DEFENSE COMMUNICATIONS SYSTEM
VOICE ORDERWIRE PROGRAM
INTERIM DATA PACKAGE

JANUARY 1981

SECTION B MANUFACTURERS DATA

HEADQUARTERS
US ARMY COMMUNICATIONS-ELECTRONICS
ENGINEERING INSTALLATION AGENCY
Fort Huachuca, Arizona 85613

DEFENSE COMMUNICATIONS SYSTEM

VOICE ORDERWIRE

INTERIM DATA PACKAGE

SECTION B - MANUFACTURER'S LITERATURE

VOICE ORDERWIRE HARDWARE CONTAINED IN
QRP 77-26 FABRICATED BY SAAD IAW HQ
USACEEIA STANDARD ASSEMBLY DRAWINGS

SECTION B - MANUFACTURER'S LITERATURE

TABLE OF CONTENTS

AN INDUCTOTHERM COMPANY

INSTRUCTION BOOK

FOR

FUSE PANELS

MODELS FP-40, FP-40A, and FP-40B

G.R.M. CORPORATION
Triangle Industrial Center
Medford, New Jersey 08055
Phone (609) 267-7950

An Inductotherm Company

BOX 337 TRIANGLE INDUSTRIAL CENTER
MEDFORD, NEW JERSEY 08055

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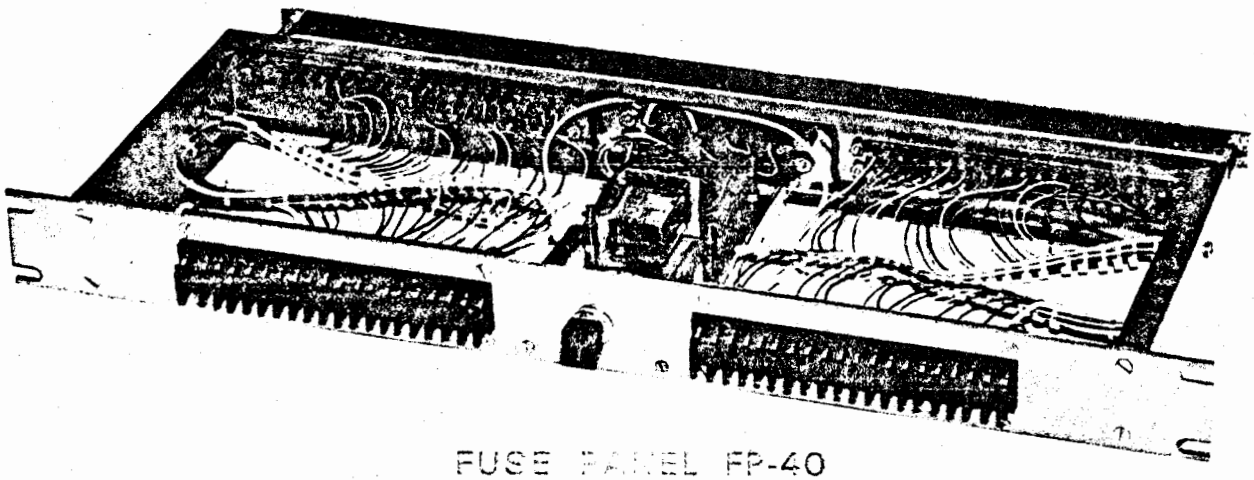


FUSE PANEL FP-40

CONDENSES 40 POINTS OF BATTERY DISTRIBUTION INTO ONE RACK SPACE AND PROVIDES VISUAL ALARM INDICATION WITH REMOTE ALARM OUTPUT

Features

- Space Saver — 40 fuses in 1¾ inches of vertical rack space
- Common alarm lamp indicator
- Flag indicator on each fuse
- Form "C" contacts to activate remote audible and visual alarms
- Strappable to accommodate various DC voltages

Specifications

- Input Voltages:*
  Type A 6V/48-50V/60-80V/120-130V
  Type B 6V/12V/24V/48V
- Input Current 18 Amperes (9 amps per input, 2 inputs)
- Fuse type: Buss GMT*
- Dimensions: 1¾"H x 19"W x 8"D
- Weight: 3½ lbs.
- Finish: Light grey enamel
- Mounts in standard 19 inch rack or cabinet
- Input and output connections via barrier terminal strips

*Specify Type A or B and desired fuse current ratings with order
Consult Factory for Price Schedule

COMMUNICATIONS [illegible] CONTROL SYSTEMS BY

BOX 337 TRIANGLE INDUSTRIAL CENTER
MEDFORD, NEW JERSEY 08055

An Inductotherm Company

FUSE PANELS
MODELS (FP-40, FP-40A, AND FP-40B)

TABLE OF CONTENTS

GUARANTEE

All machines procured hereunder are guaranteed for a period of two (2) years from the date of acceptance at the factory for delivery, except for expendable items such as integrated circuits, transistors, lamps, etc. which are guaranteed for a period of ninety (90) days from the acceptance date. During the guarantee period, all broken or defective parts not caused by accident or misuse through fault or negligence by the purchaser will be replaced (including labor and parts) at the expense of G. R. M. Corporation.

The purchaser shall not return defective equipment to G. R. M. Corporation or its service centers for repairs or replacements without prior authorization and instructions directed only from the factory. G. R. M. Corporation will not accept collect calls or telegrams; all such communications are to be made at the expense of the purchaser. The purchaser should maintain original shipping cartons for said shipments, or if elected, prepare new cartons at the expense of the purchaser.

SECTION 1. SCOPE

The FP-40 Series Fuse Panels described in this booklet, are designed to provide 40 individually fused outputs for use in a telecommunication installation.

SECTION 2. MECHANICAL DESCRIPTION

The fuse panel will occupy one rack unit of vertical space (1-3/4" X 19") in a standard cabinet and is six inches in depth. Forty Fuseholders with indicator fuses are mounted on the front panel of the unit. In addition, a designation strip, a visual alarm light and a "push-to-test" button are also mounted on the front panel. A barrier terminal board mounted on the rear of the chassis provides forty external circuit connnections. A 2" X 6" component board between the front and rear panels has a relay, four diodes and three resistors mounted thereon. Figure 1 is a pictorial view of the FP-40.

SECTION 3. ELECTRICAL DESCRIPTION

Figure 2 is a schematic presentation of the fuse panel. The panel is designed to present the fused outputs from two separate (equal) voltage inputs. Fused outputs 1 to 20 utilize one voltage input and fused outputs 21 to 40 the other. A visual alarm on the front panel will light to indicate an open fuse. This is accomplished by the action of the indicator arm of an open fuse making contact with the fuse alarm bus which will cause relay K-1 to operate and through contact action light the visual alarm DS-1. An additional set of C contacts on the relay are presented on TB5, pins 1, 2 & 3 to activate an alarm device furnished by others. A "push-to-test" button on the front panel along with associated circuitry is provided to activate the relay and visual alarm for test.

The fuse panel input voltages are shown in Table 1. The maximum recommended is 18 amperes equally divided between the two inputs. Depending on input voltage, dropping resistors R1, R2, and R3 are provided in order to provide 6 VDC to the alarm circuit.

SECTION 4. INSTALLATION

Prior to installation of the unit into a rack, determination of operating voltage must be made and dropping resistors R1, R2, and R3 must be strapped as follows:

INPUT VOLTAGE		STRAP POINTS
FP-40 and FP-40A	FP-40B	
6 VDC	6 VDC	E1 to E5
48-50 VDC	12 VDC	E1 to E4
60-80 VDC	24 VDC	E1 to E2
120-130 VDC	48 VDC	NONE

After installation in a rack connect input voltages as follows:

Input #1 to Terminals 4 and 5 of TB5

Input #2 to Terminals 6 and 5 of TB5

SECTION 4. INSTALLATION (Cont'd)

Note: Terminal 5 is common (return)

Terminals 1, 2 and 3 of TB5 are for activating an external alarm (furnished by others).

External connections to the fused outputs are accomplished on TB1 and 3 (Fused Lines) and TB2 and 4 (common-return) connecting points. Fuse valves for these panels are to be specified by the customer.

SECTION 5. MAINTENANCE

Routine maintenance consists of periodic cleaning of the unit.
Corrective Maintenance Guide:

FAULT	POSSIBLE CAUSE
Visual Alarm Indicator does not light when fuse (s) fail	Burned out lamp Broken Connection or wiring.
Alarm Condition "A" not present and visual indicator does not light when fuse (s) fail.	Relay K-1 coil open, CR2 and/or CR3 open, Broken connection or wiring.

SECTION 6. PARTS LIST

Designation	Description	P/N	Mfr. FSC
CR1 thru CR4	Diode, Rectifier	IN538 or IN4003	
DS1	Lamp, Incandescent, T-1, 3/4, 6V	CM 345	71744
F1 thru F40	Fuse, Indicating. Ampere Rating- One or a combination of the following: 18/100, ¼, ½, 65/100, 3/4, 1, 1½, 2, 3, 5, 7½	GMT-( )	71400
K1	Relay, 2PDT, 6VDC	T-154-26-6V	70309

SECTION 6. PARTS LIST Cont'd

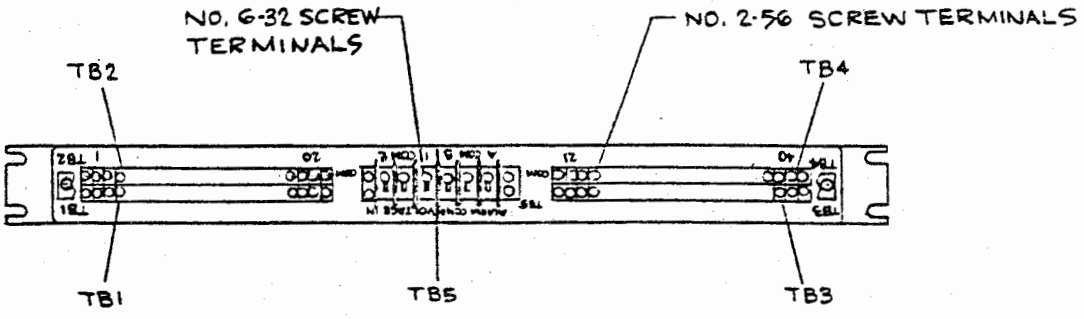
Designation	Description	P/N	Mfr. FSC
R1 *	Resistor, 400 ohm, 10W, 5%	247E4015	80183
R1 +	Resistor, 150 ohm, 10W, 5%	247E1515	80183
R2 *	Resistor, 50 ohm, 10W, 5%	247E5005	80183
R2 +	Resistor, 75 ohm, 5W, 5%	243E7505	80183
R3 *	Resistor, 300 ohm, 10W, 5%	247E3015	80183
R3 +	Resistor, 35 ohm, 5W, 5%	243E3505	80183
S1	Switch, Push Button, SPST, Illuminated, Red	513-0101-604	72619
TB1 thru TB4	Block, Terminal, 20 Terminal	411-1904-20	75382
TB5	Block, Terminal, 6 Terminal	601-Y-6	75382
XF1 thru XF40	Fuseholder	HLT	71400
XK1	Socket, Relay	30C55-1	70309
XS1	Lens, Switch	185-1871	72619

* Used with FP-40 and FP-40A

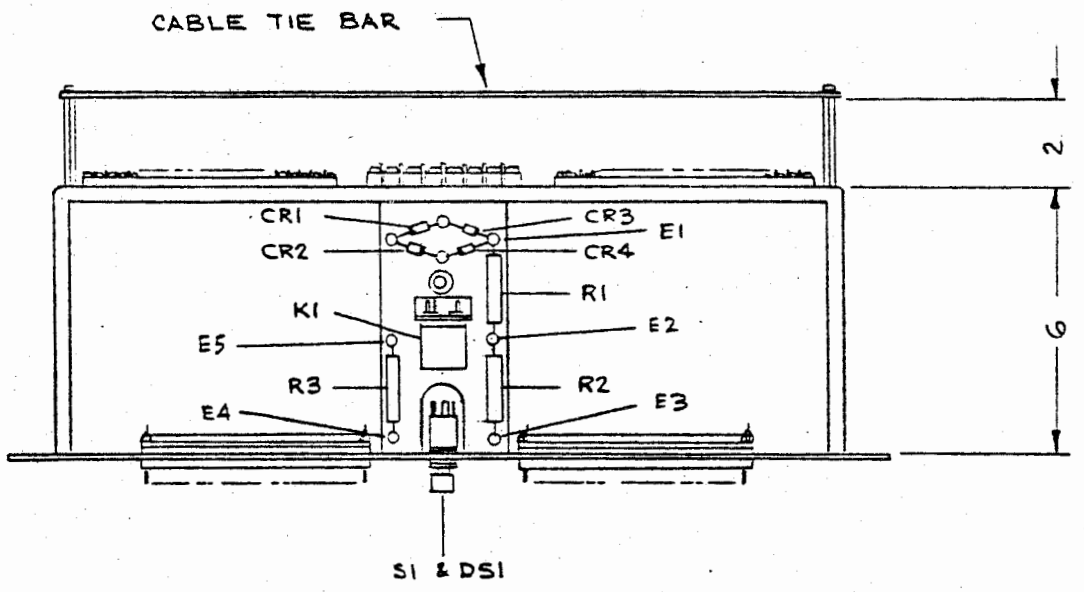
\+ Used with FP-40B

LIST OF MANUFACTURERS

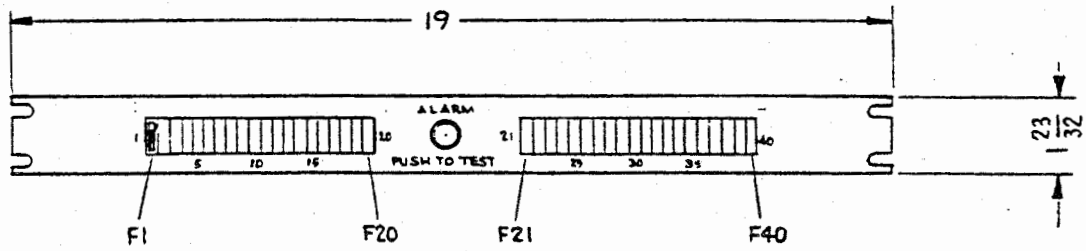
MFR'S FSC NUMBER	MANUFACTURER'S NAME AND ADDRESS
70309	Allied Control Company, Inc. 2 East End Avenue New York, N. Y. 10021
71400	Bussman Manufacturing Division University at Jefferson St. Louis, Mo. 63107
71744	Chicago Miniature Lamp Works 4433 N. Revenwood Avenue Chicago, Illinois 60640
72619	Dialight Corporation 60 Stewart Avenue Brooklyn, New York 11237
75382	Kulka Electric Corporation 633 S. Fulton Avenue Mt. Vernon, New York 10551
80183	Sprague Products Company 99 Marshall Street North Adams, Mass. 01247



REAR VIEW

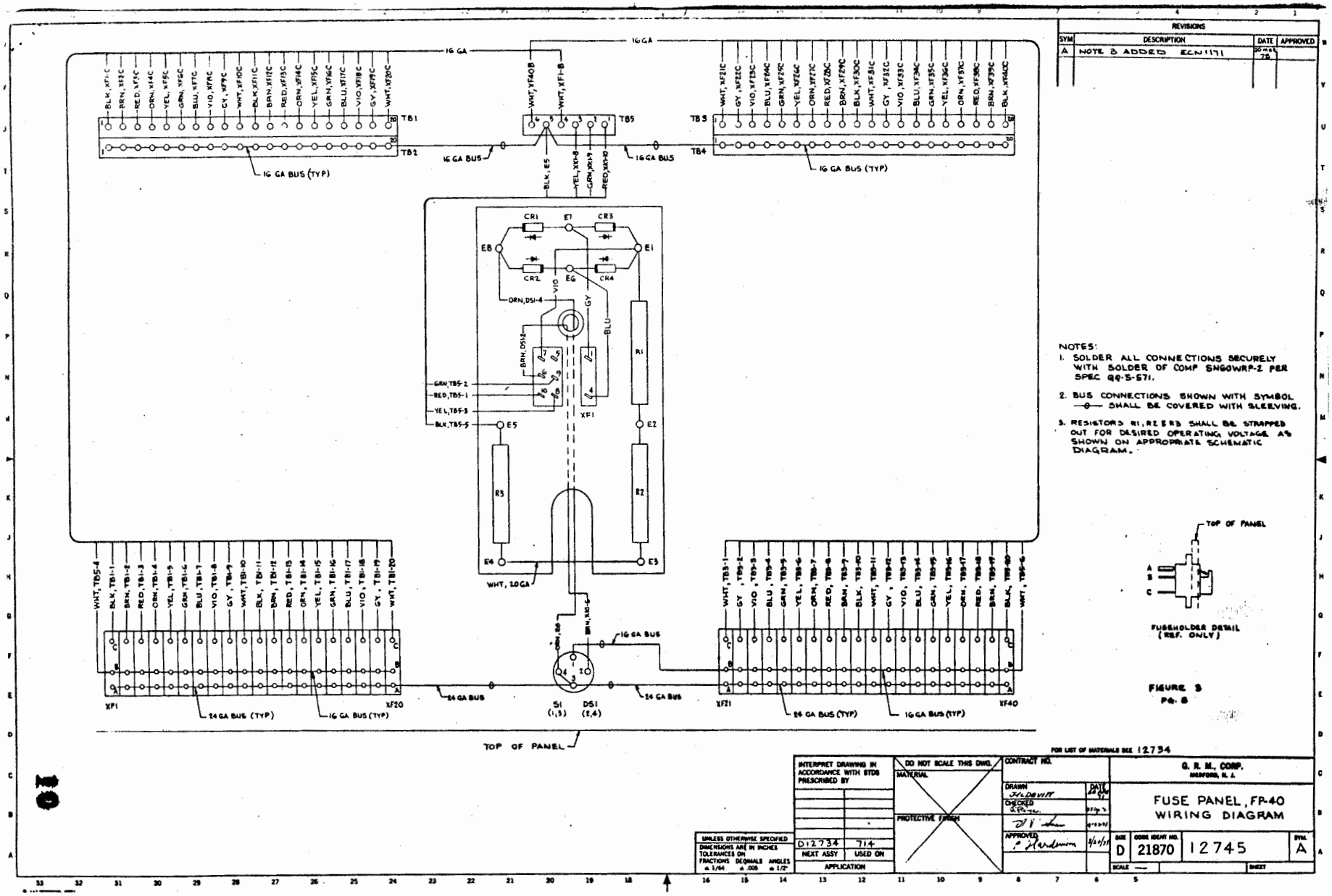


TOP VIEW



FRONT VIEW

FIGURE 1.
FUSE PANEL — OUTLINE DRAWING.
MODELS FP-40, FP-40A & FP-40B



NOTES:

1. SOLDER ALL CONNECTIONS SECURELY WITH SOLDER OF COMP SN60WRP-2 PER SPEC QQ-S-571.
2. BUS CONNECTIONS SHOWN WITH SYMBOL —0— SHALL BE COVERED WITH SLEEVING.
3. RESISTORS R1, R2 & R3 SHALL BE STRAPPED OUT FOR DESIRED OPERATING VOLTAGE AS SHOWN ON APPROPRIATE SCHEMATIC DIAGRAM.

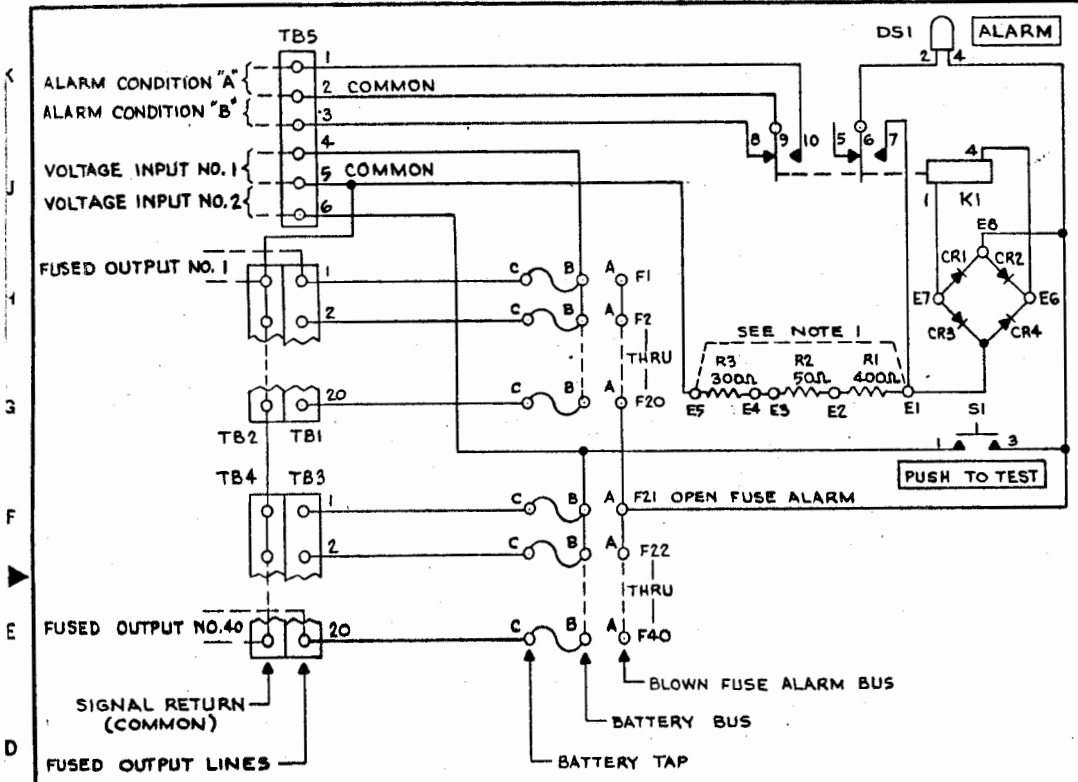
FUSEHOLDER DETAIL (REF. ONLY)

FIGURE 3
PG. 8

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
A	NOTE 3 ADDED ECN 1171	30 MAR 78	

FOR LIST OF MATERIALS SEE 12734

INTERPRET DRAWING IN ACCORDANCE WITH STDS PRESCRIBED BY	DO NOT SCALE THIS DWG.	CONTRACT NO.	G. R. M., CORP. MEDFORD, N. J.
	MATERIAL	DRAWN J.V.D.WITT 3/27/78	FUSE PANEL, FP-40 WIRING DIAGRAM
	PROTECTIVE FINISH	CHECKED	
		APPROVED	SIZE D · CODE IDENT NO. 21870 · 12745 · REV. A
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES ± 1/64 ± .005 ± 1/2°	D12734 NEXT ASSY	714 USED ON	SCALE — SHEET
	APPLICATION		



REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
A	(1) TYPE IN4003 ADDED TO NOTE 3 ECN 746	1/29/73	

NOTES:

1. STRAP AS FOLLOWS ACCORDING TO OPERATING VOLTAGE:
   - 6 VDC - E1 TO E5
   - 48-50 VDC - E1 TO E4
   - 60-80 VDC - E1 TO E2
   - 120-130 VDC - NONE
   - 12-30 VDC - E1 TO E2 AND E4 TO E5.
2. RESISTORS ARE WIREWOUND ± 5%, 10 WATT.
3. DIODES ARE TYPE IN538 OR IN4003.
4. RELAY, K1, SHOWN IN DE-ENERGIZED POSITION.

~~FOR LIST OF MATERIALS SEE LM~~

INTERPRET DRAWING IN ACCORDANCE WITH STDS PRESCRIBED BY

NEXT ASSY	USED ON
D12734	714

APPLICATION

DO NOT SCALE THIS DWG.

MATERIAL

PROTECTIVE FINISH

CONTRACT NO.

		DATE
DRAWN	McDEVITT	19APR71
CHECKED	RRRyan	23APR71
	M. V. [illegible]	4-23-71
APPROVED	E. Hardeman	3/24/73

G. R. M., INC.
MEDFORD, N. J.

FUSE PANEL, FP-40
SCHEMATIC DIAGRAM

SIZE	CODE IDENT NO.		SYM
B	21870	12743	A

SCALE — SHEET

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AN INDUCTOTHERM COMPANY

INSTRUCTION BOOK

FOR

FUSE PANELS

FP-60
FP-100
FP-140
FP-200

G.R.M. CORPORATION
Triangle Industrial Center
Medford, New Jersey 08055
Phone (609) 267-7950

GUARANTEE

All necessary adjustments of machines procured hereunder, not occasioned by accident or misuse, shall be made by G. R. M. Corporation at its own expense, including transportation costs, if any, during the 90-day period after delivery. All machines procured hereunder are guaranteed for a period of 1 year from date of delivery, except expendable items such as tubes, transistors, etc, which are guaranteed for 90 days from date of delivery. During the guarantee period, all broken or defective parts not caused by accident or misuse through fault or negligence by the purchaser will be replaced (including labor and parts) at the expense of G. R. M. Corporation including transportation costs, if any.

The purchaser shall not return defective equipment to G. R. M. Corporation or its service centers for adjustments, repairs, or replacements without prior authorization and instructions directed only from the factory. G. R. M. Corporation will not accept collect calls or telegrams; all such communications are to be made at the expense of the purchaser. The Purchaser should maintain original shipping cartons for said shipments, or if elected, prepare new cartons at the expense of the purchaser.

SECTION 1. SCOPE

The FP-60, FP-100, FP-140, FP-200 Series Fuse Panels described in this booklet are designed to provide 60, 100, 140, and 200, respectively, individually fused outputs for use in telecommunication installations.

SECTION 2. MECHANICAL DESCRIPTION

The fuse panels will mount in a standard 19" cabinet with a depth of 7-1/2". The vertical height for each is as follows:

FP-60 - 3-5/8" (60 Fused Outputs)
FP-100 - 5-5/16"(100 Fused Outputs)
FP-140 - 8-7/8" (140 Fused Outputs)
FP-200 - 8-7/8" (200 Fused Outputs)

Up to 200 fuseholders with indicator fuses are mounted on the front panel of the unit. In addition, a designation strip, a visual alarm light, and a "Push-To-Test" button is also mounted for each row of fuses on the front panel. A series of barrier terminal boards mounted on the rear of the panel provides external circuit connections. A circuit board mounted between the front and rear panel contains the diodes and all resistors for various voltage operation. An additional panel also mounted between the front and rear panels contains the relays required for alarm connections, either normally open or normally closed. Applicable drawings are included for unit purchased by customer.

SECTION 3. ELECTRICAL DESCRIPTION

Included with this instruction book is a schematic diagram, G. R. M. #D15381, when used in conjunction with Table I, all applicable fuses, switches, and lamps. Output blocks, power and alarm blocks, diodes, and resistors, may be correlated.

The panel is designed to present the fused outputs from two separate equal voltage inputs for each row of fuses. Example: For the FP-60, fused outputs 1 to 20 use one voltage input and fused outputs 21 to 40 the other, for the first row. On the second row fused outputs 41 to 50 use one voltage input; fused outputs 51 to 60 use the other. A visual alarm on the front panel will light to indicate a blown fuse in that particular row. This is accomplished by the action of the indicator arm of an open fuse making contact with the fuse alarm bus which will cause the firing of the applicable relay. K1-K5, through contact action, light the visual alarm. An additional set of "C" contacts on the relay are presented on the rear large terminal blocks as "Alarm Cond" to activate an alarm device furnished by others. A "Push-To-Test" button on the front panel along with associated circuitry is provided to activate the relay and visual alarm for test.

The fuse panel input voltages are shown in Table II. The maximum recommended is 18 amperes equally divided between the two inputs per row. Depending on the input voltage, dropping resistors are provided in order to provide 6 VDC to the alarm circuit.

SECTION 4. INSTALLATION

Prior to installation of the unit into a rack, determination of operating voltage must be made and dropping resistors must be strapped as indicated in Table II.

After installation connect input voltages to power and alarm blocks. Note common connection. Connect external alarm to alarm contacts (if used). Connect fused outputs to output terminal blocks. Note each row share common return. Fuse values are to be specified by customer.

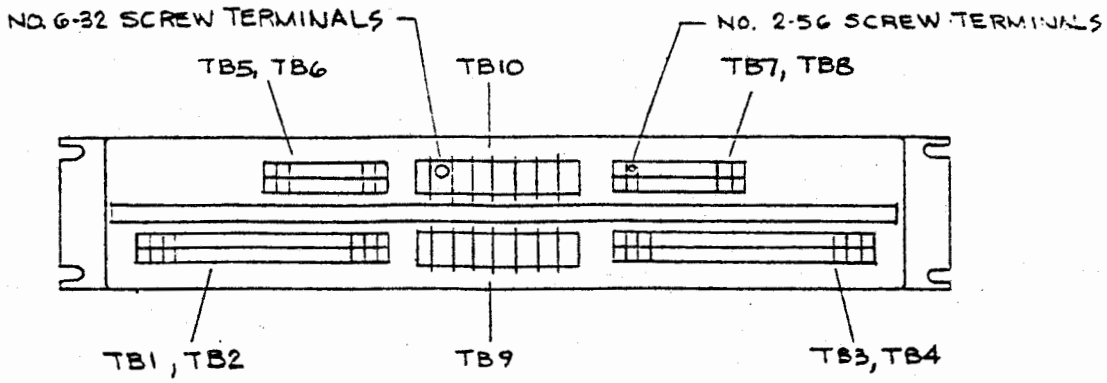
SECTION 5. MAINTENANCE

Routine maintenance consists of periodic cleaning of the unit.
Corrective Maintenance Guide:

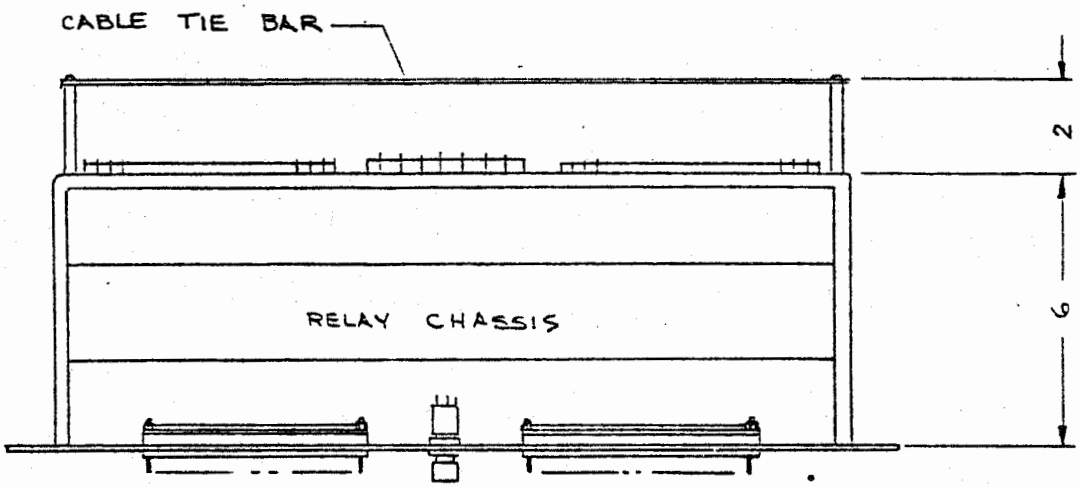
FAULT	POSSIBLE CAUSE
Visual Alarm Indicator does not light when fuse (s) fail	Burned out lamp Broken Connection or wiring.
Alarm Condition "A" not present and visual indicator does not light when fuse (s) fail.	Relay K-1 coil open, CR2 and/or CR3 open, broken connection or wiring.

SECTION 6. PARTS LIST

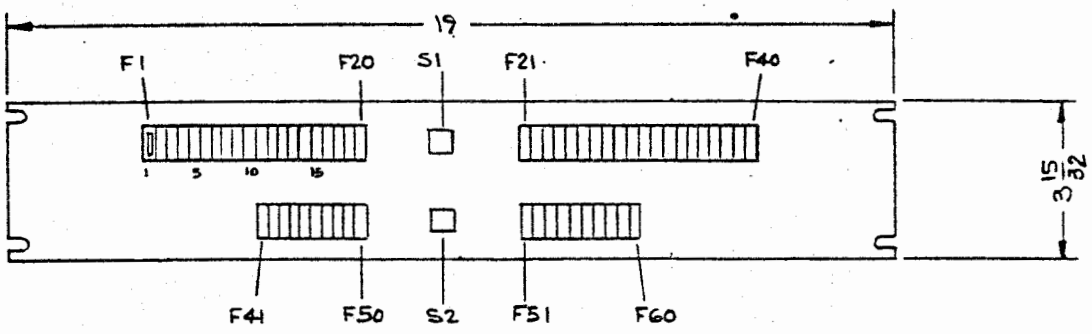
Designation	Description	P/N	Mfr.
CR1-CR20	Diode, Rectifier	IN538 or IN4003	-
DS1-DS5	Lamp Incandescent, T-1-3/4, 6V	CM345	Chicago Miniatur
F1-F200	Fuse, Indicating, ampere rating - 1 or a combination of the following: 18/100, 1/4, 1/2, 65/100, 3/4, 1, 1-1/2, 2, 3, 5, 7-1/2	GMT-( )	Bussman
K1-K5	Relay, 2PDT, 6VDC	T-154-26-6V	Allied Control
R1,4,7,10,13	Resistor, 150 ohms, 10W, 5%	247E1515	Sprague
R2,5,8,11,14	Resistor, 75 ohms, 5W, 5%	243E7505	Sprague
R3,6,9,12,15	Resistor, 35 ohms, 5W, 5%	243E3505	Sprague
S1-S5	Switch, Push Button, SPST, Illuminated, Red	513-0101-604	Dialco
XK1-XK5	Relay Socket	30055-1	Allied Control
XS1	Lense, Switch	185-1871	Dialco
Terminal Block (Power & Alarm Block)	Block, Feed Thru, 6 Terminals	601-Y-6	Kulka
Terminal Block (Output Block, 20 Stations)	Block, Feed Thru Turret, 20 Terminals	411-1904-20	Kulka
Terminal Block (Output Block, 10 Stations)	Block, Feed Thru Turret, 10 Terminals	411-1904-10	Kulka
XF1-XF200	Fuseholder	HLT	Bussman



REAR VIEW

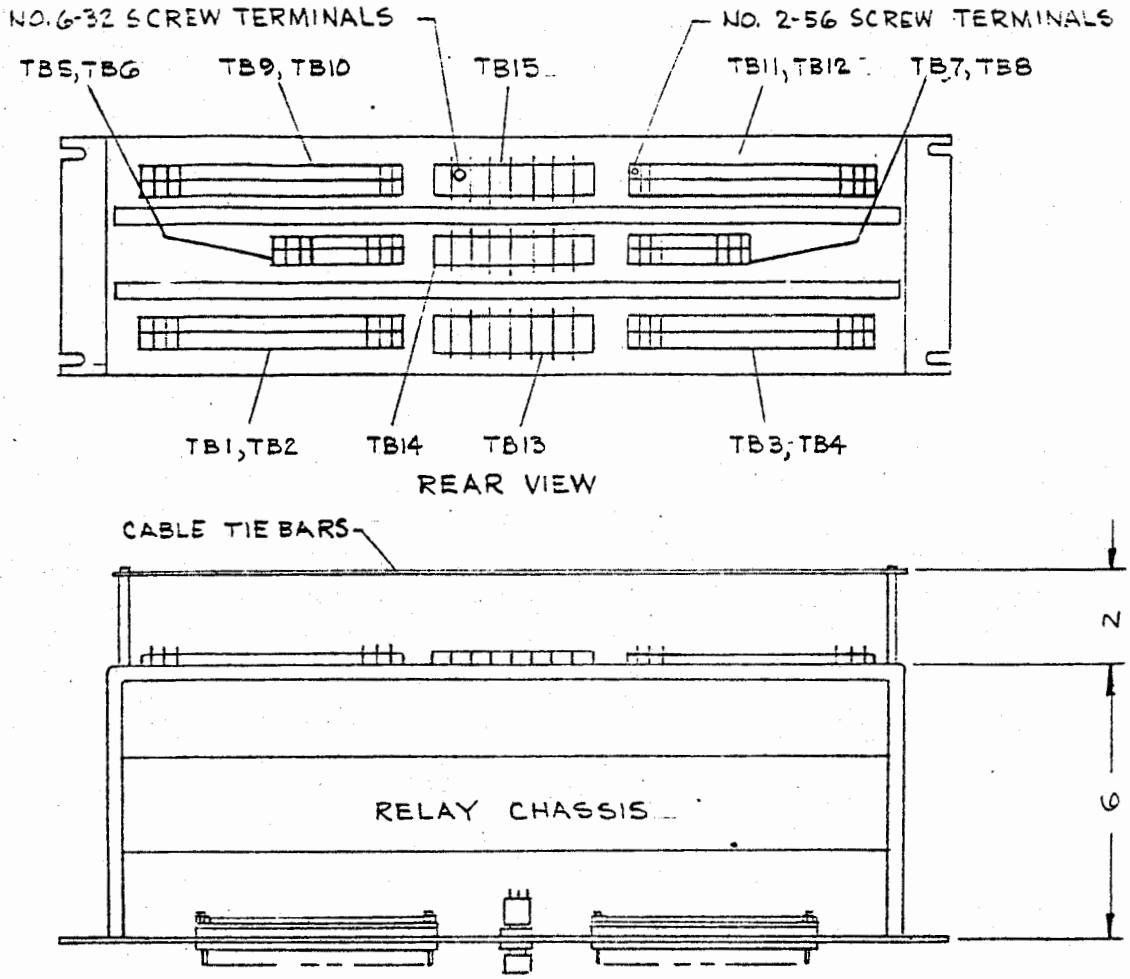


TOP VIEW



FRONT VIEW

FUSE PANEL FP-60 OUTLINE DRAWING



FUSE PANEL FP-100 OUTLINE DRAWING

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED

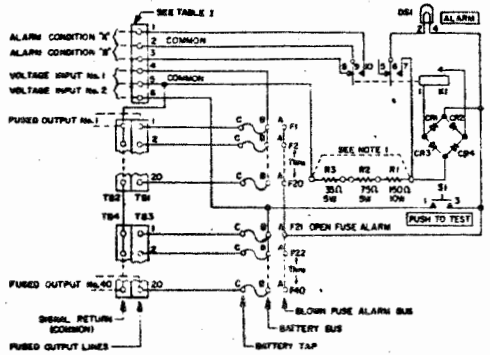


TABLE I
SYMBOLIZATION

MODEL	ROW No.	FUSES	SWITCH & LAMP	OUTPUT BLOCKS	POWER & ALARM BLOCK	DIODES	RESISTORS
FP60	1	F1- F40	S1, DS1	TB1 Thru TB4	TB9	CR1 Thru CR4	R1, 2, 3
	2	F41- F60	S2,DS2	TB5 — TB8	TB10	CR5 — CR8	R4, 5, 6
FP100	1	F1- F40	S1, DS1	TB1 — TB4	TB13	CR1 — CR4	R1, 2, 3
	2	F41- F60	S2,DS2	TB5 — TB8	TB14	CR5 — CR8	R4, 5, 6
	3	F61- F100	S3,DS3	TB9 — TB12	TB15	CR9 — CR12	R7, 8, 9
FP140	1	F1- F40	S1, DS1	TB1 — TB4	TB21	CR1 — CR4	R1, 2, 3
	2	F41- F60	S2,DS2	TB5 — TB8	TB22	CR5 — CR8	R4, 5, 6
	3	F61- F100	S3,DS3	TB9 — TB12	TB23	CR9 — CR12	R7, 8, 9
	4	F101- F120	S4,DS4	TB13 — TB16	TB24	CR13 — CR16	R10, 11, 12
	5	F121- F140	S5, DS5	TB17 — TB20	TB25	CR17 — CR20	R13, 14, 15
FP200	1	F1- F40	S1, DS1	TB1 — TB4	TB21	CR1 — CR4	R1, 2, 3
	2	F41- F80	S2,DS2	TB5 — TB8	TB22	CR5 — CR8	R4, 5, 6
	3	F81- F120	S3,DS3	TB9 — TB12	TB23	CR9 — CR12	R7, 8, 9
	4	F121- F160	S4,DS4	TB13 — TB16	TB24	CR13 — CR16	R10, 11, 12
	5	F161- F200	S5, DS5	TB17 — TB20	TB25	CR17 — CR20	R13, 14, 15

NOTES—
1- CIRCUIT SHOWN IS TYPICAL FOR ALL ROWS ON ALL MODELS, EXCEPT FOR NUMBER OF FUSES AND SYMBOLIZATION WHICH SHALL BE AS SHOWN IN TABLE I.

2- ASSEMBLIES ARE SUPPLIED WITH INPUT COMMON CONNECTED TO 35Ω RESISTORS FOR 48VDC OPERATION. IF OTHER OPERATING VOLTAGE IS TO BE USED, RESISTORS MUST BE STRAPPED OUT OF CIRCUIT AS SHOWN IN TABLE II.

3- DIODES ARE TYPE IN538 OR IN4003.

4- RELAY, K1, SHOWN IN DE-ENERGIZED POSITION.

TABLE II

OPER. VOLTAGE	STRAP OUT
6VDC	ALL RESISTORS
12VDC	ALL 150Ω & ALL 75Ω RESISTORS
24VDC	ALL 150Ω RESISTORS
48VDC	NONE

FOR LIST OF MATERIALS SEE

INTERPRET DRAWING IN ACCORDANCE WITH STDS PRESCRIBED BY	DO NOT SCALE THIS DWG.	CONTRACT NO.	G. R. M., CORP. REDFORD, N. J.
MATERIAL ——		DRAWN / DATE	SCHEMATIC DIAGRAM FUSE PANEL
PROTECTIVE FINISH ——		CHECKED / DATE	
		APPROVED / DATE	SIZE D · CODE IDENT NO. 21870 · 15381 · DWG. –
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS .XX ±.005 .XXX ±.002 ANGLES ±1°	NEXT ASSY	USED ON	SCALE —— SHEET 1 OF 1
	APPLICATION		

41028
41028-01
41028-01-22
DC POWER SUPPLY
UNIT DESCRIPTION

1. APPLICATION

The 41028 Power Supply module is designed to convert a varying DC voltage input to a regulated DC output and supply the regulated power for modules in the Raven 410 Shelf Assemblies.

2. SPECIFICATIONS

Input Voltage	-44 to -56VDC
Output Voltage	-24 ±1VDC, Adjustable
Output Voltage Regulation	±3% for specified input voltage; no load to full load
Output Current Limiting	
41028-01, 41028-01-22	1.5A, minimum @ -24VDC output
41028	2.5A, mimimum @ -24VDC output

3. THEORY OF OPERATION

3.1. Refer to schematic 410-1280.

3.2. The module contains a series regulator, a foldback current limiter, and monitoring, control and protective devices.

3.3. Input current is applied to pins S and T; passes through the P.C. Board to terminal E2, through the fuse F1 and switch S1 to terminal E. From E1 it passes back out the board on pins J and K to the resistor R1 (shelf) and transistor Q1 (shelf) to pins C and D. Current then passes through R2 to pins A & B.

3.4. Resistors R9, R10 and R11 provide a voltage divider sampling network. This sampling voltage, which is a fraction of the output voltage, is presented to the emitter of transistor Q4. Transistor Q4 operates as a grounded base stage and amplifies the signal. The signal output is then taken from the collector of Q4 and applied to the base stage and applied to the base of transistor Q2.

3.5. Transistor Q2 amplifies the signal and presents it to the base of Q1. Transistor Q1 then drives Q1 (shelf). When the output voltage rises, Q1 (shelf) turns "OFF" and lowers the output voltage to the original value.

3.6. The zener diode CR1 is the voltage reference for the regulator. Resistors R6 and R7 constitute a voltage divider and provide the proper bias voltage for transistor Q4. Resistor R10 (adjustable) is used to set the output voltage of the Regulator board.

3.7. Capacitor C3 bypassed resistor R9 so that AC signals on the output are presented directly to the emitter of Q4. C4 filters the output and provides a low output impedance.

3.8. Resistor R2 is a current sampling resistor. When the voltage across R2 reaches a pre-determined value transistor Q3 will turn "ON" causing Q1 to turn "OFF". Q1 in turn, turns Q1 (shelf) "OFF". The voltage required to turn Q3 on is less when the output is short circuited than it is when the output is functioning normally. Therefore, we have foldback current limiting i.e. short circuited output current is less than normal operating current.

3.9. Capacitor C1 bypasses the collector to bas of transistor Q2 at high frequencies preventing oscillation.

3.10. Resistor R12 limits the current to the Test Points preventing accidental shorting out of the regulator output.

3.11. F1 protects the external power source. S1 is the "ON/OFF" switch. DS1 is illuminated by the output voltage and will not be illuminated if the output is short circuited. The output voltage may be monitored at Test Point TP1 and TP2.

4. MAINTENANCE AND ADJUSTMENTS

4.1. Adjustments of the module is limited to the adjusting of R10 for correct output voltage. This is preset at the factory.

4.2. Troubleshooting.

4.2.1. Troubleshooting will be the process of checking DC voltage levels as shown on schematic 410-1280 and isolating the trouble to a faulty stage.

4.2.2. Ohmic and voltage checks should be used to isolate the trouble to the faulty component.

4.2.3. The foldback current limiting feature may be checked by terminating the output with successively smaller resistors until the maximum load current is exceeded.

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD., SUITE 12
SPARKS, NEVADA 89431
(702) 359-3700

ASSEMBLY NUMBER 4410-0280-01,4410-0281 41028,41028-01,41028-01-22
4410-0281-01-22 TITLE DC POWER SUPPLY DWG. REF: 410-1280

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		CAPACITOR, Fixed:			
C1	A401-2108	Mylar .001µf 100V	1		
C2	A550-6102	Electrolytic, tantalum 10µf 20V	1		
C3		NOT USED			
C4	A500-8116	Electrolytic, aluminum 1100µf 50V	1		
C5,6	A500-8177	Electrolytic, aluminum 1700µf 75V	2		
		RESISTOR Fixed, ¼W 5%:			
R1,7	B013-4270	2.7K	2		
R3	B013-4220	2.2K	1		
R5,9	B013-4470	4.7K	2		
R6,11	B013-4120	1.2K	2		
R8	B013-5100	10K	1		
R12	B014-4100	1K, 5%, ½W	1		
R10	B381-4100	Potentiometer, 1K 20%	1		
CR1	F110-5240	Diode, Zener	1	1N5240	
Q1	G100-4037	Transistor, PNP	1	2N4037	
Q2,3,4	G100-2907	Transistor, PNP	3	2N2907	
	SG02-0000	Transistor Pad	1		
	SG00-0207	Transistor Heat Sink	1		
	T110-2000	Terminal	12		
DS1	J100-0282	Lamp, 28V RED	1		
	SJ10-0200	Lamp Socket	1		
	SJ10-0210	Lamp Clip	1		
S1	I000-1330	Switch, SPDT	1		
	SJ00-0000	Fuseholder	1		

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395 FREEPORT BLVD., SUITE 12
SPARKS, NEVADA 89431
(702) 359-3700

ASSEMBLY NUMBER 4410-0280-01, 4410-0281 4410-0281-01-22 TITLE 41028, 41028-01, 41028-01-22 DC Power Supply DWG. REF: 410-1280

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
TP1	L300-2039	Test Point White	1		
TP2	L300-2030	Test Point Black	1		
	T101-4101	Handle	1		
	U404-2421	Bracket, Panel Mounting	1		
	T250-0000	Bushing	1		
		ASS'Y 4410-0280-01 ADD:			
	2410-0289-01	Front Panel	1		
F1	J001-2250	Fuse, 2.5A Slo-Blo	1		
R2	B180-1100	1Ω 3W Resistor	1		
R4	B013-3220	220Ω ¼W 5% Resistor	1		
	K001-1840	Connector, 18 Pin	1		
	1410-0280	P.C. Board	1		
		ASS'Y 4410-0281 ADD:			
	2410-0289	Front Panel	1		
F1	J001-2500	5A Slo -Blo Fuse	1		
R2	B184-0200	.2Ω 5W Resistor	1		
R4	B013-2300	30Ω ¼W 5% Resistor	1		
	K001-2240	Connector, 22 Pin	1		
	1410-0281	P.C. Board	1		
		ASS'Y 4410-0281-01-22 ADD:			
	2410-0289-01-22	Front Panel	1		
F1	J001-2250	Fuse, 2.5A Slo-Blo	1		
R2	B180-1100	1Ω 3W Resistor	1		
R4	B013-3220	220Ω ¼W 5% Resistor	1		
	1410-0281	P.C. Board	1		
	K001-2240	Connector, 22 Pin	1		

FIRE UP SPARES LIST

41028

	RAVEN STOCK NUMBER
1 each 2N3055	0346-0001
1 each 2N4037	0341-0007
1 each 2N2907	0341-0008
1 each 1N5240	0303-0009
5 each 2.5A Fuse	0504-0111
1 each Lamp	0502-0804

41028 POWER SUPPLY

TEST PROCEDURE

1. GENERAL

Follow this test procedure carefully, completing the Test Data Card as necessary. If difficulties are encountered, refer to the troubleshooting procedures for this module.

2. TEST EQUIPMENT REQUIRED

Power Supply	44 - 56V DC @ 3A
Oscilloscope	H.P. 130C or equivatent
VTVM	Triplet 850 or equivalent
Load Resistors	10Ω 50W, 1Ω 3W, 5Ω 50W
	240Ω 2W
Shelf	Raven 410

NOTE: IF THIS PWOER SUPPLY IS NOT TESTED WITH A SHELF ASSEMBLY WIRED FOR THE 41028 MODULE, AN EXTERNAL RESISTOR AND 2N3055 WILL BE NEEDED TO SIMULATE THE SERIES REGULATOR (Q1 and R1 Shelf - Drawing 410-1280). R1 RECONNECTS TO TERMINAL E2.

3. TEST EQUIPMENT SETUP

Connect the Test Equipment as shown in figure 1.

4. POWER SUPPLY TESTS

4.1. Connect the external power supply negative to pin S and the positive to pin V. (Or plug the module into a shelf assembly connected to the power supply. Use an extender board).

4.2. Connect the VTVM probe to the front panel white test point. Check the switch, fuse and lamp operation. Leave the module "ON".

4.3. Using clip leads, connect a 10Ω, 50W and 1Ω 3W resistor in series across pins A and V. Adjust the external power supply to -48V DC. Adjust R10 until the VTVM indicates -24VDC.

4.4. Connect the oscilloscope probe to pin A. The power supply ripple must be less than 75mV peak-to-peak.

4.5. While observing the VTVM and oscilloscope, adjust the external power supply output from -44 to -56VDC, then back to -48VDC. The VTVM reading must not vary more than ±.7VDC and the ripple must not exceed 75mV peak-to-peak.

4.6. Change the 10Ω resistor and 1Ω resistor across pins A & V to a 5Ω 50W resistor. The VTVM must read less than -22VDC. Change the 5Ω resistor to a 10Ω resistor and 1Ω resistor in series.

4.7. Connect a heavy jumper across the 10Ω and 1Ω resistors. DO NOT TOUCH THIS JUMPER DIRECTLY TO THE PRINTED CIRCUIT BOARD. The VTVM reading should drop to 0V. The fuse must not blow.

4.8. Connect the VTVM across R2. This voltage must not exceed 1VDC.

4.9. Reconnect the VTVM to the front panel test points. Remove the jumper installed in paragraph 4.7. The VTVM should rise to -24VDC, ±.7. Remove the 10Ω and 1Ω resistors.

4.10. Connect a 240Ω resistor across pins J1A and U at the rear of the Power Supply. Voltage at test points should be -24VDC ± .7 with a -48V input.

4.11. Turn off module and disconnect test equipment.

5. TEST COMPLETION

Stamp module and Test Data Card with your test stamp.

6. Q.A. ACCEPTANCE

6.1. Verify that test results are within specifications.

6.2. Verify that Test Data Card is properly filled out.

6.3. Re-inspect module per established criteria.

6.4. Stamp module and Test Data Card with "ACCEPTED" stamp.

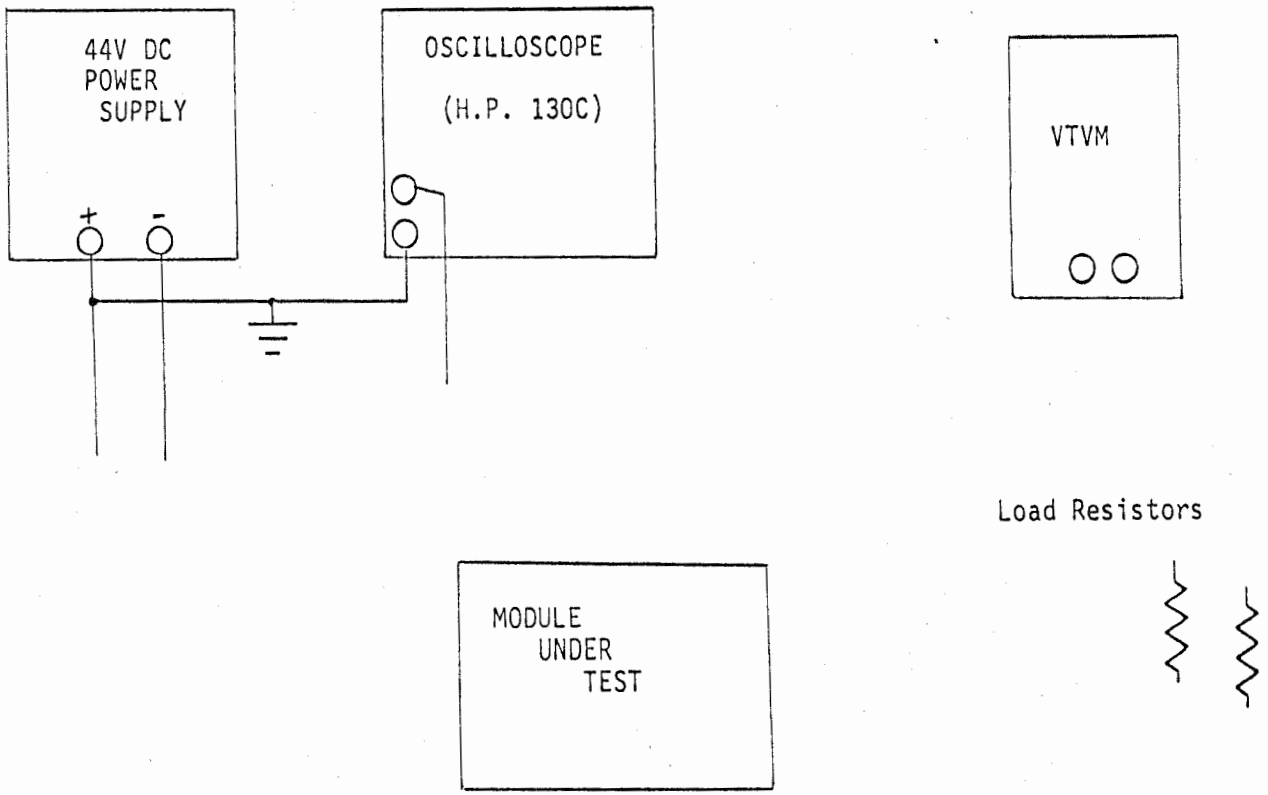

Figure 1. ⏚ Denotes preferred common earth ground.

TEST DATA CARD

-24VDC POWER SUPPLY DATE_____

41028 MODULE SERIAL NO._____

Check blocks or fill in voltages as necessary. Print neatly using a ballpoint pen. This is a permanent record.

1. GENERAL_____

2. TEST EQUIPMENT USED

POWER SUPPLY, type_____ SERIAL#_____

OSCILLOSCOPE, Type_____ SERIAL#_____

VTVM, Type_____ SERIAL#_____

SHELF, Type_____ SERIAL#_____

3._____

4.1._____

4.2._____

4.3._____ VC Output (-24)

4.4._____ mV P/P (<75)

4.5._____ to_____VDC (±.7V)

_____ mV P/P (<75)

4.6._____ VDC (<-22)

4.7._____ VDC (<.2)

4.8._____ VDC (<1.0)

4.9._____ VDC (-24, ±.7)

4.10._____ VDC (-24 ±.7)

5._____ (TEST STAMP)

6._____ (Q.A. STAMP)

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FUNCTION GENERATOR UNIT, MODEL FG-6

GENERAL

Function Generator Model FG-6, CF Electronics Part Number 200233 (Figure 1), is used to provide the following functions:

- Dc Lamp Flashing and Winking Indications
- Dc Audible Signalling Indications
- Ringback Tone Output
- 400 Hz Tone Output
- Keyed SF Signalling Circuit (optional)

All power and signal switching functions are provided by solid-state circuits with a high current capability. An integral LED can be used as a maintenance aid to indicate power loss conditions.

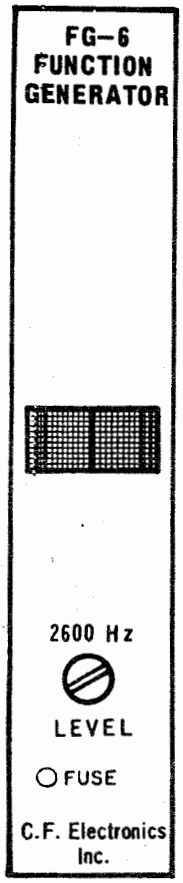

Figure 1.

SPECIFICATIONS

Input Voltage ...	24V dc or 48V dc, 15% regulation (strap across R1 for 24V dc operation, factory installed)
Output Voltage ..	24V dc or 48V dc, 2.5 ampere, continuous per output
Tone Output	400 Hz modulated by RN 400 Hz continuous 2600 Hz keyed (with optional oscillator)
Current Input ..	56 mA (no load)

THEORY OF OPERATION

A circuit schematic diagram of the function generator is shown in Figure 2. In addition to performing interrupter functions formerly provided by older key system interrupters, the FG-6 is also compatible with CF Electronics Model LCU-3 Line Control Unit for Ringback Tone applications. Input voltage selection to accomodate 24V dc or 48V dc power sources is provided as a strapping option in the power supply input circuits. A functional description of the equipment follows:

System Inputs - Two signalling inputs may be supplied. The ST inputs, at terminal E, are supplied from the associated line card circuits, and drop to -V whenever a load is connected which requires the function generator. (Other circuits using the function generator outputs will also have ST leads, if required.) ST leads are connected to a common-wired "OR" bus and applied to terminal E as an input. The optional 2600 Hz single-frequency (SF) oscillator circuit is independent of the function generator circuits, except for power supply connections, and receives a separate input at terminal N for keying.

System Outputs - The function generator has bussed outputs for lighting lamps, activating

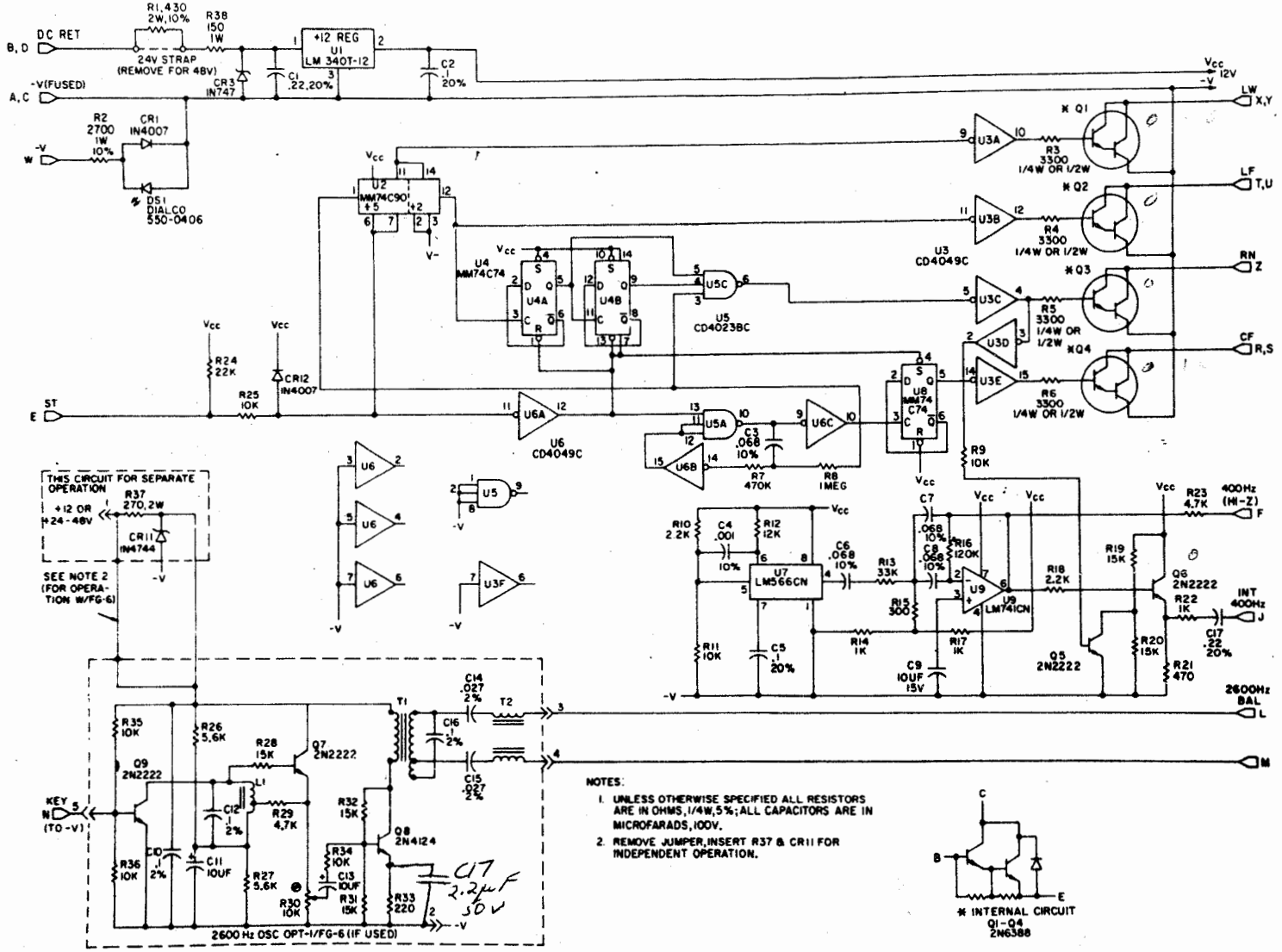
B, D
DC RET
A, C
-V(FUSED)
W
-V
R1, 430 2W, 10%
24V STRAP (REMOVE FOR 48V)
R38 150 1W
CR3 IN747
+12 REG U1 LM 340T-12
C1 .22, 20%
C2 .1 20%
R2 2700 1W 10%
CR1 IN4007
DS1 DIALCO 550-0406
Vcc
-V
12V
LW X,Y
LF T,U
RN Z
CF R,S
U2 MM74C90
U3 CD4049C
U4 MM74C74
U5 CD4023BC
U6 CD4049C
U8 MM74 C74
U3A
U3B
U3C
U3D
U3E
* Q1
* Q2
* Q3
* Q4
R3 3300 1/4W OR 1/2W
R4 3300 1/4W OR 1/2W
R5 3300 1/4W OR 1/2W
R6 3300 1/4W OR 1/2W
R24 22K
R25 10K
CR12 IN4007
ST
E
R7 470K
R8 1MEG
C3 .068 10%
R9 10K
THIS CIRCUIT FOR SEPARATE OPERATION
+12 OR +24-48V
R37 270, 2W
CR11 IN4744
SEE NOTE 2 (FOR OPERATION W/FG-6)
U7 LM566CN
U9 LM741CN
C4 .001
C5 .1 20%
C6 .068 10%
C7 .068 10%
C8 .068 10%
C9 10UF 15V
R10 2.2K
R11 10K
R12 12K
R13 33K
R14 1K
R15 300
R16 120K
R17 1K
R18 2.2K
R19 15K
R20 15K
R21 470
R22 1K
R23 4.7K
400Hz (HI-Z) F
INT 400Hz J
C17 .22 20%
Q5 2N2222
Q6 2N2222
2600Hz BAL L
M
T1
T2
C14 .027 2%
C15 .027 2%
C16 .1 2%
R35 10K
R26 5.6K
R28 15K
Q7 2N2222
Q9 2N2222
L1
C12 .1 2%
R29 4.7K
R32 15K
Q8 2N4124
KEY N (TO -V)
R36 10K
C10 .1 2%
C11 10UF
R27 5.6K
R34 10K
C13 10UF
R31 15K
R33 220
R30 10K
C17 2.2μF 50V
2600 Hz OSC OPT-1/FG-6 (IF USED)
NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, 5%; ALL CAPACITORS ARE IN MICROFARADS, 100V.
2. REMOVE JUMPER, INSERT R37 & CR11 FOR INDEPENDENT OPERATION.
C
B
E
* INTERNAL CIRCUIT Q1-Q4 2N6388

Figure 2.

dc audibles and transmitting Ringback Tone to a calling party. The SF oscillator output is not bussed but is instead assigned on a cross-connected basis to its associated circuit. Circuits for generating the LF (Lamp Flash), LW (Lamp Wink), CF (Conference Flash) and RN (Ringing) audible outputs use the same type of Darlington output driver configuration. The Darlington drivers have a 5-ampere component rating with sufficient current capability to accomodate worst case lamp and audible loading.

Darlington Driver Circuits - Each Darlington driver stage includes a type 4049 CMOS inverter input switching the transistor base voltage. When the inverter input is at logic "1", the output is at logic "0" (-V), and the stage does not conduct; when the input to the inverter goes to logic "0", the output rises to logic "1" and the stage conducts.

Ringback Tone - Voltage-Controlled Oscillator (VCO) stage U7 provides a continuous 400 Hz triangular wave output. Bandpass filter stage U9, centered at 400 Hz, converts the 400 Hz triangular waveform into a sinusoidal waveform, applied to the base of Q6 through R18. Stage Q5 switches the 400 Hz waveform at the RN rate such that when Q5 conducts, Q6 is off; and when Q5 is cut-off, Q6 conducts and supplies the 400 Hz output to terminal J via current-limiter R22. The 400 Hz output of amplifier U9 is also used to provide a high-impedance, continuous-duty 400 Hz sine wave output at terminal F via limiting resistor R23.

Logic Circuits - CMOS logic is used to determine the clocking of the various system outputs. When the ST lead at terminal E is high (input line open and voltage level is at Vcc) such that the input is a logic "1", the LW, LF, RN, CF and 400 Hz INT outputs are at their respective high impedance output states; when the ST lead is at logic "0" (-V), these outputs are enabled and switched on and off. (Loading is determined at the individual line cards.)

a. When ST is at logic "1" (off), decade counter U2 inputs 6 and 7 are at logic "1", setting outputs 11 and 12 to logic "1". With U3A and U3B inputs at logic "1", the respective outputs are at logic "0" and Q1 and Q2 are in high-impedance (off) states. Inverter U6A output is set to logic "0", resetting flip-flops U4A and U4B so that their Q outputs are at logic "0". With the two Q inputs of gate U5C also at logic "0", the output is at logic "1", inverter U3C output goes to logic "0", causing Darlington stage Q3 to remain off. With the output of U3C at logic "0", inverter U3D output rises to logic "1", causing Q5 to remain in the low-impedance state, turning Q6 off. Flip-flop U8 is held set and its Q output is at logic "1", resulting in the U3E output remaining at logic "0" and Darlington stage Q4 being off. The U5A input is held at logic "1", inhibiting operation of the 10 Hz oscillator.

b. When ST is at logic "0" (start), a 10 Hz square wave, generated by gates U5A, U6B and U6C, in combination with R7, R8, C3, is applied to the clock inputs of U2, U8, and the gate input of U5C. The 10 Hz input at U8 is divided-by-two to provide a 50% 5 Hz square wave output to U3E. Darlington stage Q4 is switched on and off at the 50% 5 Hz rate, supplying the CF signal (Conference Flash) at terminals R and S. The 10 Hz input to U2, pin 1, is divided-by-five to provide the 2 Hz output to gate U3A and to pin 14 of U2. Gate U3A then switches Darlington stage Q1 at the 2 Hz rate, supplying the LW signal (Lamp Wink) at terminals X and Y. (LW signal is 300 mS at -V, lamp lit; and 200 mS at high impedance, lamp off.) The 2 Hz input to U2, pin 14, is further divided-by-two to provide a 50% 1 Hz square wave at U2, pin 12, which is applied to gate U3B and also clocks U4A. The 50% 1 Hz output of U3B switches Darlington stage Q2 to provide the LF output (Lamp Flash) at terminals T and U. The 1 Hz input to U4A is divided-by-four so that the Q outputs of U4A and U4B are both at logic "1" for one continuous second, and they are not both logic "1" for the next three continuous seconds. These two Q outputs are then connected as two of the three inputs to gate U5C; the third input to U5C is the original 10 Hz square wave. The combination of the inputs causes the output of U5C to alternate between logic "1" and "0" at a 10 Hz rate for one second; and then to remain at logic "1" for the next three seconds (producing the RN waveform). The output from gate U5C is applied to gate U3C and switches Darlington stage Q3 on and off, providing RN at terminal Z. When the line card connection is made, the audible will sound when gate U5C output is at logic "0"; and no sound will be provided when Q3

is in a high impedance state and U5C output is logic "1". The RN waveform at U3C output is inverted by gate U3D and switches Q5. When the line card connection is made, a 400 Hz signal is connected to the associated line when gate U5C output is at logic "0"; no signal will be heard when gate U5C output is at logic "1". The 400 Hz ringback tone then simulates the actual RN signal.

SF Signalling - When the optional single-frequency oscillator is keyed, a -V signal is applied to terminal N. When terminal N is not at -V (open), transistor Q9 is biased on, lowering Q7 base voltage and inhibiting oscillation. When the SF oscillator is keyed, Q9 base voltage drops, turning Q9 off. Base voltage on Q7 rises, turning Q7 on, allowing the circuit to oscillate at 2600 Hz, set by tuned components L1, C12. Output amplitude control R30, adjustable from the front panel, is set at the time the SF circuit is assigned in the field. Output driver stage Q8 amplifies the signal, applying it through output filter T1, T2, C14, C15 and C16 to terminals L and M. The output filter provides a dc-open circuit at all times with a very high impedance to all frequencies other than 2600 Hz; and a 600 ohm impedance at 2600 Hz, when the circuit is quiescent or transmitting.

FUNCTIONAL CHECKOUT

Checkout of the FG-6 Function Generator is accomplished automatically during testing of the LCU-3 Line Control Unit. The test procedures described in the following paragraphs should be used primarily for fault isolation when more detailed measurements are needed. Note that removal of the FG-6 will interfere with key system operation; it is advisable to insert a known-good spare unit into the system, or to perform testing during equipment off-time.

TEST EQUIPMENT REQUIRED

The following test equipment is required:

- Oscilloscope
- Card Extender
- Clip-on Load Resistor, 1000 ohms, 1W
- Jumper Lead
- 24V dc or 48V dc power source

TEST PROCEDURES

No adjustments are required for proper circuit operation. Any deviation of measured output waveforms from those shown are indicative of component failures in the oscillator or counter/divider circuits.

Preliminary Test Connections

a. Connect power source Vcc to terminals B(+) and A(-). (If 48V dc is used as supply voltage, remove strap from across R1.)

b. Connect a jumper lead between terminals A and E to "start" key system functioning.

Lamp Flash (LF) Output Test

a. Connect load resistor between terminals T and B.

b. Connect oscilloscope probe between terminals T and B (dc return) and observe that oscilloscope waveform resembles that shown in Figure 3.

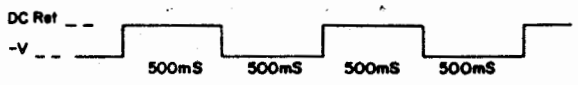

Figure 3.

Lamp Wink (LW) Output Test

a. Connect load resistor between terminals X and B.

b. Connect oscilloscope probe between terminals X and B (dc return) and observe that oscilloscope waveform resembles that shown in Figure 4.

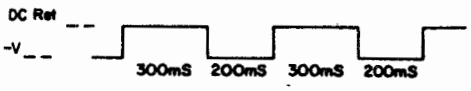

Figure 4.

Conference Flash (CF) Output Test

a. Connect load resistor between terminals R and B.

b. Connect oscilloscope probe between terminals R and B (dc return) and observe that oscilloscope waveform resembles that shown in Figure 5.

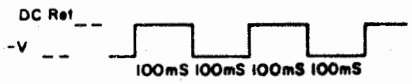

Figure 5.

Ringing (RN) Output Test

a. Connect load resistor between terminals Z and B.

b. Connect oscilloscope probe between terminals Z and B (dc return) and observe that oscilloscope waveform resembles that shown in Figure 6.

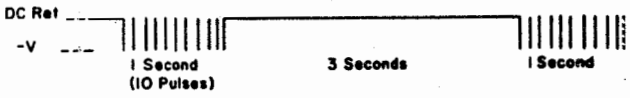

Figure 6.

Ringback Tone (400 Hz INT) Output Test

a. Connect load resistor between terminals J and B.

b. Connect oscilloscope probe between terminals J and B (dc return) and observe that oscilloscope waveform resembles that shown in Figure 6, except that:

(1) When RN is at dc return, termi- J is at -V;

(2) When RN is at -V, terminal J has a sinusoidal 400 Hz waveform, centered 5 volts above -V, with 2 volts peak-to-peak.

SF Oscillator Test (if included in circuit)

a. Remove jumper from terminals A and E and reconnect between terminals A and N.

b. Connect load resistor between terminals L and M.

c. Connect oscilloscope probe between terminals L and M (dc return) and observe a continuous 2600 Hz sinusoidal waveform.

Blown Fuse Test

To check that LED DS1 operates when the power source fails, remove (-) lead from terminal A and reconnect to terminal W. Observe that DS1 illuminates.

Upon completion of test procedures, disconnect power source, jumper lead, load resistor and oscilloscope and return FG-6 to operational usage. If unit is defective, refer to appropriate repair facility.

PARTS LIST

Refer to Figure 7 and Table 1 for parts ordering and identification data.

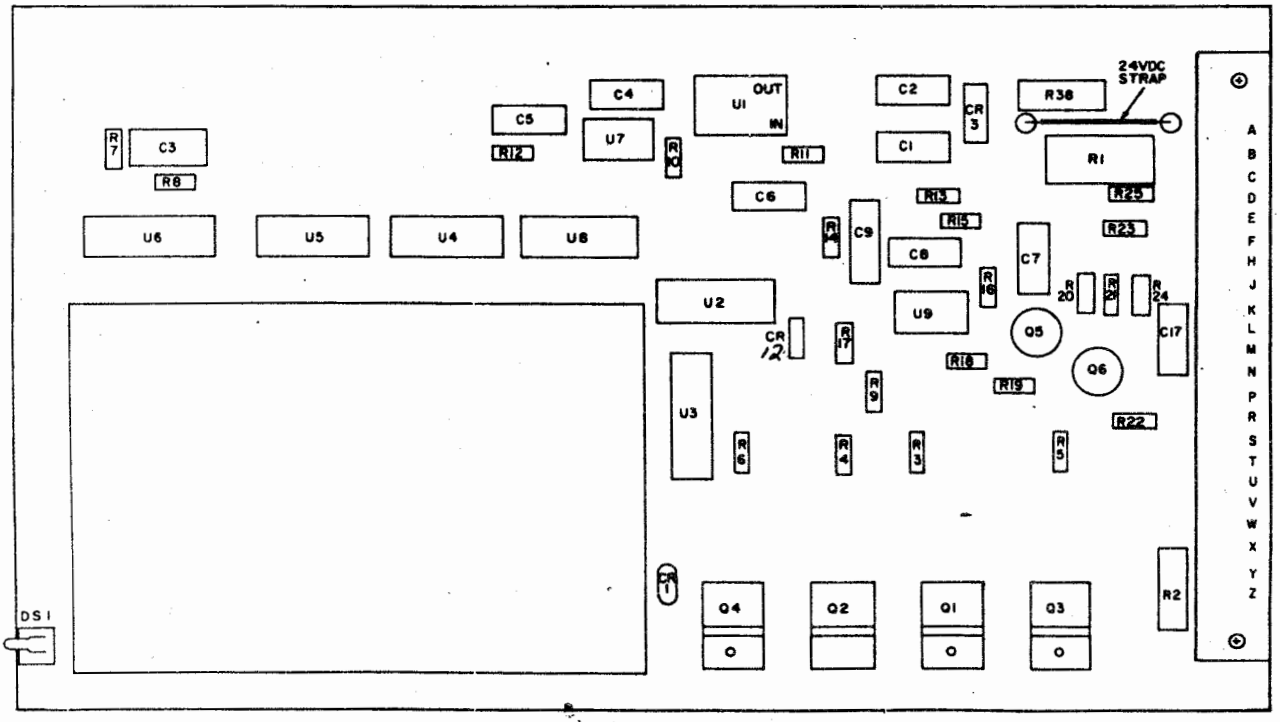

Figure 7.

Table 1. Parts List for Function Generator, Model FG-6

Reference Designation	Part Number	Description	Quantity
C1, C17	Commercial	Capacitor, Mylar, 0.22 mfd ±20%, 100V	2
C2, C5	Commercial	Capacitor, Mylar, 0.1 mfd ±20%, 100V	2
C3, C6-C8	Commercial	Capacitor, Mylar, .068 mfd ±10%, 100V	4
C4	Commercial	Capacitor, Mylar, .001 mfd ±10%, 100V	1
C9	T310B106K-015AS	Capacitor, Tantalum, 10 mfd, 15V	1
CR1, CR12	1N4007	Semiconductor Diode	2
CR3	1N4747	Zener Diode, 20V, 1W	1
DS1	550-0406	LED Indicator Assembly (Dialco)	1
P1	133-022-43	Connector, Electrical (Amphenol)	1
Q1-Q4	2N6388	Transistor, Darlington, NPN	4
Q5, Q6	2N2222	Transistor, NPN	2
R1	Commercial	Resistor, 430 ohms ±10%, 2W	1
R2	Commercial	Resistor, 2700 ohms ±10%, 1W	1
R3-R6	Commercial	Resistor, 3300 ohms ±5%, 1/2W	4
R7	Commercial	Resistor, 470K ±5%, 1/4W	1
R8	Commercial	Resistor, 1 megohm ±5%, 1/4W	1
R9, R11, R25	Commercial	Resistor, 10K ±5%, 1/4W	3
R10, R18	Commercial	Resistor, 2.2K ±5%, 1/4W	2
R12	Commercial	Resistor, 12K ±5%, 1/4W	1
R13	Commercial	Resistor, 33K ±5%, 1/4W	1
R14, R17, R22	Commercial	Resistor, 1K ±5%, 1/4W	3
R15	Commercial	Resistor, 300 ohms ±5%, 1/4W	1
R16	Commercial	Resistor, 120K ±5%, 1/4W	1
R19, R20	Commercial	Resistor, 15K ±5%, 1/4W	2
R21	Commercial	Resistor, 470 ohms ±5%, 1/4W	1
R23	Commercial	Resistor, 4.7K ±5%, 1/4W	1
R24	Commercial	Resistor, 22K ±5%, 1/4W	1
R38	Commercial	Resistor, 150 ohms ±5%, 1/4W	1
U1	LM340T-12	Regulator, 12V dc	1
U2	MM74C90	4 Bit Decade Counter	1
U3, U6	CD4049C	Hex Inverter	2
U4, U8	MM74C74	D-D Flip-Flop	2
U5	CD4023BC	Triple 3-Input NAND	1
U7	LM566CN	Voltage-Controlled Oscillator (VCO)	1
U9	LM741CN	Operational Amplifier	1
	200337	Panel	1
	200315	Bracket	1
	200321	Pull	1
	2003	Printed Circuit Board	1
	200338	Heat Sink	1
	200173	Schematic Diagram	-
	133--22-43	Connector	1

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LINE CONTROL UNIT, MODEL LCU-3

GENERAL

Line Control Unit Model LCU-3, CF Electronics Part Number 200227 (Figure 1), provides lamp, buzzer, and tone outputs to a 24V dc or 48V dc key telephone system, The LCU-3 also supplies an interrupted 400 Hz ringback signal when used in conjunction with Function Generator Model FG-6. Line detection circuitry is compatible with 24V dc or 48V dc common battery systems; and with 500-type telephone networks. Switching is provided by relay contacts and line isolation is provided by opto-isolator inputs. Front-panel LED's are used as maintenance aids to indicate proper relay operation.

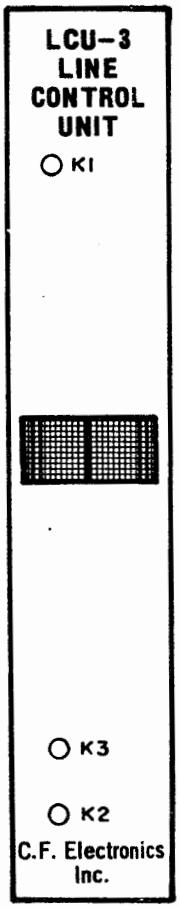


Figure 1.

SPECIFICATIONS

Input Voltages

Power input	...	24V dc or 48V dc, 15% regulation
Line AC ringing	...	60V rms (minimum)
Sleeve lead DC ring	...	24V dc or 48V dc, 12-24 mA
Line talk-battery	...	24V dc or 48V dc operation
Output Voltage	...	24V dc or 48V dc
Ringback Tone Output	...	600-ohm impedance Transformer-coupled, dc open Relay contact closure output 400 Hz interrupted signal Adjustable from 0 to -20dBm

Current Input

Line idle	...	52 mA
Maximum relay consumption	...	50 mA
Loading	...	1 ampere maximum dc load per lamp (terminal K) or buzzer (terminal X) output

Optional Strapping Connections - Factory-strapped for 24V dc input power and 9-second timeout ...

*For 24V operation (shunt as indicated)	...	Across R27 Across R14 Across R16 Across R25
**For 9 second timeout		

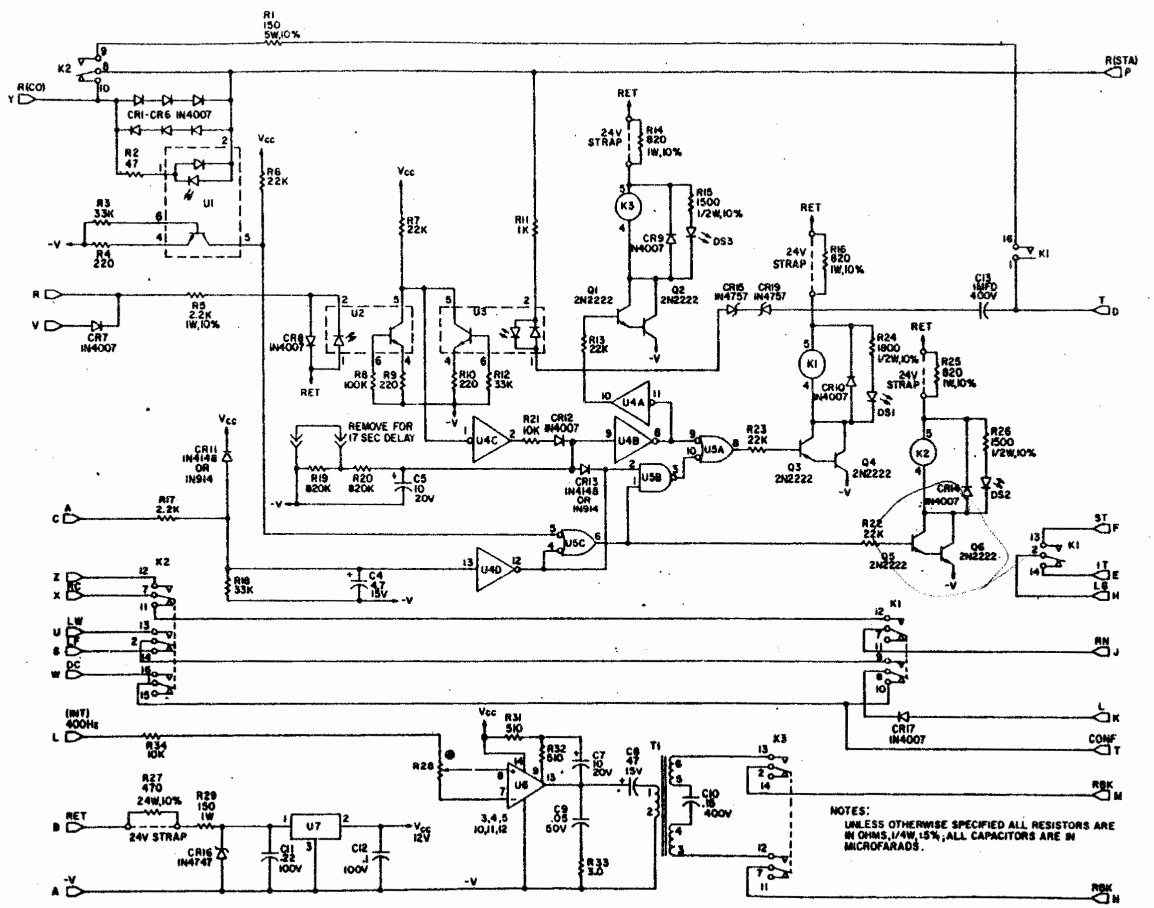
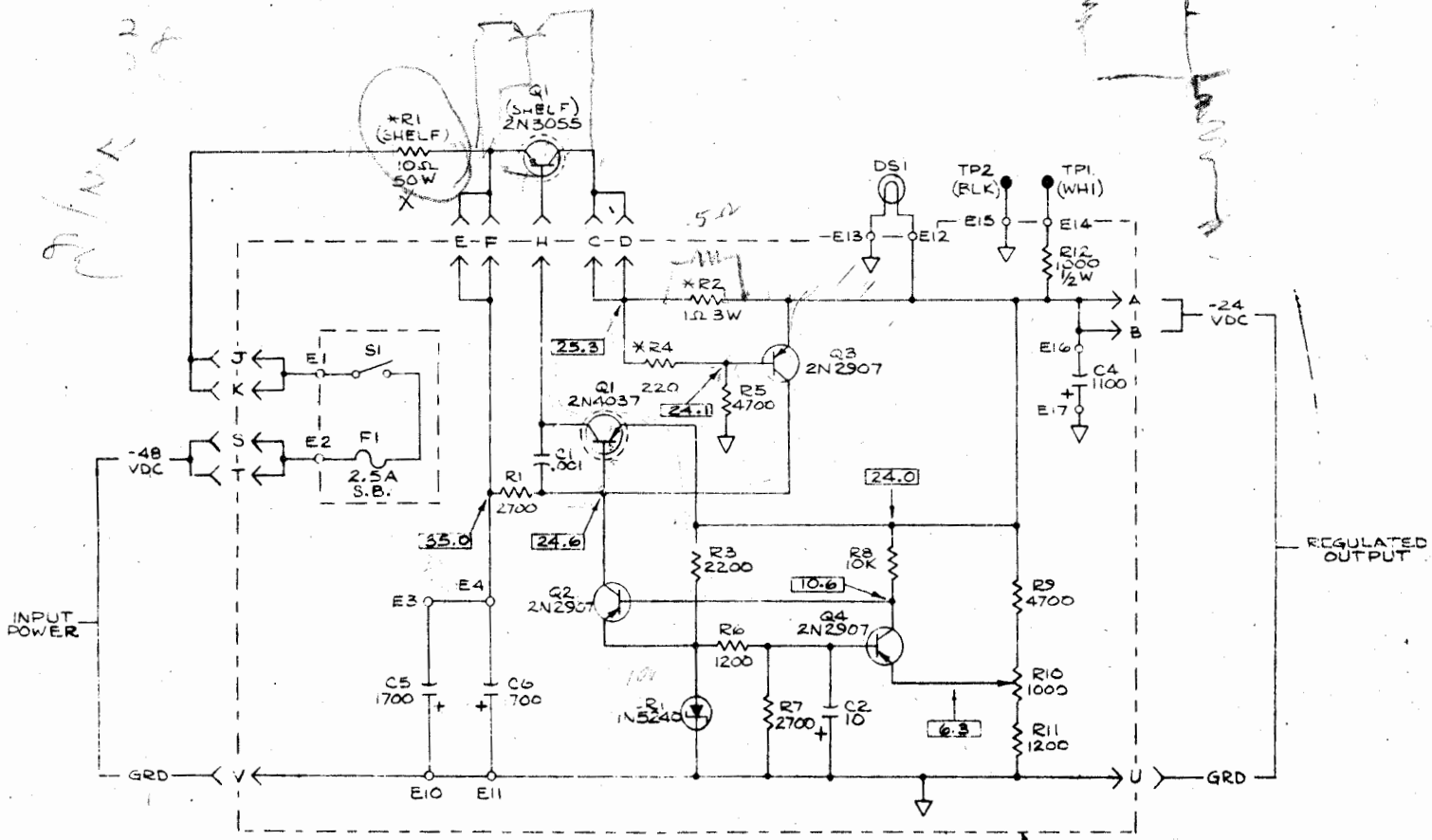

R1 150 5W,10%
R(STA) P
R(CO) Y
K2
CR1-CR6 IN4007
R2 47
U1
R3 33K
R4 220
Vcc
R6 22K
R7 22K
R11 1K
RET
24V STRAP
R14 820 1W,10%
R15 1500 1/2W,10%
K3
CR9 IN4007
DS3
Q1 2N2222
Q2 2N2222
R13 22K
CR15 IN4757
CR19 IN4757
R16 820 1W,10%
K1
C13 1MFD 400V
T D
R V
R5 2.2K 1W,10%
CR7 IN4007
CR8 IN4007
U2
U3
R8 100K
R9 220
R10 220
R12 33K
R24 1800 1/2W,10%
CR10 IN4007
DS1
R25 820 1W,10%
K2
R26 1500 1/2W,10%
CR14 IN4007
DS2
U4A
U4B
U4C
U4D
U5A
U5B
U5C
R21 10K
CR12 IN4007
R23 22K
Q3 2N2222
Q4 2N2222
REMOVE FOR 17 SEC DELAY
R19 820K
R20 820K
C5 10 20V
CR11 IN4148 OR IN914
CR13 IN4148 OR IN914
R17 2.2K
C A
R18 33K
C4 4.7 15V
R22 22K
Q5 2N2222
Q6 2N2222
ST F
LT E
LG H
RN J
L K
CONF T
(INT) 400Hz L
R34 10K
R31 510
R32 510
R28
U6
C7 10 20V
C8 4.7 15V
T1
C9 .05 50V
C10 .18 400V
R33 3.0
RBK M
RBK N
R27 470 24W,10%
R29 150 1W
U7
CR16 IN4747
C11 .22 100V
C12 .1 100V
24V STRAP
Vcc 12V
NOTES:
UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4W, ±5%; ALL CAPACITORS ARE IN MICROFARADS.

Figure 2.



CKT. BD. ASS'Y 1410-0280 FOR 41028-01
CKT BD ASS'Y 1410-0281 FOR 41028-01-22 AND 41028

NOTE:

1. Q1 AND R1 MOUNTED ON SHELF REAR PANEL (SHELF).
2. F1, S1, DS1, TP1 AND TP2 MOUNTED ON 41028 ASS'Y FRONT PANEL.
3. ALL RESISTANCE IN OHMS.
4. ALL CAPACITANCE IN UFD.
5. UNUSED TERMINALS NOT SHOWN.
6. ▭ NEGATIVE D.C. VOLTS. GRD REFERENCE.
7. * VALUE SHOWN FOR 41028-01 AND 41028-01-22. FOR 41028, R1 = 5 Ω, R2 = .2 Ω, R4 = 30 Ω.
8. ASS'Y 41028-01 HAS 18 PIN CONNECTOR
9. ASS'Y 41028-01-22 HAS 22 PIN CONNECTOR
10. ASS'Y 41028 HAS 22 PIN CONNECTOR

C	ECO # 320 ADDED 41028 REFERENCE	GH	12/7
B	ECO # 281 ADDED 41028-01-22 REFERENCE	GH	1/31
A	R1 (SHELF) WAS 15Ω, R3 WAS 3300 R4 WAS 300 C1 WAS [illegible]	JH	8-2-

ASS'Y
4410-0281-(41028)
4410-1201-01(41028-01)
4410-0281-01-22
(41028-01-22)

(shunt as indicated)... Across R19

*Omit shunts listed for 48V operation.
**Omit shunts listed for 17 second operation.

THEORY OF OPERATION

A circuit schematic diagram of the line control unit is shown in Figure 2; a functional description of the equipment follows:

Incoming Call, Ac Ring - Ac ringing signals supplied from the central office (or another exchange operating in a similar manner) are monitored across line card terminals D and Y (CO T and R inputs) and set the LCU circuits to the Incoming Call state. The Incoming Call state is defined by: relays K1 and K3 energized, relay K2 deenergized.

a. Zener diodes CR15 and CR19 (51V) insure that line noise less than 50 volts will not activate the ring detector. An ac ringing voltage greater than 50 volts causes opto-isolator U3 output to go to logic "0", in turn causing the U4C inverter's output to go to logic "1" thereby charging capacitor C5 to the logic "1" level; this charging rate is controlled by current limiting resistor R21. For increased noise immunity, the charging rate of C5 is slowed so that ringing detection occurs approximately 100 mS after the ringing signal starts. Capacitor C5 discharges through R20 for a 9-second timeout, or discharges through R20 in series with R19 (with jumper removed) for a seventeen second timeout. The discharge rate of C5 is 100 or 200 times slower than the charge rate, as a function of the ratio of R21 to the discharge resistance. Therefore, the duty cycle of ring detection, due to voltage levels or on/off ringing, will be sufficiently large to insure a constant signal from 100 mS after ringing starts until 9 (or 17) seconds after ringing stops, unless the call is answered first.

b. When capacitor C5 charges to logic "1", the output of inverter U4B goes to logic "0", causing inverter U4A and NAND U5A to go to logic "1" at their respective outputs. A logic "1" at U4A and U5A gate outputs energizes relays K3 and K1 through the respective Q1-Q2 and Q3-Q4 Darlington amplifiers.

c. With Relay K1 energized and K2 deenergized, Ringing signal (RN) at terminal J is connected through to the Ring Common (RC) output, causing the call director audible to buzz at the RN rate. The RN signal is 10 pulses per second (buzzing) for 1-second periods alternating with 3-seconds (silent) when RN is open.

d. A Ringback Tone output, consisting of 400 Hz modulated by the call director's Ringing signal (RN), is supplied during the Incoming Call State. A common Ringback Tone connection is made to all line cards at terminal L. The Ringback Tone is buffered through amplifier U6 and isolated from line transients by transformer T1. When relay K3 is energized, Ringback Tone is supplied at terminals M and N (designated as RBK pair). The Ringback Tone must be connected to the line at the appropriate point on a cross-connect basis.

e. The operation of relay K1 causes the -V signal present on terminal H to transfer from IT, at terminal E, to ST, at terminal F. In the Incoming Call State, with relay K1 energized and K2 deenergized, the RN signal at terminal J is connected to RC output terminal X to activate the audible alarm in the call director. The LF signal at terminal S is connected to the L output at terminal K to "flash" the call director line lamp.

Incoming Call, DC Ring - Incoming calls are initiated by SF signalling detectors, DTMF dialing detectors, or other call origination circuitry. A -V signal is switched on at line card terminal R by the signalling device. When the voltage at terminal R goes to -V, current flows through opto-isolator U2 input and U2 output goes to logic "0". Since the ac and dc detectors, U3 and U2, respectively, have a wired-OR output connection, the line card will perform its functions in the same manner as for the ac ringing case described above. The dc ringing and ac ringing both initiate the Incoming Call state which is defined; relays K1 and K3 energized, relay K2 deenergized.

Call-In-Progress - When the call director is off-hook and the line key associated with a particular line is selected, the line card circuit will be in the Call-in-Progress state, the call director telephone is present

as a dc load across terminals P and D (Station T and R inputs); and a +V signal is present on terminal C (A lead). This state is defined by: relay K2 energized, relays K1 and K3 deenergized.

a. A +V signal at terminal C (A input) causes gate U4D output to go to logic "0" causing capacitor C5 to discharge, if the card was in an Incoming Call state when the A input signal occurred; gate U4B input is pulled low by U4D output, via CR13, causing gates U4B and U5C outputs to go to logic "1". If the line card was in the Incoming Call state when the A input signal occurred, gate U4B output going to Logic "1" causes gates U4A and U5A outputs to go to logic "0", thereby deenergizing relays K1 and K3 by turning off their respective Darlington amplifiers. At this time, gate U5C output also goes to logic "1", relay K2 is operated through the Q5-Q6 Darlington amplifiers.

b. With relay K2 energized by Darlington amplifier Q5, Q6, and a telephone load across terminals P and D, sufficient current flows through opto-isolator U1 input for the U1 output to go to logic "0". Note that U1 output goes to logic "0" when the current exceeds 12 mA, thereby ensuring that any current sufficient for the telephone instrument will activate the current detection circuitry. Since the U1 current detector is shorted out whenever relay K2 is deenergized, the U1 output can only go to logic "0" if the line card is in the Call-in-Progress state. The U1 output is immune to false triggering at any other time. The transistion of the U1 output to logic "0" does not cause any functional change on the line card since the output of gate U5C is already at logic "1"; the U1 output signal performs its function only if, at a later time, the call director operator presses the Hold button while the line card is in the Call-in-Progress state.

c. In the Call-in-Progress state, with relay K2 energized and relays K1 and K3 deenergized, the steady lamp signal (dc) present on terminal W is connected to the L output at terminal K causing the line lamp to be lit steadily; the -V signal at terminal H is connected to the IT output at terminal E; the RC output at terminal X is off unless a signal is introduced externally through terminal Z so the call director audible is not activated through the line card.

Hold - Momentary operation of the Hold button by the call director operator, while the line card is in the Call-in-Progress state, will cause the line card to go to the Hold state. The Hold state is defined by: relays K1 and K2 energized, relay K3 deenergized.

a. The transistion into Hold is signalled to the line card by the A input signal at terminal C going open (away from +V) while the telephone load remains across terminals P and D (station T and R inputs). Since opto-isolator U1 output is already at logic "0" it remains at that level because the telephone load is still conducting current through the line. The A input signal going open causes gate U4D output to go to logic "1" while gate U5C output remains at Logic "1", as for the Call-in-Progress state. With U4D and U5C outputs at logic "1", gate U5B output goes to logic "0". A logic "0" input at the gate of U5A causes U5A output to go to logic "1", energizing relay K1 through Darlington amplifier Q3, Q4. Since gate U5C output remains at logic "1", K2 remains energized.

b. In the Hold state, with relays K1 and K2 energized and K3 deenergized, a 150 ohm load is connected across the CO telephone pair at terminals D and Y. When the operator releases the Hold button, the line key releases, causing the telephone load to be disconnected from terminals P and D (station T and R inputs), but the 150 ohm load causes current to continue flowing through the line, thereby maintaining the telephone connection. Additionally, the LW signal present on terminal U is connected to the L output on terminal K thereby causing the line lamp to wink , indicating a call on Hold. The line card remains in the Hold state until the call director operator returns to the line by selecting the line key with the telephone off hook or until the distant party (waiting on Hold) abandons the call.

c. If the distant party abandons the call, by going on hook, a signal is sent to the Central Office supplying battery current to the telephone line causing current to be interrupted for about 50 mS so as to release circuitry placed on hold. When current through the line is interrupted, current

through opto-isolator U1 stops and the U1 output goes to logic "1". Interrupting current means the Y terminal R (CO) is open, breaking the current through R1. When U1 output goes to logic "1", with U4D already at logic "1", gate U5C output goes to logic "0", causing gate U5B output to go to logic "1", in turn causing gate U5A output to go to logic "0". Relays K1 and K2 deenergize as their respective Darlington amplifiers are cut off. (Relays K1 and K2 take approximately 15 mS to deenergize, insuring against accidental release due to a shorter duration noise on the line.)

Idle - When all relays are released, the line card is in the Idle state. If a call is in progress and the operator hangs up by going on hook or by selecting another line key, the telephone load across terminals P and D (station T and R inputs) is removed at the same time that the A input signal at terminal C goes from -V to open. If the system includes conference capability, the line card goes to the Idle state when release of the Conference key removes the telephone load and opens the A lead as in the hang-up operation.

Conferencing capability is controlled external to the line card. When the call goes into conference a CF signal is switched on at terminal T and is supplied as an output at terminal K, causing the line lamp to turn on and off with the conference flash signal.

FUNCTIONAL CHECKOUT

The operation of the Line Control Unit can be checked with the aid of a subscriber station (or Call Director). The tests may be accomplished by placing the receiving calls with the aid of a second party at a distant station or, if two lines are available at the test location, by placing a call from one line through the Central Office to the second line.

TEST EQUIPMENT REQUIRED

The following test equipment is required:

- Oscilloscope
- Card Extender
- 24V dc or 48V dc power source
- Spare Line Control Unit (tested, known to be operational)

TEST PROCEDURES

No adjustments are required for proper circuit operation. The procedures given in the following paragraphs are based on functional tests performed in an operational environment. Where applicable, as a maintenance aid, corrective maintenance procedures are also suggested.

Preliminary Test Setup

a. Select a telephone station with appearance of line to be tested. The station should be wired for audible alarm when incoming calls are received on the tested line. Identify line card in the equipment rack.

b. Check that:
   (1) Line button is not selected (up) and/or telephone is on hook
   (2) Line lamp is extinguished
   (3) K1, K2 and K3 LED's on front panel are extinguished

c. Note that 24V dc is connected between terminals B(+) and A(-). If 48V dc is used as supply voltage, remove strapping.

Test Calling

a. With telephone off-hook, push tested line button. Line lamp should be lit steady, and dial tone should be audible.
   (1) If lamp does not light, inspect Line Control Unit front panel LED indicators: if K2 LED is not lit, exchange Line Control Unit. If problem persists (K2 LED does not go on when new unit is inserted), test instrument A lead for continuity.
   (2) If K2 LED is lit, LCU or line lamp may be defective. Continue testing to obtain additional data.

b. Place call to distant party by dialing or ringdown, as appropriate. Line lamp indication should not change.

c. When distant party answers, confirm testing procedure and then depress the Hold button to place LCU in Hold state. The Line lamp should have a wink indication.
   (1) If lamp indication is incorrect, inspect front panel LED's. K1 and K2 LED's should be lit in Hold state.
   (2) If LED indications are correct and line lamp has not lit since test start, install new lamp in line key.
   (3) If LED indications are incorrect, or if they are correct and line lamp indication is otherwise incor-

rect, exchange LCU. If problem persists, test telephone line voltage and noise levels.

d. After line is on Hold, distant party (by prearrangement) will hang up. On central Office lines a cut-off signal may be present to signal the end of call. If tested line has this feature, line lamp should extinguish within 60 seconds; if it does not, exchange LCU and repeat test. If problem persists, confirm CO line operation.

(1) If line is not arranged with cut-off signal, hang up telephone and wait for prearranged incoming call from distant party (or place call on a second line).

(2) If line lamp does not extinguish, check LCU front panel LED's. All LED's should be extinguished. If an LED is lit or if the line lamp is lit, exchange LCU.

e. When the incoming call is received, line lamp should flash and the audible alarm should be heard. If both signals do not occur, select line key while off hook to confirm that distant party has completed the connection.

(1) If the call was made and a connection is established without lamp and audible signal occurrence, exchange LCU. If problem persists, confirm CO or sleeve ring signal, across terminals R and B for DC Ring signal, or across terminals Y and D for CO AC Ring signal (as appropriate).

(2) If buzzer signal does not occur and the lamp flash signal does, exchange the LCU. If buzzer problem persists, first check that buzzer is operating by having a call placed on another line.

(3) If buzzer is determined to be operational, check Function Generator or Interrupter RN input signal at terminal J (with oscilloscope). If line lamp flash signal does not occur and the buzzer signal does, exchange LCU. If problem persists, check Function Generator or Interrupter LF input signal at terminal S (with oscilloscope).

f. Answer incoming call to verify the Ringback Tone reception by distant party. If signals were not correct during incoming call, repeat test while observing LCU front panel. K1 and K3 LED's should be lit during incoming call.

(1) If LED indication was incorrect, but buzzer and lamp signals were correct during incoming call, replace LCU and repeat test.

(2) If Ringback Tone was not audible, but LED indications were correct, exchange LCU and repeat the test. If problem persists, check Function Generator input to terminal L with oscilloscope.

(3) If Ringback Tone was audible, but clicked or was at too low a level, extend LCU with Card Extender and connect oscilloscope across terminals M and N. Decrease gain (if the clicking occurred) or increase gain (if level is too low) by adjusting R28 to a subjectively satisfying level (or adjust to a preset level previously determined) and make a note of the correctly adjusted level for equipment files.

Upon completion of test procedures, disconnect power source and test equipment and return LCU-3 to operational usage. If unit is defective, return to appropriate reapri facility.

PARTS LIST

Refer to Figure 3 and Table 1 for parts ordering and identification data.

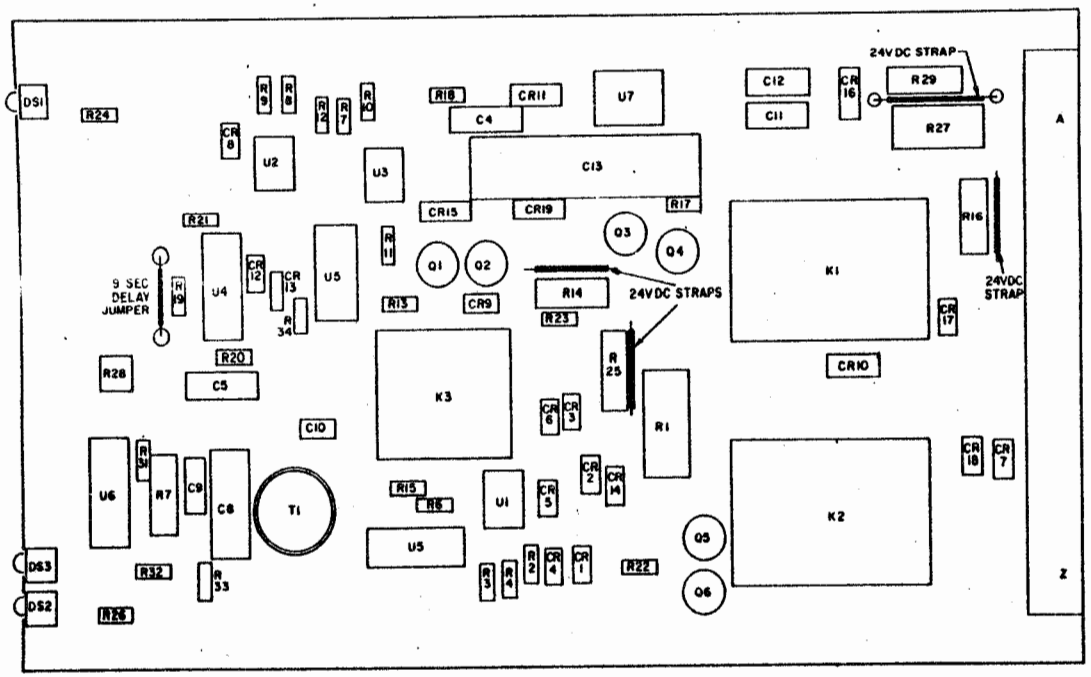

24VDC STRAP
DS1
R24
R9
R8
R7
R10
R18
CR11
U7
C12
C11
CR16
R29
R27
A
CR8
U2
U3
C4
C13
CR15
CR19
R17
R21
9 SEC DELAY JUMPER
R19
U4
CR12
CR13
R34
U5
R11
Q1
Q2
Q3
Q4
R14
24VDC STRAPS
K1
R16
24VDC STRAP
CR17
R23
R25
R20
R28
C5
K3
CR10
CR6
CR3
R1
C10
R31
U6
R7
C9
C8
T1
R15
R6
U1
CR5
CR2
CR14
K2
CR18
CR7
U5
R3
R4
R2
CR4
CR1
R22
Q5
Q6
DS3
DS2
R32
R33
R26
Z

Figure 3.

Table 1. Parts List for Line Control Unit, Model LCU-3

Reference Designation	Part Number	Description	Quantity
C4	T310A105-015AS	Capacitor, Tantalum, 1 mfd, 15V	1
C5, C7	T310B106-020AS	Capacitor, Tantalum, 10 mfd, 15V	2
C8	T310C476-015AS	Capacitor, Tantalum, 47 mfd, 15V	1
C9	Commercial	Capacitor, Ceramic, 0.05 mfd, 50V	1
C10	Commercial	Capacitor, Mylar, 0.15 mfd, 400V	1
C11	Commercial	Capacitor, Mylar, 0.22 mfd, 100V	1
C12	Commercial	Capacitor, Mylar, 0.1 mfd, 100V	1
C13	Commercial	Capacitor, Mylar, 1 mfd, 400V	1
CR1-10, 12, 14, 17	1N4007	Semiconductor Diode, 1A, 200V	13
CR11, CR13	1N4148(or 1N914)	Semiconductor Diode	2
CR15, CR19	1N4757	Zener Diode, 51V, 1W	2
CR16	1N4747	Zener Diode, 20-24V, 1W	1
DS1-DS3	550-0406	LED, Red Diffused (Dialco)	3
K1, K2	NC4-JP-DC24	Relay, 4PDT, 24V dc (Arrow)	2
K3	NC2-JP-DC24	Relay, DPDT, 24V dc (Arrow)	1
P1	133-022-43	Connector, Electrical (Amphenol)	1
Q1-Q6	2N2222	Transistor, NPN	6
R1	Commercial	Resistor, 150 ohms ±10%, 5W	1
R2	Commercial	Resistor, 47 ohms ±5%, 1/4W	1
R3, 12, 18, 35	Commercial	Resistor, 33K ±5%, 1/4W	4
R4, 9, 10	Commercial	Resistor, 220 ohms ±5%, 1/4W	3
R5	Commercial	Resistor, 2.2K ±10%, 1W	1
R6, 7, 13, 22 23	Commercial	Resistor, 22K ±5%, 1/4W	5
R8	Commercial	Resistor, 100K ±5%, 1/4W	1
R11	Commercial	Resistor, 1K ±5%, 1/4W	1
R14, 16, 25	Commercial	Resistor, 820 ohms ±5%, 1W	3
R15, 24, 26	Commercial	Resistor, 1500 ohms ±10%, 1/2W	3
R17	Commercial	Resistor, 2.2K ±5%, 1/4W	1
R19, 20	Commercial	Resistor, 820K ±5%, 1/4W	2
R21, 34	Commercial	Resistor, 10K ±5%, 1/4W	2
R27	Commercial	Resistor, 470 ohms ±10%, 2W	1
R28	3389P-103	Resistor, Variable, 10K (Bourns)	1
R29	Commercial	Resistor, 150 ohms ±10%, 1W	1
R31, 32	Commercial	Resistor, 510 ohms ±5%, 1/4W	2
R33	Commercial	Resistor, 3 ohms ±5%, 1/4W	1
T1	200273	Transformer	1
U1, U3	H11-AA-1	Photo-Isolator	2
U2	4N25	Photo-Isolator	1
U4	74C14	Hex Schmitt Trigger	1
U5	74C00	Quad 2-Input NAND	1
U6	LM388N	Power Amplifier (National)	1
U7	LM340T-12	Voltage Regulator, 12V (National)	1
-	200320	Panel	1
-	200315	Bracket	1
-	200321	Pull	1
-	200322	Printed Circuit Board	1
-	200175	Schematic Diagram	-

41052 DTMF ADDRESS DECODER

UNIT DESCRIPTION

1. REFERENCES:

41052 DTMF ADDRESS DECODER

410-1520 Schematic

2. DESCRIPTION

The 41552 DTMF Address Decoder provides 2 of 7 DTMF (Dual Tone Multi-frequency) tone detection and call decoding for two or three digit addressing. For call decoding, digit selection is performed by setting DIP switches (up to three) to respond to the desired digits. An adjustable interdigit timeout sets the allowable delay between correct digits. A correct address sets an adjustable timed latch which energizes a relay. The relay's two (2) FORM C contacts are pinned out for external use. The correct address latch can be reset before it times out, by an "ALL CLEAR" tone pair, an external reset, or optionally by a wrong digit. An option is provided which allows the "ALL CALL" tone pair to be a correct address. To prevent loading of a line, the input to the address decoder is a balanced high impedance input.

3. SPECIFICATIONS

3.1 Power.....-20 to -24VDC

3.2.0 Input

3.2.1 Impedance .....>50K Ohms

3.2.2 DTMF Level.....-22dB min. +10dB max.

3.2.3 Minimum tone duration .....40 ms

3.3.0 DTMF Tones

3.3.1 Detector Bandwidths .....±2.5%

3.3.2 Detector Outputs .....Ground

3.4.0 Inter-digit timing

3.4.1 Minimum timer .....1 Sec.

3.4.2 Maximum timer.....5 Sec.

3.5.0 Correct address timing

3.5.1 Minimum Timer .....1 Sec.

3.5.2 Maximum timer .....30 Sec.

3.6.0 Outputs

3.6.1 Regulated voltage .....-12 ±1VDC

3.6.2 Relay Contacts.....Two (2) FORM C

4. THEORY OF OPERATION

4.1 Input Amplifier and Filter

The input to the module, pins D and E, is a balanced high impedance input, as determined by resistors R80, R81 and amplifier 1C10-B. Amplifier 1C10-B converts the balanced input to an unbalanced output. This output is peak detected by CR-9, C29 and comparator 1C10-A. Q15 is turned on by 1C10A whenever a sufficient input level exists on pins D and E. The output of IC10-B also goes to a low pass filter and a high pass filter. C26, C9 and L9 comprise the Low Pass Filter, while C8, L8 and C28 comprise the High Pass Filter. The L.P.F. passes all frequencies below 1100Hz, while the H.P.F. passes all frequencies above 1100Hz. Comparators 1C9-B and 1C9-A provide square wave outputs from the L.P.F. and H.P.F. when Q15 is on. Diodes CR8 and CR7 clamp the output between ground and -12V for a constant amplitude regardless of input voltage. The L.P.F. output goes to the four low frequency detectors, while the H.P.F. output goes to the three high frequency detectors.

4.2 DTMF Tone Detectors

The seven DTMF tone detectors are shown in detail for the 697Hz detector only. All other detectors are indentical except for the value of the inductor and capacitor in the tank circuit. The tank circuits are tuned to accept the DTMF frequencies ±1.5%. Given an input frequency within the detection range, $\overline{Q2}$ provides a half wave rectified output (all component references are to the 697Hz detector). R2 and C10 filter the output of Q2. Q1 is an emitter follower amplifier, providing a low impedance output from the detector. This output is normally at -12V and goes to Ground when the tone frequency is received.

4.3 Address Decoding

4.3.1 Parity Time Check

For a valid DTMF tone to exist, the two tones must be present for a minimum of 40ms. IC2-A, IC2-B and IC6-A monitor the seven detector outputs, providing a high output on pin 4 of IC6 whenever both a low and high tone exists. R45 and C19 provide a 40ms delay for a low to high transition, while CR1 and R44 provide a minimal delay for a high to low transition. Gates IC5-B and IC5-A enable IC6-A and IC5-D respectively, allowing detection of a DTMF digit only after the 40ms parity time.

4.3.2 "All Call", "All Clear"

For the "All Call" (star sign) and "All Clear" (pound sign) tone pairs, separate logic is provided. IC2-B detects 941Hz and 1209Hz for an "All Call" while IC2-A detects 941Hz and 1477Hz for an "All Clear". To provide protection from talk-up due to noise or voice, a 140ms parity time delay is provided (R42, CR2, R43 and C17) before IC2A & B are enabled. Provisions are included to allow "All Call" to be a correct address while the "All Clear" provides a reset to the address detection through IC7-C and IC6-D.

4.3.3 Address Detection

Switches S1, S2 and S3 are used to select the digits to be recognized as a correct address. S1 selects Digit 1, S2 selects Digit 2, and S3 selects Digit 3 (if 3 digit addressing is used). The seven positions on the switches correspond to the seven tones. Selecting a digit requires selecting the tone pair associated with the digit (refer to Section 5.1,"Address Strapping").

IC4 is an octal counter, providing a single high output on one of eight outputs (4 of which are used). With no DTMF input, the monostable timer Q16-C47 has a low output. This low output puts a high on the reset (pin 15) of IC4, through IC5. The "0" output of IC4 (pin 2) is held "high" whever IC4 is reset, enabling IC3-A.

With IC3-A enabled, receipt of DTMF tones corresponding to those selected on S1 will cause a low output from pin 10 of IC5. After the 40ms parity time check IC5-D is enabled. The high to low transition from IC5-D

triggers Q16, releasing the reset from IC4 for the time duration determined by R53, R54 and C21. When the DTMF tones cease, IC5-D goes high, clocking IC4 one count and enabling IC3-B via output "1" of IC4 (pin 1). If the DTMF tone pair selected by S2 is received before C21 times out, IC5-D will again go low (after 40ms), re-triggering Q16 and clocking IC4 on the low to high transition. A similar sequence takes place for the tone pair selected by S3, if 3 digit addressing is used.

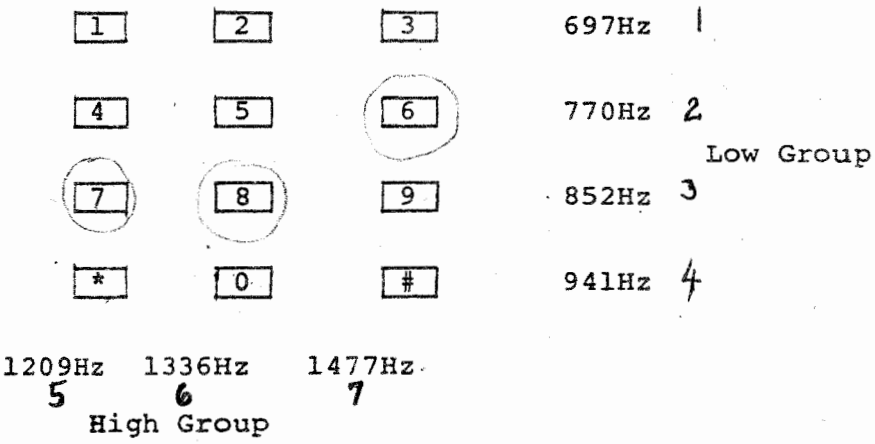
In addition to the reset provided by the inter-digit timer (Q16, C21), IC4 may be reset (via IC8-A) by an "All Clear" tone pair, a wrong digit or an external reset. The external reset may be either via IC6-D by a ground on pin M (positive reset) or via IC6-D and IC7-C by providing -V on pin R (negative reset).

Depending on whether 2 digit or 3 digit addressing is desired, either output "2" or output "3" of IC4 is strapped to pins 8 and 9 of IC6-C, which drives pin 12 of IC8. IC8-C and IC7-A comprise a latch triggered by a high on pin 12 of IC8-C. This latch drives Q18 which in turn drives relay K1, whose two (2) form C contacts are pinned out for external use. The correct address output of IC4 also triggers the correct address timer (Q17, C22) through IC6-C. The correct address timer's output is routed through IC8-B and IC7-D to reset the latch IC8-C and IC7-A). The latch may also be reset by an "All Clear" tone pair, an external reset (as described above) or optionally by a wrong digit (if R49 is installed.)

5. STRAPPING AND ADJUSTMENTS

5.1 Address Strapping

The 41052 DTMF Address Decoder detects and utilizes Dual Tone Multifrequency (DTMF) signals to provide selective address decoding functions. (DTMF signals are unique tone pair generated by standard Touch Tone encoder arrays. Each button on a Touch Tone encoder is identified by the pair of frequencies generated when the button is pushed. Four low-group frequencies correspond to the four rows of buttons, and three high-group frequencies correspond to the three columns.



To program the 41052 DTMF Address Decoder, determine the number of digits to be used, (two or three) and install a strap between solder terminals as follows:

two digit code - Strap center terminal to terminal "2"
three digit code- Strap center terminal to terminal "3"

The three DIP switches labled S1, S2 and S3 are programming switches for first, second and third code digits respectively. The seven individual rocker switches on each programmer correspond to the seven frequencies making up the DTMF encoder array. Rocker switch 1 represents the 697Hz tone, switch 2 represents the 770Hz tone, and so on in ascending frequencies to switch 7, which represents the 1477Hz tone.

If the address code 357, for instance, is to be detected, a strap from the 3 digit terminal to A or B is installed. Close rocker switches on S1 to correspond to the two tones which represent a 3 on the DTMF matrix: 697Hz and 1477Hz, switches 1 and 7 on S1. The second digit, 5, is programmed into S2 by closing switches 2 and 6, corresponding to the tone pair 770Hz and 1336Hz. S3 is programmed for the third digit, 7, by closing switches 3 and 5, which represent the tone pair 852Hz and 1209Hz.

If a two-digit code is selected, the settings of the switches in S3 will have no effect.

5.2 Miscellaneous Strapping

The "All Call" tone pair can be used as a correct address by strapping the *C.A. strap option.

If it is desired to not have a wrong digit reset relay K1, the optional resistor R49 (10K Ohms) must be removed.

5.3 Timing Adjustments

The inter-digit time period may be changed from approximately 1 second to 5 seconds by adjusting potentiometer R54.

The correct address latch time may be changed from approximately 5 second to 30 seconds by adjusting potentiometer R55.

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD., SUITE 12
SPARKS, NEVADA 89431
(702) 359-3700

ASSEMBLY NUMBER 4410-0520 TITLE DTMF 41052 ADDRESS DECODER DWG. REF: 410-1520

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		ASSEMBLY:			
		4410-0520 DTMF ADDRESS DECODER			
		CAPACITOR, Fixed	35		
C1	0103-3301	Polystyrene, 30Kpf 2.5%	1	Mial Type 611H	
C2,C27	0103-3271	" 27Kpf "	2	" " "	
C3	0103-3241	" 24Kpf "	1	" " "	
C4,C25	0103-3221	" 22Kpf "	2	" " "	
C5	0103-3181	" 18Kpf "	1	" " "	
C6	0103-3161	" 16Kpf "	1	" " "	
C7	0103-3151	" 15Kpf "	1	" " "	
C8	0103-3121	" 12Kpf "	1	" " "	
C9	0103-3131	" 13Kpf "	1	" " "	
C10-C16,C19 C20,C29	0104-0005	Mylar, .1uf	10		
C17, 35	0102-0041	Electrolytic, 1uf	2		
C18*,C28	0103-2201	Polystyrene, 2200pf	2		
C21,C22	0104-0031	Electrolytic, 47uf	2		
C23,C24	0104-0028	Mylar, .33m	2		
C26	0103-3511	Polystyrene, 51Kpf	1		
C30	0102-0018	Electrolytic, 100uf	1		
C31	0102-0003	" 10uf	1		
C32	0101-0010	Mica, 150pf	1		
C33,C34	0104-0012	Mylar, .047uf	2		
		RESISTOR; Fixed, Composition 5% unless indicated otherwise	81		
R1,3,6,8,11 13,16,18,21 23,26,28,31 33	0206-3321	3.3K	14		

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SPARKS, NEVADA 89431
(702) 358-3700

ASSEMBLY NUMBER 4410-0520 TITLE DTMF 41052 ADDRESS DECODER DWG. REF:

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
R2,7,12,17 22,27,32	0206-3341	330K	7		
R4,9,14,19	0206-1341	130K	4		
R24,29,34	0206-1541	150K	3		
R5,10,15,20 25,30,35,42 47,49,50,60	0206-1031	10K	12		
R36-41,43,48 52,59,73,75	0206-1041	100K	12		
R44,64	0206-1021	1K	2		
R45	0206-3941	390K	1		
R46	0206-2241	220K	1		
R53	0206-4721	4.7K	1		
R54	0234-0046	Pot, 100K	1		
R55	0234-0038	" 500K	1		
R56,57,58,61	0206-2031	20K	4		
R62,63,70,76	0206-5621	5.6K	4		
R66,67,71	0206-2221	2.2K	3		
R68	0206-3631	36K	1		
R69	0206-2231	22K	1		
R72	0206-2731	27K	1		
R77	0206-8221	8.2K	1		
R78,65	0210-2003	200K, 1%	2		
R79	0206-2021	2K	1		
R80,81	0210-1003	100K, 1%	2		
R74	0206-1011	100 ohm	1		
R51	0206-4731	47K	1		
		SEMICONDUCTOR DEVICES:			
CR1-CR9	0300-0001	Diode	9	IN4001	
Q1-Q15	0340-0008	Transistor, NPN	15	2N2222	
Q16,17	0341-0008	" PNP	2	2N2907	

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ASSEMBLY NUMBER 4410-0520 TITLE DTMF 41052 ADDRESS DECODER DWG. REF:

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
IC1	0361-0053	Integrated Circuit	1	CD4002	
IC2,3,8	0361-0055	" "	3	CD4023	
IC4	0361-0054	" "	1	CD4022	
IC5,7	0361-0024	" "	2	CD4011	
IC6	0361-0023	" "	1	CD4001	
IC9,10	0361-0044	" "	2	4558DN	
IC11	0361-0059	" "	1	LM320T-12	
L1	0441-0042	Inductor	1	Raven	
L2	0441-0043	"	1	"	
L3	0441-0044	"	1	"	
L4	0441-0045	"	1	"	
L5	0441-0046	"	1	"	
L6	0441-0047	"	1	"	
L7	0441-0048	"	1	"	
L8,9	0441-0090	"	2	"	
S1,S2,S3	0501-0302	Switch, 7 Pos. DIP	3		
	0612-0104	Terminal	5		
	0510-0017	Connector, 22 pin	1	Amphenol 133-022-43	
	1410-0520	Board, P.C.	1	Raven	
	0450-0016	Socket, 16 pin	1		
	0450-0019	" 14 pin	7		
	0450-0020	" 8 pin	2		
K1	0411-0012	Relay	1	R40-E1-y4-V800	
	0450-0004	Relay Socket			

41052 DTMF ADDRESS DECODER

TEST PROCEDURE

1. REFERENCES

410-1520 DTMF Address Decoder Schematic
41052 DTMF Address Decoder Description

2. GENERAL

Complete the Test Data Card for this procedure as required. Do no change levels or settings until instructed to do so.

3. TEST EQUIPMENT REQUIRED

1 - -20VDC Power Supply
1 - Oscilloscope
1 - DC Voltmeter
1 - AC VTVM
1 - Signal Generator
1 - Frequency Counter
1 - ET 1001 Test Fixture

4. TEST PROCEDURE

4.1 Power

4.1.1 Connect the -20VDC supply to pins A (-V) and B (+V Gnd). Turn on the -20VDC supply and read a current drain of 40ma

4.1.2 Monitor pin C with a DC voltmeter. Read .....-12VDC ±.5V

4.2 High/Low Pass Filters

4.2.1 Connect a signal generatbr to pins D and E. Set the signal generator level to .....-10db
Set the signal generator frequency to 830Hz
Connect an oscilloscope to pin 1 of IC9. Tune L8 for a minimum level on the oscilloscope.

4.2.2 Set the generator frequency to 133Hz
Connect an oscilloscope to pin 7 of IC9. Tune L9 for a minimum level on the oscilloscope.

4.2.3 Set the generator frequency to 850Hz
Adjust the generator level from.....-22dBm to +10dBm
The output on the oscilloscope should be a square wave.

4.2.4 Set the generator frequency to.....135Hz
Connect an oscilloscope to pin 1 of IC9. Adjust the generator level from .....-22dBm to +10dBm
The output on the oscilloscope should be a square wave.

4.3 Tone Detectors

4.3.1 Connect the ET 1001 Test Fixture to pins D and E. Turn on the latch output on the ET 1001. Select digit 1. Connect an oscilloscope to the emitter of Q1. Adjust L1 for a minimum voltage (between ground and -3VDC). Vary the frequency deviation by ±1.5%. The output should be ..... -3VDC
Vary the frequency deviation by ±2.5%. The output should be ..... -3VDC
Select digit 4. The output should be ..... -9VDC

4.3.2 Select digit 4. Connect an oscilloscope to the emitter of Q4. Adjust L2 for a level of ..... -3VDC
Vary the frequency deviation by ±2.5%. The output should be ..... -3VDC
Select digit 7. The output should be .....-9VDC

4.3.3 Repeat 4.3.2 for the following digit/output pin combinations.

DIGIT	TUNE	OSCILLOSCOPE TO
7 (0 for last step)	L3	Emitter of Q5
0 (7 " " ")	L4	Emitter of Q7
1 (2 " " ")	L5	Emitter of Q9
2 (3 " " ")	L6	Emitter of Q11
3 (2 " " ")	L7	Emitter of Q13

4.4 Decoding Logic

4.4.1 Wrong Digit

Strap the 3-digit address strap option. Set the address switches (S1, S2, S3) for a 1-5-9 address. Set R54 to mid-range. Monitor pin 4 of IC7 with an oscilloscope. Select all digits (one at a time) except 1. Each digit should cause pin 4 of IC7 to go low. Select a 1-5-9 sequence. No low should appear at pin 4 of IC7 and the relay (K1) should energize. With R49 installed, selecting a wrong digit should cause K1 to de-energize.

4.4.2 Inter-Digit Timing

Monitor pin 15 of IC4 with an oscilloscope. Momentarily select a "1". Pin 15 of IC4 should go from high to low for 1-5 seconds, depending on the setting of R54. Adjust for a high level of 2 second duration.

4.4.3 All Clear (#)

Set R54 and R55 to their maximums (fully clockwise). Monitor pin 15 of IC4. Select a 1-5-9 sequence. K1 should energize and pin 15 of IC4 should go low for the inter-digit time period. Quickly and momentarily select an "ALL CLEAR" (#), before interdigit timer removes the low from pin 15 of IC4. K1 should relax (independent of the inter-digit timer) and pin 15 of IC4 should momentarily go high.

4.4.4 All Call (*)

If the *C.A. strap is not installed, jumper it with a clip lead. Momentarily select an "ALL CALL" (*). K1 should energize.

4.4.5 Correct address Timing

Select a 1-5-9 sequence. K1 should energize and remain in that state for 5-30 seconds, depending on the setting of R55. Adjust for a 15 second time out.

4.4.6 External Resets

Follow the procedure described for "ALL CLEAR"

(Section 4.4.3), but instead of selecting an "ALL CLEAR" apply a ground to pin M (positive reset). The results should be the same.

Repeat this procedure again but instead of selecting an "ALL CLEAR" apply -V to pin R (negative reset). The results should be the same.

4.4.7 Relay Contact Continuity

Select a 1-5-9 sequence to energize K1. Check for continuity between pins V and W and between pins Y and Z. There should be no continuity between pins U and V and between X and Y. Select an "ALL CLEAR" to relax K1. Check for continuity between pins and U and V and between pins X and Y. There should be no continuity between pins V and W and between pins Y and Z.

4.5 Disconnect all test equipment. Stamp the module and Test Data Card with Test Stamp.

41052 ADDRESS DECODER

WORK ORDER NO. _____

SERIAL NO._____

DATE_____

TEST PROCEDURE RESULTS

4.1.1_____

4.1.2_____

4.2.1_____

4.2.2_____

4.2.3_____

4.2.4_____

4.3.1_____

4.3.2_____

4.3.3_____(L3)

_____(L4)

_____(L5)

_____(L6)

_____(L7)

4.4.1_____

4.4.2_____

4.4.3_____

4.4.4_____

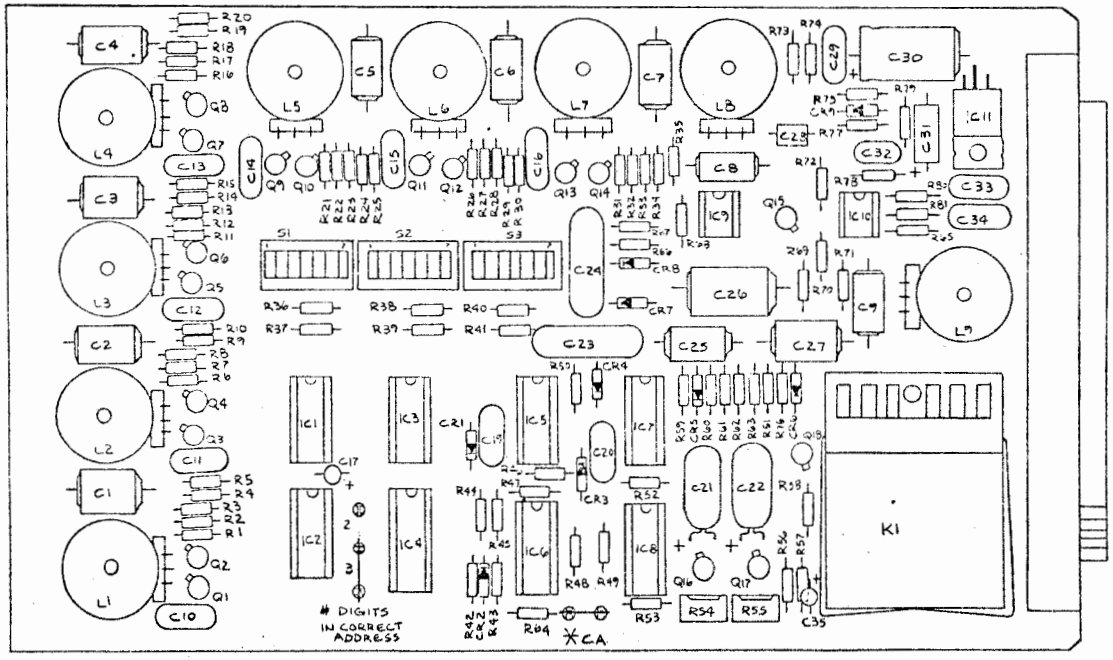
4.4.5_____

4.4.6_____(positive reset)

_____(negative reset)

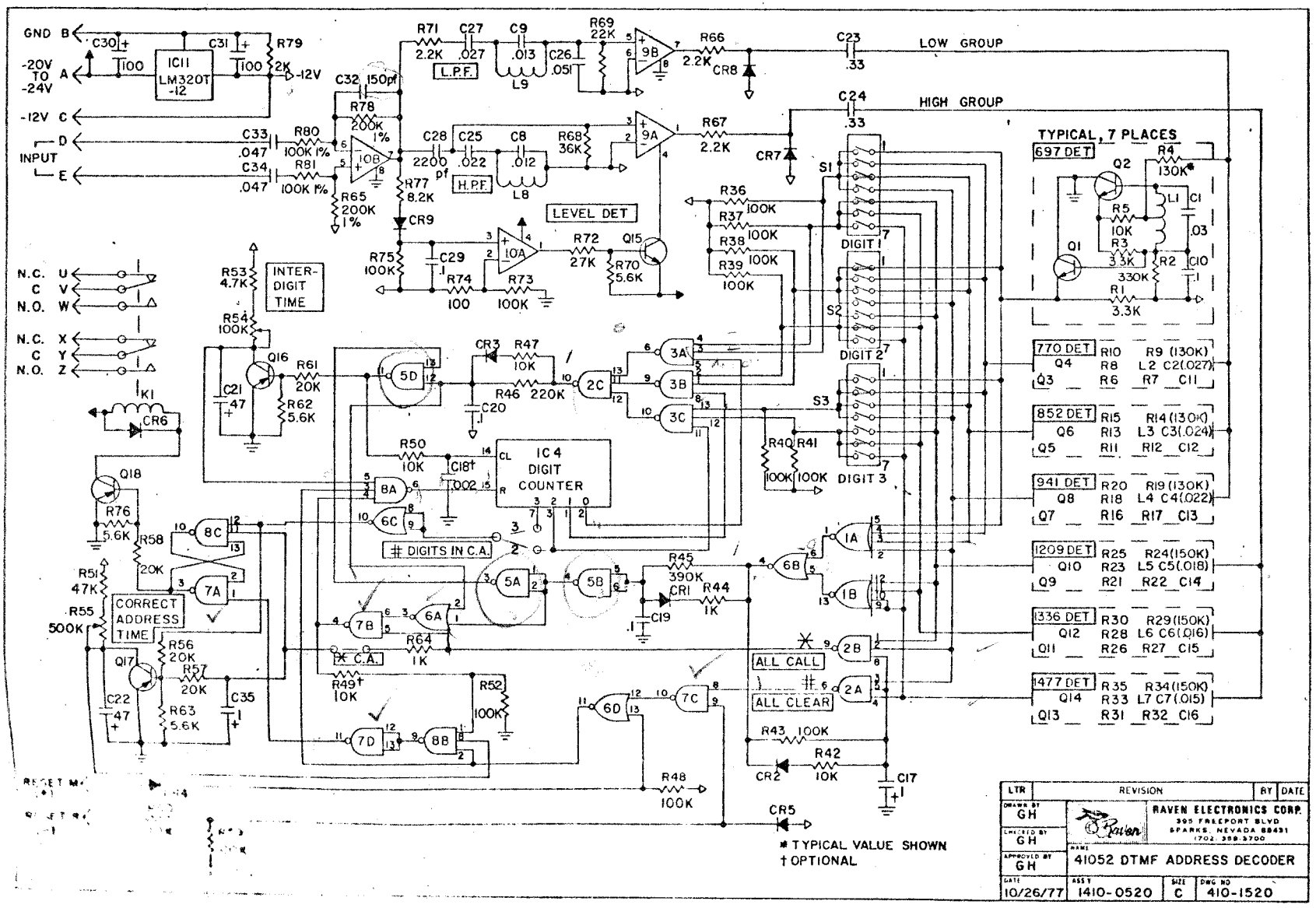
4.4.7_____

4.5_____(test stamp)



LTR.	REVISION	BY	DATE

DRAWN BY: MG	RAVEN ELECTRONICS CORP. 395 FREEPORT BLVD. SPARKS, NEVADA 89431 (702) 359-3700			
CHECKED BY: GH	NAME: PC. ASSEMBLY			
APPROVED BY:	41052 DTMF ADDRESS DECODER			
DATE: 6/23/78	ASS'Y: 1410-0520	SIZE: B	DWG. NO.: 410-6520	


GND B
-20V TO -24V A
-12V C
INPUT D E
C30 100
IC11 LM320T -12
C31 100
R79 2K
-12V
C32 150pf
R78 200K 1%
C33 .047
C34 .047
R80 100K 1%
R81 100K 1%
R65 200K 1%
R71 2.2K
C27 .027
L.P.F.
C9 .013
L9
C26 .051
R69 22K
9B
R66 2.2K
CR8
C23 .33
LOW GROUP
C24 .33
HIGH GROUP
C28 2200 pf
C25 .022
H.P.F.
C8 .012
L8
R68 36K
9A
R67 2.2K
CR7
TYPICAL, 7 PLACES
697 DET
Q2
R4 130K
L1
C1 .03
R5 10K
R3 3.3K
Q1
R2 330K
C10 .1
R1 3.3K
10B
R77 8.2K
CR9
LEVEL DET
R75 100K
C29 .1
R74 100
10A
R72 27K
Q15
R70 5.6K
R73 100K
R36 100K
R37 100K
R38 100K
R39 100K
S1
DIGIT 1
S2
DIGIT 2
S3
DIGIT 3
R40 100K
R41 100K
N.C. U
C V
N.O. W
N.C. X
C Y
N.O. Z
K1
CR6
R53 4.7K
INTER-DIGIT TIME
R54 100K
Q16
R61 20K
R62 5.6K
C21 .47
5D
CR3
R47 10K
R46 220K
C20 .1
2C
3A
3B
3C
R50 10K
C18† .002
IC 4 DIGIT COUNTER
8A
6C
DIGITS IN C.A.
Q18
R76 5.6K
8C
R58 20K
7A
R51 47K
R55 500K
CORRECT ADDRESS TIME
R56 20K
R57 20K
Q17
C22 .47
R63 5.6K
C35 .1
5A
5B
R45 390K
CR1
R44 1K
C19 .1
6B
1A
1B
7B
6A
R64 1K
* C.A.
R49† 10K
R52 100K
7D
8B
6D
7C
ALL CALL
2B
6
ALL CLEAR
2A
R43 100K
R42 10K
CR2
C17 .1
R48 100K
CR5
770 DET Q4 Q3 R10 R8 R6 R9 (130K) L2 C2(.027) R7 C11
852 DET Q6 Q5 R15 R13 R11 R14 (130K) L3 C3(.024) R12 C12
941 DET Q8 Q7 R20 R18 R16 R19 (130K) L4 C4(.022) R17 C13
1209 DET Q10 Q9 R25 R23 R21 R24(150K) L5 C5(.018) R22 C14
1336 DET Q12 Q11 R30 R28 R26 R29(150K) L6 C6(.016) R27 C15
1477 DET Q14 Q13 R35 R33 R31 R34(150K) L7 C7(.015) R32 C16
* TYPICAL VALUE SHOWN
† OPTIONAL
LTR REVISION BY DATE
DRAWN BY GH
CHECKED BY GH
APPROVED BY GH
DATE 10/26/77
RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD
SPARKS, NEVADA 89431
(702) 358-3700
NAME 41052 DTMF ADDRESS DECODER
ASSY 1410-0520
SIZE C
DWG NO 410-1520

41052-01 DTMF DECODER

UNIT DESCRIPTION

1. REFERENCES:

   41052-01 DTMF DECODER

   410-1521 Schematic

2. DESCRIPTION

   The 41552-01 DTMF Decoder provides 2 of 7 DTMF (Dual Tone Multi-frequency) tone detection and call decoding for two or three digit addressing. For call decoding, digit selection is performed by setting DIP switches (three) to respond to the desired digits. An adjustable interdigit timeout sets the allowable delay between correct digits. The correct address provides a two (2) Form C output, or an open collector output for use as an enable to a 41052-02 or 41052-03 Module. A correct address timeout is provided for both the 2 and 3 digit correct address outputs. The correct address output can be reset, before it times out, by an "ALL CLEAR" tone pair, and external reset, or optionally by a wrong digit. An option is provided which allows the "ALL CLEAR" tone pair to be a correct address. To prevent loading of a line, the input to the address decoder is a balanced high impedance input.

3. SPECIFICATIONS

   3.1 Power.....-20 to -24VDC

   3.2.0 Input

   3.2.1 Impedance..... 50K Ohms

   3.2.2. DTMF level.....-20 dB min. +7dB max.

   3.2.3 Minimum tone duration..... 40 ms

   3.3.0 DTMF tones

   3.3.1 Detector Bandwidths .....±1.5%

   3.3.2 Detector Outputs..... Ground

   3.4.0 Inter-digit timing

3.4.1 Minimum timer .....1 Sec.

3.4.2 Maximum timer .....5 Sec.

3.5.0 Correct address timing

3.5.1 Minimum timer .....1 Sec.

3.5.2 Maximum timer .....30 Sec.

3.6.0 Outputs

3.6.1 Regulated voltage .....-12 ±1VDC

3.6.2 Relay Contacts, 2 or 3 Digit .... Two (2) Form C

3.6.3 Enable output ..... Open Collector, Going to Ground

4. THEORY OF OPERATION

4.1 Input Amplifier and Filter

The input to the module, pins D and E, is a balanced high impedance input, as determined by resistors R80, R81 and amplifier U10-B. Amplifier U10-B converts the balanced input to an unbalanced output. This output is peak detected by CR-9, C29 and comparator U10-A. Q15 is turned on by U10A whenever a sufficient input level exists on pins D and E. The output of U10-B also goes to a low pass filter and a high pass filter. C26, C9 and L9 comprise the Low Pass Filter, while C8, L8 and C28 comprise the High Pass Filter. The L.P.F. passes all frequencies below 1100Hz, while the H.P.F. passes all frequencies above 1100Hz. Comparators U9-B and U9-A provide square wave outputs from the L.P.F. and H.P.F. when Q15 is on. Diodes CR8 and CR7 clamp the output between ground and -12V for a constant amplitude regardless of input voltage. The L.P.F. output goes to the four low frequency detectors, while the H.P.F. output goes to the three high frequency detectors.

4.2 DTMF Tone Detectors

The seven DTMF tone detectors are shown in detail for the 697Hz detector only. All other detectors are identical except for the value of the inductor and capacitor in the tank circuit. The tank circuits are tuned to accept the DTMF frequencies ±1.5%. Given an input frequency within the detection range, Q2 provides a half wave rectified output (all component references are to the 697Hx detector). R2 and C10 filter the output of Q2. Q1 is an emitter follower amplifier, providing a low impedance output from the detector. This output is normally at -12V and goes to Ground when the tone frequency is received.

4.3 Address Decoding

4.3.1 Parity Time Check

For a valid DTMF tone to exist, the two tones must be present for a minimum of 40ms. U2-A, U2-B and U6-A monitor the seven detector outputs, providing a high output on pin 4 of U6 whenever both a low and high tone exists. R45 and C19 provide a 40ms delay for a low to high transition, while CR1 and R44 provide a minimal delay for a high to low transition. Gates U5B and U5-A enable U6-A and U5-D respectively, allowing detection of a DTMF digit only after the 40ms parity time.

4.3.2 "ALL CALL", "ALL CLEAR"

For the "ALL CALL" (star sign) and "ALL CLEAR" (pound sign) tone pairs, separate logic is provided. U2-B detects 941Hz and 1209Hz for an "ALL CALL" while U2-A detects 941Hz and 1477Hz for an "ALL CLEAR". To provide protection from talk-up due to noise or voice, a 140ms parity time delay is provided (R42, CR2, R43 and C17) before U2A & B are enabled. Provisions are included to allow "ALL CALL" to be a correct address while the "ALL CLEAR" provides a reset to the address detection through U7-C and U6-D.

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4.3.3 Address Detection

Switches S1, S2 and S3 are used to select the digits to be recognized as a correct address. S1 selects Digit 1, S2 selects Digit 2, and S3 selects Digit 3. The seven positions on the switches correspond to the seven tones. Selecting a digit requires selecting the tone pair associated with the digit (refer to section 5.1, "Address Strapping").

U4 is an octal counter, providing a single high output on one of eight outputs (4 of which are used). With no DTMF input, the monostable timer Q16-C47 has a low output. This low output puts a high on the reset (pin 15) of U4, through U5. The "0" output of U4 (pin 2) is held "high" whever U4 is reset, enabling U3-A.

With U3-A enabled, receipt of DTMF tones corresponding to those selected on S1 will cause a low output from pin 10 of U5. After the 40ms parity time check U5-D is enabled. The high to low transition from U5-D triggers Q16, releasing the reset from U4 for the time duration determined by R53, R54 and C21. When the DTMF tones cease, U5-D goes high, clocking U4 one count and enabling U3-B via output"1" of U4 (pin 1). If the DTMF tone pair selected by S2 is received before C21 times out, U5-D will again go low (after 40ms), re-triggering Q16 and clocking takes place for the tone pair selected by S3, if 3 digit addressing is used.

In addition to the reset provided by the inter-digit timer (Q16, C21), U4 may be reset (via U8-A) by an "ALL CLEAR" tone pair, a wrong digit or an external reset. The external reset may be either via U6-D by a ground on pin M (positive reset) or via U6-D and U7-C by providing -V on pin R (negative reset).

Depending on whether 2 digit or 3 digit addressing has been received either output "2" or output "3" of U4 will set its respective correct address latch. U8-C and U7-A comprise a latch triggered by a high on pin

12 of U8-C. This correct address latch drives Q18. If the relay strap is installed, Q18 drives relay K1, whose two (2) form C contacts are pinned out for external use. In this mode the 41552-01 DTMF Encoder is functionally identical to and pin-compatible with the Raven 41052 DTMF Address Decoder. If the enable strap is installed, the collector of Q18 provides a ground out pin S when Q18 is turned on.

The correct address output of U4 also triggers the correct address timer (Q17, C22) through U6-C. The correct address timer's output is routed through U8-B and U7-D to reset the latch (U8-C and U7-A). The outputs can also be reset by an "ALL CLEAR" tone pair, an external reset (as described above) or optionally by a wrong digit (if R49 is installed).

5. STRAPPING AND ADJUSTMENTS

5.1 Address Strapping

The 41052-01 DTMF Decoder detects and utilizes Dual Tone Multifrequency (DTMF) signals to provide selective address decoding functions. (DTMF signals are unique tone pairs generated by standard Touch Tone encoder arrays). Each button on a Touch Tone encoder is identified by the pair of frequencies generated when the button is pushed. Four low-group frequencies correspond to the four rows of buttons, and three high-group frequencies correspond to the three columns.

	1	2	3	697Hz
	4	5	6	770Hz
	7	8	9	852Hz
	*	0	#	941Hz
High Group	1209Hz	1336Hz	1477Hz	

Low Group

The three DIP switches labled S1, S2 and S3 are programming-switches for first, second and third code digits

respectively. The seven individual rocker switches on each programmer correspond to the seven frequencies making up the DTMF encoder array. Rocker switch 1 represents the 697Hz tone, switch 2 represents the 770Hz tone, and so on in ascending frequencies to switch 7, which represents the 1477Hz tone.

If the address code 357, for instance, is to be detected, close rocker switches on S1 to correspond to the two tones which represent a 3 on the DTMF matrix: 697Hz and 1477Hz, switches 1 and 7 on S1. The second digit, 5, is programmed into S2 by closing switches 2 and 6, corresponding to the tone pair 770Hz and 1336Hz. S3 is programmed for the third digit, 7, by closing switches 3 and 5, which represent the tone pair 852Hz and 1209Hz.

5.2 Miscellaneous Strapping

The "ALL CALL" tone pair can be used as a correct address by strapping the *C.A. strap option. If it is desired to not have a wrong digit reset relay K1, the optional resistor R49 (10K Ohms) must be removed.

5.3 Timing Adjustments

The inter-digit time period may be changed from approximately 1 second to 5 seconds by adjusting potentiometer R54.

The correct address latch time may be changed from approximately 5 second to 30 seconds by adjusting potentiometer R55.

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ASSEMBLY NUMBER 4410-0520-01 TITLE 41052-01 DTMF DECODER DWG. REF: 410-1520-01

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		ASSEMBLY:			
		4410-0520-01 DTMF DECODER	59069-01-158-7726		
		CAPACITOR, Fixed	35		
C1	A410-3303	Polystyrene, 30Kpf 2.5%	1	Mial Type 611H	
C2,C27	A410-3273	" 27Kpf "	2	" " "	
C3	A410-3246	" 24Kpf "	1	" " "	
C4,C25	A410-3226	" 22Kpf "	2	" " "	
C5	A410-3186	" 18Kpf "	1	" " "	
C6	A410-3166	" 16Kpf "	1	" " "	
C7	A410-3156	" 15Kpf "	1	" " "	
C8	A410-3126	" 12Kpf "	1	" " "	
C9	A410-3136	" 13Kpf "	1	" " "	
C10,-C16,C19 C20,C29	A401-4109	Mylar, .1uf	10		
C17	A551-5104	Electrolytic, 1uf	1		
C18*,C28	A410-2226	Polystyrene, 2200pf	2		
C21,C22	A551-6474	Electrolytic, 47uf	2		
C23,C24	A200-4336	Mylar, .33m	2		
C26	A410-3513	Polystyrene, 51Kpf	1		
C30	A500-7105	Electrolytic, 100uf	1		
C31	A500-6103	" 10uf	1		
C32	A001-1159	Mica, 150pf	1		
C33,C34	A201-3478	Mylar, .047uf	2		
C35	A551-5474	Electrolytic, 4.7uf	1		
		RESISTOR; Fixed, Composition			
		5% unless indicated otherwise	83		
R1,3,6,8,11 13,16,18,21 23,26,28,31 33	B013-4330	3.3K	14		

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ASSEMBLY NUMBER 4410-0520-01 TITLE 41052-01 DTMF DECODER DWG. REF: 410-1520-01

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
R2,7,12,17 22,27,32	B013-6330	330K	7		
R4,9,14,19	B013-6130	130K	4		
R24,29,34	B013-6150	150K	3		
R5,10,15,20 25,30,35,42, 47,49,50,60	B013-5100	10K	12		
R36-41,43,48 52,59,73,75	B013-6100	100K	12		
R44,64	B013-4100	1K	2		
R45	B013-6390	390K	1		
R46	B013-6220	220K	1		
R53	B013-4470	4.7K	1		
R54	B321-6100	Pot, 100K	1		
R55	B321-6500	" 500K	1		
R56,57,58,61,	B013-5200	20K	4		
R62,63,70,76,	B013-4560	5.6K	4		
R66,67,71	B013-4220	2.2K	3		
R68	B013-5360	36K	1		
R69	B013-5220	22K	1		
R72	B013-5270	27K	1		
R77	B013-4820	8.2K	1		
R78,65	B022-6124	124K 1%	2		
R79	B013-4200	2K	1		
R80,81	B022-5487	48.7K 1%	2		
R74	B013-3100	100 ohm	1		
R51	B013-5470	47K	1		
		SEMICONDUCTOR DEVICES:			
CR1-CR9	F020-4001	Diode	9	1N4001	
Q1-Q15	G000-2222	Transistor, NPN	15	2N2222	
Q16,17,18,	G100-2907	" PNP	3	2N2907	

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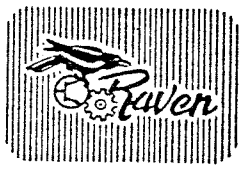
ASSEMBLY NUMBER 4410-0520-01 TITLE DTMF 41052-01 DECODER DWG. REF: 410-1520-01

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
U1	H120-4002	Integrated Circuit	1	CD4002	
U2,3,8	H120-4023	" "	3	CD4023	
U4	H120-4022	" "	1	CD4022	
U5,7	H120-4011	" "	2	CD4011	
U6	H120-4001	" "	1	CD4001	
U9,10	H010-1458	" "	2	4558DN	
U11	H001-7912	" "	1	LM320T-12	
L1	C051-6174	Inductor	1	Raven	
L2	C051-6158	"	1	"	
L3	C051-6145	"	1	"	
L4	C051-6130	"	1	"	
L5	C051-5963	"	1	"	
L6	C051-5887	"	1	"	
L7	C051-5775	"	1	"	
L8,9	C050-5109	"	2	"	
S1,S2,S3	I250-7020	Switch, 7 Pos. DIP	3		
	T110-2000	Terminal	8		
	K001-2240	Connector, 22 pin	1	Amphenol 133-022-53	
	1410-0521	Board, P.C.	1	Raven	
	SH00-1610	Socket, 16 pin	1		
	SH00-1410	" 14 pin	7		
	SH00-0810	" 8 pin	2		
K1	D000-4C53	Relay	1	R40-E1-Y4-V800	
	SD00-0000	Relay Socket	1		
	T100-4101	Handle	1		
	2410-0520-01	Front Panel	1		
	4410-2470	Bracket			

41052-01 DTMF DECODER

TEST PROCEDURE



1. REFERENCES

410-1521 DTMF Decoder Schematic
41052-01 DTMF Decoder Description

2. GENERAL

Complete the Test Data Card for this procedure as required. Do not change levels or settings until instructed to do so.

3. TEST EQUIPMENT REQUIRED

1- -20VDC Power Supply
1- Oscilloscope
1- DC Voltmeter
1- AC VTVM
1- Signal Generator
1- Frequency Counter
1- ET1001 Test Fixture

4. TEST PROCEDURE

4.1. POWER

4.1.1. Connect the -20VDC supply to pins A (-V) and B (+V GND). Turn on the -20VDC supply and read a current drain of .....<40ma

4.1.2. Monitor pin C with a DC voltmeter. Read.....-12VDC ±.5V

4.2. HIGH/LOW PASS FILTERS

4.2.1. Connect a signal generator to pins D and E.
Set the signal generator level to.....-10dB
Set the signal generator frequency to.....830Hz
Connect an oscilloscope to pin 1 of U9.
Tune L8 for a minimum level on the oscilloscope.

4.2.2. Set the generator frequency to.....1330Hz
Connect an oscilloscope to pin 7 of U9. Tune L9 for a minimum level on the oscilloscope.

4.2.3. Set the generator frequency to.....850Hz
Adjust the generator level from.....-22dBm to +10dBm

The output on the oscilloscope should be square wave.

4.2.4. Set the generator frequency to.....1350Hz
Connect an oscilloscope to pin 1 of U9.
Adjust the generator level from.....-22dBm to +10dBm

The output on the oscilloscope should be a square wave.

4.3. TONE DETECTORS

4.3.1. Connect the ET1001 Test Fixture to pins D and E. Turn on the latch output on the ET1001.
Select digit 1. Set level to.....-15dB
Connect an oscilloscope to the emitter of Q1.
Adjust L1 for a minimum voltage (between ground and -3VDC). Vary the frequency deviation by ±1.5%. The output should be.....0 to -3VDC
Vary the frequency deviation by ±2.5%. The output should be.....0 to -6VDC
Select digit 4. The output should be.....-8 to -12VDC

4.3.2. Select digit 4. Connect an oscilloscope to the emitter of Q4. Adjust L2 for a level of...0 to -3VDC
Vary the frequency deviation by ±2.5%. The output should be.....0 to -6VDC
Select digit 7. The output should be.....-8 to -12VDC

4.3.3. Repeat 4.3.2. for the following digit/output pin combinations.

DIGIT	TUNE	OSCILLOSCOPE TO
7 (0 for last step)	L3	Emitter of Q5
0 (7 " " ")	L4	Emitter of Q7
1 (2 " " ")	L5	Emitter of Q9
2 (3 " " ")	L6	Emitter of Q11
3 (2 " " ")	L7	Emitter of Q13

4.4. DECODING LOGIC

4.4.1. WRONG DIGIT

Install the relay strap. Strap the 3-digit address strap option. Set the address switches (S1, S2, S3) for a 1-5-9 address. Set R54 to mid-range. Monitor pin 4 of U7 with an oscilloscope. Select all digits (one at a time) except 1 & * ("ALL CALL"). Each digit should cause pin 4 of U7 to go low. Select a 1-5-9 sequence. No low should appear at pin 4 of U7 and the relay (K1) should energize. With R49 installed, selecting a wrong digit should cause K1 to de-energize.

4.4.2. ALL CLEAR (#)

Set R54 and R55 to their maximums (fully clock-wise). Monitor pin 15 of U4. Select a 1-5-9 sequence. K1 should energize and pin 15 of U4 should go low for the inter-digit time period. Quickly and momentarily select an "ALL CLEAR" (#), before interdigit timer removes the low from pin 15 of U4. K1 should relax (independent of the interdigit timer) and pin 15 of U4 should momentarily go high.

4.4.3. INTER-DIGIT TIMING

Monitor pin 15 of U4 with an oscilloscope. Momentarily select a "1". Pin 15 of U4 should go from high to low for 1-5 seconds, depending on the setting of R54. Adjust for a high level of 2 second duration.

4.4.4. ALL CALL (*)

If the *C.A. strap is not installed, jumper it with a clip lead. Momentarily select an "ALL CALL" (*). K1 should energize.

4.4.5. CORRECT ADDRESS TIMING

Select a 1-5-9 sequence. K1 should energize and remain in that state for 5-30 seconds, depending on the setting of R55. Adjust for a 15 second time out.

4.4.6. EXTERNAL RESETS

Follow the procedure described for "ALL CLEAR" (section 4.4.2.), but instead of selecting an "ALL CLEAR" apply a ground to pin M (positive reset). The results should be the same.

Repeat this procedure again but instead of selecting an "ALL CLEAR" apply -V to pin R (negative reset). The results should be the same.

4.4.7. RELAY CONTACT CONTINUITY

Select a 1-5-9 sequence to energize K1. Check for continuity between pins V and W and between pins Y and Z. There should be no continuity between pins U and V and between X and Y. Select an "ALL CLEAR" to relax K1. Check for continuity between pins U and V and between pins X and Y. There should be no continuity between pins V and W and between pins Y and Z.

4.4.8. Set the level of the ET1001 Test Fixture to +7. Select a 1-5-9 sequence. Relay K1 should energize. Select an "ALL CLEAR" to relax K1.

Lower the level to -20dB and repeat. Continue lowering the level by 1dB steps and repeating. Record the minimum level required for proper operation of the module.

4.5. ENABLE OUT FUNCTION

4.5.1. Remove the relay strap. Connect the enable strap. Use an ohmmeter to check for continuity between the collector of Q18 and pin S.

4.6. Disconnect all test equipment. Stamp the module and Test Data Card with test stamp.

TEST DATA CARD

41052-01 DTMF DECODER

WORK ORDER NO._____

SERIAL NO._____

DATE_____

TEST PROCEDURE RESULTS

4.1.1._____ma

4.1.2._____VDC

4.2.1._____

4.2.2._____

4.2.3._____

4.2.4._____

4.3.1._____

4.3.2._____

4.3.3._____(L3)

_____(L4)

_____(15)

_____(L6)

_____(L7)

4.4.1._____

4.4.2._____

4.4.3._____

4.4.4._____

4.4.5._____

4.4.6._____(positive reset)

_____(negative reset)

4.4.7._____

4.4.8._____dB

4.5.1._____

4.6._____(Test Stamp)

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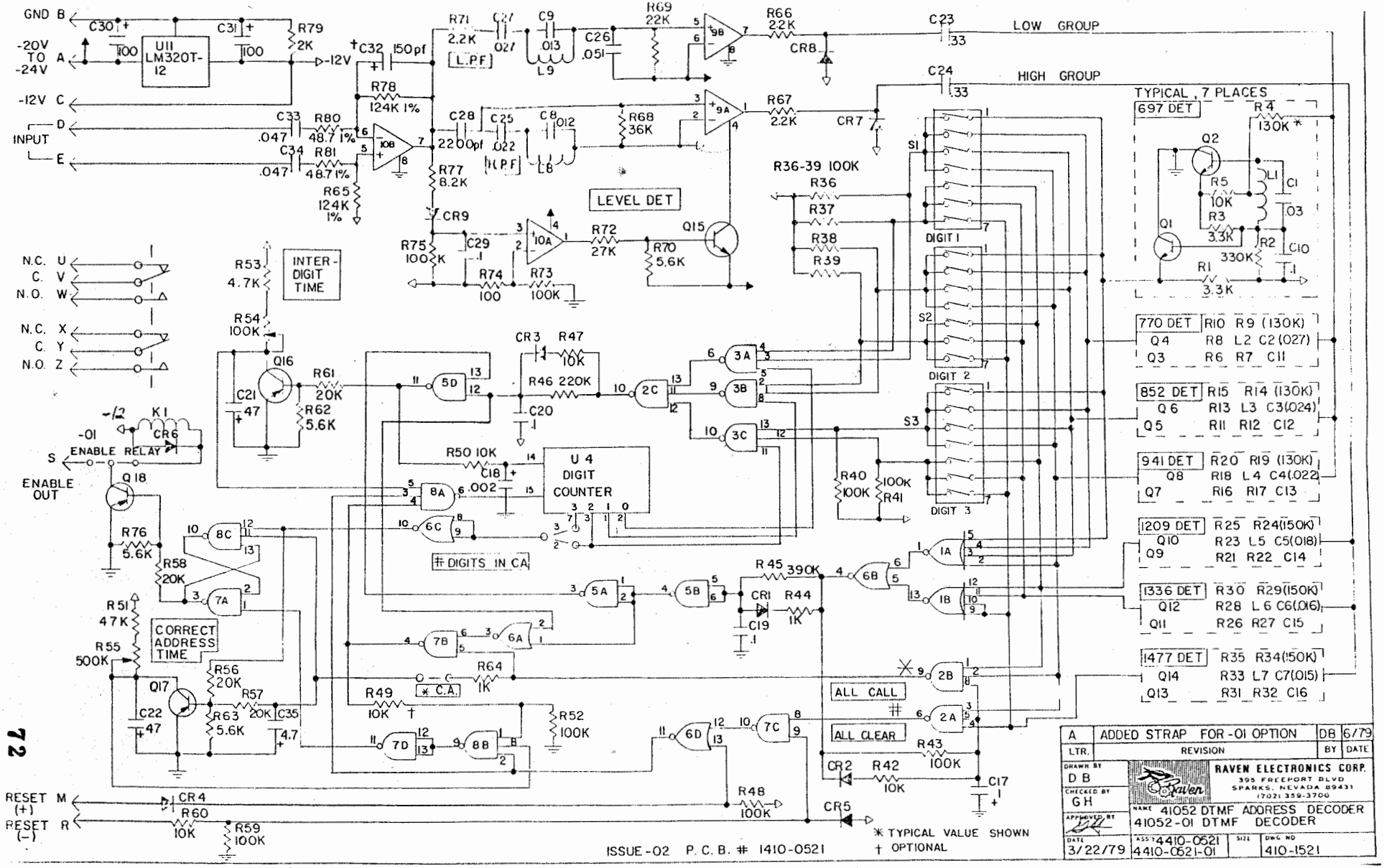
GND B
-20V TO -24V A
-12V C
INPUT D
E
U11 LM320T-12
C30
C31
100
R79 2K
-12V
C32 150pf
R78 124K 1%
R80 48.7 1%
C33 .047
C34 .047
R81 48.7 1%
R65 124K 1%
R77 8.2K
C28 2200pf
C25 .022
C8 .012
L8
R68 36K
R71 2.2K
C27 .027
C9 .013
L9
C26 .051
R69 22K
R66 2.2K
CR8
C23 .33
LOW GROUP
C24 .33
HIGH GROUP
R67 2.2K
CR7
LEVEL DET
CR9
R75 100K
C29 .1
R74 100
R73 100K
R72 27K
R70 5.6K
Q15
R36-39 100K
R36
R37
R38
R39
S1
S2
S3
DIGIT 1
DIGIT 2
DIGIT 3
TYPICAL, 7 PLACES
697 DET
R4 130K *
Q2
R5 10K
L1
C1
R3 3.3K
C3
Q1
R2 330K
C10
R1 3.3K
770 DET R10 R9 (130K)
Q4 R8 L2 C2 (027)
Q3 R6 R7 C11
852 DET R15 R14 (130K)
Q6 R13 L3 C3 (024)
Q5 R11 R12 C12
941 DET R20 R19 (130K)
Q8 R18 L4 C4 (022)
Q7 R16 R17 C13
1209 DET R25 R24 (150K)
Q10 R23 L5 C5 (018)
Q9 R21 R22 C14
1336 DET R30 R29 (150K)
Q12 R28 L6 C6 (016)
Q11 R26 R27 C15
1477 DET R35 R34 (150K)
Q14 R33 L7 C7 (015)
Q13 R31 R32 C16
N.C. U
C. V
N.O. W
N.C. X
C. Y
N.O. Z
R53 4.7K
INTER-DIGIT TIME
R54 100K
Q16
C21 47
R61 20K
R62 5.6K
CR3 R47 10K
R46 220K
C20
-/2 K1
-01 CR6
ENABLE RELAY
S
ENABLE OUT
Q18
R76 5.6K
R50 10K
C18 .002
U4 DIGIT COUNTER
DIGITS IN CA
R58 20K
R51 47K
R55 500K
CORRECT ADDRESS TIME
R56 20K
R57 20K
R63 5.6K
C35 4.7
Q17
C22 47
R64 1K
* C.A.
R49 10K †
R52 100K
R45 390K
CR1
R44 1K
C19 .1
ALL CALL
ALL CLEAR
R43 100K
CR2
R42 10K
C17 1
R40 100K
R41 100K
R48 100K
CR5
CR4
R60 10K
R59 100K
RESET M (+)
RESET R (-)
* TYPICAL VALUE SHOWN
† OPTIONAL
ISSUE-02 P. C. B. # 1410-0521
A ADDED STRAP FOR -01 OPTION DB 6/79
LTR. REVISION BY DATE
DRAWN BY D B
CHECKED BY G H
APPROVED BY
DATE 3/22/79
RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD
SPARKS, NEVADA 89431
(702) 359-3700
NAME 41052 DTMF ADDRESS DECODER
41052-01 DTMF DECODER
ASS'Y 4410-0521
4410-0521-01
SIZE
DWG NO 410-1521

41052-02/-03 SECONDARY/TERTIARY DECODER

UNIT DESCRIPTION

1. REFERENCES

410-1520-02/-03 Schematic

2. DESCRIPTION

The Raven 41052-02/-03 Secondary/Tertiary Decoders provide 2 of 7 DTMF (Dual Tone Multi-frequency) tone detection and decoding. The -02 option provides digit decoding for digits "0" through "5", and the -03 option provides digit decoding for digits "5" through "9". Upon decoding, each digit will set a relay which corresponds to the digit decoded. The normally-open contacts of each relay are pinned out for external use. All relays are simultaneously reset by either a positive or negative input to the module. If the module receives no digit within approximately 1.5 seconds after the module is enabled, the "0" relay is automatically set.

3. SPECIFICATIONS

3.1	Power	-20 to -24VDC
3.2	Input	
3.2.1	Impedance	>50K ohms
3.2.2	DTMF Level	-20dB min. +7dB max.
3.2.3	Minimum Tone Duration	40ms
3.3	DTMF Tones	
3.3.1	Detector Bandwidths	±1.5%
3.3.2	Detector Outputs	Ground
3.4	Outputs	
3.4.1	Regulated Voltage	-12 ±1VDC
3.4.2	Relay Contacts	Two (2) FORM C

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4. THEORY OF OPERATION

4.1 Input Amplifier and Filter

The input to the module, pins D and E, is a balanced high impedance input, as determined by resistors R18, R19 and amplifier IC8B. Amplifier IC8B converts the balanced input to an unbalanced output. This output is peak detected by CR9, C16 and comparator IC8A. IC8 is operative only when -20VDC is supplied to it via Q19, which is turned on when a ground is applied to pin S, the module's enable pin. Q11 is turned on by IC8A whenever a sufficient input level exists on pins D and E. The output of IC8B also goes to a low pass filter and high pass filter. C20, C9 and L6 comprise the Low Pass Filter, while C8, L7 and C19 comprise the High Pass Filter. The L.P.F. passes all frequencies below 1100Hz, while the H.P.F. passes all frequencies above 1100Hz. Comparators IC7B and IC7A provide square wave outputs from the L.P.F. and H.P.F. when Q11 is on. Diodes CR8 and CR7 clamp the output between ground and -12V for a constant amplitude regardless of input voltage. The L.P.F. output goes to the four low frequency detectors, while the H.P.F. output goes to the three high frequency detectors.

4.2 DTMF Tone Detectors

The five DTMF tone detectors are shown in detail for the lowest tone detector only. All other detectors are identical except for the value of the inductor and capacitor in the tank circuit. The tank circuits are tuned to accept the DTMF frequencies ±1.5. Given an input frequency within the detection range, Q2 provides a half wave rectified output (all component references are to the lowest tone detector). R2 and C10 filter the output of Q2. Q1 is an emitter follower amplifier, providing a low impedance output from the detector. This output is normally at -12V and goes to ground when the tone frequency is received.

For the -02 option, detector #1 responds to 697Hz and detector #2 responds to 770Hz. For the -03 option, detector #1 responds to 770Hz and detector #2 responds to 852Hz.

4.3 Logic Section

4.3.1 A ground applied to pin S will enable the input filters as described in Section 4.1. In addition, when a ground is applied to pin S, Q20 is turned on. This resets IC5A via C27. Receipt of a valid digit will set IC5A via IC1, IC4 and CR1. If IC5A is not reset by receipt of a valid digit within approximately 1.5 seconds after being reset by the enable, IC5B will be reset via R50 and C26. This turns on Q12, which drives relay K1.

4.3.2 If a valid digit is received within approximately 1.5 seconds after the module is enabled, IC5A is set again as described above. The latch corresponding to the digit received is set by the logic of S1, IC2 and IC3. Each latch turns on its corresponding transistor, which drives its corresponding relay.

In the -02 option, switches 1,3,5,7 and 9 of S1 should be closed. In the -03 option, switches 2,4 6,8 and 10 should be closed.

4.3.3 Each relay has two (2) FORM C contacts. The normally-open and common contacts of one of these FORM C contacts of each relay are connected in parallel and are pinned out pins M and N, respectively, for external use.

The normally-open contacts of the other FORM C contacts of each relay are pinned out individually on pins U through Z, with the common contact of each relay connected in parallel and pinned out pin T.

4.3.4 All the relay circuits may be reset by applying a reset input at pin R. If the "+" strap is installed, a ground at pin R will set the relay latches (de-energizing the relays) via IC1. If the "-" strap is installed, minus (-) voltage at pin R will set the relay latches via R62.

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD., SUITE 12
SPARKS, NEVADA 89431
(702) 359-3700

ASSEMBLY NUMBER 4410-0520-02/-03 TITLE 41052-02/-03 SECONDARY/TERTIARY DECODER DWG. REF: 410-1520-02/-03

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		ASSEMBLY: 4410-0520-02/-03 Secondary/Tertiary Decoder			
		CAPACITOR, Fixed	23		
C3,10,11,12, 13,14,16	0104-0005	Mylar, .1uf	7	Mial Type 611H	
C4	0103-3271	" , 27pf	1	" " "	
C15	0103-3221	" , 22Kpf	1	" " "	
C5	0103-3181	" , 18Kpf	1	" " "	
C6	0103-3161	" , 16Kpf	1	" " "	
C7	0103-3151	" , 15Kpf	1	" " "	
C8	0103-3121	" , 12Kpf	1	" " "	
C9	0103-3131	" , 13Kpf	1	" " "	
C19	0103-2201	Polystyrene, 2200pf	1		
C17,18	0104-0028	Mylar, .33m	2		
C20	0103-3511	Polystyrene, 51Kpf	1		
C21	0102-0018	Electrolytic, 100uf	1		
C22,26	0102-0003	" , 10uf	2		
C23	0101-0010	Mica, 150pf	1		
C24,25	0104-0012	Mylar, .047uf	2		
C27	0101-0019	Mica, .01uf	1		
		RESISTOR; Fixed, composition 5% unless indicated otherwise	67		
R1,3,6,8,21, 23,26,28,31, 33	0206-3321	3.3K	10		
R2,7,22,27, 32,50	0206-3341	330K	6		
R4,9	0206-1341	130K	2		
R5,10,25,30, 35,51,62	0206-1031	10K	7		

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SPARKS, NEVADA 89431
(702) 359-3700

ASSEMBLY NUMBER 4410-0520-02/-03 TITLE 41052-02/-03 SECONDARY/TERTIARY DECODER DWG. REF: 410-1520-02/-03

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
R11,36,38,40, 42,44,46,48, 55,59	0206-2231	22K	10		
R12	0206-3631	36K	1		
R13,66,67	0206-2221	2.2K	3		
R14	0206-8221	8.2K	1		
R15,17,52,53, 63	0206-1041	100K	5		
R16	0206-1011	100 ohm	1		
R18,19	0210-4872	48.7K, 1%	2		
R20	0206-2021	2K	1		
R24,29,34	0206-1541	150K	3		
R37,39,41,43, 45,47,49,54, 58	0206-5121	5.1K	9		
R56	0206-1021	1K	1		
R57	0206-3941	390K	1		
R60	0206-2731	27K	1		
R61	0206-5621	5.6K	1		
R64,65	0210-1243	124K, 1%	2		
		SEMICONDUCTOR DEVICES:			
CR1-15	0300-0001	Diode	15	1N4001	
Q1-11,19,20	0340-0008	Transistor, NPN	13	2N2222	
Q12-18	0341-0008	" , PNP	6	2N2907	
U1	0361-0028	Integrated Circuit	1	CD4025	
U2,3	0361-0055	" "	2	CD4023	
U4	0361-0023	" "	1	CD4001	
U5,6	0361-0039	" "	2	CD4044	
U7,8	0361-0087	" "	2	LF353	
U9	0361-0059	" "	1	LM320T-12	

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(702) 359-3700

ASSEMBLY NUMBER 4410-0520-02/-03 TITLE 41052-02/-03 SECONDARY/TERTIARY DECODER DWG. REF: 410-1520-02/-03

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
L3	0441-0046	Inductor	1	Raven	
L4	0441-0047	" "	1	"	
L5	0441-0048	" "	1	"	
L6,7	0441-0090	" "	2	"	
S1	0501-0302	Switch, 10 Pos. DIP	1		
	0612-0104	Terminal	5		
	0510-0017	Connector, 22 Pin	1	Amphenol 133-022-43	
	1410-0502 -02/03	Board, P.C.	1	Raven	
	0450-0004	Relay Socket	6		
	0450-0016	Socket, 16 Pin	2		
	0450-0019	" , 14 Pin	4		
	0450-0020	" , 8 Pin	2		
K1-6	0411-0012	Relay	6	R40-E1-Y4-V800	
	1404-2421	Bracket			
	1404-2431	Handle			
	1410-3520	Screened Panel			

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(702) 359-3700

ASSEMBLY NUMBER 4410-0520-02/-03 TITLE 41052-02/-03 SECONDARY/ TERTIARY DECODER DWG. REF: 410-1520-02/-03

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		ADD FOR -02 OPTION:			
C1	0103-3301	Capacitor, Polystyrene, 30Kpf	1	Mial Type 611H	
C2	0103-3271	" " , 27Kpf	1	" " "	
L1	0441-0042	Inductor	1	Raven	
L2	0441-0043	"	1	"	
		ADD FOR -03 OPTION:			
C1	0103-3271	Capacitor, Polystyrene, 27Kpf	1	Mial Type 611H	
C2	0103-3241	" " , 24Kpf	1	" " "	
L1	0441-0043	Inductor	1	Raven	
L2	0441-0044	"	1	"	

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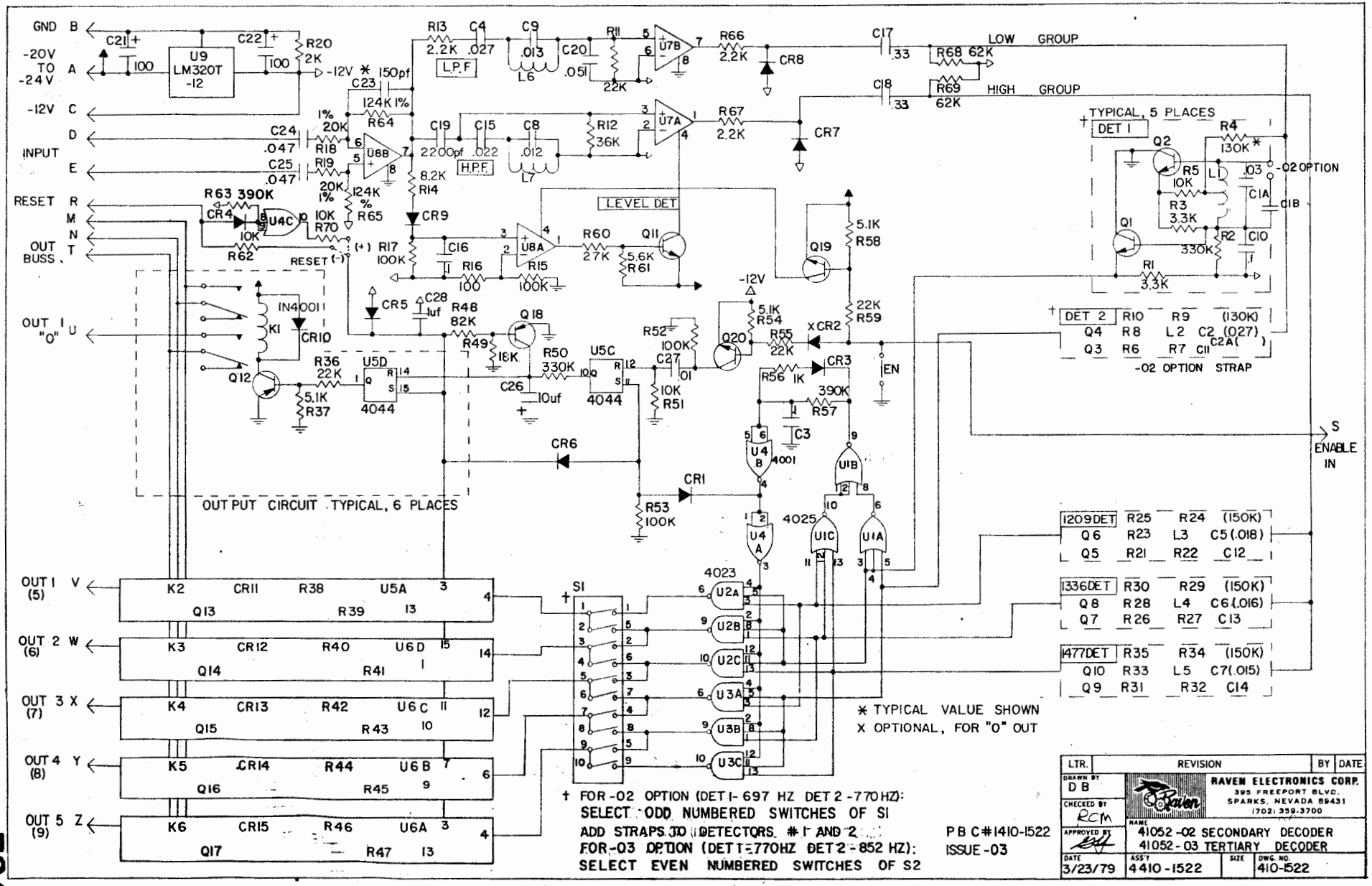
GND B
-20V TO -24V A
-12V C
D
INPUT
E
RESET R
M
N
OUT BUSS T
OUT I "0" U
OUT 1 V (5)
OUT 2 W (6)
OUT 3 X (7)
OUT 4 Y (8)
OUT 5 Z (9)
U9 LM320T -12
-12V * 150pf
L.P.F
H.P.F
LEVEL DET
LOW GROUP
HIGH GROUP
TYPICAL, 5 PLACES
DET 1
-02 OPTION
-02 OPTION STRAP
DET 2 R10 R9 (130K)
Q4 R8 L2 C2 (027)
Q3 R6 R7 C11
1209DET R25 R24 (150K)
Q6 R23 L3 C5(.018)
Q5 R21 R22 C12
1336DET R30 R29 (150K)
Q8 R28 L4 C6(.016)
Q7 R26 R27 C13
1477DET R35 R34 (150K)
Q10 R33 L5 C7(.015)
Q9 R31 R32 C14
OUTPUT CIRCUIT TYPICAL, 6 PLACES
S ENABLE IN
EN
* TYPICAL VALUE SHOWN
X OPTIONAL, FOR "0" OUT
† FOR -02 OPTION (DET 1 - 697 HZ DET 2 - 770 HZ):
SELECT ODD NUMBERED SWITCHES OF S1
ADD STRAPS TO DETECTORS # 1 AND 2
FOR -03 OPTION (DET 1 - 770HZ DET 2 - 852 HZ):
SELECT EVEN NUMBERED SWITCHES OF S2
PB C#1410-1522
ISSUE -03
LTR. REVISION BY DATE
DRAWN BY D B
CHECKED BY RCM
APPROVED BY
DATE 3/23/79
RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700
NAME 41052-02 SECONDARY DECODER
41052-03 TERTIARY DECODER
ASS'Y 4410-1522
SIZE
DWG. NO. 410-1522

41078 RELAY MODULE

UNIT DESCRIPTION

1. REFERENCES

410-1780 41078 Relay Module Schematic

2. GENERAL

2.1. The Raven 41078 Relay module provides "E" and "M" lead signaling conditioning.

3. SPECIFICATIONS

3.1.	ENVIRONMENTAL	
3.1.1.	Operating Temperature	0° to 50° C
3.1.2.	Storage Temperature	-40° to +125° C
3.1.3.	Humidity, Relative	0 to 95%
3.2.	E-LEAD	
3.2.1.	E-Lead Input	GND
3.2.2.	E-Lead Output	-24V
3.3.	M-LEAD	
3.3.1.	M-Lead Input	-24V
3.3.2.	M-Lead Output	-48V, GND 1A. max.

4. THEORY OF OPERATION

4.1. E-LEAD

4.1.1. The E-lead output, pin W, is normal open contact of K1. When ground is applied to pin H, the E-lead input, K1 activates and places -24V on pin W, the E-lead output. Removing ground from pin H removes -24V from the E-lead output.

4.2. M-LEAD

4.2.1. The M-lead output, pin J, is the pole connection of K2. When K2 is not energized, ground is applied to the M-lead output through the normal connected contact. Applying -24V to pin L, the M-lead input, activates K2, with -48V being applied to the M-lead output via the normal open contact of K2.

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395 FREEPORT BLVD., SUITE 12
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(702) 358-3700

ASSEMBLY NUMBER 4410-0780 TITLE 41078 RELAY MODULE DWG. REF: 410-1780

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
CR1,2	F020-4001	Diode, Rectifier	2		1N4001
K1,2	D021-IC53	Relay	2	Arrow HB1DC24V	
	1410-0780	P.C Board	1	Raven	
	K001-2240	Connector	1		
	T350-0440-x ½"	Screw, Binding Head Machine 4-40 x ½"	2		
	T900-0440	Hex Nut 4-40	2		
	2410-0780	Front Panel	1		
	U410-2470	Bracket	1		
	T100-4101	Handle	1		
	T350-0440-x 3/16	Screw, Binding Head Machine 4-40 x 3/16"	2		
	T400-0632-x 3/8	Screw, Self Tapping 6-32 x 3/8"	2		

41078 RELAY MODULE

UNIT TEST PROCEDURE

1. REFERENCES

410-1780 41078 Relay Module Schematic

2. TEST EQUIPMENT REQUIRED

-24V DC Power Supply
DC Voltmeter

3. TEST PROCEDURE

3.1. E-LEAD

3.1.1. Connect the -24V DC Power Supply to pins A (-V) and B (ground). Connect the DC voltmeter between pin B and pin W. Read.....0VDC

3.1.2. Connect pin H to pin B.
Read on the voltmeter.....-24VDC
Remove strap from pin H to pin B.

3.2. M-LEAD

3.2.1. Strap pin A to pin N. Connect DC voltmeter to pin J. Read.....0VDC

3.2.2. Strap pin L to pin A.
Read on the voltmeter.....-24VDC

3.3. Disconnect all test equipment. Stamp the module and Test Data Card with test stamp.

TEST DATA CARD

41078 RELAY MODULE

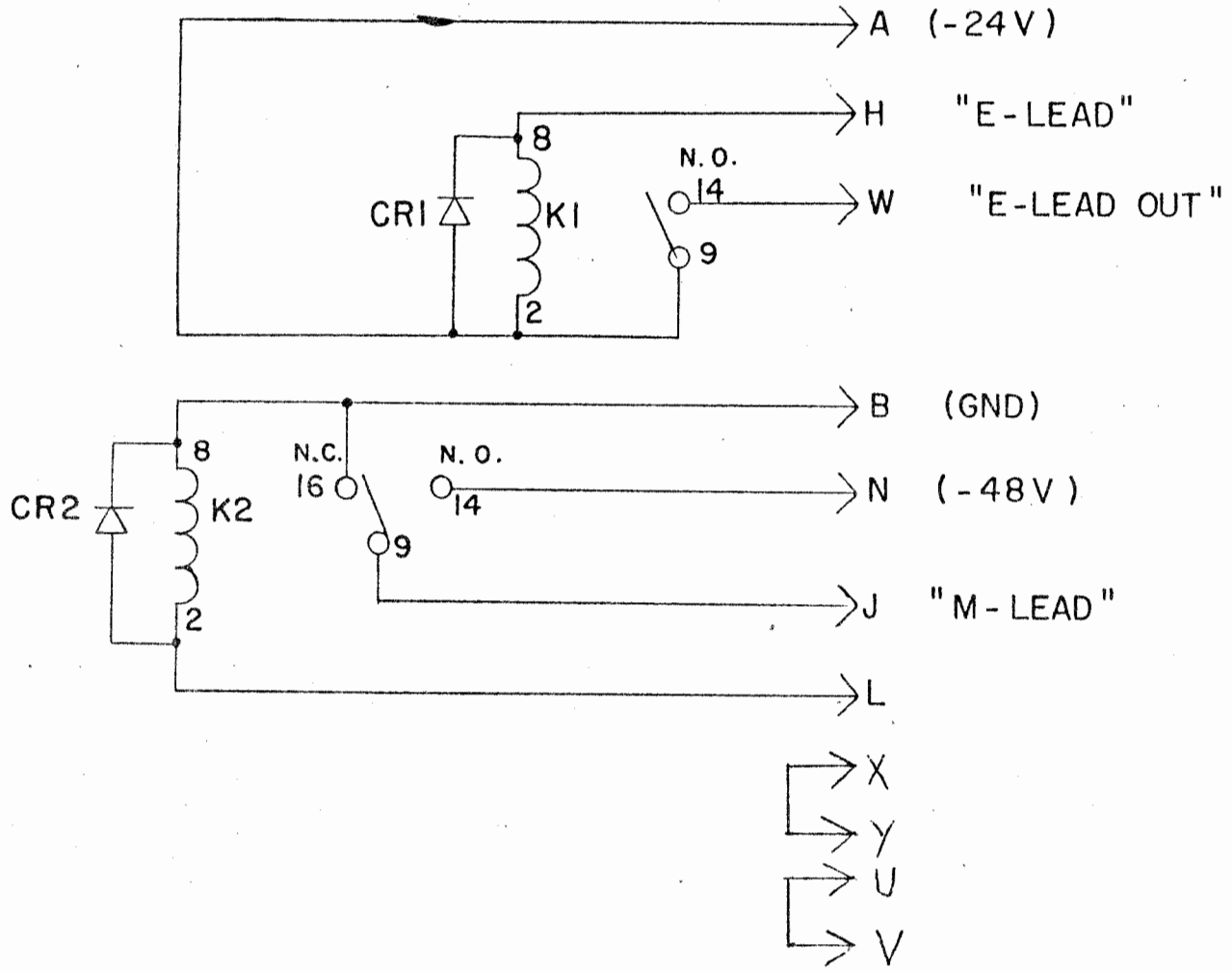
WORK ORDER NO._____
SERIAL NO._____
DATE_____

TEST PROCEDURE RESULTS

3.1.1._____
3.1.2._____

3.2.1._____
3.2.2._____

3.3._____(TEST STAMP)



LTR.	REVISION	BY	DATE

DRAWN BY: DB
CHECKED BY:
APPROVED BY:
DATE: 8/16/79

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700

NAME: 41078 RELAY MODULE

ASS'Y: 4410-0780
SIZE:
DWG. NO.: 410-1780

P.C.B.# 1410-0780
ISSUE-01

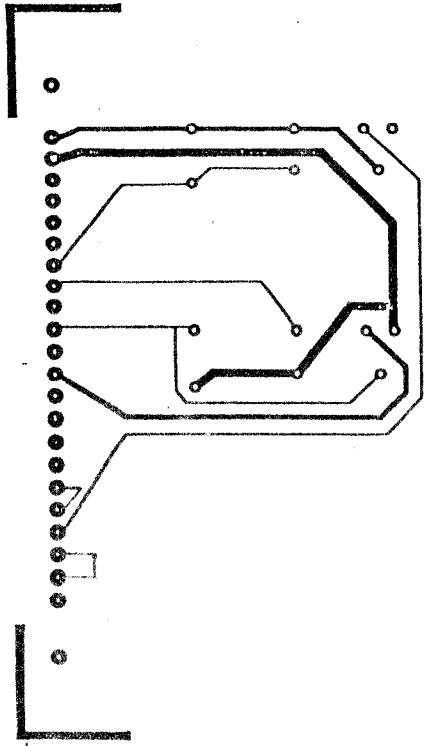
DIODES IN4001

LTR	REVISION	BY	DATE
DRAWN BY DB	RAVEN ELECTRONICS CORP.		
CHECKED BY	NAME 41078 RELAY MODULE		
APPROVED BY			
DATE 9/14/79	ASS'Y 4410-0780	SIZE	DWG. NO. 410 - 6780

P.C.B. # 1410-0780
ISSUE -01

1410-0780
ISSUE -01

RAVEN ELECTRONICS CORPORATION



CIRCUIT SIDE AS VIEWED ON FINISHED PRODUCT

REDUCE TO 8.72"(2:1)

18"

-01	FIRST		8/79
ISSUE	REVISION	BY	DATE

TOLERANCES

DB

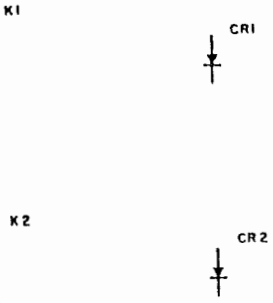
RAVEN ELECTRONICS CORP

4107B RELAY MODULE

8/16/79 | 1410-0780 | 410-7780

SHEET 1 OF 3
P.C.B. # 1410-0780

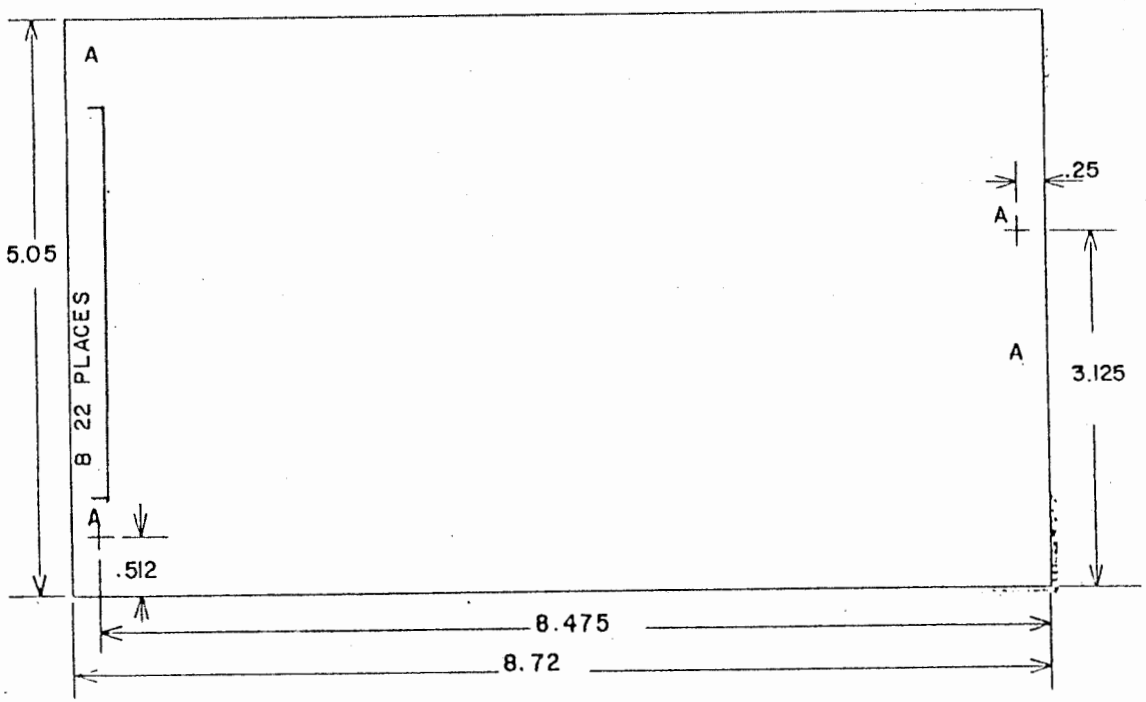
41078 RELAY MODULE



SCREEN ON COMPONENT SIDE OF FINISHED PRODUCT

-01	FIRST		8/79
ISSUE	REVISION	BY	DATE
TOLERANCES	DRAWN BY O B	RAVEN ELECTRONICS CORP.	
	CHECKED BY	NAME 41078 RELAY MODULE	
	APPROVED BY	DATE 8/16/79	P.C.B. # 4410-0780	SIZE C	DWG # 410-7780

SHEET 2 OF 3



MATERIAL : FR-4 GLASS EPOXY BOARD
THICKNESS : 1/16"
COPPER: 2 OZ.
SOLDER: Sn63 FLOW OR DIP, SOLDER TO BE HEAT FUSED AFTER PLATING, MIN. 0.0003" THICK
EDGES: ROUTED TO ± .010
TRACKWIDTH: +2%,-10%
WARP & TWIST: 5%
WORKMANSHIP: REF. TO IPC-A-600B

HOLE	DESCRIPTION	QTY.
A	(#30) .1285	4
B	(#55) .0520	22
UNMARKED	(#60) .0400	—

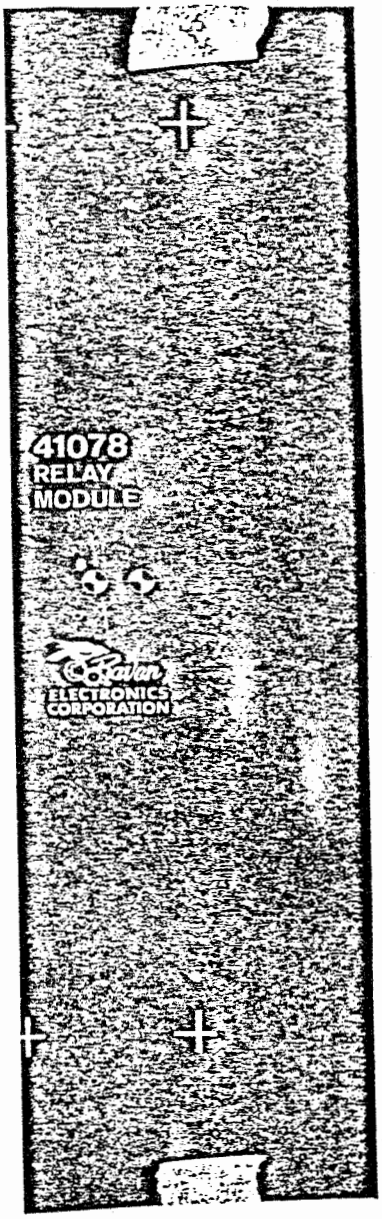
SHEET 3 OF 3
P.C.B. # 1410-0780

-01		DB	8/79
ISSUE	REVISION	BY	DATE

DRAWN BY: DB
CHECKED BY: DB
APPROVED BY: DH
DATE: 8/27/79

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700

NAME: 41078 RELAY MODULE
ASS'Y: 4410-0780
SIZE:
DWG. NO.: 410-7780



41078
RELAY
MODULE

Raven
ELECTRONICS
CORPORATION

LTR.	REVISION	BY	DATE

DRAWN BY

CHECKED BY

APPROVED BY

DATE 7-21-89

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700

NAME FRONT PANEL ARTWORK
41078 RELAY MODULE

ASS'Y 4410-0750

SIZE A

DWG. NO. 4M-3780

89

1056 -01/02 4W/2W SIGNALING UNIT

UNIT DESCRIPTION

1. REFERENCE

410-1560 Schematic

2. GENERAL

The Raven 41056 4W/2W Signaling Unit provides amplification and 4-Wire to 2-Wire conversion in the VF path, detection of signaling tone in the 4-Wire RCV path, and, in the -02 version, signaling tone origination in the 4-Wire XMT path. The 4W/2W Hybrid is a 2-coil inductive hybrid, with an idle line termination on the 2-Wire line and a XMT cut on the 4-Wire XMT port. Amplifiers in the VF paths provide gain adjustments in both directions. The 4-Wire RCV path has a band elimination filter for rejection of signaling tone in the VF path. The signaling detector compares both signaling and speech energy before providing an E-lead indication, with priority circuitry included to minimize "Talk Up" and "Talk Down" of the E-lead output.

The -02 version includes a signaling oscillator, controlled by an M-lead input. The signaling tone is summed into the 4-Wire XMT path.

3. SPECIFICATIONS

Power	-24VDC
Environmental	
Temperature	0-50°C
Humidity, relative	0-95%
Impedance, all ports	600 ohm balanced
2-Wire XMT level, max.	+3dBm
2-Wire RCV level, min.	-20dBm
4-Wire XMT level, max	+10dBm
4-Wire RCV level, min.	-30dBm
4-Wire XMT Gain Adj. range	>30db
4-Wire RCV Gain Adj. Range	>30db

Signaling Detector	
Bandwidth	±30Hz
Min. Detection Level	-45dBm
Detector Output	2 Form C contacts
Signaling Oscillator Freq.	F_C ±1Hz
Signaling Oscillator Level	-30dBm to 0dBm

4. THEORY OF OPERATION

4.1 4-Wire/2-Wire Hybrid

The 4-Wire/2-Wire Hybrid provids an interface between the 2-Wire line and the 4-Wire transmit and receive paths. The Hybrid is a 2-coil inductive Hybrid, coupling received signals from T3 to the 2-Wire line and transmitted signals from the 2-Wire line to the transmit path via T1. R28 is used to adjust the Hybrid for maximum transhybrid loss. The "OFF HOOK" detection circuitry comprised of Q4, Q5 and K1 controls the idle line termination and the XMT cut. When K1 is relaxed ("ON HOOK" condition), R38 terminates the 2 wire line and the XMT side of the Hybrid is terminated by R5. When K1 is energized ("OFF HOOK" condition), R38 is removed from the 2 wire line and the XMT side of the Hybrid is connected to the XMT path of the module.

4.2 XMT Path, VF

VF XMT signal levels from T1 are adjusted by R2 before being amplified by the XMT AMP (1C4-B). The signals from the XMT AMP are coupled to the 4-wire line by T2, which also provides coupling to the 4-wire line for external XMT inputs.

4.3 RCV Path, VF

VF RCV signals from the 4 wire line are amplified by 1C3-B, a balanced high impedance input amplifier. R34 provides an optional line termination. VF signals pass through the band reject filter (L4,C4) which blocks signaling tones. VF RCV levels are then adjusted by amplifier 1C2-A (via R1) before being applied to T3 in the Hybrid.

4.4 XMT Path, Signaling Tone

4.4.1 For the -02 option, C1, L1 and 1C4-A form a signaling oscillator. Signaling levels are adjusted by R40 before being summed at the XMT AMP via R49. Q6 and associated components provide for external keying of signaling tone. When pin J is open or at ground, the channel impedance of Q6 is at minimum

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and essentially shorts the signaling tone path to the -V/2 reference. When pin J is held at -V, Q6 is pinched off and presents a high impedance relative to R40, allowing signaling tone to interface to amplifier IC4-B.

4.4.2 If the -02 option is not selected, signaling tone may be inserted via pin K, C18 and R44. R48 provides a 600 termination at pin K. Signaling level may be adjusted by R40 and keying at pin J takes place as described in 4.4.1, via Q6.

4.5 RCV Path, Signaling Tone

Signaling tone from the 4-wire line is also routed through 1C3-B (described in Section 4.3). L3 and C3 act as a band pass filter for the signaling tone before it is amplified by 1C3-A. The gain of 1C3-A is adjustable by R19 for different signal levels. Q2, L2, C2 and associated components detect the signling tone and turn Q1 "ON" when tone is present, giving a high to pin 13 of 1C1. R8, R9 and C6 provide an adjustable turn OFF time for Q2 when signaling tone is removed.

VF signals from the band reject filter (L4, C4) are amplified by 1C2-B (R18 adjusts for levels) and are detected by CR3, C8 and associated components. This places a high on pin 8 of IC1-C when VF signals are present.

IC1-C and IC1-D comprise a latch which drives relay K2 through Q3. K2's two (2) form C contacts are pinned out for external use. If signaling tone is received, the high given to pin 13 of IC1 sets the latch and energizes the relay. As long as signaling tone is present, the latch is held set and cannot be reset by a high on pin 8 of IC1 caused by subsequent VF signals. If VF signals are received first, the corresponding high on pin 8 of IC1 holds the latch reset regardless of any highs on pin 13 of IC1 due to subsequent signaling tones. In this way the signal received first is given priority. Loss of the signal given priority will allow the other signal to take effect. Such a priority circuit minimizes "TALK UP" and "TALK DOWN" of the signaling tone.

5.0 Alignment

Check to see that the proper straps are installed in the "OFF HOOK" detection circuitry. If -V is to be the "OFF HOOK" input, straps (-) should be installed. For a ground "OFF HOOK" input, straps (+) should be installed.

5.1 Transhybrid Null

Go "OFF HOOK". Connect a signal generator @ 1KHz and 0dBm to pins Y and Z. Connect an AC VTVM to pins F and H. With the 2-Wire line properly terminated, adjust R8 for a minimum reading on the AC VTVM. R1 and/or R2 may have to be adjusted to receive a level on the AC VTVM.

5.2 VF XMT Level

Go "OFF HOOK". Insert a 1KHz signal @ 0dBm into the 2-Wire line. Connect an AC VTVM to pins F and H. Terminate with 600Ω if no connection exists and read 0dBm. Adjust R2 if required.

5.3 VF RCV Level

Go "OFF HOOK". Connect a signal generator @ 1KHz and 0dBm to pins Y and Z. Bridge the 2-Wire line and read 0dBm. Adjust R1 if required.

5.4 Signaling Level

5.4.1 If the module is equipped with the -02 option, place -V on pin J. Connect an AC VTVM on pins F and H and read 0dBm. Adjust R40 if required.

5.4.2 If the module is not equipped with the -02 option, apply a signal @ 2600Hz and 0dBm to pin K. Place -V on pin J. Connect an AC VTVM on pins F and H and read 0dBm. Adjust R40 if required.

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(702) 358-3700

ASSEMBLY NUMBER 4410-0560 TITLE 41056-01-02 4-W/2-W SIGNALING UNIT DWG. REF: 415-1560

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		ASSEMBLY 4410-0560 4-W/2-W SIGNALING UNIT			
		CAPACITOR, FIXED	26		
C2-C4	0103-3151	Polystyrene, 15Kpf	3		
C5, C13	0103-2101	Polystyrene, 1Kpf	2		
C6	0104-0048	Electrolytic, 4.7uf	1		
C7, 8, 10, 18 19, 21	0104-0005	Mylar, .1uf	6		
C9, 20	0102-0003	Electrolytic, 10uf	2		
C11, 12	0101-0009	Ceramic Disk, .01uf	2		
C14, 16	0102-0020	Mylar, 2u1% *	2		
C15,	0102-0020	Mylar, 2uf	1		
C22, 23	0102-0018	Electrolytic,100uf	2		
C24, 25, 26	0104-0012	Mylar, .047 uf	3		

*Selected for 1% tolerance difference

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ASSEMBLY NUMBER 4410-0560 TITLE 41056-01/02 DWG. REF:

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		RESISTOR, FIXED, COMPOSITION 5%, 1/4W UNLESS SPECIFIED OTHERWISE	58		
R1	0234-0043	Pot. Cermet 5K	1		
R2	0234-0042	Pot, Cermet 1K	1		
R3	0206-2151	1.5K	1		
R4, 29, 54, 55	0206-2201	2K	4		
R5, 34, 38	0210-6040	604 1%	3		
R6	0206-8221	8.2K	1		
R47, 36,37,46	0206-2031	20K	4		
R7, R14, 33	0206-1041	100K	3		
R8	0234- 0038	Pot, 500K	1		
R9, 32, 35, 39, 57	0206-4721	4.7K	5		
R10	0206-1021	1K	1		
R11	0206-3321	3.3K	1		
R12, 50, 53	0206-1031	10K	3		

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ASSEMBLY NUMBER 4410-0560 TITLE DWG. REF:

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
R13	0206-4701	47	1		
R15	0206-2421	2.4K	1		
R16	0206-3341	330K	1		
R17, 21, 27	0206-1011	100	3		
R18, 19	0234-0036	Pot. 10K	2		
R20, 44	0206-6831	68K	2		
R22	0206-1341	130K	1		
R23, 24, 25, 26	0210-1003	100K, 1%	4		
R28	0234-0035	Pot. 1K	1		
R30	0206-3031	30K	1		
R31, 48, 51	0206-6211	620	3		
R40	0234-0028	50K	1		
R52	0206-6841	680K	1		
R56	0206-7521	7.5K	1		
R49	0206-5131	51K	1		

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ASSEMBLY NUMBER 4410-0056 TITLE DWG. REF:

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		SEMICONDUCTOR DEVICES			
CR1-CR 8	0300-0001	Diode	8	1N4001	
Q1-4	0341-0008	Transistor	4	2N2907	
Q5	0340-0008	Transistor	1	2N2222	
Q6	0344-0004	FET	1	2N4091	
1C1	0361-0024	Integrated circuit	1	CD4011	
1C1-4	0361-0044	Integrated Circuit	3	4558DN	
1C5	0361-0059	Integrated Circuit	1	LM320T-12	
L2-L4	0441-0085	Inductor	3	Raven	
T1, T3	0441-0094	Transformer	2	Raven	
T2	0441-0064	Transformer	1	Raven	
K1, K2	0411-0012	Relay	2	R40-E1-Y4-V800	
	0450-0004	Relay Socket	2		
	0612-0104	Terminal	5		
	0510-0017	Connector, 22 pin	1		
	1410-0560	Board, P.C.	1		
	0450-0020	Sockets, 8 pin	3		
	0450-0019	Socket 14 pin	1		

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ASSEMBLY NUMBER 4410-0560		TITLE 41056		DWG. REF:	
REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		-02 OPTION			
C1	0103-3151	Polystyrene, 15Kpf	1		
C17	0104-0005	Mylar, .1uf	1		
R41, 42, 45	0206-1241	120K	3		
R43	0206-5131	51K	1		
L1	0441-0085	Inductor	1	Raven	
S1	0501-0214	Switch, Momentary	1		
R58	0206-1051	1 Meg	1		

41056 4W/2W SIGNALING UNIT

TEST PROCEDURE

1. REFERENCES

   41056 4W/2W Signaling Unit Description

   410-1560 Schematic

2. GENERAL

   Complete the test Data Card for this procedure as required. Do not change levels or settings until instructed to do so.

3. TEST EQUIPMENT REQUIRED

   1 - -24VDC POWER SUPPLY

   1 - OSCILLOSCOPE

   1 - MULTIMETER

   1 - AC VTVM

   2 - SIGNAL GENERATOR

   1 - FREQUENCY COUNTER

4. TEST PROCEDURE

   4.1 Power

   4.1.1 Connect the -24VDC supply to pins A (-V) and B (+V Gnd). Turn on the -24VDC supply and read a current drain of .....<60 ma.

   4.1.2 Monitor pin C with a DC voltmeter. Read .....-12VDC ±.5V

   4.2.0 "OFF HOOK" Detection

   4.2.1 Check to see that the two (-) straps are installed. Apply -V to pin L. Relay K1 should energize. Remove -V from pin L. Relay K1 should relax.

   4.3 Hybrid

   Connect a 600Ω resistor and a 2.2uf capacitor in series

across pins M and N. Place -V on pin L. Connect a signal generator @ 1KHz and 0dBm across pins Y and Z. Connect an AC VTVM to pins F and H. Adjust R1 and/or R2 if required to get a reading on the AC VTVM. Adjust R28 for a minimum reading on the AC VTVM.

4.4 XMT Path

4.4.1 Connect a 600Ω resistor across pins D and E. Connect a 600Ω signal generator in series with a 2.2uf capacitor to pins M and N. Set the frequency to 1KHz

Set the generator level to 0dBm
Place -V on pin L. Connect an AC VTVM (600 termination) to pins F and H. Adjust R2 from one extreme to the other. The range in level at pins F and H should be .....>30dB
With R2, set the level to 0dBm

4.4.2 Sweep the signal generator frequency from .....300Hz to 2KHz
The output should be .....0dBm +1dBm -3dBm
Return the signal generator to.....1KHz

4.4.3 Replace the 600Ω resistor on pins D and E with the signal generator. Read on the AC VTVM.....-3.5dBm ±1dBm

4.5 RCV Path

4.5.1 Connect a signal generator to pins Y and Z. Set the frequency to 1KHz
Set the generator level to .....-10dBm
Connect a 600 resistor in series with a 2.2uf capacitor across pins M and N. Bridge the 600 resistor with an AC VTVM. Place -V on pin L. Adjust R1 from one extreme to the other. The range in level across the 2-Wire line should be .....-8 to +5dBm

4.5.2 Set the generator frequency to 2600Hz
Tune L4 for a minimum reading on the AC VTVM.
Return the generator frequency to...1KHz
With R1, set the level on the AC VTVM to .....-10dBm

4.5.3 Sweep the signal generator frequency from .....300Hz to 2KHz
The output should be .....-10dBm +1,-3dB
Disconnect all test equipment.

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4.6 Signaling Oscillator

4.6.1 -01 Option

Connect a 600 signal generator to pin K (ref. to ground). Set the signal generator frequency to 2600Hz
Set the signal generator level to ..OdBm
Connect a 600 resistor across pins D & E.
Connect an AC VTVM (600 termination) across pins F & H. Place -V on pin J. Adjust R40 from one extreme to the other. The range in level should be .....-30dBm to OdBm
Adjust R40 for a level of .....OdBm
Remove -V from pin J. Read a level of .....<-50dBm

4.6.2 -02 Option

Connect a 600 resistor across pins D & E.
Connect an AC VTVM (600Ω termination) across pins F & H. Connect a frequency counter to pins F & H. Place -V on pin J. Adjust R40 for a reading on the frequency counter. Adjust L1 for a frequency of .....2600Hz ±1Hz
Adjust R40. The output should adjust from .....-30dBm to OdBm
Adjust R40 for an output of .....OdBm

4.7 Signaling Detector

4.7.1 Connect a 600Ω signal generator to pins Y & Z. Set the signal generator frequency to .....2600Hz ±1Hz
Set the level to .....-20dBm
Connect an oscilloscope to pin 1 of IC3-A. Adjust L3 for a maximum level on the oscilloscope.

4.7.2 Connect the oscilloscope to the emitter of Q2. Adjust L2 for maximum signal. Adjust R19 if required to tune L2.

4.7.3 Adjust R8 for a minimum value. Connect an oscilloscope to pin 13 of IC1. Adjust R19 for a level of .....GND (0V to -3V)

4.7.4 Set the signal generator frequency to 1KHz
Set the signal generator level to .....-20dBm
Connect an oscilloscope to pin 8 of IC1.
Adjust R18 for a level of .....-2V ±.5V

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4.7.5 Signaling Detector Priority

4.7.5.1 Connect a signal generator (#1) to pins Y and Z. Connect another signal generator (#2) to pins Y and Z. Set signal generator #1 to a frequency of 1KHz
Set the level of signal generator #1 to .....-20dBm
Set signal generator #2 to a frequency of .....2600Hz ±1Hz
Set the level of signal generator #2 to 0dBm

4.7.5.2 Disconnect signal generator #1. Relay K2 should energize. Connect signal generator #1. Relay K2 should remain energized. Vary the frequency of signal generator #1 from .....300Hz to 2KHz
Relay K2 should remain energized.
Return signal generator #1 to 1KHz

4.7.5.3 Vary signal generator #2 from .....2575Hz to 2625Hz
Relay K2 should remain energized.
Vary signal generator #2 below 2600Hz until relay K2 de-energizes (vary the frequency slowly as there is a turn off delay, C6). This frequency should be.....2540Hz to 2575Hz
Return signal generator #2 to.....2600Hz
Disconnect signal generator #1 and reconnect when relay K2 energizes. Vary the signal generator #2 above 2600Hz until relay K2 de-energizes. This frequency should be .....2625Hz to 2650Hz
Return signal generator #2 to.....2600Hz

4.7.5.4 Disconnect signal generator #2. Relay K2 should de-energize. Adjust R8 for a turn-off delay of ..... 0.5 sec.
Reconnect signal generator #2. Relay K2 should remain de-energized. Vary the frequency of signal generator #1 from .....300Hz to 2KHz
Relay K2 should remain de-energized.
Return signal generator #1 to 1KHz

4.7.5.5 Repeat steps 4.7.5.1 through 4.7.5.4 using the following levels: Signal generator #1: OdBm. Signal generator #2: -10dBm.

4.8 Connect a 600 signal generator to pins Y and Z. Set signal generator frequency to 2600Hz
Set the signal generator level to .....OdBm
Relay K2 should energize. Verify contact closure between pins S & T and V & W. There should be no path between pins T & U and W & X. Disconnect the signal generator. Relay K2 should de-energize. Verify contact closure between pins T & U and W & X. Verify no path between pins S & T and V & W.

4.9 Disconnect all test equipment and stamp the module and Test Data Card with the Test Stamp.

1056 4W/2W SIGNALING UNIT

WORK ORDER_____

SERIAL NO._____

DATE_____

TEST DATA CARD

4.1.1_____

4.1.2_____

4.2.1_____

4.3_____

4.4.1_____

4.4.2_____

4.4.3_____

4.5.1_____

4.5.2_____

4.5.3_____

4.6.1_____

4.6.2_____

4.7.1_____

4.7.2_____

4.7.3_____

4.7.4_____

4.7.5.1_____

7.5.2_____

4.7.5.3_____

4.7.5.4_____

4.7.5.5_____

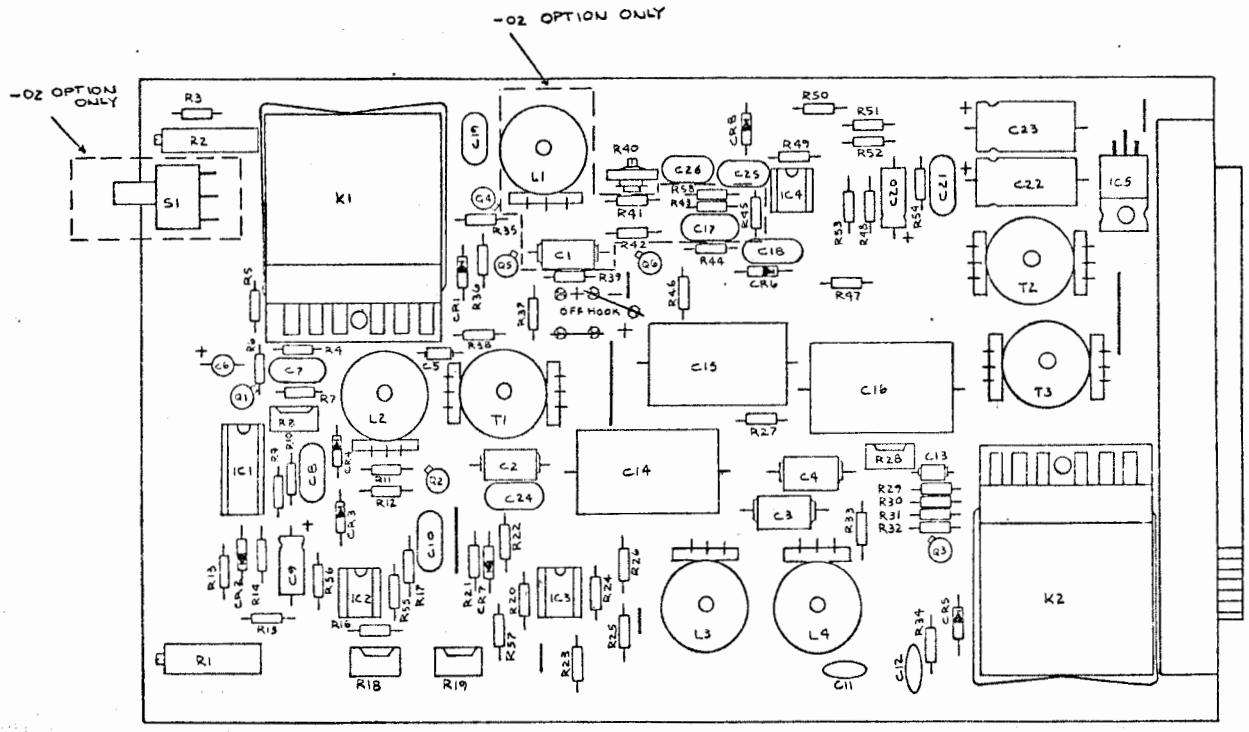
_____

_____

_____

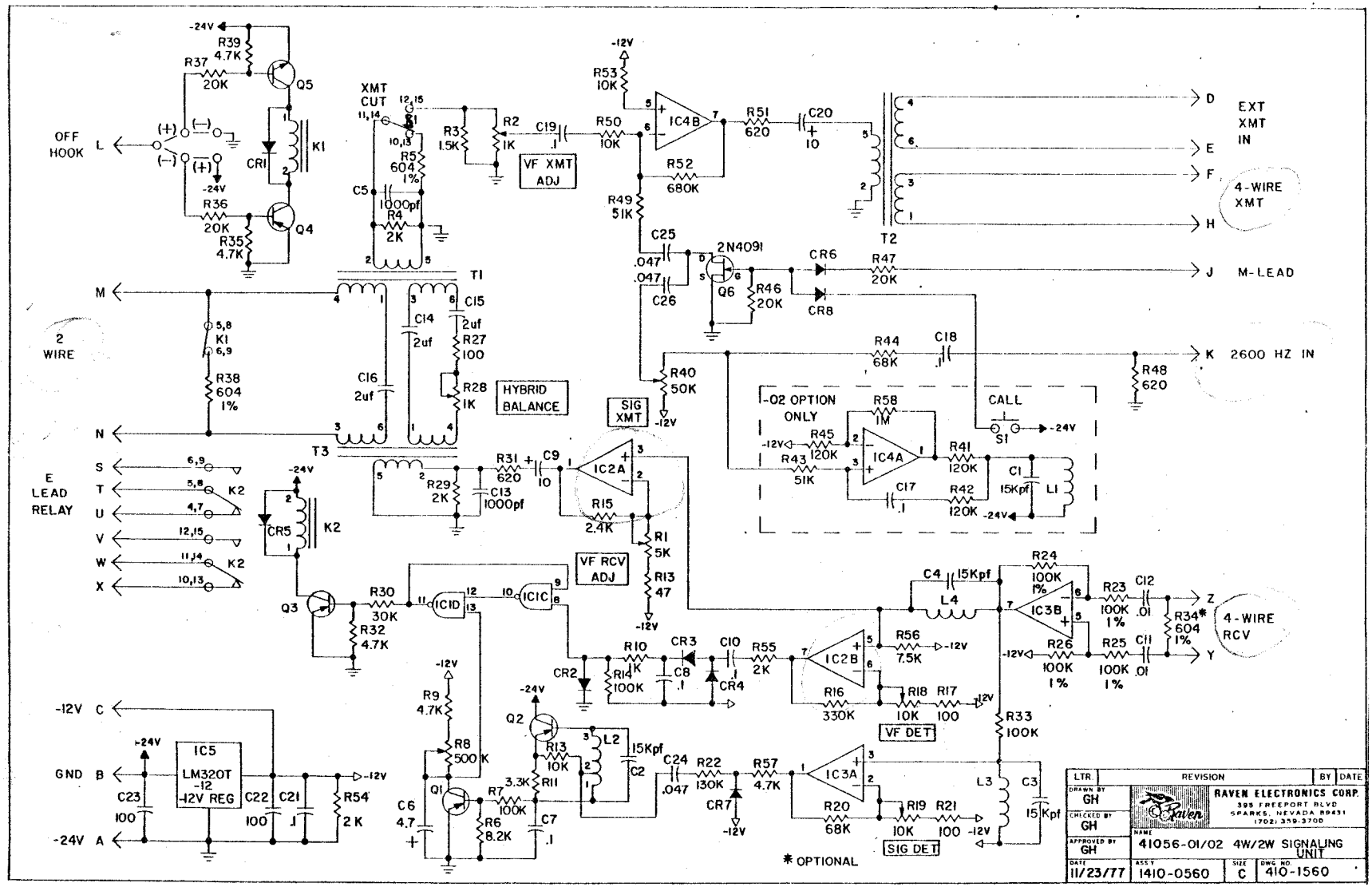
4.8_____

4.9_____ (Test Stamp)



-PARTS OUTLINED -02 OPTION ONLY

LTR.	REVISION	BY	D.
DRAWN BY MG.	RAVEN ELECTRONICS CO		
CHECKED BY	395 FREEPORT BLVD. SPARKS, NEVADA 89431 (702) 359-3700		
APPROVED BY	NAME P.C. ASSEMBLY 41056 4W/2W SIGNALING UNIT		
DATE 6/27/78	ASS'Y 1410-0560	SIZE B	DWG. NO. 410-6560


OFF HOOK
2 WIRE
E LEAD RELAY
XMT CUT
VF XMT ADJ
HYBRID BALANCE
SIG XMT
VF RCV ADJ
VF DET
SIG DET
-02 OPTION ONLY
CALL
EXT XMT IN
4-WIRE XMT
M-LEAD
2600 HZ IN
4-WIRE RCV
* OPTIONAL
RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD SPARKS, NEVADA 89431 (702) 359-3700
41056-01/02 4W/2W SIGNALING UNIT
11/23/77
1410-0560
410-1560

41084 4-WAY/4-WIRE ACTIVE BRIDGE

UNIT DESCRIPTION

1. REFERENCES:

410-0840 Schematic

2. GENERAL

The Raven 41084 4-Way/4-Wire Active Bridge provides a multi-path interface (between a maximum of 4 ports) on a 4-Wire basis. An input at one of the ports is routed through to the output at all other ports, with a minimum of intrachannel crosstalk. Potentiometer adjustments on all inputs and outputs allow input level coordination and through path gain adjustments. P.C. mounted test points are provided on inputs and outputs to facilitate alignment.

3. SPECIFICATIONS

3.1 Power Input .....-20VDC to -24VDC @ 75 ma. MAX.

3.2 Environmental

3.2.1 Operating Temperature.....0 - 50°C

3.2.2 Storage Temperature .....-40°C - 80°C

3.2.3 Humidity, Relative .....0 - 95%

3.3 Inputs

3.3.1 Input Impedance.....600Ω±10%

3.3.2 Input Level.....-40dBm to +7dBm

3.4 Outputs

3.4.1 Output Impedance.....600Ω

3.4.2 Output Level.....-40dBm to +7dBm continuously adjustab

3.4.3 Through path gain, max. 30db

3.5 Intrachannel Crosstalk.....<-60db

4 THEORY OF OPERATION

4.1 Input Circuitry

4.1.1 Each of the four inputs consist of a terminating resistor, input attenuator, and balanced amplifier.

4.1.2. For input one (1), R33 terminates the input. R34, 35, and 36 provide continuously adjustable attenuation between 7 and 40db, as determined by the setting of R36.

4.1.3 The input amplifier for leg 1 input consists of C9, C10, R17, 21, 22, 23 and 1C2B. The balanced input amplifier is set for +22db gain. C5 and R20 provide a path to the input amplifier for the P.C. mounted input 1 test point. The output of the input amplifier is equal to the input on the test point (for the test point input, 1C2B has unity gain). The impedance of the input 1 test point is 600Ω as determined by R19.

4.1.4 All other inputs (leg 2 through leg 4) have circuitry identical to leg 1, with only reference designations being different. Terminating resistors for legs 2, 3, and 4 are R29, 59 and 63, respectively. Input attenuators consist of R30, 31, and 32 for leg 2, R60, 61 and 62 for leg 3, and R64, 65 and 66 for leg 4. Potentiometers R32, 62, and 66 adjust attenuation on legs 2, 3, and 4. The leg 2 input amplifier consists of C7, 8, R24, 25, 27, 28 and 1C2A. C6, R26 and R18 provide the input 2 test point path.

C13, C14, R51, 55, 57, 58 and 1C4B comprise the leg 3 input, with C12, R56 and R68 providing the IN 3 test point path.

The input amplifier for leg 4 consists of C15, 16, R49, 50, 52, 54 and 1C4A. The IN 4 test point path is provided by R53, R67 and C11.

4.2 Output Amplifiers

4.2.1 Each leg output is driven by a 3-input summing amplifier, the output of which is transformer

coupled to provide a balanced output.

4.2.2 The output amplifier for output 1 consists of C3, R10-15, R1, T1 and 1C1A. Potentiometer R1 provides >30db level adjustment. Resistors R15, 14 and 13 sum inputs from legs 2, 3, and 4 respectively. The OUT 1 test point is taken from the unbalanced side of T1.

4.2.3 The leg 2 output amplifier is comprised of C1, R5-R9, R16, R2, T3 and 1C1B. R2 provides level adjusting capability and the OUT 2 test point is connected to the unbalanced side of T3. Resistors R16, 6, and 5 sum inputs from inputs leg 1, 3, and 4.

4.2.4 C2, R37-42, R3, T4 and 1C3A provide the output 3 amplifier, with R3 adjusting the output level. Resistors R37, 38, and 39 sum inputs from inputs leg 1, 2, and 4.

4.2.5 The output 4 amplifier consists of C4, R43-48, R4, and T2 and 1CB3. R4 sets the output level, with R46, 47 and 48 summing inputs from legs 1, 2 and 3.

4.3 Regulator

4.3.1 A. -12VDC reference voltage for 1C1-1C4 is provided by a 3-pin regulator, 1C5. Capacitors C17, 18 and 19 provide filtering of the -24V and -12VDC supplies.

5. ALIGNMENT

5.1 Outputs 2, 3, and 4

5.1.1 Connect a 600Ω signal generator to IN 1, TP1. Set the signal generator frequency to 1KHz, at a level of OdBm. Connect an AC VTVM to OUT 2, TP4. Terminate the AC VTVM with 600Ω if no connection exists on pins L & M. Read on the AC VTVM a level of OdBm. Adjust R2 if required.

5.1.2 Connect the AC VTVM to OUT 3, TP5. Terminate the AC VTVM with 600Ω if no connection exists on pins P & R. Read a level of OdBm. Adjust R3 if required.

5.1.3 Connect the AC VTVM to OUT 4, TP6. Terminate the AC VTVM with 600Ω if no connection exists on pins T & U. Read a level of OdBm. Adjust R4 if required.

5.2 Output 1

5.2.1 Connect a 600Ω signal generator to IN 2, TP2. Set th signal generator frequency to 1KHz, at a level of OdBm. Connect an AC VTVM to OUT 1, TP3. Terminate the AC VTVM with 600Ω if no connection exists on pins J & K. Read on the AC VTVM a level of OdBm. Adjust R1 if required.

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ASSEMBLY NUMBER 4410-0840 TITLE 4W/4W 41084 ACTIVE BRIDGE DWG. REF: 415-1840

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		CAPACITOR, Fixed:	19		
C1-C4	0102-0016	Electrolytic, 10uf	4		
C5-C16	0104-0012	Mylar, .047uf	12		
C17	0104-0005	Mylar, .1uf	1		
C18, 19	0102-0018	Electrolytic, 100uf	2		
		RESISTOR, ¼W, 5% Carbon Comp. unless otherwise specified:	60		
R1-R4	0234-0047	Pot. 500K multi-turn	4		
R5, 6, 9, 10, 13, 14, 15, 16, 37, 38, 39, 42, 43, 46, 47, 48	0206-3331	33K	16		
R7, 12, 40, 45, 18, 19, 67, 68	0206-6211	620 ohm	8		
R8, 11, 41, 44	0206-1231	12K	4		
R17, 24, 50, 51	0210-9312	93.1K 1% 1/8W	4		
R20, 23, 25, 55,56, 49, 53, 26	0210-1873	187K 1%, 1/8W	8		
R21, 22, 27, 28, 57, 58, 52, 54	0210-1502	15K 1%, 1/8W	8		
R33, 29, 59, 63	0210-6040	604 1%, 1/8W	4		
R32,36,62,66	0234-0044	Pot. 10K multi-turn	4		
R34,35,30,31, 60,61,64,65	0210-6041	6.04K 1%, 1/8W	8		
R69	0206-2021	2K	1		

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ASSEMBLY NUMBER		TITLE		DWG. REF:	
REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		SEMICONDUCTOR DEVICE:			
IC1-IC4	0361-0044	Op-Amp, dual	4	RC4558DN	
IC5	0361-0059	Regulator, -12V	1	LM320T-12	
T1-T4	0441-0073	Transformer	4	Raven	
	0450-0020	IC Socket, 8 pin	4		
	1410-0840	Board P.C.	1		
	0510-0017	Connector, 22 pin	1		
	0608-0208	TEST POINTS	8	H. H. Smith 63-3009	

41084 4-WAY/4-WIRE ACTIVE BRIDGE

TEST PROCEDURE

1. REFERENCES

410-1840 Schematic

2. TEST EQUIPMENT REQUIRED

-24V DC power supply
AC VTVM
Signal generator
DC Voltmeter
DC Milliammeter
Frequency counter
Oscilloscope

3. TEST PROCEDURE

3.1 Power

Connect the -24V power supply to pins A (-V) and B (+V, Gnd). Connect a DC milliammeter in series with the supply. Turn power on and read a current drain of .....<80 ma.

3.2 Input amplifiers

3.2.1 Input leg 1

3.2.1.1 Connect a 600Ω signal generator to input leg 1, pins C & D. Set the signal generator frequency to 1KHz

Set the signal generator level to.....0dBm

Connect an AC VTVM (unterminated) to the output of 1C2B (pin 7). Adjust R36.

The output of 1C2B should vary from..... -20dB to +15dB

Set R36 for a level of 0dB

3.2.1.2 Disconnect the signal generator from

pins C & D and connect to TP1. Read a level at the output of 1C2B of .....0dB ±5dB

3.2.2 Input leg 2

3.2.2.1 Connect a 600Ω signal generator to input leg 2, pins E & F. Set the signal generator frequency to 1KHz

Set the signal generator level to 0dBm

Connect an AC VTVM (unterminated) to the output of 1C2A (pin 1). Adjust R32.

The output of 1C2A should vary from .....-20dB to +15dB

Set R32 for a level of 0dB

3.2.2.2 Disconnect the signal generator from pins E & F and connect to TP2. Read a level at the output of 1C2A of .....0dB ± .5dB

3.2.3 Input leg 3

3.2.3.1 Connect a 600Ω signal generator to input leg 3, pins W & X. Set the signal generator frequency to 1KHz

Set the signal generator level to 0dBm

Connect an AC VTVM (unterminated) to the output of 1C4B (pin 7). Adjust R62. The output of 1C4B should vary from ..... -20dB to +15dB

Set R62 for a level of 0dB

3.2.3.2 Disconnect the signal generator from pins W & X and connect to TP3. Read a level at the output of 1C4B of .....0dB ±.5dB.

3.2.4 Input leg 4

3.2.4.1 Connect a 600Ω signal generator to input leg 4, pins Y & Z. Set the signal generator frequency to.....1KHz

Set the signal generator level to .....OdBm

Connect an AC VTVM (unterminated) to the output of 1C4A (pin 1). Adjust R66. The output of 1C4A should vary from ..... -20dB to +15

Set R66 for a level of ..... OdB

3.2.4.2 Disconnect the signal generator from pins Y & Z and connect to TP4. Read a level at the output of 1C4A of .....Odb ±.5dB

3.3 Output Amplifiers

3.3.1 Outputs, leg 1 IN

3.3.1.1 Connect 600Ω signal generator to input leg 1, pins C & D. Set the signal generator frequency to 1KHz

Set the signal generator level to .....OdBm

Connect an AC VTVM (600Ω termination) to the output leg 2, pins L & M. Adjust R2. The output should vary from .....<-15dBm to+10dBm (The output will exceed +10dBm, but clipping will occur at approximately +13dBm).

Adjust R2 for an output of ....OdBm. Move the AC VTVM (600Ω) to OUT 2, TP4. Read a level of .....OdBm ±1dBm Reconnect the AC VTVM to output leg 2, pins L & M.

3.3.1.2 Vary the signal generator frequency from .....300Hz to 10KHz The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to 1KHz

3.3.1.3 Connect an AC VTVM (600Ω termination) to the output leg 3, pins P & R. Adjust R3. The output should vary from .....<-15dBm to +10dBm (The output will exceed +10dBm, but clipping will occur at approximately +13dBm). Adjust R3 for an output of .....0dBm.

Move the AC VTVM (600Ω) to OUT 3, TP5. Read a level of .....0dBm ±1dBm Reconnect the AC VTVM to output leg 3, pins P & R.

3.3.1.4 Vary the signal generator frequency from .....300Hz to 10KHz. The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to 1KHz

3.3.1.5 Connect an AC VTVM (600 termination) to the output leg 4, pins T & U. Adjust R4. The output should vary from .....<-15dBm to +10dBm, (The output will exceed +10dBm, but clipping will occur at approximately +13dBm). Adjust R4 for an output of .....0dBm.

Move the AC VTVM (600Ω) to OUT 4, TP6. Read a level of .....0dBm ±1dBm Reconnect the AC VTVM to output leg 4, pins T & U.

3.3.1.6 Vary the signal generator frequency from .....300Hz to 10KHz. The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to 1KHz

3.3.1.7 Connect an AC VTVM (600Ω termination) to the output leg 1, pins J & K. Read on the AC VTVM .....<-55dBm.

3.3.2 Outputs, leg 2 IN

3.3.2.1 Connect 600Ω signal generator to input leg 2, pins E & F. Set the signal generator frequency to ...1KHz. Set the signal generator level to.....0dBm.

Connect an AC VTVM (600Ω termination) to the output leg 1, pins J & K. Adjust R1. The output should vary from .....<-15dBm to +10dBm. (The output will exceed +10dBm, but clipping will occur at approximately +13dBm). Adjust R1 for an output of .....0dBm.

Move the AC VTVM (600Ω) to OUT 1, TP3. Read a level of .....0dBm ±1dBm Reconnect the AC VTVM to output leg 1, pins J & K.

3.3.2.2 Vary the signal generator frequency from .....300Hz to 10KHz The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to 1KHz

3.3.2.3 Connect an AC VTVM (600Ω termination) to the output leg 3, pins P & R. Read on the AC VTVM .....0dBm ±.5dBm

3.3.2.4 Vary the signal generator frequency from .....300Hz to 10KHz. The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to .....1KHz.

3.3.2.5 Connect an AC VTVM (600Ω termination) to the output leg 4, pins T & U. Read on the AC VTVM .....0dBm ±.5dBm

3.3.2.6 Vary the signal generator frequency from .....300Hz to 10KHz. The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to .....1KHz.

3.3.2.7 Connect an AC VTVM (600Ω termination) to the output leg 2, pins L & M. Read on the AC VTVM .....<-55dBm.

3.3.3 Outputs, leg 3 IN

3.3.3.1 Connect 600Ω signal generator to input leg 3, pins W & X. Set the signal generator frequency to ...1KHz Set the signal generator level to .....0dBm. Connect an AC VTVM (600Ω termination) to the output leg 1, pins J & K. Read

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on the AC VTVM .....0dBm ±.5dBm.

3.3.3.2 Vary the signal generator frequency from.....300 HZ to 10KHz. The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to .....1KHz.

3.3.3.3 Connect an AC VTVM (600Ω termination) to the output leg 2, pins L & M. Read on the AC VTVM .....0dBm ±.5dBm

3.3.3.4 Vary the signal generator frequency from .....300Hz to 10KHz The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to .....1KHz.

3.3.3.5 Connect an AC VTVM (600Ω termination) to the output leg 4, pins T & U. Read on the AC VTVM .....0dBm ±.5dBm.

3.3.3.6 Vary the signal generator frequency from .....300Hz to 10KHz. The output on the AC VTVM should be within .....+1dBm to -3dBm. Set the signal generator frequency to .....1KHz.

3.3.3.7 Connect the AC VTVM (600Ω termination) to output leg 3, pins L & M. Read on the AC VTVM .....<-55dBm.

3.3.4 Outputs, leg 4 IN

3.3.4.1 Connect a 600Ω signal generator to input leg 4, pins & & Z. Set the signal generator frequency to .....1KHz. Set the signal generator level to .....0dBm. Connect an AC VTVM (600 termination) to the output leg 1, pins J & K. Read on the AC VTVM .....0dBm ±.5dBm.

3.3.4.2 Vary the signal generator frequency from .....300Hz to 10KHz. The output on the AC VTVM should

be within .....+1dBm to -3dBm.
Set the signal generator frequency
to .....1KHz.

3.3.4.3 Connect an AC VTVM (600Ω termination)
to the output leg 2, pins L & M.
Read on the AC VTVM....OdBm ±.5dBm.

3.3.4.4 Vary the signal generator frequency
from .....300Hz to 10KHz.
The output on the AC VTVM should be
within .....+1dBm to -3dBm.
Set the signal generator frequency
to .....1KHz.

3.3.4.5 Connect an AC VTVM (600Ω termination)
to the output leg 3, pins P & R. Read
on the AC VTVM .....OdBm ±.5dBm.

3.3.4.6 Vary the signal generator frequency
from .....300Hz to 10KHz.
The output on the AC VTVM should be
within.....+1dBm to -3dBm.
Set the signal generator frequency
to .....1KHz.

3.3.4.7 Connect the AC VTVM (600Ω termination)
to output leg 4, pins T & U. Read
on the AC VTVM .....<-55dBm.

3.4 Disconnect all test equipment from the module. Stamp the module and Test Data Card with Test Stamp.

41084 4-WAY/4-WIRE ACTIVE BRIDGE WORK ORDER _____

SERIAL NO._____ DATE_____

TEST DATA CARD

3.1_____

3.2.1.1_____

3.2.1.2_____

3.2.2.1_____

3.2.2.2_____

3.2.3.1_____

3.2.3.2_____

3.2.4.1_____

3.2.4.2_____

3.3.1.1_____

3.3.1.2_____

3.3.1.3_____

3.3.1.4_____

3.3.1.5_____

3.3.1.6_____

3.3.1.7_____

3.3.2.1_____

3.3.2.2_____

3.3.2.3_____

3.3.2.4_____

3.3.2.5_____

3.3.2.6_____

3.3.2.7_____

3.3.3.1_____

3.3.3.2_____

3.3.3.3_____

3.3.3.4_____

3.3.3.5_____

3.3.3.6_____

3.3.3.7_____

3.3.4.1_____

3.3.4.2_____

3.3.4.3_____

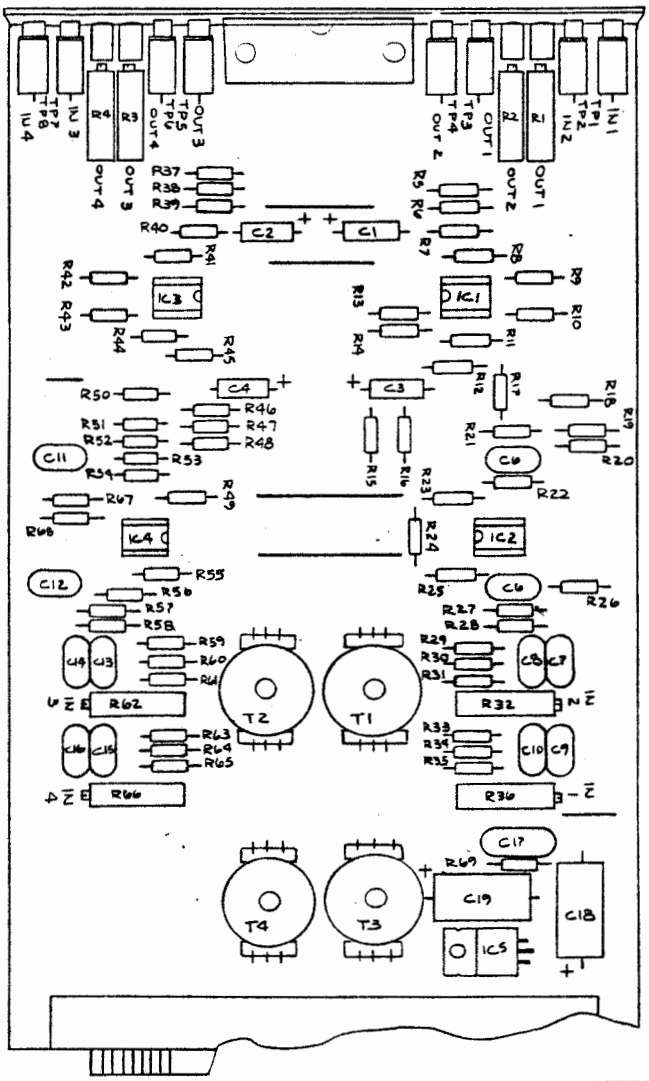
3.3.4.4_____

3.3.4.5_____

3.3.4.6_____

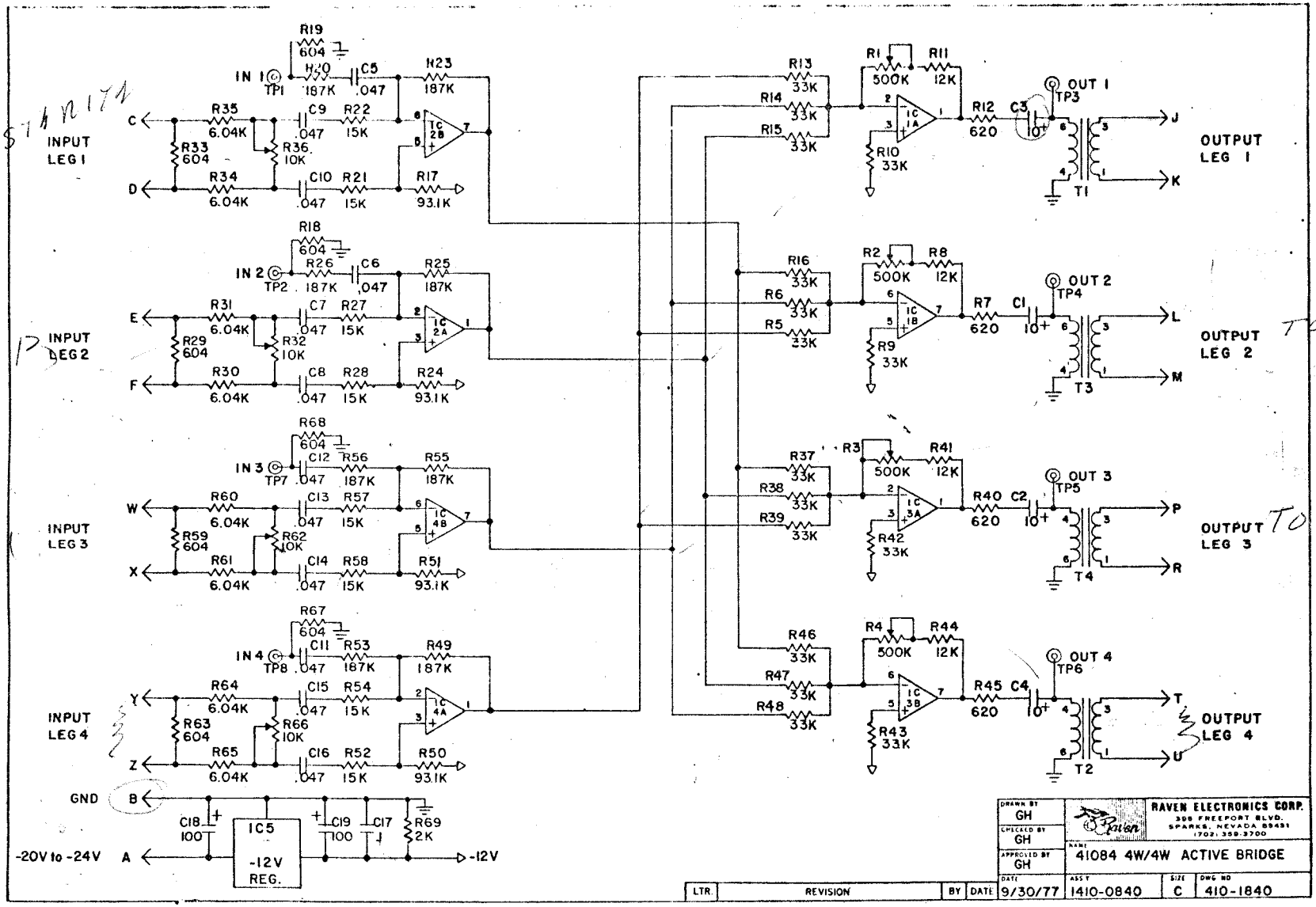
3.3.4.7_____

3.4_____(Test Stamp



LTR.	REVISION	BY	DATE

DRAWN BY: MG.	RAVEN ELECTRONICS CORP. 395 FREEPORT BLVD. SPARKS, NEVADA 89431 (702) 359-3700		
CHECKED BY: GH	NAME: P.C. ASSEMBLY		
APPROVED BY:	41084 4/W 4/W ACTIVE BRIDGE		
DATE: 6/22/78	ASS'Y: 1410-0840	SIZE: A	DWG. NO.: 410-6840


INPUT LEG 1
INPUT LEG 2
INPUT LEG 3
INPUT LEG 4
IN 1
IN 2
IN 3
IN 4
OUTPUT LEG 1
OUTPUT LEG 2
OUTPUT LEG 3
OUTPUT LEG 4
OUT 1
OUT 2
OUT 3
OUT 4
GND
-20V to -24V
-12V
IC5
-12V REG.
RAVEN ELECTRONICS CORP.
358 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700
DRAWN BY GH
CHECKED BY GH
APPROVED BY GH
NAME 41084 4W/4W ACTIVE BRIDGE
DATE 9/30/77
ASS'Y 1410-0840
SIZE C
DWG NO 410-1840
LTR REVISION BY DATE

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RAVEN ELECTRONICS CORPORATION

TEST PROCEDURE
41010-96 COMMON EQUIPMENT SHELF

1.0 GENERAL

Complete the Test Data Card as required for this procedure. If difficulties are encountered, refer to the troubleshooting procedures for the 41028-01 Power Supply and the Shelf.

2.0 TEST EQUIPMENT REQUIRED

VTVM — TRIPLET 850 OR EQUIVALENT
EXTENDER BOARD — RAVEN 4404-1650
1 EACH IN4001 DIODE
1 EACH 28V DC LAMP
1 EACH 15 OHM, 50W RESISTOR
1 EACH 41028-01 (PRETESTED)
1 EACH 48V DC POWER SUPPLY

3.0 TEST EQUIPMENT SET UP

Set up the Test Equipment as shown in Figure 1.

4.0 POWER SUPPLY TEST

4.1 Lower the rear panel of the Shelf. Connect the DC Power Supply plus (+) lead to pin J1-V and the minus (-) lead to J1-S. Plug in the 41028-01 Power Supply in its proper jack. (Refer to the assembly drawing.)

4.2 Connect the 15 ohm, 50W Resistor across pins J1-A and U at the rear of the power supply.

4.3 Turn the Power Supply "on". Measure the voltage at the test points. If this is not -24V DC, adjust the supply. Remove resistor.

4.4 Connect a 240 ohm resistor across pins J1-A and U at the rear of the Power Supply. Voltage at test points should be -24V DC ± .7 with a 48V input.

5.0 WIRING TESTS

5.1 Using the extender board as set up in figure 1, Detail A, plug in the extender to each of the following jacks. The lamp must illuminate in each position.

5.1 cont'd.

J2	J7	J12
J3	J8	J13
J4	J9	J14
J5	J10	J15
J6	J11	J16

6.0 TEST COMPLETION

6.1 This completes the test of the Shelf. Disconnect the test equipment.

6.2 Re-install the rear panel.

6.3 Stamp the rear panel below the left side of the serial number tag with your test stamp.

7.0 Q.A. ACCEPTANCE

7.1 Verify that test results are within specifications.

7.2 Verify that Test Data Card is properly filled out.

7.3 Re-inspect Shelf per established criteria.

7.4 Stamp Shelf (below the right side of the serial number tag) and the Test Data Card with "ACCEPTED" Stamp.

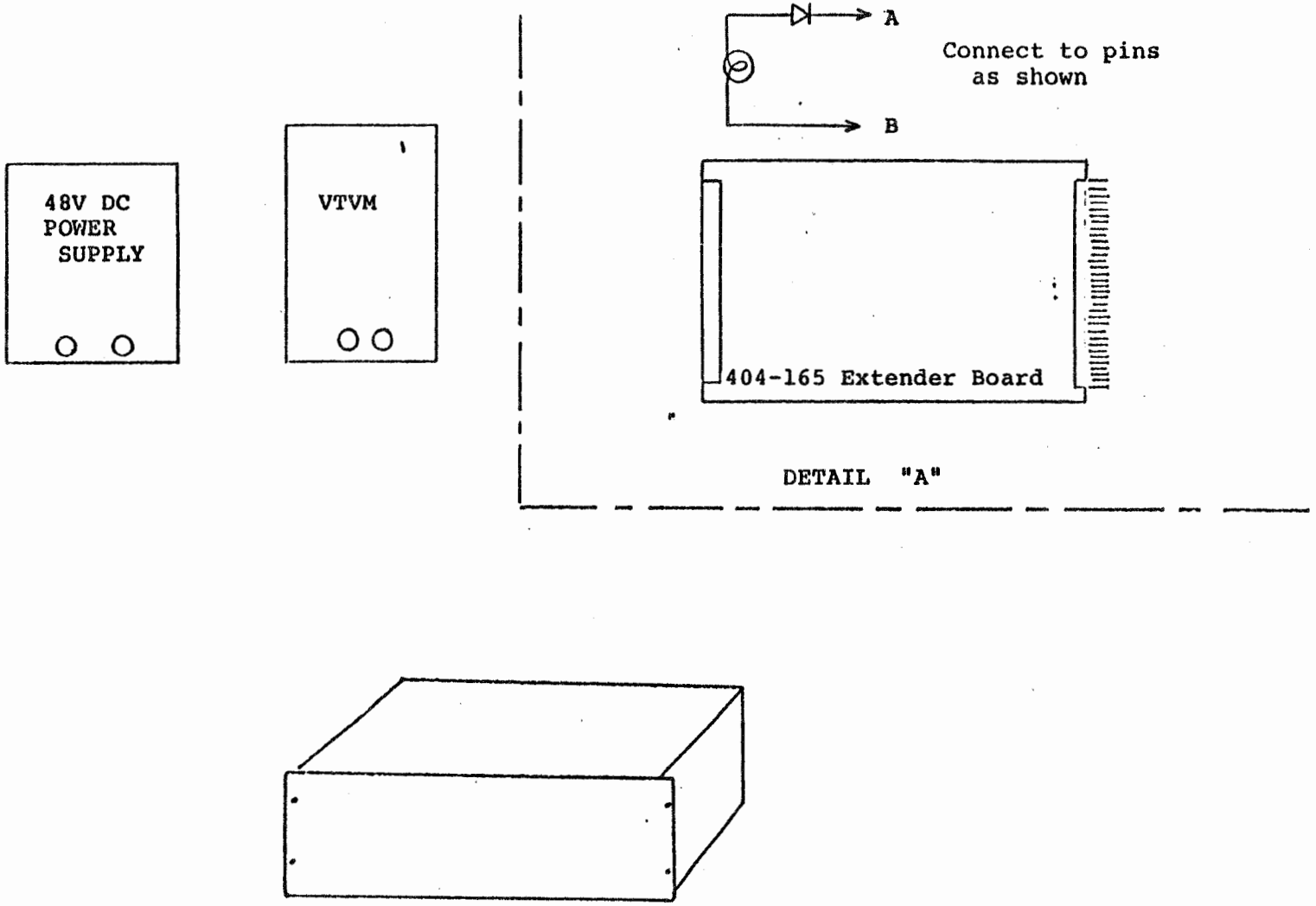
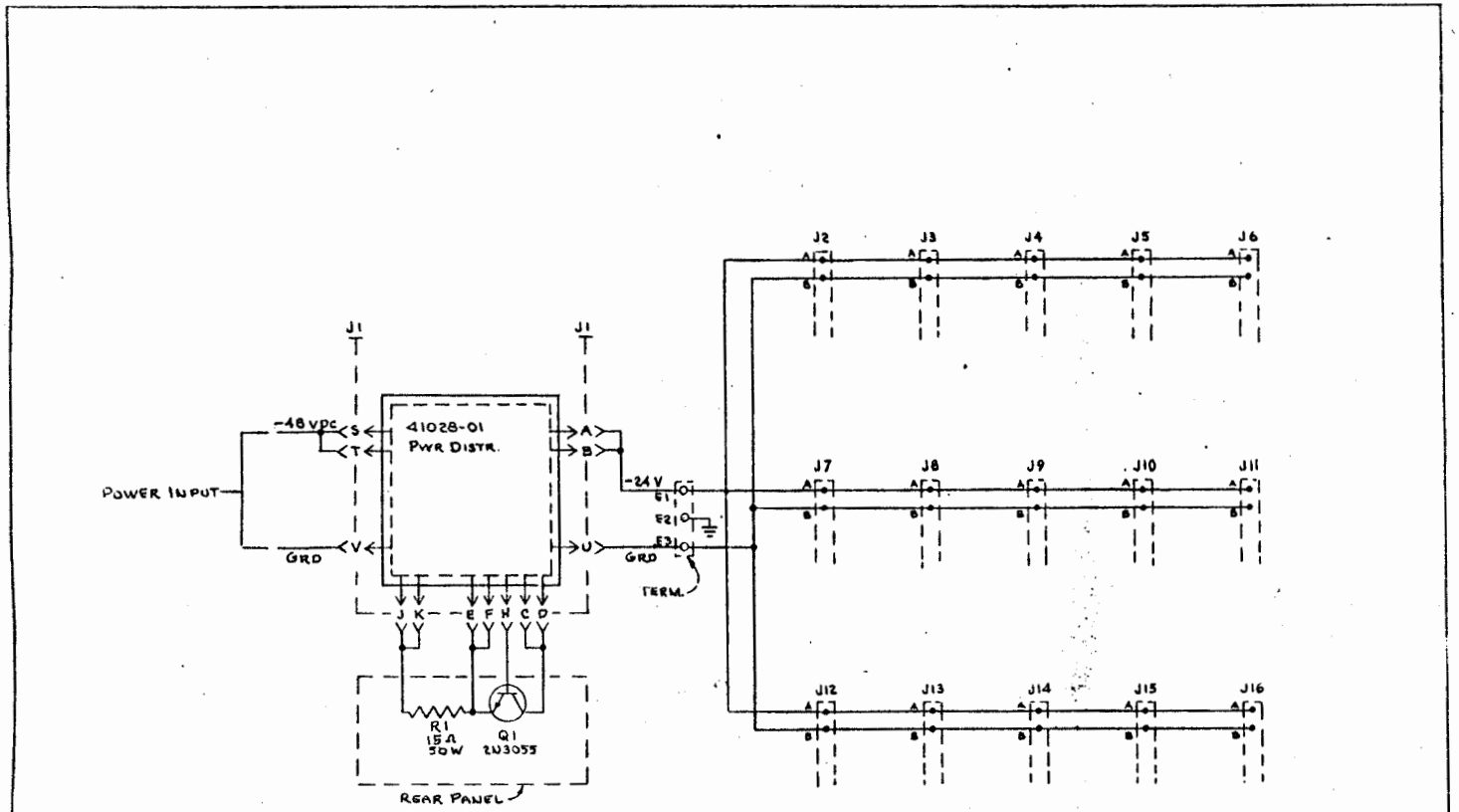


Figure 1. Test Equipment setup.



LTR	REVISION	BY	DATE
			8-1-78

DRAWN BY	PWL
CHECKED BY	GSM
APPROVED BY	GK
DATE	8-1-78

RAVEN ELECTRONICS CORP.
884 PASSPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700

NAME: WIRING DIAGRAM
COMMON EQUPT SHELF-P.F

ASSY	SIZE	DWG NO
41010-96	C	410-4005

SPEAKER AMPLIFIER

41030-01 MODULE

1. APPLICATION

This Module provides the audio electronic interface for the orderwire lines or assemblies. It contains alert circuitry to announce to the operator that a call is incoming. It provides parts for the transmission and reception of signaling tones to the 4-wire line.

2. SPECIFICATIONS

Impedance:	Transmit Output and Receive Input: 150 ohms or 600 ohms, ± 10%, balanced
Signaling Tone Input:	600 ohm, ± 10%, single ended
Signaling Output:	High impedance
Audio Output Power:	Greater then 1W into the speaker

3. THEORY OF OPERATION

3.1 Refer to schematic 410-1300.

3.2 The microphone is connected to J1. Microphone current comes from "A" to Terminal E1, through the contacts of switch S1 (which are closed when off-hook) through resistor R1, Terminal E2, out the microphone J1, Terminal E4 and through "B" to ground.

3.3 Talking into the microphone changes its impedance and these audio signal variations are taken through R2 and R3, through capacitor C1 through the emitter of transistor Q2. Transistor Q2 functions as a common base amplifier. The signals are taken from the collector of Q2 and presented directly to the base of Q1, and at the emitter of Q1 we see the amplified signal.

3.4 Resistor R12 serves to terminate the secondary of transformer T1 or drive the secondary of T1 in its characteristic impedance. Signal flow is through R12 to C4 to the primary of T1. Capacitor C5 acts to filter out high frequency noise.

3.5 Signals from the secondary of T1 pass through pins C and E for the 600 ohm output; or through pins D and E for the 150 ohm output. Both outputs are balanced.

3.6 The signaling tone is presented to pin F and ground. Resistor R5 serves to provide a 600 ohm input impedance. Signals go from the junction of R5 and pin F through R6 and C2 to the emitter of Q2 (where they follow the same path as do the voice signals).

3.7 The signals coming into the Module arrive via pins M and P for 600 ohm balanced input; or pins N and P for 150 ohm balanced input. Signals are coupled across transformer T2 and are derived at across R21. The same signals now may be taken off pin K and ground for external sampling.

3.8 The signals are presented to terminal E9 and pass through resistor R43 (VOLUME CONTROL) to terminal E8 and to ground. The wiper of R43 samples part of the input signals and present this portion to terminal E6, through C7 to the base of transistor Q3. Transistor Q3 is used as a buffer stage for the Volume Control. Output signals are taken from the emitter of Q3, pass through resistor R16 to a summing point.

3.9 Transistor Q4 is a side tone amplifier. It samples the transmitted signals through R11 and C8. The side tone signals are taken from the emitter, pass through R17 to the common summing point. The summed signals of the side tone and receive signals pass through capacitor C6 to terminal E7.

3.10 The signal present at terminal E7 may go either to the handset earpiece or to the speaker power amplifier, depending on the external conditions. If the handset is plugged in and is off-hook, switch S1 will be in the position as shown on the schematic.

3.11 Signals will pass through switch S1 to the handset jack J1 to terminal E3, through resistor R4 to point "A" (-24V DC). If the handset is on-hook, S1 will be in the lower position and signals will go from terminal E7 to terminal E12 and to the input of the speaker power amplifier.

3.12 If the handset is not plugged-in, the signals will pass from terminal E7, through the normally open contacts of S1 to the lower section of the handset jack through the normally closed connection of the handset jack and back down to terminal E12 to the input of the speaker power amplifier.

3.13 The speaker power amplifier consists of a common emitter gain stage (Q9) and two emitter followers operating in a class AB mode. Input signals from terminal E12 is developed across R32 and presented to the base of Q9. These signals are amplified by Q9 and are seen on its collector. The signals are then presented to transistors Q7 and Q8.

3.14 Transistors Q7 and Q5 operate as a Darlington pair while Q8 and Q6 operate as the gain stage. Diodes CR1, CR2, and CR3 are temperature compensating devices for the amplifier and bias it correctly. Capacitor C11 provides shunting at high frequencies and lowers the gain of the amplifier.

3.15 The current will be amplified by the two output pairs and will be seen at the junction of R22, C10 and Q6. Feedback from the output is derived across R25 and C13 and is fed back to the input, C14 serves to roll off the high frequency gain of the amplifier.

3.16 The output of the amplifier passes through capacitor C10 to terminal E14, through the loudspeaker and back to terminal E13 to ground.

3.17 The Alert Call circuit is a modulated Uni-junction stage. Transistors Q10 and Q11, the two Uni-junction relaxation oscillators, will operate when pin S is connected to ground. Simultaneously, the ALERT LAMP DS1 will light.

3.18 Capacitor C16 charges through R37 until it reaches the firing point of transistor Q10 which is approximately six-tenths of the supply voltage. At this time, the transistor 'fires' causing C16 to discharge through it and across R35. The rate at which the charging and discharging occurs determines the basic frequency as heard in the speaker.

3.19 At the same time C16 charges and discharges, Q11 provides a means of charging and discharging capacitor C17. This is done at a much slower rate than that of Q10 and C16. This action produces the frequency modulated signal seen at the emitter of Q10.

3.20 The signal from the emitter of Q10 passes through resistor R34 and capacitor C15 to the speaker power amplifier. The signal is amplified and is heard through the speaker.

4. INSTALLATION

Since the Speaker Amplifier is part of an overall system, installation of the Module is covered in the system assembly.

5. ADJUSTMENTS

The only adjustment is that of R2 (VOICE LEVEL ADJ). This adjustment is preset at the factory to provide the correct output.

5.1 Remove handset from the jacks.

5.2 Connect a 600 ohm Signal Generator between terminals E2 and E4.

5.3 Set the Signal Generator level to -20 dBm.

5.4 Terminate pins C and D with 600 ohms and connect the AC voltmeter across pins C and E.

5.5 Adjust R2 for a 0 dBm reading on the AC voltmeter.

6. TROUBLESHOOTING

Troubleshooting shall consist of injecting AC signals as shown on the schematic and tracing the signals through the system. DC and ohmic checks should serve to locate the faulty component.

7. MAINTENANCE

Maintenance should consist mainly of parts replacement. However, the selection of R32 is critical and should be covered in the following manner:

7.1 Connect a 600 ohm Signal Generator across pins M and P.

7.2 Set the frequency to 1 KHz and the level to 0 dBm.

7.3 Adjust the VOLUME CONTROL R43 maximum clockwise.

7.4 Connect an AC voltmeter across terminals E13 and E14.

7.5 Select a value for R32 which will provide a reading of 2.8V RMS or greater, as read on the voltmeter.

8. PARTS LIST

The following parts list contains all parts associated with the 41030-01 Module. Unless otherwise specified, part numbers are Raven Electronics Corporation part numbers.

9. REFERENCE DIAGRAMS

41030-01 SPEAKER AMPLIFIER, Schematic Diagram 410-1300, dtd. 7/6/72.

RAVEN ELECTRONICS CORPORATION

41030-01
SPEAKER AMPLIFIER — PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
	4410-0300-01	SPEAKER AMPLIFIER ASSEMBLY		DWG REF 410-030, 3/21/72	
	1410-2320	CHASSIS			
	1410-3301	PANEL	1		
	0604-0501	Captive Screw Set, 6-32	2		
	0606-0204	Knob	1	KN500-BA ALCO	
S1	0501-0401	Hookswitch	1		
DS1	0502-0804	Lamp, 28V	1		
	0502-6006	Socket, Lamp	1	300-058 DRAKE	
	0502-6007	Clip, Lamp	1	116A DRAKE	
	1404-2270	PHONE JACK MTG. BLOCK	1		
J1	0608-0203	Phone Jack	2	JJ042 ADC	
	1404-2360	SPEAKER MOUNT	1		
LS1	0505-0201	Speaker, 8 ohm	1	28A8C OAKTRON	
	0609-0202	SOLDER LUG, #10	2	1414-10 H.H. SMITH	
C18	0102-0007	CAPACITOR, 8400 uf, 40V	1	36D842G040BB2A SPRAGUE	
	0603-0302	Clamp, Capacitor	1	CMC32 SPRAGUE	
R41	0234-0014	RESISTOR, Variable, 1K Audio Taper	1	53C3 CLAROSTAT	
	1410-2350	P.C. BOARD SUPPORT	1		
	4404-1300	SPEAKER AMPLIFIER P.C. BOARD Consisting of:	1	DWG REF 410-1300, 7/6/72 REV B	
		CAPACITOR: fixed	17		
C1	0102-0016	Tantalum, 10 uf, 20V		K10C20K KEMET	
C2	0102-0016	Tantalum, 10 uf, 20V		K10C20K KEMET	
C3	0102-0005	Electrolytic, 100 uf, 25V		B41283 SIEMANS	
C4	0102-0016	Tantalum, 10 uf, 20V		K10C20K KEMET	

REVISED 9/20/72
Supersedes P/L - 7/18/72

RAVEN ELECTRONICS CORPORATION

41030-01
SPEAKER AMPLIFIER

PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
C5	0104-0016	Mylar, .033 uf, 100V		1MDF-1-333 ELMENCO	
C6	0102-0016	Tantalum, 10 uf, 20V		K10C20K KEMET	
C7	0102-0017	Tantalum, 1.8 uf, 20V		K1R8C20K KEMET	
C8	0104-0005	Mylar, .1 uf, 160V		Type MR NPC	
C9	0102-0018	Electrolytic, 100 uf, 40/50V		C437AR/G100 AMPEREX	
C10	0102-0018	Electrolytic, 100 uf, 40/50V		C437AR/G100 AMPEREX	
C11	0104-0014	Mylar, .0047 uf, 100V		1MDF-1-472 ELMENCO	
C12	0102-0016	Tantalum, 10 uf, 20V		K10C20K KEMET	
C13	0102-0016	Tantalum,10 uf, 20V		K10C20K KEMET	
C14	0104-0015	Mylar, .001 uf, 100V		1MDF-1-102 ELMENCO	
C15	0104-0005	Mylar, .1 uf, 160V		Type MR NPC	
C16	0104-0014	Mylar, .0047 uf, 100V		1MDF-1-472 ELMENCO	
C17	0102-0016	Tantalum, 10 uf, 20V		K10C20K KEMET	
		RESISTOR: Composition; fixed; 1/4W 10% unless otherwise specified	42		
R1	0203-6811	680 ohm, 1W		SR 1W AIRCO SPEER	
R2	0234-0017	POT., Cermet, 10K		3359W-1-103 BOURNS	
R3	0201-3321	3.3K		SR 1/4W AIRCO SPEER	
R4	0201-6811	680 ohm		SR 1/4W AIRCO SPEER	
R5	0206-6211	620, 1/4W, 5%		SR 1/4W AIRCO SPEER	
R6	0201-6821	6.8K		SR 1/4W AIRCO SPEER	
R7	0201-1531	15K		SR 1/4W AIRCO SPEER	
R8	0201-1021	1K		SR 1/4W AIRCO SPEER	
R9	0201-1021	1K		SR 1/4W AIRCO SPEER	
R10	0201-1011	100 ohm		SR 1/4W AIRCO SPEER	
R11	0201-1231	12K		SR 1/4W AIRCO SPEER	
R12	0211-4640	464, 1/4W, 1%		NC6/RN65 CORNING GLASS	
R13	0201-1531	15K		SR 1/4W AIRCO SPEER	
R14	0201-1231	12K		SR 1/4W AIRCO SPEER	
R15	0202-1021	1K, 1/2W, 10%		SC 1/2W AIRCO SPEER	
R16	0201-4711	470 ohm		SR 1/4W AIRCO SPEER	
R17	0201-1821	1.8K		SR 1/4W AIRCO SPEER	

REVISED 9/20/72
Supersedes P/L - 7/18/72

41030-01
SPEAKER AMPLIFIER

PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
R18	0201-1831	18K		SR 1/4W AIRCO SPEER	
R19	0201-2731	27K		SR 1/4W AIRCO SPEER	
R20	0201-1511	150 ohm		SR 1/4W AIRCO SPEER	
R21	0201-1821	1.8K		SR 1/4W AIRCO SPEER	
R22	0202-0471	4.7 ohm, 1/2W		SC 1/2W AIRCO SPEER	
R23	0202-0471	4.7 ohm, 1/2W		SC 1/2W AIRCO SPEER	
R24	0201-1021	1K		SR 1/4W AIRCO SPEER	
R25	0201-1831	18K		SR 1/4W AIRCO SPEER	
R26	0201-1811	180 ohm		SR 1/4W AIRCO SPEER	
R27	0201-1021	1K		SR 1/4W AIRCO SPEER	
R28	0201-5621	5.6K		SR 1/4W AIRCO SPEER	
R29	0201-5611	560 ohm		SR 1/4W AIRCO SPEER	
R30	0201-4721	4.7K		SR 1/4W AIRCO SPEER	
R31	0201-4731	47K		SR 1/4W AIRCO SPEER	
R32	0201-2221	2.2K		SR 1/4W AIRCO SPEER	
R33	0201-1021	1K		SR 1/4W AIRCO SPEER	
R34	0201-1831	18K		SR 1/4W AIRCO SPEER	
R35	0201-1011	100 ohm		SR 1/4W AIRCO SPEER	
R36	0201-1011	100 ohm		SR 1/4W AIRCO SPEER	
R37	0201-1541	150K		SR 1/4W AIRCO SPEER	
R38	0201-1541	150K		SR 1/4W AIRCO SPEER	
R39	0201-4731	47K		SR 1/4W AIRCO SPEER	
R40	0201-1021	1K		SR 1/4W AIRCO SPEER	
R41	0202-0471	4.7 ohm, 1/2W		SC 1/2W AIRCO SPEER	
R42	0201-2231	22K		SR 1/4W AIRCO SPEER	
		SEMICONDUCTOR DEVICE: Diode	3		
CR1	0302-0002	1N4148			
CR2	0302-0002	1N4148			
CR3	0302-0002	1N4148			
		TRANSISTOR:	11		
Q1	0340-0008	Type 2N2222			

REVISED 9/20/72
Supersedes P/L - 7/18/72

RAVEN ELECTRONICS CORPORATION

41030-01
SPEAKER AMPLIFIER — PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
Q2	0340-0008	Type 2N2222			
Q3	0340-0008	Type 2N2222			
Q4	0340-0008	Type 2N2222			
Q5	0340-0003	Type 40347			
Q6	0340-0003	Type 40347			
Q7	0340-0008	Type 2N2222			
Q8	0341-0008	Type 2N2907			
Q9	0340-0008	Type 2N2222			
Q10	0348-0002	Type 2N4851			
Q11	0348-0002	Type 2N4851			
	0607-0103	PAD: Transistor	2	MP-34095-1 FORAKER	
	0513-0004	HEAT SINK:	2	NF 207 WAKEFIELD	
		TRANSFORMER:	2		
T1	0441-0032	600 ohm, impedance		124-5 ADC	
T2	0441-0032	600 ohm, impedance		124-5 ADC	
	0612-0104	TERMINAL: Swage	16	2000C-1 USECO	
	0510-0012	CONNECTOR: 18 pin	1	133-018-43 AMPHENOL	
	1410-1300	BOARD, P.C.:	1		

REVISED 9/20/72
Supersedes P/L - 7/18/72

FIRE UP SPARES LIST

41030-01

	RAVEN STOCK NUMBER
1 each 2N2222	0340-0008
1 each 40347	0340-0003
1 each 2N2907	0341-0008
1 each 2N4851	0348-0002
1 each 1N4148	0302-0002
1 each Lamp	0502-0804

TEST PROCEDURE
41030-01 SPEAKER AMPLIFIER

1.0 GENERAL

Complete the Test Data Card as required for the procedure. If difficulties are encountered, refer to the troubleshooting procedure for this module.

2.0 TEST EQUIPMENT REQUIRED

24V DC POWER SUPPLY	
AC VOLTMETER/DISTORTION ANALYZER	H.P. 331A or equivalent
SIGNAL GENERATOR	H.P. 650A or equivalent
VTVM	Triplett 850 or equivalent
ADC PLUG (HANDSET)	
HANDSET	Raven 5505-0101

3.0 TEST EQUIPMENT

3.1 Set up the test equipment as shown on Figure 1.

3.2 Connect the Power Supply minus (-) lead to pins V and A; the plus lead (+) to pins B and U. Using the VTVM, set power supply voltage to -24V DC.

3.3 Connect the Signal Generator across pins M and P. Set the generator frequency to 1 KHz and the level to 0 dBm.

4.0 RECEIVE TESTS

4.1 An audible tone should now be coming from the speaker. Vary the Volume Control. The speaker output level must vary.

4.2 Plug in a handset. The 1 KHz tone must be present in the earpiece. Vary the Volume Control. The level of the tone must vary. Speaker level must be muted. Press the hook switch down; the speaker level should now be on and the handset receiver muted. Disconnect the handset.

4.3 Connect the AC VM/DA across the speaker. Record the voltage reading. This must exceed 2.8 but not greater than 3.2 volts RMS with R41 (volume) maximum clockwise.

4.4 Connect the AC VM/DA, common to pin R. Signal lead to pin K. Record the output level. This must exceed -2 dBm. Disconnect the Signal Generator.

4.5 Connect pin S to pin R. The alert lamp must illuminate and the call alert tones must be present.

4.6 This completes the receive section of this test procedure.

5.0 TRANSMIT TESTS

5.1 Connect a 75 ohm resistor across terminals E2 and E4. Connect the 600 ohm Signal Generator in series with a 560 ohm resistor and a 1 uf (non polarized) capacitor to E2. The common of the Signal Generator should be connected to E4. With the AC VM/DA, measure across the 75 ohm resistor (common to E4) and set the Signal Generator at 1 KHz for a -20 dBm voltage reading on the AC VM/DA.

5.2 Connect the AC VM/DA across pins C and E, and terminate pins C and E with 600 ohms. Adjust pot R2 for a reading of -20 dBm.

5.3 With the AC VM/DA measure across terminals E7 (Signal) and E4 (Common). The reading should be -35, ±3 dB. This checks the sidetone amplifier Q4. Remove the Signal Generator and the 75 ohm resistor.

5.4 Plug a handset into the telephone jack. Connect the AC VM/DA to pins C and E (already terminated with 600 ohms). Blow into the transmitter of the handset. A reading of -10 to 0 dBm should be observed.

5.5 Press the hook switch down. Measure the output noise level on pins C and E. The noise must be less than -60 dBm. Remove the handset.

5.6 Connect the Signal Generator to pin F and the common to pin B. Set Signal Generator to 1 KHz and adjust the output level for 0 dBm. The voltage output on pins C and E must be greater than -3 dBm. Adjust Signal Generator output for a reading of 0 dBm on the AC VM/DA.

5.7 Vary the Signal Generator frequency from 300 to 3000 Hz. From the 1 KHz reference, the frequency response must be less than ±1 dB variation.

5.8 With the Signal Generator at 1 KHz, terminate pins C and E, with an additional 600 ohm 1% resistor. The reading on the AC VM/DA must drop 3.5, ±0.2 dB.

5.9 This completes the transmit tests of this module .

6.0 TEST COMPLETION

Turn off Module and disconnect all Test Equipment. Stamp Module and Test Data Card with your stamp.

7.0 Q. A. ACCEPTANCE

7.1 Verify that test results are within specifications.

7.2 Verify that Test Data Card is properly filled out.

7.3 Re-inspect Module per established criteria.

7.4 Stamp Module and Test Data Card with "ACCEPTED" stamp.

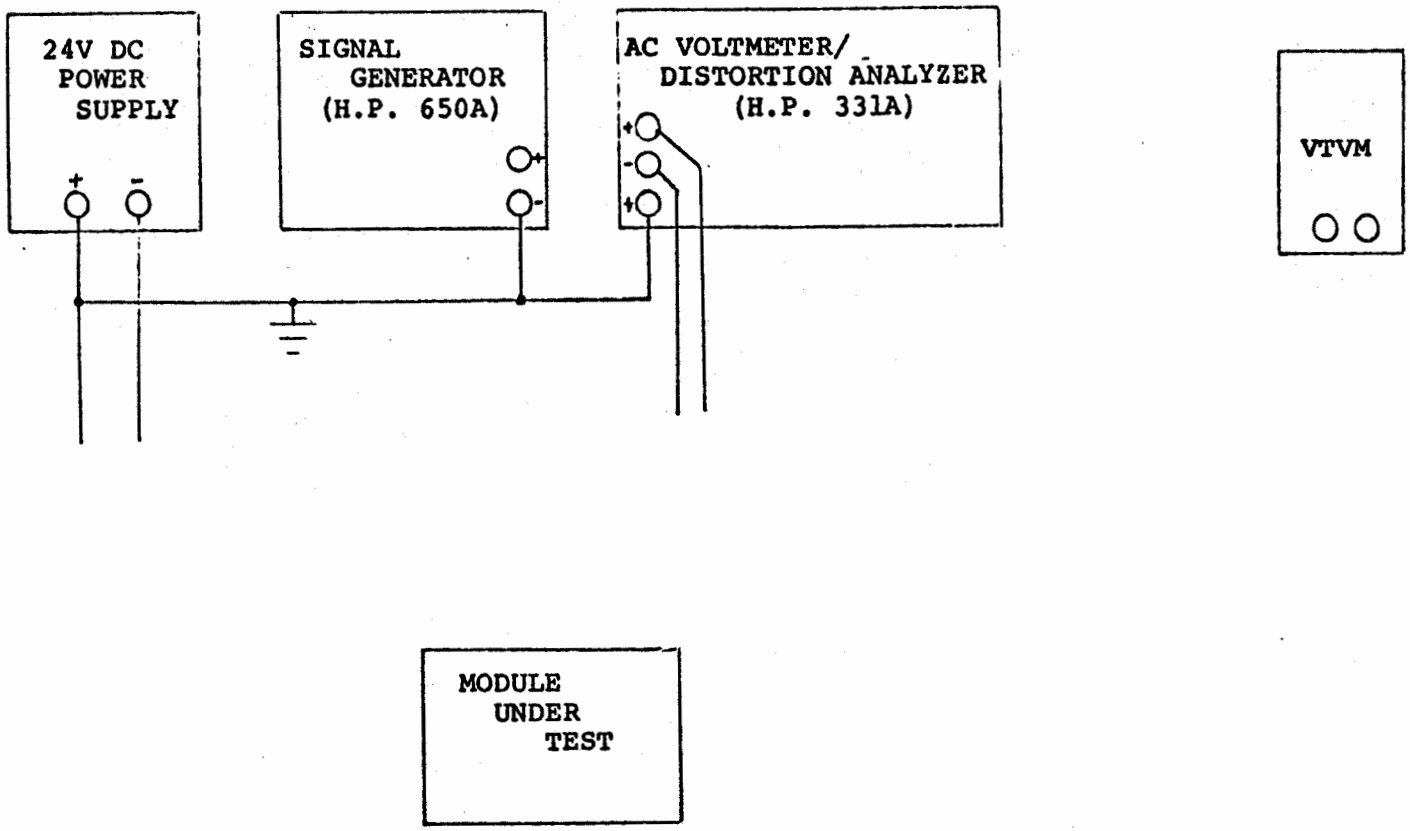
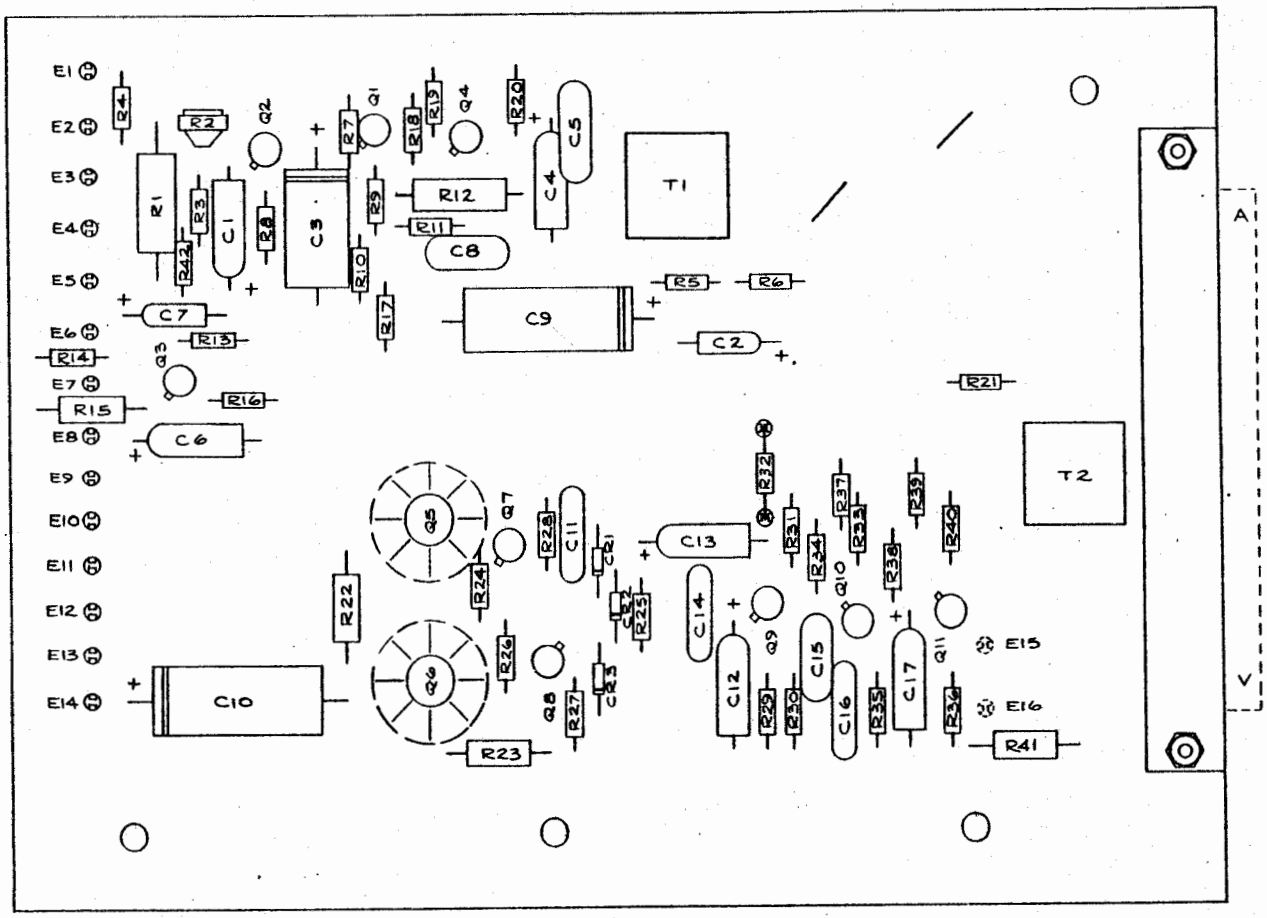


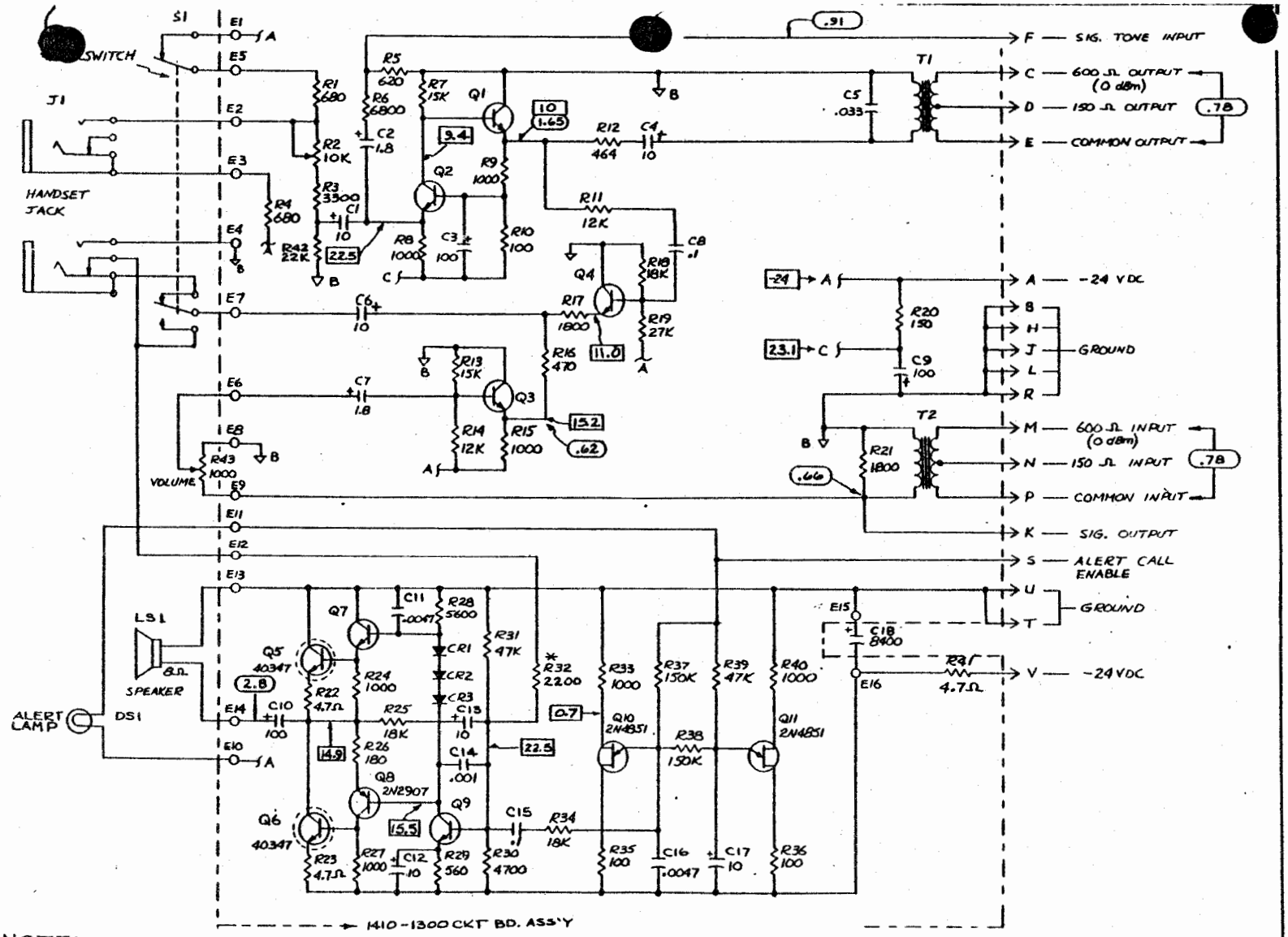
Figure 1. ⏚ Denotes preferred common earth ground.



ASS'Y NO. 4410-1300

LTR.	REVISION	BY	DATE
A	C6 REVERSED; C13 REVERSED; R23 CHGD TO R41 TO CORRESPOND TO TRACKING	BD	9-29-72

DRAWN BY: JN	RAVEN ELECTRONICS CORP. 884 FREEPORT BLVD. SPARKS, NEVADA 89431 (702) 358-3700		
CHECKED BY: GSM	NAME: SPEAKER AMP.		
APPROVED BY:			
DATE: 7-24-72	NEXT ASS'Y: 41030-01	SIZE: C	DWG. NO.: 410-6300



NOTE:

1. ALL RESISTANCE IN OHMS
2. ALL CAPACITANCE IN UFD.
3. ALL UNMARKED TRANSISTORS 2N2222
4. ( ) R.M.S. VOLTS
   [ ] NEGATIVE D.C. VOLTS
   ALL VOLTAGES REFERENCED TO GRD.
5. * FACTORY SELECTED - TYP. VALUE SHOWN

LTR	REVISION	BY	DATE
B	R32 WAS FIXED. ADDED NOTE 5	JN	9-20-72
A	R3 WAS 6800, R21 WAS 1000, R32 WAS SELECTED; NOTE 5 DELETED	N	7-28-72

DRAWN BY: DR
CHECKED BY: GSM
APPROVED BY: AL
DATE: 7-6-72

RAVEN ELECTRONICS CORP.
SPARKS, NEVADA

NAME: SPEAKER AMP.
SIZE: 41050-01 | REV: C | DWG. NO.: 410-1300

41010-95
WAYSTATION COMMON EQUIPMENT SHELF

SEE STD-TC-0007

41022 DUAL POWER SUPPLY

UNIT DESCRIPTION

1. REFERENCE

410-1220 41022 Dual Power Supply Schematic

2. GENERAL

The Raven Model 41022 Dual Power Supply provides regulated -48VDC and -24VDC outputs from an AC input of 115 or 220VAC, 50 or 60Hz. The -48VDC output is capable of supplying 2A., while the -24VDC output can source up to 4A. Power indications are provided on each output and both outputs have foldback current limiting protection circuitry. A STRAP OPTION PERMITS OPERATION FROM STATION -48 VDC FACILITIES.

3. SPECIFICATIONS

	-48 VDC (STRAP OPTION)
Input Voltage	115 or 220VAC, 50 or 60Hz
Output Voltages	-48VDC, adjustable -24VDC, adjustable
Output Current	2A @ -48VDC 4A @ -24VDC
Output Ripple	<75mV (Full Load)

4. THEORY OF OPERATION

Power input to the 41022 is derived from either a 120VAC or 220VAC 50/60Hz source.

4.1 The AC input is applied to pins V and Z with the external ground connected to pin X. The input voltage completes the circuit through fuse F1 and power switch S1 to the primary of transformer T1. T1 steps down the incoming 120VAC or 220VAC to a nominal 24VAC in each secondary.

The 24VAC of each secondary is full wave rectified by a separate silicon bridge rectifier (RT-1 and RT-2), producing unregulated DC voltages of about -34 volts each. C1 and C2 provide ripple filtering for the two unregulated DC voltages. The unregulated DC voltage produced by RT-1 is applied to the emitter of the series pass transistor Q1, the input to the -24VDC regulator. The unregulated

DC voltage produced by RT-2 is placed in series with that produced by RT-1 (For a total unregulated voltage of -68VDC) and applied to the emitter of series pass transistor Q2, the input to the -48VDC regulator.

4.2 -24VDC REGULATOR

Q9 provides the necessary current drive to the series pass transistor Q1 from the rest of the regulator circuitry.

Q7, R23, R19 comprise the current limiting circuitry of the regulator. The current through R23 is sensed by Q7 and causes the output voltage to "foldback" when the output current attempts to exceed approximately 4.0 amperes.

Q5, Q3 and associated components comprise a voltage sensing error amplifier which compares the output voltage to that of the stable voltage reference from CR1 (a 10V Zener diode). The error amplifier output causes the Q9, Q1 transistor pair to increase or decrease the output voltage as necessary to maintain the output at a constant voltage level. The -20VDC may be monitored at the front panel test point and adjusted by potentiometer R1, accessible through the front panel.

An LED (CR3) at the front panel indicates the presence of -24VDC.

4.3 -48VDC REGULATOR

The circuitry of the -48VDC regulator operates in an identical manner to that of the -24VDC regulator. The -48VDC may be monitored at it's front panel test point and adjusted through the front panel by R2. An LED (CR4) at the front panel indicates the presence of -48VDC.

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD., SUITE 12
SPARKS, NEVADA 89431
(702) 359-3700

ASSEMBLY NUMBER 4410-0220 TITLE 41022 DUAL POWER SUPPLY DWG. REF: 410-1220

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		CAPACITOR, Fixed;	8		
C1,2	0102-0045	Electrolytic, 2700uf 40V	2		
C3	0102-0034	" , 1100uf 50V	1		
C4	0102-0042	" , 1000uf 75V	1		
C5,6	0102-0016	" , 10uf	2		
C7,8	0104-0015	Mylar, .001uf	2		
		RESISTOR, Fixed; Composition ½W, 5% unless otherwise specified	24		
R1,2	0234-0035	Pot, Cermet 1K ohm	2		
R3	0206-2421	2.4K	1		
R4,9,19	0206-4721	4.7K	3		
R5,15,16	0206-1221	1.2K	3		
R6	0206-1821	1.8K	1		
R7,8,17	0206-2721	2.7K	3		
R10	0206-3321	3.3K	1		
R20	0206-2731	27K	1		
R11,12	0206-1031	10K	2		
R13	0206-2221	2.2K	1		
R14	0206-4321	4.3K	1		
R21	0206-1511	150 ohm	1		
R23	0204-0024	.249 ohm, 10W	1		
R24	0204-0025	.499 ohm, 10W	1		
R22	0206-2211	220 ohm	1		
R18	0206-6821	6.8K	1		
		SEMICONDUCTOR DEVICE:			
CR1	0303-0009	Diode, Zener 10V	1	1N5240	
CR2	0303-0015	" " 24V	1	1N4749	
CR3,4	0304-0002	" , Light Emitting	2	Dialight	

RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD., SUITE 12
SPARKS, NEVADA 89431
(702) 359-3700

ASSEMBLY NUMBER 4410-0220 TITLE 41022 Power Supply DWG. REF: 410-1220

REFERENCE NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
RT-1,2	0301-0004	Diode, Bridge	2	MDA-960-3	
Q1	0346-0001	Transistor, NPN	1	2N3055	
Q2	0346-0004	" "	1	2N6254	
Q3,4,5,6,7,9	0341-0011	" , PNP	6	2N4033	
Q8,10	0341-0009	" "	2	MM4002	
S1	0501-0110	Switch, SPDT	1	JBT T02-123	
T1	0440-0026	Transformer	1	23V392	
F1	0504-0113	Fuse, 2½ Amp slow blow	1		
	0504-0202	Fuse holder	1		
	0608-0208	Test Points, P.C. Mount	3	H.H Smith 63-3009	
	0608-0301	Bushing, white	2		
	0612-0104	Terminals	22		
	0510-0017	Connector, 22 Pin	1	Amphenol 133-022-12	
	1410-3220	Front Panel	1	Raven	
	0513-0004	Heat Sink	2	Wakefield 207AB	
	0513-0009	" "	1	Aham 5053-3	
	0607-0103	Transistor Pad	8		
	1405-2160	Handle	2	Raven	
	1410-2670	XFMR Mount	1	Raven	
	1410-2680	Angle Guide	1	Raven	
	1410-2690	Mounting Clip	1	Raven	

41022 REGULATED POWER SUPPLY

EST PROCEDURE

1.0 REFERENCES

41022 Regulated Power Supply Unit Description
410-1220 Regulated Power Supply Schematic

2.0 GENERAL

Complete the Test Data Card for this procedure as required for each step. Do not change settings until instructed to do so. WARNING: Practice extreme caution when taking measurements or probing in or around the unit as hazardous voltages may exist in certain areas of the board.

3.0 TEST EQUIPMENT REQUIRED

Multimeter
Ammeter
Oscilloscope
120/220 Transformer (For 220 Model only)
120V Variac
35 ohm, 25W Potentiometer Load Resistor
-44V to -56V DC Power Supply (optional).

.0 INITIAL TEST SET UP

4.0.1 The strap between terminals 9 and 10 is installed for normal AC operation; the strap is removed for DC primary input on pins N and P.

For 120V AC operation, use clip leads to connect the transformer as follows:

A. Input leads to terminals 1 and 4.
B. Terminals 1 and 2 strapped together.
C. Terminals 3 and 4 strapped together.

4.1.0 120V AC OPERATION

4.1.1 Connect pins V and Z to the output of the Variac. Connect the Variac input to a 120V AC. Turn switch S1 on the 41022 to "ON". Connect a DC Voltmeter to pins J & D.

Read.....-24VDC
Adjust R1 on the 41022 to comply with this reading if required.

4.1.2 Connect the oscilloscope and the 35 ohm load potentiometer to pins J and D. Adjust the Variac so that the AC input to the 41022 module varies from 108VAC to 132VAC. The reading on the DC voltmeter should not vary more than.....±.7VDC
The ripple observed on the oscilloscope should not exceed.....50mv P-P

4.1.3 Connect the 35 ohm 25 watt potentiometer in series with the Ammeter. Adjust the potentiometer for maximum resistance. Connect the potentiometer/Ammeter series combination to pins J and D.
Read on the DC Voltmeter.....-24VDC ±.7VDC

The DC Ammeter should read.....650ma ± 60ma

7V DC

7V DC

4.1.4 Adjust the potentiometer to the position where the output voltage begins to drop. The Ammeter should read approximately.....4.0A

4.1.5 Connect a DC Voltmeter to pins A and D.
Read.....-48VDC
Adjust R2 on the 41022 to comply with this reading if required.

4.1.6 Connect the oscilloscope and the 35 ohm load potentiometer to pins A and D. Adjust the variac so that the AC input to the 41022 module varies from 108VAC to 132VAC. The reading on the DC Voltmeter should not vary more than .....±.7VDC
The ripple observed on the oscilloscope should not exceed.....50mv P-P

4.1.7 Connect the 35 ohm 25 watt potentiometer in series with the Ammeter. Adjust the potentiometer for maximum resistance. Connect the Potentiometer/Ammeter series combination to pins A and D.
Read on the DC Voltmeter.....-48VDC ±.7VDC

The DC Ammeter should read.....1.4A ±.1A

INFORMATION NOT

AVAILABLE AT

PRINTING TIME

4.3.5 Connect the 35 ohm 25 watt potentiometer in series with the Ammeter. Adjust the potentiometer for maximum resistance. Connect the potentiometer/Ammeter series combination to pins J and D.
Read on the DC Voltmeter.....-24VDC ±.7VDC

The DC Ammeter should read..... 650ma ± 60ma

4.3.6 Adjust the potentiometer to the position where the output voltage begins to drop. The Ammeter should read approximately..... 4.0A

4.4 Disconnect all test equipment. Stamp the module and module Test Data Card with the Test Stamp.

TEST DATA CARD

41022 REGULATED POWER SUPPLY

WORK ORDER NO._____

SERIAL NO._____

DATE_____

TEST PROCEDURE RESULTS

4.0.1._____

4.1.1._____
4.1.2._____
4.1.3._____
4.1.4._____
4.1.5._____
4.1.6._____
4.1.7._____
4.1.8._____

4.2.1._____
4.2.2._____

4.3.3._____
4.3.4._____
4.3.5._____
4.3.6._____
} DC input only

4.3.0._____(TEST STAMP)

RAVEN ELECTRONICS CORP.

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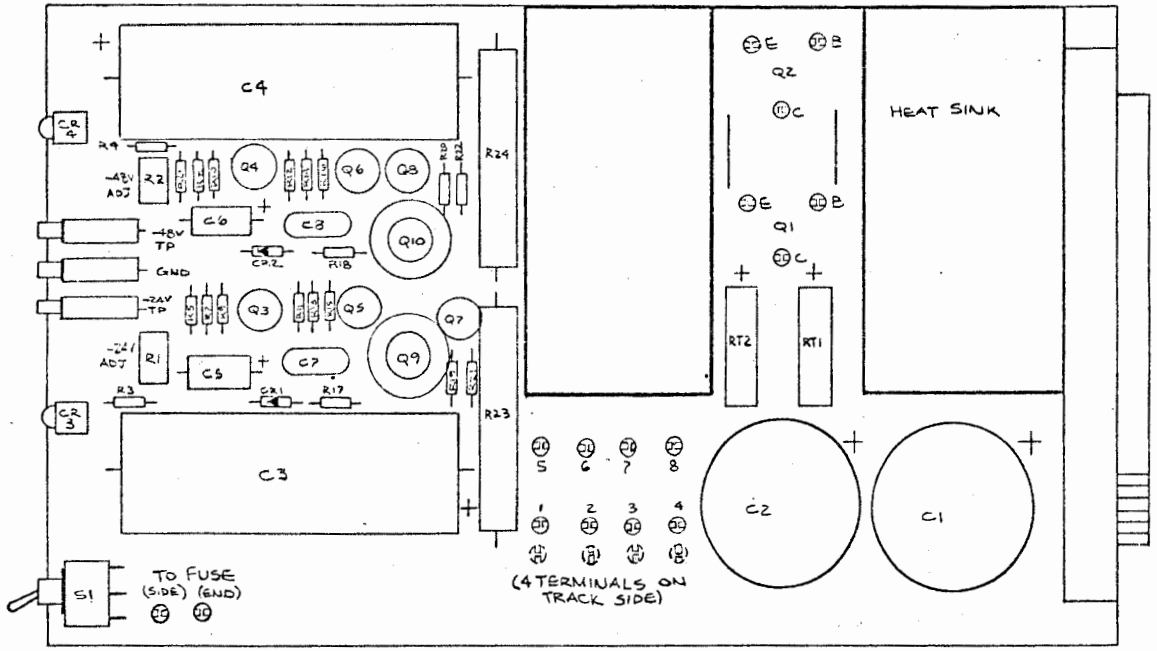
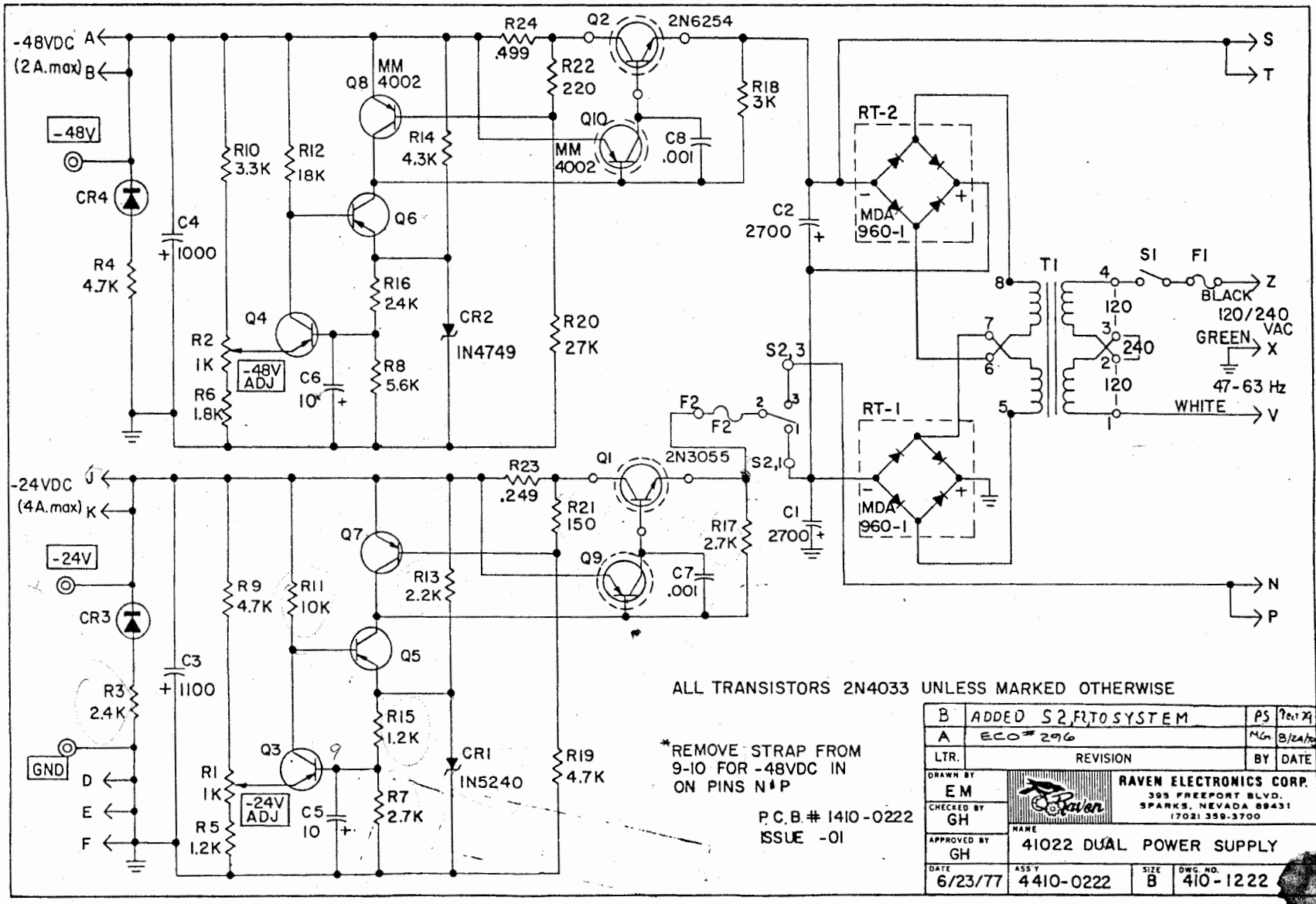
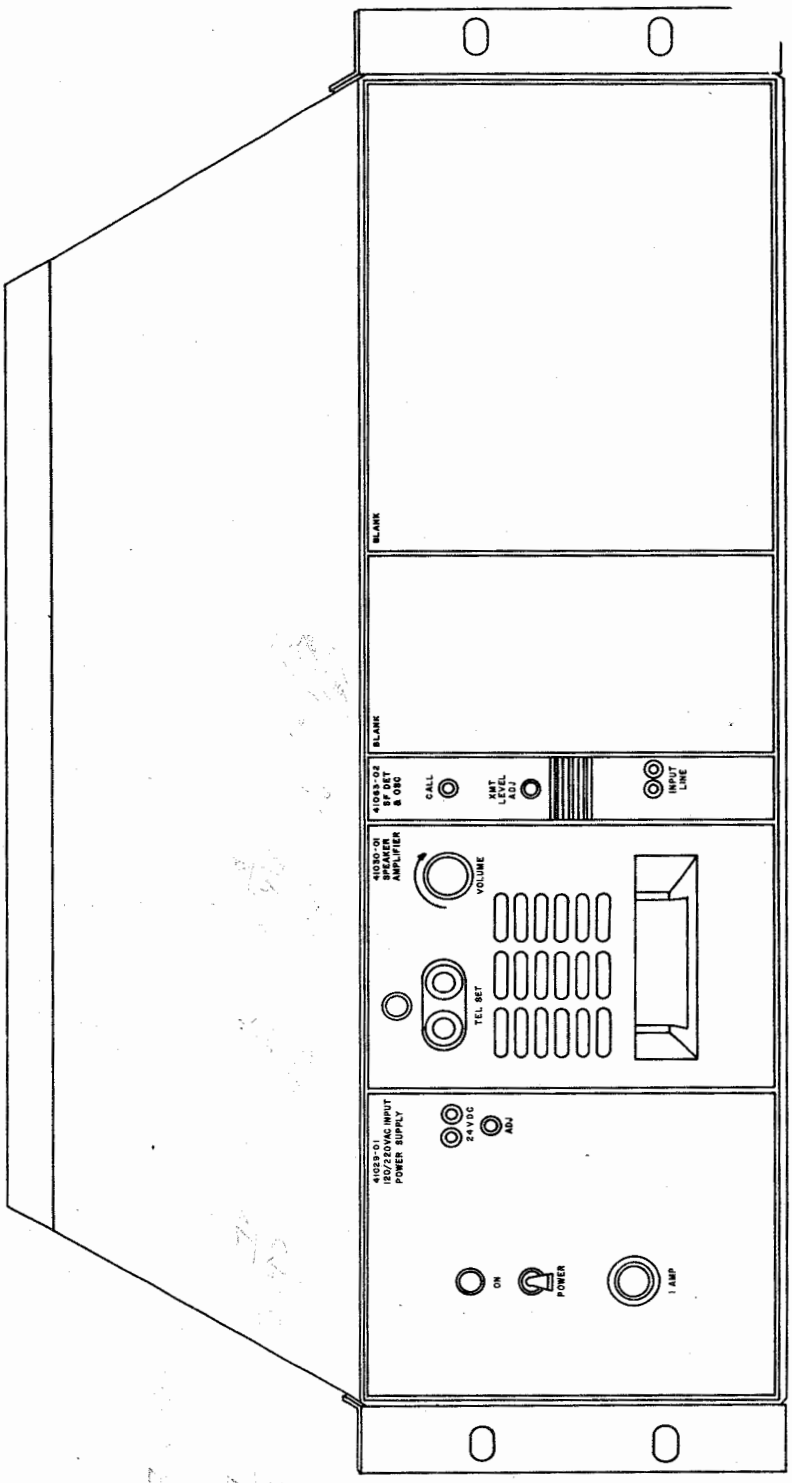


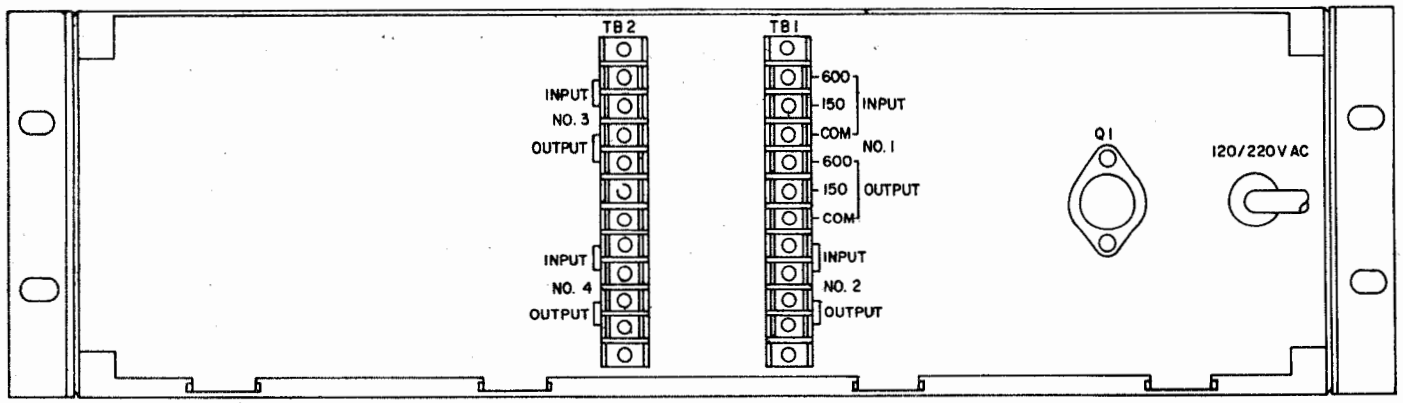
LTR.	REVISION	BY	DATE

DRAWN BY MG	RAVEN ELECTRONICS CORP. 395 FREEPORT BLVD. SPARKS, NEVADA 89431 (702) 359-3700			
CHECKED BY				
APPROVED BY	NAME PC ASSEMBLY 41022 DUAL POWER SUPPLY			
DATE 6/29/78	ASS'Y 1410-0220	SIZE B	DWG. NO. 410-6220	

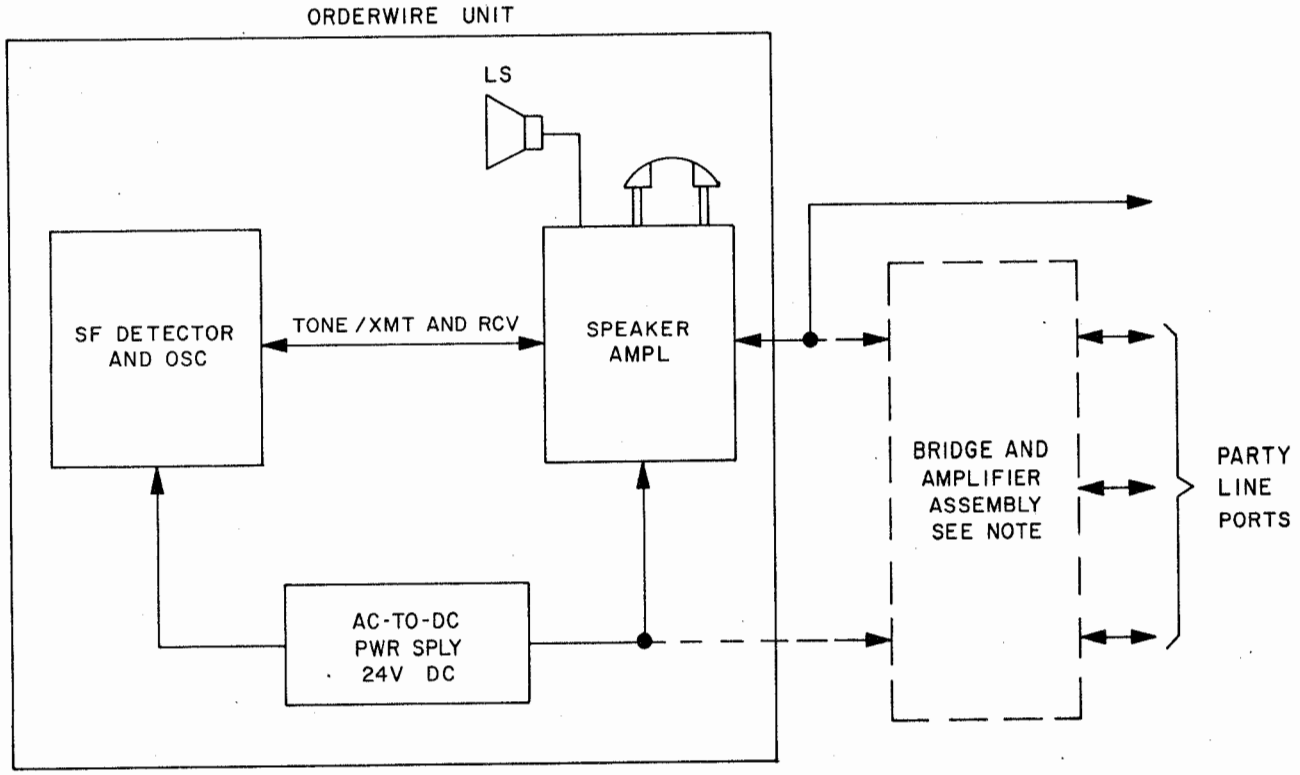

-48VDC A
(2A.max) B
-48V
CR4
R4 4.7K
C4 1000
R10 3.3K
R12 18K
Q8 MM 4002
R14 4.3K
Q6
R16 24K
Q4
R2 1K
-48V ADJ
R6 1.8K
C6 10
CR2 IN4749
R8 5.6K
R20 27K
R24 .499
Q2 2N6254
R22 220
Q10 MM 4002
C8 .001
R18 3K
C2 2700
RT-2 MDA 960-1
S T
T1
S1 F1
BLACK 120/240 VAC
GREEN X
47-63 Hz
WHITE V
S2,3
F2
RT-1 MDA 960-1
S2,1
C1 2700
-24VDC J
(4A.max) K
-24V
CR3
R3 2.4K
C3 1100
R9 4.7K
R11 10K
Q7
R13 2.2K
Q5
R15 1.2K
Q3
R1 1K
-24V ADJ
R5 1.2K
C5 10
CR1 IN5240
R7 2.7K
R19 4.7K
R23 .249
Q1 2N3055
R21 150
Q9
C7 .001
R17 2.7K
N P
GND
D
E
F
ALL TRANSISTORS 2N4033 UNLESS MARKED OTHERWISE
*REMOVE STRAP FROM 9-10 FOR -48VDC IN ON PINS N & P
P.C.B.# 1410-0222
ISSUE -01
B ADDED S2,F2,TO SYSTEM PS 9oct74
A ECO# 296 MCM 8/24/76
LTR. REVISION BY DATE
DRAWN BY EM
CHECKED BY GH
APPROVED BY GH
DATE 6/23/77
RAVEN ELECTRONICS CORP.
395 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700
NAME 41022 DUAL POWER SUPPLY
ASS'Y 4410-0222
SIZE B
DWG. NO. 410-1222



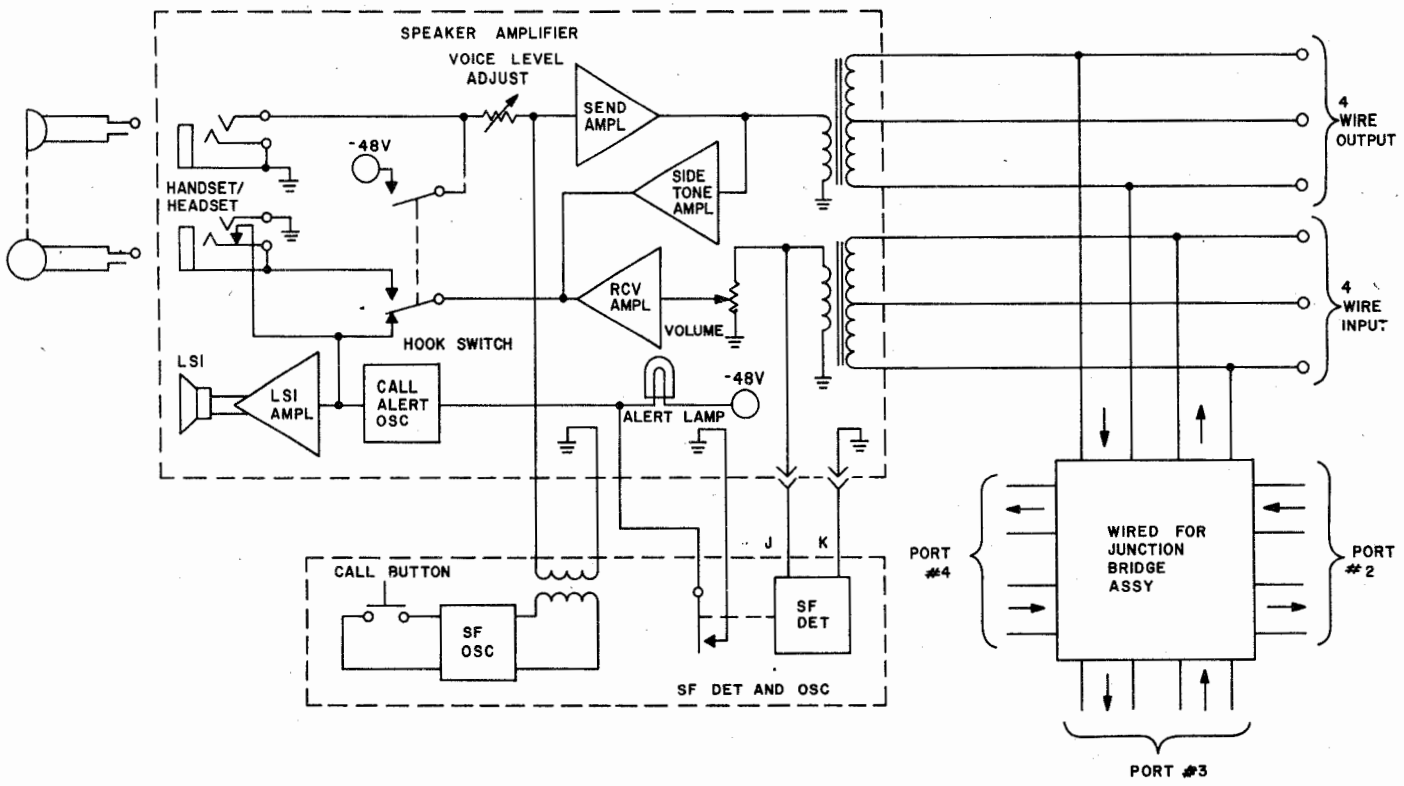
Local *Orderwire Unit 41010-97*



Local *Orderwire Unit 41010-97, Connection Terminals (Rear)*



Orderwire Unit 41010-97 Simplified Block Diagram



Orderwire Unit 41010-97 Functional Block Diagram

TEST PROCEDURE
41010-97 LOCAL ORDER WIRE

1.0 GENERAL

Complete the Test Data Card as required for each step of this procedure. Follow the procedure carefully. DO NOT CHANGE ANY SETTING UNTIL INSTRUCTED TO DO SO. If difficulties are encountered, refer to the Troubleshooting Procedure for the Local Order Wire and the Modules.

2.0 TEST EQUIPMENT REQUIRED

SIGNAL GENERATOR	H.P. 650A or equivalent
AC VOLTMETER/DISTORTION ANALYZER	H.P. 331A or equivalent
VTVM	Triplett 850 or equivalent
3 each, 600 ohm RESISTORS	

3.0 MODULES REQUIRED

3.1 Pretested modules are required to perform this test. The modules required are:

41030-01	Speaker Amplifier
41029-01	Power Supply
41063-02	E & M Tone Transmitter and Receiver
40472-03/41072-03	Dual Amplifier (2 each)
40455-03/41055-03	4W/4W Bridge (9 dB pads in)
5505-0101	Handset

4.0 TEST EQUIPMENT SETUP

Set up the test equipment as shown in Figure 1.

5.0 BASIC LOCAL ORDER WIRE TESTS - RECEIVE DIRECTION

5.1 On the 41029-01 Module, strap terminals E13 to E15 and E17 to E19. Plug the Power Supply 41029-01 into the appropriate slot. (Refer to the assembly drawing). Plug the shelf power cord into a 110 V AC outlet.

5.2 Turn the Power Supply "on". Using the VTVM, monitor the test points on the front panel of the Power Supply. Voltage must be -24 V DC. Adjust the power supply regulator if it is not.

5.3 Plug in the 41030-01 Speaker Amplifier. Plug in a handset to the front panel jacks and place the handset "on hook". Plug in the 41063-02 Module in its proper location.

5.4 Connect the Signal Generator across the #1 600 ohm INPUT terminals. Set the generator frequency to 1 KHz and the level to 0 dBm. This must be audible from the speaker. Vary the volume control; speaker level must vary.

5.5 Lift the handset, speaker must now be muted and the tone present in the earpiece. Replace the handset on the hook switch.

5.6 Increase the Signal Generator frequency to 2600 Hz. The CALL ALERT must now be operating and the lamp illuminated on the front of the speaker amplifier. Disconnect the Signal Generator.

6.0 BASIC LOCAL ORDER WIRE TESTS - TRANSMIT DIRECTION

6.1 Connect the AC VM/DA to the TB1-4 and 6 (#1 OUTPUT). Terminate with 600 ohms. Press the CALL BUTTON on the front of the 41063 Module. Adjust the 41063 level for a reading of 0 dBm on the AC VM/DA. Release the button.

6.2 Lift the handset from the hookswitch and talk into it in a normal tone of voice. Sidetone must be present in the earpiece. The AC VM/DA shall be indicating the output level which must be between 0 and -16 dB. Replace the handset. Remove termination across TB1- 4 and 6 (#1 OUTPUT).

7.0 HYBRID ASSEMBLY TESTS

7.1 Plug in both 41072-03 Modules and the 41055-03 Module. Connect the Signal Generator across TB1-7 and 8 (#2 INPUT). Terminate across TB2-1 and 2 (#3 INPUT), and 7 and 8 (#4INPUT) with 600 ohm terminations. Set the Signal Generator frequency to 1 KHz. Connect the AC VM/DA across TB1-1 and 3 (#1 INPUT).

7.2 Adjust the "A GAIN ADJ" of the 41072 in J4 to provide a 0 dBm reading on the AC VM/DA. The tone must now be present from the speaker.

7.3 Connect the AC VM/DA and terminate in 600 ohms across TB1-9 and 10 (#2 OUTPUT). The output level must be less than -50 dBm.

7.4 Connect the AC VM/DA and terminate in 600 ohms across TB2-3 and 4 (#3 OUTPUT). Adjust the "A GAIN ADJUST" of the 41072 in J6 for a 0 dBm reading.

7.5 Connect the AC VM/DA and termination across TB2-9 and 10 (#4 OUTPUT). Adjust the "B GAIN ADJUST" for a 0 dBm reading.

7.6 Connect the Signal Generator to TB2-1 and 2 (#3 INPUT). Remove the termination from these pins and place across TB1-7 and 8 (#2INPUT).

7.7 Connect the AC VM/SA and terminations across TB1-9 and 10 (#2 OUTPUT). Adjust the "B GAIN ADJUST" of the 41072 in J4 for an 0 dBm reading.

7.8 Connect the AC VM/DA and termination across TB2-3 and 4 (#3 OUTPUT). The output level must be less than -50 dBm.

7.9 Connect the Signal Generator across TB2-7 and 8 (#4 INPUT). Remove the termination from these pins and connect it across TB2-1 and2 (#3 INPUT). A 0 dBm, ±.5 dBm reading must be present on the AC VM/DA.

7.10 Connect the AC VM/DA and termination across TB2-9 and 10 (#4 OUTPUT). The reading must be less than -50 dBm.

7.11 Press the CALL BUTTON on the 41063. The AC VM/DA must read 0 dBm,±.5 dBm.

8.0 TEST COMPLETION

8.1 This completes the tests of the Local Order Wire. Disconnect all test equipment and remove the 41072-03 Modules and the 41055 -03 Module from the shelf. The other modules remain as part of the Local Order Wire Shelf.

8.2 Install the blank which covers J4, J5 AND J6.

8.3 Place your test stamp below the left side of the serial number tag.

9.0 Q. A. ACCEPTANCE

9.1 Verify that test results are within specifications.

9.2 Verify that Test Data Card is properly filled out.

9.3 Re-inspect Shelf per established criteria.

9.4 Stamp Shelf (below the right side of the serial number tag), and the Test Data Card with "ACCEPTED" Stamp.

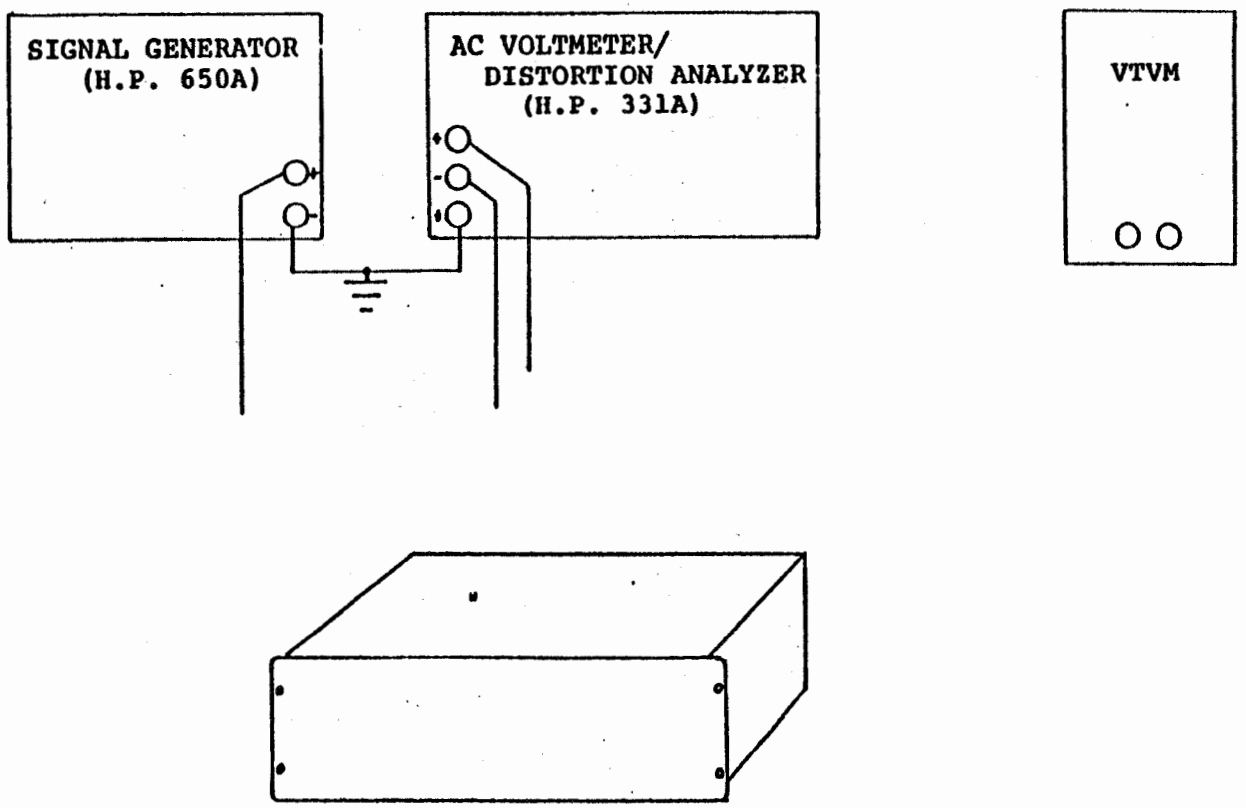


Figure 1. ⏚ Denotes preferred common earth ground.

INSTALLATION

The Local Orderwire Shelf is prewired for all internal connections, including the optional Modules (41072-03 Dual Amplifier and 41055-03 4W/4W Bridge). Accessible connections for external equipment are available on the Terminal Boards on the back panel of the shelf.

1. Without the optional Modules inserted, the Input and Outputs are connected to the shelf as follows:

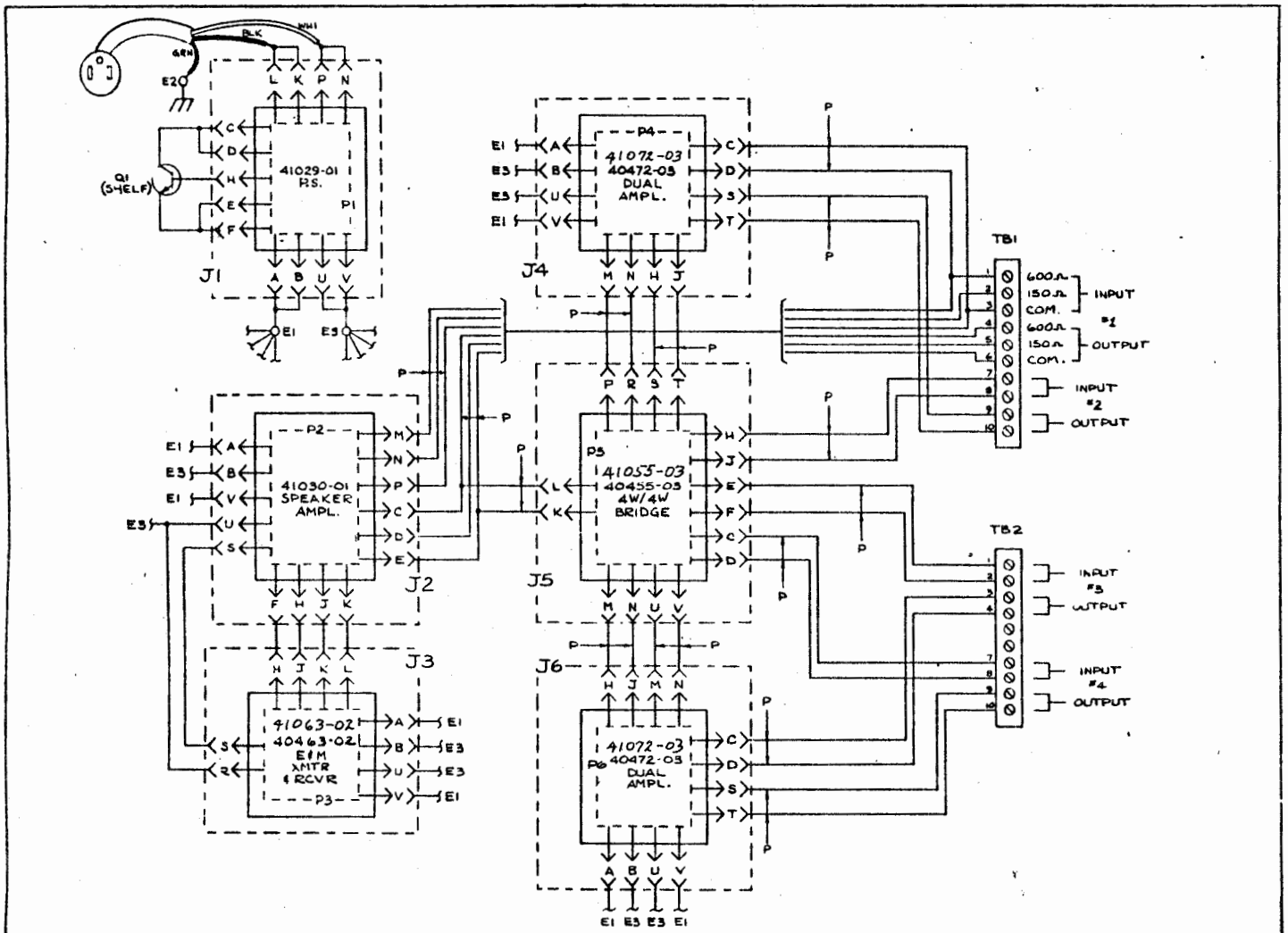
   a. 600 ohm Input - TB1 pins 1 and 3
   b. 150 ohm Input - TB1 pins 2 and 3
   c. 600 ohm Output - TB1 pins 4 and 6
   d. 150 ohm Output - TB1 pins 5 and 6

2. When the 41072-03 Dual Amplifier Modules and the 41055-03 4W/4W Bridge Module are installed, the #1 Input connection is not used; the input to the Speaker Amplifier is derived from the 41072-03 Module inserted in J4. A combination of other inputs and outputs can be utilized.

3. When the 41055-03 Bridge Module is installed, IT IS NECESSARY TO TERMINATE ALL UNUSED INPUTS AND OUTPUTS WITH 600 OHMS.

4. Insure all Modules are secure prior to plugging the shelf into an AC outlet. Once all Modules are secure, plug power cord into a 110V AC convenience outlet and turn the Power Switch "on".

5. Check the Power Supply output voltage; and adjust levels as required for system operation.



NOTE

1. THE TWISTED PAIRS MAY HAVE CONNECTIONS REVERSED FROM THOSE SHOWN.
2. T P TWISTED PAIR

LTR	REVISION	BY	DATE
A	REDRAWN. CHANGED J1 & J2 WIRING	JN	7-5-72

DRAWN BY JN	RAVEN ELECTRONICS CORP	
CHECKED BY GSAI		
APPROVED BY RK	WIRING - LOCAL C.W.	
DATE 7-5-72	41010-97	SIZE C / DWG NO 410-4006

POWER SUPPLY
41029-01 MODULE

1. APPLICATION

The 41029 Power Supply Module is designed to convert incoming AC voltage (120/220 VAC) into regulated DC voltage for distribution of input voltages to power Raven 410 shelf assemblies.

2. SPECIFICATIONS

Input Voltage:	120 or 220 V AC, ±10%, single phase, 47 to 63 H_z, 96 volt Amps maximum
Output Voltage:	-24V DC ±1V, adjustable; 1.5A, maximum
Output Voltage Regulation:	±3% for ±10% line regulation; no load to full load
Output Current Limiting:	1.5A, minimum

3. THEORY OF OPERATION

3.1 The Module front panel contains a fuse, power switch, indicator lamp and test points (for monitoring the output voltage).

3.2 A split-winding primary transformer is used in the Module to achieve the 120/220 VAC input capability. The use of a bridge rectifier with a capacitive input filter converts the AC to a useable DC voltage. The Module uses a feedback type regulator for voltage regulation and incorporates a foldback current limiting feature to limit the maximum output current.

3.3 Refer to Schematic 410-1290.

3.4 When 120V AC is used as the input voltage, it is applied to pins L and N; passes through the Module to Terminal E20 of the Voltage Regulator board. From terminal E20, the voltage goes through the Power Switch (S1) and the fuse (F1) to the power transformer, T1. The two sections on the primary are connected in parallel for 120V AC operation. See Note 1 on Schematic.

3.5 For 220V AC operation, terminals E15 and E17 are jumpered. The 220V AC input voltage is applied to pins L and N and pins K and P; passes through the Module to Terminal E20 of the Voltage Regulator board and on through the switch and fuse to the transformer. The two sections on the primary of the power transformer (T1) are connected in series for 220V AC operation.

3.6 The secondary of the Power Transformer (T1) is connected to terminals E1 and E8 on the Rectifier Board (1410-1990). The Rectifier Board contains the bridge rectifier CR1 through CR4 and makes connections to the filter capacitor, C5.

3.7 CR1 through CR4 rectify the incoming sinewave from the secondary of T1 and present a 4-way rectified AC signal to the filter capacitor. C5 filters the signal and its' outputs are taken from terminals E3 and E6 of the Rectifier Board and presented to terminals E10 (-) and E9 (+) on the Voltage Regulator (1410-1202).

3.8 The Minus lead from the filter capacitor is tied to terminal E10 which is connected to the emitter of Q5 (the external series pass transistor). Base current of Q5 re-enters the Regulator Board via pin H to the collector of transistor Q1. The collector of the external transistor (Q5) is connected to pins C and D. It can be seen that the unregulated input power arriving at terminal E10 will become a regulated output at pins A and B.

3.9 Resistors R9, R10 and R11 provide a voltage divider sampling network. This sampling voltage is presented to the emitter of transistor Q4. Transistor Q4 operates as a grounded base stage and amplifies the signal. The signal output is taken from the collector of Q4 and applied to the base of transistor Q2.

3.10 Transistor Q2 amplifies the signal and presents it to the base of Q1. Transistor Q1 then drives Q5.

3.11 The zener diode VR1 is the voltage reference for the regulator. Resistors R6 and R7 constitute a voltage divider and provide the proper bias voltage for transistor Q4. Resistor R10 (adjustable) is used to set the output voltage of the Regulator Board.

3.12 Capacitor C3 bypasses resistor R9 so that AC signals on the output are presented directly to the emitter of Q4. C4 filters the output and provides a low output impedance.

3.13 Resistor R2 is a current sampling resistor. When the voltage across R2 reaches a pre-determined value (approximately 1.5A output current) transistor Q3 will turn "on" causing Q1 to turn "off". Q1 in turn, turns Q5 "off". The voltage required to turn Q3 on is less when the output is short circuited than it is when the output is normally functioning, therefore, we have foldback current limiting i.e. short circuited output current is less than normal operating current.

3.14 Capacitor C1 bypasses the collector to base of transistor Q2 at high frequencies preventing high frequency oscillation.

3.15 Resistor R12 limits the current to the Test Points preventing accidental shorting out of the regulator.

4. MAINTENANCE AND ADJUSTMENTS

4.1 Check notes 1 and 2 on Schematic 410-1290. Insure that the Regulator is strapped for the correct input power. ALL UNITS ARE STRAPPED AT THE FACTORY FOR 120V AC OPERATION.

4.2 Adjustments of the Module is limited to the adjusting of R10 for correct output voltage. This resistor is preset at the factory.

4.3 Troubleshooting.

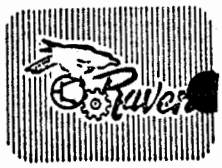
4.3.1 Troubleshooting will be the process of checking AC and DC voltage levels as shown on Schematic 410-1290 and isolating the trouble to a faulty stage.

4.3.2 Ohmic and voltage checks should be used to isolate the trouble to the faulty component.

4.3.3 The foldback current limiting feature may be checked by terminating the output with successively smaller resistors until the load current exceeds 1.5 Amps. (The current limiting should initially start at a load current of approximately 1.8 Amps).

5. PARTS LIST

The following parts list contains all parts associated with the 41029-01 Power Supply. Unless otherwise specified, part numbers are Raven Electronics Corporation part numbers.



6. REFERENCE DIAGRAMS

41029-01 POWER SUPPLY, Schematic Diagram 410-1290 dated 7/12/72.

RAVEN ELECTRONICS CORPORATION

41029-01
POWER SUPPLY — PARTS LIST

REF. NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
	4410-0290	A. C. POWER SUPPLY ASSEMBLY		DWG REF 410-029, 3/22/72	
	1410-2320	CHASSIS			
	1410-3291	PANEL	1		
	0604-0501	Captive Screw Set, 6-32	2		
S1	0501-0104	Switch, SPST	1	CK7101P	
DS1	0502-0804	Lamp, 28V	1		
	0502-6007	Clip, Lamp	1	116A DRAKE	
	0502-6006	Socket, Lamp	1	300-058 DRAKE	
F1	0504-0107	Fuse, 1A MDL	1		
	0504-0202	Fuseholder	1	342012 LITTLEFUSE	
	0608-0201	Test Point White	1	SKT10W SEALECTRO	
	0608-0202	Test Point Black	1	SKT10B SEALECTRO	
	0608-0301	Bushing	1	B1473W SEALECTRO	
	0440-0023	TRANSFORMER	1	TC1129 AMERICAN TRANSFORMER	
	0102-0007	CAPACITOR, 8400 uf, 40V	1	36D842G040BB2A SPRAGUE	
	0603-0302	Clamp, Capacitor	1	CMC-32 SPRAGUE	
	4410-1990	RECTIFIER P.C. BOARD Consisting of:	1	DWG REF 410-1290, 7/12/72 REV D	
	0301-0003	Bridge Rectifier	1	MDA-960-1 MOTOROLA	
	0612-0104	Terminal Swage	8	2000C-1 USECO	
	1410-1990	Board, P.C.	1		
	1410-2350	P. C. BOARD SUPPORT	1		
	4410-1202	A. C. POWER SUPPLY REGULATOR Consisting of:	1	DWG REF 410-1290, 7/12/72 REV D	

REVISED 9/__/72
Superseses P/L - 7/10/72

RAVEN ELECTRONICS CORPORATION

41029-01
POWER SUPPLY — PARTS LIST

REF. NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
		CAPACITOR: Fixed;	3		
C1	0101-0011	Mica, 100 pf		CD10ED101K03 CDE	
C2	0102-0016	Tantalum, 10 uf, 20V		K10C20K KEMET	
C3		NOT USED			
C4	0102-0034	Electrolytic, 1100 uf, 50V		39D118G050HP4	
		RESISTOR: Composition; fixed; 1/4W 10%, unless otherwise specified	12		
R1	0201-2721	2.7K		SR 1/4W AIRCO SPEER	
R2	0204-0004	1 ohm, 3W, 5%		242E1R05 SPRAGUE	
R3	0201-2221	2.2K		SR 1/4W AIRCO SPEER	
R4*		Factory Selected Value			
R5	0206-4721	4.7K, 5%		SR 1/4W AIRCO SPEER	
R6	0201-1221	1.2K		SR 1/4W AIRCO SPEER	
R7	0201-2721	2.7K		SR 1/4W AIRCO SPEER	
R8	0201-1031	10K		SR 1/4W AIRCO SPEER	
R9	0201-4721	4.7K		SR 1/4W AIRCO SPEER	
R10	0234-0011	POT., Cermet, 1K		3359-W-1-102 BOURNS	
R11	0201-1221	1.2K		SR 1/4W AIRCO SPEER	
R12	0202-1021	1K, 1/2W, 10%		SC 1/2W AIRCO SPEER	
		SEMICONDUCTOR: Diode;	1		
VR1	0303-0009	1N5240 Zener			
		TRANSISTOR:	4		
Q1	0341-0007	Type 2N4037			
Q2	0341-0008	Type 2N2907			
Q3	0341-0008	Type 2N2907			
Q4	0341-0008	Type 2N2907			
	0510-0012	CONNECTOR: 18 pin	1	133-018-43 AMPHENOL	
	0612-0104	TERMINAL: Swage	18	2000C-1 USECO	

REVISED 9/[illegible]/72
Supersedes [illegible]/L - 7/10/72

RAVEN ELECTRONICS CORPORATION

41029-01
POWER SUPPLY

PARTS LIST

REF. NO.	RAVEN STOCK NO.	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
	0513-0004	HEAT SINK:	1	NF-207 WAKEFIELD	
	1410-1202	BOARD, P.C.:	1		

REVISED 9/22/72

FIRE UP SPARES LIST
41029-01

	Raven Stock Number
1 each 2N3055	0346-0001
1 each 2N4037	0341-0007
1 each 2N2907	0341-0008
1 each 2N2222	0340-0008
1 each 1N4148	0302-0002
5 each 1A Fuse	0504-0107
1 each Lamp	0502-0804
1 each 1N5232	0303-0005

RAVEN ELECTRONICS CORPORATION

TEST PROCEDURE
41029-01 -24V DC POWER SUPPLY

1.0 GENERAL

Follow this test procedure carefully, completing the Test Data Card as necessary. If difficulties are encountered, refer to the Troubleshooting Procedure for this Module.

WARNING: DURING THESE TESTS, VOLTAGES OF 110/220 VAC ARE PRESENT. FOLLOW SAFETY PRACTICES CAREFULLY WHEN PERFORMING THESE TESTS.

2.0 TEST EQUIPMENT REQUIRED

OSCILLOSCOPE	H.P. 130C or equivalent
AC/DC VTVM	Triplett 850 or equivalent
120V VARIAC	
LOAD RESISTORS,15 ohm 50W, 48 ohm 20 watt	
SHELF	Raven 410
EXTENDER BOARD	Raven 404-165
120-220 TRANSFORMER	

NOTE: If this Module is not tested with a Shelf Assembly wired for the 41029 Module, a power cord and a 2N3055 (Q1 Shelf) transistor will be required (See Drawing 410-1290).

3.0 TEST EQUIPMENT SET UP

Connect Test Equipment as shown in Figure 1. DO NOT TURN VARIAC "ON" UNTIL INSTRUCTED TO DO SO.

4.0 POWER SUPPLY TESTS

4.1 Strap terminals E13 to E15 and E17 to E19 for 120V AC operation.

4.2 Connect the variac output to pins L and P. (Alternately plug Module into a 41010-97 Shelf on an extender board. Plug the Shelf power cord into the variac). Turn on the variac. Set output to 120V AC using the AC VTVM.

4.3 Connect the DC VTVM probe to the white test point on the Front Panel and the common lead to the black test point. Check the switch, fuse and lamp operation. Leave the Module "on".

4.4 Using clip leads connect a 15 ohm, 50 watt resistor across pins A and V. Adjust R10 until the VTVM indicates -24V DC.

4.5 Connect the oscilloscope probe to pin A. The power supply ripple must be less than 50 mV peak to peak.

4.6 While observing the VTVM and oscilloscope, adjust the variac output to 132V AC, then to 108V AC, and back to 115V AC. The VTVM reading must not vary more than ±.7V DC, and the ripple must not exceed 50 mV peak to peak.

4.7 Connect an additional 48 ohm, 15W resistor across pins A and V. The VTVM must read less than -22V DC. Remove the 48 ohm resistor.

4.8 Connect a heavy jumper across the 15 ohm resistor. (Do not touch this jumper directly to the printed circuit board). The VTVM reading should drop to 0V. The fuse must not blow.

4.9 Connect VTVM across R2. This voltage must not exceed 1V DC.

4.10 Reconnect DC VTVM to the front panel test points. Remove the jumper installed in paragraph 4.8. The VTVM should rise to -24V DC, ±.7 volt.

4.11 Turn variac "off". Remove straps across E13 to E15 and E17 to E19. Strap E15 to E17 for 220V AC operation.

4.12 Connect the input of a 120 to 220V AC transformer to the output of the variac. Connect the output of the 120-220V AC transformer to pins L and P. (Alternately plug module into a 41010-97 shelf on an extender board. Plug the shelf power cord into the variac).

4.13 Turn variac "on" and set the AC input to the module to 220V AC. DC VTVM should read -24V, ±.7V.

4.14 Adjust variac so that the AC input to the module varies from 198V AC to 242V AC. The DC output voltage must not vary more than ±.7V DC.

4.15 Turn off variac and disconnect the test equipment and straps.

5.0 TEST COMPLETION

Stamp Module and Test Data Card with your Test Stamp.

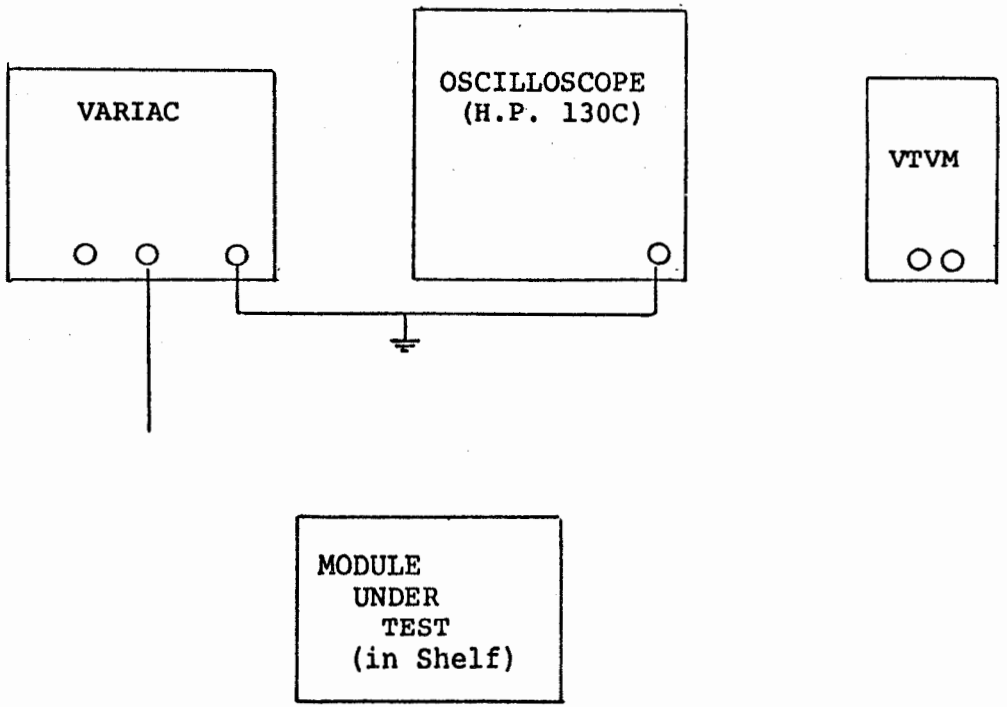
6.0 Q.A. ACCEPTANCE

6.1 Verify that test results are within specifications.

6.2 Verify that Test Data Card is properly filled out.

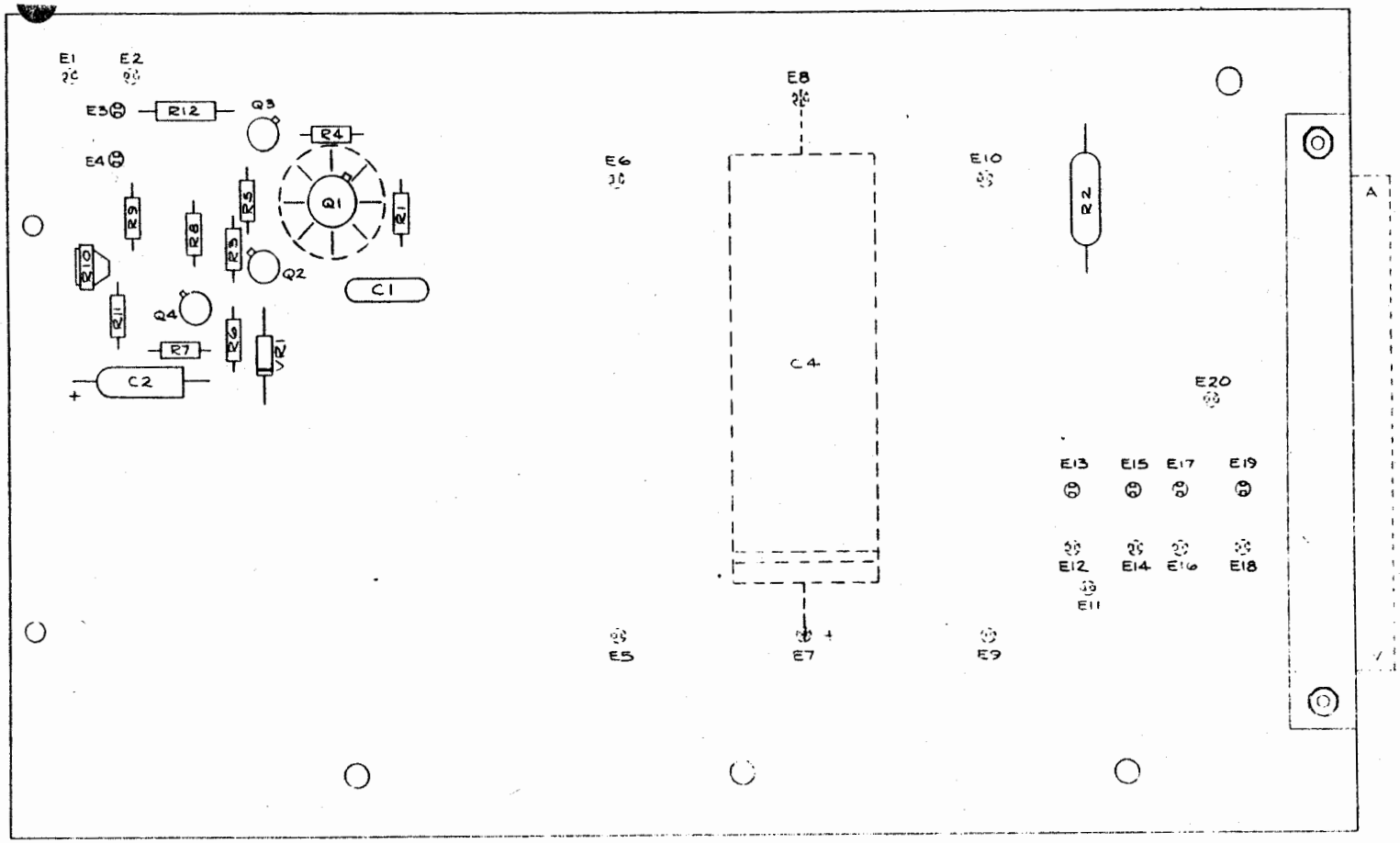
6.3 Re-inspect Module per established criteria.

6.4 Stamp Module and Test Data Card with "ACCEPTED" Stamp.

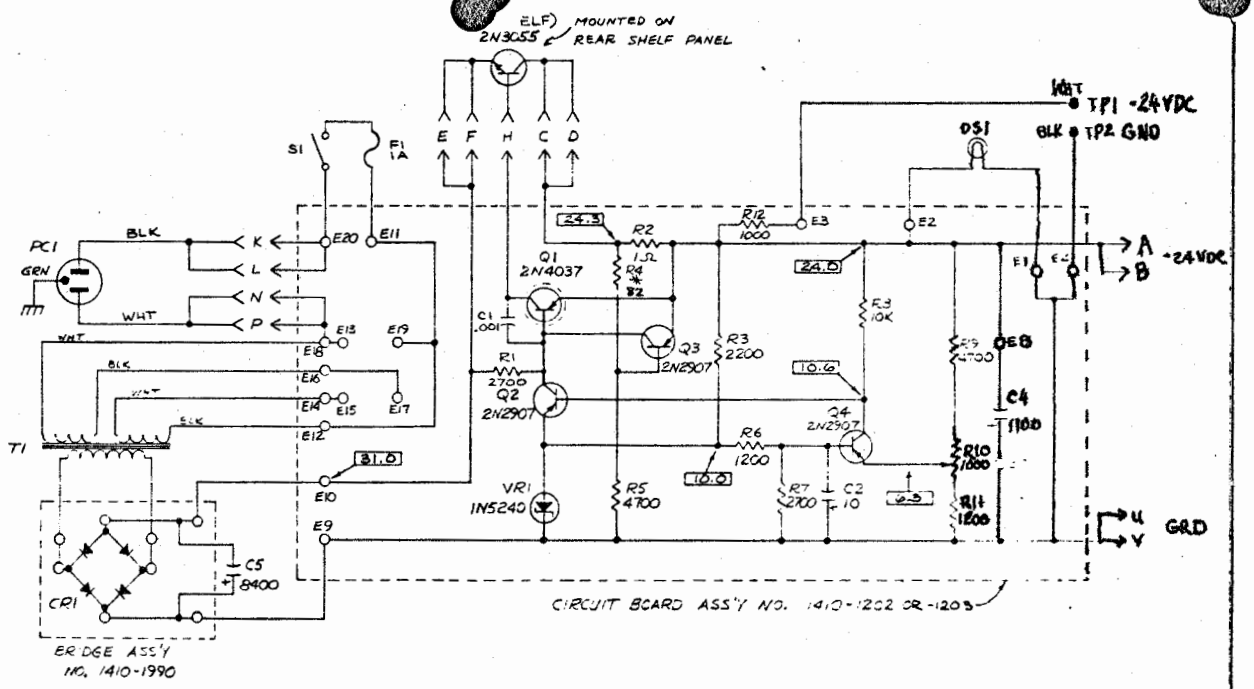


NOTE: If Shelf is not used; connect Q1 as shown in Drawing 410-1200.

Figure 1. ⏚ Denotes preferred common earth ground.



LTR	REVISION	BY	DATE
DRAWN BY JN	RAVEN ELECTRONICS CORP. 884 FREEPORT BLVD. SPARKS, NEVADA 89431 (702) 359-3700		
CHECKED BY GJM	NAME REGULATOR BD		
APPROVED BY [illegible]			
DATE 8-3-72	SIZE 4410-1204	C	DWG NO 4410-6



NOTE

1. FOR 120 VAC INPUT STRAP E13 TO E15 AND STRAP E17 TO E19
2. FOR 220 VAC INPUT STRAP E15 TO E17
3. ALL RESISTANCE IN OHMS
4. ALL CAPACITANCE IN UFD
5. UNUSED TERMINALS NOT SHOWN
6. ☐ NEG. DC VOLTS, GRD. REFERENCE.
7. * SELECTED VALUE - TYP. VALUE SHOWN

LTR	REVISION	BY	DATE
D	C4 TYP VALUE WAS 220		
C	REVERSED S,T,E		
B	ADDED NOTE 7, C3 DELETED, CKT BD ASS'Y AND BASE OF SCHEMATIC WAS 1202 BASE OF SCHEMATIC		
A	29 WAS 3300, C1 WAS 100		

DRAWN BY: DR
CHECKED BY: GSM
APPROVED BY:
DATE: 7-12-2

RAYER ELECTRONICS CORP.
684 FREEPORT BLVD
SPARKS NEVADA 89431
(702) 359-3700

NAME: AC PWR. SUPPLY
ASS'Y: 41029-01
SIZE: C
SHEET: 1 - 230

S.F DETECTOR/S.F.
DETECTOR AND OSCILLATOR
41063-01/02

MODIFIED FOR 2600 Hz

1. APPLICATION

The 41063-01 version is designed to be the detector for the Supervision Frequency (S.F.). It may also be used as a signaling module. The 41063-02 version adds the S.F. Oscillator to the previous unit so that the supervisory frequency signals may be generated as well as received.

2. SPECIFICATIONS

GENERAL:

POWER REQUIREMENTS:	41063-01: 24V DC @ 40 mA 41063-02: 24V DC @ 60 mA
TEMPERATURE RANGE:	0°C to 50°C
HUMIDITY RANGE:	0% to 95%

S.F. DETECTOR:

INPUT IMPEDANCE:	Greater than 20K ohms, Balanced
INPUT LEVEL:	Factory set @ -26 dBm, minimum. 600 ohms reference.
BAND PASS:	±2%, ±.5% of center frequency.
CENTER FREQUENCY:	2600 Hz
RELAY OUTPUT CONTACTS:	Dual form "C", 5A @ 48V DC
TURN ON DELAY FOR OUTPUT RELAY:	Adjustable and strappable; 1/2 sec. minimum, 7 sec. maximum.

S.F. OSCILLATOR:

OUTPUT IMPEDANCE:	600 ohms, ±10%
OUTPUT LEVEL:	Adjustable, maximum of greater than 0 dBm.
OUTPUT FREQUENCY:	2600 Hz ± 13 Hz over temperature, humidity, and altitude specifications
SIGNALING CURRENT:	5 mA @ -48V DC

3. THEORY OF OPERATION

3.1 The S.F. Detector contains two main circuits. The first circuit is the actual detection circuitry for the supervisory signals; the second is detection circuitry to detect the presence of voice or of voice frequency signals.

3.2 Refer to Schematic 410-1630. All input signals enter the Module on pins L and K. These signals are presented to the primary of transformer T1 and transferred to the secondary. Signals are then presented to transistor Q1 (common emitter amplifier).

3.3 The supervisory signals are developed across C4 and presented to the base of Q2. Transistor Q2 is an emitter follower and serves as a driver for the high pass filter (L1, L2, C5, and C12). This filter keeps voice frequency signals out of the supervisory signaling path.

3.3.1 Transistors Q3 and Q4 act as amplifiers for the supervisory signal. Q5, Q6, Q7, and Q8 serve to provide a constant level output for the tone detector, and operate in the following manner:

a. During the positive half cycle of an incoming signal, transistor Q6 is biased "on" through CR1, R21, and C16. When Q6 is "on", it also turns Q7 "on".

b. During the negative half cycle of an incoming signal, Q5 is turned "on" through CR2, C17, and R19. Transistor Q5 turns Q8 "on", so the wave form at the collector of Q8 is a square wave at the incoming frequency whose amplitude is constant.

c. The square wave at the collector of transistor Q8 goes through C34 and the parallel combination of R40 and R41 to the tone detector. The tone detector responds to a frequency that is determined by C22, C23, and L4.

3.3.2 The action of the tone detector is such that the voltage across C24 will be 0 volts with no signal in, and 4 to 6 volts when a signal of the correct frequency is present. The voltage at the plus end of C24 will turn Q16 "on" when the correct signaling frequency tone is present. Q16, in turn, drives the output of relay K1.

3.3.3 Transistors Q15 and Q16 form a set, reset flip-flop such that when either transistor is "on", it is latched and will remain "on" until an external signal is sent to turn it "off". Normally, Q15 is "on" by being continually reset by Q14 which is gated "on" or "off" by Q13.

a. When a signaling tone is present, Q13 is biased "on" and prevents Q14 from resetting the flip-flop.

b. When no signaling is present, Q13 is "off" and Q14 continually resets or turns Q15 "on".

c. The rate at which Q14 turns Q15 "on" is determined by the setting of R48 and whether terminals E5 and E6 are strapped.

3.4 The voice signals are presented to the base of Q1. From the collector of Q1 these signals go through R30 and C13 and through C18, L3, and C19 to the base of transistor Q9. R30 and C13 form a low pass filter.

3.5 The band reject filter, C18 and L3, is tuned to the supervisory frequency (2600 Hz). This prevents the supervisory frequency from being amplified by transistor Q9. Transistor Q9 then amplifies all voice frequency input signals. Transistor Q10 is an AC signal detector.

3.6 When no voice is present, the voltage across C21 is zero. When voice is present, the voltage will vary between 12 and 24 volts. This voltage across C21 causes current to flow through resistors R36 and R37 to turn Q11 "on". When Q11 turns "on", it discharges C24 through R39 and prevents a signaling tone from turning on the relay.

3.7 Also, if a signaling tone is present, transistor Q16 is "on" and through CR3, prevents Q11 from being turned "on". Therefore, a priority system has been set up: Whichever signal is present first (whether voice or supervisory), it will control. i.e. If we have voice present first, we cannot receive signaling tones to actuate the relay; if we have signaling first, voice signals will not cause the relay to fall-out.

3.8 The theory for the S.F. Oscillator section of the Module is described below.

3.8.1 Transistors Q17 and Q19 form an amplifier with a zero degree phase-shift. Both the input and output of the amplifier are connected together and to the parallel tank circuit (L5, C28, and C29).

3.8.2 Under normal conditions, the tank circuit will oscillate. Oscillation is prevented when Q18 is turned "on". This causes the collector of Q19 to be shorted out to the -24V DC, preventing gain in that stage, hence oscillation.

3.8.3 When switch S1 is closed, transistor Q18 is turned "off" allowing the oscillator to function normally. Also, when pin F is at -48V DC, this biases Q18 "off" and again allows the oscillator to function normally.

3.8.4 The signal is sampled from the L3 network via R69 to the base of Q20. Transistor Q20 (common collector or emitter follower) serves as an impedance lowering stage. The output signal is taken from the wiper of R71 which serves as a level adjust.

3.9 Transistor Q21 serves as a power amplifier and drives the output transformer T2 via C32. The secondary windings of T2 are set up to either drive two 600 ohm lines, or to serve as a summing point for voice and tone signals.

4. MAINTENANCE AND ADJUSTMENTS

4.1 Receive Amplifier Tests

4.1.1 Connect the 24V DC Power Supply minus lead to pin V and the positive lead to pin U. Using the VTVM, set the power supply voltage to 24V DC.

4.1.2 Connect the Signal Generator across pins K and L. Connect a 600 ohm termination across the Signal Generator. Use the Frequency Counter to monitor the Generator frequency. Set the frequency to 1402 Hz. Set the output level to -10 dBm.

4.1.3 Connect the AC VTVM between the junction of C5 and C9 and ground. Adjust R4 maximum counterclockwise.

4.1.4 Tune inductor L1 for a minimum reading on the AC VTVM. Connect the AC VTVM between the junction of C9 and C11 and ground.

4.1.5 Set the signal generator frequency to 1973 Hz. Adjust inductor L2 for a minimum reading on the AC voltmeter.

4.1.6 Connect the AC voltmeter to the collector of Q9 and ground. Set the signal generator to a frequency of 2600 Hz and the output level to -20 dBm. Adjust inductor L3 for a minimum reading on the AC voltmeter. Disconnect the AC VTVM.

4.1.7 Connect the DC VTVM between the positive side of C24 and -24V. Adjust inductor L4 for a maximum reading on the DC VTVM. If necessary, decrease the signal generator level to allow a very sharp peak to be seen while adjusting L4.

4.1.8 Set the resistance decade to 300K ohms and connect it across terminals E3 and E4. Connect a VTVM in the OHMS function and R x 1 scale across pins M and N to monitor the relay pull in. 0 ohms should be read when the relay is in and ∞ ohms when the relay is out. Set the signal generator level to -10 dBm and set the frequency to 2548 Hz. Adjust the resistance decade until the relay K1 pulls in. Record the resistance setting of the Resistance Decade and solder in the nearest E.I.A. resistance value across terminals E3 and E4.

NOTE: The relay latch and unlatch circuit exhibits a wide hysteresis with approximately a 1/2 second time constant. Therefore, to check that the correct value of resistance has been found, decrease the signal generator frequency until the relay drops out. Very, very slowly increase the frequency in 5 Hz steps until the relay pulls in. This frequency should be 2548 Hz. If not, readjust resistance and repeat above step.

4.2 Bandwidth Checks

4.2.1 Set the Signal Generator level to 0 dBm and its frequency to approximately 2520 Hz. Very slowly increase the frequency until K1 energizes. This must be between 2535 and 2561 Hz.

4.2.2 Set the Signal Generator frequency to approximately 2680 Hz. Very slowly decrease the frequency until relay K1 energizes. This must occur between 2639 and 2665 Hz.

4.2.3 Decrease Signal Generator level to -26 dBm. Set the frequency to approximately 2520 Hz. Very slowly increase the frequency until relay K1 energizes. This must occur between 2535 and 2561 Hz.

4.2.4 Set Signal Generator frequency to approximately 2680 Hz. Very slowly decrease the frequency until K1 energizes. This must occur between 2639 and 2665 Hz.

4.3 Minimum Signal And Drop-Out Time Checks

4.3.1 Connect the Oscilloscope probe to the collector of Q8. Set the Signal Generator to 2600 Hz and the level to -20 dBm. Adjust potentiometer R4 so that the square wave displayed on the scope just stops. This sets the minimum input level at which the detector will operate.

4.3.2 Relay time out adjustments.

Connect the oscilloscope probe to the junction of R49, CR4, and the cathode of Q14. Disconnect the Signal Generator and sync. the scope to the pulses being displayed. Adjust Pot. R48 until these pulses are .5 seconds apart.

4.4 Voice Inhibit Circuit Checks

4.4.1 Connect Signal Generator #2 to pins K and L and set for 2600 Hz at 0 dBm. Connect Signal Generator #1 also to pins K and L and set for 1000 Hz at -20 dBm. Observe that the relay is operating. Remove Signal Generator #2 and observe that the relay has dropped out. When reconnecting the #2 Signal Generator, the relay should stay dropped out over the frequency range of Generator #1 from 300 Hz to 2000Hz. This will insure that if voice is present on a line before the signaling tone, a false relay operation is prevented even though the correct signaling tone is present.

4.4.2 Set Generator #2 to a level of -10 dBm still at 2600 Hz. Set Signal Generator #1 to a level of 0 dBm. By momentarily disconnecting Signal Generator #1 the relay should pull in. When the Signal Generator #1 is reconnected the relay should stay in over the frequency range of 300 to 2000 Hz. This will insure voice not interrupting a signal tone once it is being received. Remove Signal Generator #2.

4.4.3 Insert a series 22K ohm 5% resistor in series with the Signal Generator #1 and pin K. Connect common of the Generator to pin L. With an AC VTVM, measure the voltage across the Signal Generator and across pins K and L. The voltage difference must be less than 6 dB.

4.5 Transmit Tests - (Not required on -01 option)

4.5.1 Connect the 24V DC Power Supply negative lead to pin A and the positive lead to pin B.

4.5.2 Terminate across pins D and E with a 604 ohm 1% resistor. Connect the ACVM/DA across pins H and J and terminate with 604 ohm ± 1%.

4.5.3 Connect the Frequency Counter to the ACVM/DA output terminals.

4.5.4 Set the level adjustment (R-71) to maximum.

4.5.5 Close S-1. The Module should now be transmitting with a level greater than 0 dBm. Record this level. Tune L4 for 2600 ± 2 Hz as read on the Frequency Counter. Open S-1.

4.5.6 Connect pin F to -44V DC. The Module must transmit as in the previous step. Disconnect pin F from the -44V DC supply. Disconnect termination across pins D and E.

5. TROUBLESHOOTING

Troubleshooting will consist of localizing the trouble to one particular section: 1) Receiver or detector supervisory frequency section; 2) the detector logic section; or 3) the S.F. Oscillator. Once the defective stage is located, voltage and ohmic checks should allow the technician to isolate the defective component.

6. PARTS LIST

The following parts list contains all parts associated with the 41063-01 and -02 Module. Unless otherwise specified, part numbers are Raven Electronics Corporation part numbers.

7. REFERENCE DIAGRAMS

41063-01/02 S.F. DETECTOR AND OSCILLATOR, Schematic Diagram, 410-1630, dtd. 8/9/72 REV A.

RAVEN ELECTRONICS CORPORATION

TEST PROCEDURE

41063-01 S.F. DETECTOR

41063-02 S.F. DETECTOR AND OSCILLATOR

MODIFIED FOR 2600 Hz

1.0 GENERAL

Complete the Test Data Card for this procedure as required for each step. Follow the procedure carefully. DO NOT CHANGE LEVELS OR SETTINGS UNTIL INSTRUCTED TO DO SO. If difficulties are encountered, refer to the Troubleshooting procedure for this Module. Reference Drawing 410-1630.

2.0 TEST EQUIPMENT REQUIRED

AC VOLTMETER/DISTORTION ANALYZER	H.P. 331A or equivalent
VTVM	Triplett 850 or equivalent
2 ea. SIGNAL GENERATOR	H.P. 650A or equivalent
-24V DC POWER SUPPLY	
FREQUENCY COUNTER	H.P. 5216 or equivalent
RESISTANCE DECADE	
-44V DC POWER SUPPLY	
OSCILLOSCOPE	H.P. 130C or equivalent

3.0 TEST EQUIPMENT SET-UP

Connect the test equipment as shown in Figure 1.

4.0 RECEIVE AMPLIFIER TESTS

4.1 Connect the 24V DC Power Supply minus lead to pin V and the positive lead to pih U. Using the VTVM, set the power supply voltage to 24V DC.

4.2 Connect the Signal Generator across pins K and L. Connect a 600 ohm termination across the Signal Generator. Use the Frequency Counter to monitor the Generator frequency. Set the frequency to 1402 Hz. Set the output level to -10 dBm.

4.3 Connect the AC VTVM between the junction of C5 and C9 and ground. Adjust R4 maximum counterclockwise.

4.4 Tune inductor L1 for a minimum reading on the AC VTVM. Connect the AC VTVM between the junction of C9 and C11 and ground.

4.5 Set the signal generator frequency to 1973 Hz. Adjust inductor L2 for a minimum reading on the AC voltmeter.

4.6 Connect the AC voltmeter to the collector of Q9 and ground. Set the signal generator to a frequency of 2600 Hz and the output level to -20 dBm. Adjust inductor L3 for a minimum reading on the AC voltmeter. Disconnect the AC VTVM.

4.7 Connect the DC VTVM between the positive side of C24 and -24V. Adjust inductor L4 for a maximum reading on the DC VTVM. If necessary, decrease the signal generator level to allow a very sharp peak to be seen while adjusting L4.

4.8 Set the resistance decade to 300K ohms and connect it across terminals E3 and E4. Connect a VTVM in the OHMS function and R x 1 scale across pins M and N to monitor the relay pull in. 0 ohms should be read when the relay is in and ∞ ohms when the relay is out. Set the signal generator level to -10 dBm and set the frequency to 2548 Hz. Adjust the resistance decade until the relay K1 pulls in. Record the resistance setting of the Resistance Decade and solder in the nearest E.I.A. resistance value across terminals E3 and E4.

NOTE: The relay latch and unlatch circuit exhibits a wide hysteresis with approximately a 1/2 second time constant. Therefore, to check that the correct value of resistance has been found, decrease the signal generator frequency until the relay drops out. Very, very slowly increase the frequency in .5 Hz steps until the relay pulls in. This frequency should be 2548 Hz. If not, readjust resistance and repeat above step.

5.0 BANDWIDTH CHECKS

5.1 Set the Signal Generator level to 0 dBm and its frequency to approximately 2520 Hz. Very slowly increase the frequency until K1 energizes. This must be between 2535 and 2561 Hz.

5.2 Set the Signal Generator frequency to approximately 2680 Hz. Very slowly decrease the frequency until relay K1 energizes. This must occur between 2639 and 2665 Hz.

5.3 Decrease Signal Generator level to -26 dBm. Set the frequency to approximately 2520 Hz. Very slowly increase the frequency until relay K1 energizes. This must occur between 2535 and 2561 Hz.

5.4 Set Signal Generator frequency to approximately 2680 Hz. Very slowly decrease the frequency until K1 energizes. This must occur between 2639 and 2665 Hz.

6.0 MINIMUM SIGNAL AND DROP OUT TIME CHECKS

6.1 Connect the Oscilloscope probe to the collector of Q8. Set the Signal Generator to 2600 Hz and the level to -20 dBm. Adjust potentiometer R4 so that the square wave displayed on the scope just stops. This sets the minimum input level at which the detector will operate.

6.2 Relay time out adjustments.

Connect the oscilloscope probe to the junction of R 49, CR4 and the cathode of Q14. Disconnect the Signal Generator and sync. the scope to the pulses being displayed. Adjust Pot. R48 until these pulses are .5 seconds apart.

7.0 VOICE INHIBIT CIRCUIT CHECKS

7.1 Connect Signal Generator #2 to pins K and L and set for 2600 Hz at 0 dBm. Connect Signal Generator #1 also to pins K and L and set for 1000 Hz at -20 dBm. Observe that the relay is operating. Remove Signal Generator #2 and observe that the relay has dropped out. When reconnecting the #2 Signal Generator, the relay should stay dropped out over the frequency range of Generator #1 from 300 Hz to 2000 Hz. This will insure that if voice is present on a line before the signaling tone, a false relay operation is prevented even though the correct signaling tone is present.

7.2 Set Generator #2 to a level of -10 dBm still at 2600Hz. Set Signal Generator #1 to a level of 0 dBm. By momentarily disconnecting Signal Generator #1 the relay should pull in. When the Signal Generator #1 is reconnected the relay should stay in over the frequency range of 300 to 2000 Hz. This will insure voice not interrupting a signal tone once it is being received. Remove Signal Generator #1.

7.3 Insert a series 22K ohm 5% resistor in series with the Signal Generator #1 and pin K. Connect common of the Generator to pin L. With an AC VTVM, measure the voltage across the Signal Generator and across pins K and L. The voltage difference must be less than 6 dB.

8.0 RELAY OPERATION

8.1 With the relay activated, make the following measurements with the ohmeter. Set the resistance scale to the R x 1 position.

Between Pins	Reading
M & N	0 Ohms
N & P	∞
R & S	0 Ohms
S & T	∞

8.2 Disconnect the Signal Generator. With the VTVM make the following measurements:

Between Pins	Reading
M & N	∞
N & P	0 Ohms
R & S	∞
S & T	0 Ohms

8.3 This completes the receiver portion of the test. Disconnect the Test Equipment from the Module.

9.0 TRANSMIT TESTS - (Not required on -01 option)

9.1 Connect the 24V DC Power Supply negative lead to pin A and the positive lead to pin B.

9.2 Terminate across pins D and E with a 604 ohm 1% resistor. Connect the ACVM/DA across pins H and J and terminate with 604 ohm ± 1%.

9.3 Connect the Frequency Counter to the ACVM/DA output terminals.

9.4 Set the level adjustment (R-71) to maximum.

9.5 Close S-1. The Module should now be transmitting with a level greater than 0 dBm. Record this level. Tune L-4 for 2600 ± 2 Hz as read on the Frequency Counter. Open S-1.

9.6 Connect pin F to -44V DC. The Module must transmit as in the previous step. Disconnect pin F from the -44V DC supply. Disconnect termination across pins D and E.

10.0 TRANSFORMER TEST - (Not required on -01 option)

10.1 Adjust Pot. R71 with switch S-1 closed for a reading of 0 dBm on the AC voltmeter which is across pins H and J. Terminate pins H and J with an additional 604 ohm 1% resistor. The AC voltmeter reading should drop 3.5 dB ± .2 dB. Record this level drop.

10.2 Adjust Pot. R71 with switch S-1 closed for a reading of 0 dBm on the AC voltmeter which is across pins D and E. Terminate pins D and E with an additional 604 ohm 1% resistor. The AC voltmeter reading should drop 3.5 dB ± .2 dB. Record this level drop.

11.0 This completes all tests of this Module. Disconnect the Test Equipment from the Module. Cement all tuning slugs and core clamps so that the alignment may not change.

12.0 TEST COMPLETION

Stamp the Module and Test Data Card with your Test Stamp.

13.0 Q.A. ACCEPTANCE

11.1 Verify that test results are within specifications.

11.2 Verify that Test Data Card is properly filled out.

11.3 Re-inspect Module per established criteria.

11.4 Stamp Module and Test Data Card with "ACCEPTED" Stamp.

TEST DATA CARD

S.F. DETECTOR AND
OSCILLATOR
41063-01/02

SERIAL #_____ DATE_____

Check blocks or fill in levels where required. Print neatly using a ballpoint pen. This is a permanent record. Number designations correspond to the Test Procedure for this Module.

1.0 GENERAL_____

2.0 TEST EQUIPMENT USED

RESISTANCE DECADE, Type_____ SERIAL#_____
VTVM, Type_____ SERIAL#_____
ACVM/DA, Type_____ SERIAL#_____
FREQUENCY COUNTER, Type_____ SERIAL#_____
SIGNAL GENERATOR, Type_____ SERIAL#_____
24V POWER SUPPLY, Type_____ SERIAL#_____
44V POWER SUPPLY, Type_____ SERIAL#_____
SIGNAL GENERATOR, Type_____ SERIAL#_____
OSCILLOSCOPE, Type_____ SERIAL#_____

3.0 ____

4.1 ____

4.2 ____

4.3 ____

4.4 ____

4.5 ____

4.6 ____

4.7 ____

4.8 ____K

5.1 ____Hz (2535-2561)

5.2 ____Hz (2639-2665)

5.3 ____Hz (2535-2561)

5.4 ____Hz (2639-2665)

6.1 ____

6.2 ____

7.1 ____

7.2 ____

7.3 ____db (< 6)

8.1 ____

8.2 ____

9.1 ____

9.2 ____

9.3 ____

9.4 ____

9.5 ____dBm (> 0)

9.6 ____

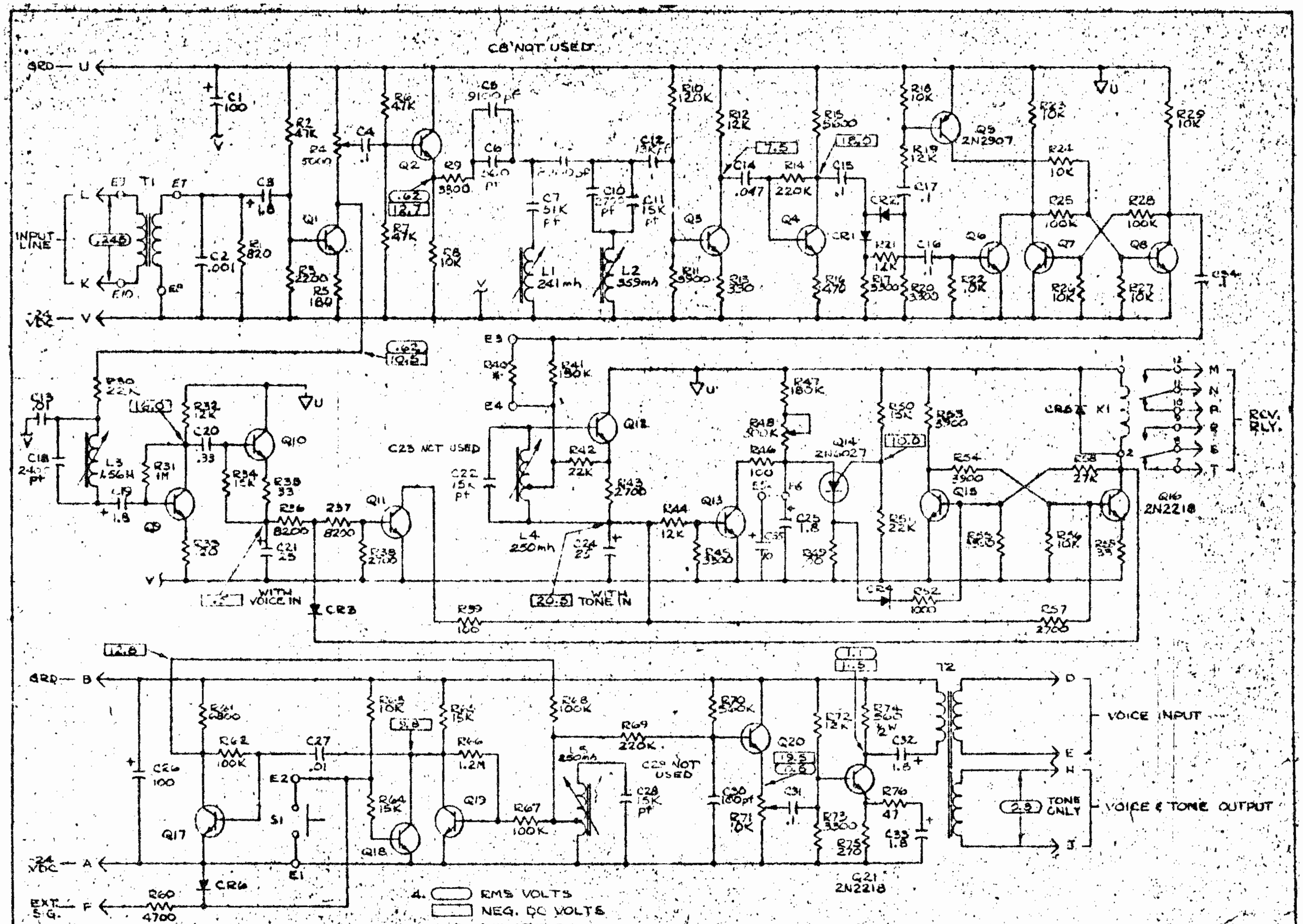
10.1 ____dB (3.5±.2)

10.2 ____dB (3.5±.2)

11.0 ____

12.0 (Test Stamp)

13.0 (Q.A. Stamp)



NOTES

1. UNLESS NOTED:
   - A. ALL RESISTANCE IN OHMS
   - B. ALL CAPACITANCE IN UFD.
   - C. ALL DIODES 1N4148
   - D. ALL TRANSISTORS 2N2222
2. * FACTORY SELECTED - TYP. VALUE SHOWN
3. EXT. VOLTAGES SHOWN WITH S1 CLOSED

LTR.	REVISION	BY	DATE

RAVEN ELECTRONICS CORP.

2600 HZ S.F. DET. AND OSC.

41065-01/-02 C 410-1631

NOTE: 41072-03 Later Model Systems
40172-03 Horizontal Model
40472-03 Early Model Systems
All models are electrically interchangeable.
410--- and 404--- are mechanically interchangeable.

DUAL AMPLIFIER
41072/40172/40472-03 MODULE

1. APPLICATION

The 40472-03 Dual Amplifier Module functions as two direct-coupled, temperature compensated amplifiers on a single printed circuit board and provides amplification for a balanced 600 ohm system. It may be used in any application where this type of unit is required.

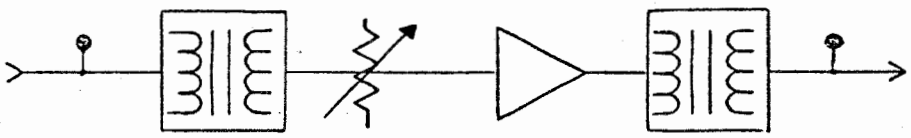
2. SPECIFICATIONS

Input Impedance:	600 ohms, ±10%
Output Impedance:	600 ohms, ±10%
Gain:	Greater than 20 dB @ 1 KHz
Output Noise:	Less than -60 dBm @ maximum gain
Cross talk:	
(A to B or B to A)	Less than -60 dBm
Frequency Response:	
(at 1 KHz reference)	±1/2 dB @ 600 Hz and 5 KHz
	±1 dB @ 300 Hz and 8 KHz
	±3 dB @ 200 Hz and 12 KHz
Distortion:	Less than 1% @ 0 dBm output
Output Level:	+10 dBm, maximum
Power Requirement:	40 mA @ 24V DC, total (20 mA per amplifier)

3. THEORY OF OPERATION

3.1 As state previously, the Module functions as two independent amplifiers on a single printed circuit board. Input and output levels can be monitored by the use of available test points for each amplifier. The power supply leads are decoupled to provide a maximum power supply rejection level. Both amplifiers function in an identical manner and are electrically the same.

3.2 A block diagram of the 40472-03 Module is shown below.



Amplifier "A" portion only.

3.3 A signal is applied to the Module at the input pins and coupled across a transformer. A variable resistor is provided in order to adjust the input to the 3-stage direct-coupled amplifier. The output of the amplifier is fed to a second transformer and coupled through to the output pins to a 600 ohm external load.

3.4 Refer to Schematic 404-1721. Since both the "A" and "B" Amplifiers are electrically and functionally identical, the discussion below will cover only the "A" Amplifier.

3.5 The input signal is applied to pins H and J on the Module. Input level can be monitored at TP 1 and TP 2. The signal is then applied across the primary of transformer T1 and coupled to the secondary. The secondary of T1 feeds resistors R2 and R3 (which are in parallel). These resistors form the terminating impedance for the transformer. R3 provides a variable input level to the amplifier itself.

3.6 The amplifier input signal is developed across the portion of R3 (between the wiper and ground) and passes through C2 to the base of transistor Q1. Capacitor C3 serves to decouple the base bias current of Q1. Resistor R4 (selected value) is in parallel with resistor R7 and serves to bias the amplifier correctly. Diode CR1 is a temperature compensating device to assure that the correct DC levels in the amplifier are constant, regardless of the temperature changes.

3.7 Transistor Q1 is the initial input amplifier and drives Q2 directly. Capacitor C5 bypasses the emitter to Q1, giving a high AC gain but a low DC gain. The emitter of Q2 is bypassed by capacitor C6 for low DC gain and high AC gain. Transistor Q2 amplifies the signal and feeds it directly to the base of Q3 (the output amplifier). Feedback is obtained from the emitter of Q3 and is fed back to the emitter of the input amplifier Q1 via the combination of R13, C7 and R14.

3.8 Resistor R13 determines the broadband gain of the amplifier while capacitor C7 and resistor R14 serve to roll off the gain of the amplifier at high frequencies. The collector of Q3 is bypassed by capacitor C8, eliminating high frequency noise in the output stage.

3.9 The output signal passes through capacitor C9 to the primary of transformer T2. The secondary of T2 is coupled via pins C and D to an external 600 ohm load.

3.10 The -24V DC operating voltage for this amplifier is applied

to pin A and fed across resistor R1 (the power supply decoupling resistor). Capacitor C1 filters the power supply voltage and provides low impedance power for the total amplifier.

4. INSTALLATION

4.1 Printed Circuit Board Pin Identification

Pin H - Input pin for "A" Amplifier
Pin J - Input pin for "A" Amplifier
Pin B - Ground, "A" Amplifier
Pin A - -24V DC, "A" Amplifier
Pin C - Output pin for "A" Amplifier
Pin D - Output pin for "A" Amplifier
Pin M - Input pin for "B" Amplifier
Pin N - Input pin for "B" Amplifier
Pin U - Ground, "B" Amplifier
Pin V - -24V DC, "B" Amplifier
Pin S - Output pin for "B" Amplifier
Pin T - Output pin for "B" Amplifier

4.2 Level Adjustment

4.2.1 Terminate input and output with 600 ohms.

4.2.2 Apply -24V DC to pin A or V

4.2.3 Apply an input signal of 1 KHz to pins H and J of Amplifier "A" or M and N of Amplifier "B". (Input signal can be measured at the input test points of the appropriate amplifier).

4.2.4 Adjust the input amplitude to the desired operating level.

4.2.5 Connect an AC voltmeter (HP 400 D or equivalent) at the output pins of the appropriate amplifier.

4.2.6 Adjust R3 for Amplifier "A" or R19 for Amplifier "B" so the correct output level is obtained.

4.3 If any component in the circuitry is replaced, the amplifier will need re-biasing. To re-bias the amplifier, refer to the Maintenance procedures for this Module.

5. TROUBLESHOOTING

5.1 The following troubleshooting guide lines are presented to help in isolating trouble to a stage in the Module. Once a defective stage has been located, ohmic and voltage checks should serve to locate the defective component.

NOTE: DC VOLTAGES AS SHOWN ON THE SCHEMATIC MAY DEVIATE ±20% DUE TO COMPONENT TOLERANCES. AC VOLTAGES MAY DEVIATE ±30% OR 3 dB (THIS IS A FUNCTION OF THE GAIN OF INDIVIDUAL TRANSISTORS AND SHOULD NOT BE OF CONCERN IN ACTUAL PRACTICE.)

5.2 DC Measurements

All measurements are made with respect to ground (pin B or U).

Point of Measurement	Voltage Reading
Junction of R1 and C1	-20V DC, ±10%
Collector of Q1	-1.7V DC
Collector of Q2	-17.9V DC
Collector of Q3	-9.2V DC
Junction of R17 and C10	-20V DC, ±10%
Collector of Q4	-1.7V DC
Collector of Q5	-17.9V DC
Collector of Q6	-9.2V DC

5.3 AC Testing

5.3.1 Equipment required: Signal Generator (HP 651 or equivalent); AC voltmeter (HP 400D or equivalent); and 604 ohm, 1/4W or 1/2W, 1% resistor.

5.3.2 Connect the Signal Generator to the input pins (H and J of Amplifier "A"; M and N of Amplifier "B") and set the input level to 39 mV or -26 dBm, 600 ohms.

5.3.3 Terminate the output of the amplifier being checked with a 600 ohm load. Output pins are C and D for Amplifier "A"; S and T for Amplifier "B".

5.3.4 Set level control (R3 or R19) maximum clockwise. Using the AC voltmeter, trace the signals through the appropriate amplifier circuit as marked on the schematic.

NOTE: ALL SIGNALS ARE SINUSOIDAL OR VOICE. AN OSCILLOSCOPE MAY BE USED TO TRACE THE SIGNALS.

5.3.5 Make AC voltage checks at the collectors of Q1, Q2, Q3 or Q4, Q5, Q6 for voltages as indicated on the schematic. This would allow a 'spot check' on the amplifier performance.

6. MAINTENANCE

6.1 Test Equipment Required

VTVM	Triplett 850
AC VOLTMETER/DISTORTION ANALYZER	H.P.331A or equivalent
SIGNAL GENERATOR	H.P.650A or Equivalent
OSCILLOSCOPE	H.P.130C or equivalent
24V DC POWER SUPPLY	
RESISTANCE DECADE	

NOTE: References in parenthesis () refer to Amplifier "B".

6.2 Power Supply Connection.

6.2.1 Connect the Module as follows: Minus to pin A (V) and plus to pin B (U).

6.2.2 Use the VTVM to monitor the supply voltage which must be -24V DC, ±1V.

6.3 Bias Adjustment.

6.3.1 Connect the Oscilloscope common to pin B (U) and the probe to the Collector of Q3 (Q6).

6.3.2 Connect the Signal Generator to pins J (N) and H (M). Set the frequency to 1 KHz and the level to -16 dBm.

6.3.3 Terminate pins C (S) and D (T) with 600 ohms. Set GAIN ADJUST to maximum clockwise.

6.3.4 Connect the Resistance Decade across terminals E1 (E3) and E2 (E4). Adjust the Decade to 100K.

6.3.5 Adjust the Signal Generator level until the waveform displayed on the Oscilloscope is beginning to be clipped.

6.3.6 Adjust the Resistance Decade and Signal Generator level until the clipping is minimized and symmetrical.

6.3.7 Turn power "off"; remove the Resistance Decade and select the nearest E.I.A. value of resistor to the resistance determined by the Decade and solder it across terminals E1 (E3) and E2 (E4)

6.3.8 Turn power "on" Recheck symmetry; if not symmetrical, repeat steps 6.3.4 through 6.3.6. Increase the Signal Generator level to the point where the signal just begins to clip.

6.4 Gain Impedance and Frequency Response.

6.4.1 Connect the AC Voltmeter/Distortion-Analyzer across pins C (S) and D (T). The meter must read between +10 and +13 dBm.

6.4.2 Set the Signal Generator level to -20 dBm. Disconnect the Oscilloscope.

6.4.3 Adjust the Signal Generator level until the AC Voltmeter/Distortion Analyzer indicates 0 dBm. The Signal Generator level now must be -22 dBm and -30 dBm.

6.4.4 Terminate the Signal Generator with 600 ohms. OUTPUT level must decrease 3.5±0.2 dB. Remove the termination and terminate the AC Voltmeter/Distortion Analyzer. OUTPUT level must decrease 3.5±0.2 dB. Remove the additional termination.

6.4.5 The frequency response is checked by setting the indicated frequencies on the Signal Generator and comparing the reading of the AC Voltmeter/Distortion Analyzer to the acceptable reading. Adjust R3 (R19) for 0 dBm output with -20 dBm input.

GENERATOR SETTING	READING
200 Hz	0 ±2 dBm
300 Hz	0 ±1 dBm
1 KHz	0 dBm (Reference)
2 KHz	0 ±.5 dBm
3 KHz	0 ±.5 dBm
8 KHz	0 ±1 dBm
12 KHz	0 ±2 dBm

6.4.6 Measure the OUTPUT distortion at 0 dBm, 1 KHz. This must be less than 1%.

6.4.7 Disconnect the Signal Generator. Terminate pins H (M) and J (N) with 600 ohms. Measure the noise level of the amplifier output; noise level must be less than -60 dBm.

6.5 Test Completion.

Disconnect test equipment from the Amplifier.

7. PARTS LIST

The following parts list contains all parts associated with the 40472-03 Module. Unless otherwise specified, part numbers are Raven Electronics Corporation part numbers.

8. REFERENCE DIAGRAMS

40472 DUAL AMPLIFIER, Schematic Diagram 404-1721, dtd. 5/19/72

RAVEN ELECTRONICS CORPORATION

40472-03
DUAL AMPLIFIER — PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
	4404-0721-03	DUAL AMPLIFIER MODULE		40472-03	
	1404-3723	PANEL			
	0608-0201	Test Point, White	4	SKT10-W SEALECTRO	
	0608-0202	Test Point, Black	4	SKT10-B SEALECTRO	
	0608-0301	Bushing	2	B1473W SEALECTRO	
	1404-2431	HANDLE	1		
	1404-2420	BRACKET	1		
	4404-1721	DUAL AMPLIFIER P.C. BOARD Consisting of:	1	DWG REF 404-1721, 5/19/72 REV A	
		CAPACITOR: Fixed;	18		
C1	0102-0018	Electrolytic, 100 uf, 40V, 10%		C437AR/G100 AMPEREX	
C2	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C3	0102-0005	Electrolytic, 100 uf, 25V, 10%		B41283 SIEMANS	
C4	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C5	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C6	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C7	0101-0001	Disc, Ceramic, 470 pf		Style 506 M.I.A.L.	
C8	0101-0010	Mica, 150 pf		CD10ED151K03 CDE	
C9	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C10	0102-0018	Electrolytic, 100 uf, 40V, 10%		C437AR/G100 AMPEREX	
C11	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C12	0102-0005	Electrolytic, 100 uf, 25V, 10%		B41283 SIEMANS	
C13	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C14	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C15	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
C16	0101-0001	Disc, Ceramic, 470 pf		Style 506 M.I.A.L.	
C17	0101-0010	Mica, 150 pf		CD10ED151K03 CDE	
C18	0102-0016	Tantalum, 10 uf, 20V, 10%		K10C20K KEMET	
		RESISTOR: Composition; fixed; 1/4W 10% unless otherwise specified	32		
R1	0201-2711	270 ohm		SR 1/4W AIRCO SPEER	

REVISED 9/21/72
Supersedes P/L - 7/11/72

RAVEN ELECTRONICS CORPORATION

40472-03
DUAL AMPLIFIER — PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
R2	0201-1021	1K		SR 1/4W AIRCO SPEER	
R3	0234-0011	POT., 1K, Cermet		3359W-1-102 BOURNS	
R4*		Factory Selected Value			
R5	0201-2731	27K		SR 1/4W AIRCO SPEER	
R6	0201-3941	390K		SR 1/4W AIRCO SPEER	
R7	0201-4731	47K		SR 1/4W AIRCO SPEER	
R8	0201-1831	18K		SR 1/4W AIRCO SPEER	
R9	0201-1021	1K		SR 1/4W AIRCO SPEER	
R10	0201-1031	10K		SR 1/4W AIRCO SPEER	
R11	0201-1221	1.2K		SR 1/4W AIRCO SPEER	
R12	0201-3321	3.3K		SR 1/4W AIRCO SPEER	
R13	0201-1031	10K		SR 1/4W AIRCO SPEER	
R14	0201-1021	1K		SR 1/4W AIRCO SPEER	
R15	0206-5111	510 ohm, 5%		SR 1/4W AIRCO SPEER	
R16	0201-1011	100 ohm		SR 1/4W AIRCO SPEER	
R17	0201-2711	270 ohm		SR 1/4W AIRCO SPEER	
R18	0201-1021	1K		SR 1/4W AIRCO SPEER	
R19	0234-0011	POT., 1K, Cermet		3359W-1-102 BOURNS	
R20*		Factory Selected Value			
R21	0201-2731	27K		SR 1/4W AIRCO SPEER	
R22	0201-3941	390K		SR 1/4W AIRCO SPEER	
R23	0201-4731	47K		SR 1/4W AIRCO SPEER	
R24	0201-1831	18K		SR 1/4W AIRCO SPEER	
R25	0201-1021	1K		SR 1/4W AIRCO SPEER	
R26	0201-1031	10K		SR 1/4W AIRCO SPEER	
R27	0201-1221	1.2K		SR 1/4W AIRCO SPEER	
R28	0201-3321	3.3K		SR 1/4W AIRCO SPEER	
R29	0201-1031	10K		SR 1/4W AIRCO SPEER	
R30	0201-1021	1K		SR 1/4W AIRCO SPEER	
R31	0206-5111	510 ohm, 5%		SR 1/4W AIRCO SPEER	
R32	0201-1011	100 ohm		SR 1/4W AIRCO SPEER	
		SEMICONDUCTOR DEVICE: Diode	2		
CR1	0302-0002	1N4148			

REVISED 9/22/72
Supersedes P/L - 6/22/72

RAVEN ELECTRONICS CORPORATION

40472-03
DUAL AMPLIFIER — PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
CR2	0302-0002	1N4148			
		TRANSISTOR:	6		
Q1	0340-0008	Type 2N2222			
Q2	0341-0008	Type 2N2907			
Q3	0340-0008	Type 2N2222			
Q4	0340-0008	Type 2N2222			
Q5	0341-0008	Type 2N2907			
Q6	0340-0008	Type 2N2222			
		TRANSFORMER: Impedance	4		
T1	0441-0032	600 ohm		124-5 ADC	
T2	0441-0032	600 ohm		124-5 ADC	
T3	0441-0032	600 ohm		124-5 ADC	
T4	0441-0032	600 ohm		124-5 ADC	
	0510-0012	CONNECTOR: 18 pin	1	133-018-43 AMPHENOL	
	0612-0104	TERMINAL: Swage	12	2000C-1 USECO	
	1404-1721	BOARD, P.C.:	1		

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REVISED 9/22/72
Supersedes P/L - 6/22/72

FIRE UP SPARES LIST
40472-03

	Raven Stock Number
1 each 2N2222	0340-0008
1 each 2N2907	0341-0008
1 each 1N4148	0302-0002

RAVEN ELECTRONICS CORPORATION

TEST PROCEDURE
40172/40472-03 DUAL AMPLIFIER

1.0 TEST EQUIPMENT REQUIRED

VTVM	Triplett 850
AC VOLTMETER/DISTORTION ANALYZER	H.P. 331A or equivalent
SIGNAL GENERATOR, 600 ohm	H.P. 650A or equivalent
OSCILLOSCOPE	H.P. 130C or equivalent
24V DC POWER SUPPLY	
RESISTANCE DECADE	
TERMINATING RESISTOR, 600 ohm ±1%	

2.0 TEST EQUIPMENT SETUP

Set up the test equipment as shown in Figure 1.

3.0 "A" AMPLIFIER TESTS

3.1 Power Supply Connection.

3.1.1 Connect the Module as follows: Minus to pin A and plus to pin B.

3.1.2 Use the VTVM to monitor the supply voltage which must be -24V DC, ±1V.

3.2 Bias Adjustment.

3.2.1 Connect the Oscilloscope common to pin B and the probe to the collector of Q3.

3.2.2 Connect the Signal Generator to pins J and H. Set the frequency to 1 KHz and the level to -16 dBm.

3.2.3 Terminate pins C and D with 600 ohms. Set "A" GAIN ADJUST to maximum clockwise.

*3.2.4 Connect the Resistance Decade across terminals E1 and E2. Adjust the Decade to 100K.

*3.2.5 Adjust the Signal Generator level until the waveform displayed on the Oscilloscope is beginning to be clipped.

*See Note 1.

*3.2.6 Adjust the Resistance Decade and Signal Generator level until the clipping is minimized and symmetrical.

*3.2.7 Turn power "off"; remove the Resistance Decade and select the nearest E.I.A. value resistor to the resistance determined by the Decade and solder it across terminals E1 and E2.

3.2.8 Turn power "on". Recheck symmetry; if not symmetrical, repeat steps 3.2.4 through 3.2.6. Increase the Signal Generator level to the point where the signal just begins to clip.

3.3 Gain Impedance and Frequency Response

3.3.1 Connect the AC voltmeter/Distortion-Analyzer across pins C and D. The meter must read between +10 and +14 dBm.

3.3.2 Set the Signal Generator level to -20 dBm. Disconnect the Oscilloscope.

3.3.3 Adjust the Signal Generator level until the AC Voltmeter/Distortion Analyzer indicates 0 dBm. The Signal Generator level now must be between -22 dBm and -30 dBm.

3.3.4 Terminate the Signal Generator with 600 ohms. "A" OUTPUT level must decrease 3.5 ±0.2 dB. Remove the termination and terminate the AC Voltmeter/ Distortion Analyzer. "A" OUTPUT level must decrease 3.5 ±0.2 dB. Remove the additional termination.

3.3.5 The frequency response is checked by setting the indicated frequencies on the Signal Generator and comparing the reading of the AC Voltmeter/Distortion Analyzer to the acceptable reading. Adjust R3 for 0 dBm output with -20 dBm input.

GENERATOR SETTING	READING
200 Hz	0 ±2 dBm
300 Hz	0 ±1 dBm
400 Hz	0 ±.7 dBm
500 to 3500 Hz	0 ±.5 dBm
1 KHz	0 dBm (Ref.)
8 KHz	0 ±1 dBm
12 KHz	0 ±2 dBm

3.3.6 Measure the "A" OUTPUT distortion at +10 dBm, 1 KHz. This must be less than 1%

3.3.7 Disconnect the Signal Generator. Terminate pins H and J with 600 ohms. Measure the noise level of the amplifier output; noise level must be less than -60 dBm at maximum gain.

3.4 Test Completion of Amplifier "A"

Disconnect test equipment from the "A" Amplifier and continue to step 4.

4.0 "B" AMPLIFIER TESTS

4.1 Power Supply Connection.

4.1.1 Connect the Module as follows: Minus to pin V and plus to pin U.

4.1.2 Use the VTVM to monitor the supply voltage which must be -24V DC, ±1V.

4.2 Bias Adjustment.

4.2.1 Connect the Oscilloscope common to pin U and the probe to the collector of Q6.

4.2.2 Connect the Signal Generator to pins N and M. Set the frequency to 1 KHz and the level to -16 dBm.

4.2.3 Terminate pins S and T with 600 ohms. Set "B" GAIN ADJUST to maximum clockwise.

*4.2.4 Connect the Resistance Decade across terminals E3 and E4. Adjust the Decade to 100K.

*4.2.5 Adjust the Signal Generator level until the waveform displayed on the Oscilloscope is beginning to be clipped.

*4.2.6 Adjust the Resistance Decade and Signal Generator level until the clipping is minimized and symmetrical.

*4.2.7 Turn power "off"; remove the Resistance Decade and

select the nearest E.I.A. value resistor to the resistance determined by the Decade and solder it across terminals E3 and E4.

4.2.8 Turn power "on". Recheck symmetry; if not symmetrical, repeat steps 4.2.4 through 4.2.6. Increase the Signal Generator level to the point where the signal just begins to clip.

4.3 Gain Impedance and Frequency Response.

4.3.1 Connect the AC Voltmeter/Distortion Analyzer across pins S and T. The meter must read between +10 and +14 dBm.

4.3.2 Set the Signal Generator level to -20 dBm. Disconnect the Oscilloscope.

4.3.3 Adjust the Signal Generator level until the AC Voltmeter/Distortion Analyzer indicates 0 dBm. The Signal Generator level now must be between -22 dBm and -30 dBm.

4.3.4 Terminate the Signal Generator with 600 ohms. "B" OUTPUT level must decrease 3.5 ±0.2 dB. Remove the termination and terminate the AC Voltmeter/Distortion Analyzer. "B" OUTPUT level must decrease 3.5 ±0.2 dB. Remove the additional termination.

4.3.5 The frequency response is checked by setting the indicated frequencies on the Signal Generator and comparing the reading of the AC Voltmeter/Distortion Analyzer to the acceptable reading. Adjust R19 for 0 dBm output with -20 dBm input.

GENERATOR SETTING	READING
200 Hz	0 ±2 dBm
300 Hz	0 ±1 dBm
400 Hz	0 ±.7 dBm
500 to 3500 Hz	0 ±.5 dBm
1 KHz	0 dBm (Ref.)
8 KHz	0 ±1 dBm
12 KHz	0 ±2 dBm

4.3.6 Measure the "B" OUTPUT distortion at +10 dBm, 1 KHz. This must be less than 1%.

4.3.7 Disconnect the Signal Generator. Terminate pins M and N with 600 ohms. Measure the noise level of the amplifier output; noise level must be less than -60 dBm, at maximum gain.

4.3.8 This completes the Tests of Amplifier B.

5.0 CROSSTALK MEASUREMENTS

5.1 Crosstalk "A" to "B"

5.1.1 Connect pin B to U.

5.1.2 Connect pin A to V.

5.1.3 Connect Signal Generator to pins H and J.

5.1.4 Set Signal Generator to -20 dBm @ 1 KHz.

5.1.5 Terminate pins C and D with 600 ohms.

5.1.6 Set R3 and R19 maximum clockwise.

5.1.7 Level measured on the ACVM/DA (pins S and T) is the Crosstalk level. Level must be less than -60 dBm.

5.2 Crosstalk "B" to "A"

5.2.1 Remove Signal Generator from pins H and J; connect to pins M and N.

5.2.2 Disconnect the 600 ohm termination from pins M and N. Connect the 600 ohms to pins H and J.

5.2.3 Connect the ACVM/DA to pins C and D.

5.2.4 Level measured on the ACVM/DA (pins C and D) is the Crosstalk level. Level must be less than -60 dBm.

6.0 TEST COMPLETION OF MODULE

Disconnect all test equipment from the Module. Stamp the Module and the Test Data Card with your Test Stamp.

7.0 Q.A. ACCEPTANCE

7.1 Verify that test results are within specifications.

7.2 Verify that Test Data Card is properly filled out.

7.3 Re-inspect the Module per established criteria.

7.4 Stamp the Module and Test Data Card with the "ACCEPTED" stamp.

*Note: Paragraphs 3.2.4 through 3.2.7 and 4.2.4 thru 4.2.7 do not require witnessing by customer Q.A. and shall be accomplished prior to said customer Q.A.

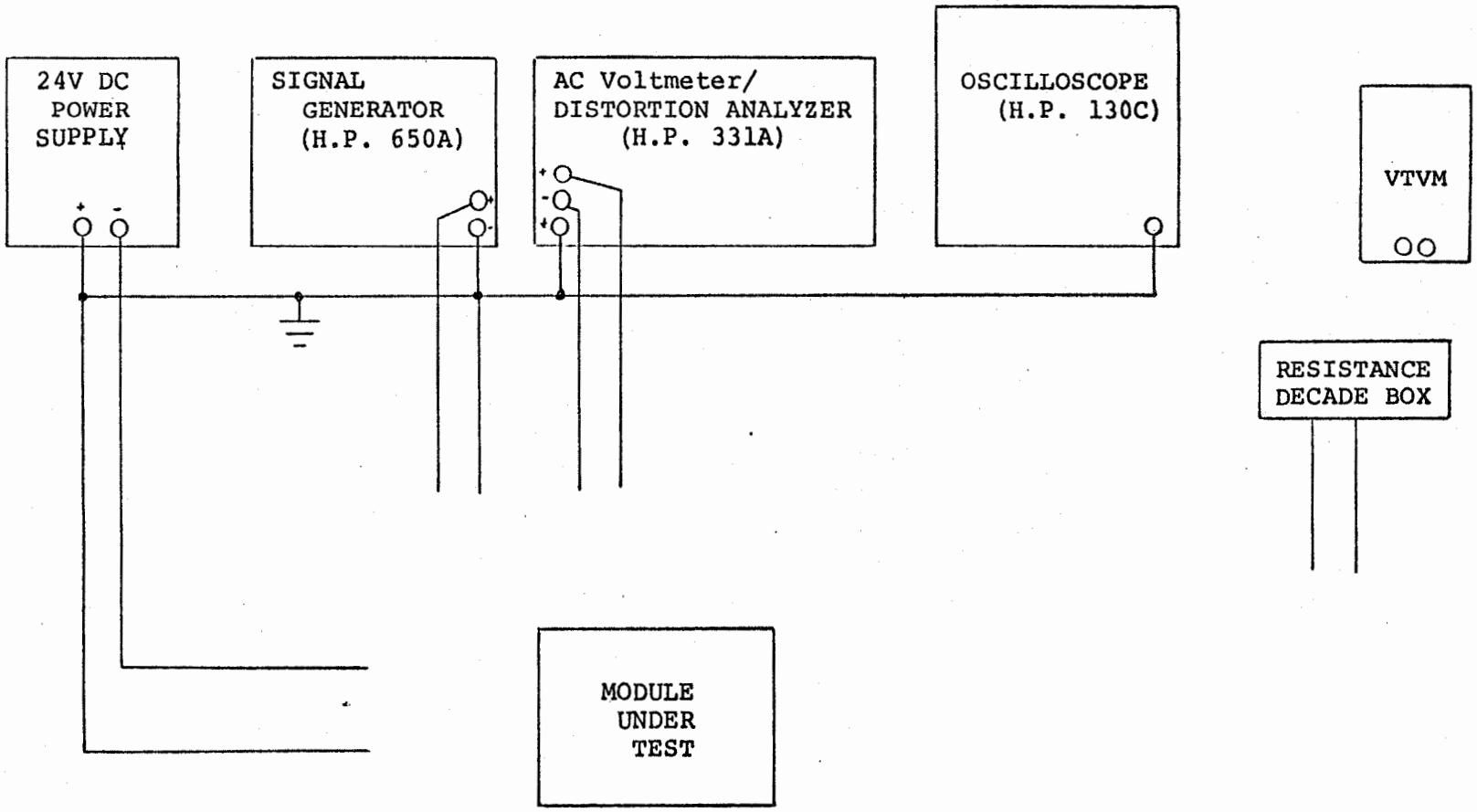
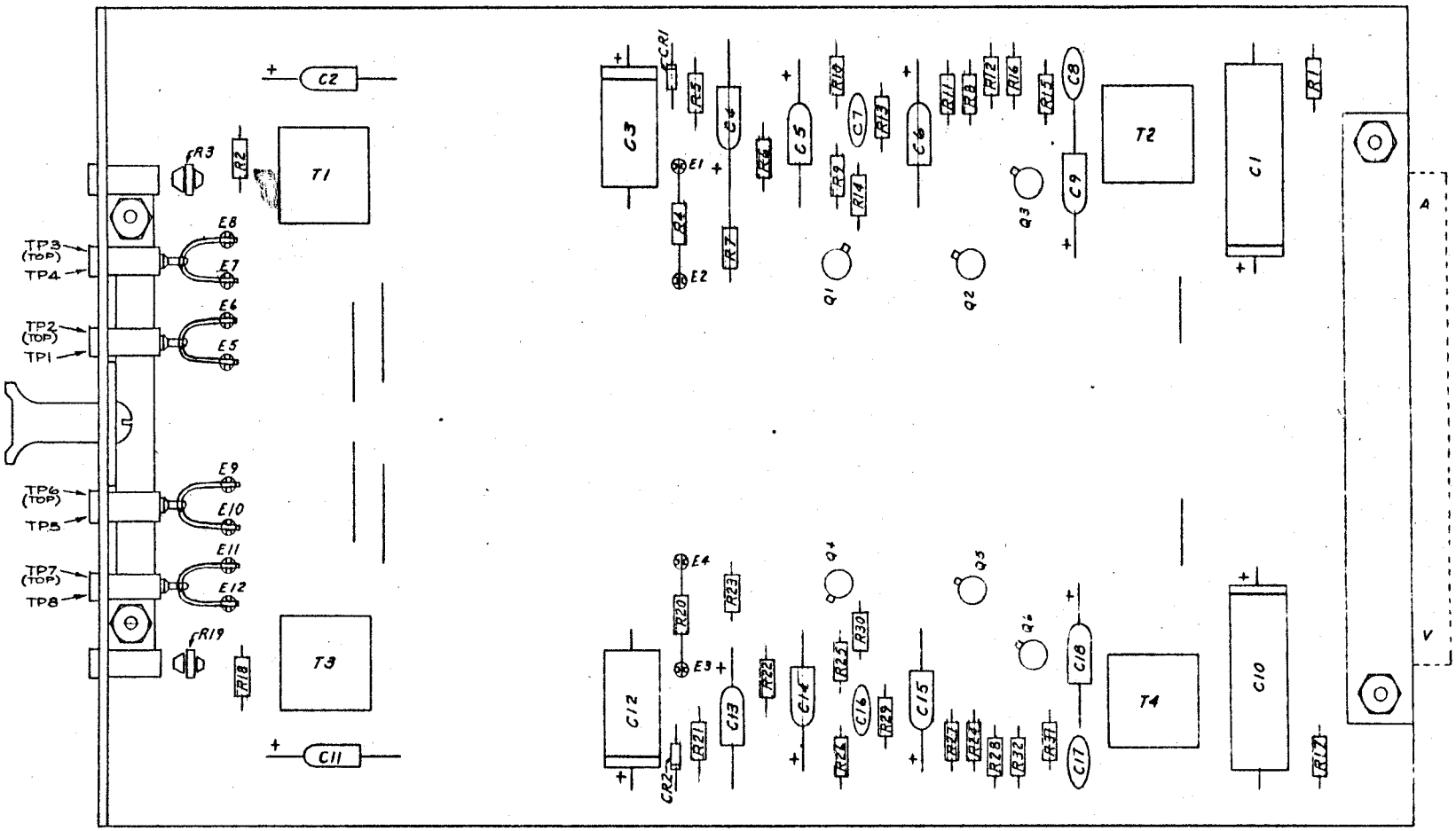


Figure 1. ⏚ Denotes preferred common earth ground.



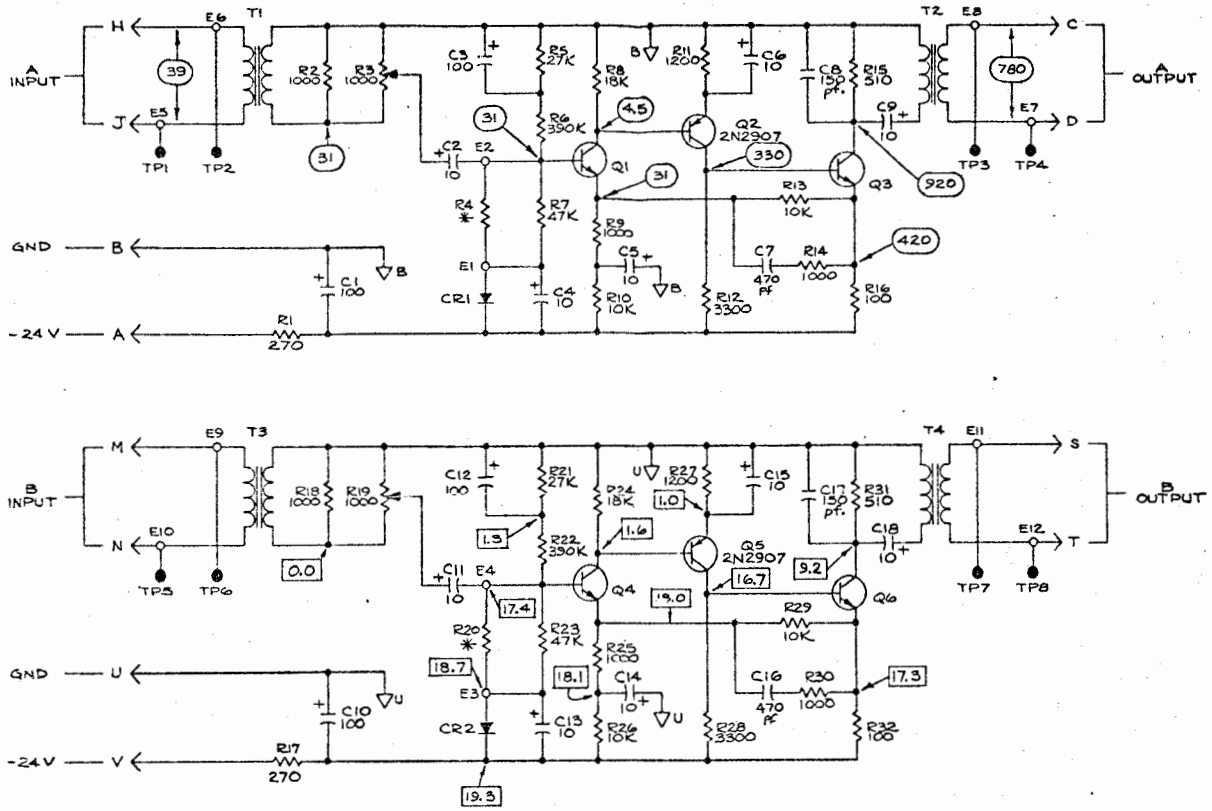
LTR	REVISION	BY	DATE
A	C7 & C16 WERE EPOXY	JJ	7-26-72

DRAWN BY	WJB
CHECKED BY	JH
APPROVED BY	JN
DATE	5-19-72

RAVEN ELECTRONICS CORP.
884 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 359-3700

NAME: DUAL AMPLIFIER

KEY	SIZE	DWG NO.
40472-03	C	404-6721



NOTE:

1. UNLESS NOTED:
   - A. ALL RESISTANCE IN OHMS
   - B. ALL CAPACITANCE IN UFD.
   - C. ALL DIODES IN4148
   - D. ALL TRANSISTORS 2N2222
2. * DENOTES SELECTED VALUE 220K TYP.
3. [ ] NEG. D.C. VOLTS
   ( ) AC RMS MILLIVOLTS
4. ALL VOLTAGES REFERENCED TO GRD. ALL VOLTAGES TYPICAL

LTR.	REVISION	BY	DATE
A	R7 & R23 WERE 39K C7 & C16 WERE .001	JN	7/25/72

DRAWN BY: JN
CHECKED BY:
APPROVED BY: WHW
DATE: 5-19-72

RAVEN ELECTRONICS CORP.
604 FREEPORT BLVD.
SPARKS, NEVADA 89431
(702) 358-3108

PANEL: DUAL AMPLIFIER

NEXT ASS'Y: 401/40472-03
SIZE: C
DRG NO.: 404-1721

NOTE: 41055-03 Later Model Systems
40155-03 Horizontal Model
40455-03 Early Model Systems
All models are electrically identical.
410--- and 404--- are mechanically interchangeable.

41055/4 WAY-4 WIRE BRIDGE
40155/40455-03 MODULE

1. APPLICATION

The 40455-03 4W/4W Bridge Module provides a method of interconnecting, terminating and summing 4-wire voice frequency signals.

2. SPECIFICATIONS

Input Impedance:	600 ohms, ± 10%
Output Impedance:	600 ohms, ± 10%
Insertion Loss:	15 dB, ± ½dB
Input Level:	+20 dBm, 600 ohm, maximum
Transhybrid Loss:	Greater than 60 dB
Frequency Response:	0.3 to 3 KHz, flat

3. THEORY OF OPERATION

3.1 The module contains strappable pads and a bridge for the purpose of terminating up to four 4-wire lines. Test points are provided on each Input Leg of the Module to measure the input levels.

3.2 Pad Strapping Options.

PAD	STRAPPING FOR PAD IN	STRAPPING FOR PAD OUT
Leg 1	E11 to E12 & E14 to E15	E11 to E14 & E13 to E16
Leg 2	E2 to E4 & E3 to E5	E2 to E3 & E7 to E8
Leg 3	E17 to E18 & E20 to E21	E17 to E20 & E19 to E22
Leg 4	E28 to E30 & E 29 to E31	E25 to E26 & E30 to E31

NOTE: TWO STRAPS ARE REQUIRED TO MAKE THE CORRECT CONNECTION WHETHER THE PAD IS "IN" OR "OUT". As an example: to connect the Leg 3 pad "in" the circuit, strap E17 to E18 and E20 to E21.

3.3 Any input is connected to three other outputs through resistors, which produce a 15 dB insertion loss. Because of the bridge configuration, the signal on the input leg does not get to its own output.

3.4 Refer to Schematic 404-1555. All legs of the bridge work in an identical manner. Therefore, the following discussion will

be limited to Leg 1 only.

3.5 A signal is applied to LEG 1 IN, pins L and K. The signal is presented to a 9 dB pad, which may be bypassed if no attenuation is desired. If the pad is strapped into the circuit, there will be a -24 dB attenuation from the input to any of the other three outputs.

3.6 The 4W/4W Bridge receives the signals from the pad (if strapped in) and attenuates them by -15 dB, and transfers them to the OUT terminals of legs 2,3 and 4.

4. MAINTENANCE AND ADJUSTMENTS

4.1 There is no alignment or adjustment needed on this Module.

4.2 Troubleshooting of the Module is limited to ohmic checks of the resistors or broken tracks of the printed circuit board.

4.3 Module test. The following procedure should be performed on all four legs.

4.3.1 Insert signal of 0 dBm level on leg 1 input; 1 KHz frequency.

4.3.2 Check for -15 dBm output level on leg 2,3 and 4 output.

4.3.3 Check for less than -60 dBm output level on leg 1 output.

4.3.4 Repeat the above procedure at 300 Hz and 3 KHz.

5. PARTS LIST

The following parts list contains all parts associated with the 40455-03 Module. Unless otherwise specified, part numbers are Raven Electronics Corporation part numbers.

6. REFERENCE DIAGRAMS

40455-03 4W/4W, Schematic Diagram 404-155, dtd 5/9/72

RAVEN ELECTRONICS CORPORATION

40455-03
4W/4W BRIDGE

PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
	4404-0555-03	40455-03 4W/4W BRIDGE MODULE		40455-03	
	1404-3553	PANEL	1		
	0608-0201	Test Point, White	4	SKT10-W SEALECTRO	
	0608-0202	Test Point, Black	4	SKT10-B SEALECTRO	
	1404-2431	HANDLE	1		
	1404-2420	BRACKET	1		
	4404-1555	4W/4W BRIDGE P.C. BOARD	1	DWG REF 404-1551, 5/9/72	
		Consisting of:			
		RESISTOR: Metal film fixed; 1/2W 1% unless otherwise specified	40		
R1	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
R2	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	
R3	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	
R4	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
R5	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R6	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R7	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R8	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R9	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R10	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R11	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R12	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R13	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R14	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R15	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R16	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R17	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	
R18	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
R19	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
R20	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	
R21	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	

912

REVISED 9/20/72
Supersedes P/L - 6/28/72

RAVEN ELECTRONICS CORPORATION

40455-03
4W/4W BRIDGE

PARTS LIST

REF. NO.	RAVEN STOCK NUMBER	DESCRIPTION	QTY.	MFG. NO. & NAME	FSN or JAN NO.
R22	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
R23	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
R24	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	
R25	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R26	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R27	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R28	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R29	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R30	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R31	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R32	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R33	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R34	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R35	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R36	0212-8060	806 ohm		NC6/RN65C CORNING GLASS	
R37	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
R38	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	
R39	0212-1271	1270 ohm		NC6/RN65C CORNING GLASS	
R40	0212-3650	365 ohm		NC6/RN65C CORNING GLASS	
	0510-0012	CONNECTOR: 18 pin	1	133-018-43 AMPHENOL	
	0612-0104	TERMINAL: Swage	32	2000C-1 USECO	
	1404-1555	P.C. BOARD:	1		

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REVISED 9/20/72
Supersedes P/L - 6/28/72

TEST PROCEDURE
40155/40455-03 4 WAY/4 WIRE BRIDGE

1.0 GENERAL

Complete the Test Data Card as required for each step of this procedure. Follow the procedure carefully. DO NOT CHANGE ANY SETTING UNTIL INSTRUCTED TO DO SO. If difficulties are encountered, refer to the Troubleshooting Procedure for this Module.

2.0 TEST EQUIPMENT REQUIRED

SIGNAL GENERATOR, 600 ohms H.P. 650A or equivalent
AC VOLTMETER/DISTORTION ANALYZER H.P. 331A or equivalent
7 each, 604 ohm TERMINATIONS
2 each, BALANCED 600/600 ohm TRANSFORMER

3.0 TEST DATA

Complete the Test Data Card by filling in levels, measurements, equipment, etc. as obtained in each step of this procedure.

4.0 TEST SETUP

Set up the test equipment as shown in Figure 1.
NOTE: FOR THE PURPOSES OF THIS TEST PROCEDURE, "Measure the level" means to do the following:

1. Remove the termination from the indicated pins.
2. Connect the leads from the transformer on the AC VM/DA as shown in Figure 1 across the indicated pins.
3. Note the level shown on the AC VM/DA.
4. Disconnect the transformer leads and replace the termination.

5.0 INPUT, OUTPUT AND ISOLATION TESTS

5.1 Place 604 ohm terminations across pins as follows: U and V, C and D, M and N, F and E, P and R, J and H, S and T, (7 required).

5.2 Connect Signal Generator across pins K and L. Adjust the Signal Generator level to +10 dBm plus loss of the transformer and the frequency to 1 KHz. DO NOT CHANGE THIS SETTING UNTIL INSTRUCTED TO DO SO.

5.3 "Measure the level" across the pins indicated. The level obtained must be -14 dBm, ±.5 dBm.

U and V
M and N
P and R

5.4 "Measure the level" across pins S and T. The level obtained must be less than -74 dBm.

5.5 Disconnect the AC VM/DA and Signal Generator from the Module. Remove the termination from pins C and D and connect it across pins K and L.

5.6 Connect the Signal Generator to pins C and D.

5.7 "Measure the level" across the pins indicated. The level obtained must be -14 dBm, ±,5 dBm.

M and N
P and R
S and T

5.8 "Measure the level" across pins U and V. The level obtained must be less than -74 dBm.

5.9 Disconnect the AC VM/DA and the Signal Generator from the Module. Remove the termination from pins F and E and connect it across pins C and D.

5.10 Connect the Signal Generator to pins F and E.

5.11 "Measure the level" across the pins indicated. The level obtained must be -14 dBm, ±.5 dBm.

P and R
S and T
U and V

5.12 "Measure the level" across pins M and N. The level obtained must be less than -74 dBm.

5.13 Disconnect the AC VM/DA and the Signal Generator from the Module. Remove the termination from pins J and H and connect it across pins F and E.

5.14 Connect the Signal Generator to pins J and H.

5.15 "Measure the level" across the pins indicated. The level obtained must be -14 dBm, ±.5 dBm.

S and T
U and V
M and N

5.16 "Measure the level" across pins P and R. The level obtained must be less than -74 dBm.

6.0 TEST COMPLETION

The tests are completed on this Module. Disconnect test equipment. Stamp Module and Test Data Card with your Test Stamp.

7.0 Q. A. ACCEPTANCE

7.1 Verify that test results are within specifications.

7.2 Verify that Test Data Card is properly filled out.

7.3 Re-inspect Module per established criteria.

7.4 Stamp Module and Test Data Card with "ACCEPTED" Stamp.