

CTCSS ENCODER-DECODER
RTA-54 B
Sub - Assembly No.14.0581

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RTA-54B CTCSS ENCODER-DECODER SUB-ASSEMBLY 14.0581

1 SPECIFICATIONS

POWER REQUIREMENTS	8 VDC at 5 mA.,10 mA decode.
FREQUENCY RANGE	67 to 250 Hz.
FREQUENCY STABILITY	That of ext.clock
PERIOD RESOLUTION	10 us
FREQUENCY RESOLUTION	0.4 Hz at 200Hz
TONE OUTPUT LEVEL	1 Vpp or more at 0.5% THD
DECODER INPUT LEVEL	200 mVpp nominal
DECODER RESPONSE TIME	Less than 200 ms
DECODER BANDWIDTH	+/-1% nominal
P.C. EDGE CONNECTOR	22 pin, 3.96 mm spacing
DIMENSIONS LXWXH	154 mm x 20 mm x 107 mm

2 DESCRIPTION

This card is a programmable CTCSS tone encoder-decoder using a 200 kHz reference clock provided from an external source. The card plugs into a 22 pin P.C. edge connector. A labelled front-panel allows easy access to the adjustment controls. A folded metal card-holder permits quick removal of the plug-in assembly for service and testing.

The synthesizing encoder and decoder are independently programmed and tuned so that the input tone frequency may be different from the output tone frequency. The tone frequencies are programmed on the circuit board with two DIP rocker switches and two jumpers.

The encoder output tone is enabled onto a tone bus by the decoder. When the decoder responds to an input tone a front panel L.E.D. labelled ACTIVE lights up. A front panel switch can be used to prevent signal retransmission through a repeater when the switch is placed in the mid-position. The decoder and ACTIVE light still function in the mid-position. A TEST position will key the transmitter and enable the tone encoder for level adjustments.

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tone frequency (refer to Programming Information). The diode AND gates will thus cause 3 us pulses at the output of U6C (U7A) after the appropriate number of 5 us intervals of the clock for the encoder (decoder).

The encoder R-pulse produces an operating frequency square wave at U5A which is filtered using U3B and gated out with Q2 and CR13, 14 to the TONE BUS.

The decoder R-pulse together with an S-pulse is applied to the sync. delay counter U4. This counter produces a local square wave at pin 3 at the operating tone frequency which is compared at U9A with the output of the input BPF-limiter U3A, U3C, U3D, U7B. The BPF-limiter output also causes a (synchronizing) S-pulse when gated after 8 cycles of the local square wave by U4 pin 14. The S-pulse periodically synchronizes the local square wave so that the output of U9A will be narrow, positive pulses whose width will increase with increasing input frequency error and time after synchronization.

Thus Q3 will be OFF if the correct tone is decoded causing its collector to go high (for TOS ENABLE high). This will turn on Q4 (S3 in OPERATE position) and set the TOS LATCH U5B, turning on Q4 and Q2 (the tone gate). The LATCH is reset at power up or by external signal at LATCH RESET. This latch can be used in a system that has last-user tone modulation during the repeater dropout delay time. For such a system a TRANSMIT logic signal is applied to LATCH RESET causing the release of the active tone card at repeater dropout time.

Switch S3 has a momentary TEST position that closes the encoder tone gate through U6D and keys the transmitter through Q6.

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3 FUNCTIONAL CONNECTIONS (BY PIN NUMBER)

1 GND	Common ground
8 +8V IN	+8 volt supply input.
9 TONE BUS	This bus carries the output tone from the active card to the radio transmitter CTCSS tone interface.
11 RX AF IN	Receiver audio input to the tone decoder.
13 $\overline{\text{TOS}}$ BUS	This pin will go low when a tone is decoded, provided S3 is in mid-position. It connects to a bus that is common to other cards (if used).
14 LATCH $\overline{\text{RESET}}$	Decoder latch reset input.
15 TOS ENABLE	The tone decoder is enabled when this pin is high.
16 $\overline{\text{TOS}}$ LATCH BUS	This pin goes low when a tone is detected and stays low until the latch is reset.
17 TEST	This output goes low when S1 is in TEST position.
21 200 kHz. CLOCK	This is the 200 kHz clock input for the encoder and decoder synthesizers.
22 GND	Common ground.

4 CIRCUIT DESCRIPTION

The 200 kHz clock input is amplified using Q1 and applied to the decoder and encoder programmable counters. Each counter will generate a 3 us positive pulse on its reset line (R-pulse) at a pulse repetition frequency of twice the programmed tone frequency. The encoder R-pulse is applied to a type-D flip-flop wired as a type-T flip-flop. The output of the latter will be symmetrical square-waves at the operating frequency. The 200 kHz clock has a period of 5 us. This allows a 10 us resolution for the period of the programmed operating tone frequency.

The encoder (decoder) counter U1 (U2) is programmed with DIP switch S1 (S2) and jumper J1 (J2) according to the operating

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5 PROGRAMMING INFORMATION

Frequency	ABCDEFGHIJK	Frequency	ABCDEFGHIJK
67.0	10111010100	136.5	01011011101
71.9	10101101110	141.3	01011000100
74.4	10101000000	146.2	01010101100
77.0	10100010010	151.4	01010010101
79.7	10011100111	156.7	01001111110
82.5	10010111100	162.2	01001101001
85.4	10010010011	167.9	01001010100
88.5	10001101010	173.8	01000111111
91.5	10001000101	179.9	01000101100
94.8	10000011111	186.2	01000011001
100.0	01111101000	192.8	01000000111
103.5	01111000110	203.5	00111101011
107.2	01110100101	210.7	00111011010
110.9	01110000110	218.1	00111001010
114.8	01101100111	225.7	00110111011
118.8	01101001010	233.6	00110101100
123.0	01100101101	241.8	00110011101
127.3	01100010010	250.3	00110001111
131.8	01011110111		

1 REPRESENTS CONNECTED DIODE, CLOSED SWITCH

0 REPRESENTS DISCONNECTED DIODE, OPEN SWITCH

POSITION	WEIGHTING (us)
JUL	10240
1	5120
2	2560
3	1280
4	640
5	320
6	160
7	80
8	40
9	20
10	10

6 ADJUSTMENTS

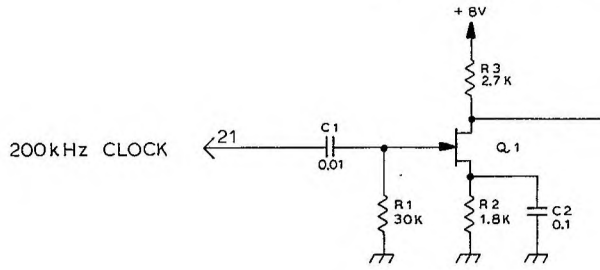
TONE IN - Control R21 tunes the input tone filter. With a proper tone input to the card, observe an oscilloscope connected to test point TPL. Tune the TONE IN control for a peak in the sinewave by starting from the low-frequency end (or fully counter clockwise). Failure to follow this procedure may result in the filter being tuned to a harmonic.

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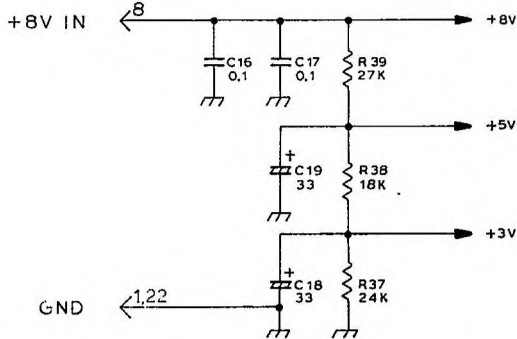
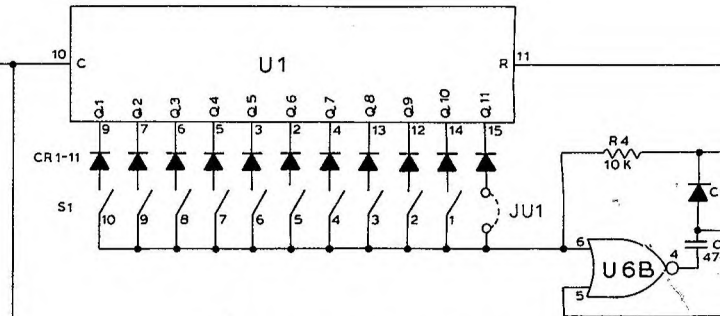
TONE OUT - Control R9 tunes the output tone filter. It is tuned in the same manner as the input tone filter whilst observing test point TP2. The tone will be present at this point continuously but the level is set by the LEVEL control and therefore one must increase the level if it is insufficient to tune the filter.

LEVEL - Place S3 in TEST position. Adjust the LEVEL control R7 for 600 Hz deviation (or as desired) of the transmitter carrier.

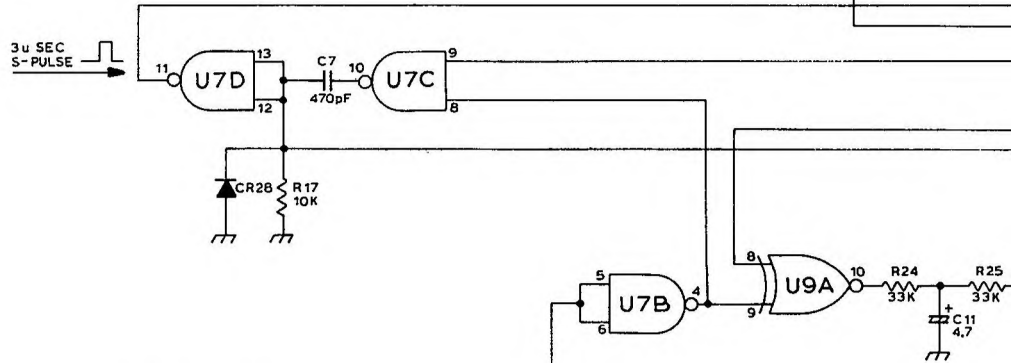
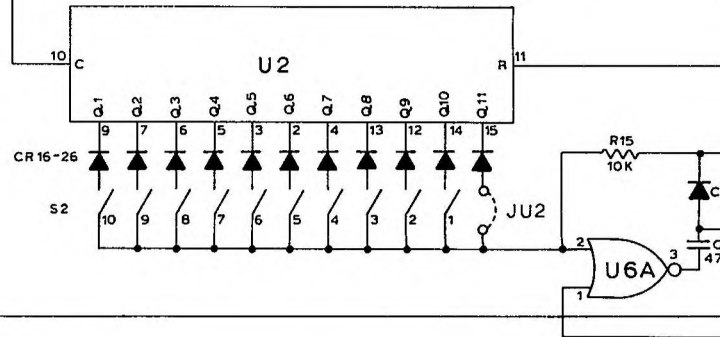
CLOCK BUFFER



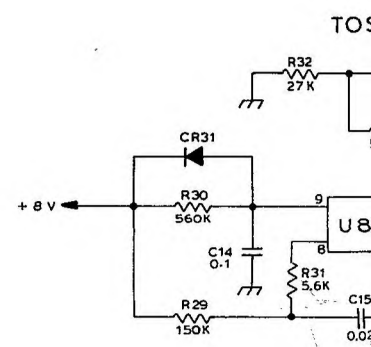
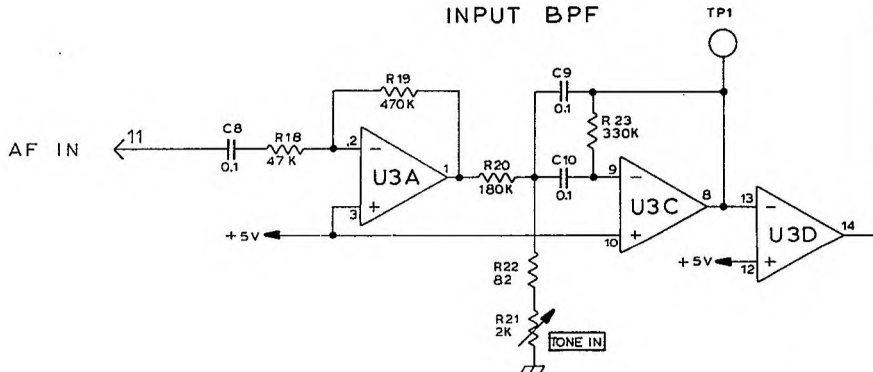
ENCODER SYNTHESIZER



DECODER SYNTHESIZER



INPUT BPF

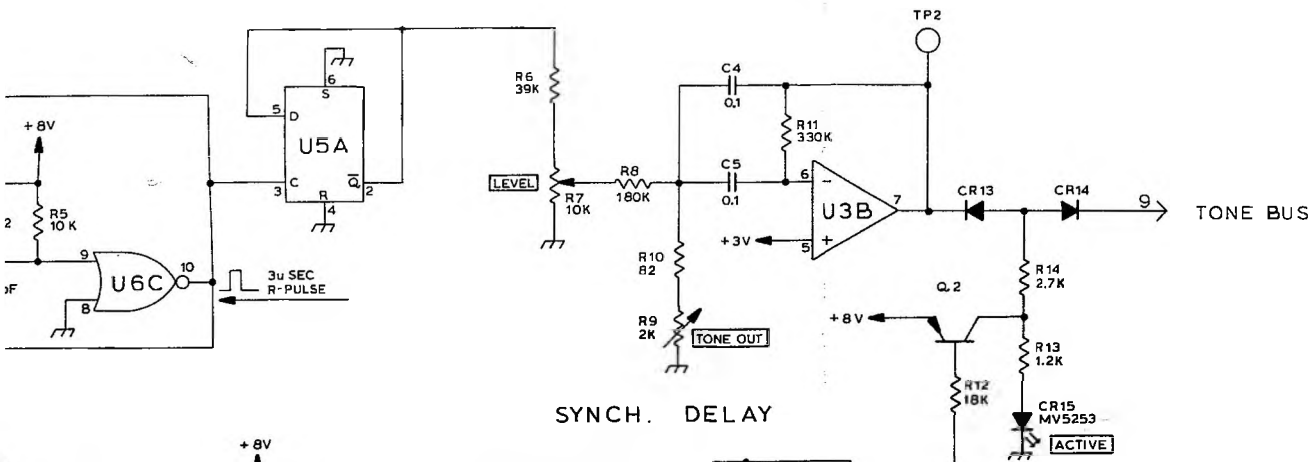


- CR1-14, 16-31 1N4148
- CR15 MV5253
- Q1 2N5458
- Q2 2N3906
- Q3-6 2N3904
- U1,2 4040
- U3 4741
- U4 4520
- U5 4013
- U6 4001
- U7,8 4093
- U9 4070

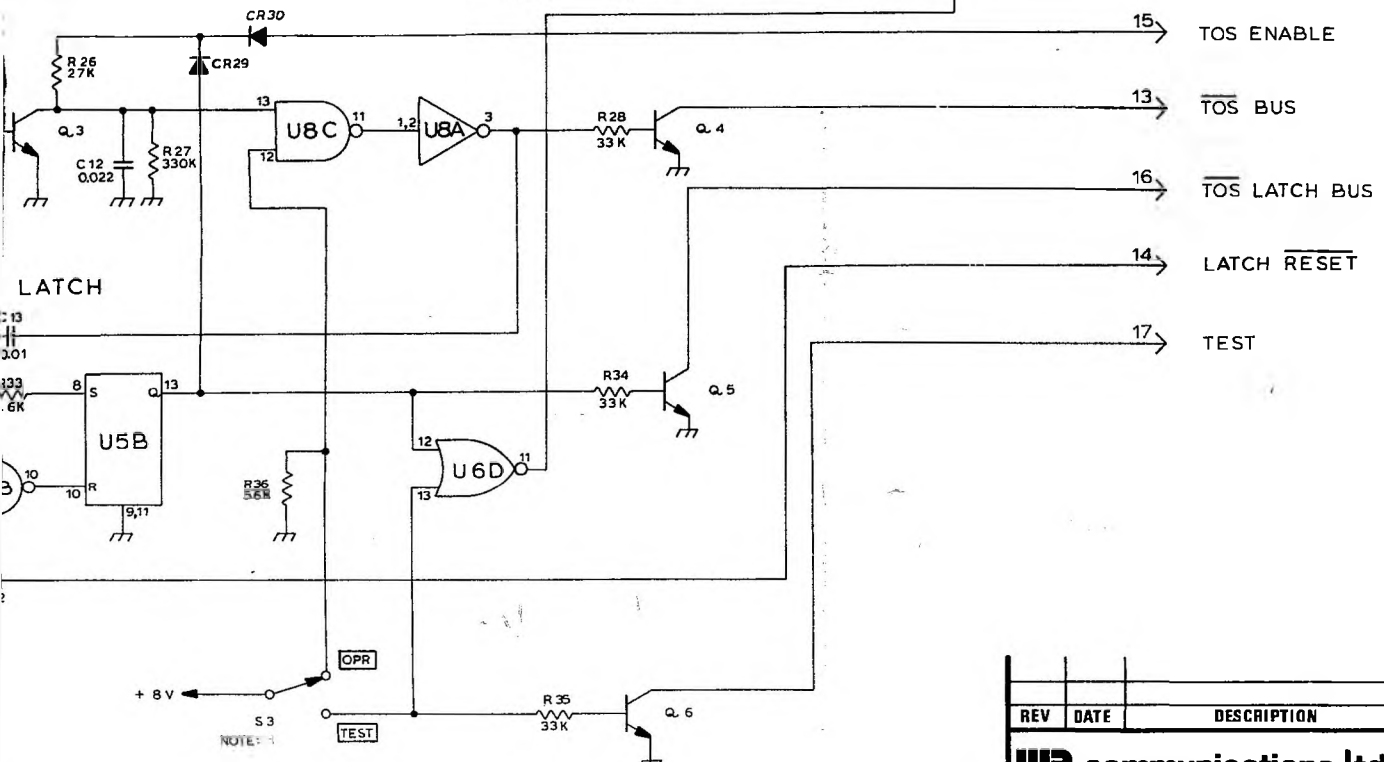
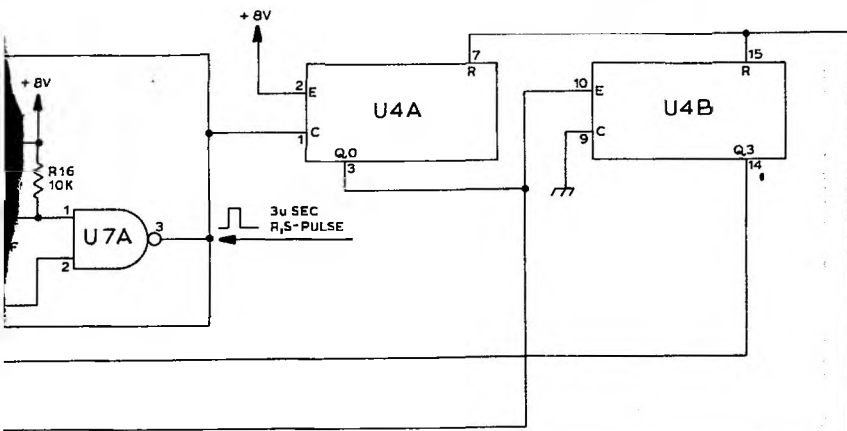
CAPACITANCE IS IN uF UNLESS OTHERWISE SPECIFIED

NOTE 1 S3 IS 3-POSITION SWITCH WITH POSITION
UP - OPERATE
CENTER - DISABLE
DOWN - TEST (MOMENTARY)

OUTPUT BPF

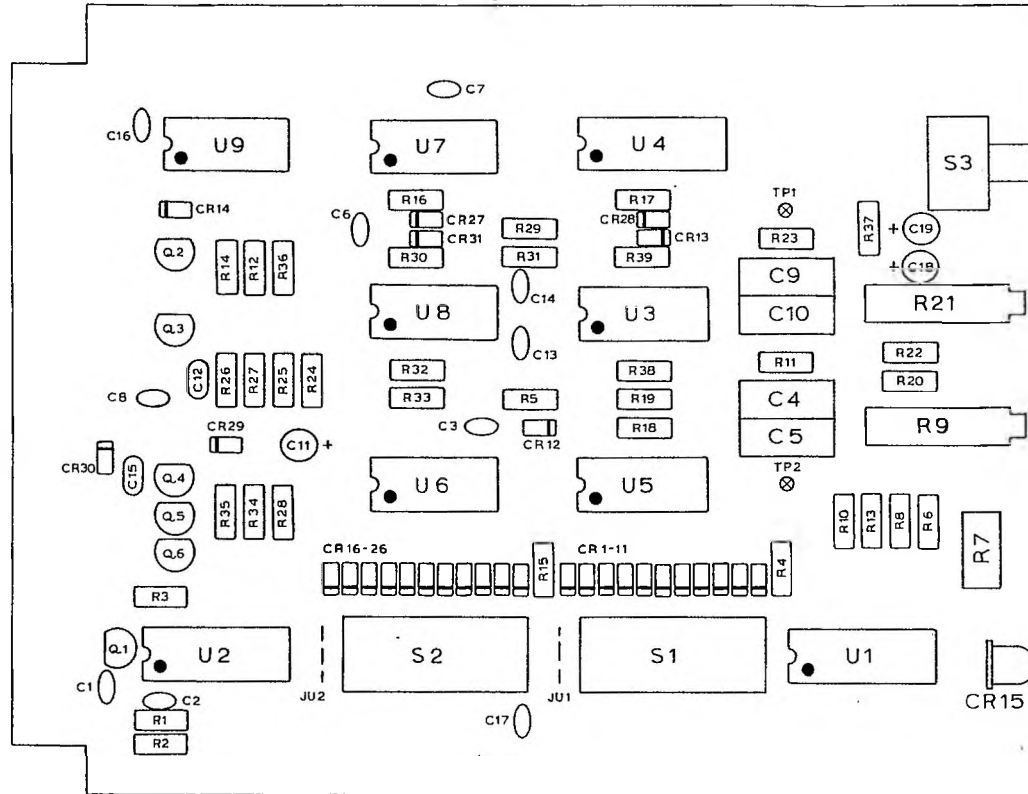


SYNCH. DELAY



REV	DATE	DESCRIPTION	DRN	CHKD	APPVD
UR communications ltd. vancouver, b.c., canada.					
TITLE: MODEL RTA-54B, 14.0581 CTCSS ENCODER-DECODER SCHEMATIC DIAGRAM					
DRAWN <i>JSchuler</i>		DATE MAY 26, 1980.		DRAWING NUMBER	
CHECKED <i>lc</i>		SCALE		10-3	
APPROVED					

VIEW FROM COMPONENT SIDE



0 1 2 3 4 5 6 7 8 9 10 cm

REV	DATE	DESCRIPTION	DRN	CHKD	APPVD
UR communications Ltd. vancouver, b.c., canada.					
TITLE: MODEL RTA-54B, 14.05B1 CTCSS ENCODER-DECODER P.C. ASSEMBLY					
DRAWN		DATE JUN 5, 1980		DRAWING NUMBER	
CHECKED		SCALE		10-4	
APPROVED					

C1	0.01 uF ceramic	Kemet	C320C103M1R5CA	24.4044		
C2	0.1 uF ceramic	"	C320C104M5R5CA	24.4045		
C3	470 pF "	"	C312C471M2R5CA	24.4042		
C4	0.1 uF polyester	Phil.	344CHA100K	24.4090		
C5	0.1 uF polyester	Phil.	344CHA100K	24.4090		
C6	470 pF ceramic	Kemet	C312C471M2R5CA	24.4042		
C7	470 pF "	"	C312C471M2R5CA	24.4042		
C8	0.1 uF "	"	C320C104M5R5CA	24.4045		
C9	0.1 uF polyester	Phil.	344CHA100K	24.4090		
C10	0.1 uF polyester	Phil.	344CHA100K	24.4090		
C11	4.7 uF tant., 20V			26.1021		
C12	0.022uF ceramic	Kemet	C330C223M1R5CA	24.4050		
C13	0.01 uF "	"	C320C103M1R5CA	24.4044		
C14	0.1 uF "	"	C320C104M5R5CA	24.4045		
C15	0.022 uF "	"	C330C223M1R5CA	24.4050		
C16	0.1 uF "	"	C320C104M5R5CA	24.4045		
C17	0.1 uF "	"	C320C104M5R5CA	24.4045		
C18	33 uF tant. 10V			26.1010		
C19	33 uF tant. 10V			26.1010		
CR1-14	Si		1N4148	37.0600	14	
CR15	LED, green		MV5253	58.0023		
CR16-31	Si		1N4148	37.0600	16	
Q1	N-chan JFET		2N5458	64.0209		
Q2	PNP trans.		2N3906	64.0122		
Q3	NPN "		2N3904	64.0120		
Q4	NPN "		2N3904	64.0120		
Ref	Description	Mfr	Mfr Part No	WR Part No	Qty	Item

UR communications ltd.
vancouver, b.c., canada.

PARTS LIST

DATE: May 26, 1980	MODEL: RTA-54B
APPROVED: <i>LC</i>	ASSY. NO. 14.0581
SHEET 1	OF 4

REV	APP	DATE	ITEM	CHANGE TO	WR PART NO.
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Q5	NPN trans.		2N3904	64.0120		
Q6	NPN "		2N3904	64.0120		
R1	30K 1/4W 5% tol.	Rohm	R25J	55.2303		
R2	1.8K "	"	"	55.2182		
R3	2.7K "	"	"	55.2272		
R4	10K "	"	"	55.2103		
R5	10K "	"	"	55.2103		
R6	39K "	"	"	55.2393		
R7	10K pot. single-turn P.C.	Spect.	63X103	54.5201		
R8	180K 1/4W 5% tol.	Rohm	R25J	55.2184		
R9	2K pot. 20-turn P.C.	Spect.	43P202	54.5004		
R10	82 1/4W 5% tol.	Rohm	R25J	55.2820		
R11	330K "	"	"	55.2334		
R12	18K "	"	"	55.2183		
R13	1.2K "	"	"	55.2122		
R14	2.7K "	"	"	55.2272		
R15	10K "	"	"	55.2103		
R16	10K "	"	"	55.2103		
R17	10K "	"	"	55.2103		
R18	47K "	"	"	55.2473		
R19	470K "	"	"	55.2474		
R20	180K "	"	"	55.2184		
R21	2K pot. 20-turn P.C.	Spect.	43P202	54.5004		
R22	82 1/4W 5% tol.	Rohm	R25J	55.2820		
R23	330K "	"	"	55.2334		
R24	33K "	"	"	55.2333		
R25	33K "	"	"	55.2333		
R26	27K "	"	"	55.2273		
R27	330K "	"	"	55.2334		
R28	33K "	"	"	55.2333		
R29	150K "	"	"	55.2154		
Ref	Description	Mfr	Mfr Part No	WR Part No	Qty	Item

UR communications ltd.
vancouver, b.c., canada.

PARTS LIST

DATE : May 26, 1980

MODEL : RTA-54B

APPROVED : *JC*

ASSY. NO. 14.0581

REV	APP	DATE	ITEM	CHANGE TO	WR PART NO.

SHEET 2 OF 4

R30	560K ¼W 5% tol.	Rohm	R25J	55.2564		
R31	5.6K "	"	"	55.2562		
R32	27K "	"	"	55.2273		
R33	5.6K "	"	"	55.2562		
R34	33K "	"	"	55.2333		
R35	33K "	"	"	55.2333		
R36	56K "	"	"	55.2563		
R37	24K "	"	"	55.2243		
R38	18K "	"	"	55.2183		
R39	27K "	"	"	55.2273		
S1	Rocker, D.I.P. 10 pos.	Gray	76RSB10	61.0705		
S2	Rocker, D.I.P. 10 pos.	Gray	76RSB10	61.0705		
S3	toggle, P.C. ON-OFF- (ON)	C&K	7107A	61.0610		
TP1	test point	Amp	60874-1	33.1023		
TP2	test point	Amp	60874-1	33.1023		
U1	CMOS 12-bit count.	Mot.	MCL4040BCP	41.1739		
U2	CMOS 12-bit count.	"	MCL4040BCP	41.1739		
U3	quad. Op. Amp.	"	MC4741CP	41.1565		
U4	CMOS dual 4-bit count.	"	MCL4520BCP	41.1908		
U5	CMOS dual type-D FF	"	MCL4013BCP	41.1714		
U6	CMOS quad NOR	"	MCL4001BCP	41.1700		
U7	CMOS quad Schmitt NAND	"	MCL4093BCP	41.1796		
U8	CMOS quad Schmitt NAND	"	MCL4093BCP	41.1796		
U9	CMOS quad XNOR	"	MCL4070BCP	41.1771		
Ref	Description	Mfr	Mfr Part No	WR Part No	Qty	Item

UR communications ltd.
vancouver, b.c., canada.

PARTS LIST

DATE: May 26, 1980 MODEL: RTA-54B
APPROVED: *JC* ASSY. NO. 14.0581

	PCB			51.0581			
	Card Handle			23.1070			
	Card Holder RTA-54B			23.1085			
	IC Socket	14-pin	TI	C8414-02	33.1176		
	" "	16-pin	"	C8416-02	33.1177		
Ref	Description		Mfr	Mfr Part No	WR Part No	Qty	Item

UR communications ltd.
vancouver, b.c., canada.

PARTS LIST

DATE: May 26, 1980	MODEL: RTA-54B
APPROVED: <i>jc</i>	ASSY. NO. 14.0581