



Rockwell
International

instructions

Frequency Display (637-1781-())

Collins Telecommunications Products Division

523-0767975-004211

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1. DESCRIPTION

The Frequency Display 635-1781-() consists of two subassemblies hard-wired together. One subassembly, the frequency display driver board, contains the logic and decoder/driver circuits. The other, the frequency display board, contains the 7-segment displays. The subassemblies are 2-layer circuit boards with a cable connector on the section containing the decoder/drivers. Figure 1 is a picture of the assembled subassemblies.



TP5-2370-017

Frequency Display
Figure 1

2. PRINCIPLES OF OPERATION

2.1 General

The frequency display configuration differences are as follows:

- 637-1781-001, -006, 100 Hz operating frequency display and no BFO frequency display.
- 637-1781-002, -007, 10 Hz operating frequency display and no BFO frequency display.
- 637-1781-003, -008, 10 Hz operating frequency display and BFO frequency display of $\pm 0-9990$ Hz (operating frequency can be expanded to 1 Hz by adding display device U27).
- 637-1781-004, -009, 1 Hz operating frequency display and BFO frequency display of $\pm 0-9990$ Hz.
- 637-1781-005, -010, 100 Hz operating frequency display and no BFO frequency display (can be expanded to 10/1 Hz operating frequency display and/or BFO frequency display by adding display devices U26/U27 and/or U15 through U19).

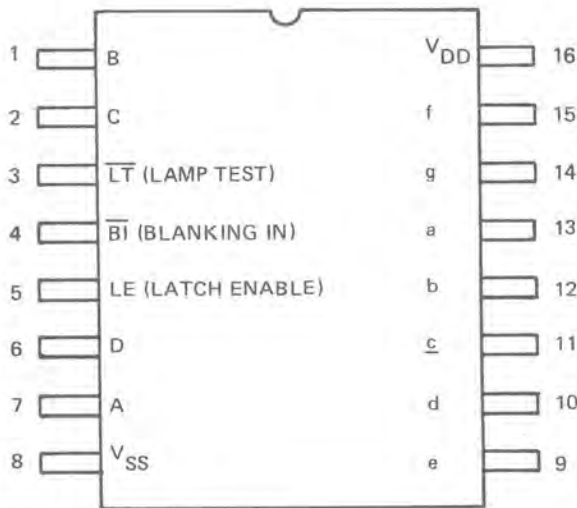
2.2 Theory of Operation (Refer to figure 4.)

For each frequency digit, a 4-bit binary input is applied to the decoder/driver. This input data is decoded into seven binary outputs. These logic-level outputs are applied directly to the 7-segment display associated with the decoder/driver. Each output causes a certain LED segment to light to form a part of the numeral equivalent to the 4-bit binary input to the board.

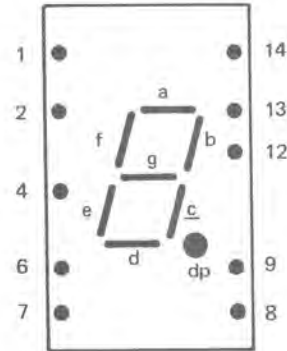
Figure 2 shows the decoder/driver input-output truth table and the 7-segment display connections.

The units and tens megahertz displays are blanked if the frequency is not within the 1- to 30-MHz range (for which these digits would be needed). This suppresses the leading zeros in lower frequency displays. The blanking (suppression) input (\overline{BI} at logic 0 level) is generated by OR gates U6B-U6D. When all inputs

NOTICE: This section replaces third edition dated 1 January 1979.



BCD-TO-7-SEGMENT DECODER/DRIVER



TRUTH TABLE

INPUTS					OUTPUTS							DISPLAY
LE	BI	LT	D	C B A	a	b	c	d	e	f	g	
0	0	1	X	X X X	0	0	0	0	0	0	0	BLANK
0	1	1	0	0 0 0	1	1	1	1	1	1	0	0
0	1	1	0	0 0 1	0	1	1	0	0	0	0	
0	1	1	0	0 1 0	1	1	0	1	1	0	1	
0	1	1	0	0 1 1	1	1	1	1	0	0	1	
0	1	1	0	1 0 0	0	1	1	0	0	1	1	1
0	1	1	0	1 0 1	1	0	1	1	0	1	1	
0	1	1	0	1 1 0	0	0	1	1	1	1	1	
0	1	1	0	1 1 1	1	1	1	0	0	0	0	
0	1	1	1	0 0 0	1	1	1	1	1	1	1	1
0	1	1	1	0 0 1	1	1	1	0	0	1	1	
0	1	1	1	0 1 0	0	0	0	0	0	0	0	
0	1	1	1	0 1 1	0	0	0	0	0	0	0	
0	1	1	1	1 0 0	0	0	0	0	0	0	0	BLANK
0	1	1	1	0 1 0	0	0	0	0	0	0	0	BLANK
0	1	1	1	0 1 1	0	0	0	0	0	0	0	BLANK
0	1	1	1	1 0 0	0	0	0	0	0	0	0	BLANK
0	1	1	1	1 0 1	0	0	0	0	0	0	0	BLANK
0	1	1	1	1 1 0	0	0	0	0	0	0	0	BLANK
0	1	1	1	1 1 1	0	0	0	0	0	0	0	BLANK

X = DON'T CARE

7-SEGMENT LED DISPLAY

PIN NO.	PIN CONNECTIONS
1	ANODE F
2	ANODE G
3	NO PIN
4	COMMON CATHODE
5	NO PIN
6	ANODE E
7	ANODE D
8	ANODE C
9	ANODE DP
10	NO PIN
11	NO PIN
12	COMMON CATHODE
13	ANODE B
14	ANODE A

TP5-2300-011

Decoder/Driver and Display Elements Operation
Figure 2

to the decoder/driver are at logic 0, the OR gate outputs cause the BI input to be logic 0, causing a blanking command to be applied to the display. For this input to the indicators, no LED segments light and the display remains off, or blank.

3. TESTING/TROUBLESHOOTING PROCEDURES

3.1 Test Equipment and Power Requirements

Test equipment and power sources required to test and troubleshoot the frequency display board are

listed in the maintenance section of this instruction book.

3.2 Testing

The test procedures in table 1 check the total performance of the frequency display. These test procedures permit isolation of a fault to a specific component or circuit when the results are used with the schematic to circuit trace the fault.

Table 1. Frequency Display Testing and Troubleshooting Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL																																	
1. Test setup	Set PWR switch on and CONT switch to TEST. Set FREQUENCY KHZ display for all 0's.																																			
2. Zero suppression and decimal point display	Set FREQUENCY KHZ display for 500 kHz. Observe FREQUENCY KHZ readout display.	Units' and tens' zeros of MHz range suppressed (blanked). Zeros for kHz and tenths displayed. Decimal point after fifth digit from left displayed.	If MHz-range zeros displayed, check U6B, U6C, U6D, and U7. If decimal point not displayed, check U24.																																	
3. Digit selection and display (applicable only when used with thumb-wheel frequency control switches)	<p>Rotate each FREQUENCY kHz switch through all its positions. (Leftmost switch has positions 0, 1, and 2 only.) Observe readout display to see that corresponding selected digit is displayed.</p> <p style="text-align: center;">Note</p> <p>Wait approx 1 second after switching for time delay to elapse and circuit to strobe in new digit.</p> <p>If switch is changed too slowly, strobe signal may be generated while old number is still applied to circuit. In this case, the new number will not be displayed even though switch is set to new position. Switch away from and back to new position if this occurs.</p>	Readout digit displayed corresponds to that selected on thumb-wheel switch.	<p>Refer to schematic diagram and check decoder/driver and readout unit corresponding to digit showing malfunction.</p> <p>For normal display, decoder/driver inputs and outputs at logic 1 are listed below for each digit.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">DIGIT</th> <th style="text-align: left;">INPUTS</th> <th style="text-align: left;">OUTPUTS</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>(all 0's)</td> <td>a+b+c+d+e+f</td> </tr> <tr> <td>1</td> <td>A</td> <td>b+c</td> </tr> <tr> <td>2</td> <td>B</td> <td>a+b+c+e+g</td> </tr> <tr> <td>3</td> <td>A+B</td> <td>a+b+c+d+g</td> </tr> <tr> <td>4</td> <td>C</td> <td>b+c+f+g</td> </tr> <tr> <td>5</td> <td>A+C</td> <td>a+c+d+f+g</td> </tr> <tr> <td>6</td> <td>B+C</td> <td>c+d+e+f+g</td> </tr> <tr> <td>7</td> <td>A+B+C</td> <td>a+b+c</td> </tr> <tr> <td>8</td> <td>D</td> <td>a+b+c+d+e+f+g</td> </tr> <tr> <td>9</td> <td>A+D</td> <td>a+b+c+f+g</td> </tr> </tbody> </table>	DIGIT	INPUTS	OUTPUTS	0	(all 0's)	a+b+c+d+e+f	1	A	b+c	2	B	a+b+c+e+g	3	A+B	a+b+c+d+g	4	C	b+c+f+g	5	A+C	a+c+d+f+g	6	B+C	c+d+e+f+g	7	A+B+C	a+b+c	8	D	a+b+c+d+e+f+g	9	A+D	a+b+c+f+g
DIGIT	INPUTS	OUTPUTS																																		
0	(all 0's)	a+b+c+d+e+f																																		
1	A	b+c																																		
2	B	a+b+c+e+g																																		
3	A+B	a+b+c+d+g																																		
4	C	b+c+f+g																																		
5	A+C	a+c+d+f+g																																		
6	B+C	c+d+e+f+g																																		
7	A+B+C	a+b+c																																		
8	D	a+b+c+d+e+f+g																																		
9	A+D	a+b+c+f+g																																		
4. Frequency display (applicable only when used with incremental tuning frequency control)	Set DIAL switch to FINE. Rotate TUNING dial through complete frequency range and observe FREQUENCY KHZ display.	All digits are displayed in sequence through complete frequency range of unit under test.	Same as test 3.																																	

Table 1. Frequency Display Testing and Troubleshooting Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
<p>5. Vbfo digit selection and display (applicable only when used with thumb-wheel dvbfo control switches)</p>	<p>Set BFO switch to VAR. Rotate each VBFO OFFSET Hz switch through all its positions. Observe readout display to see that corresponding selected digit is displayed.</p> <p style="text-align: center;">Note</p> <p>Wait approx 1 second after switching for time delay to elapse and circuit to strobe in new digit.</p> <p>If switch is changed too slowly, strobe signal may be generated while old number is still applied to circuit. In this case, the new number will not be displayed even though switch is set to new position. Switch away from and back to new position if this occurs.</p>	<p>Readout digit displayed corresponds to that selected on thumb-wheel switch.</p>	<p>Same as test 3.</p>
<p>6. Vbfo display (applicable only when used with incremental tuning vbfo control)</p>	<p>Set BFO switch to TUNE. Rotate TUNING dial through complete vbfo range and observe VBFO OFFSET HZ display.</p>	<p>All digits are displayed in sequence through complete vbfo range of unit under test.</p>	<p>Same as test 3.</p>

4. REPAIR

Repair of the frequency display is accomplished using standard maintenance and planar card repair procedures. Refer to the maintenance section of this instruction book for planar card repair procedures.

5. PARTS LIST/DIAGRAMS

This paragraph assists in identification, requisition, and issuance of parts and in maintenance of the equipment. A parts location illustration, schematic diagram, parts list tabulation, and modification history are included in the schematic diagram (figure 3). The parts location illustration is a design engineering drawing that shows exact component placement on the circuit cards.

Use the reference designator indicated on the schematic and parts location diagram to locate parts in the parts list tabulation. The Collins part number and description are listed for each reference designator.

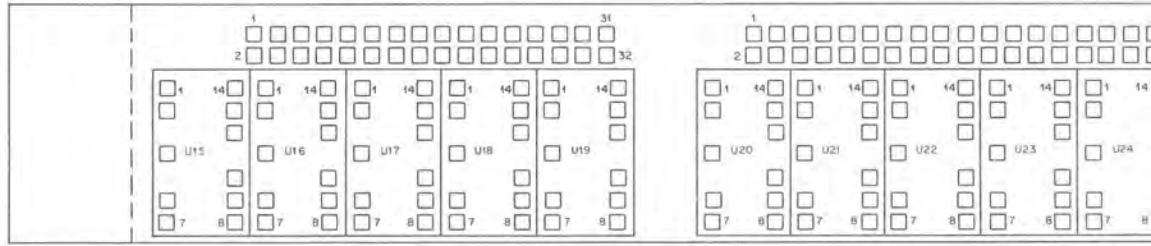
Modifications are identified by an alphanumeric identifier assigned to each design change. These identifiers are referenced in the DESCRIPTION column of the parts list in parentheses and on the schematic diagram inside an arrow that points to the change. Each change relates to the revision identifier (REV)

stamped on the circuit card/subassembly and is listed in the EFFECTIVITY column of the modification history.

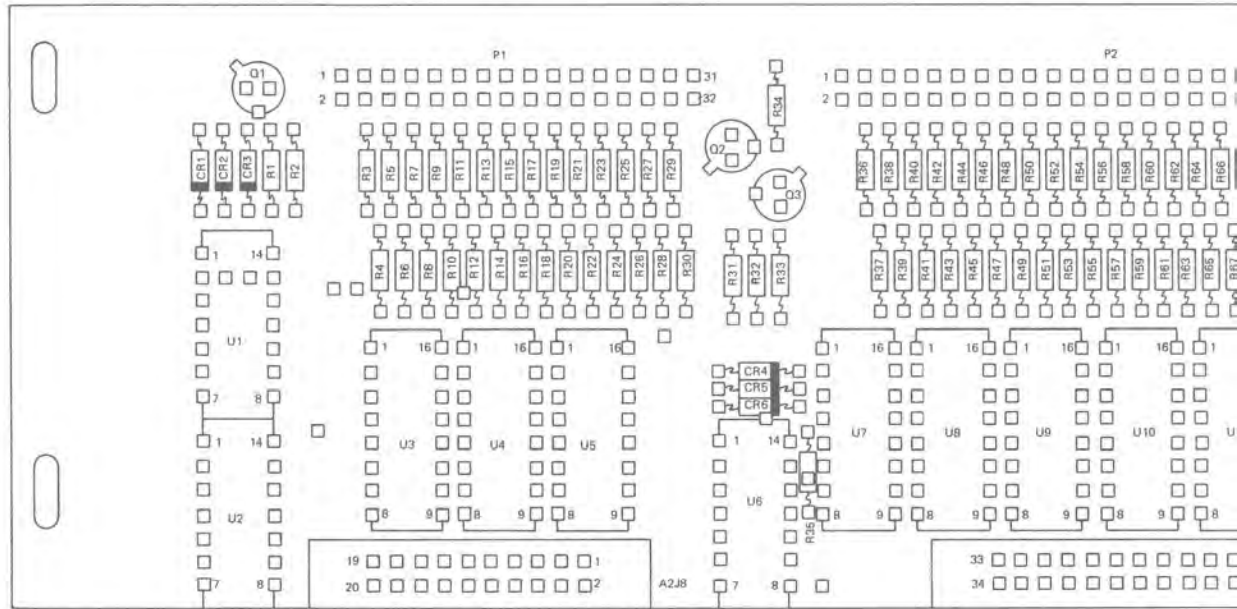
Listed below are the circuit cards/subassemblies with the latest effectivity covered by these instructions.

<u>COLLINS CIRCUIT CARD/ SUBASSEMBLY</u>	<u>PART NUMBER</u>	<u>LATEST EFFECTIVITY</u>
Frequency Display	637-1781-001	REV B
Frequency Display	637-1781-002	REV B
Frequency Display	637-1781-003	REV F
Frequency Display	637-1781-004	REV F
Frequency Display	637-1781-005	REV F
Frequency Display	637-1781-006	REV G
Frequency Display	637-1781-007	REV G
Frequency Display	637-1781-008	REV G
Frequency Display	637-1781-009	REV G
Frequency Display	637-1781-010	REV G
Frequency Display Driver Board	635-0896-001	REV H
Frequency Display Driver Board	635-0896-002	REV H
Frequency Display Driver Board	635-0896-004	REV G
Frequency Display Board	635-0897-001	REV C
Frequency Display Board	635-0897-002	REV C
Frequency Display Board	635-0897-003	REV D
Frequency Display Board	635-0897-004	REV E
Frequency Display Board	635-0897-005	REV F
Frequency Display Board	635-0897-006	REV F
Frequency Display Board	635-0897-007	REV F
Frequency Display Board	635-0897-008	REV F

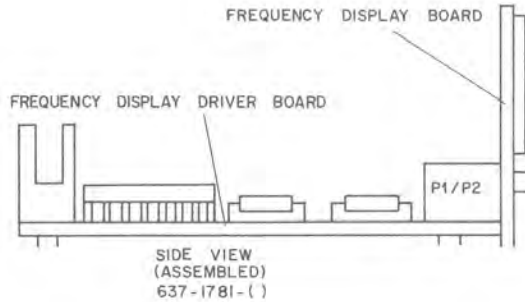
①

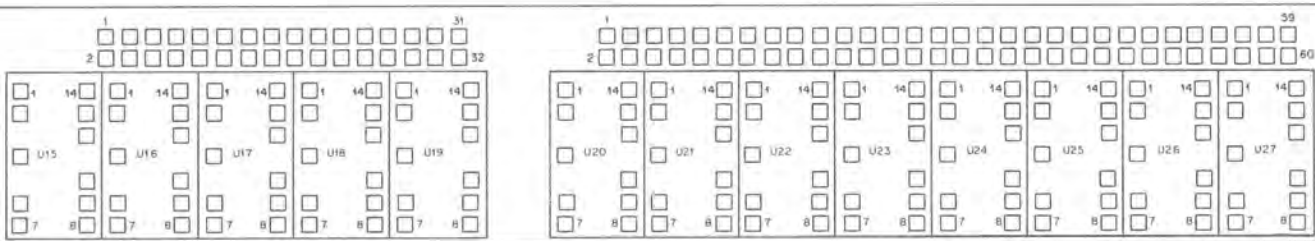


FREQUENCY DISPLAY BOARD 635-0897- ()

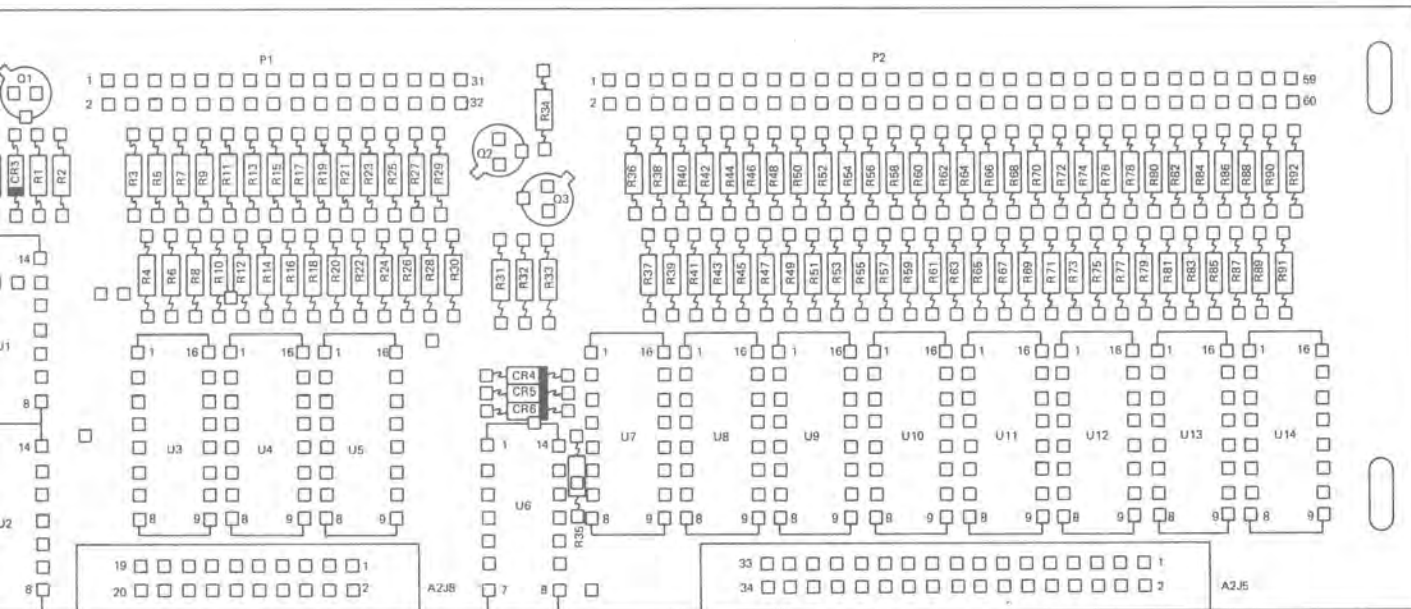


FREQUENCY DISPLAY DRIVER BOARD 635-0896- ()

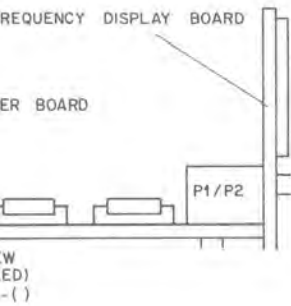




FREQUENCY DISPLAY BOARD 635-0897-()



FREQUENCY DISPLAY DRIVER BOARD 635-0896-()



NOTE:

- ① FREQUENCY DISPLAY BOARD 635-0895-005, -006, -007, AND -008 IS A SHORTENED BOARD.

TP5-1039-014

Frequency Display, Schematic Diagram
Figure 3 (Sheet 1 of 4)

PARTS LIST

PARTS

REF DES	DESCRIPTION	COLLINS PART NUMBER	USABLE ON CODE	MFR CODE	MFR PART NUMBER	REF DES	DESCRIPTION
	FREQUENCY DISPLAY	637-1781-001	A				
	FREQUENCY DISPLAY	637-1781-002	B				
	FREQUENCY DISPLAY	637-1781-003	C				
	FREQUENCY DISPLAY	637-1781-004	D				
	FREQUENCY DISPLAY	637-1781-005	E				
	FREQUENCY DISPLAY	637-1781-006	F				
	FREQUENCY DISPLAY	637-1781-007	G				
	FREQUENCY DISPLAY	637-1781-008	H				
	FREQUENCY DISPLAY	637-1781-009	J				
	FREQUENCY DISPLAY	637-1781-010	K				
	FREQUENCY DISPLAY DRIVER BD	635-0896-001	A,F				
	FREQUENCY DISPLAY DRIVER BD	635-0896-002	B,G				
	FREQUENCY DISPLAY DRIVER BD	635-0896-004	C,D,E,H				
			J,K				
	FREQUENCY DISPLAY BD	635-0897-001	A,E				
	FREQUENCY DISPLAY BD	635-0897-002	B				
	FREQUENCY DISPLAY BD	635-0897-003	C				
	FREQUENCY DISPLAY BD	635-0897-004	D				
	FREQUENCY DISPLAY BD	635-0897-005	F,K				
	FREQUENCY DISPLAY BD	635-0897-006	G				
	FREQUENCY DISPLAY BD	635-0897-007	H				
	FREQUENCY DISPLAY BD	635-0897-008	J				
	FREQUENCY DISPLAY DRIVER BD	635-0896-001					
CR1-CR3	NOT USED						
CR4-CR6	SEMICONV DEVICE IN4454	353-3644-010		03508	IN4454GE		
J1-J4	NOT USED						
J5	HOUSING,CONN,EL	372-0043-450		00779	87478-5		
P1	CONNECTOR,HDR	372-0028-030		00779	1-87566-6		
P2	CONNECTOR,HDR	372-0028-040		00779	3-87566-0		
R1-R34	NOT USED						
R35	RESISTOR,FXD CHPSN, 1MEGO, 10%, 1/8W	745-2449-000		81349	RCR05G105KS		
R36-R78	RESISTOR,FXD CHPSN, 180 OHMS, 10%, 1/8W	745-2314-000		81349	RCR05G181KS		
U1-U5	NOT USED						
U6	INTEGRATED CIRCUIT MC14071BCP	351-8287-010		04713	MC14071BCP		
U7-U12	INTEGRATED CIRCUIT MC14511BCP	351-8304-010		04713	MC14511BCP		
	FREQUENCY DISPLAY DRIVER BD	635-0896-002	B,G				
CR1-CR3	NOT USED						
CR4-CR6	SEMICONV DEVICE IN4454	353-3644-010		03508	IN4454GE		
J1-J4	NOT USED						
J5	HOUSING,CONN,EL	372-0043-450		00779	87478-5		
P1	CONNECTOR,HDR	372-0028-030		00779	1-87566-6		
P2	CONNECTOR,HDR	372-0028-040		00779	3-87566-0		
R1-R34	NOT USED						
R35	RESISTOR,FXD CHPSN, 1MEGO, 10%, 1/8W	745-2449-000		81349	RCR05G105KS		
R36-R85	RESISTOR,FXD CHPSN, 180 OHMS, 10%, 1/8W	745-2314-000		81349	RCR05G181KS		
U1-U5	NOT USED						
U6	INTEGRATED CIRCUIT MC14071BCP	351-8287-010		04713	MC14071BCP		
U7-U13	INTEGRATED CIRCUIT MC14511BCP	351-8304-010		04713	MC14511BCP		
	FREQUENCY DISPLAY DRIVER BD	635-0896-004	C,D,E,H				
			J,K				
CR1-CR6	SEMICONV DEVICE IN4454	353-3644-010		03508	IN4454GE		
J1-J4	NOT USED						
J5	HOUSING,CONN,EL	372-0043-450		00779	87478-5		
J6,J7	NOT USED						
J8	HOUSING,CONN,EL	372-0043-380		00779	87478-3		
Q1-Q3	TRANSISTOR 2N2222A	352-0661-020		07263	2N2222A		
R1	RESISTOR,FXD CHPSN, 470K, 10%, 1/8W	745-2437-000		81349	RCR05G474KS		
R2	RESISTOR,FXD CHPSN, 47K, 10%, 1/8W	745-2401-000		81349	RCR05G473KS		
R3-R30	RESISTOR,FXD CHPSN, 180 OHMS, 10%, 1/8W	745-2314-000		81349	RCR05G181KS		
R31	RESISTOR,FXD CHPSN, 100K, 10%, 1/8W	745-2413-000		81349	RCR05G104KS		
R32	RESISTOR,FXD CHPSN, 470K, 10%, 1/8W	745-2437-000		81349	RCR05G474KS		
R33	RESISTOR,FXD CHPSN, 3.9K, 10%, 1/8W	745-2362-000		81349	RCR05G392KS		
R34	RESISTOR,FXD CHPSN, 470K, 10%, 1/8W	745-2437-000		81349	RCR05G474KS		
R35	RESISTOR,FXD CHPSN, 1MEGO, 10%, 1/8W	745-2449-000		81349	RCR05G105KS		
R36-R92	RESISTOR,FXD CHPSN, 180 OHMS, 10%, 1/8W	745-2314-000		81349	RCR05G181KS		
U1	INTEGRATED CIRCUIT MC14081BCP	351-8287-030		04713	MC14081BCP		
U2	INTEGRATED CIRCUIT MC14072BCP	351-8287-040		04713	MC14072BCP		
U3-U5	INTEGRATED CIRCUIT MC14511BCP	351-8304-010		04713	MC14511BCP		
U6	INTEGRATED CIRCUIT MC14071BCP	351-8287-010		04713	MC14071BCP		
U7-U14	INTEGRATED CIRCUIT MC14511BCP	351-8304-010		04713	MC14511BCP		
	FREQUENCY DISPLAY BD	635-0897-001	A,E				
U1-U19	NOT USED						
U20-U25	SEMICONV DEVICE MAN3640A	262-1461-010		50522	MAN3640A		
	FREQUENCY DISPLAY BD	635-0897-002	B				
U1-U19	NOT USED						
U20-U26	SEMICONV DEVICE MAN3640A	262-1461-010		50522	MAN3640A		
	FREQUENCY DISPLAY BD	635-0897-003	C				
U1-U14	NOT USED						
U15-U27	SEMICONV DEVICE MAN3640A	262-1461-010		50522	MAN3640A		
	FREQUENCY DISPLAY BD	635-0897-004	D				
U1-U14	NOT USED						
U15-U27	SEMICONV DEVICE MAN3640A	262-1461-010		50522	MAN3640A		
	FREQUENCY DISPLAY BD	635-0897-005	F,K				
U1-U19	NOT USED						
U20-U25	SEMICONV DEVICE MAN3640A	262-1461-010		50522	MAN3640A		

PARTS LIST (Cont)

REF DES	DESCRIPTION	COLLINS PART NUMBER	USABLE ON CODE	MFR CODE	MFR PART NUMBER
U1-U19 U20-U26	FREQUENCY DISPLAY BD NOT USED SEMICONV DEVICE MAN3640A	635-0897-006	G		
		262-1461-010		50522	MAN3640A
U1-U14 U15-U26	FREQUENCY DISPLAY BD NOT USED SEMICONV DEVICE MAN3640A	635-0897-007	H		
		262-1461-010		50522	MAN3640A
U1-U14 U15-U26	FREQUENCY DISPLAY BD NOT USED SEMICONV DEVICE MAN3640A	635-0897-008			
		262-1461-010		50522	MAN3640A

454GE
78-5
7566-6
7566-0

05G105KS
05G181KS

4071BCP
4511BCP

454GE
78-5
7566-6
7566-0

05G105KS
05G181KS

4071BCP
4511BCP

454GE
78-5

78-3
222A
R05G474KS
R05G473KS
R05G181KS
R05G104KS
R05G474KS
R05G392KS
R05G474KS
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14081BCP
14072BCP
14511BCP
14071BCP
14511BCP

MAN3640A

MAN3640A

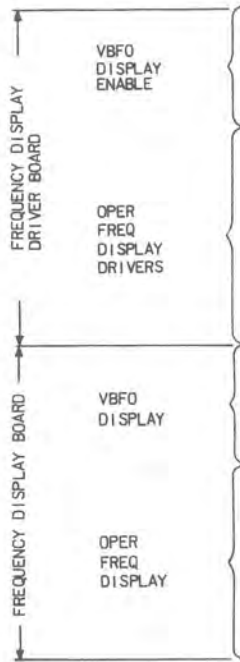
MAN3640A

MAN3640A

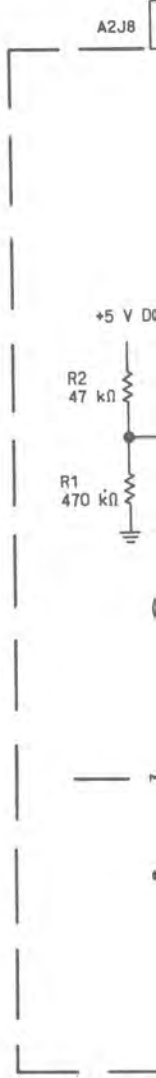
MAN3640A

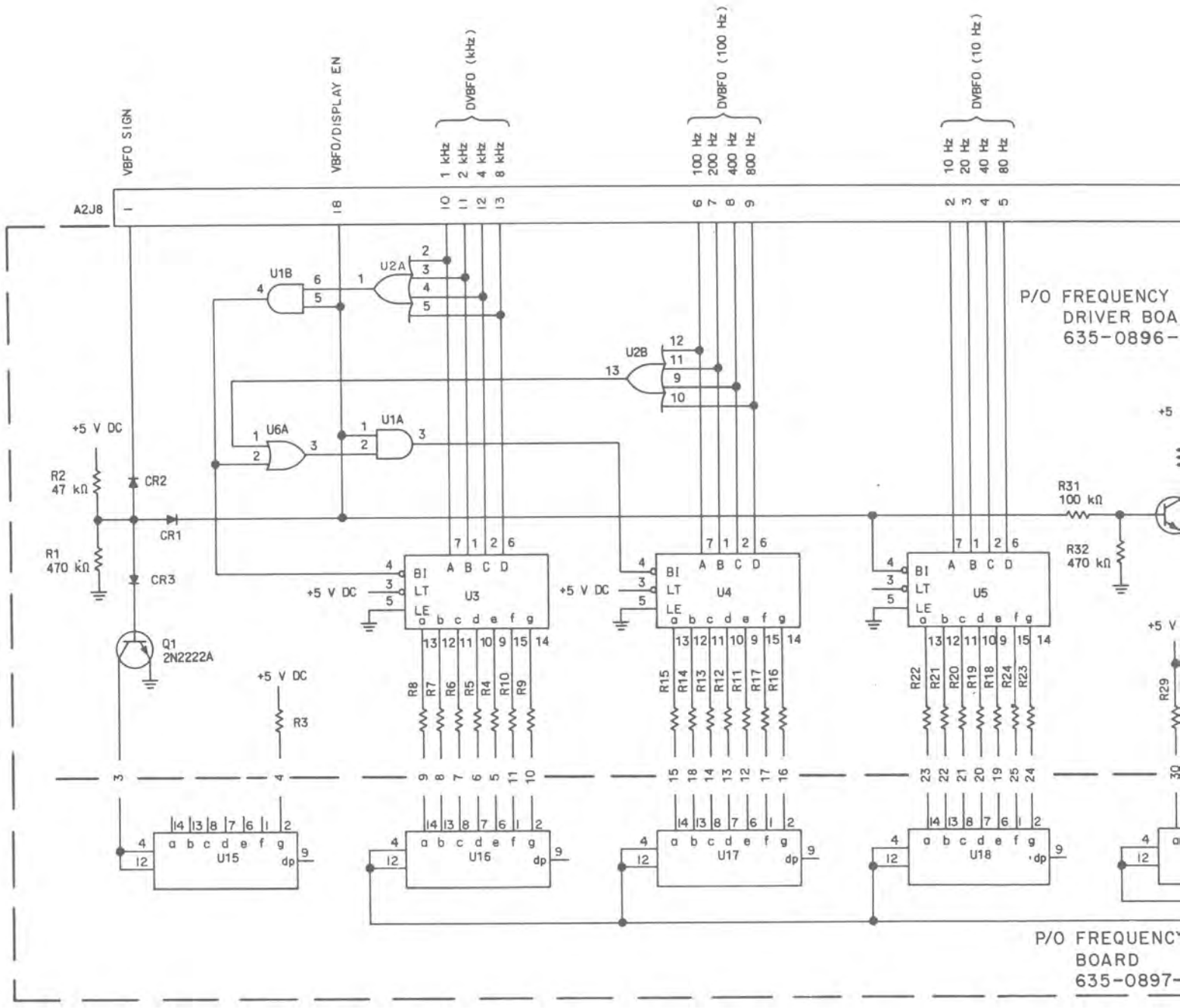
Frequency Display, Schematic D
Figure 3 (Sheet 2)

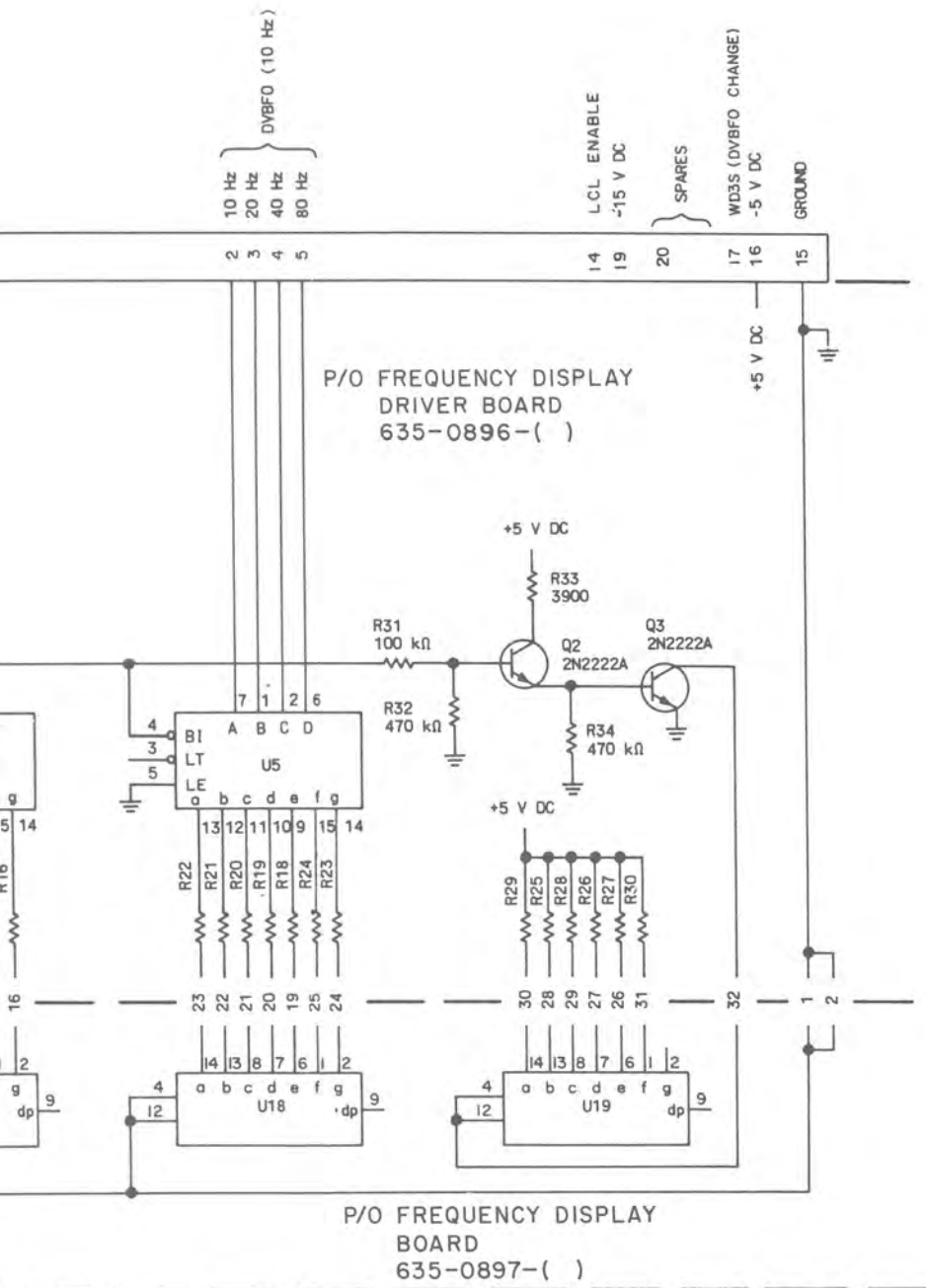
CIRCUITS USED PER FREQUENCY DISPLAY



CIRCUIT	637-1781-()									
	-001	-002	-003	-004	-005	-006	-007	-008	-009	-010
U1			X	X	X			X	X	X
U2			X	X	X			X	X	X
1 kHz U3			X	X	X			X	X	X
100 Hz U4			X	X	X			X	X	X
10 Hz U5			X	X	X			X	X	X
U6	X	X	X	X	X	X	X	X	X	X
10 MHz U7	X	X	X	X	X	X	X	X	X	X
1 MHz U8	X	X	X	X	X	X	X	X	X	X
100 kHz U9	X	X	X	X	X	X	X	X	X	X
10 kHz U10	X	X	X	X	X	X	X	X	X	X
1 kHz U11	X	X	X	X	X	X	X	X	X	X
100 Hz U12	X	X	X	X	X	X	X	X	X	X
10 Hz U13		X	X	X	X		X	X	X	X
1 Hz U14			X	X	X			X	X	X
SIGN U15			X	X				X	X	
1 kHz U16			X	X				X	X	
100 Hz U17			X	X				X	X	
10 Hz U18			X	X				X	X	
1 Hz U19			X	X				X	X	
10 MHz U20	X	X	X	X	X	X	X	X	X	X
1 MHz U21	X	X	X	X	X	X	X	X	X	X
100 kHz U22	X	X	X	X	X	X	X	X	X	X
10 kHz U23	X	X	X	X	X	X	X	X	X	X
1 kHz U24	X	X	X	X	X	X	X	X	X	X
100 Hz U25	X	X	X	X	X	X	X	X	X	X
10 Hz U26		X	X	X			X	X	X	
1 Hz U27				X					X	

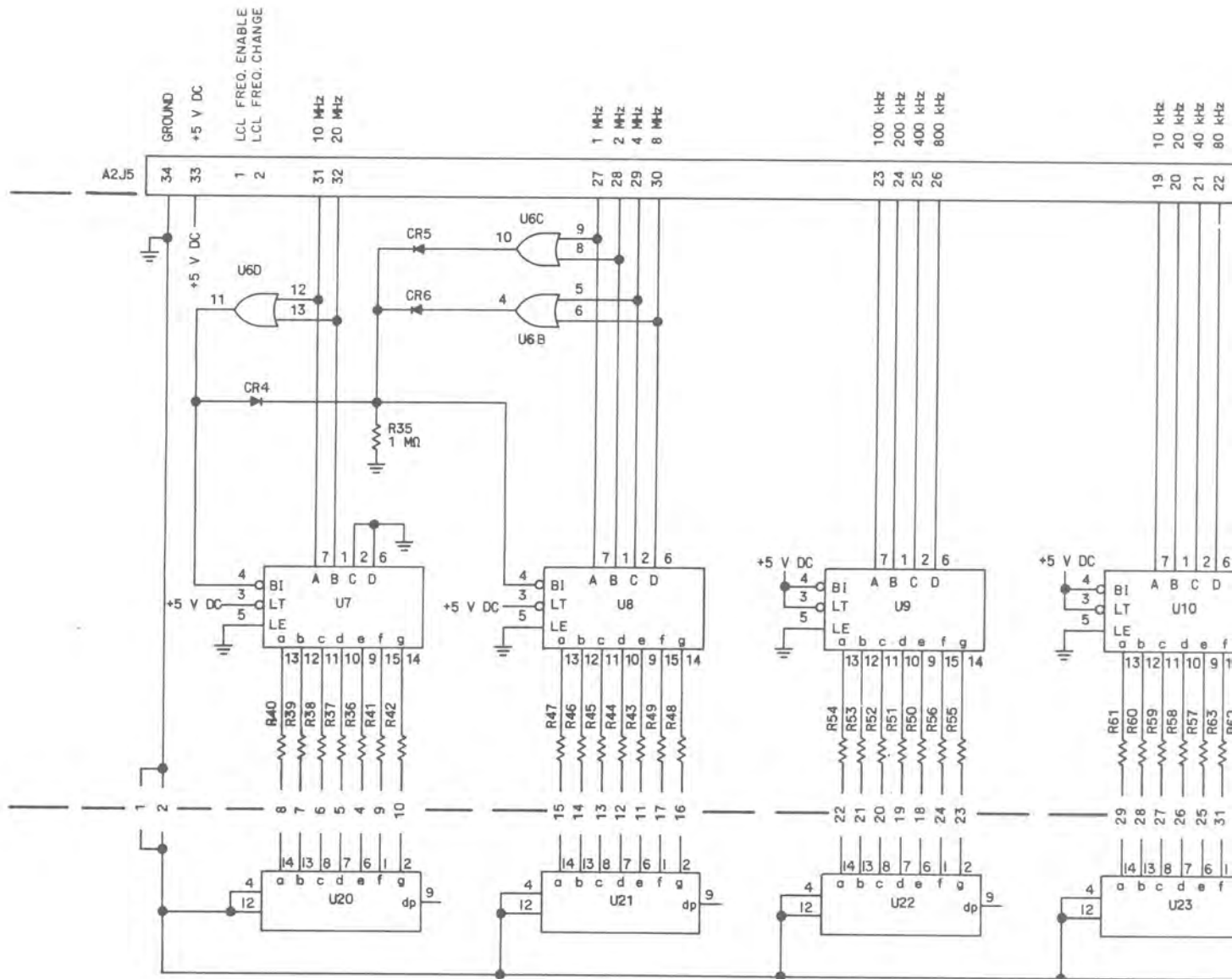






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Frequency Display, Schematic Diagram
Figure 3 (Sheet 3)

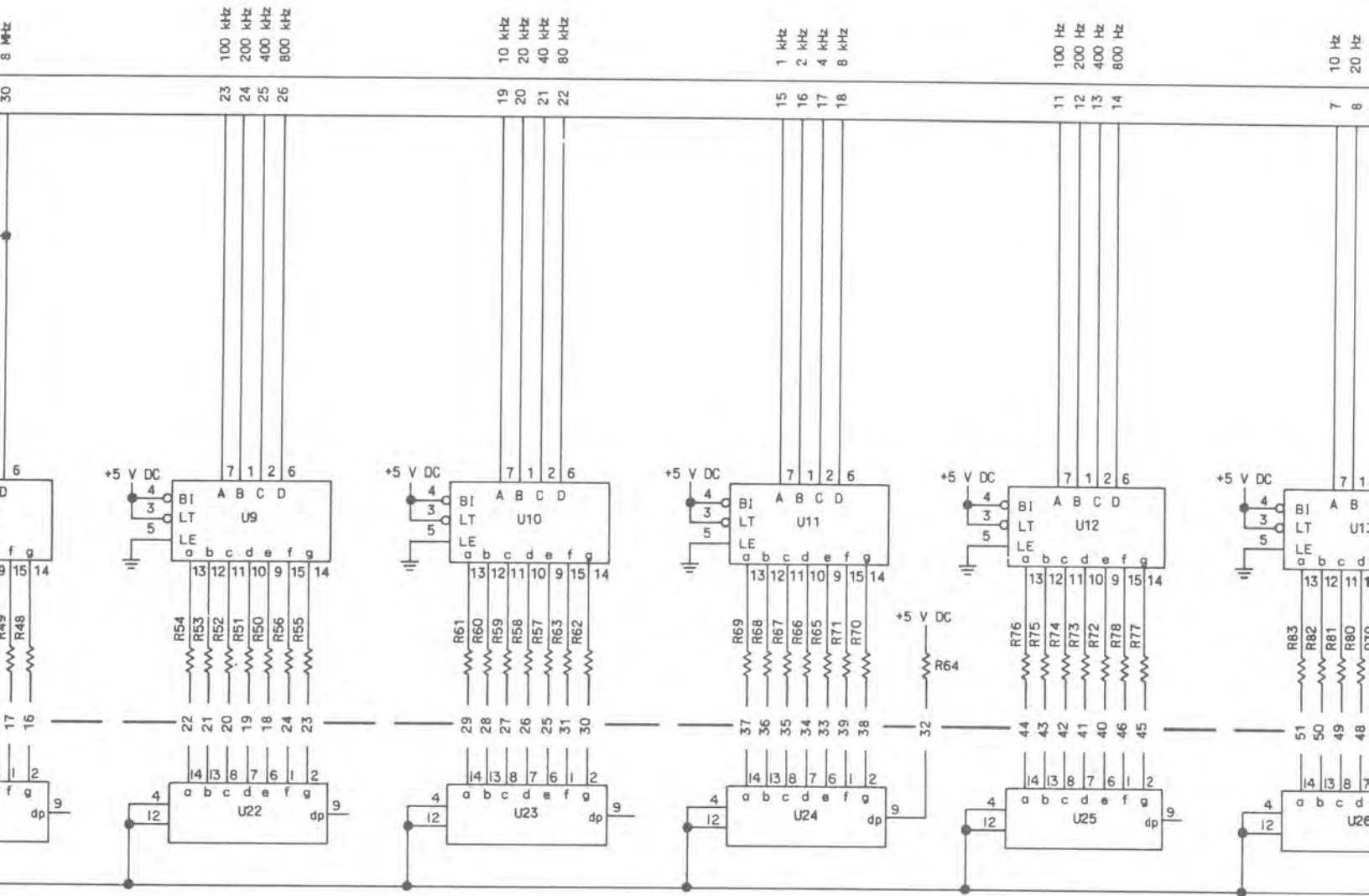


NOTES:

- ① RESISTORS R3 THRU R30 AND R36 THRU R92 ARE 180 OHM.
- ② DIODES ARE TYPE 1N4454.

- ③ POWER AND GROUND CONNECTIONS

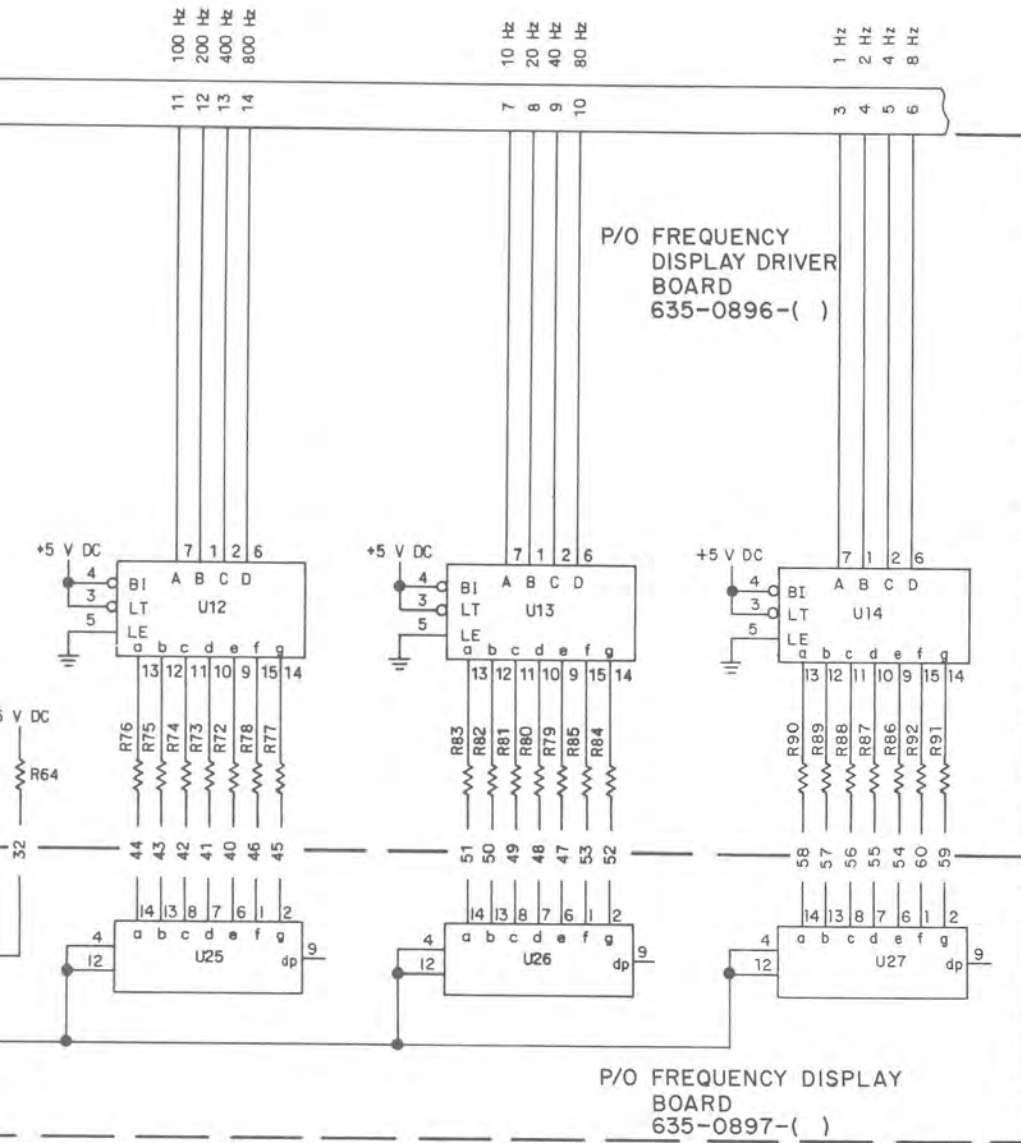
U NO.	TYPE	POWER
		+5
U1	MC14081BCP	14
U2	MC14072BCP	14
U3, U4, U5, AND U7 THRU U14	MC14511BCP	16
U6	MC14071BCP	14
U15 THRU U27	MAN3640A	



180 OHM.

③ POWER AND GROUND CONNECTIONS

U NO.	TYPE	POWER (V DC)	
		+5	GND
U1	MC14081BCP	14	7
U2	MC14072BCP	14	7
U3, U4, U5, AND U7 THRU U14	MC14511BCP	16	8
U6	MC14071BCP	14	7
U15 THRU U27	MAN3640A		



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Frequency Display, Schematic Diagram
Figure 3 (Sheet 4)