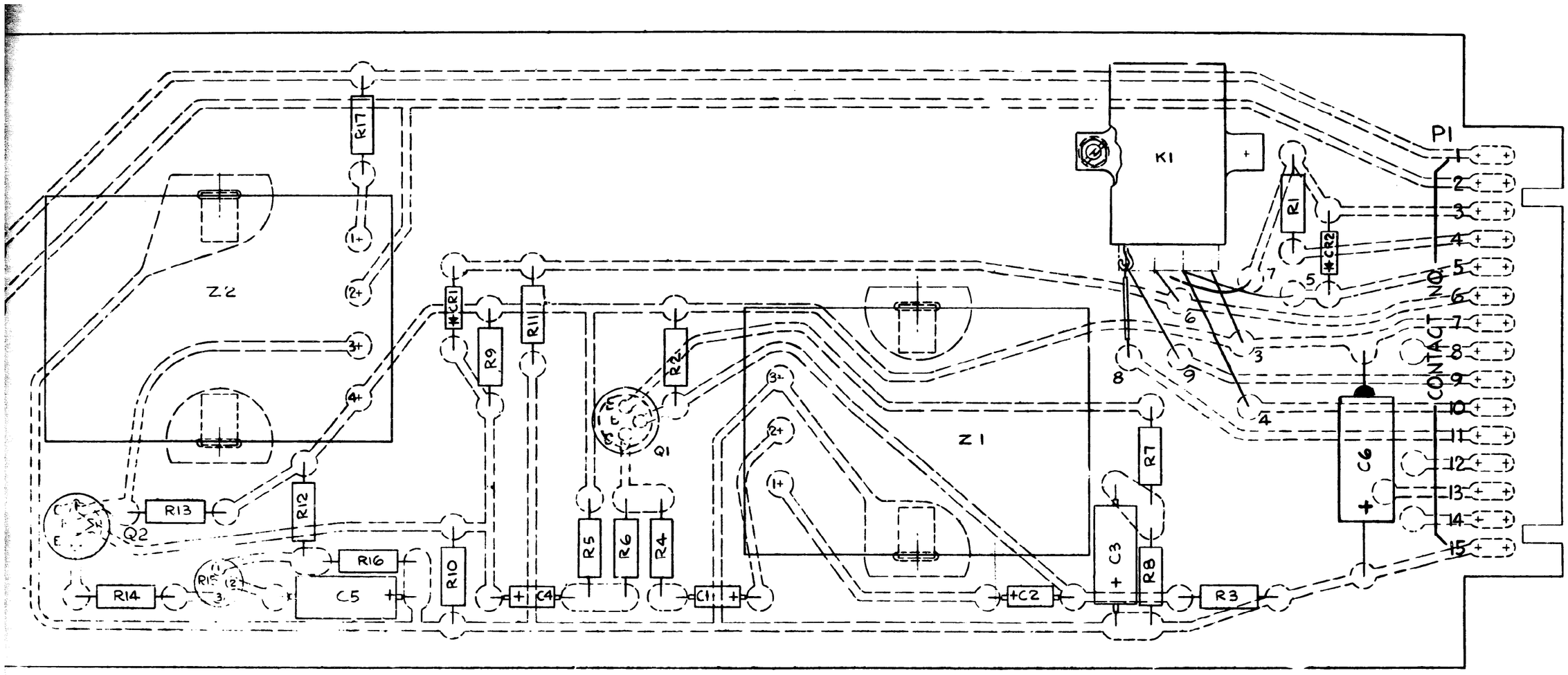
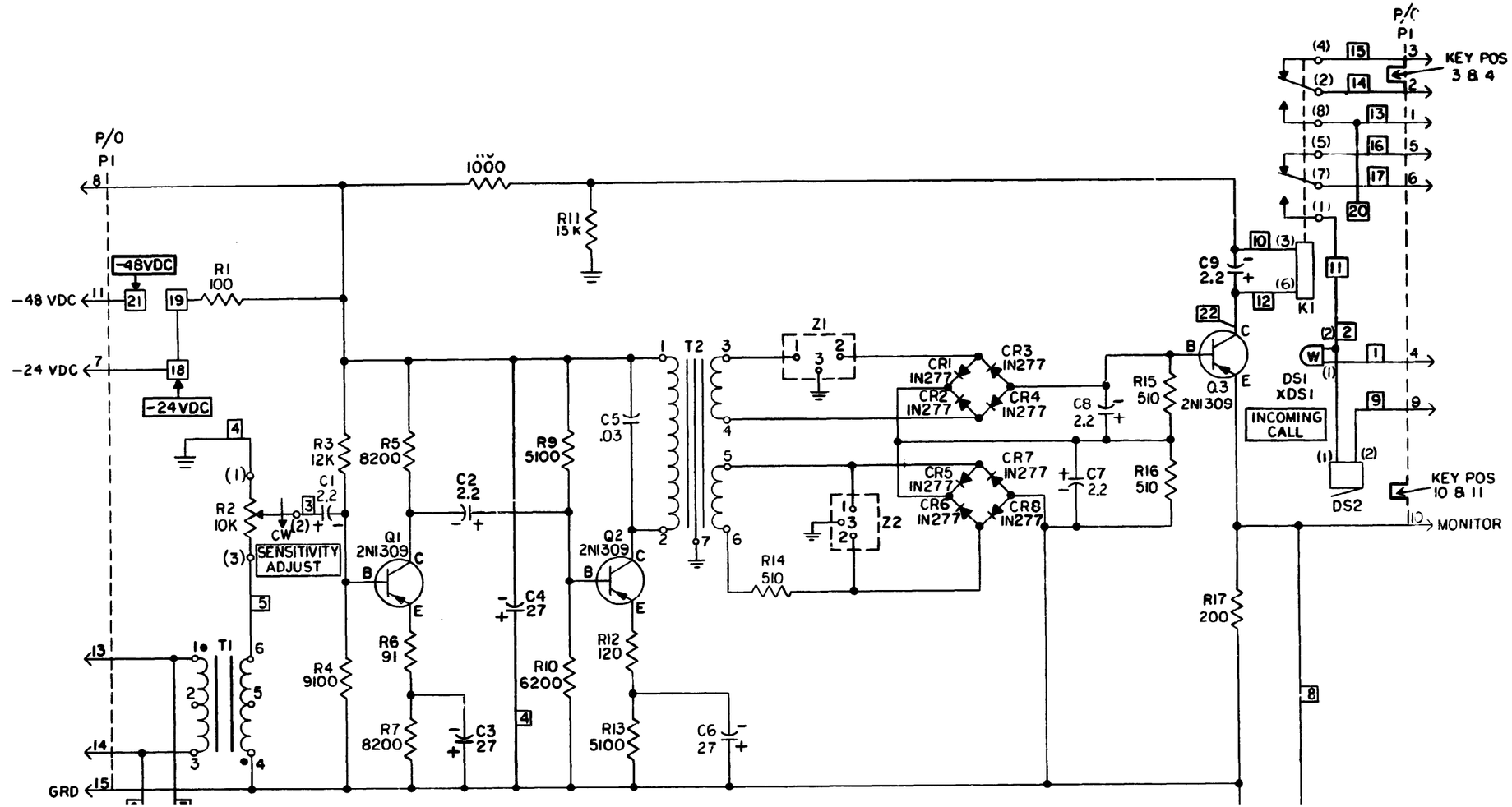


Figure 2. 1600 CPS Tone Generator
NUS 5165-30G1
Parts Location

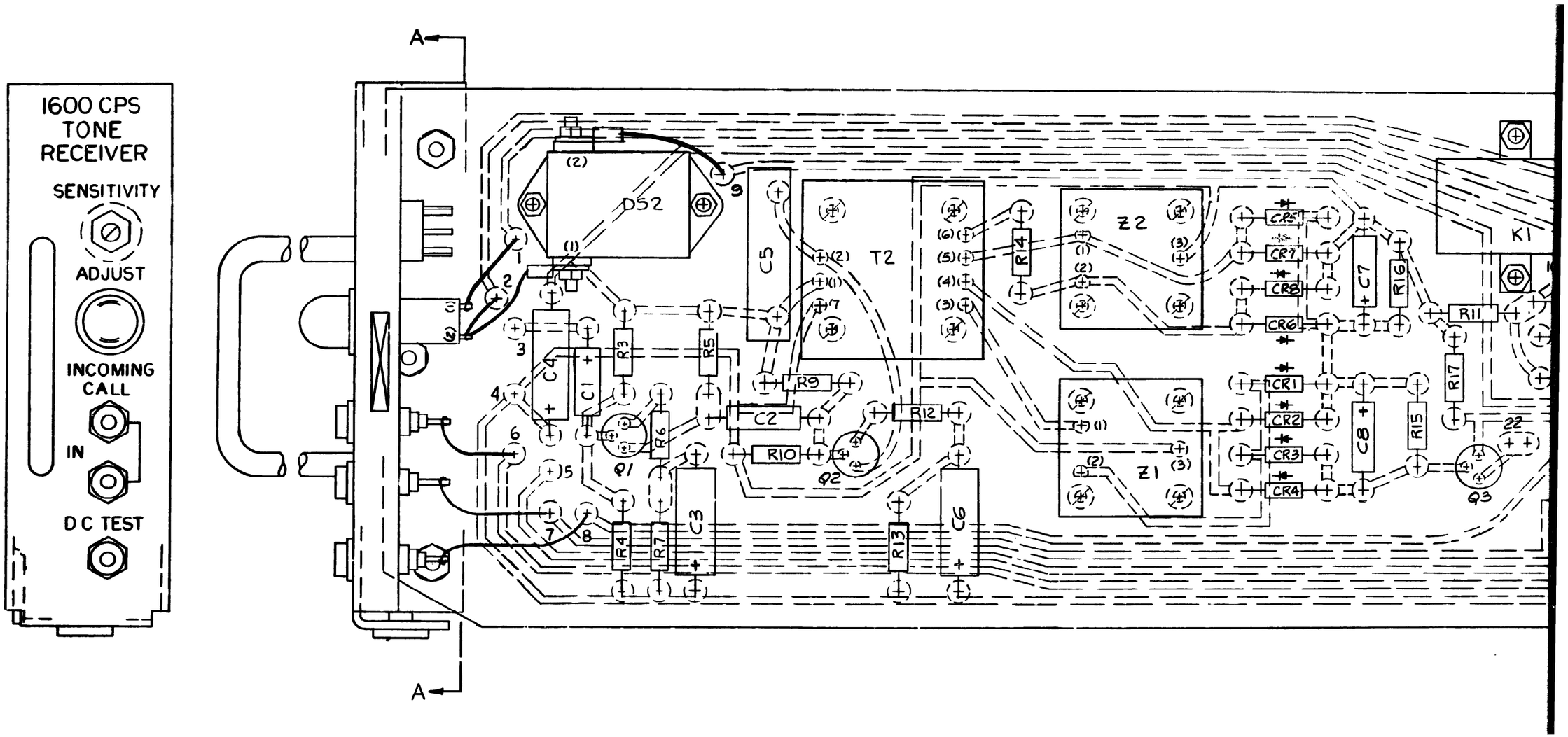


NOTES:

1. NUMBERS IN PARENTHESIS ARE FOR REFERENCE ONLY.
2. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES IN OHMS, 1/2 WATT.
   CAPACITANCE VALUES ARE IN MICROFARADS.
3. ON T1 DENOTES START OF WINDINGS.
4. DENOTES PADS ON PRINTED CIRCUIT BOARD.

64-595-1

Figure 1. 1600 CPS Tone Receiver NUS 5165-37G1, Schematic Diagram


1600 CPS
TONE
RECEIVER
SENSITIVITY
ADJUST
INCOMING
CALL
IN
DC TEST
A
A
DS2
C5
T2
R14
Z2
K1
CR5
CR7
CR8
CR6
C7
R16
R11
R17
C4
C1
R3
R5
R9
C2
R12
R10
Q1
Q2
R6
C3
R4
R7
R13
C6
Z1
CR1
CR2
CR3
CR4
C8
R15
Q3
1
2
3
4
5
6
7
8
9
22

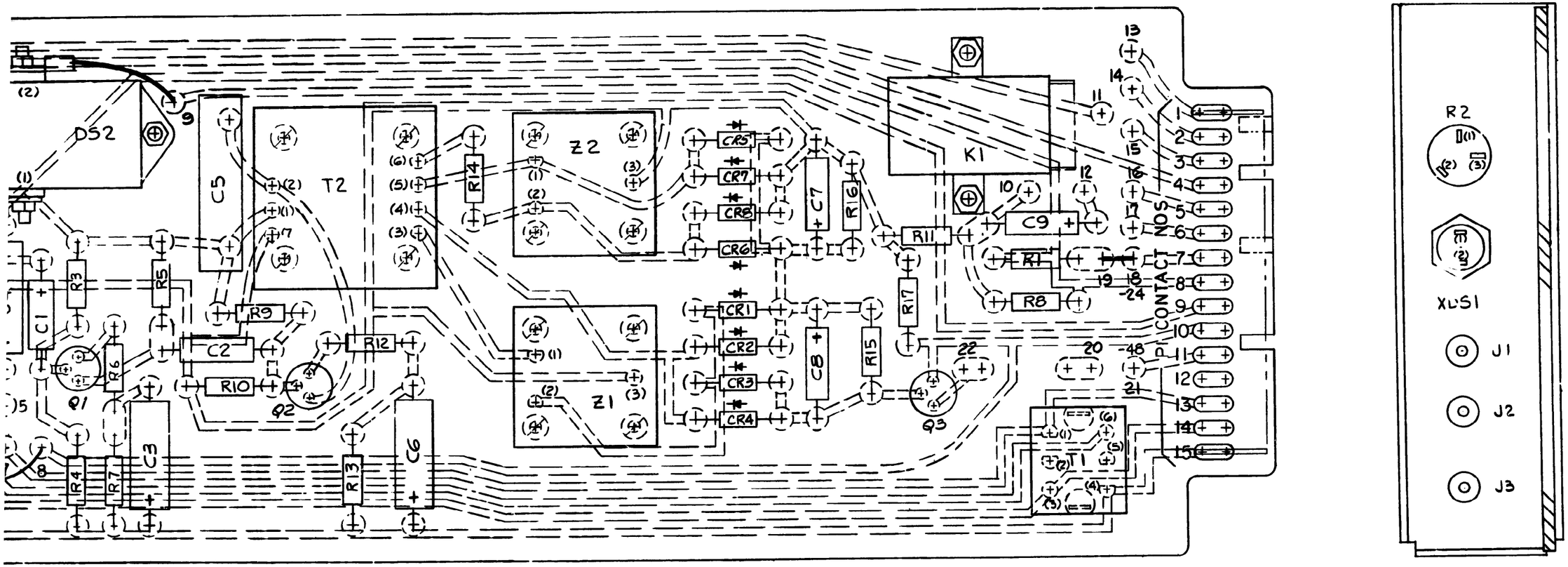
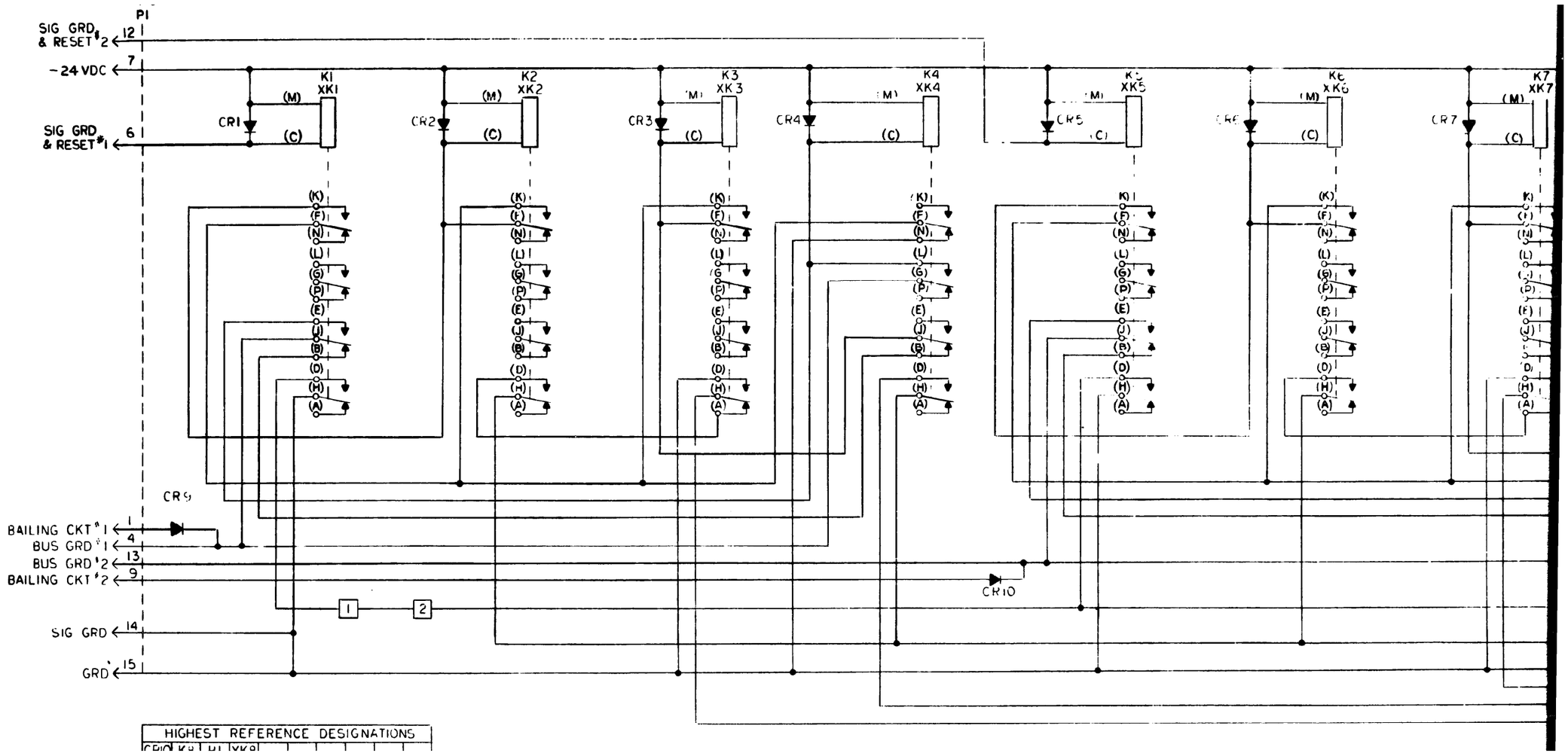


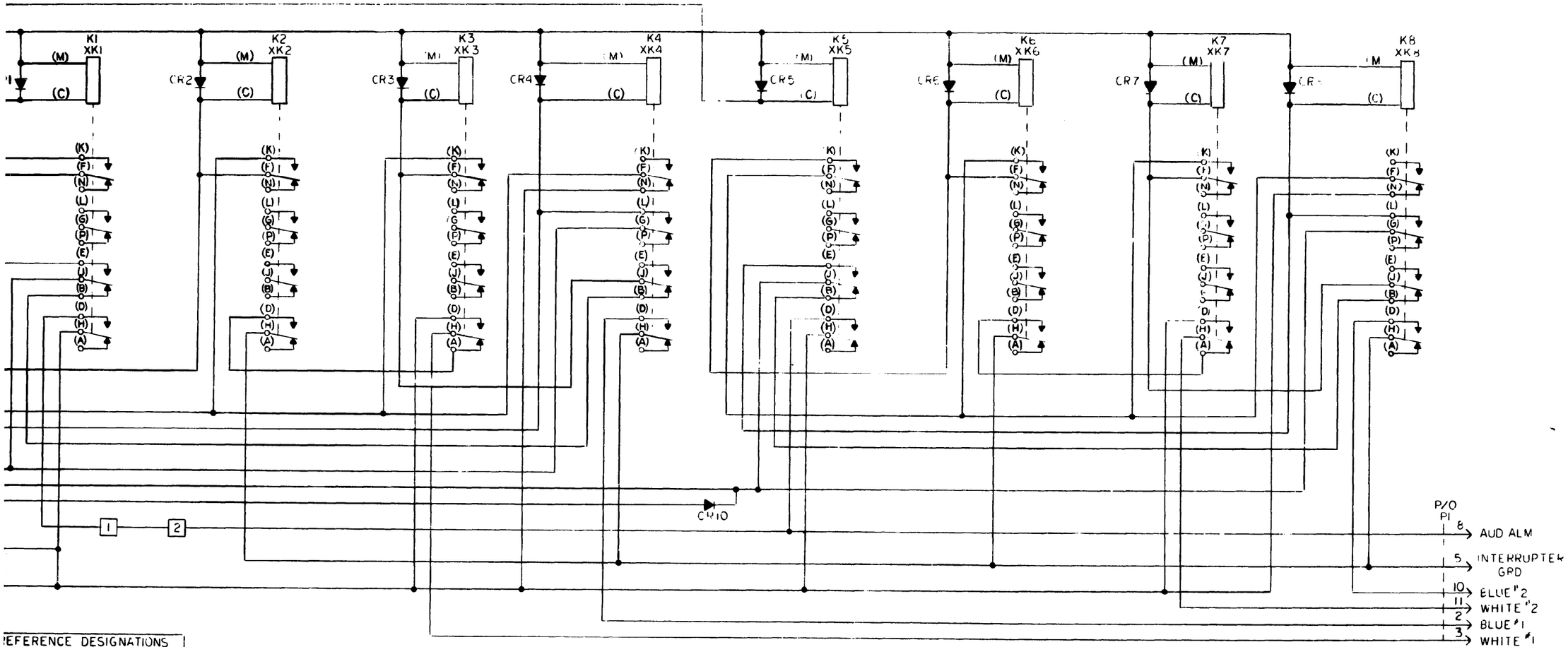
Figure 2. 1600 CPS Tone Receiver NUS 5165-37G1. Parts Location



HIGHEST REFERENCE DESIGNATIONS										
CR10	K8	P1	XK8							
REFERENCE DESIGNATIONS NOT USED										

NOTE:

1. ALL DIODES ARE TYPE IN459.
2. LETTERS IN PARENTHESES ARE FOR REFERENCE ONLY.
3. □ DENOTES PAD NUMBERS ON PRINTED CIRCUIT BOARD.

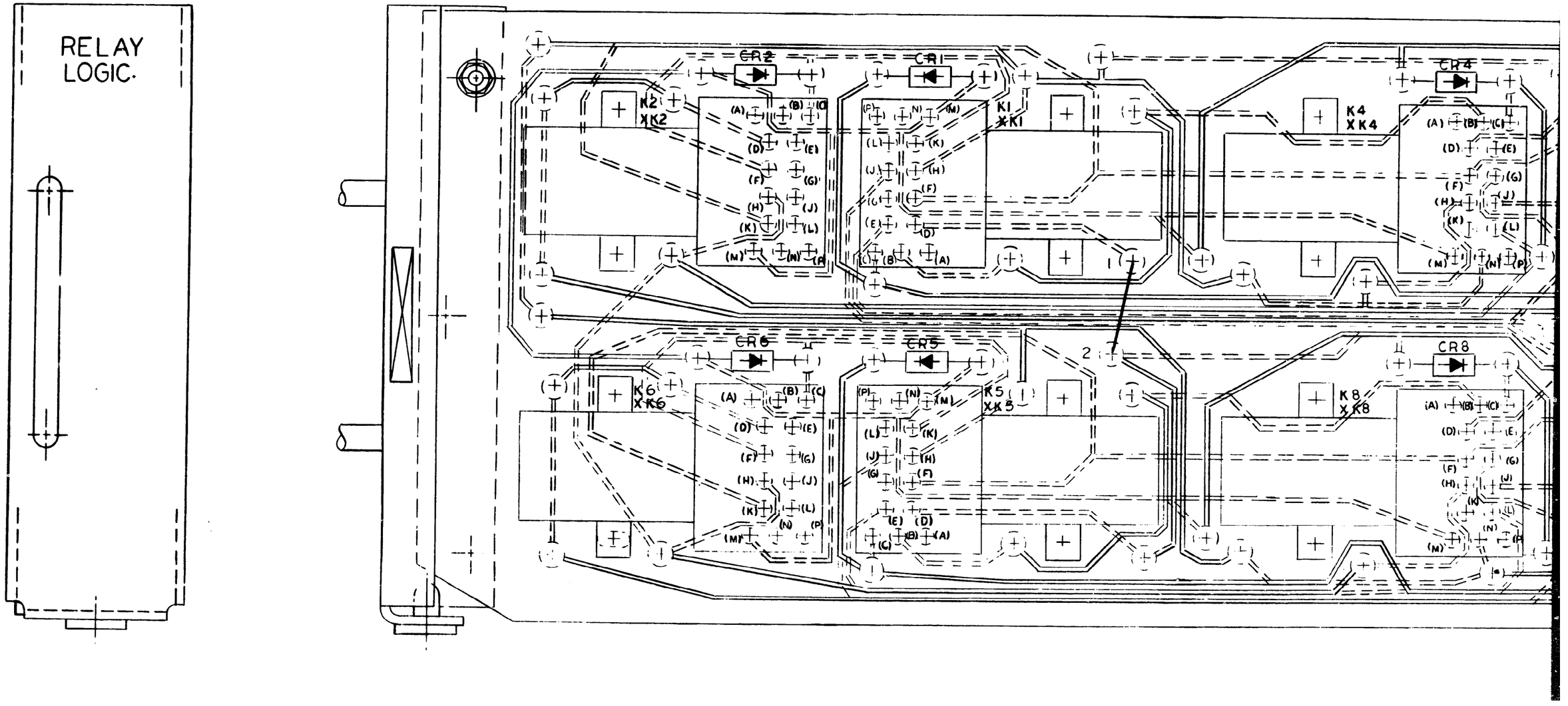


REFERENCE DESIGNATIONS
(K8
(K8
DESIGNATIONS NOT USED

NOTE:

1. ALL DIODES ARE TYPE IN459.
2. LETTERS IN PAREMTHESES ARE FOR REFERENCE ONLY.
3. DENOTES PAD NUMBERS ON PRINTED CIRCUIT BOARD.

Figure 1. Relay Logic NUS 5165-41G1 Schematic Diagram


RELAY
LOGIC.
CR2
CR1
CR4
K2
XK2
K1
XK1
K4
XK4
CR6
CR5
CR8
K6
XK6
K5
XK5
K8
XK8
2

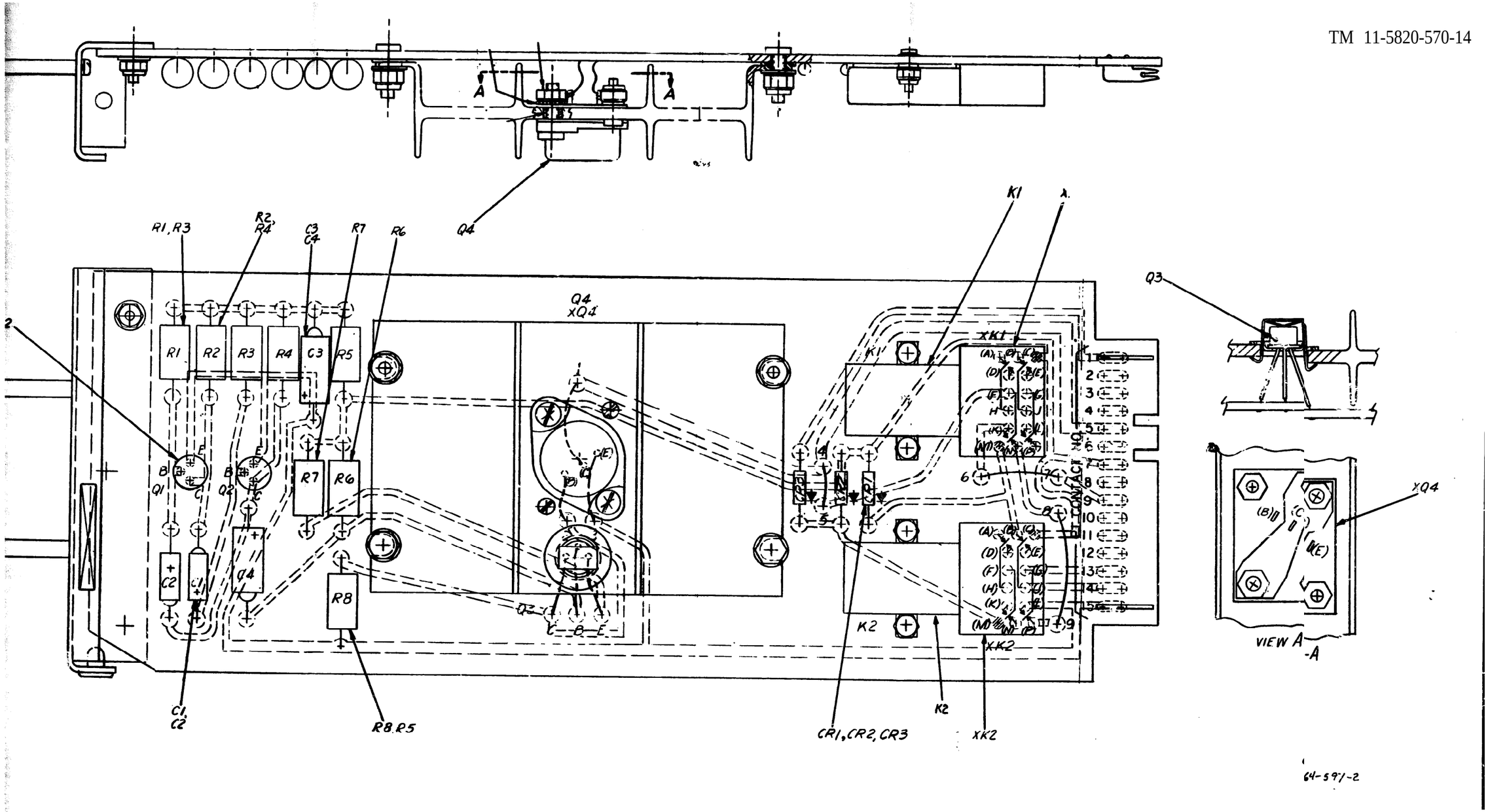
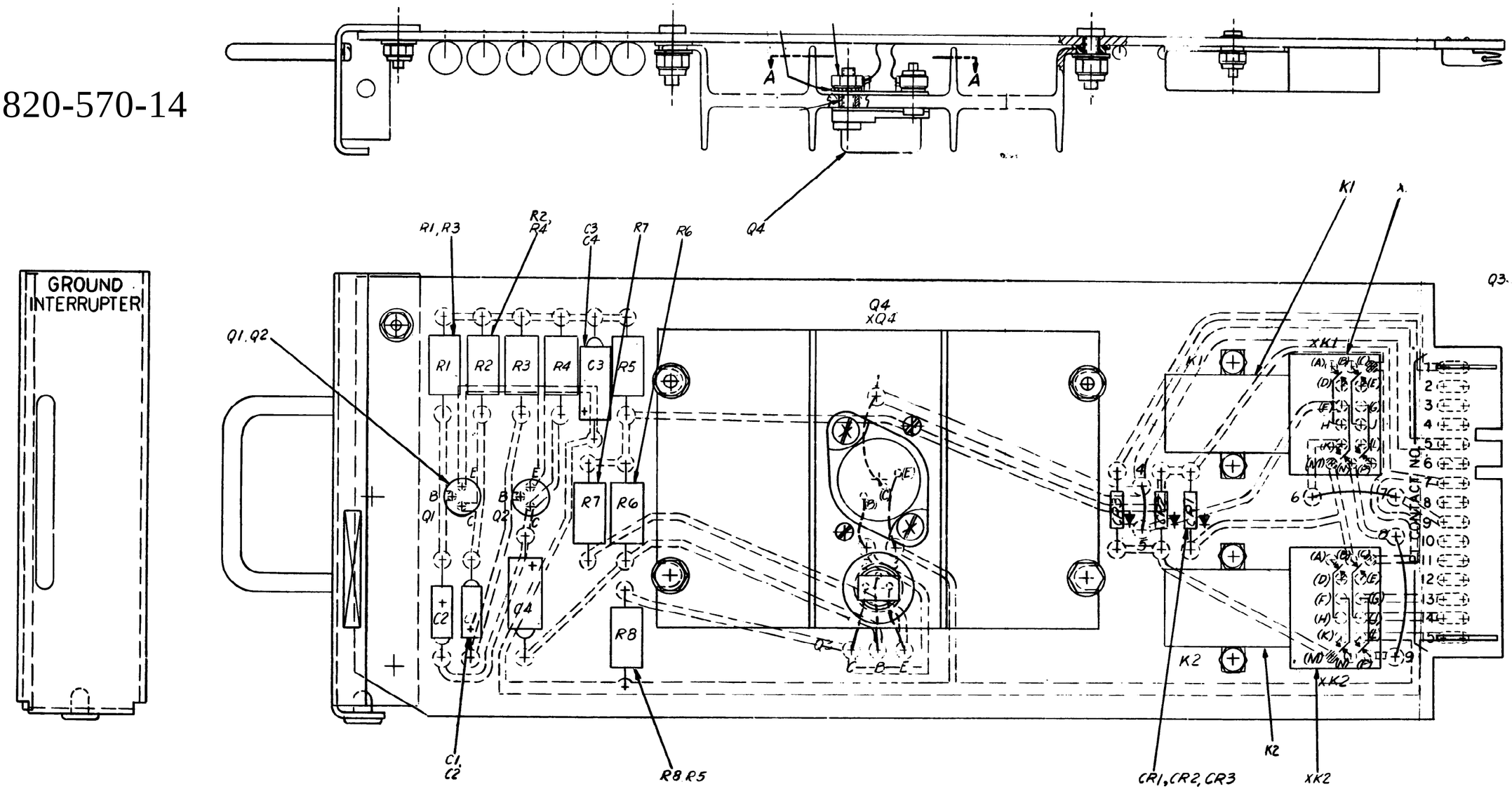
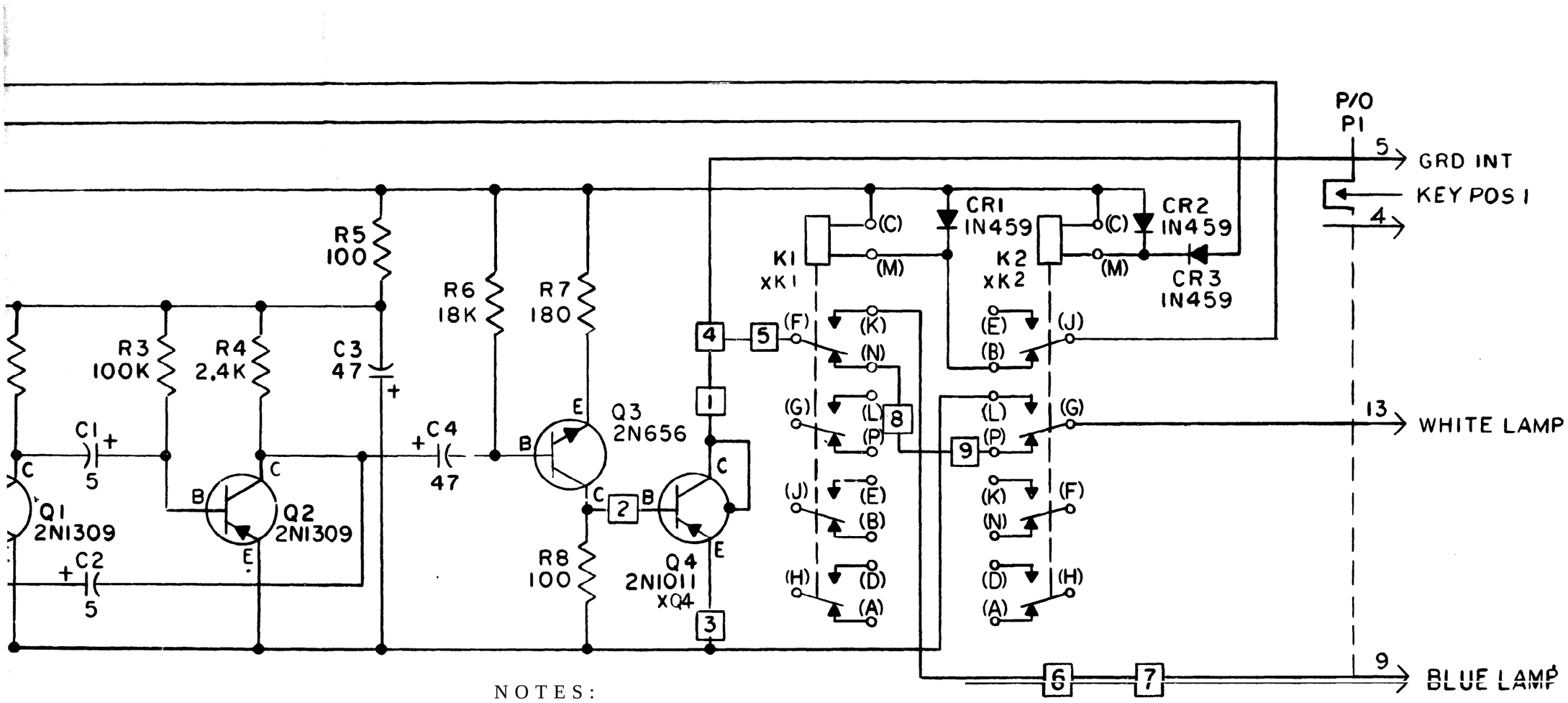


Figure 2. Ground Interrupter NUS 5165-43G1, Parts Location


GROUND INTERRUPTER
A
A
Q4
R1, R3
R2, R4
C3 C4
R7
R6
Q1, Q2
R1
R2
R3
R4
C3
R5
R7
R6
Q1
Q2
C2
C1
Q4
R8
Q4 XQ4
K1
A
XK1
Q3
K2
XK2
C1, C2
R8 R5
CR1, CR2, CR3
K2
XK2

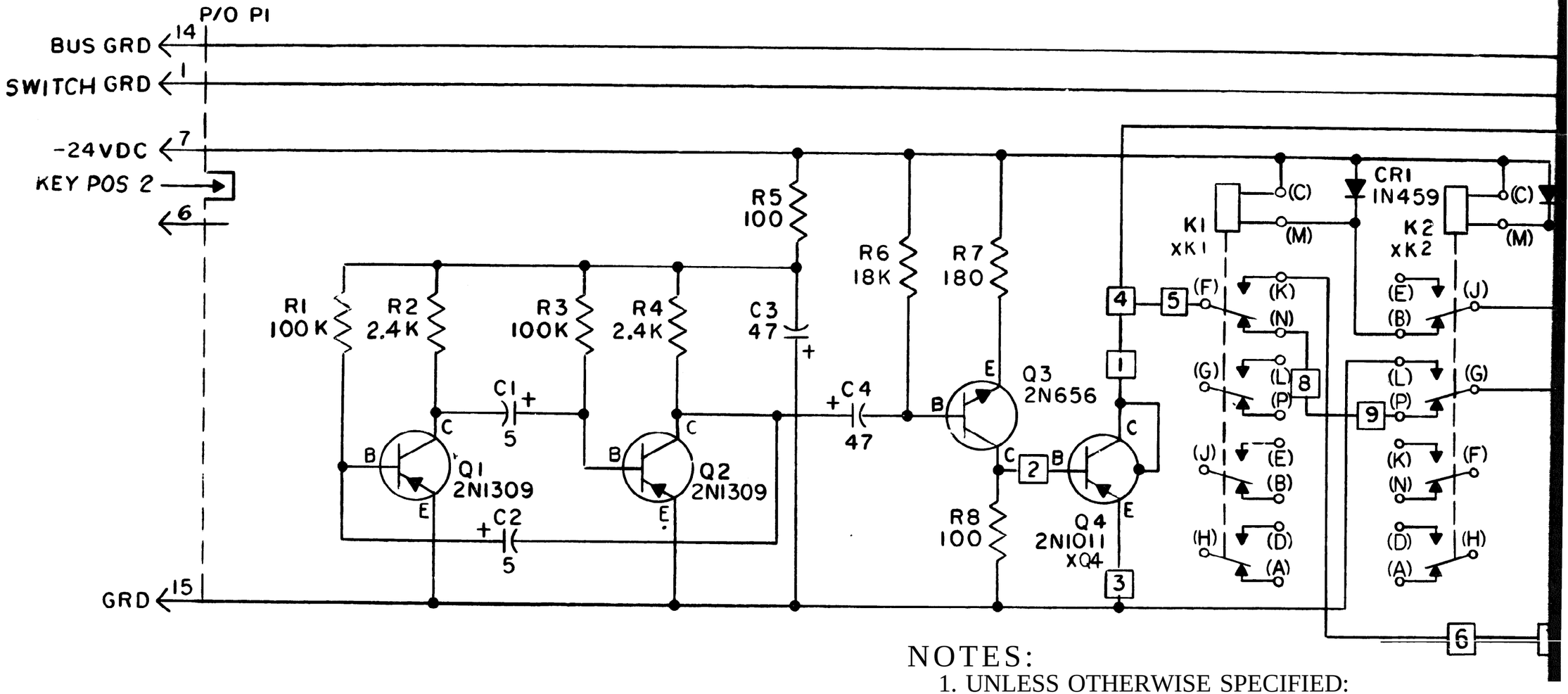


NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, 2 WATT.
   CAPACITANCE VALUES ARE IN MICROFARADS.
2. DENOTES PAD ON PRINTED CIRCUIT BOARD.
3. LETTERS IN PARENTHESES ARE FOR REFERENCE ONLY.

64-597-1

Figure 1. Ground Interrupter NUS 5165-43G1, Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, 2 WATT.
   CAPACITANCE VALUES ARE IN MICROFARADS.
2. DENOTES PAD ON PRINTED CIRCUIT BOARD.
3. LETTERS IN PARENTHESES ARE FOR REFERENCE ONLY.

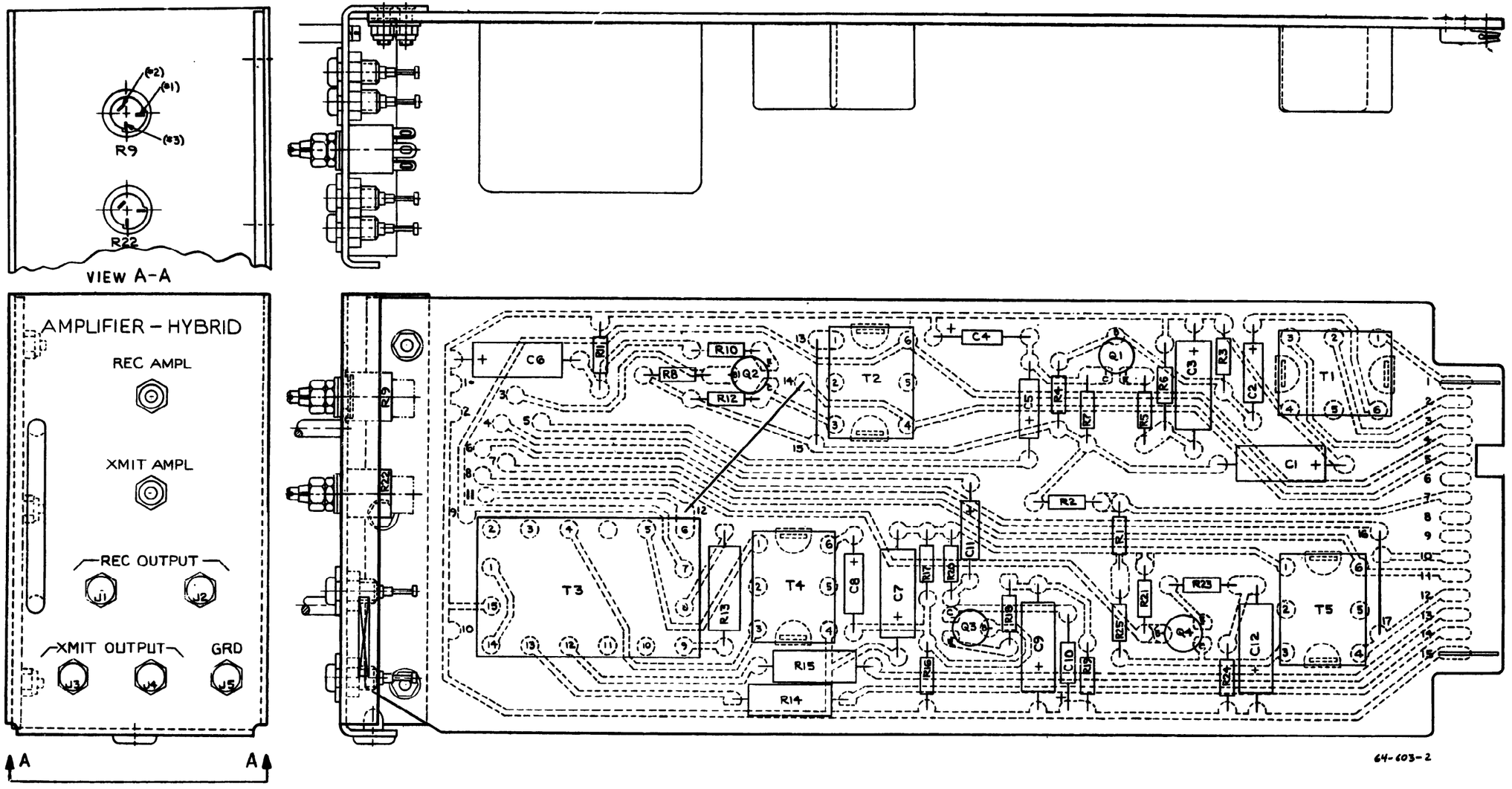
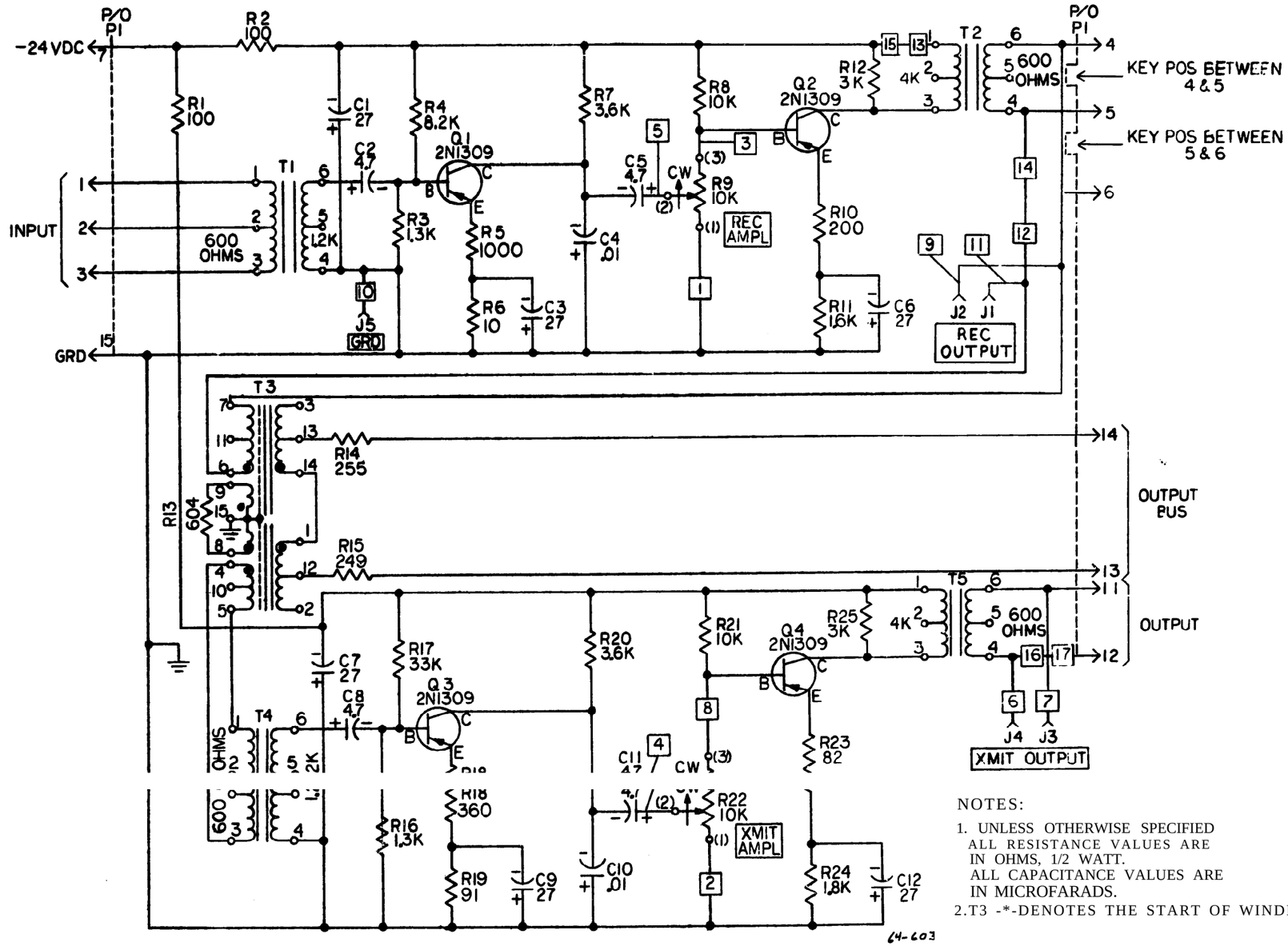


Figure 2. Amplifier-Hybrid NUS 5165-42G1, Parts Location



NOTES:

1. UNLESS OTHERWISE SPECIFIED
   ALL RESISTANCE VALUES ARE
   IN OHMS, 1/2 WATT.
   ALL CAPACITANCE VALUES ARE
   IN MICROFARADS.
2. T3 -*-DENOTES THE START OF WINDINGS

Figure 1. Amplifier-Hybrid NUS 5165-42G1, Schematic Diagram

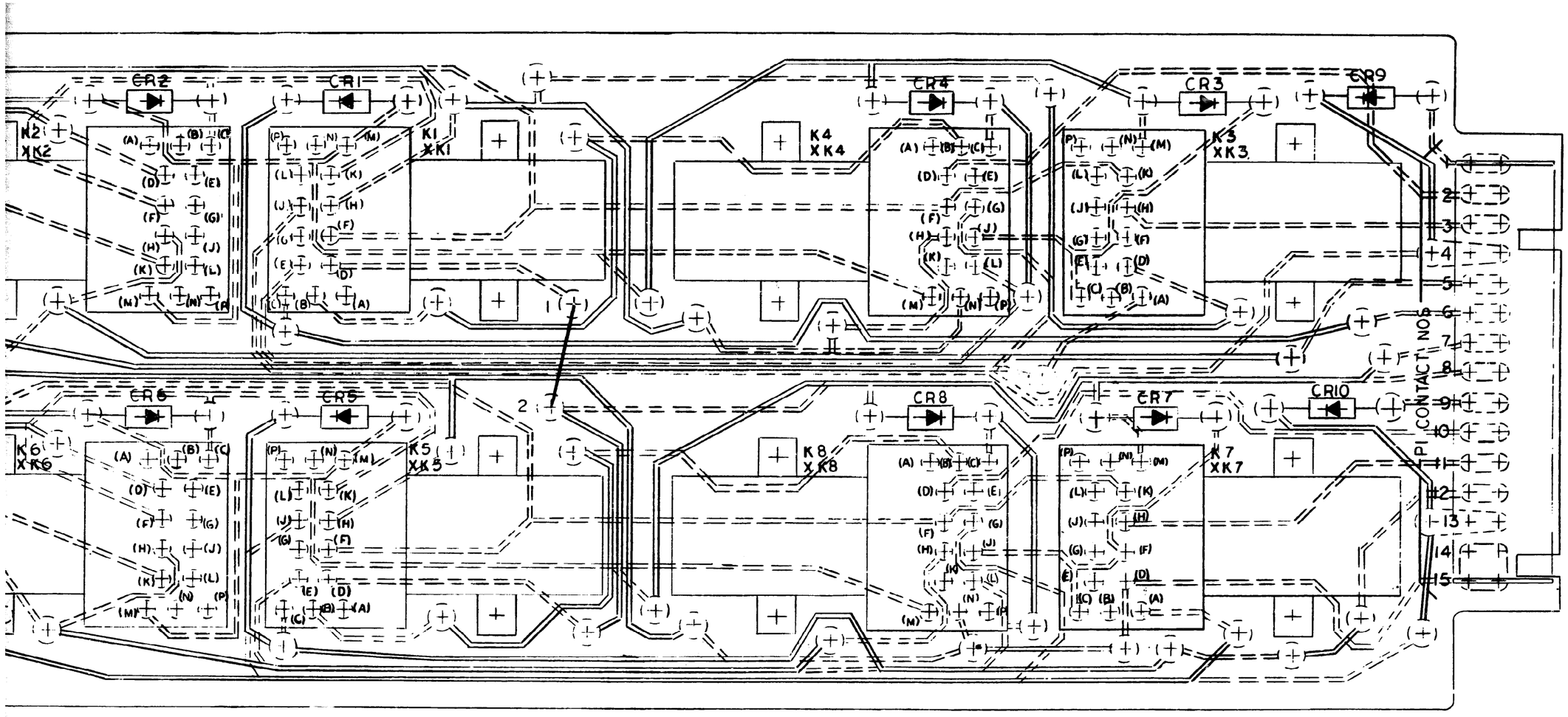
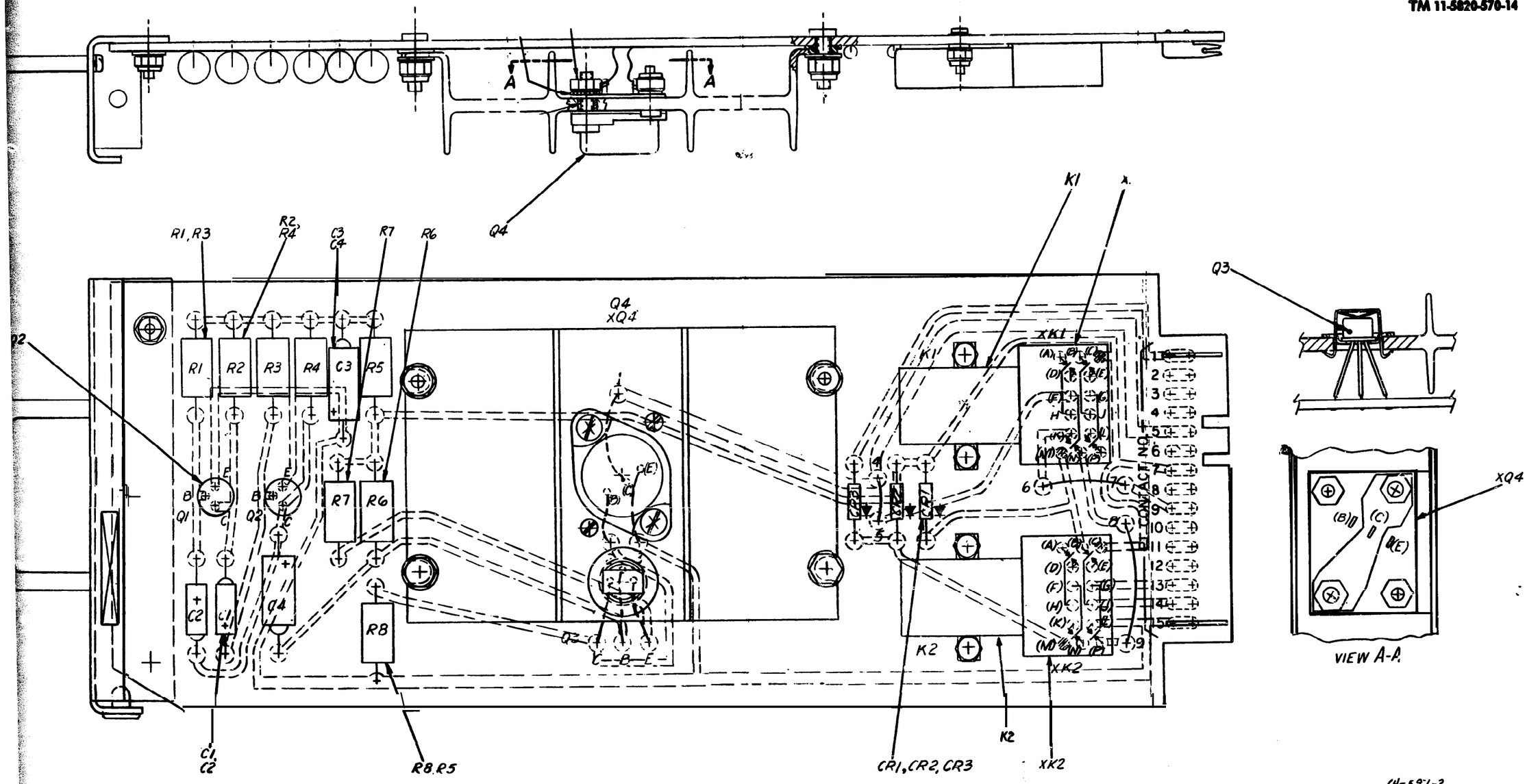
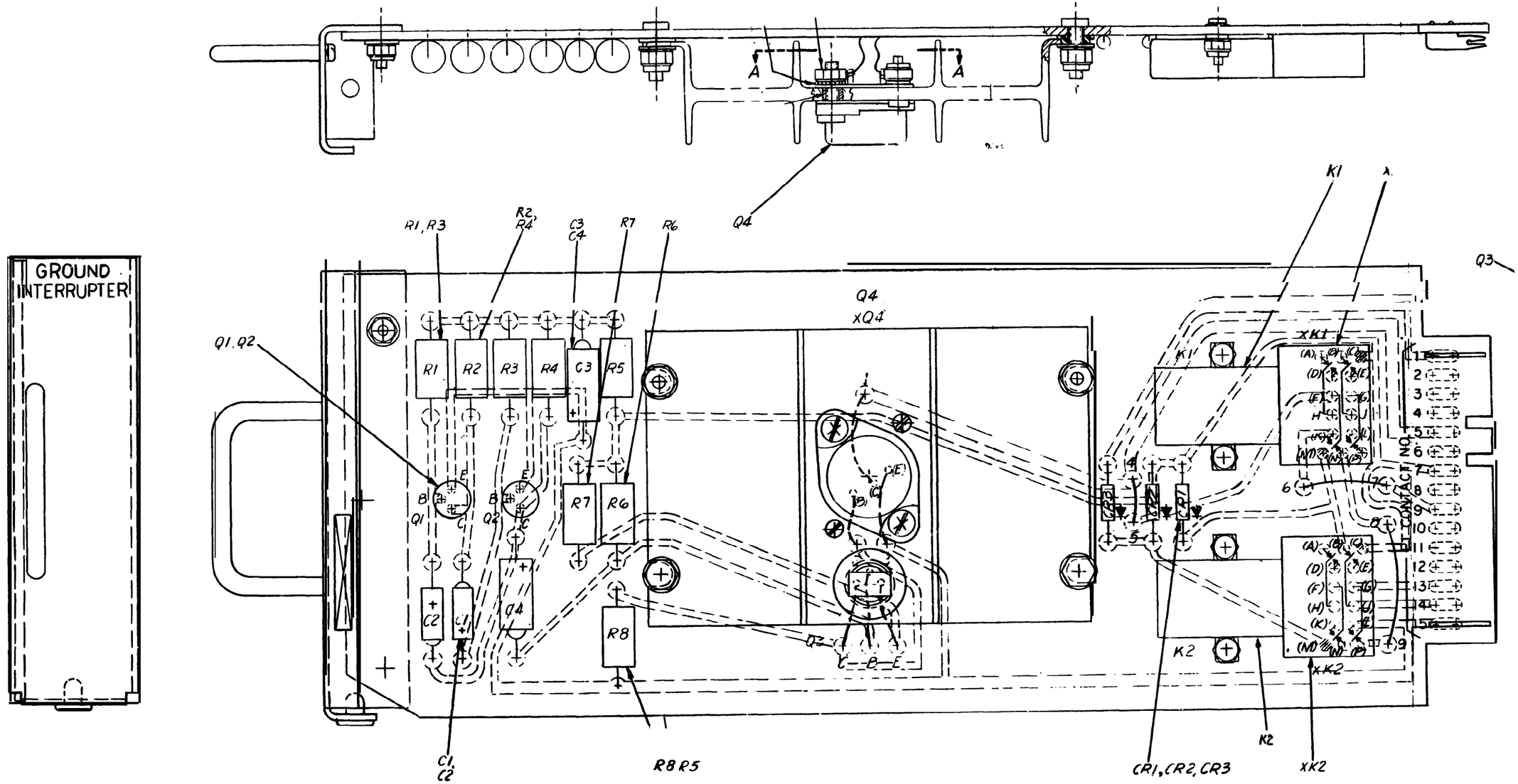
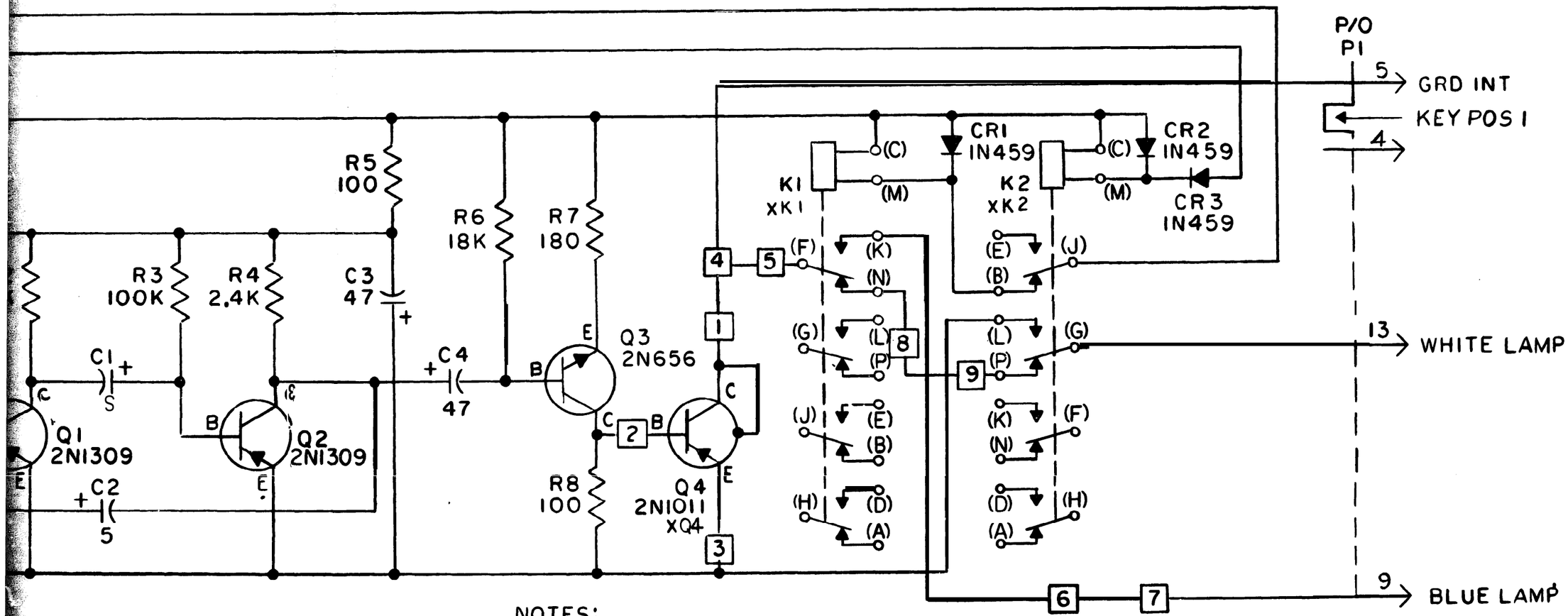


Figure 2. Relay Logic NUS 5165-41G1.
Parts Location



Ground Interrupter NUS 5165-43G1, Parts Location


GROUND INTERRUPTER
A
A
Q4
R1, R3
R2, R4
C3 C4
R7
R6
Q1, Q2
R1
R2
R3
R4
C3
R5
Q4
XQ4
R7
R6
R8
C2
C1
Q1
Q2
C1 C2
R8 R5
K1
XK1
Q3
K1
K2
XK2
CR1, CR2, CR3
K2
XK2
EDGE CONTACT NO.

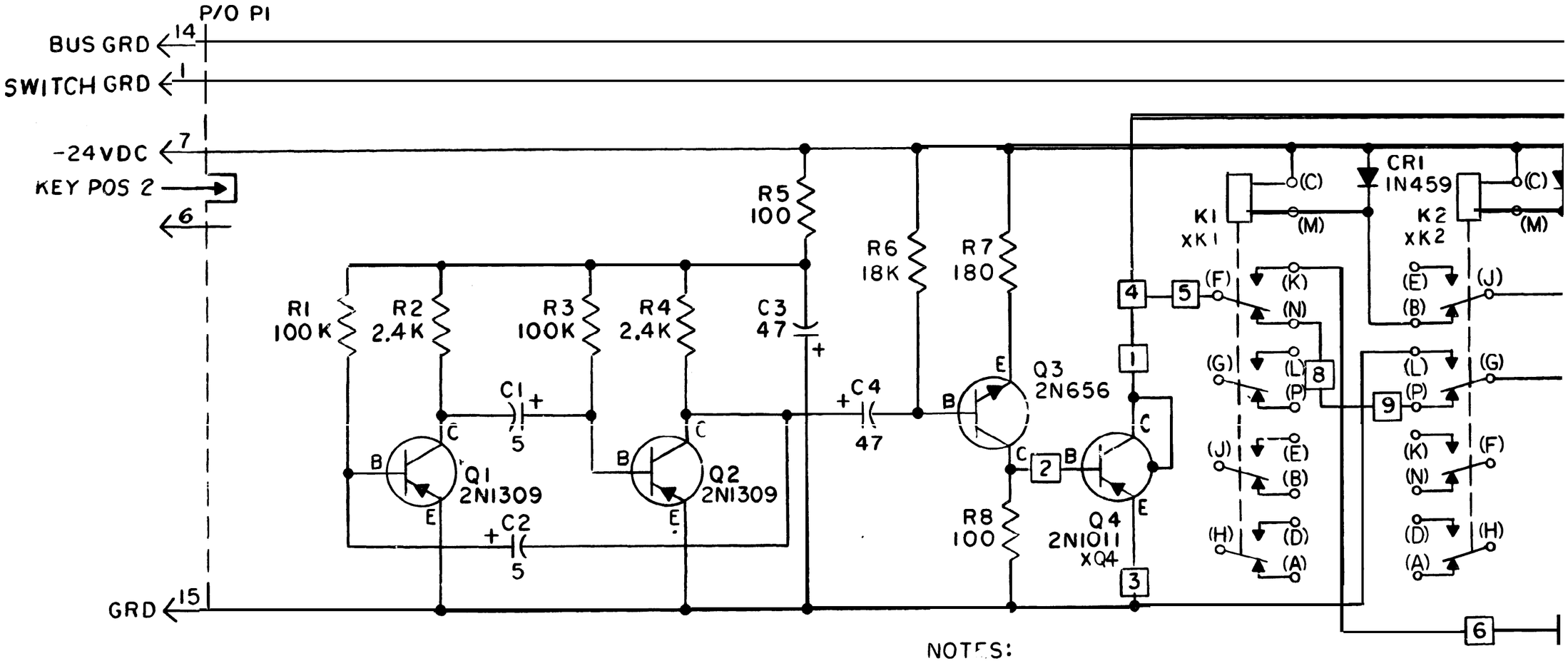


NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, 2 WATT.
   CAPACITANCE VALUES ARE IN MICROFARADS.
2. ☐ DENOTES PAD ON PRINTED CIRCUIT BOARD.
3. LETTERS IN PARENTHESES ARE FOR REFERENCE ONLY.

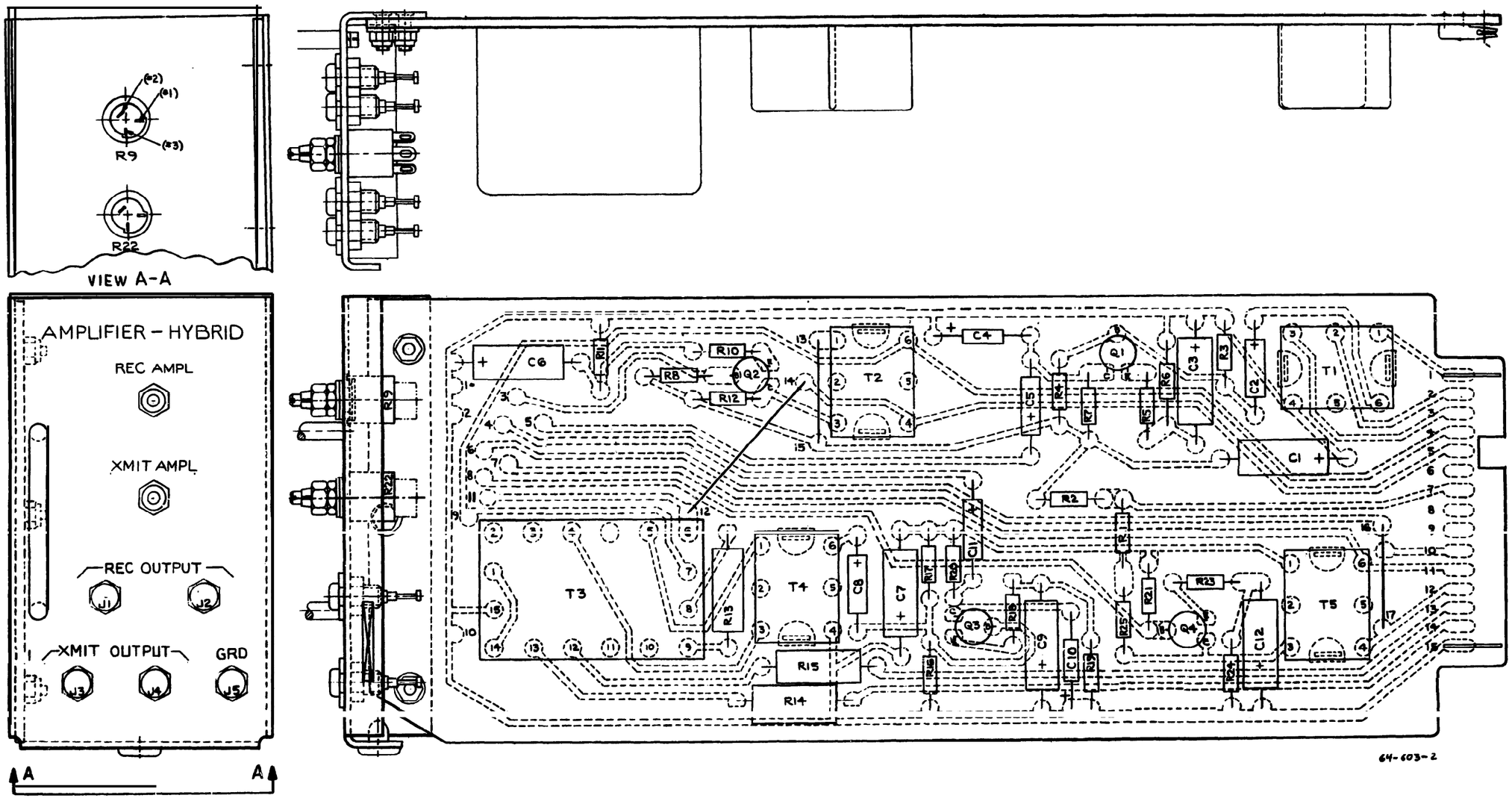
64-597-1

Ground Interrupter NUS 5165-43G1, Schematic Diagram

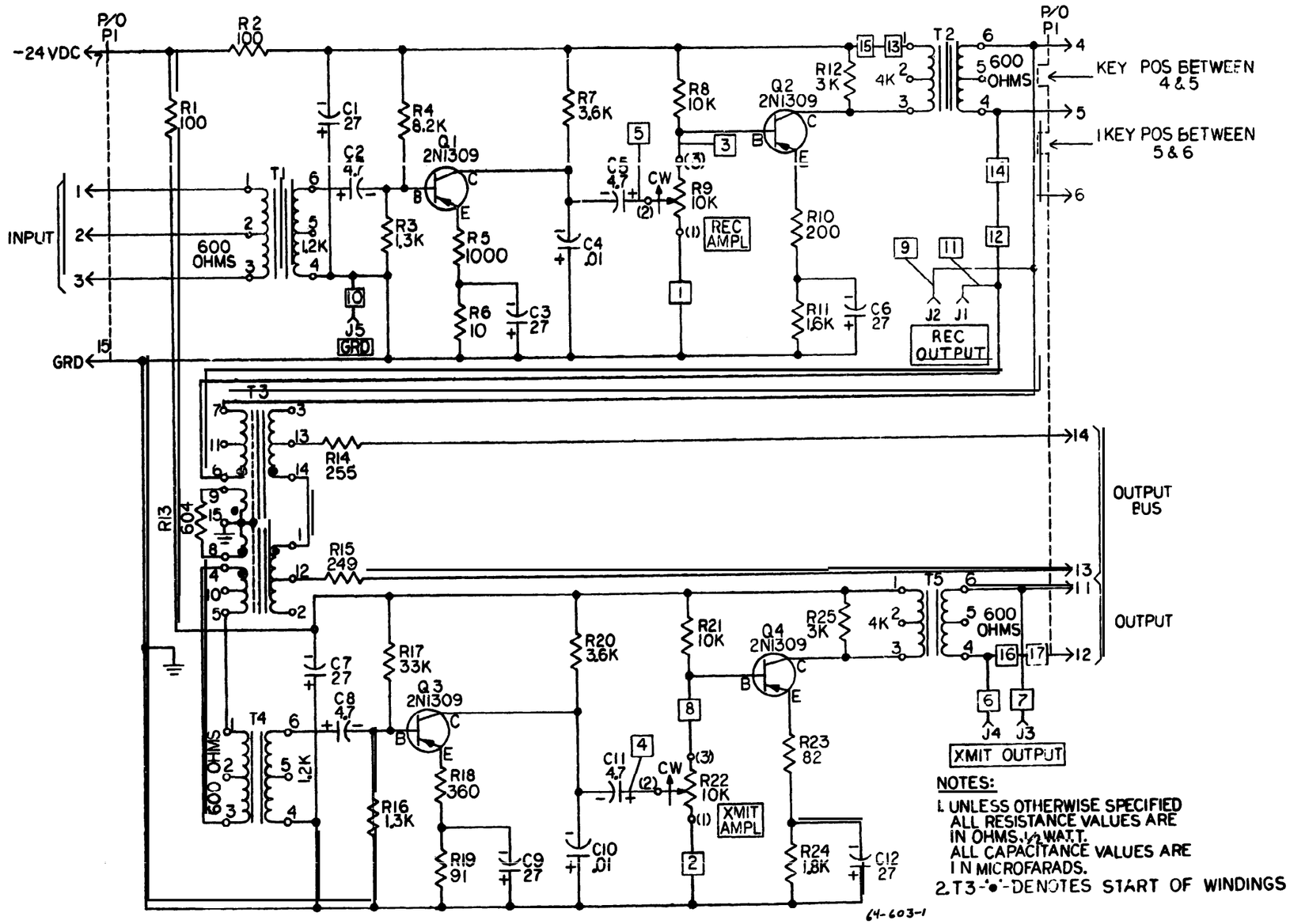


NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, 2 WATT.
   CAPACITANCE VALUES ARE IN MICROFARADS.
2. ☐ DENOTES PAD ON PRINTED CIRCUIT BOARD.
3. LETTERS IN PARENTHESES ARE FOR REFERENCE ONLY



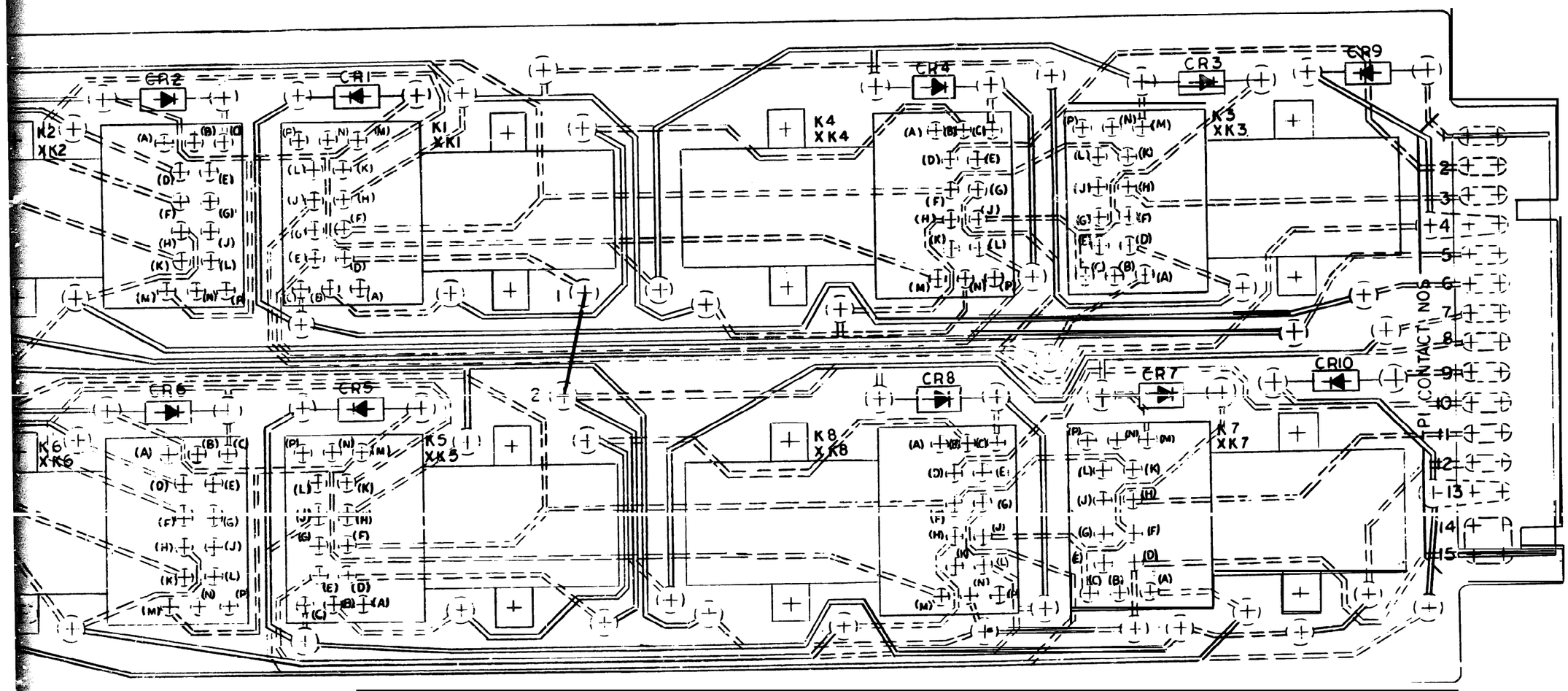
Amplifier-Hybrid NUS 5165-42G1, Parts Location



NOTES:

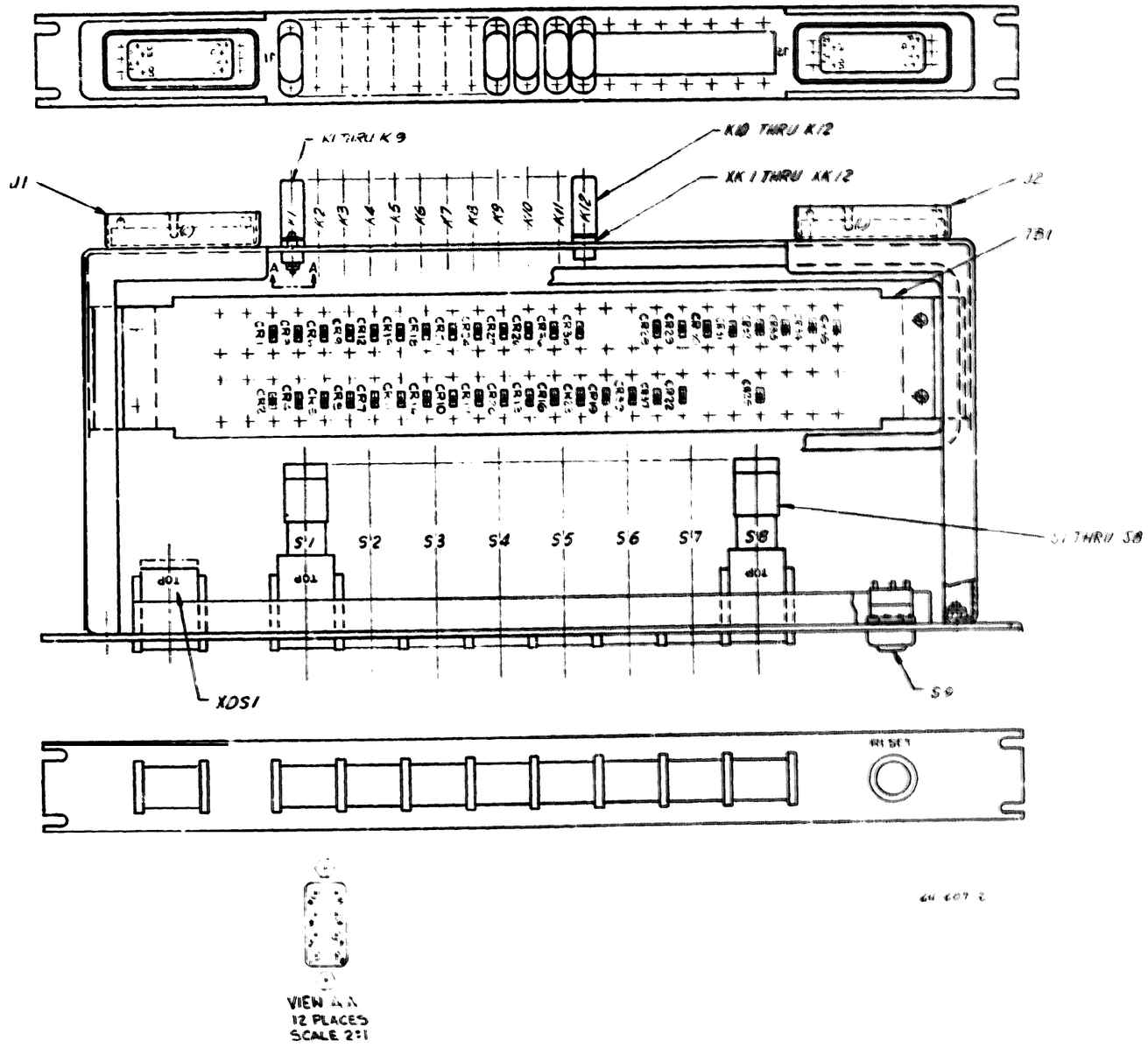
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, ½ WATT. ALL CAPACITANCE VALUES ARE IN MICROFARADS.
2. T3-'•'-DENOTES START OF WINDINGS

Amplifier-Hybrid NUS 5165-42G1, Schematic Diagram



64-596-2

Relay Logic NUS 5165-41G1.
Parts Location



Select Panel NUS 6295-2,
Parts Location

END

03-04-83

DATE

DEPARTMENT OF THE ARMY
US ARMY AG PUBLICATIONS CENTER
1655 WOODSON ROAD
ST. LOUIS, MISSOURI 63114

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States A
Chief of Staff

Official:
PAUL T. SMITH
Major General, United States Army
The Adjutant General

Distribution:

Active Army:

USASA (2)	SAAD (30)
COE (1)	LBAD (14)
TSG (1)	TOAD (14)
USAARENBD (1)	SHAD (3)
DARCOM (1)	HISA (Ft Monmouth) (33)
MICOM (2)	Ft Richardson (ECOM Ofc) (2)
TECOM (2)	Svc Colleges (1)
TRADOC (2)	USASESS (5)
OS Maj Comd (4)	USAICS (3)
LOGCOMD (J)	USAADS (2)
USACC (4)	USAFAS (2)
MDW (1)	USAARMS (2)
Armies (2)	USAIS (2)
Corps (2)	USAES (2)
Instl (2) except	MAAG (1)
Ft Gillem (10)	USARMIS (1)
Ft Gordon (10)	USAERDAA (1)
Ft Huachuca (10)	USAERDAW (1)
Ft Carson (5)	Sig FLDMS (1)

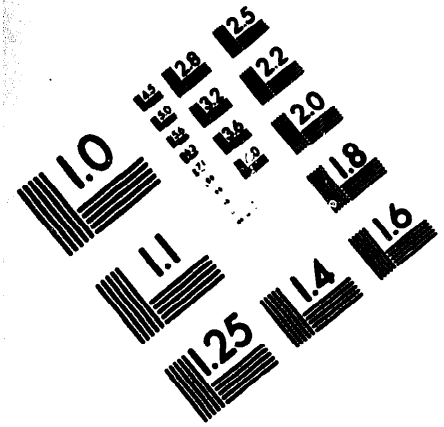
ARNG & USAR: None.

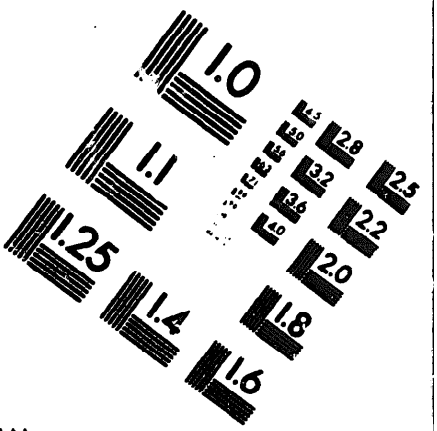
For explanation of abbreviations used, see AR 310-50.

☆U.S. GOVERNMENT PRINTING OFFICE: 1978—6

DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET





150 MM

1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

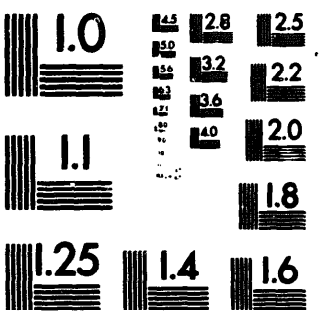
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*



1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

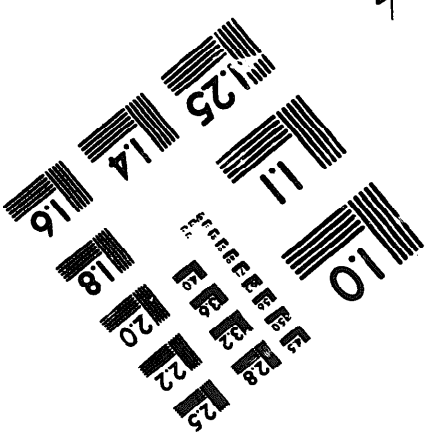
2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

200 MM



250 MM