PRELIMINARY DRAFT COPY

The ICRC Control Station Manual

Rick Swenton WA1LMV

September 1980

SYSTEM CONFIDENTIAL

10/80
WA1LMV

ICRC Repeater Control Codes

K1DFS/R 28-88
Bristol

#1-Voice Bulletin Chan. 1
#2-Voice Bulletin Chan. 2
#3-Voice Bulletin Chan. 3
#4-Voice Bulletin Chan. 4
#7-Autopatch Access
*-Autopatch Dump
Ø-Bulletin Cancel and ID Start

Autopatch Speed-Dial:

2#-State Police (Hartford)
3#-Hartford Police
4#-West Hartford Police
5#-New Britain Police
6#-Bristol Police
7#-Plainville Police
8#-Southington Police
911-Farmington Police

K1DFS/R 442.85/447.85
Bristol

2-Crosslink Receive
3-Crosslink Transmit
4-Access 15 Monitor Receiver
5-Inhibit 28 RX during Patch
6-Inhibit 28 RX during 450 RX
#-Autopatch Access (only during Crosslink)
Ø-Restore All to Normal Condition

Autopatch Speed-Dial: Same as 88

W1TNS/R 75-15
Burlington

#1-Six Meter Receiver Access
#2-Six Meter Transmitter Access
#7-Autopatch Access
#8-MCW ID Start
5-Six Meter Transmitter Dump
*-Autopatch Dump
Ø-Six Meter Link Dump

Autopatch Speed-Dial:

2#-State Police (Litchfield)
3#-Thomaston Police
4#-Southington Police
5#-Wolcott Police
6#-Plymouth Police
7#-Plainville Police
8#-Farmington Police
911-Bristol Police

TOUCHTONE FUNCTIONS ARE RESTRICTED TO ICRC MEMBERS ONLY.

INTRODUCTION

The scope of this manual is to provide the ICRC Control Station Operator with the necessary information required to operate the ICRC Control System Network.

The manual is divided into two parts: Part 1 for control of K1DFS/R at the Bristol Site (Including the Autopatch Split Site Aux Link at Farmington) , and Part 2 for Control of W1TNS/R at the Burlington Site.

There are three main reasons why we need a Control System.

1) It is required by FCC rules and regulations
2) It is a tool used by the Technical Committee to enable or disable certain functions or equipment for diagnostics or malfunctioning.
3) It is a tool used by the Control Stations to enforce compliance with FCC rules and regulations by the User Stations.

Please note that this manual and its contents are the property of the Insurance City Repeater Club and is made available to Control Station Operators with the intention that the Control Station Operators will use discretion while acting in the capacity of Control Station enforcing FCC rules and regulations and that persons entrusted with this manual will take the necessary precautions to ensure security of the manual and the information contained herein. This manual and its information must not be disclosed to anyone outside the ICRC Control Station System without expressed permission of the Technical Vice-President or associated repeater Trustee/Licensee.

The Control Station Operators are appointed by the Technical Vice-President. The appointment may be revoked with or without cause at any time by the Technical Vice-President.
Consistent indiscretion on the part of the Control Station Operator may result in revocation of appointment.

This manual can not attempt to convey every and all aspects of our sophisticated control system network. Therefore, your questions should be directed to WA1LMV or WA1SZU. Do not use the repeaters to discuss Control System operation.

PART 1: K1DFS/R

Control System

Bristol Facility

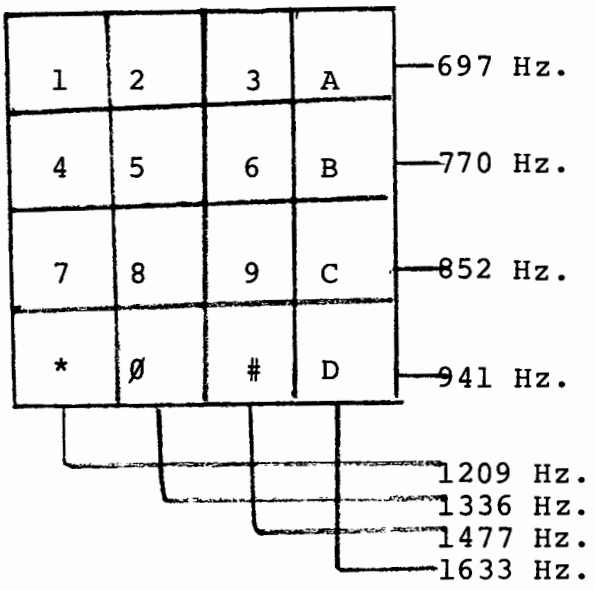
For Control of 146.28/146.88
442.85/447.85
444.675 Input

And Touchtone Accessories

The Touchtone Format

All of the ICRC Control Systems, Except for Burlington Telephone Line Control, require the use of a sixteen digit touchtone dial.

The standard sixteen digit touchtone format is shown below along with the associated tone frequencies.



Almost any touchtone dial can be modified to generate all sixteen digits with a simple switch arrangement. If you require this data, contact Rick, WAlLMV.

Part 1: The K1DFS/R Bristol Facility Control System

Operating frequencies:

Two Meter Repeater: Input-146.88 MHz. Output-146.88 MHz.
UHF Uplink (Autopatch) Input-444.675 MHz.

UHF Repeater: Input-442.85 MHz. Output-447.85 MHz.
Sub-audible Tone Squelch frequency- 71.9 Hz. EIA code L2
Autopatch Telephone Number: 677-8072 (Non-Published)

Subpart A: Operating the Control System on the UHF Input
(a sixteen digit touchtone dial is required)

To initialize the control system, press "A"

To unlock the control system, press "817" (see note 1)

To perform a control function, select the appropriate function(s) from the table below:

Code	Function
1	450 Tranmsitter Disable
2	88 Tranmsitter Disable
3	88 Autopatch ~~and Uplink Receiver~~ Disable
4	450 User Touchtone Functions Disable
5	450 Receiver Tone Squelch Enable
6	450 Touchtone Mute Disable (for control of Burlington)
7	450 Control System Sub-Audible Tone access enable
8	88 Bulletins Disable and MCW ID set to High Pitch
9	88 COS Disable
*	88 Bulletins Dump and MCW ID Start
Ø	Restores all functions to normal conditions

To relock the Control System, press "B"

Note 1: The unlock code "817" is required only if the Control Station does not have sub-audible tone transmitted along with the touchtones.

All touchtone transmissions made on the UHF input are muted, that is, touchtones are not repeated, except during control of Burlington, where function 6 is activated to disable the mute. This provides security so that monitoring stations can not decipher our control codes.

Subpart B: Operating the Control System on the 28 Input

A limited number of control functions are available on the 146.28 input. This is our Secondary, Non-secure control. It is secondary because our primary control is required to be above 220 MHz. It is non-secure because stations can monitor the control codes on the 28 input and possibly decipher them. It is therefore important that the use of this mode of control be used only when absolutely necessary. A sixteen digit touchtone dial is required.

To perform a control function, select the appropriate function(s) from the table below:

Code	Function
C61	88 Transmitter Disable
C62	88 Autopatch ~~and Uplink Receiver~~ Disable QC DIS.
C63	88 ~~Bulletins~~ Disable and MCW ID set to High Pitch PX+BCL
C64	450 Crosslink Enable (To call a station on 450)
C65	Spare
C66	Spare
C6Ø	Restores all functions to normal conditions

The control system automatically relocks five seconds after receiving the unlock code "C6"

Subpart C: Control of the Uplink Transmitter in Farmington (KlDFS/A)

This system may be operated on the 28 input or the 442.85 input with the 450 to 88 crosslink enabled. The control tones MUST appear on the 88 output.

To access the Farmington control press any of the following functions:

D1-Spare
D2-Spare
D3-Uplink Transmitter Disable (444.675 MHz)
D4-Spare
DØ-Restores all functions to normal conditions

The Farmington Control relocks in five seconds.

PART 2: W1TNS/R

Control System

Burlington Facility

For Control of 147.75/147.15
52.525 Link

And Touchtone Accessories

Part 2: The W1TNS/R Burlington Facility Control System

Operating Frequencies:

Two Meter Repeater: Input-147.75 MHz. Output-147.15 MHz.
Six Meter Crossband Link: Input/Output-52.525 MHz.
Control Receiver Input: 447.85 MHz. (K1DFS/R Bristol output frequency)
Autopatch Telephone Number: 589-2148 (Non-Published)

Subpart A: Operating the Control System on theBristol UHF Input

The Burlington Control Receiver is tuned to the K1DFS/R UHF repeater output frequency. Normally, touchtones are muted on the UHF repeater. Therefore touchtones will not appear at the Control Receiver unless touchtone mute is disabled on the UHF repeater. To place K1DFS/R in the 15 control mode (touchtone mute disable), press "A8176B" (If the control station has subaudible tone, only "A6B" is necessary)

To unlock the Burlington Control System, Press "C".

To perform a control function, use the following table of codes keeping in mind that some of these functions are generally used during landline control. Those functions with the "*" are primarily for landline control.

Code	Function
1	15 Transmitter Disable (see note 1)
2	Autopatch Disable,Dump, and ID high pitch
3	Six Meter Link Disable,Dump, and ID high pitch
4	UHF Receiver Access
5	*Landline Monitor
6	*Autopatch Access
7	Voice ID Start
8	MCW ID Start
9	Six Meter Receiver Access
*	*Resets Landline Control(see note 2)
#	*Landline Access Code and Timer Reset
Ø	Restores ALL Functions to Normal condition

To relock the Burlington Control System,press "D".

To restore the K1DFS/R UHF Repeater,press "A817ØB" (Subaudible tone users, press "AØB")

Note 1: Code 1, 15 transmitter Disable also disables the Autopatch and disables and dumps the Six Meter Link.

Note 2: Code *, Reset Landline Control. Though primarily for landline users to hang-up the phone line, a UHF control oparator will use this function to hang-up the line is the landline operator forgot to hang-up the repeater phone before he hung-up his phone.

Subpart B: Operating the Burlington Control System on the Telephone Line

This is a secondary control system which becomes ineffective if the Autopatch is in use on 15 since it uses the Autopatch telephone line.

To access the system, dial 589-2148, or 677-8072
The phone will ring once and answer. You now have two seconds to press the digit "#" to unlock the system. Failure to press the "#" before the two second period will cause the phone to hang-up.

After unlocking the system, select the appropriate code from the UHF control codes table on the preceeding page.

Explanation of functions:

Code 5 Landline Monitor
Allows the control station to monitor the 75input

Code 6 Autopatch Access
Allows the control station to monitor the 75 input and simultaneously talk on the 15 output (reverse autopatch)

Code # Timer Reset
Landline Control is limited to ten minutes. Use this code if you wish to stay connected longer.

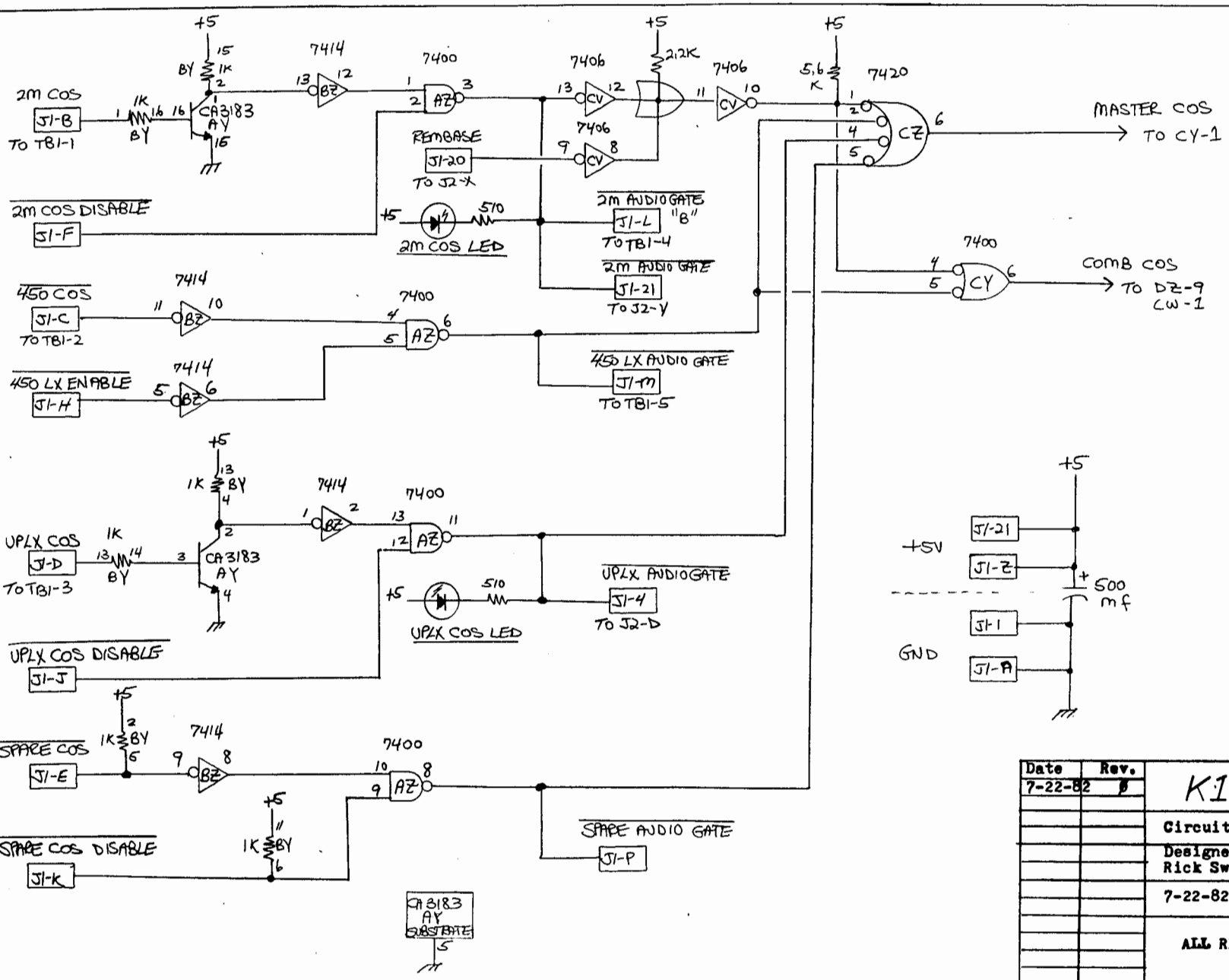
Code * Reset Landline Control
Before hanging-up your phone, you must hang-up the repeater phone with this code. Failure to do this will cause a tie-up of the Autopatch until the ten minute maxumum expires.

It is a good idea to monitor the repeater while attempting to control the 15 repeater to ensure that you have performed the desired functions. It is not advisable to attempt "blind control". Use the IDpitch as audible feedback.

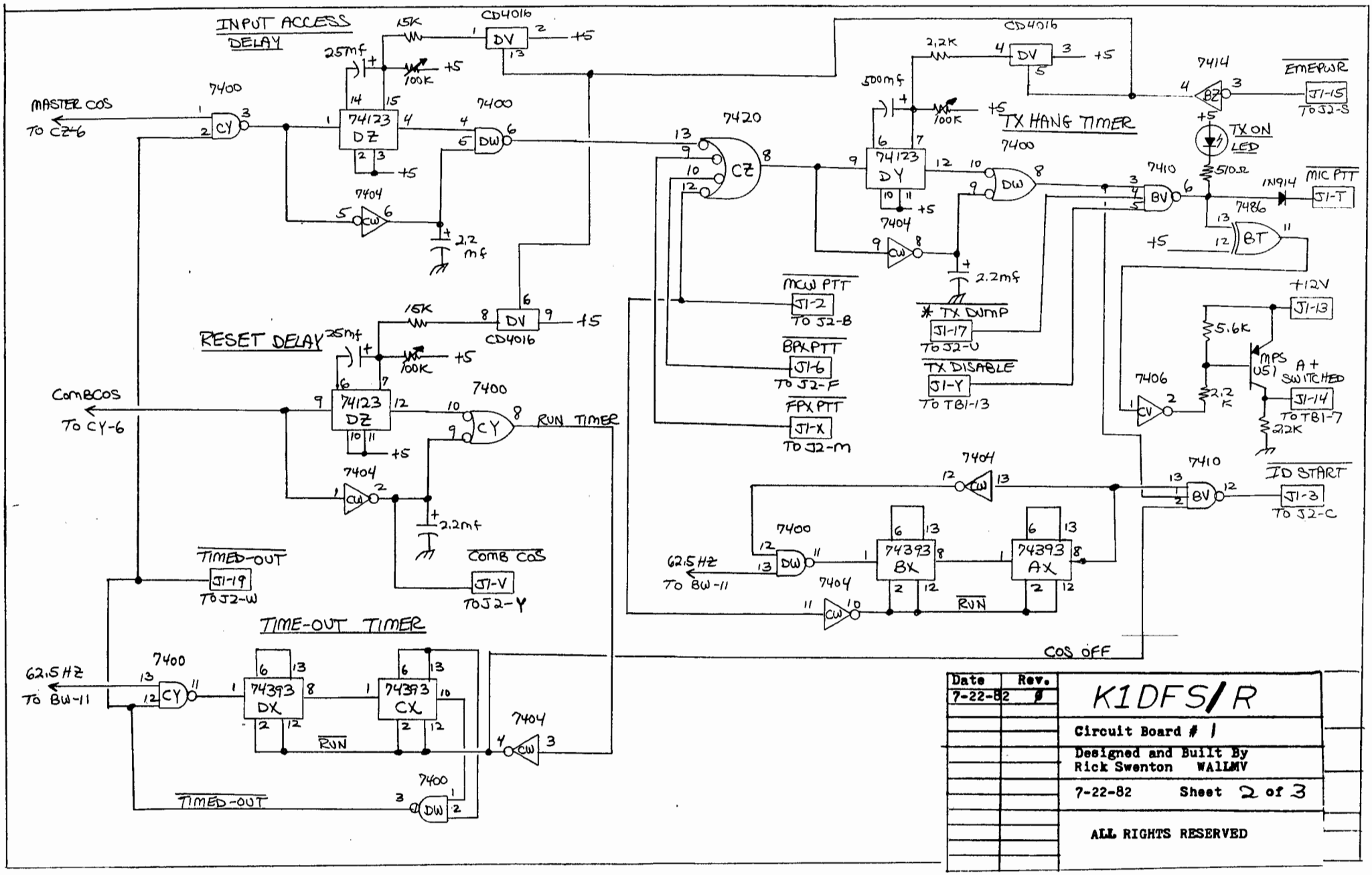
Subpart C: Operating the Burlington Control System on the 75 Input

The following functions are available on the 75 input. Proper ID is required to access. The first digit mutes audio.

Code	Function
C71	15 Transmitter Disable (see note 1 preceeding
C72	Autopatch Disable,Dump, and ID high pitch page)
C73	Six Meter Link Disable,Dump, and ID high pitch
C74	Reset Landline Control
C75	Spare
C7Ø	Restores All functions to Normal Condition

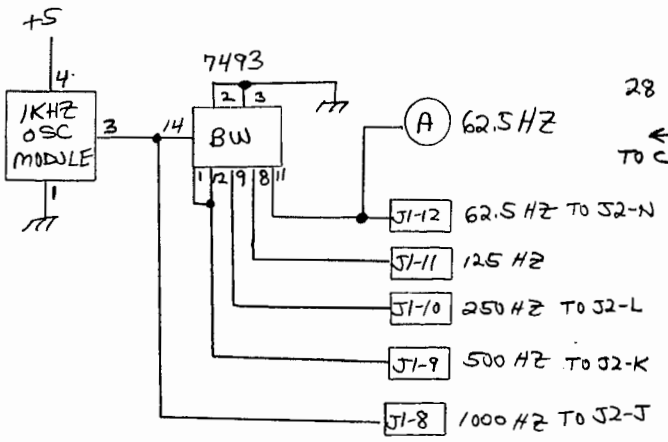


Date	Rev.	
7-22-82	B	K1DFS/R
		Circuit Board # 1
		Designed and Built By Rick Swenton WA1LMV
		7-22-82 Sheet 1 of 3

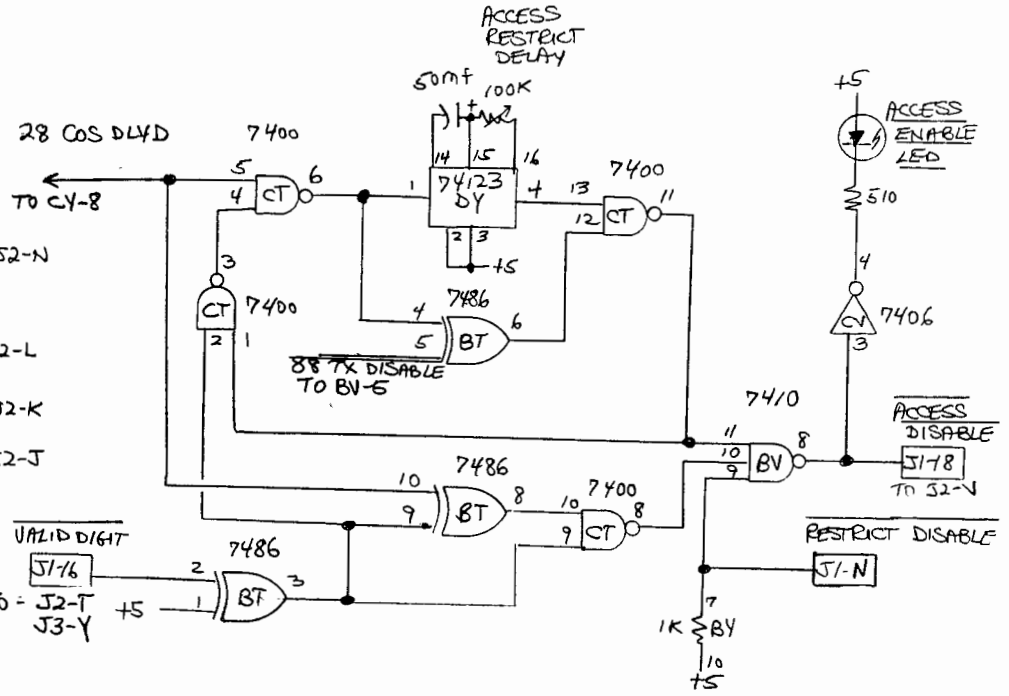


Date	Rev.	
7-22-82	0	K1DFS/R
		Circuit Board # 1
		Designed and Built By Rick Swenton WA1LMV
		7-22-82 Sheet 2 of 3

TIME BASE



ACCESS RESTRICTION



Date	Rev.
7-22-82	B

K1DFS/R

Circuit Board # 1

Designed and Built By
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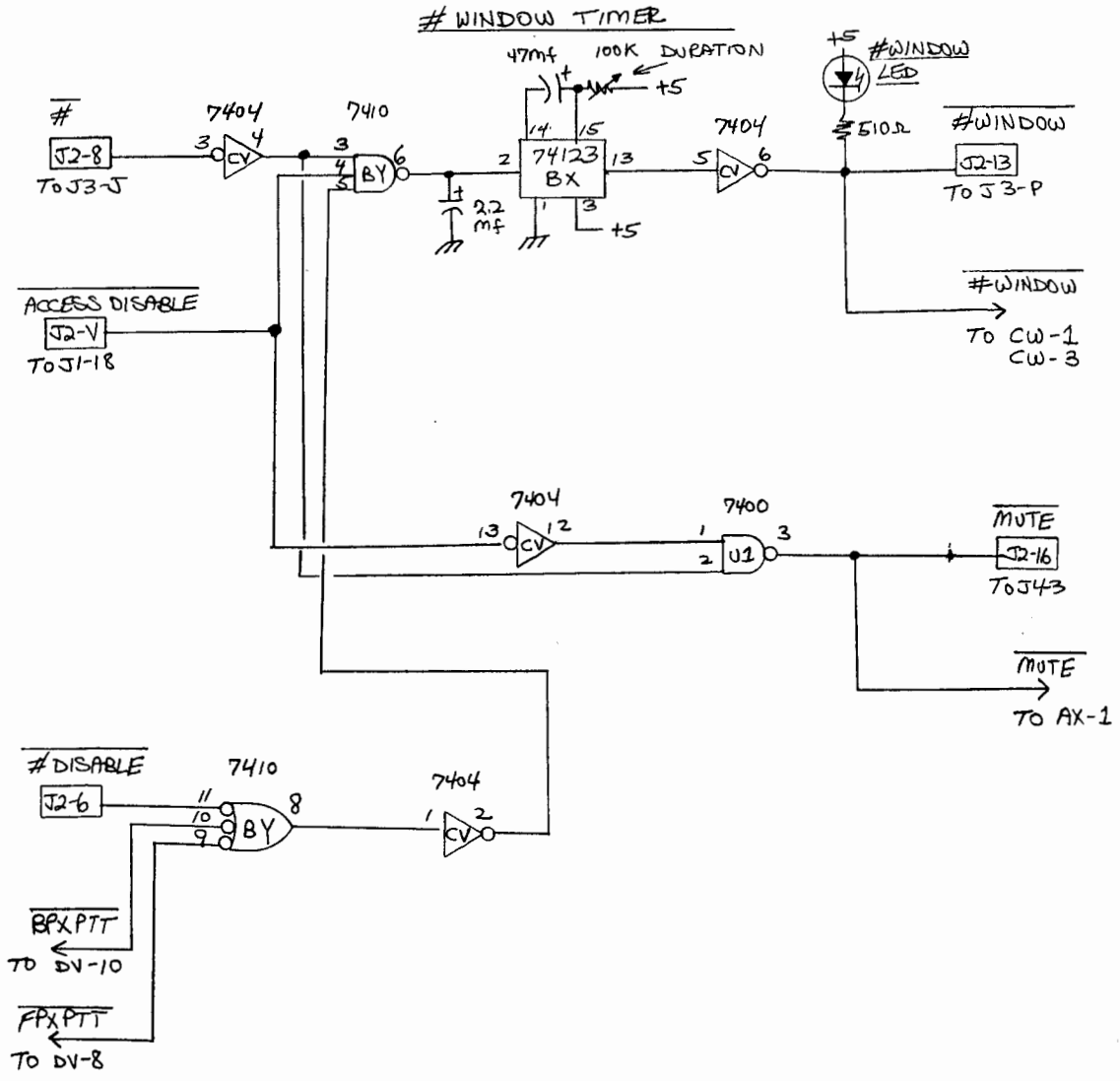
7-22-82 Sheet 3 of 3



Date	Rev.	
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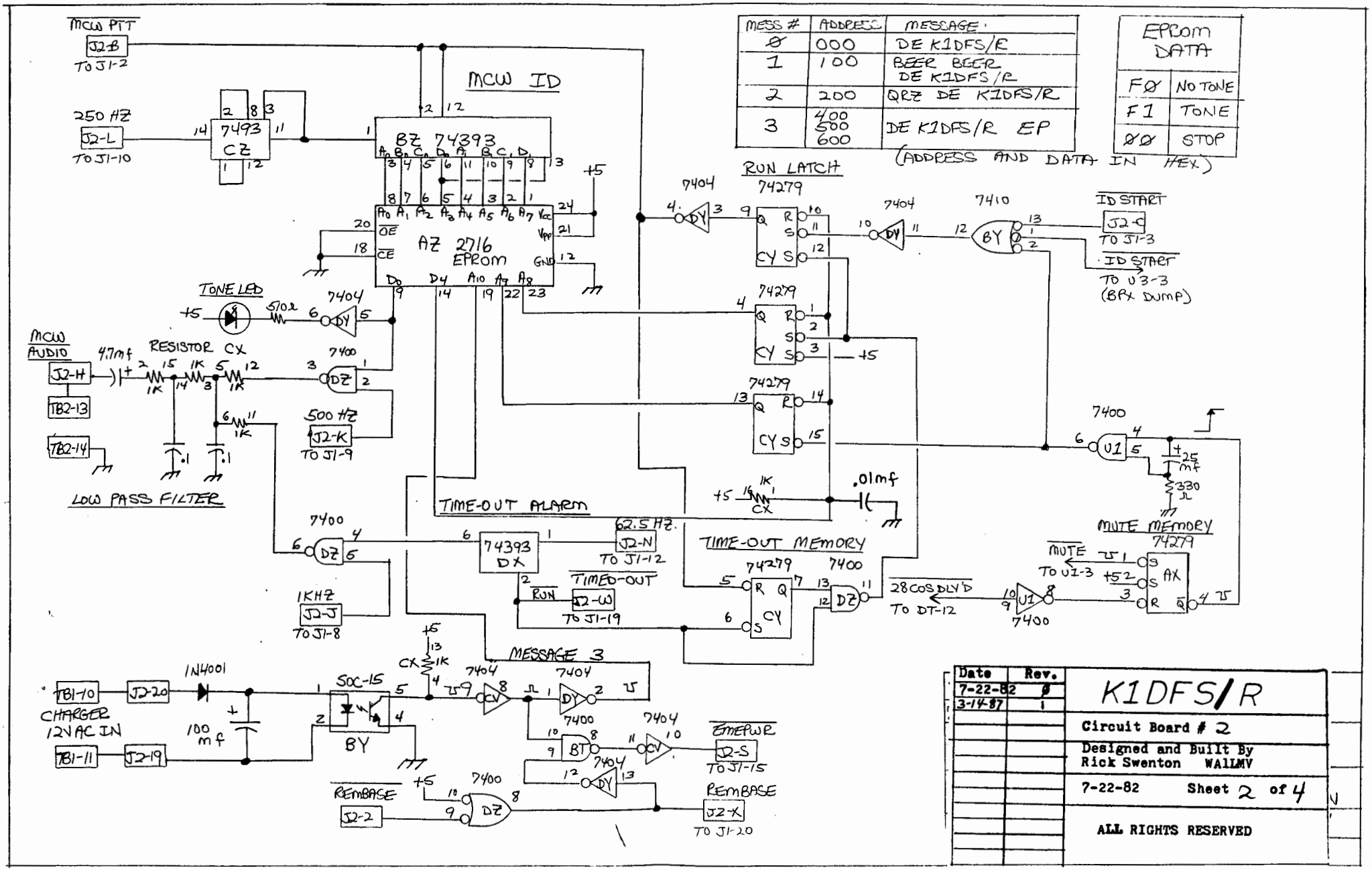
		Circuit Board # 2
		Designed and Built By Rick Swenton WA1LMV
		7-22-82 Sheet 1 of 4



MESS #	ADDRESS	MESSAGE
Ø	000	DE K1DFS/R
1	100	BEER BEER DE K1DFS/R
2	200	QRZ DE K1DFS/R
3	400 500 600	DE K1DFS/R EP

(ADDRESS AND DATA IN HEX.)

EPROM DATA	
FØ	NO TONE
F1	TONE
ØØ	STOP

Date	Rev.
7-22-82	Ø
3-14-87	1

K1DFS/R

Circuit Board # 2

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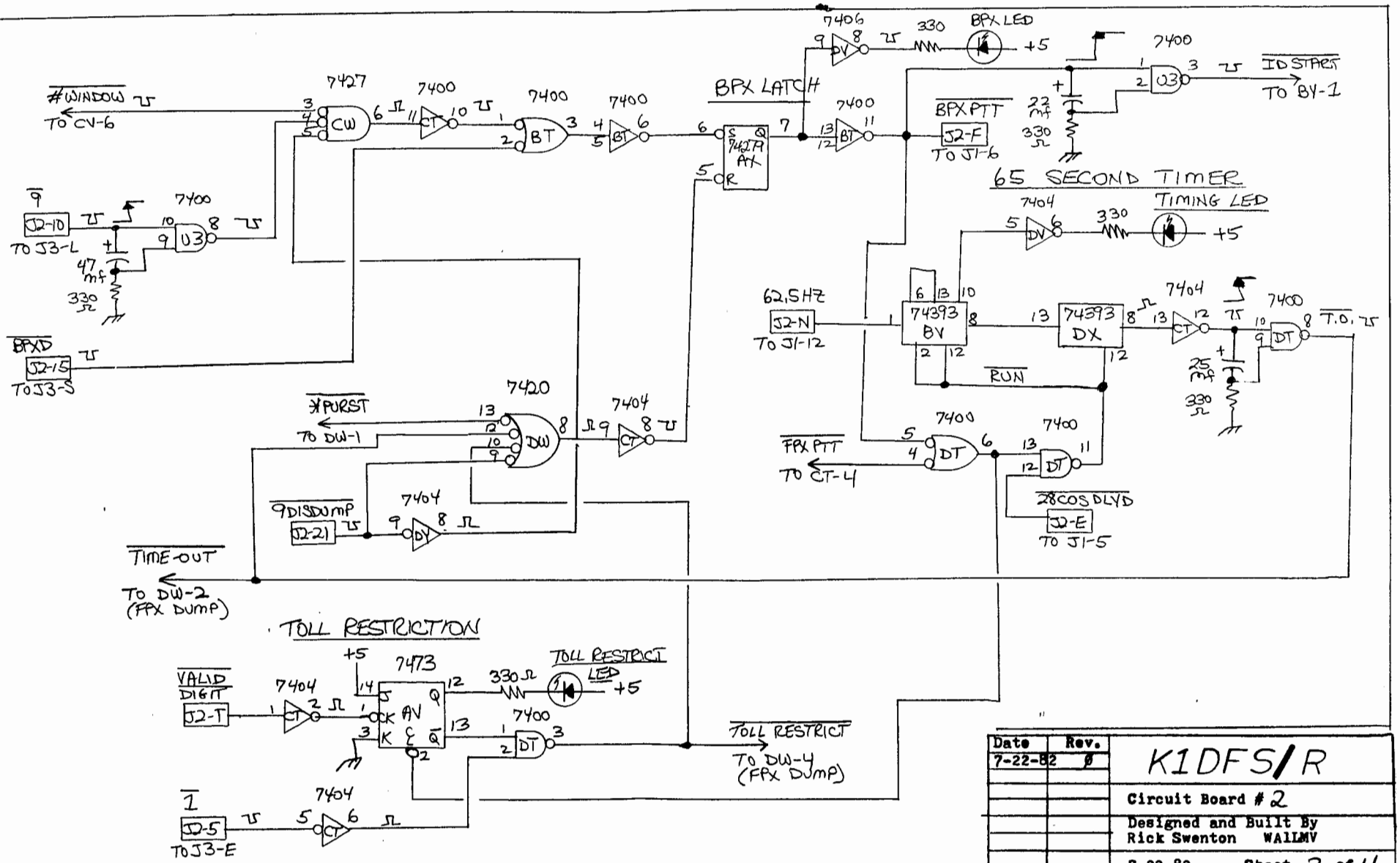
7-22-82 Sheet 2 of 4



Date	Rev.
7-22-82	Ø

K1DFS/R

Circuit Board # 2

Designed and Built By
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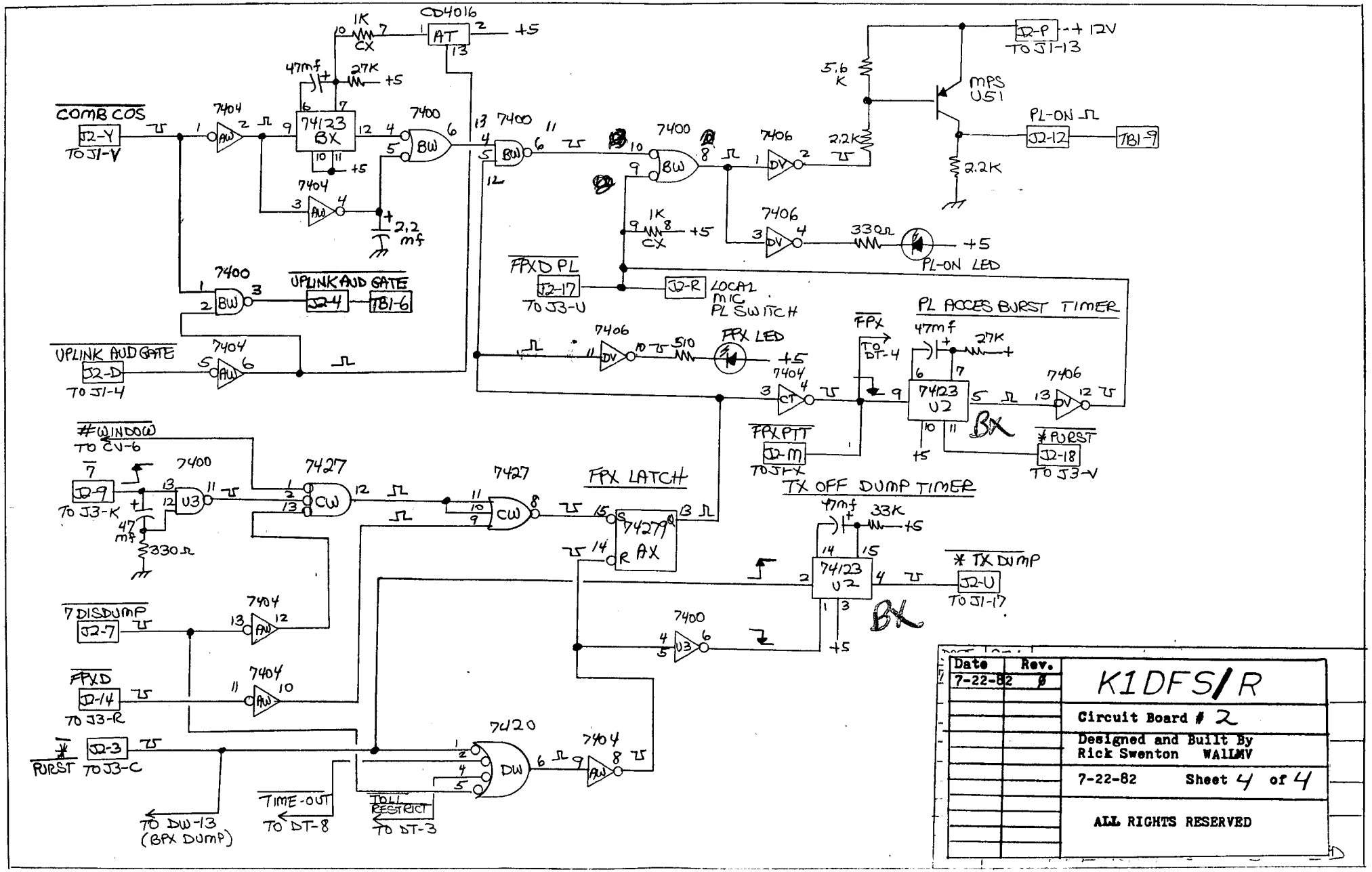
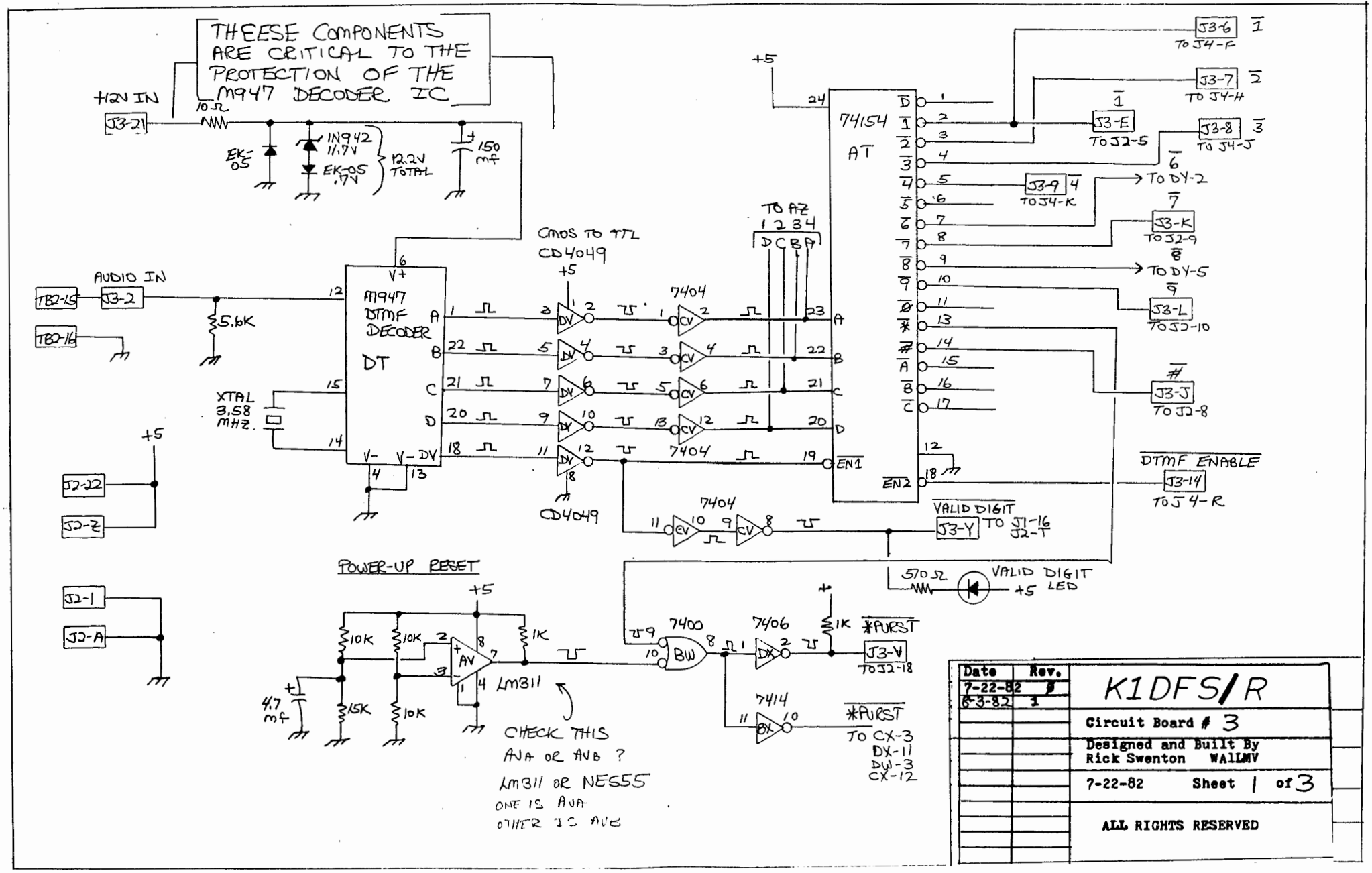
7-22-82 Sheet 3 of 4





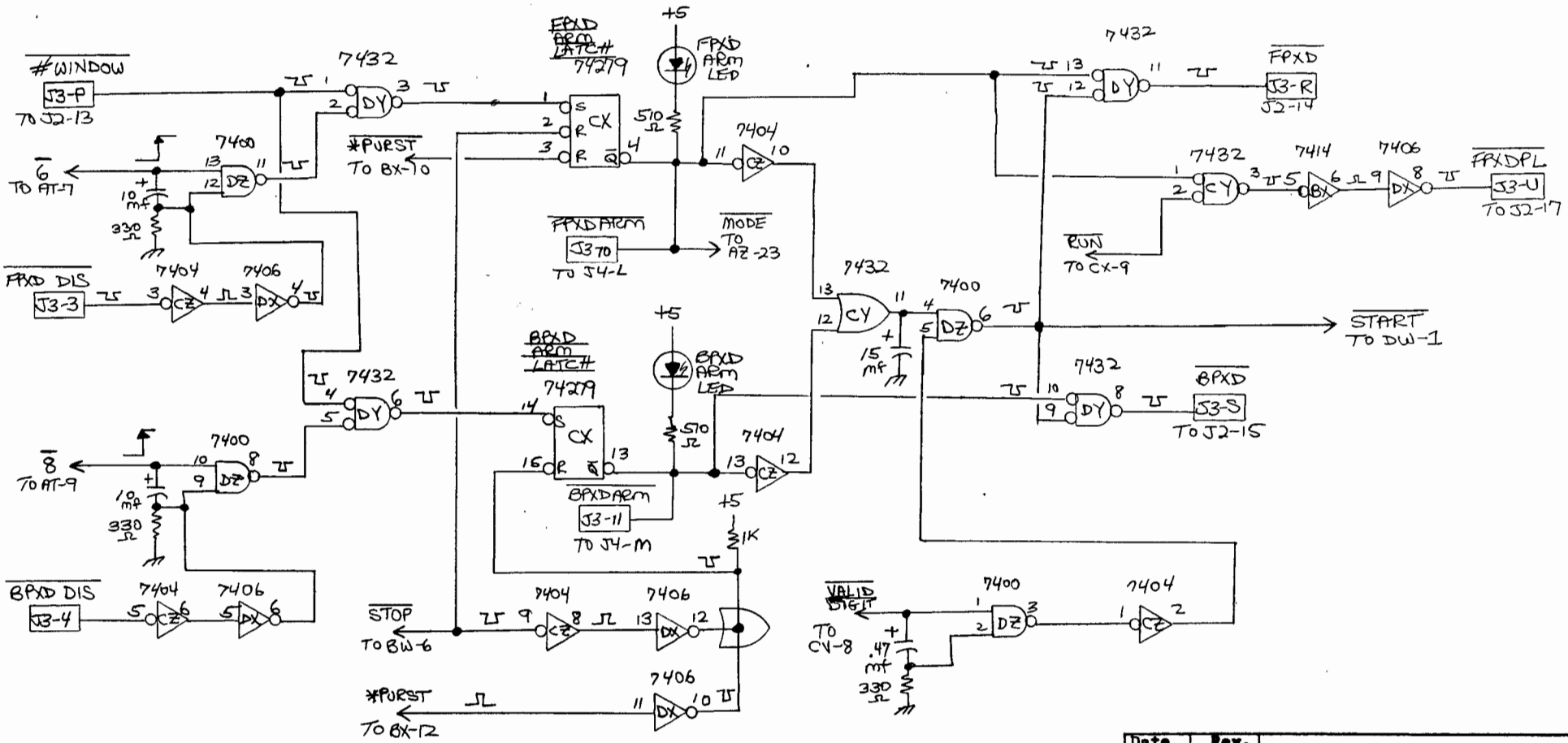
Date	Rev.
7-22-82	0
8-3-82	1

K1DFS/R

Circuit Board # 3

Designed and Built By
Rick Swenton WA1LMV

7-22-82 Sheet 1 of 3



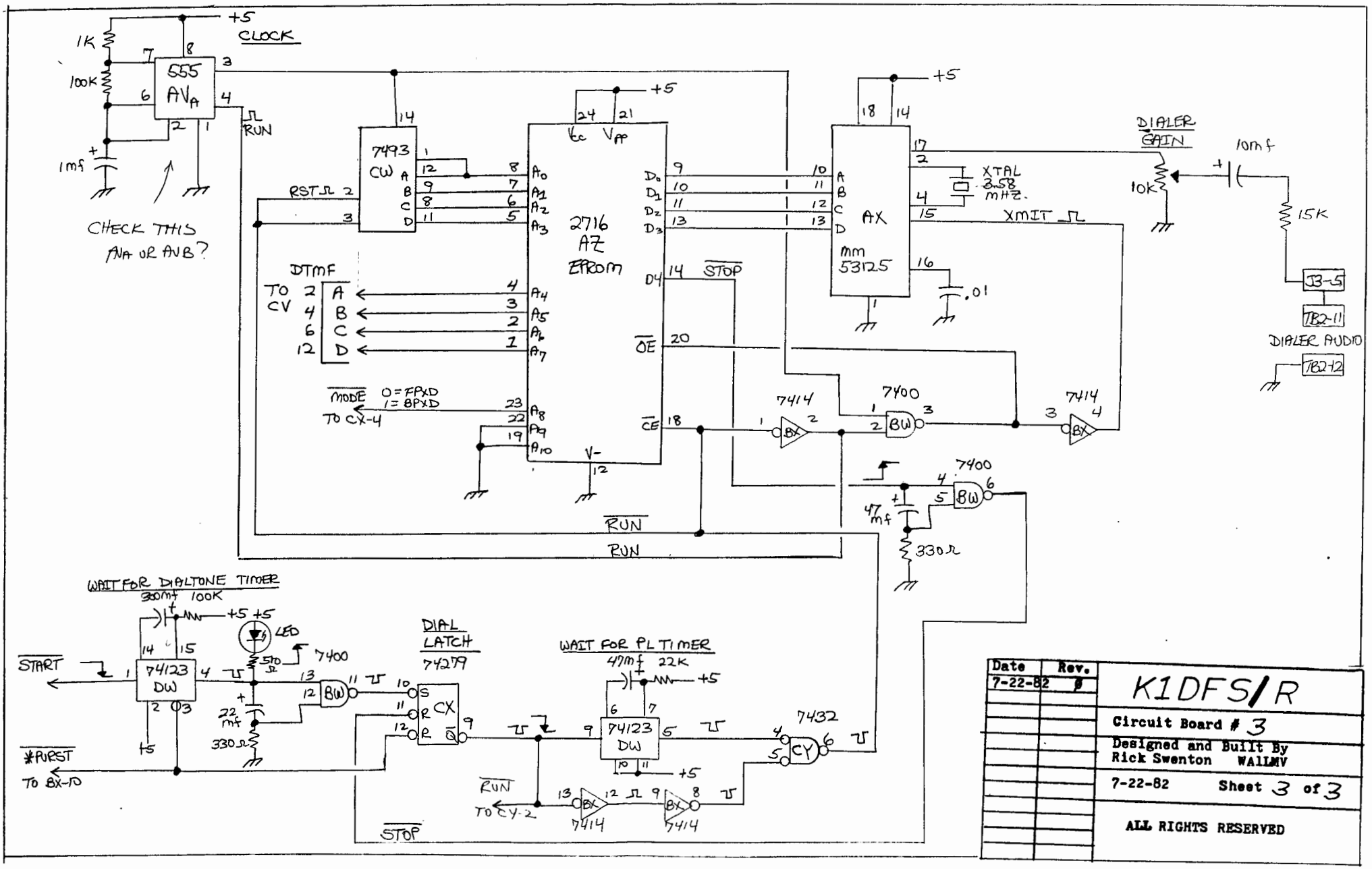
Date	Rev.
7-22-82	0
8-3-82	1

K1DFS/R

Circuit Board #3

Designed and Built By
Rick Swenton WA1LMV

7-22-82 Sheet 2 of 3



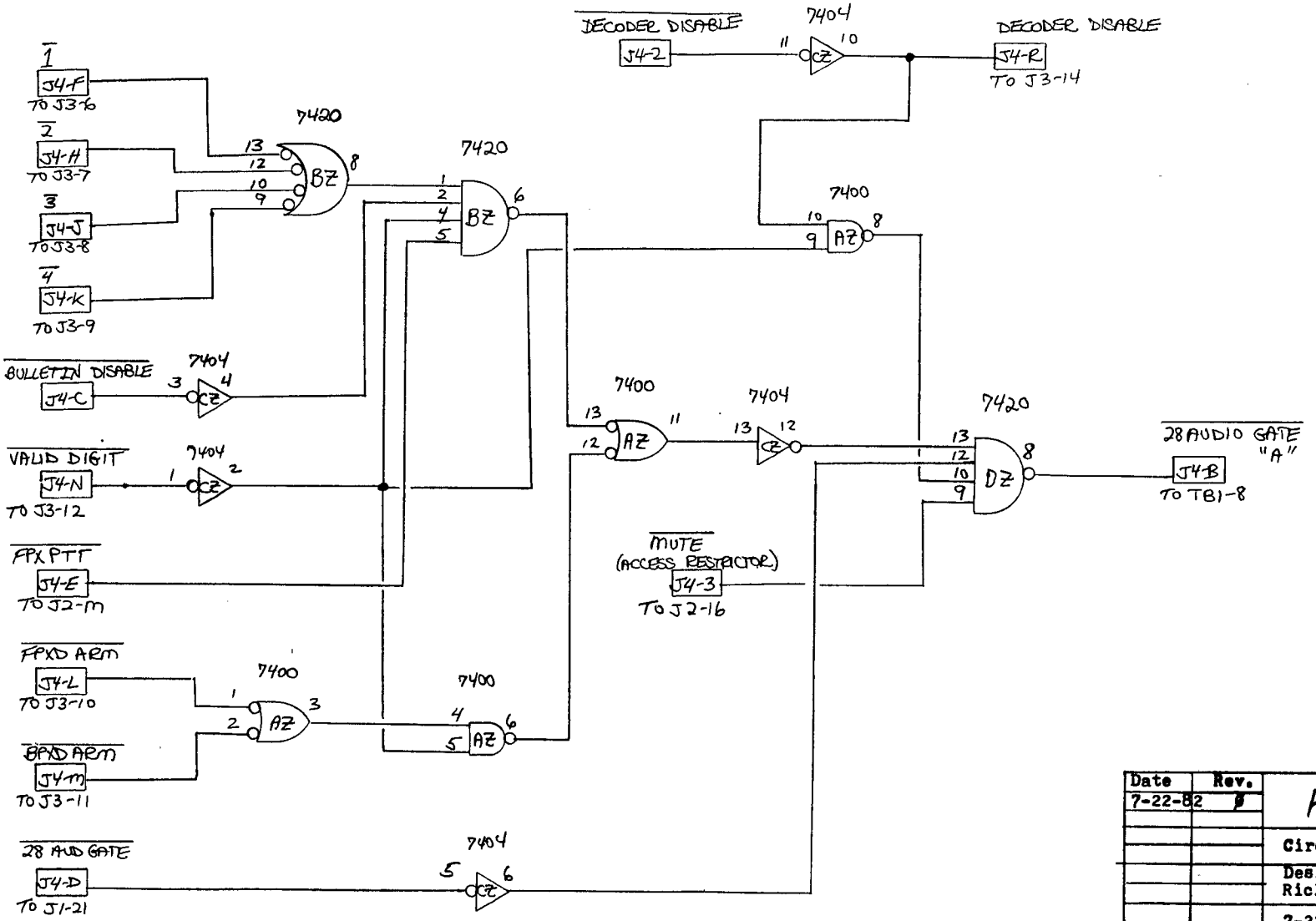
Date	Rev.
7-22-82	B

K1DFS/R

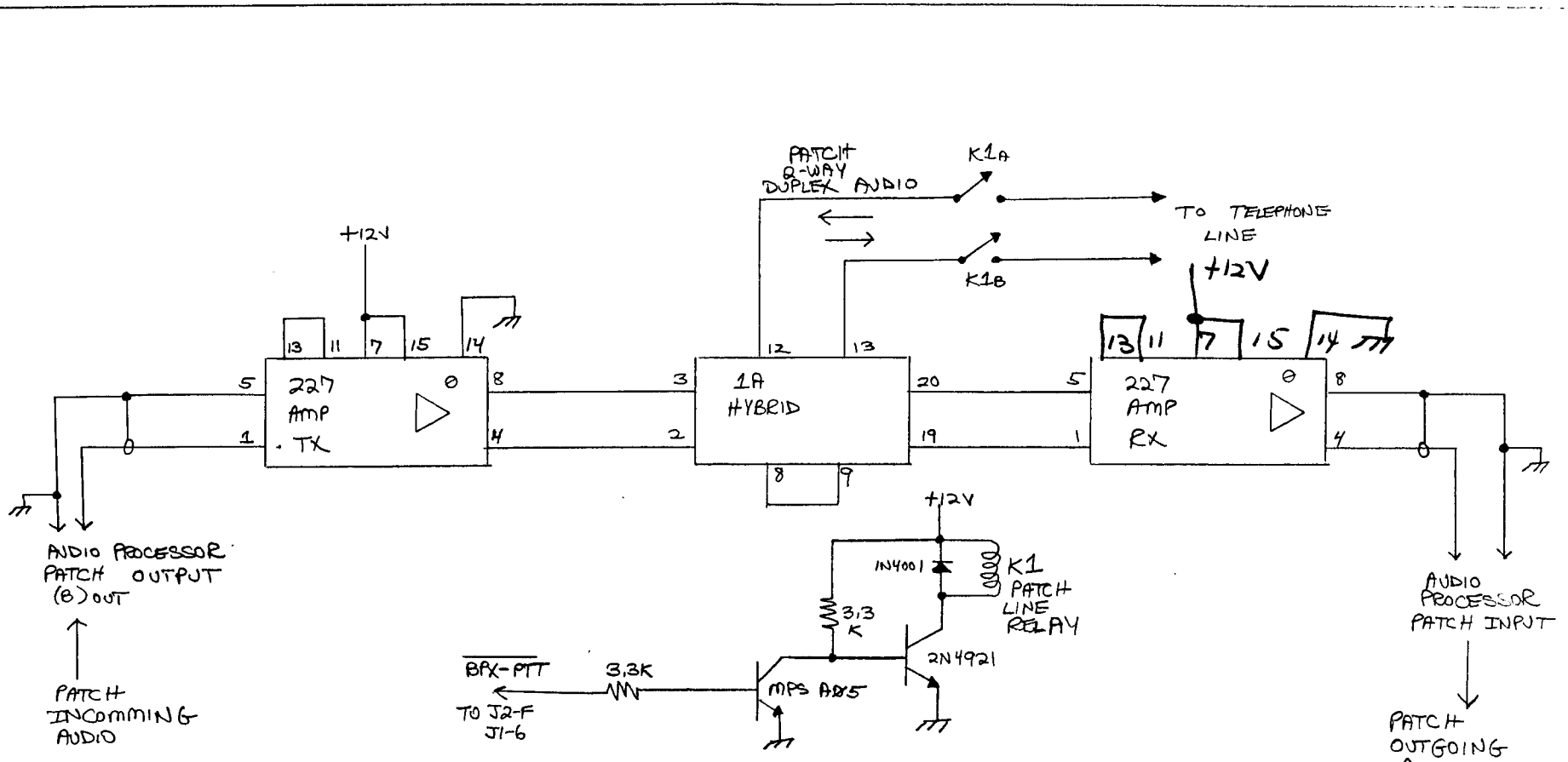
Circuit Board # 3

Designed and Built By
Rick Swenton WA1LMV

7-22-82 Sheet 3 of 3



Date	Rev.	K1DFS/R
7-22-82		
		Circuit Board # 4
		Designed and Built By Rick Swenton WA1LMV
		7-22-82 Sheet 1 of 1



Date	Rev.
7-22-82	0
3-18-87	1

K1DFS/R

Circuit Board # N/A

Designed and Built By
Rick Swenton WA1LMV

7-22-82 Sheet 1 of 1

BRISTOL AUTOPATCH

KlDFS/R Speed Dialer
EPROM Programming
Data
Bristol Group

100-0F
101-FF
↓
10F-FF

110-F5 Test Tone
111-F8 589-0960
112-F9
113-F0
114-F9
115-F6
116-00
117-FF
↓
11F-FF

120-F5 State
121-F8 Police
122-F2 Litchfield
123-F8 582-8143
124-F1
125-F4
126-03
127-FF
↓
12F-FF

130-F2 Thomaston
131-F8 Police
132-F3 283-4343
133-F4
134-F3
135-F4
136-03
137-FF
↓
13F-FF

140-F6 Farmington
141-F7 Police
142-F3 673-2525
143-F2
144-F5
145-F2
146-05
147-FF
↓
14F-FF

150-F8 Wolcott
151-F7 Police
152-F9 879-1414
153-F1
154-F4
155-F1
156-04
157-FF
↓
15F-FF

160-F5 Plymouth
161-F8 Police
162-F9 589-7779
163-F7
164-F7
165-F7
166-09
167-FF
↓
16F-FF

170-F7 Plainville
171-F4 Police
172-F7 747-1616
173-F1
174-F6
175-F1
176-06
177-FF
↓
17F-FF

180-F6 Southington
181-F2 Police
182-F1 621-0103
183-F0
184-F1
185-F0
186-03
187-FF
↓
18F-FF

190-F5 Test Tone
191-F8 589-0960
192-F9
193-F0
194-F9
195-F6
196-00
197-FF
↓
19F-FF

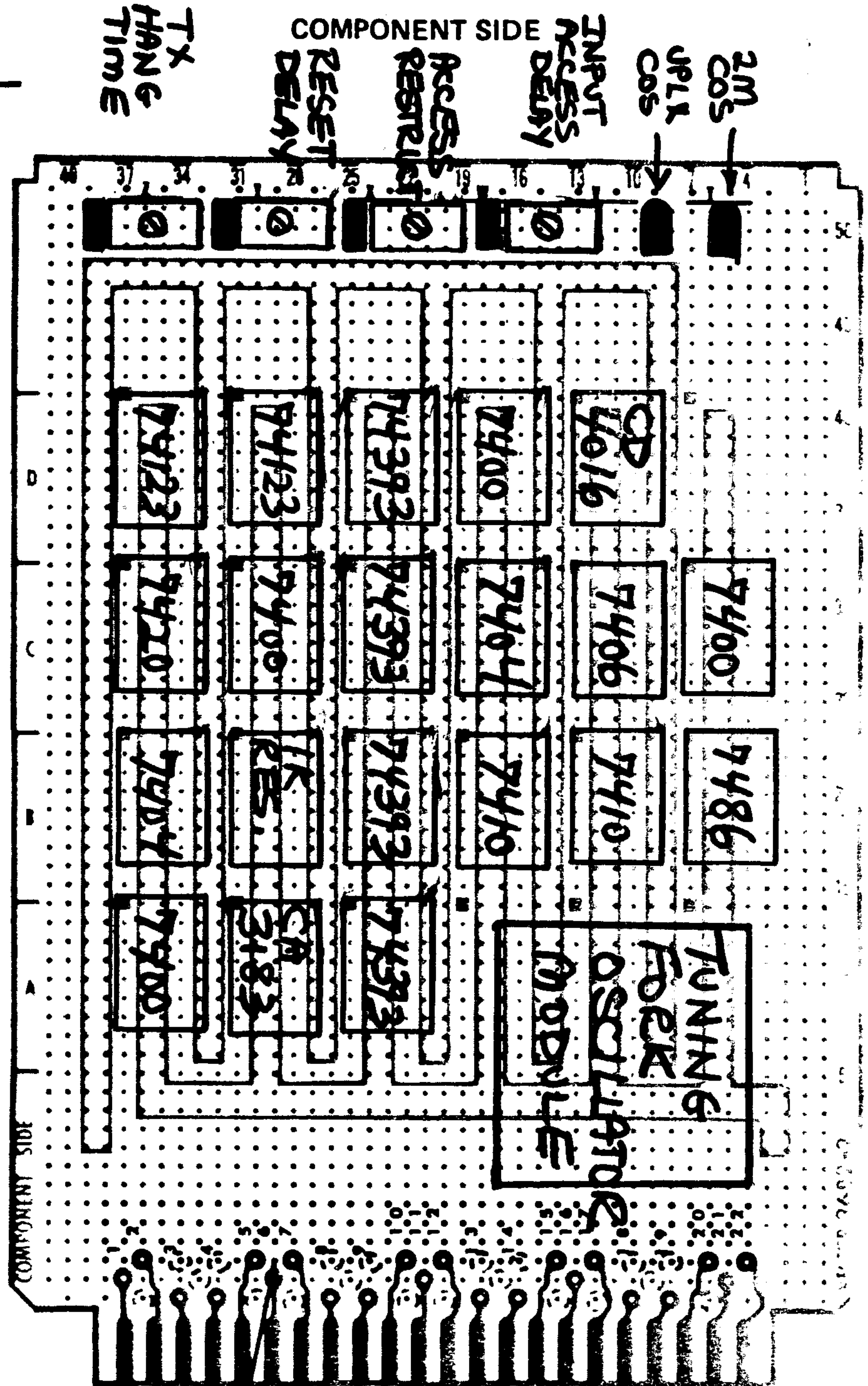
**K1DFS/R
Circuit Board
Pictorial**

Board # 1

**7-22-82
WA1LMV**

3682-2 6.5" LONG CARD

COMPONENT SIDE



CAUTION: In any plug contact area on either side of Plugbord, use only those holes having pads. Holes without pads may have insufficient clearance to adjacent circuitry and using them could cause shorting.

= No. 1 DIP Position

3. INTENDED FOR USE IN NON-HOSTILE ENVIRONMENTS UP TO 200 VOLTS RMS OR 300 VOLTS DC.

2. DOTTED CIRCLES REPRESENT PLUG PADS ON OPPOSITE SIDE OF BOARD.

1. ZONE LETTERS A,B,C, ETC. ON Y AXIS AND X,Y,Z ON X AXIS MARK POSITION FOR 14- OR 16-PIN DIPS.

NOTES

NOTICE: Where tin coated circuitry exists a small percentage of the holes may have solder blockage. This is USUALLY a light "skin" easily penetrated by component leads. In some cases, a soldering iron may be required.

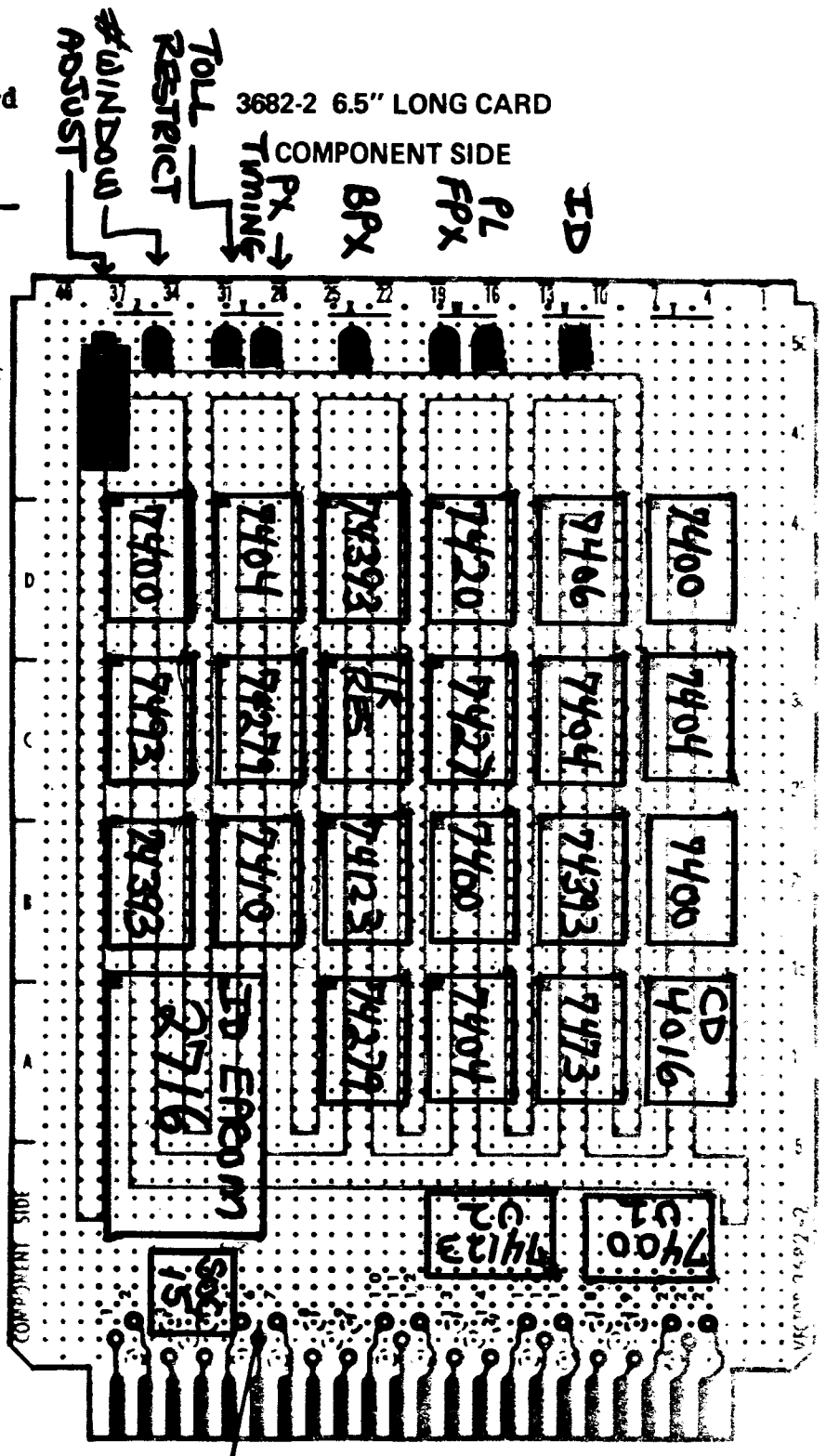
K1DFS/R
Circuit Board
Pictorial

Board # 2

7-22-82
WA1LMV

3682-2 6.5" LONG CARD

COMPONENT SIDE



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= No. 1 DIP Position

3. INTENDED FOR USE IN NON-HOSTILE ENVIRONMENTS UP TO 200 VOLTS RMS OR 300 VOLTS DC.
2. DOTTED CIRCLES REPRESENT PLUG PADS ON OPPOSITE SIDE OF BOARD.
1. ZONE LETTERS A,B,C, ETC. ON Y AXIS AND X,Y,Z ON X AXIS MARK POSITION FOR 14- OR 16-PIN DIPS.
NOTES

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VECTOR D.I.P. PLUGBORD
PATTERN .042" x 0.1" SPACED HOLES
LA3-P5 LAYOUT PAPER Issue 78-8

VECTOR ELECTRONIC CO., INC.
12460 GLADSTONE AVE.
SYLMAR, CALIF. 91342

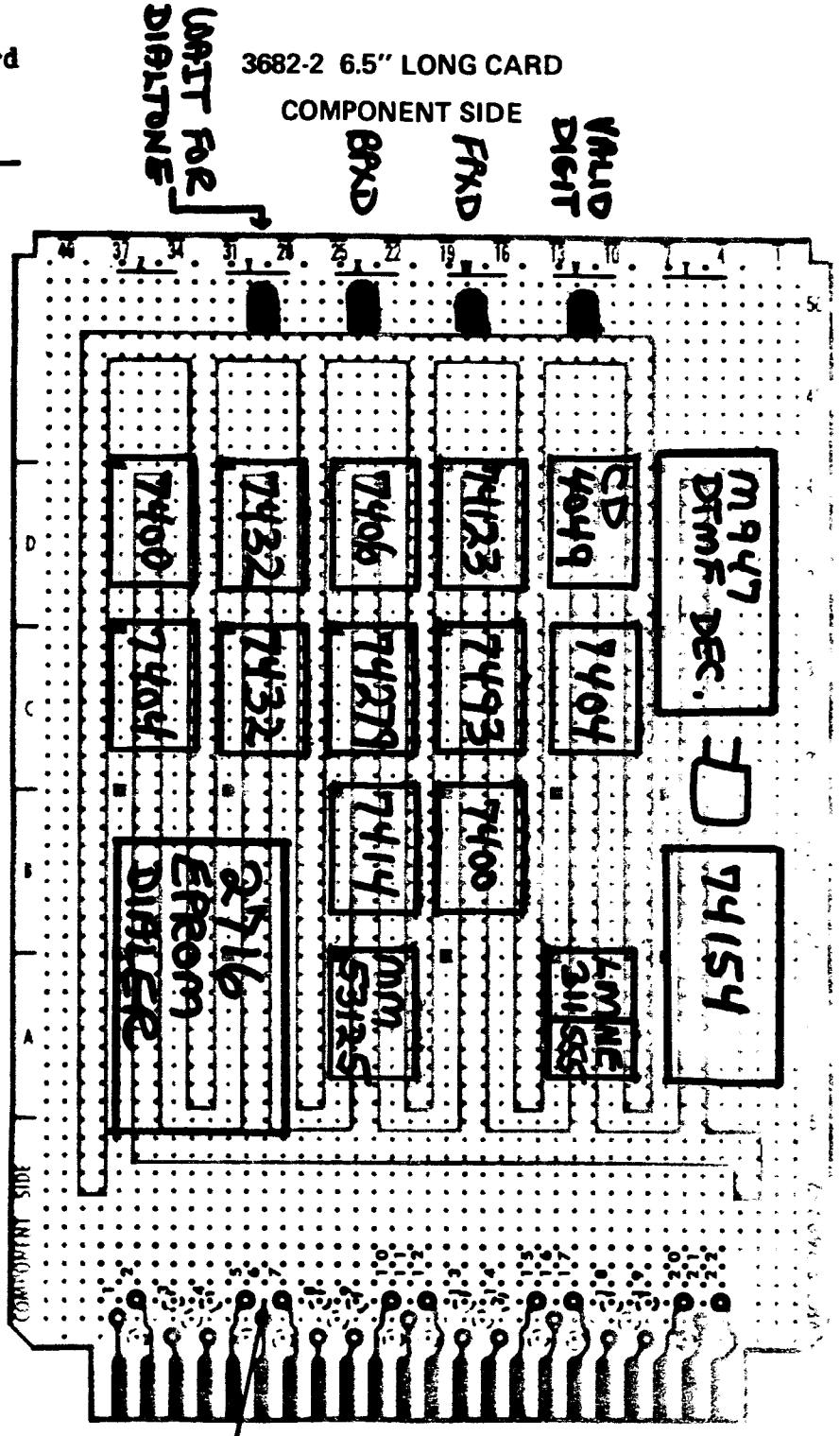
KIDFS/R
Circuit Board
Pictorial

Board # 3

7-22-82
WALLMV

3682-2 6.5" LONG CARD

COMPONENT SIDE



CAUTION: In any plug contact area on either side of Plugbord, use only those holes having pads. Holes without pads may have insufficient clearance to adjacent circuitry and using them could cause shorting.

= No. 1 DIP Position

3. INTENDED FOR USE IN NON-HOSTILE ENVIRONMENTS UP TO 200 VOLTS RMS OR 300 VOLTS DC.
2. DOTTED CIRCLES REPRESENT PLUG PADS ON OPPOSITE SIDE OF BOARD.
1. ZONE LETTERS A,B,C, ETC. ON Y AXIS AND X,Y,Z ON X AXIS MARK POSITION FOR 14- OR 16-PIN DIPS.
NOTES

NOTICE: Where tin coated circuitry exists a small percentage of the holes may have solder blockage. This is USUALLY a light "skin" easily penetrated by component leads. In some cases, a soldering iron may be required.

VECTOR D.I.P. PLUGBORD
PATTERN .042" x 0.1" SPACED HOLES
LA3-P5 LAYOUT PAPER Issue 78-8

VECTOR ELECTRONIC CO., INC.
12460 GLADSTONE AVE.
SYLMAR, CALIF. 91342

K1DFS/R Speed Dialer
EPROM Programming Data
Farmington Group

000-0F	
001-FF	
↓	
01F-FF	
010-F6	677-0960
011-F7	Test Tone
012-F7	
013-F0	
014-F9	
015-F6	
016-00	
017-FF	
↓	
01F-FF	
020-F5	State Pol.
021-F6	Hartford
022-F6	566-5990
023-F5	
024-F9	
025-F9	
026-00	
027-FF	
↓	
02F-FF	
030-F5	Hartford Pol.
031-F2	522-0111
032-F2	
033-F0	
034-F1	
035-F1	
036-01	
037-FF	
↓	
03F-FF	
040-F2	West
041-F3	Hartford Pol.
042-F3	233-2121
043-F2	
044-F1	
045-F2	
046-01	
047-FF	
↓	
04F-FF	

050-F2	New
051-F2	Britain Pol.
052-F9	229-0321
053-F0	
054-F3	
055-F2	
056-01	
057-FF	
↓	
05F-FF	
060-F5	Bristol Pol.
061-F8	582-8131
062-F2	
063-F8	
064-F1	
065-F3	
066-01	
067-FF	
↓	
06F-FF	
070-F7	Plainville
071-F4	Police
072-F7	747-1616
073-F1	
074-F6	
075-F1	
076-06	
077-FF	
↓	
07F-FF	
080-F1	Southington
081-F6	Police
082-F2	1-621-0103
083-F1	
084-F0	
085-F1	
086-F0	
087-03	
088-FF	
↓	
08F-FF	

090-F5	Time
091-F2	524-8123
092-F4	
093-F8	
094-F1	
095-F2	
096-03	
097-FF	
↓	
09F-FF	
0A0-F6	Test Tone
0A1-F7	677-0960
0A2-F7	
0A2-F0	
0A3-F9	
0A4-F6	
0A5-00	
0A6-FF	
↓	
0AF-FF	

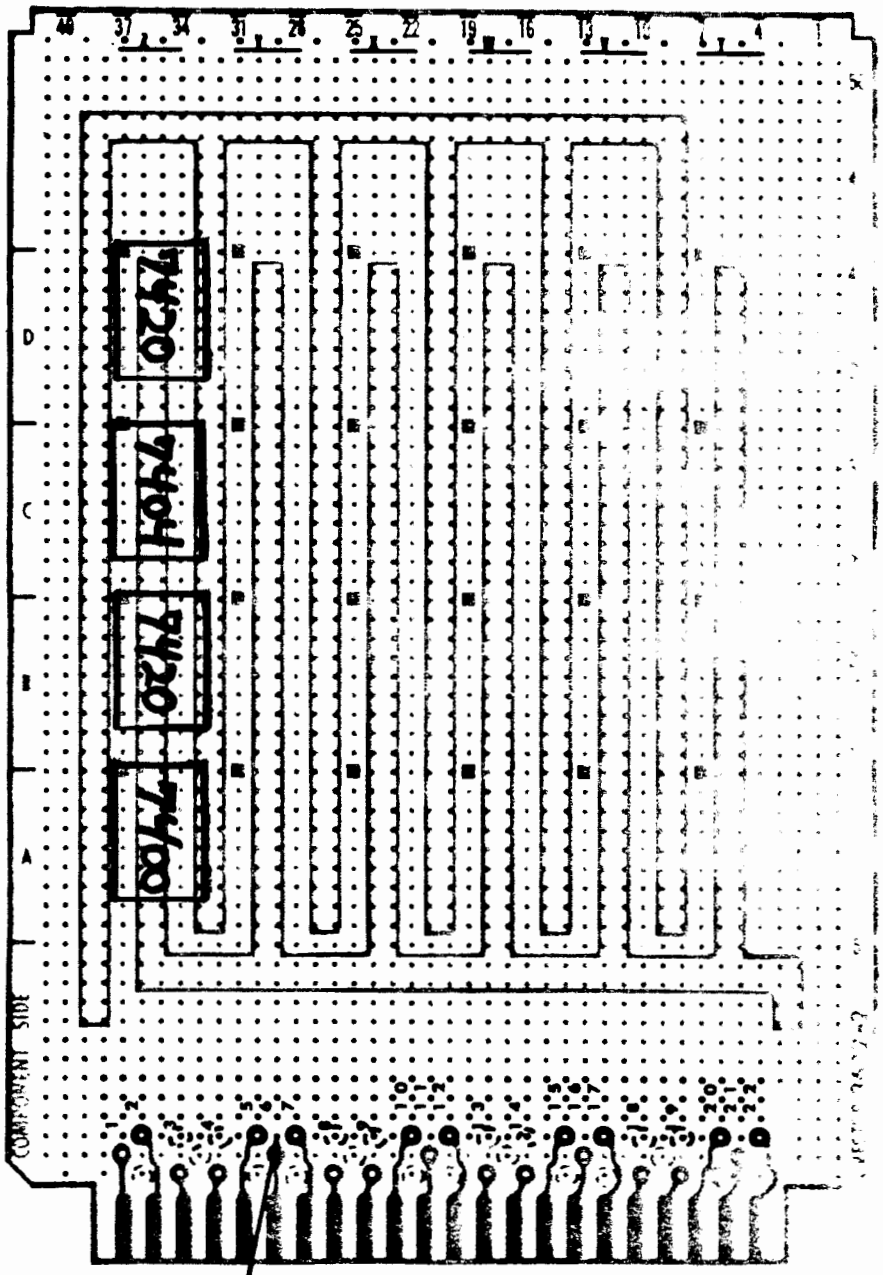
KIDFS/R
Circuit Board
Pictorial

Board # 4

7-22-82
WALLMV

3682-2 6.5" LONG CARD

COMPONENT SIDE



NOTICE: Where tin coated circuitry exists a small percentage of the holes may have solder blockage. This is USUALLY a light "skin" easily penetrated by component leads. In some cases, a soldering iron may be required.

CAUTION: In any plug contact area on either side of Plugbord, use only those holes having pads. Holes without pads may have insufficient clearance to adjacent circuitry and using them could cause shorting.

= No. 1 DIP Position

3. INTENDED FOR USE IN NON-HOSTILE ENVIRONMENTS UP TO 200 VOLTS RMS OR 300 VOLTS DC.
2. DOTTED CIRCLES REPRESENT PLUG PADS ON OPPOSITE SIDE OF BOARD.
1. ZONE LETTERS A,B,C, ETC. ON Y AXIS AND X,Y,Z ON X AXIS MARK POSITION FOR 14- OR 16-PIN DIPS.
NOTES

VECTOR D.I.P. PLUGBORD
PATTERN .042" x 0.1" SPACED HOLES
LA3-P5 LAYOUT PAPER Issue 78-8

VECTOR ELECTRONIC CO., INC.
12460 GLADSTONE AVE.
SYLMAR, CALIF. 91342

VOICE BULLETIN
SYSTEM
for WR1ABM

Designed by
R. Swenton WA1LMV
1-18-79

Please note: The information contained herein is the sole property of R. Swenton and/or C. Cayer any must not be divulged to others in any maner or form without permission.

Publication date: 12-21-81

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This information is believed to be accurate and up to date. However, no liability is expressed or implied.

This issue replaces publication dated: 11-30-79

Publication Number A1

ICRC VOICE BULLETIN SYSTEM

BY WA1LMV

OPERATING INSTRUCTIONS (Revision 11-81)

The assembly is broken down to four units: (from top to bottom) (See figure 1)

1-DTMF Decoder
2-UHF Receiver and Transmitter
3-8 Track Play/Record Deck
4-VHF Receiver

Controls and indicators are denoted with numbered arrows on Figure 1.

DTMF DECODER:

Indicator LEDs respond to incomming Touchtone signals from the VHF receiver.(1) Tuning adjustments for each tone frequency are located at (2). The Valid Digit LED (3) responds to any valid touchtone and indicates which tones are rejected by not lighting. The PAD SWITCH (4) is used to switch the Local PAD (5) between the DTMF Decoder input and the UHF Transmitter input. This is so the PAD can be used locally to test the Decoder, or used on the air on the UHF transmitter to control through the 450 repeater.

UHF RECEIVER/TRANSMITTER:

The Audio and Squelch Controls (6) control the UHF Receiver on 447.85 (K1DFS/R) when the RECEIVER/TAPE Switch (7) is in the "R" position. When the RECEIVER/TAPE Switch is in the "T" position, the UHF Receiver is disabled and the Tape Deck audio is fed through the audio amplifier in the UHF Receiver for local monitoring purposes. The REPEATER/LINK SWITCH (8) is used to switch the UHF Transmitter from the 442.85 repeater input (K1DFS/R) in the RPT position to the 444.675 uplink frequency to the 88 Repeater in the LINK position.

8 TRACK TAPE DECK:

To record a Channel on the Tape:
Set the Control Audio (19) to zero. Set the Mic Audio(18) to the desired level. Remove the Tape. Press the Record switch (13). Insert the tape while still holding the record switch. The tape may start. Press the Reset Switch (10) to stop the tape. Press the Program Selector (12) to step to the desired channel as displayed at (9). Switch the PTT OFF (16) to prevent the UHF transmitter from keying up during the recording session. When ready to record, press and hold the PTT Switch on the Microphone. When you are through with your announcement, release the Mic PTT Switch and raise the Control Audio (19) to ten for a few seconds. This will record the audio control tone on the tape to indicate the message end. After a few seconds, lower both Audio and Control Gains (18 & 19) to zero and allow the tape to return to the starting point. This can be speeded by entering Digit Ø or * into the DTMF Decoder from the Local Pad.

8 Track Tape Deck continued:

After the tape has stopped, remove the tape to allow the Record Switch to return to the Play position.

To enable the Deck for Playback:
Restore the PTT Switch (16) to the ON position. Place the Control Gain (19) to ten. Place the Audio Gain (18) to the desired level. Place the Channel Switches (11) to the ON position unless it is desired to inhibit any or all Channels. In this case, place the desired switches in the center OFF position.

To manually access a channel:

Move the desired Channel Switch (11) to the Start position and then return to the ON or OFF position. An alternate method would be to place the PAD Switch (4) in the "D" position and access the Channel with the digit # followed by the Channel number.
Should you desire to listen to the audio without transmitting, place the PTT Switch (16) to the OFF position and place the Receiver/ Tape Switch (7) to the "T" Position.

The Play/Fast Forward Switch (14) performs no function.

VHF RECEIVER:

To set the controls on the VHF Receiver, proceed as follows:

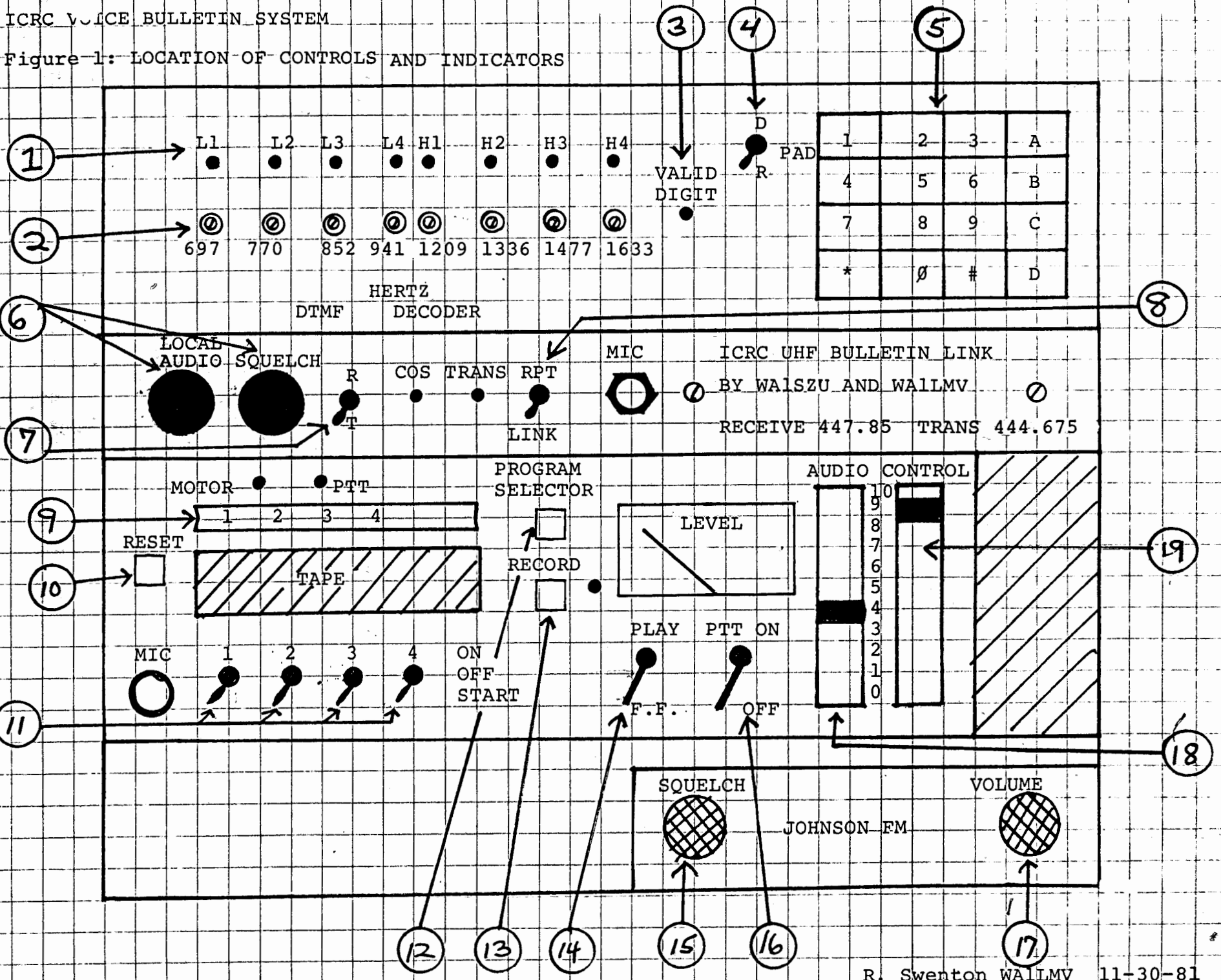
Set the Squelch Control (15) to approx. one o'clock.
Set the Volume control to the minimum position, fully counter clockwise without actually turning the receiver off.

If the VHF Receiver is turned off with the Volume Control, none of the channels can be accessed by the repeater users.

IF USING THE UHF RECEIVER/TRANMSITTER ON THE 450 REPEATER, REMEMBER TO RETURN THE RPT/LINK SWITCH (8) TO THE LINK POSITION, OR THE NEXT BULLETIN WILL COME OUT ON THE 450 REPEATER INSTEAD OF THE 88 REPEATER.

ICRC VOICE BULLETIN SYSTEM

Figure 1: LOCATION OF CONTROLS AND INDICATORS



R. Swenton WA1LMV 11-30-81

WR1ABM Voice Bulletin System

Designed by R. Swenton, WA1LMV 1-18-79

The WR1ABM Voice Bulletin System consists of a specially modified Panasonic eight track tape deck and associated custom designed logic circuitry. Because the tape deck was positive ground, relay interfacing was required. There are three relays inside the tape deck: 1) Motor control, 2) Program select, and 3) Fast Forward motor control. The relays are controlled by the logic board. Other modifications to the tape deck include: changing the channel indicator lamp voltage from 12VAC to +12VDC to drive the logic board inputs, disabling the foil sensing program change circuit and provide separate foil sensing wires to the logic board and separate program solenoid wires to the program relay, and wiring from the fast forward relay to the motor.

Operation: (Playback) DTMF signals from the four touchtone signals 1,2,3,and 4, are fed into the logic board through inhibit switches. When a bulletin access signal is detected by the touchtone decoder the signal sets the channel requested latch. This will start scanning where the logic will activate the program solenoid until the channel requested coincides with the channel selected. When this coincidence occurs, the program solenoid stops, the transport motor starts, the repeater PTT line activates, and further DTMF input signals are inhibited. The tape is now playing on the repeater output. Playback will continue until a control tone appears on the right side control channel. When the tone is detected, the PTT signal stops, the repeater transmitter is unkeyed, the transport motor goes into fast forward, and this will continue until the tape has returned to the beginning. When the tape returns to start, the foil on the tape will short the foil sensing contacts. This will signal the logic to stop the transoprt motor and enable further access commands.

(Record) When recording a message, manually select the desired channel with the front panel Channel Button. Remove the cartrige and press the Record Button. While holding the Record Button in, reinsert the cartrige. Shut off the PTT switch to keep the repeater from being keyed while you are recording. Turn down the right channel audio level control to zero. Set the left channel (record level) audio control to 5. When you are ready to record, press the PTT lever on the mic. Speak in a normal voice. When you finish the message, lower the left channel audio to zero and immediately raise the right channel level control to 10 for one second, then return to zero. At this point you have recorded the control tone on the right channel. You now must wait until the tape returns to the beginning so that the tape deck will erase any message which may follow the new message. When the tape returns to start, the motor will automatically shut off. Remove the cartrige and reinsert it. This will place the deck back into playback mode and ready for access. Return the PTT switch back to the ON position.

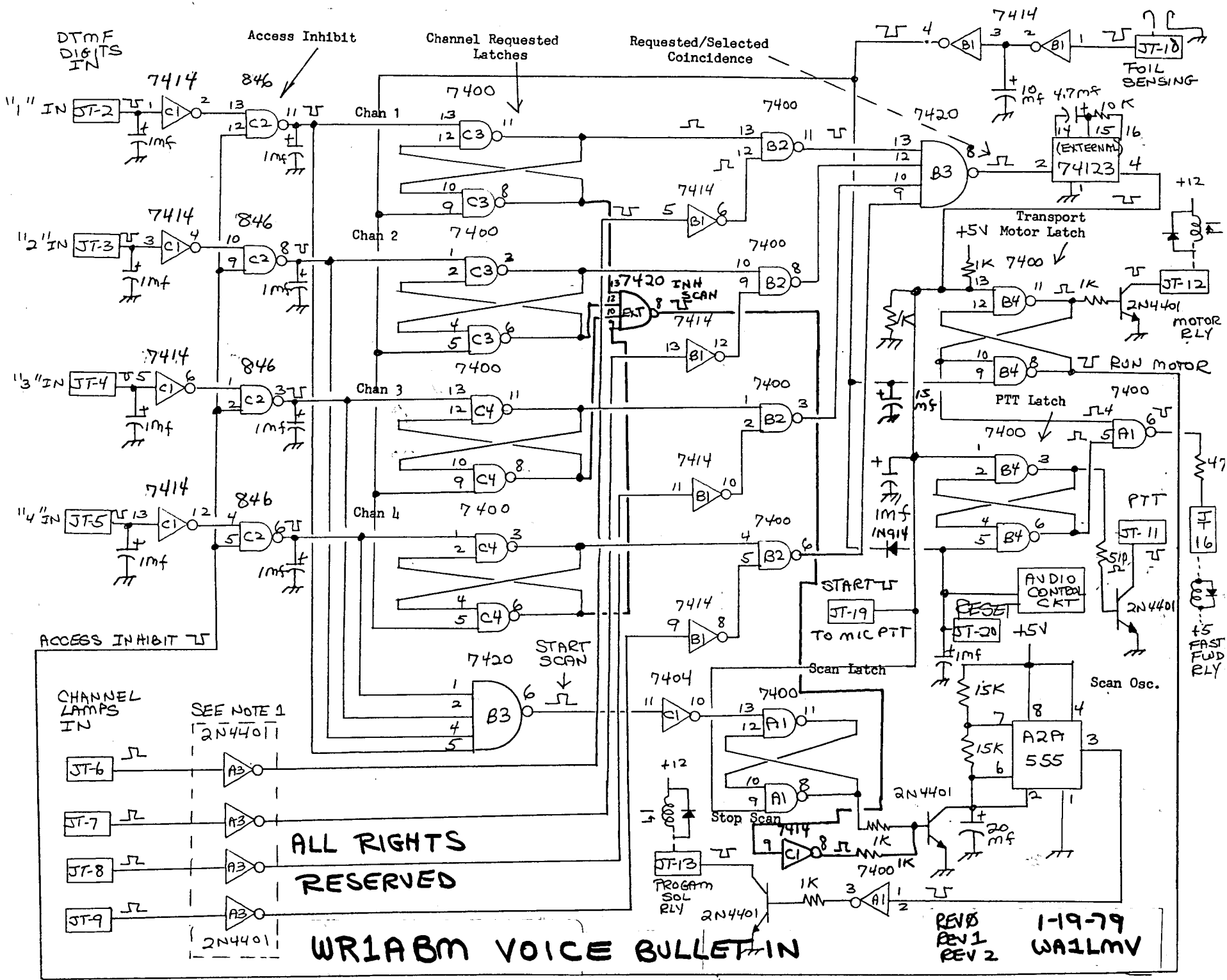
Two LED indicators are present on the front control panel. The left side lights when the transport motor is running in the normal or fast forward mode, the right side lights whenever the logic is providing a repeater transmitter PTT signal. This PTT LED still lights even though the PTT switch is off. If only the Motor LED is lit, this indicates that the motor is in the fast forward mode. The repeater will never be keyed during fast forward.

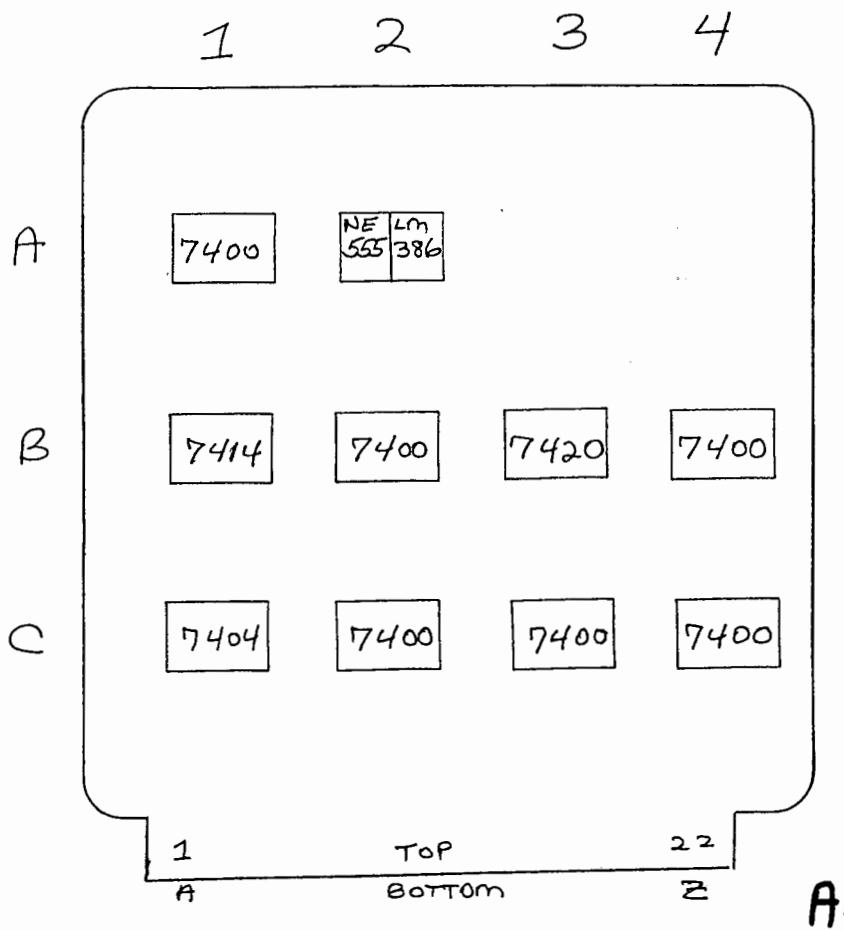
Bulletins can be cancelled during a message by pressing the "*". This signal performs the same function as the control tone: It unkeys the transmitter and runs the motor in fast forward.

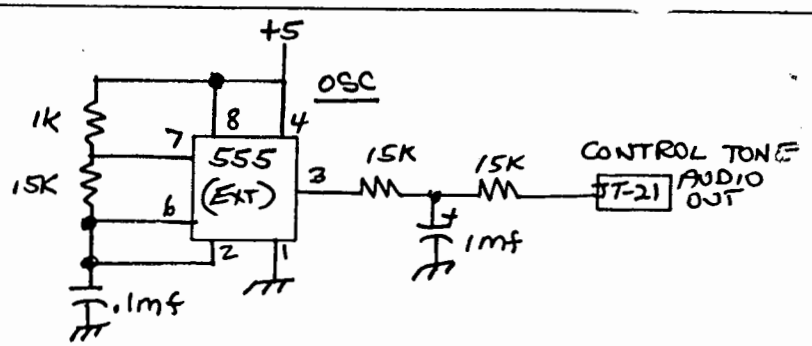
Bulletins can be accessed locally fron the repeater console by either of two ways: 1) press the appropriate button on the local touchtone pad, or 2) activate the appropriate switch on the tape deck panel.

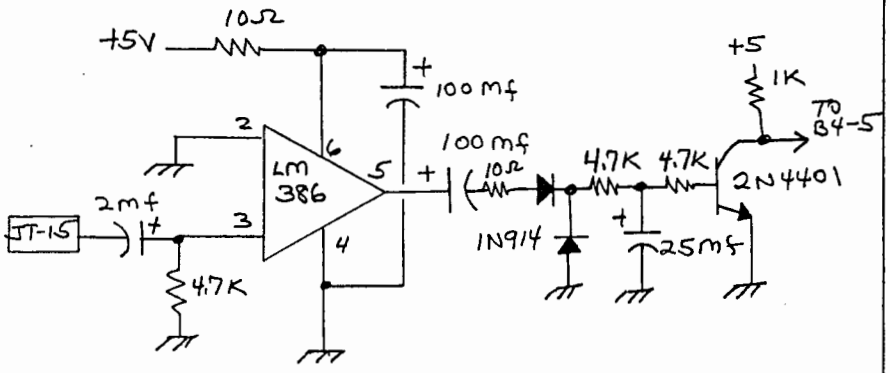
The front panel tape deck switches perform a dual function. They are three position switches. The up position enables that channel, the middle position disables that channel, and momentairily placing the switch in the down position accesses that channel.

The logic circuitry is located on one 44 pin plug-in circuit board. Power to the board (+5V Regulated) is provided by a regulator mounted to the deck chassis. Power requirements to the tape deck are 110 VAC and +12 VDC for the logic regulator and relays.

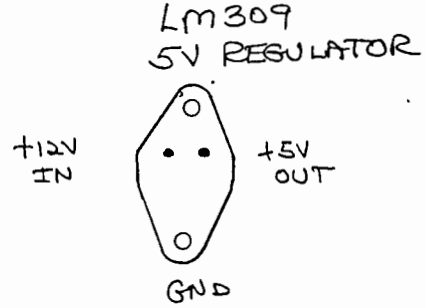

DTMF DIGITS IN
Access Inhibit
Channel Requested Latches
Requested/Selected Coincidence
"1" IN
"2" IN
"3" IN
"4" IN
JT-2
JT-3
JT-4
JT-5
7414
846
7400
7420
Chan 1
Chan 2
Chan 3
Chan 4
INH SCAN
ACCESS INHIBIT
START SCAN
CHANNEL LAMPS IN
SEE NOTE 1
2N4401
JT-6
JT-7
JT-8
JT-9
7404
JT-10
FOIL SENSING
74123
Transport
+5V Motor Latch
JT-12
MOTOR RLY
RUN MOTOR
PTT Latch
PTT
JT-11
JT-19
TO MIC PTT
START
Scan Latch
AUDIO CONTROL CKT
RESET
JT-20
+5V
Scan Osc.
555
Stop Scan
JT-13
PROGRAM SOL RLY
IN914
FAST FWD RLY
ALL RIGHTS RESERVED
WR1ABM VOICE BULLETIN
REV0
REV1
REV2
1-19-79
WA1LMV



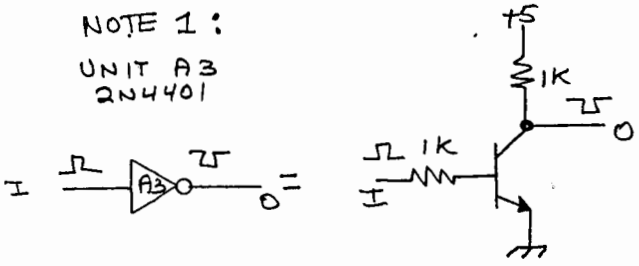




11-20-78
WA1LMV



NOTE 1:
UNIT A3
2N4401



WR1ABM
VOICE
BULLETIN

DIGITAL AUDIO PROCESSING UNIT

DESIGNED BY
R. Swenton WA1LMV
and
C. Cayer WA1SZU

Publication Number R2

Publication Date 6-11-79

Replaces previous publication dated: 2-23-79

DIGITAL AUDIO PROCESSING UNIT

Introduction: This unit replaces two existing repeater circuit boards: Board #1 and Board #3. The existing boards provided six channel gated audio mixing and receiver audio processing. The drawbacks of the existing boards were hum and RFI pick-up caused by lack of proper shielding and a limited number on audio inputs for future expansion. Also, design was lacking in some areas which caused momentary loss of audio in some instances.

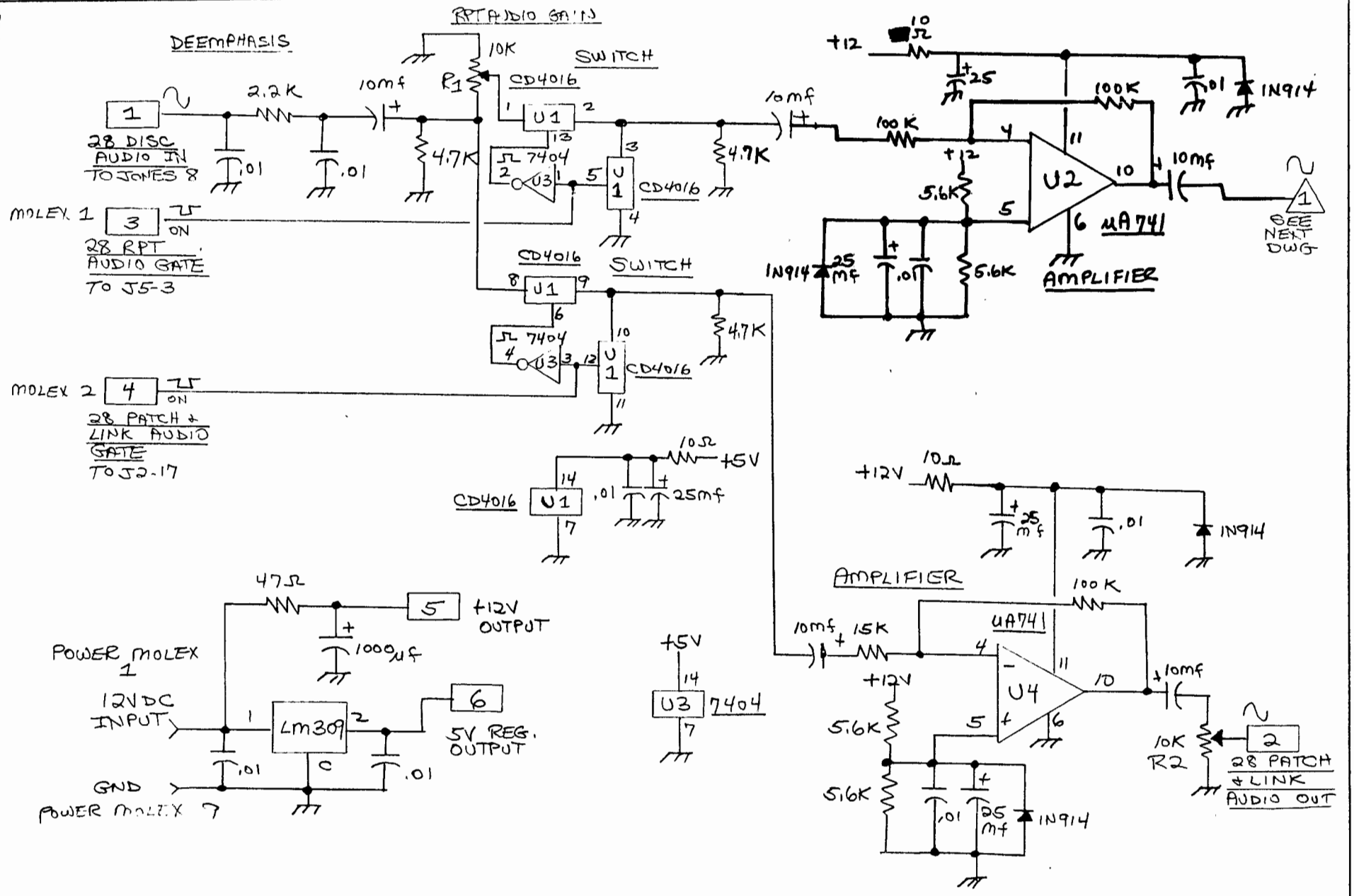
Description: The Digital Audio Processor was designed and built to correct the design faults of the old system. Some of the corrective measures were incorporating both old circuits on one main circuit board, improving shielding by enclosing the circuit in a double-clad copper chassis using RCA phono audio connectors and feed-thru capacitors for DC and control, onboard +5V regulation for the TTL compatible circuits to minimize hum pick-up from the mainframe +5V bus, improved design in operational amplifier circuits to improve hum pick-up, transient response, drifting, noise immunity and crosstalk, increased number of inputs some of which are ungated for versatility, additional bypassing and decoupling for the CMOS switches, and one power source (+12V) required where there was previously two.

Carefull design and planning was the main objective in this Digital Audio Processing Unit. The results are a repeater whose carrier is free from undesirable noise and whose audio becomes the standard of excellence for FM repeaters.

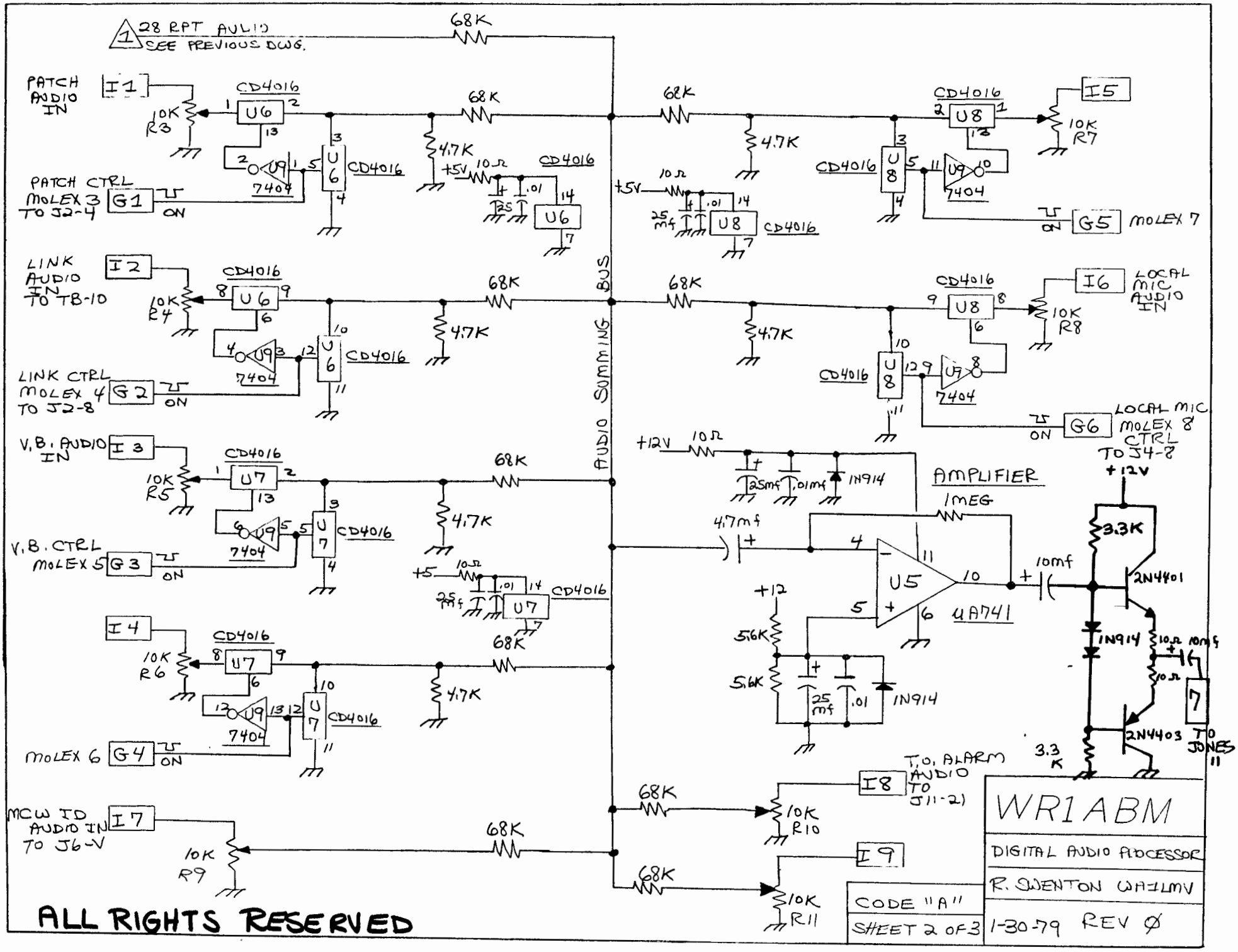
Theory of Operation: (See sheet 1) Receiver discriminator audio is deemphasized and fed into two CMOS switches (U1). One gates the audio into the summing bus, the other gates the audio into the Patch & Link Amplifier (U4) which outputs to the Autopatch and LINK circuits through gain adjustment pot R2. The output of the Repeat Audio Switch feeds the summing bus. The balance of the circuitry (see sheet 2) is the mixing circuit. U6, U7, and U8 CMOS switches perform the gating of inputs 1 through 6 . R3 through R8 are the gain pots for inputs 1 through 6 respectively. Three ungated inputs are provided through R9, R10 and R11. Amplifier (U5) provides the necessary increase in gain from the summing bus and drives the output.

Power requirements to the processor are +12V. Onboard regulator provides the TTL +5V power. Feed-thru capacitors are incorporated on the power and control lines coming into the chassis, RCA phono connectors are used for audio in and out.

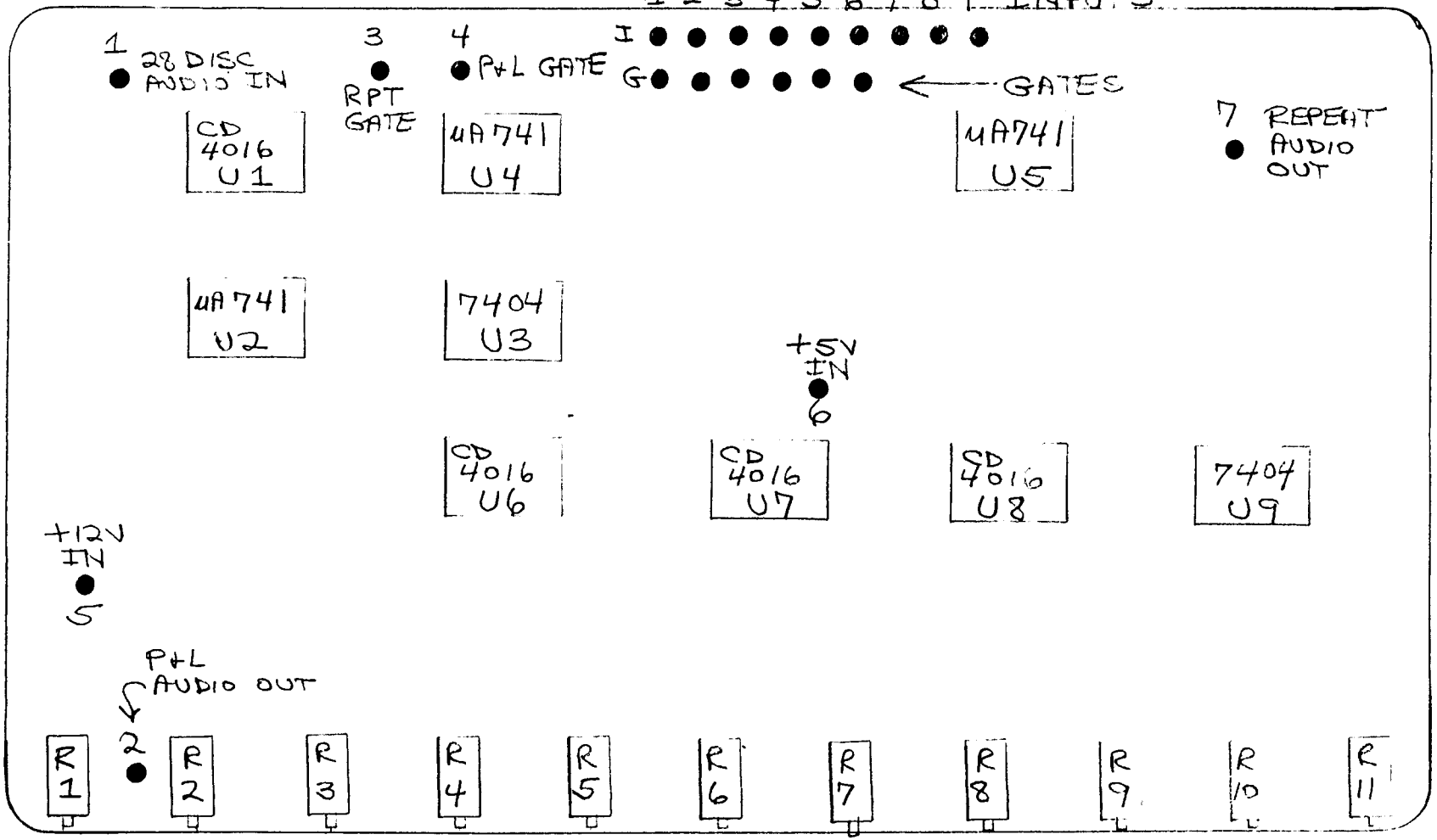
R. Swenton WA1LMV
1-30-79



	WR1ABM
REV 1 2-23-79	DIGITAL AUDIO PROCESSOR
CODE "A"	R. CLENTON (WA1LMV)
SHEET 1 OF 3	1-26-79 REV Ø



DIGITAL AUDIO PROCESSING UNIT (88)



Note: Gate lines for inputs 1 through 6 and RPT Gate and Patch & Link Gates are wired to 8 feed-thru capacitors.

Audio Input lines for inputs 1 through 9 and 28 Audio input and RPT Audio Out and Patch & Link Output have Ferrite Beads.

WR1ABM

R. SWENTON WA1LMV

SHEET 3 OF 3

1-30-79 REV Ø

WR1ABM
442.85/447.85
RCA UHF Repeater
System
Designed and Built
BY R. Swenton WA1LMV
and C. Cayer WA1SZU
6-11-79

Please Note: The Information contained herein is the sole property of R. Swenton and/or C. Cayer and is provided to the Insurance City Repeater Club for the purpose of maintaining the club repeater systems. The information may not be divulged to others without permission.

Publication Number: R1

Publication Date: 10-13-80

Replaces Previous Publication Dated: 10-3-79

Includes supplements Dated: N/A

Copy: LMV---
SZU---
DFS---
88Hill---

ICRC UHF REPEATER AND CONTROL SYSTEM

RCA Transceiver Jones plug designations

Pin	Function
1	+12 volts for receiver and exciter
2	Ground
3	PTT (+12V keys Tx)
4	COS out
5	Tone gate in
6	TOS out
7	Discriminator meter
8	Receiver discriminator audio out
9	Ground
10	Limiter meter
11	Transmitter audio in
12	Ground

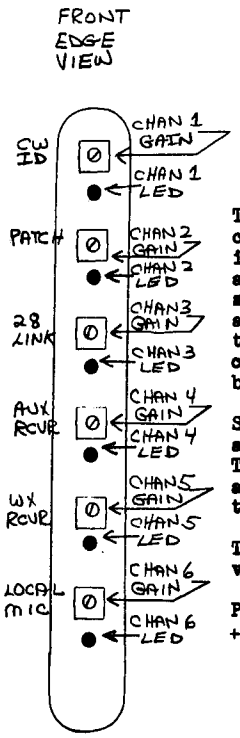
R. Swenton WA1LMV
6-19-78

Main rear chassis terminal block (denoted in diagrams as "TB")

Pin	Function
1	+12 Volts in
2	Ground
3	Autopatch audio in (to J1-3)
4	Autopatch on (to J4-2, J1-10, J12-15)
5	Ground
6	28 Audio in (to J1-4)
7	28 COR in (to J2-9)
8	Ground
9	450 Audio out (to J3-5)
10	450 COR out (to J2-17)
11	Ground
12	Aux Receiver Audio in (to J1-5)
13	Aux COR in (to J2-19)
14	Ground
15	Weather Audio in (to J1-6)
16	Weather Alert on (to J11-10)
17	Weather Alert off (to J11-11)
18	Ground
19	88 Transmitter off (to J13-C)
20	88 Amplifier off (to J13-D)
21	User touchtone off (to J13-E)
22	Spare C1 off (to J13-K)
23	Spare C2 off (to J13-L)
24	88 Downlink on (to J12-D)
25	Spare U1 on (to J12-F)
26	Spare U2 on (to J12-H)
27	Spare U3 on (to J12-J)
28	Spare U4 on (to J12-K)
29	# out (to J12-N)
30	* out (to J12-M)
31	ID Message Length long (to J6-20)
32	88 Autopatch control dump (to J13-M)

CHECK

R. Swenton WA1LMV
6-19-78



UHF Board #1 Gated Audio Mixer

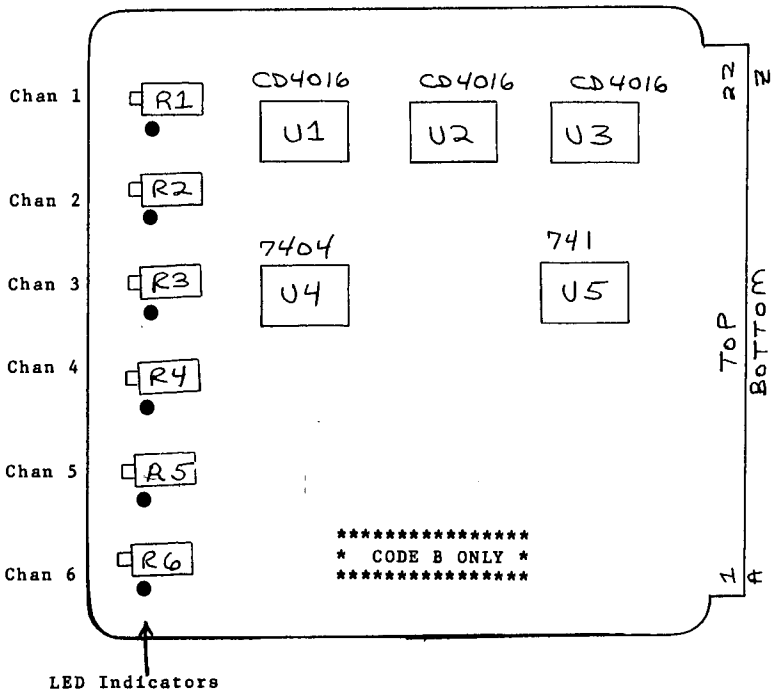
Designed by R. Swenton WA1LMV
and C. Cayer WA1SZU

This board contains a six channel audio mixer. The circuitry uses CMOS analog switches to gate the audio input signals. Thus, the switching takes place without any moving parts. The mixing takes place with six summing resistors on the input of a single transistor amplifier. The amplifier offers slight gain to increase the output level and overcome losses in the summing circuit. Voltage gain bandwidth is flat well above and below the normal speech band.

Separate gain controls are provided on all six inputs along with LED indicators to show active inputs. The control inputs can be permanently wired on such as the CW ID input, or can be gated on and off with the control logic such as the crosslink or autopatch.

The control inputs are TTL compatible. The control voltages are- 0V on, +5V (or floating) off.

Power requirements to the board are +5V regulated and +12V$_V$ regulated.



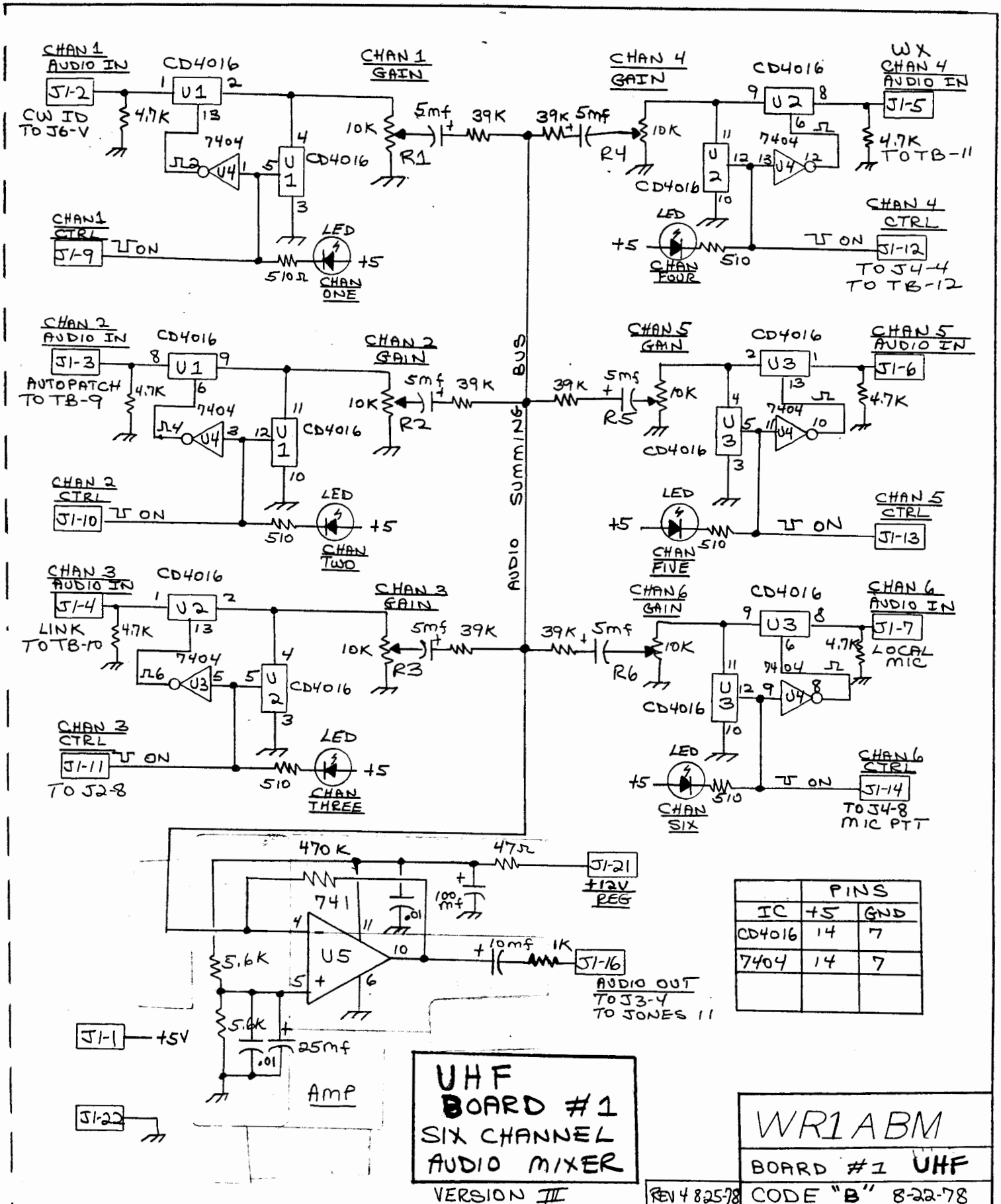
LED Indicators

UHF Board #1

Six Channel Gated
Audio Mixer

R. Swenton WA1LMV

8-22-78



IC	PINS +5	PINS GND
CD4016	14	7
7404	14	7

UHF BOARD #1 SIX CHANNEL AUDIO MIXER

VERSION III

REV 4 8-25-78

WR1ABM

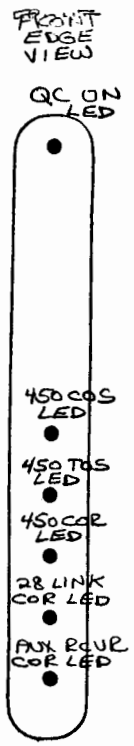
BOARD #1 UHF

CODE "B" 8-22-78

ORIGINAL DESIGN FOR 28/88 RPT | REV 3 8-22-78

EDGE CONNECTOR - J1

DESIGNED BY:
R. SWENTON WA1LMV
C. CAYER WA1SZU



UHF Board #2 Input Select Logic and Time Base

Designed by R. Swenton WA1LMV

This board contains the necessary logic to respond to an input carrier on the 450 receiver, an input carrier with subaudible tone encoding on the 450 receiver, an input on the two meter repeater receiver (for crosslink operation), and an input on an auxiliary receiver. The logic also has control inputs to enable or disable these inputs. The board provides output to gate the repeat and autopatch audio from the 450 received signal whether it comes from carrier detection (COS) or subaudible tone detection (TOS), whichever is selected. The board also provides output to the repeat logic board #4, which keys the repeat transmitter.

There are six LED status indicators:

1) COS LED indicates the presence of a 450 input carrier.
2) TOS LED indicates the presence of a 450 input carrier with subaudible tone.

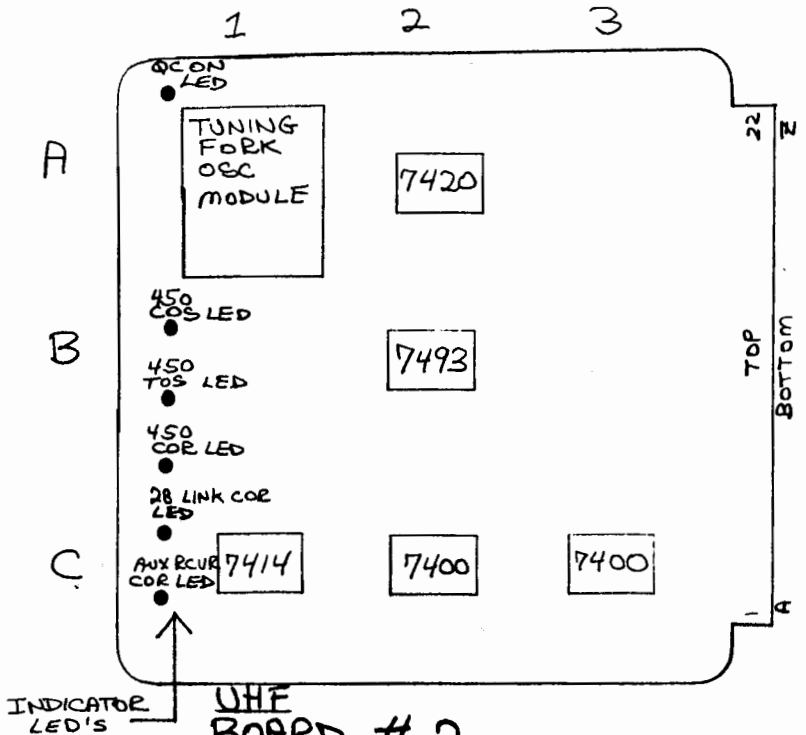
(In the case of an input carrier with tone, both COS and TOS LED indicators will be lit)

3) COR LED indicates whether the input selection logic is responding to the COS or TOS input.

(In the case of an input carrier without tone, and the 450 input select logic has subaudible tone detection selected, then the COS LED will be lit, but the COR LED will not be lit because the logic has been selected to respond only to tone on the input.)

4) 28 Input COS LED indicates the presence of a carrier on the 28 input if the crosslink is enabled.
5) Aux Input COS LED indicates the presence of a carrier on the Aux receiver if the Aux receiver is enabled.
6) QC ON LED indicates when control system has Quiet Channel enabled.

Also present on this board is a precision tuning fork oscillator operating at 1 KHz. This 1 KHz. signal is digitally divided down to 500, 250, 125, and 62.5 Hz. The 62.5 Hz. is used to clock all timers on other boards and the other frequencies are used for tone bursts.



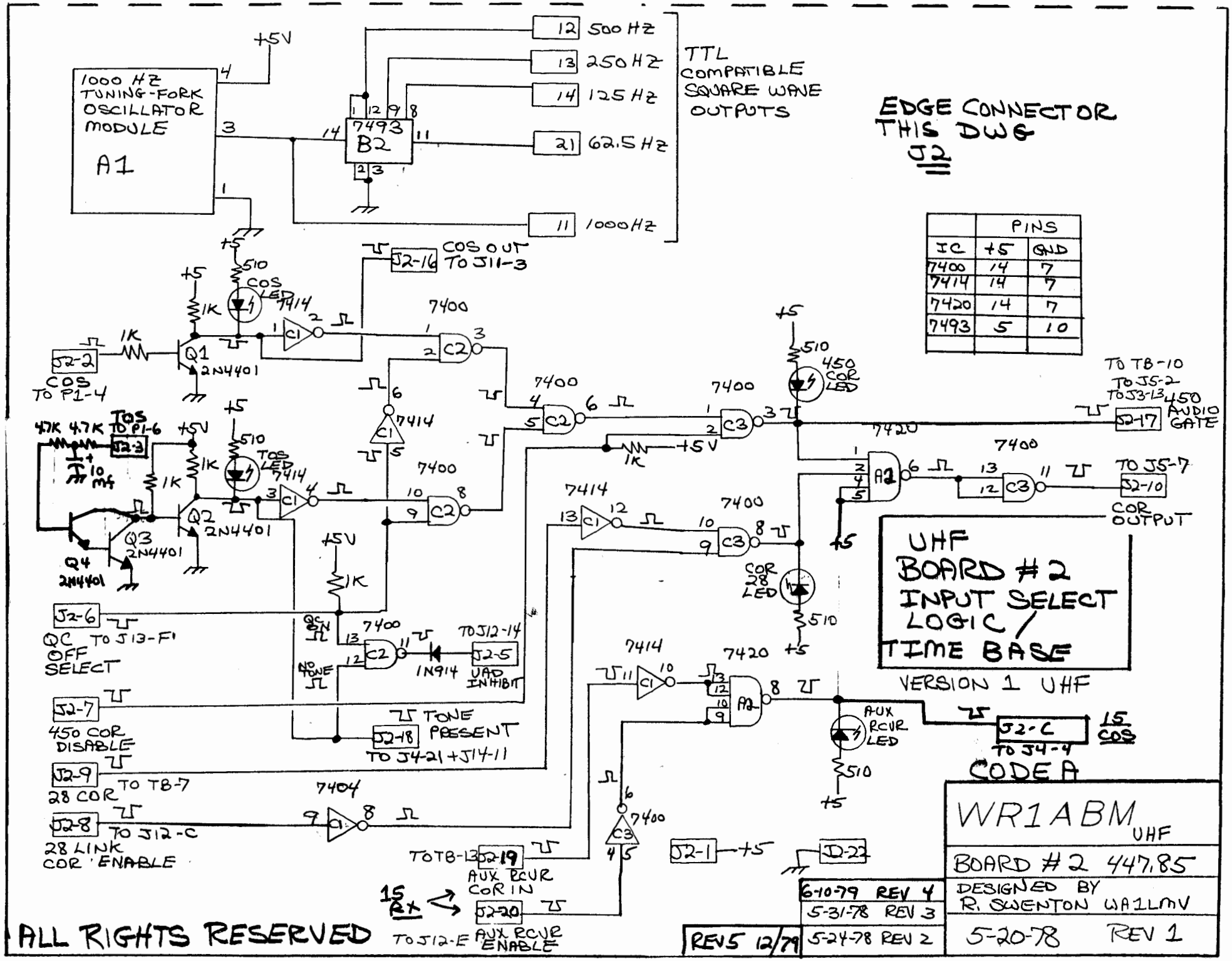
UHF BOARD #2

INPUT SELECT LOGIC

TIME BASE

J2 Edge Connector

1 - +5V Regulated
2 - COS Input
3 - TOS Input
4 -
5 -
6 - QC Off Select
7 - 450 COR Disable
8 - 28 Link COR Disable
9 - 28 COR Input
10 - COR Output
11 - 1000 Hz Output
12 - 500 Hz Output
13 - 250 Hz Output
14 - 125 Hz Output
15 -
16 -
17 - 450 Audio Gate Output
18 -
19 - Aux Rcvr COR In
20 - Aux Rcvr Enable
21 -
22 - Ground



Repeat Audio Gain

Patch and Link Audio Gain

UHF Board #3 Receiver Audio Processor

Designed by R. Swenton WA1LMV

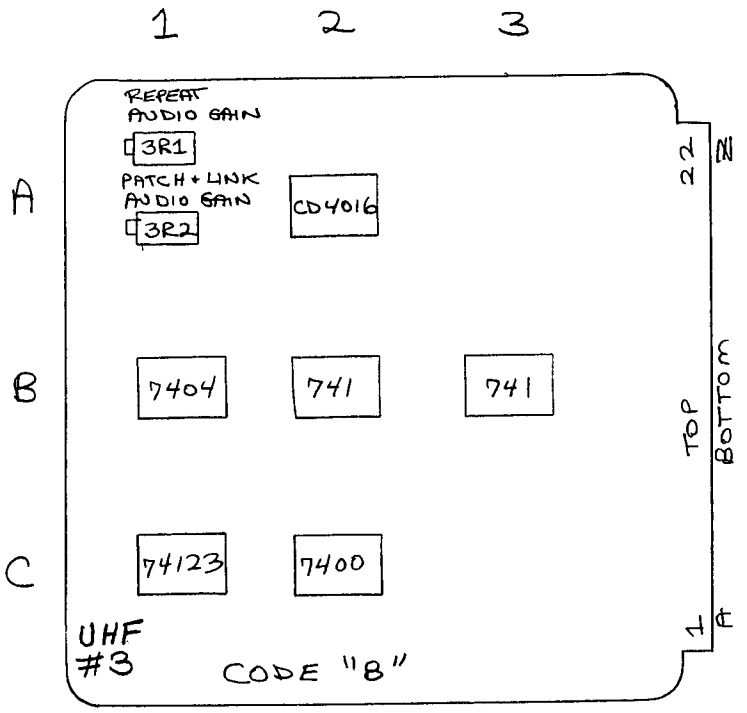
This board brovides the audio switching of the 450 input discriminator audio before it is fed into the 450 transmitter. It provides two isolated audio outputs fed by identical line amplifiers. One output feeds the 450 transmitter, the other feeds the link and autopatch. Separate gain controls are provided for each output.

The board also provides control of the CTCSS sub-audible tone on transmit with aux key tone inputs available for patch and ID.

Also, the circuitry for the control system reset signal tone is on the board.

Power requirements to the board are +5V regulated and +12V regulated.

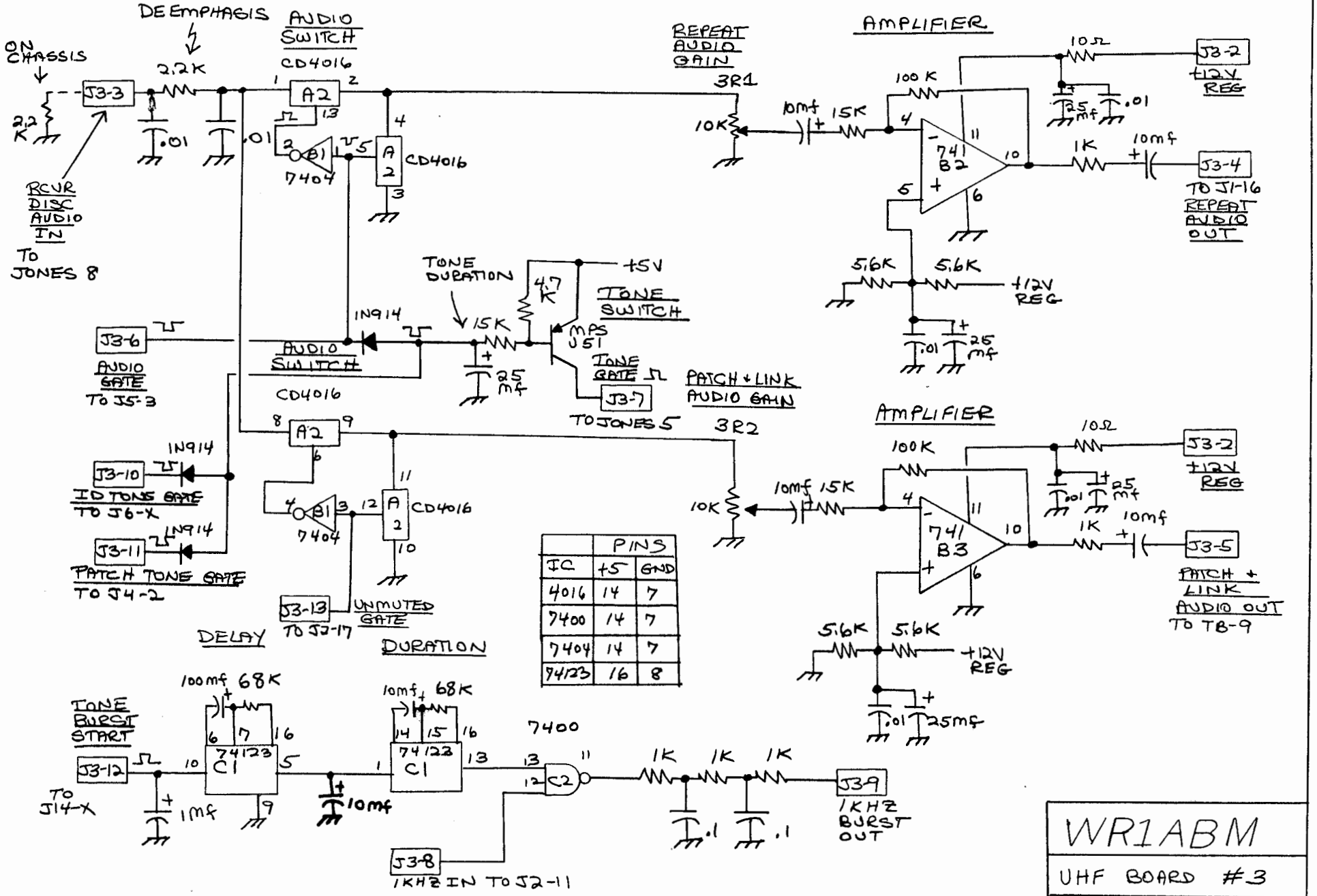
Code "B" ONLY 12-26-78



UHF Board #3 Audio Processing

Code "B" only

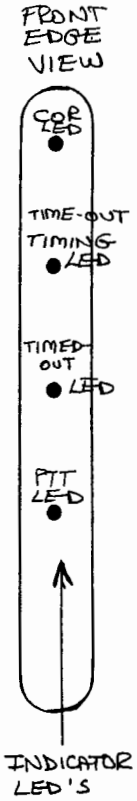
R, Swenton WA1LMV
12-26-78



	PINS	
IC	+5	GND
4016	14	7
7400	14	7
7404	14	7
74123	16	8

UHF BOARD #3 AUDIO PROCESSING

WR1ABM			
UHF BOARD #3			
DESIGNED BY R. SWENTON WA1LMV			
	EDGE CONNECTOR J3	CODE "C" ONLY	10-3-78 REV Ø



UHF BOARD #4 REPEAT LOGIC

This is the primary control board for the 450 repeater transmitter. The COR signal starts several sequents of events. First, the transmitter keys and the Time-Out Timer starts timing. If QC is detected on the input carrier, then the Time-Out Timer is held in the reset mode. When the COR signal is removed, a timer holds the Time-Out Timer running for a short period of time. Another timer holds the 450 transmitter on for five seconds after the input carrier is removed.

Auxiliary PTT inputs are provided for ID, Patch, and a spare.

Also provided is a transmitter dump input for control of the 450 transmitter.

There are four LED Indicators on the front edge of the board:

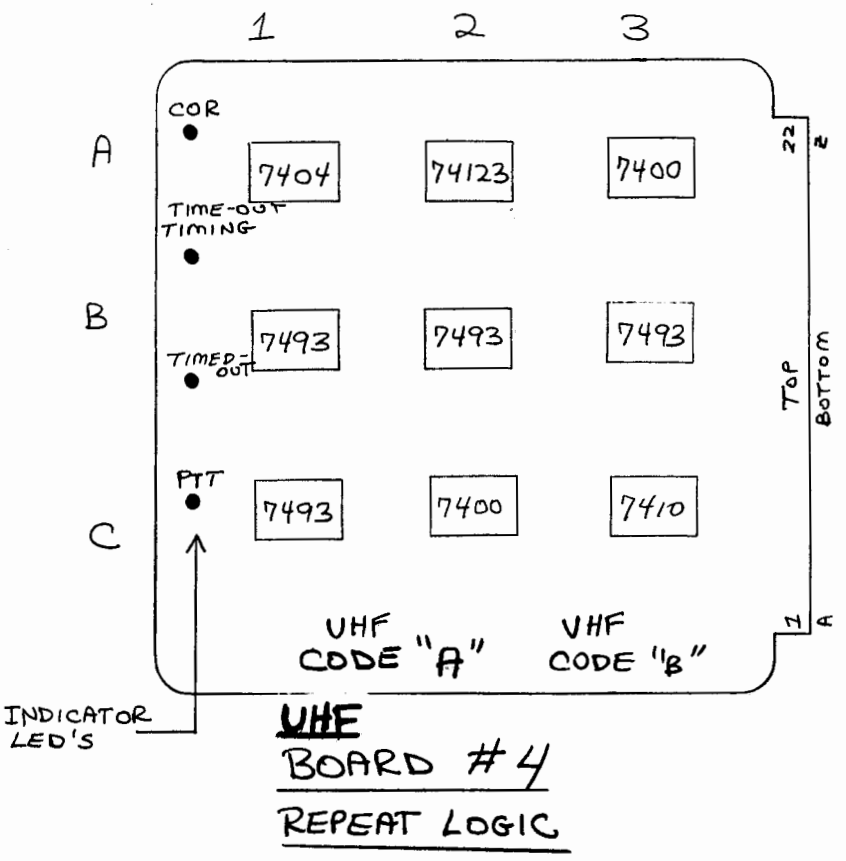
COR LED Indicates when the board is responding to a COR Input and remains lit until the time-out timer resets.

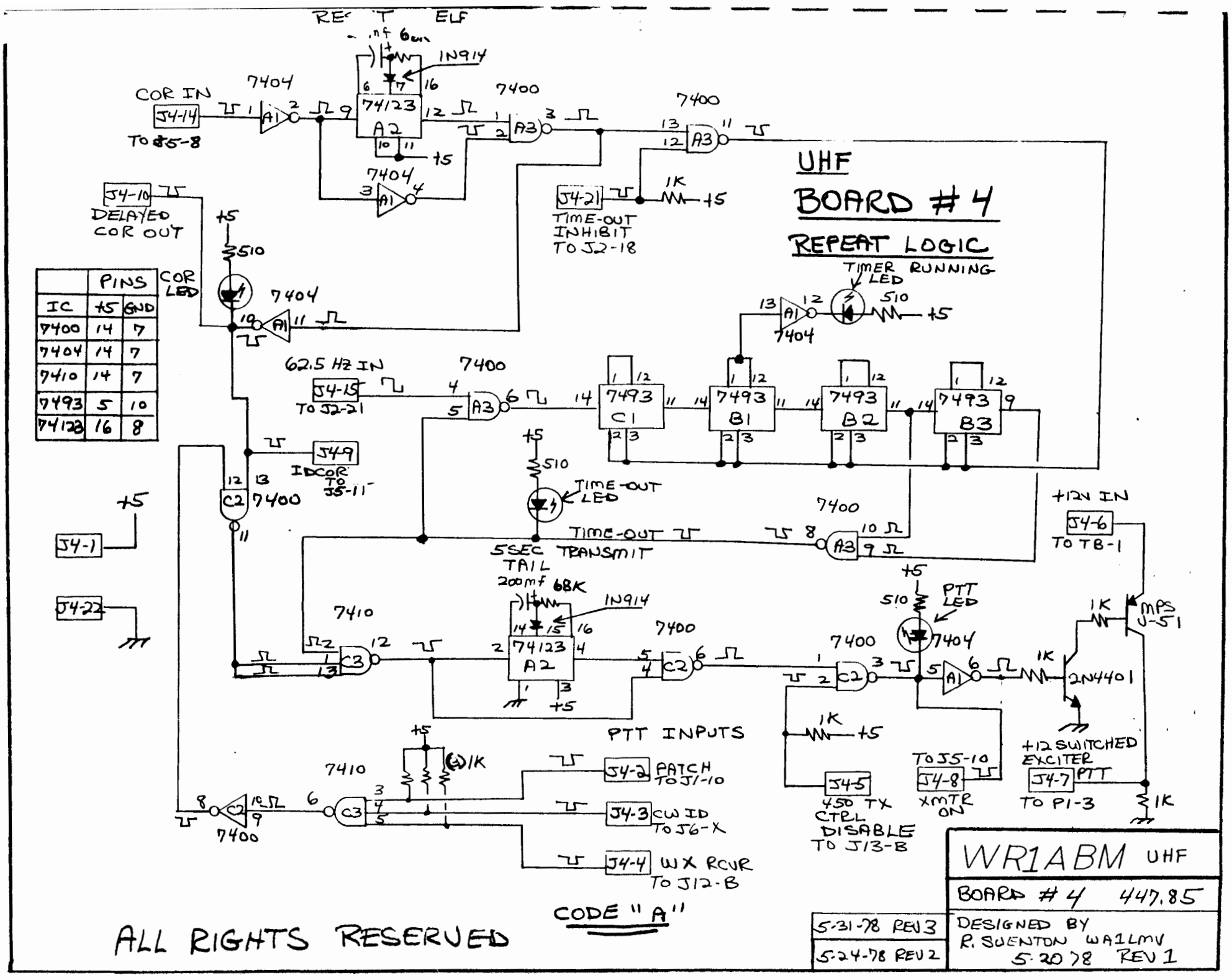
Time-Out Timing LED Indicates when the timer is running. It will not flash when there is an absence of an input carrier. Also will not flash if the input carrier has QC.

Timed-Out LED Lights when the transmitter is timed-out.

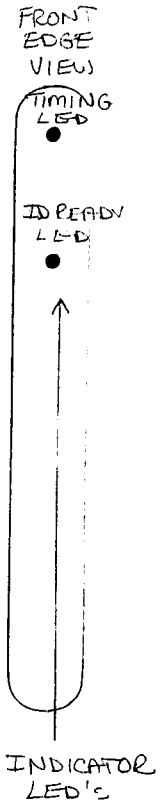
PTT LED Indicates when the 450 Transmitter is keyed.

Power requirements to the board are +5V regulated.





IC	PINS +5	PINS GND
7400	14	7
7404	14	7
7410	14	7
7493	5	10
74123	16	8



UHF BOARD #5 ID TIMER

Control Audio Mute

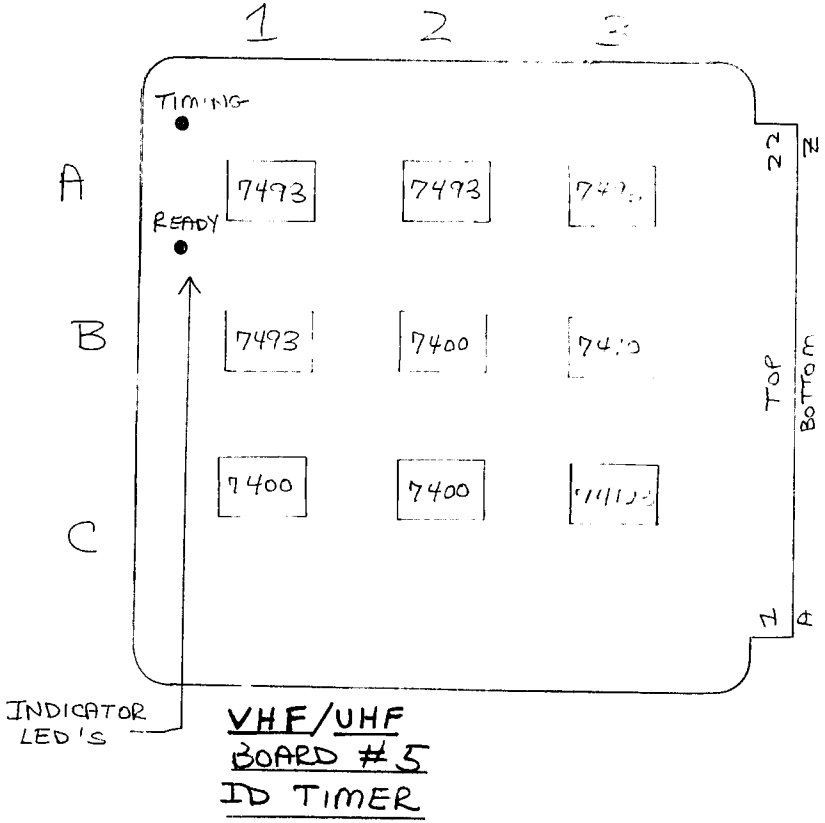
Input Access Delay

The board contains a 9 minute timer to control MCW ID interval. The ID start pulse will occur only if three conditions exist: 1) The ID timer must be timed out, 2) The 450 transmitter must be on, 3) The COR must be off.

Two LED indicators provide ID Timer timing and ID Ready.

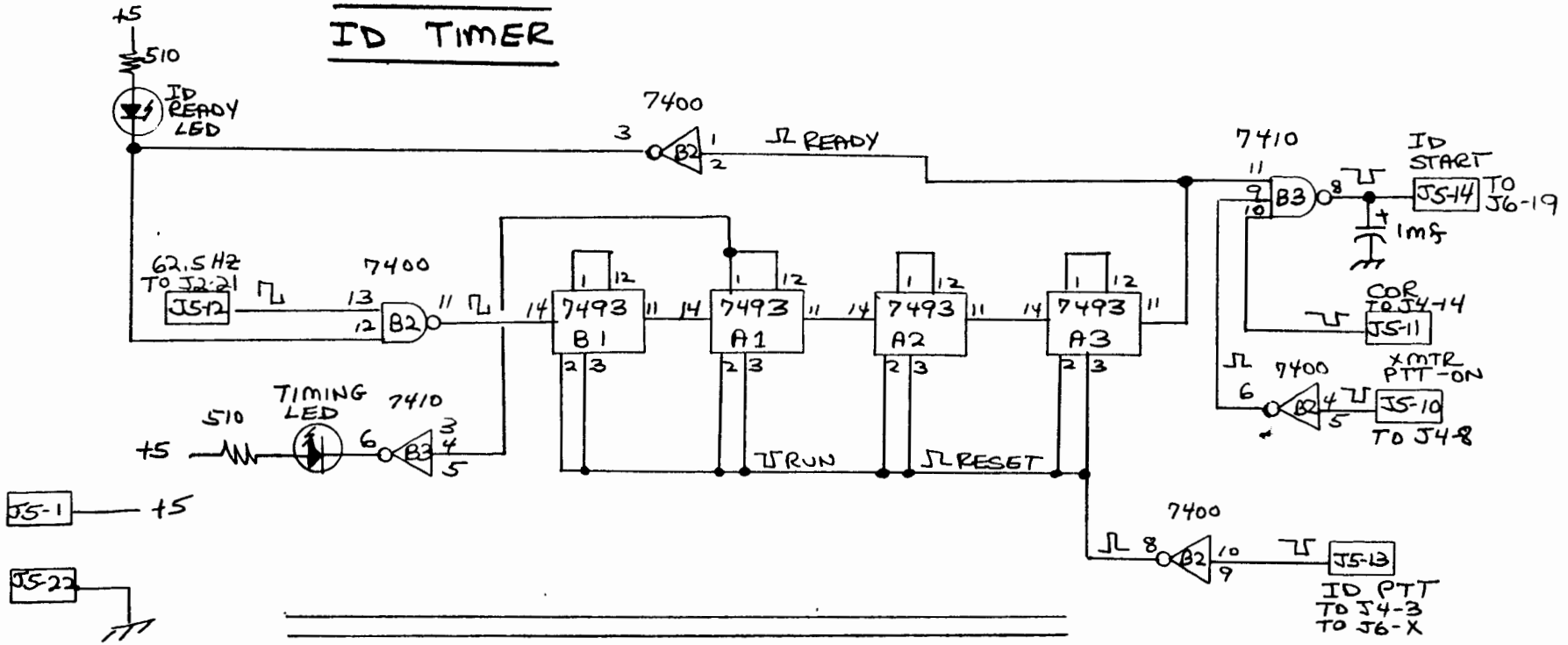
Two control touchtone audio mute paths are provided. One mutes all tones and audio when the Control board IAD is accessed. The other provides muting whenever touchtones are received. This input also has a mute disable input for 450 control of WR1AFU, this input can be disabled via control board CAD.

Power requirements to the board are +5V regulated.

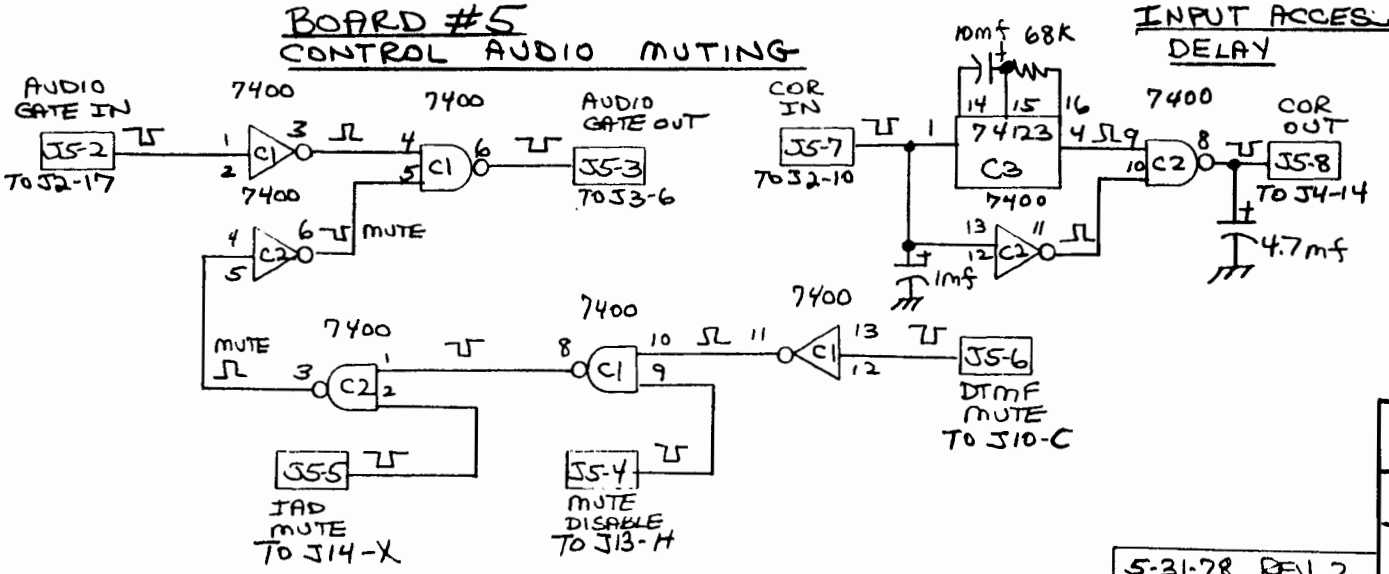


VHF/UHF
BOARD #5
ID TIMER

UHF BOARD #5 ID TIMER



BOARD #5 CONTROL AUDIO MUTING



IC	PINS +5	PINS GND
7400	14	7
7410	14	7
7493	5	10

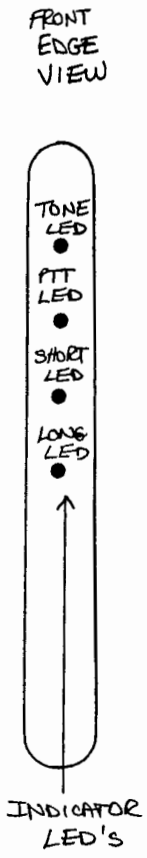
5-31-78 REV 2	
5-24-78 REV 1	

WR1ABM

BOARD #5 UHF

DESIGNED BY R. SWENTON WA1LMV

5-18-78 REV Ø



VHF Board #6
UHF BOARD #6 MCW ID

Designed by R. Swenton WA1LMV

This board provides the station identification in MCW. There are two control modes of the ID unit: 1) Tone pitch 2) Message Length

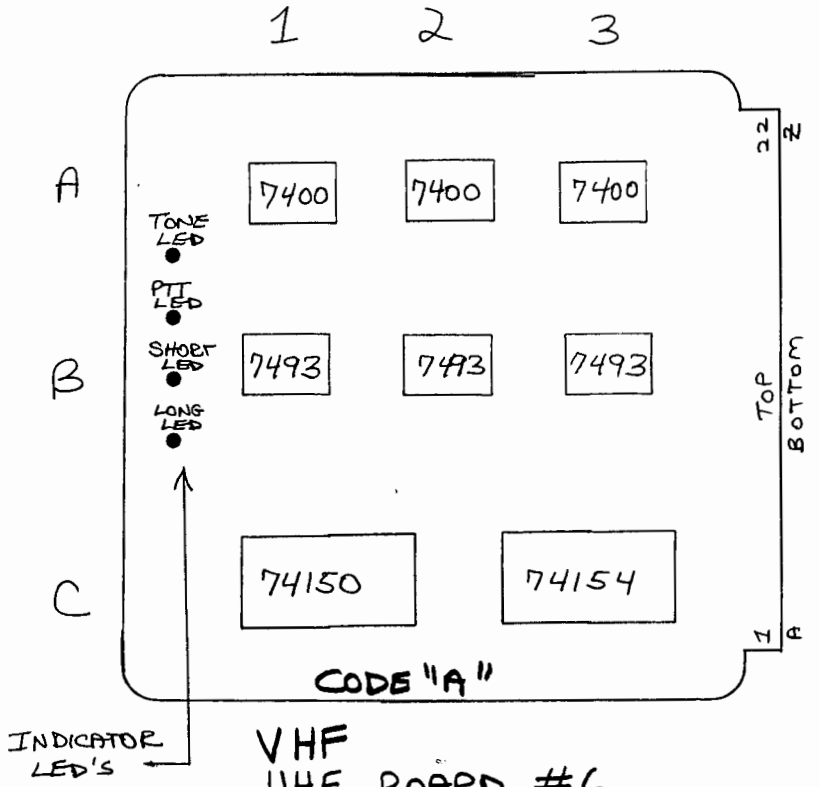
1) Tone pitch. The pitch of the ID tone is normally 500 Hz. It will be lowered to 250 Hz. when the receiver Quiet Channel is activated.

2) Message Length. The ID unit normally sends "DE WR1ABM ICRC" When the commercial power fails, the ID unit will send "DE WR1ABM ICRC EP" The "EP" of course stands for Emergency Power.

LED's indicate the ID Tone, ID PTT, Short Message, and Long Message.

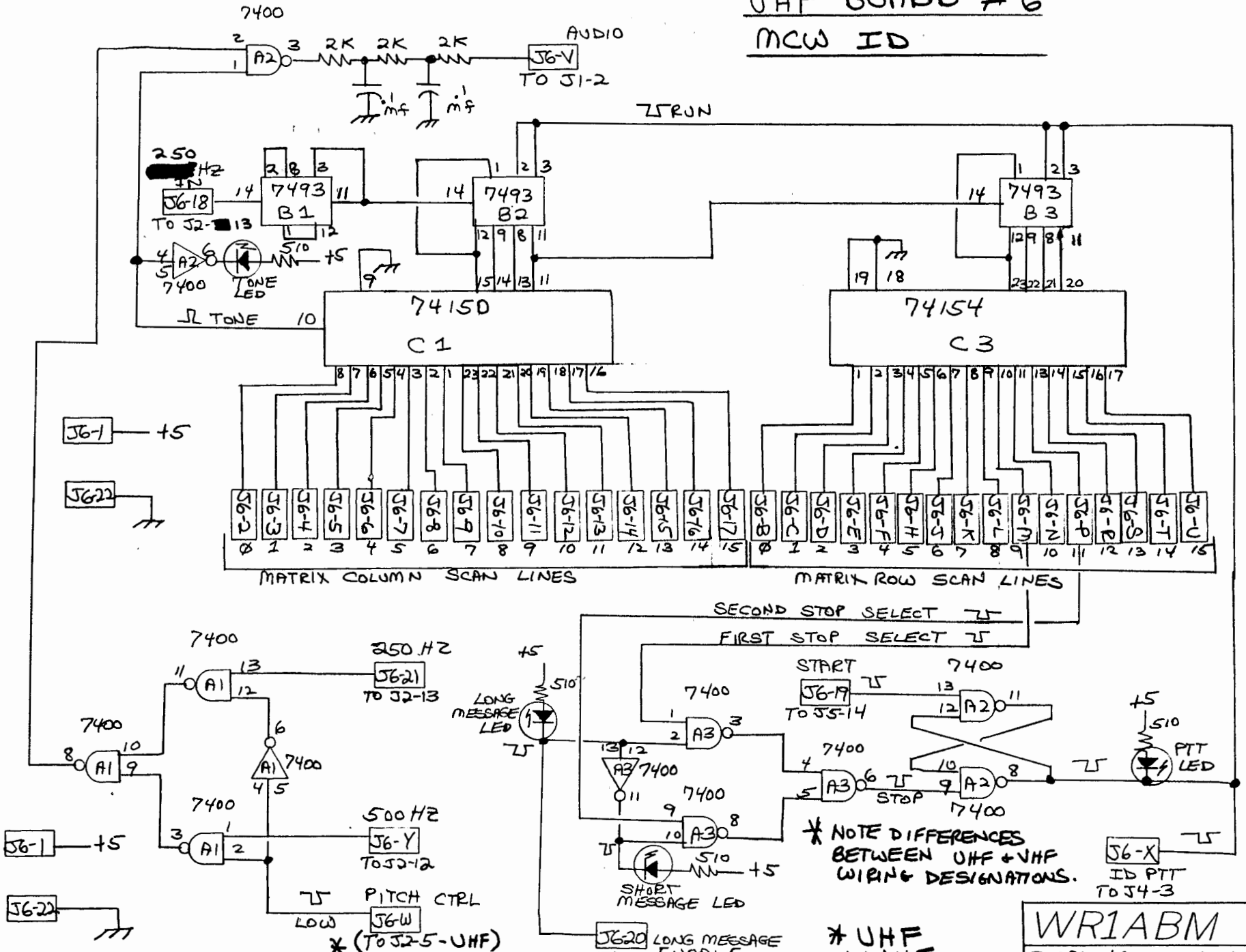
Power requirements to the board are +5V regulated.

9-21-78



VHF
UHF BOARD #6
MCW ID

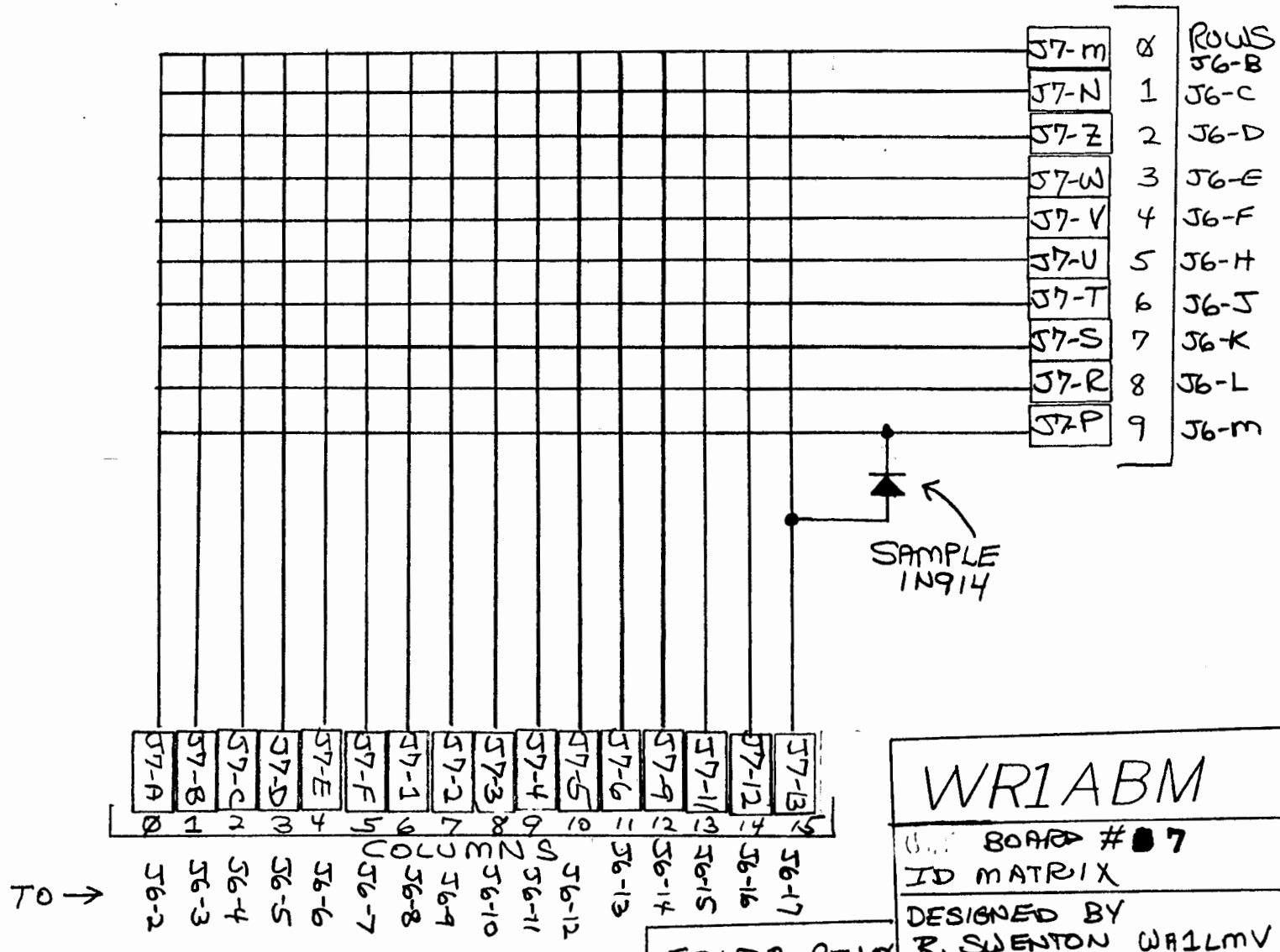
UHF BOARD #6
MCW ID



CODE "A"

WR1ABM	
BOARD #6 MCW ID	
DESIGNED BY R. SWENTON WA1LMV	
5-31-78 REV Ø	

UHF-VHF BOARD #7 ID MATRIX



WR1ABM

BOARD #7

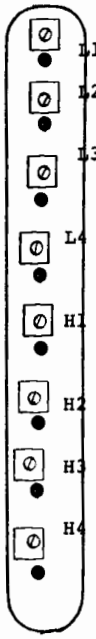
ID MATRIX

DESIGNED BY
R. SWENTON WA1LMV

5-31-78 REV Ø

VHF Board #8
UHF BOARD #8

DTMF Decoder



This board contains the circuitry to detect DTMF (Dual Tone Multi-Frequency) audio signals. It uses NE/LM 567 PLL tone decoders tuned to the standard eight touchtone frequencies.

Output is is two out of eight format.

Input must be pre-filtered by an appropriate bandpass filter.

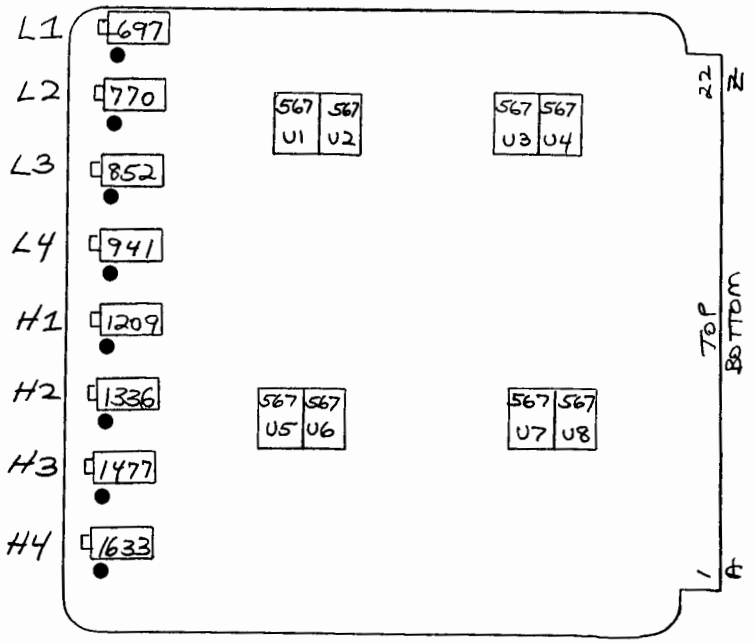
Power requirements to the board are +5V regulated.

LED indicators
under each adjustment
pot.

Designed by R. Swenton
WA1LMV

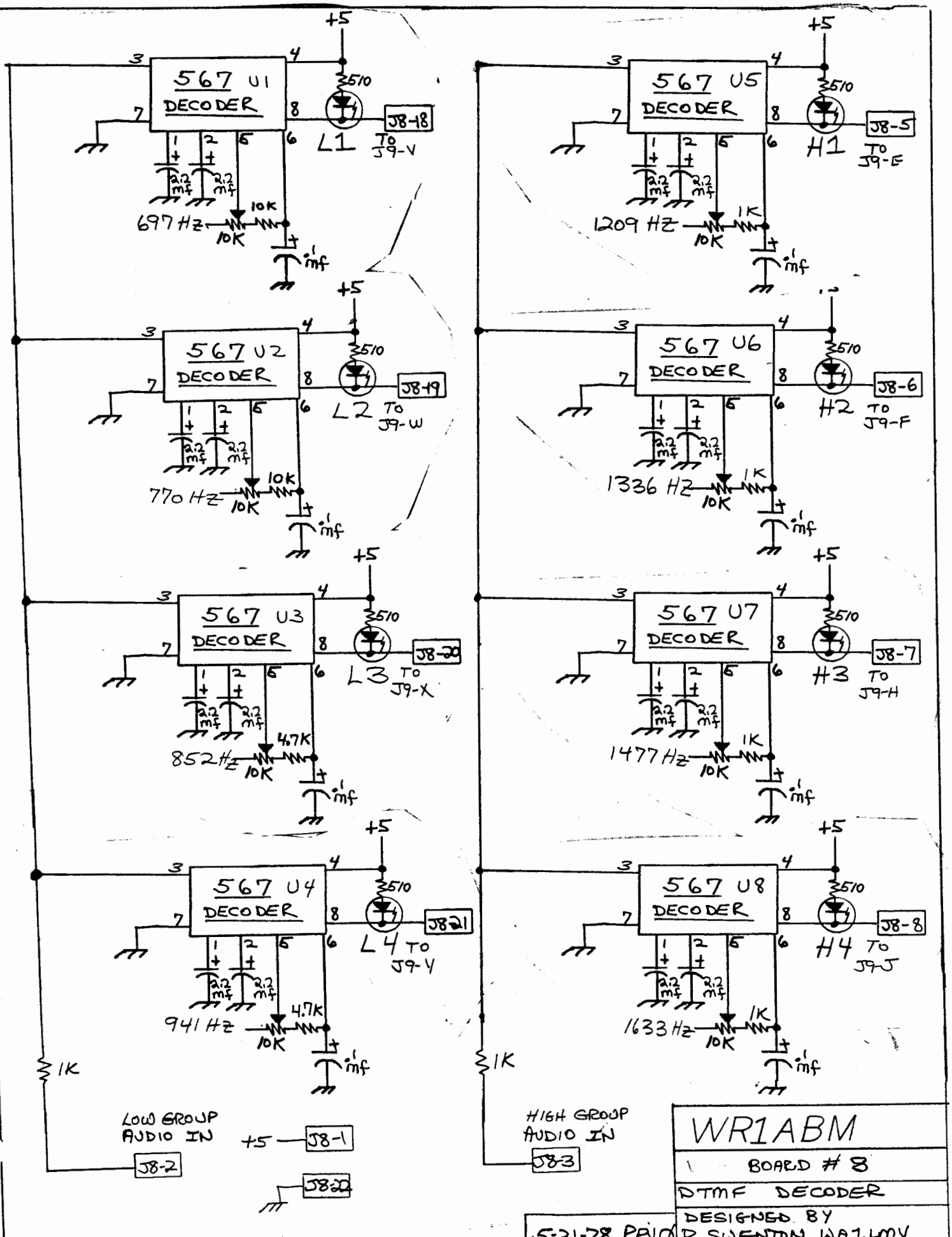
VHF Board #8
UHF BOARD #8

DTMF Decoder



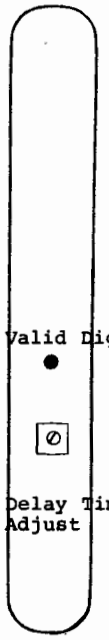
R. Swenton WA1LMV

6-19-78


567 U1 DECODER
697 Hz
L1
J8-18
567 U2 DECODER
770 Hz
L2
J8-19
567 U3 DECODER
852 Hz
L3
J8-20
567 U4 DECODER
941 Hz
L4
J8-21
567 U5 DECODER
1209 Hz
H1
J8-5
567 U6 DECODER
1336 Hz
H2
J8-6
567 U7 DECODER
1477 Hz
H3
J8-7
567 U8 DECODER
1633 Hz
H4
J8-8
+5
510
2.2 mf
10K
4.7K
1K
1 mf
LOW GROUP AUDIO IN
J8-2
+5
J8-1
J8-22
HIGH GROUP AUDIO IN
J8-3
WR1ABM
BOARD # 8
DTMF DECODER
DESIGNED BY R. SWENTON WA1LMV
5-31-78 REV Ø

VHF Board #9
UHF Board #9 TAF

Tone Anti-False



This board contains the necessary circuitry to signal-condition the outputs of DTMF Board #8. Since Board #8 is not imune to voice falsing, it is necessary to determine whether the signal coming in is a valid touchtone digit or noise.

The Board #9 TAF sets the following conditions before signalling will occur:

1) There must be only one tone present in the high group AND there must be only one tone present in the low group.

2) Both high and low tones must remain without interruption for the time duration set by the adjustment.

Thus, the #9 TAF board "screens" the output of #8 DTMF before allowing the signals to be decoded and passed along to other circuits as valid touchtone digits.

The LED indicator indicates the presence of a valid digit.

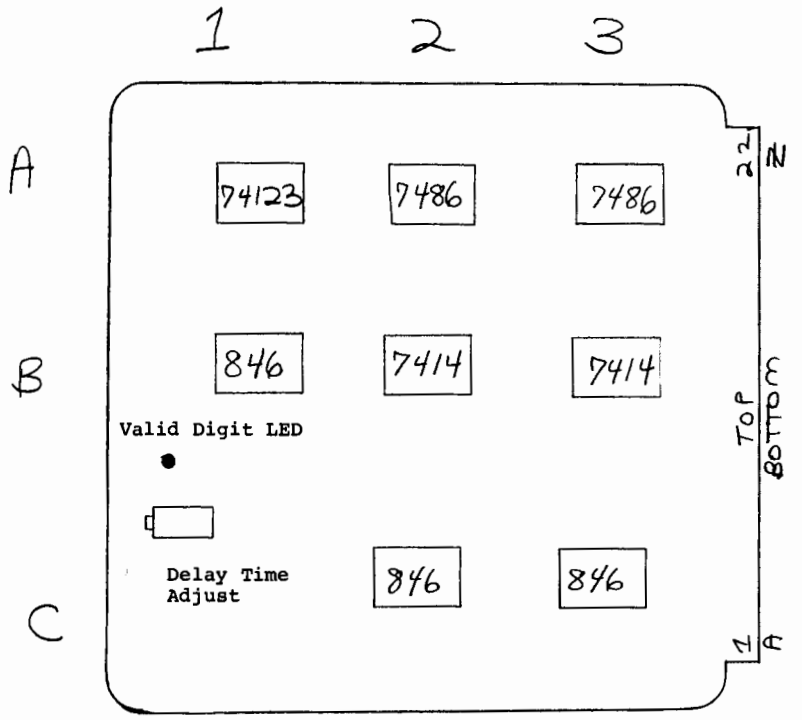
Power requirements to the board are +5V Regulated.

Designed by

R. Swenton WA1LMV
6-19-78

VHF Board #9
UHF Board #9 TAF

Tone Anti-False Board



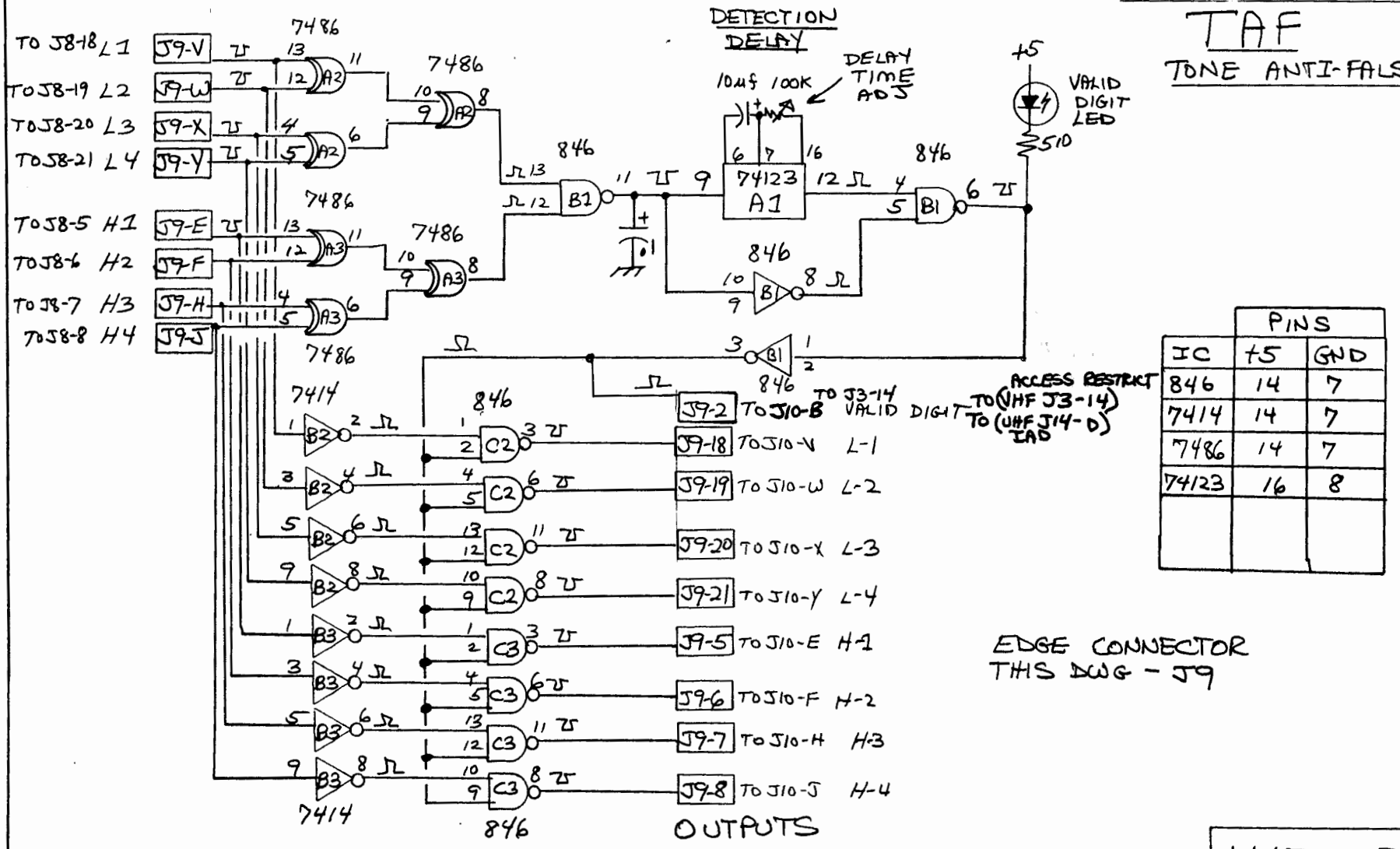
R. Swenton WA1LMV

6-19-78

UHF VHF BOARD #9

TAF

TONE ANTI-FALSE



IC	PINS +5	PINS GND
846	14	7
7414	14	7
7486	14	7
74123	16	8

EDGE CONNECTOR
THIS DWG - J9

CODE "A"

WR1ABM
UHF ~~VHF~~ BOARD #9 TAF
DESIGNED BY R. SWENTON WA1LMV
6-6-78 REV Ø

VHF Board #10
UHF Board #10 DAM

Decode and Audio Mute

This board contains the circuitry to convert the 2 of 8 formatted input into 1 of 16 decoded outputs. This is esentially the output of the DTMF Decoder SYSTEM.

Also on this board is the audio amplifier which feeds the audio into board #8, DTMF Decoder. The amplifier drives the Bandpass filter which splits the High and Low tones prior to being applied to Board #8. A gain control for this amplifier is provided.

R1
Audio Gain

R2

Mute Duration

Circuitry for providing audio mute upon reception of Touchtone signals. The valid digit signal comes from Board #9. When this signal is present, Board #10 output signals to mute the repeat receiver audio. When valid digit signal is removed, the audio remains muted for the duration set by R2, Mute Duration Adjust.

Power requirements to the board are +5V Regulated.

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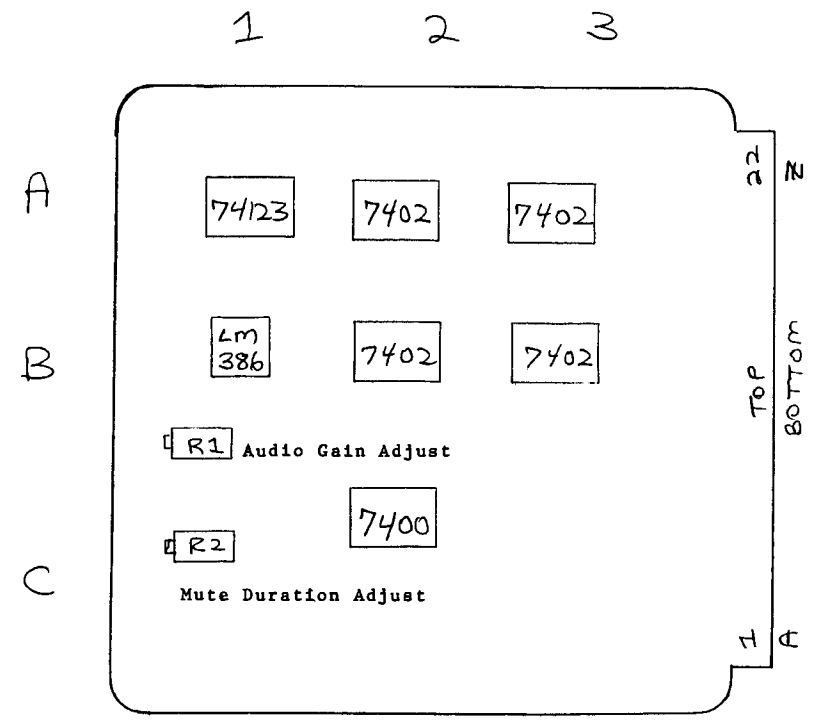
7-5-78

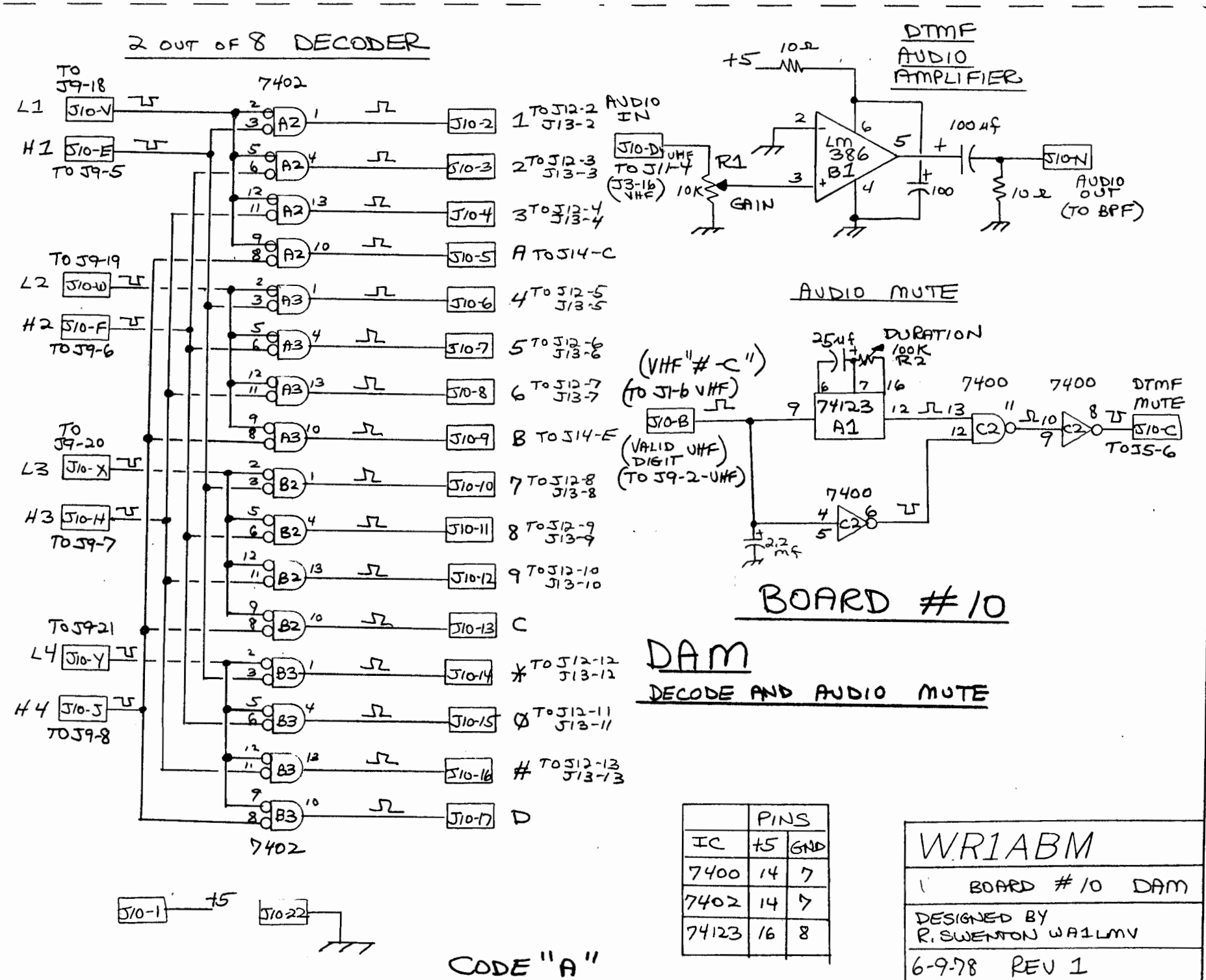
VHF Board #10
UHF Board #10 DAM

Decode and Audio Mute



R. Swenton WA1LMV

7-5-78

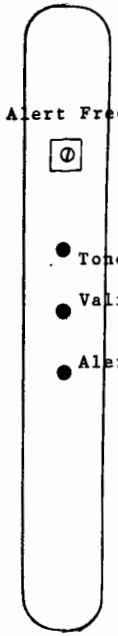


	PINS	
IC	+5	GND
7400	14	7
7402	14	7
74123	16	8

WR1ABM	
1	BOARD #10 DAM
DESIGNED BY R. SWENTON WA1LMV	
6-9-78	REV 1

UHF Board #11 TGB

Tone Gate and Burst Board



This board contains the audio gate for the DTMF Decoder System. The audio to the decoder is gated with the COS signal only and still gates with COS even if Receiver or Control Quiet Channel is enabled. This is so that when Receiver QC is enabled, stations without QC can still access the control system. If Control QC is enabled, non-QC stations will still be heard by the decoder, but the control system will ignore the initialize command, "A". This is so that when Control QC is enabled, only stations with QC can gain access to the control system.

Also present on this board is the audio tone burst circuitry for the 28/88-450 crosslink. When the 28 to 450 uplink is enabled, the circuit produces a short 1 KHz. burst when the user releases his carrier. When both the uplink and the 450 to 88 downlink is enabled, a longer 1 KHz. burst is produced.

In addition, this board has the Weather Alert System which consists of a 1050 Hz. Decoder, Anti-False, and Alert Duration Timer. When the Weather Receiver provides a 1050 Hz. alert tone to the board, the Decoder responds to the signal. If the signal remains uninterrupted for the time duration set by the Anti-False, then the Anti-False activates the Weather Audio on 450 and 88. When the Alert Duration Timer times-out, it deactivates both repeaters weather audio and PTT signals.

Power requirements to the board are +5V Regulated.

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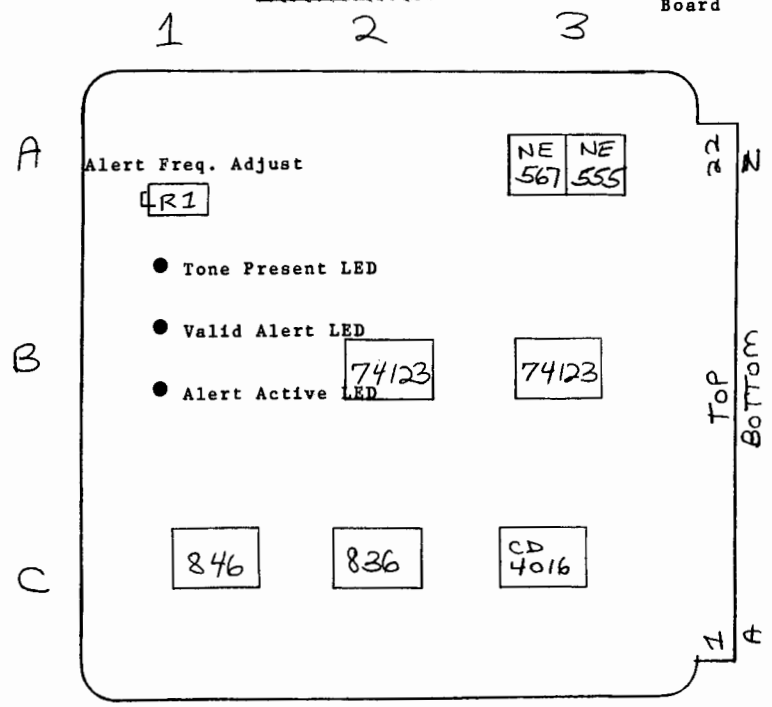
7-5-78

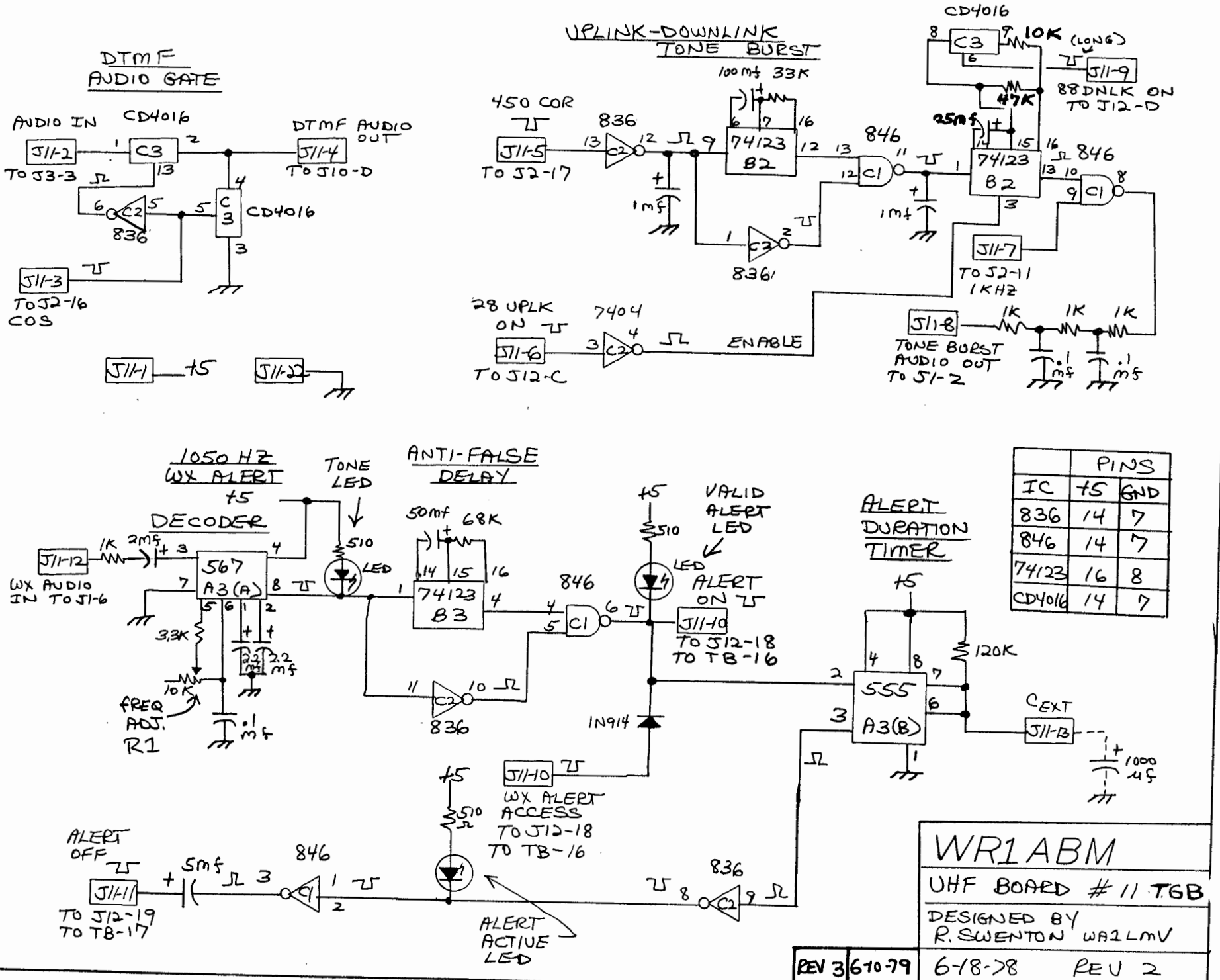
UHF Board #11 TGB

Tone Gate and Burst Board

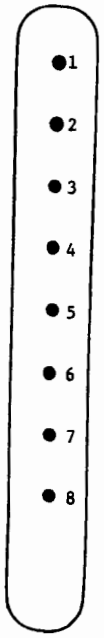


R. Swenton WA1LMV

7-5-78


DTMF AUDIO GATE
AUDIO IN
CD4016
DTMF AUDIO OUT
J11-2
TO J3-3
C3
J11-4
TO J10-D
C2
836
CD4016
J11-3
TO J2-16
COS
J11-1
+5
J11-12
UPLINK-DOWNLINK TONE BURST
CD4016
10K (LONG)
J11-9
88DNLK ON
TO J12-D
47K
450 COR
J11-5
TO J2-17
836
100mf 33K
74123 B2
846
25mf
1mf
J11-7
TO J2-11
1KHZ
28 UPLK ON
J11-6
TO J12-C
7404
ENABLE
J11-8
1K
TONE BURST AUDIO OUT
TO J1-2
1050 HZ WX ALERT DECODER
+5
TONE LED
J11-12
1K
2mf
WX AUDIO IN TO J1-6
567 A3(A)
LED
3.3K
10K
FREQ ADJ. R1
2.2 mf
.1 mf
ANTI-FALSE DELAY
50mf
68K
74123 B3
846
836
VALID ALERT LED
510
ALERT ON
J11-10
TO J12-18
TO TB-16
IN914
J11-10
WX ALERT ACCESS
TO J12-18
TO TB-16
ALERT DURATION TIMER
555 A3(B)
120K
CEXT
J11-13
1000 uf
ALERT OFF
J11-11
TO J12-19
TO TB-17
5mf
ALERT ACTIVE LED
PINS
IC | +5 | GND
836 | 14 | 7
846 | 14 | 7
74123 | 16 | 8
CD4016 | 14 | 7
WR1ABM
UHF BOARD #11 T6B
DESIGNED BY R. SWENTON WA1LMV
REV 3 6-10-79
6-18-78 REV 2

UHF Board #12 UAD
User Address Decode Board



This board contains all the necessary logic to enable and disable the user control functions. There are 8 latched on/off functions and 3 pulsed functions available.

The UAD board is inhibited under the following conditions: by control User Touchtone Disable, by initializing control system, by front panel unlock, and by DTMF mute disable.

Power requirements to the board are +5V Regulated.

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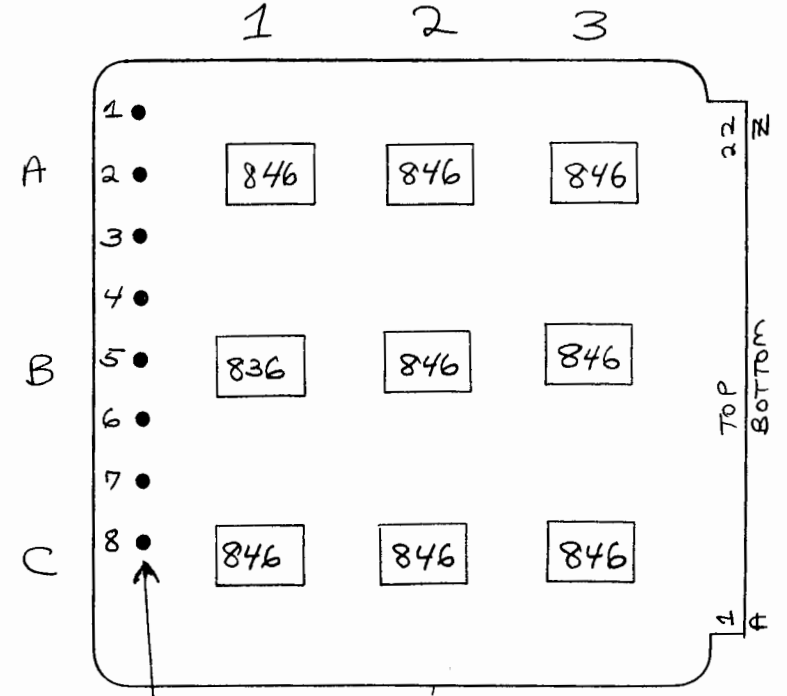
7-6-78



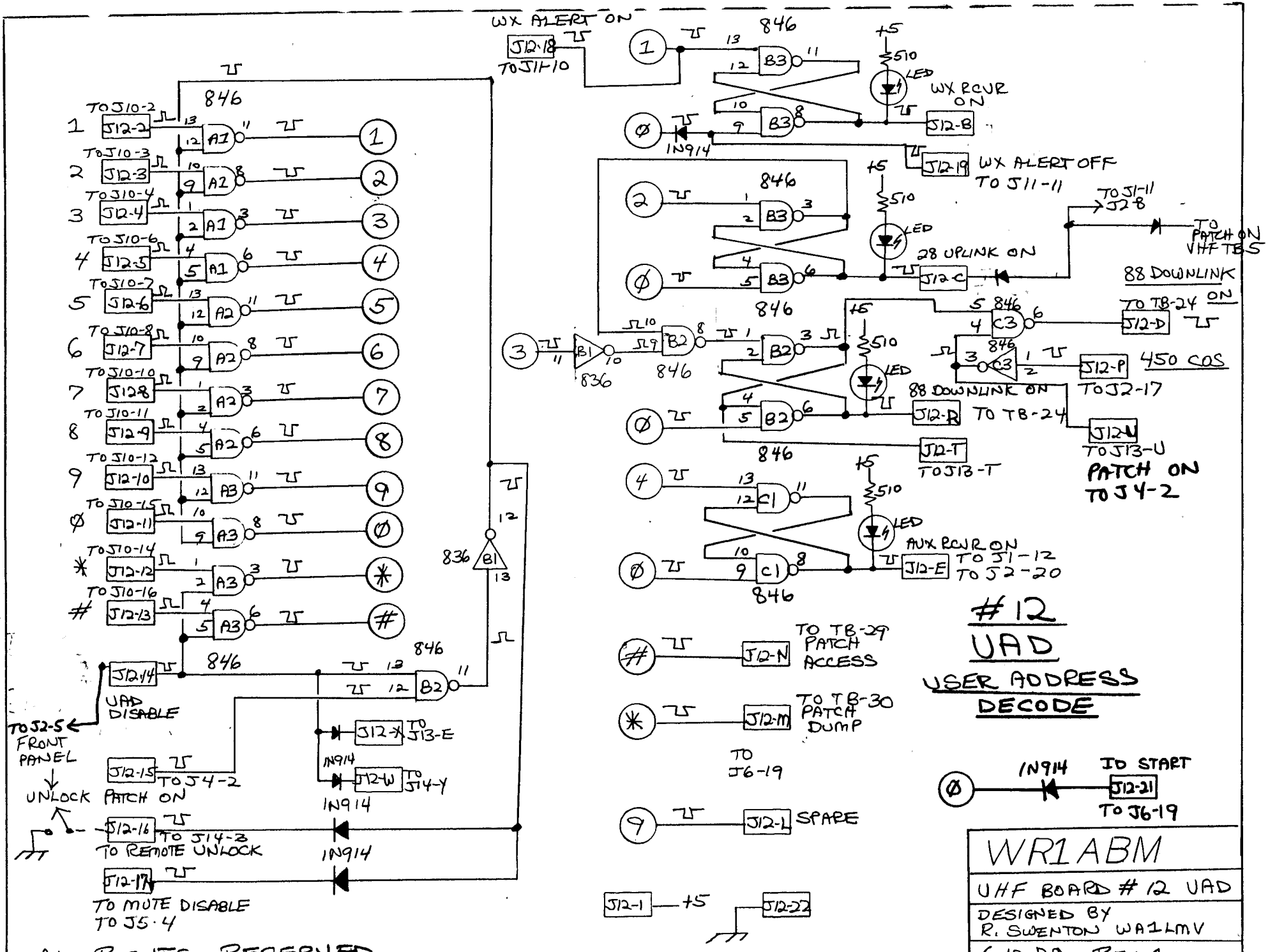
UHF BOARD # 12

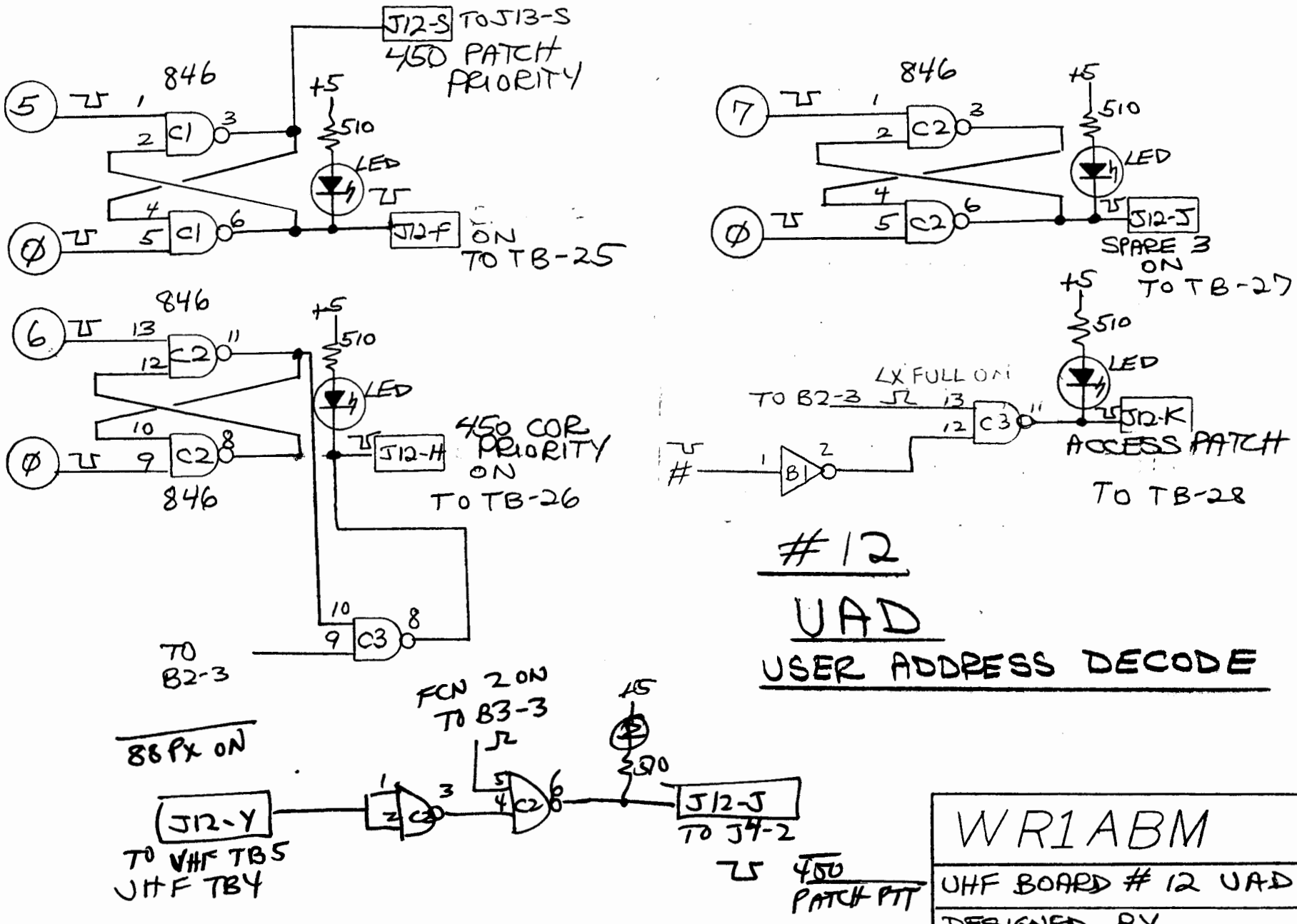
UAD

USER ADDRESS DECODE

User Codes:
1-Weather On
2-28 Uplink On
3-88 Downlink On
4-Aux. Receiver On
5-6-7-8 Spares on
Ø-Master Reset

R. Swenton WA1LMV
7-6-78


WX ALERT ON
J12-18
TO J11-10
846
WX RCVR ON
J12-B
WX ALERT OFF
TO J11-11
J12-19
28 UPLINK ON
J12-C
TO J1-11
J2-8
TO PATCH ON VHF TBS
88 DOWNLINK ON
TO TB-24
J12-D
450 COS
TO J2-17
J12-P
88 DOWNLINK ON
TO TB-24
J12-R
TO J13-U
J12-U
PATCH ON TO J4-2
J12-T
TO J13-T
AUX RCVR ON
TO J1-12
TO J2-20
J12-E
#12
UAD
USER ADDRESS DECODE
TO TB-29 PATCH ACCESS
J12-N
TO TB-30 PATCH DUMP
J12-M
TO J6-19
SPARE
J12-L
IN914
TO START
J12-21
TO J6-19
TO J10-2
J12-2
TO J10-3
J12-3
TO J10-4
J12-4
TO J10-6
J12-5
TO J10-7
J12-6
TO J10-8
J12-7
TO J10-10
J12-8
TO J10-11
J12-9
TO J10-12
J12-10
TO J10-15
J12-11
TO J10-14
J12-12
TO J10-16
J12-13
J12-14
UAD DISABLE
TO J2-5
FRONT PANEL
UNLOCK PATCH ON
J12-15
TO J4-2
J12-16
TO J14-3
TO REMOTE UNLOCK
J12-17
TO MUTE DISABLE
TO J5-4
J12-X
TO J13-E
J12-W
TO J14-Y
IN914
J12-1
+5
J12-22
ALL RIGHTS RESERVED
WR1ABM
UHF BOARD #12 UAD
DESIGNED BY
R. SWENTON WA1LMV
6-12-78 REV 1

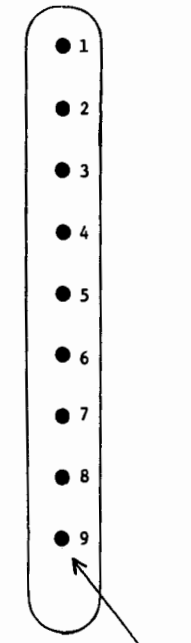


#12

UAD

USER ADDRESS DECODE

WR1ABM
UHF BOARD # 12 UAD
DESIGNED BY R. SWENTON WA1LMV
6-12-78 REV Ø



LED INDICATORS

UHF BOARD #13 CAD

Control Address Decode Board

This board contains the necessary logic to control non-user repeater functions. The board is normally disabled and becomes enabled with the "Unlock" signal from the IAD Board #14.

Nine RS Flip-Flops control the on/off functions which have a common set or reset signal.

LED Indicators indicate the status of the functions.

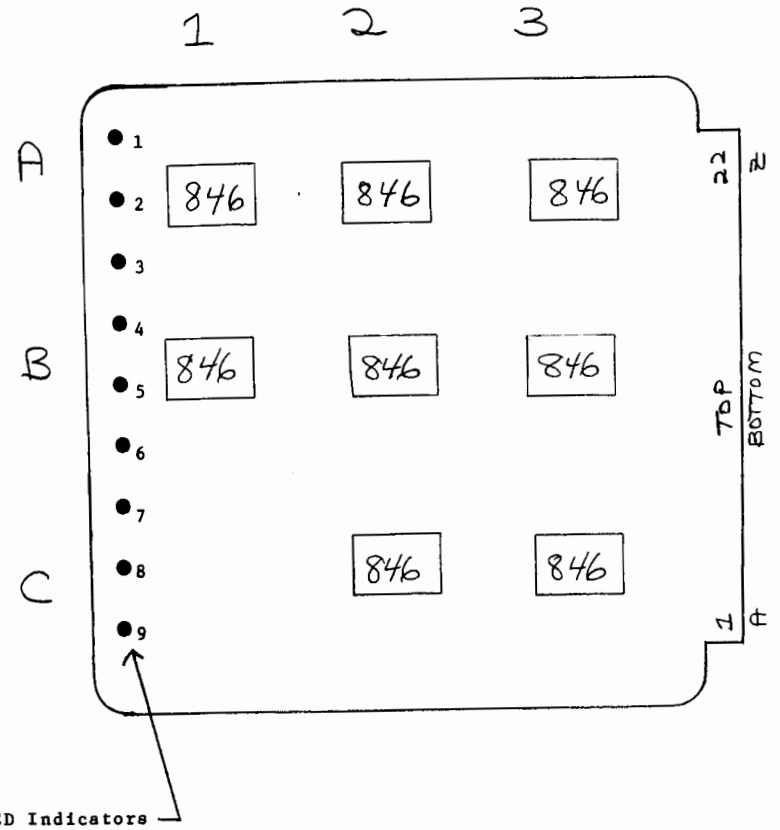
The digit "Ø" Restore to Normal function turns all indicators off.

Power requirements to the board are +5V Regulated.

R. Swenton WA1LMV

7-7-78

UHF Board #13 CAD
Control Address Decode Board

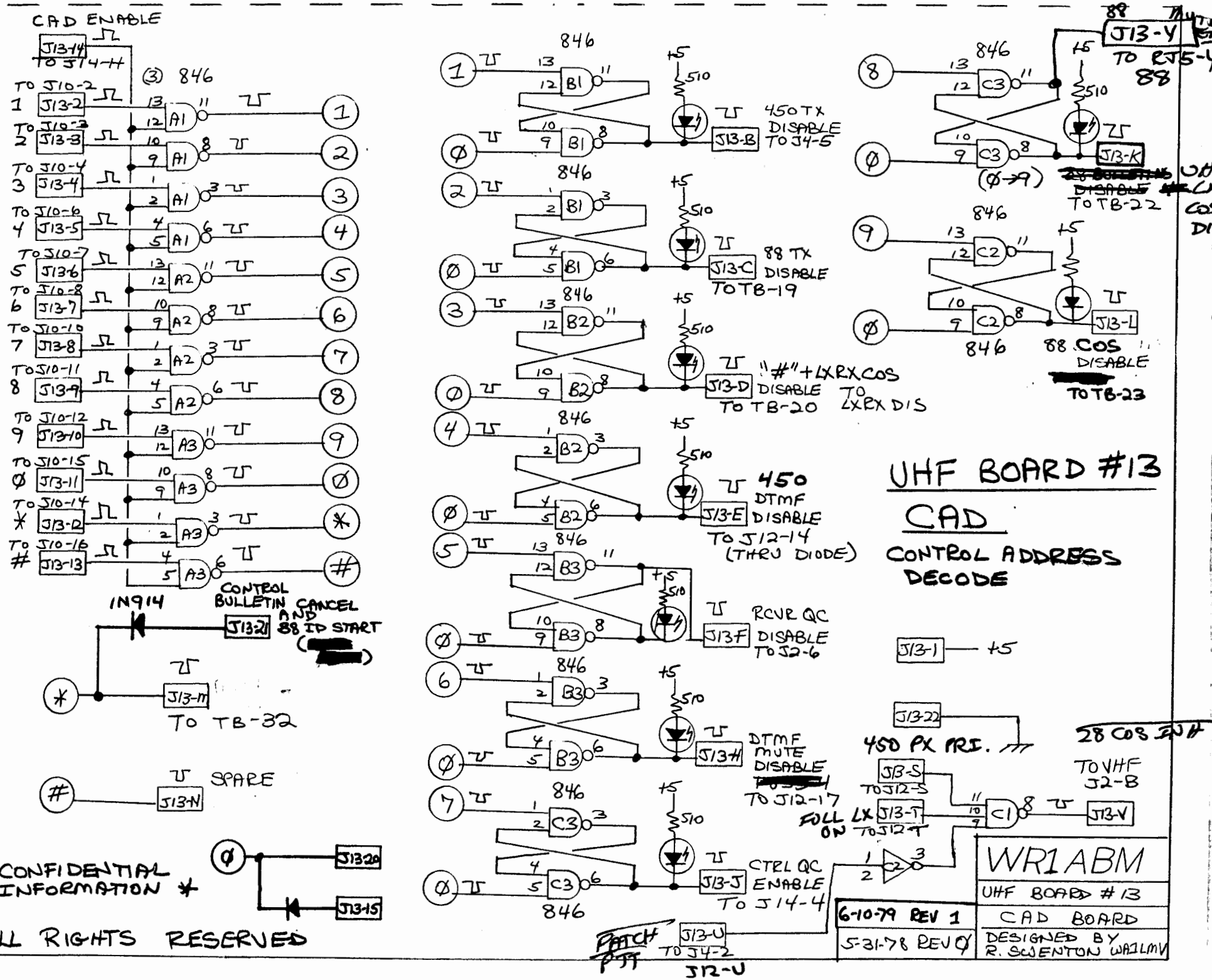


LED Indicators

Control Functions:
1-450 Tx Off
2-88 Tx Off
3-~~88 Amp Off~~ PATCH LINK OFF 450 ONLY
4-User Touchtone Disable (~~Both repeaters~~)
5-450 Rcvr Quiet Channel on
6-450 Touchtone Mute Disable (for control of WR1AFU)
7-Control System Quiet Channel On
8-~~Spare~~ off VOICE BULLETINS DUMP + DISABLE + ID START + PITCH RAISE
9-~~Spare~~ off 28 COR DISABLE
Ø-Restore to Normal

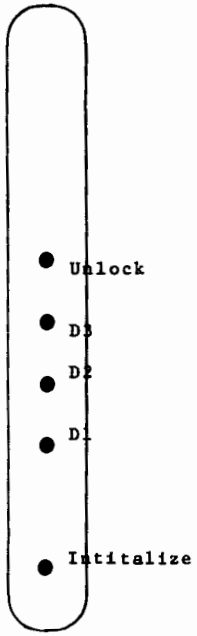
R.H. Swenton WA1LMV
~~7-7-78~~
6-10-79

CONFIDENTIAL INFORMATION


CAD ENABLE
J13-14
TO J14-H
③ 846
TO J10-2
1 J13-2
TO J10-3
2 J13-3
TO J10-4
3 J13-4
TO J10-6
4 J13-5
TO J10-7
5 J13-6
TO J10-8
6 J13-7
TO J10-10
7 J13-8
TO J10-11
8 J13-9
TO J10-12
9 J13-10
TO J10-15
Ø J13-11
TO J10-14
* J13-12
TO J10-16
J13-13
A1
A2
A3
1
2
3
4
5
6
7
8
9
Ø
*
#
1N914
CONTROL BULLETIN CANCEL AND 88 ID START
J13-21
J13-M
TO TB-32
J13-N
SPARE
J13-20
J13-15
CONFIDENTIAL INFORMATION
ALL RIGHTS RESERVED
846
B1
B2
B3
510
+5
450 TX DISABLE TO J4-5
J13-B
88 TX DISABLE TO TB-19
J13-C
"#" + LX RX COS DISABLE TO TB-20
J13-D
LX RX DIS
450 DTMF DISABLE TO J12-14 (THRU DIODE)
J13-E
RCVR QC DISABLE TO J2-6
J13-F
DTMF MUTE DISABLE TO J12-17
J13-H
CTRL QC ENABLE TO J14-4
J13-J
PATCH PTT
J13-U
TO J4-2
J12-U
C1
C2
C3
88
J13-Y
TO RJ5-4
J13-K
DISABLE
TO TB-22
88 COS DISABLE
J13-L
TO TB-23
UHF BOARD #13
CAD
CONTROL ADDRESS DECODE
J13-1
+5
J13-22
450 PX PRI.
28 COS
TO VHF J2-B
J13-S
TO J12-S
J13-T
TO J12-T
FULL ON LX
J13-V
WR1ABM
UHF BOARD #13
CAD BOARD
DESIGNED BY R. SWENTON WA1LMV
6-10-79 REV 1
5-31-78 REV Ø

UHF Board #14 IAD

Initialize and Access Decode Board



This board is the heart of the UHF control system. When the board is accessed with the digit "A", it disables the user functions, and receives the three digit combination. When the combination is correctly entered, the board "unlocks" and enables the control functions.

The board locks-out if an attempt to enter an invalid combination .

LED indicators indicate initialize, First Digit, Second Digit, Third Digit, and Unlock.

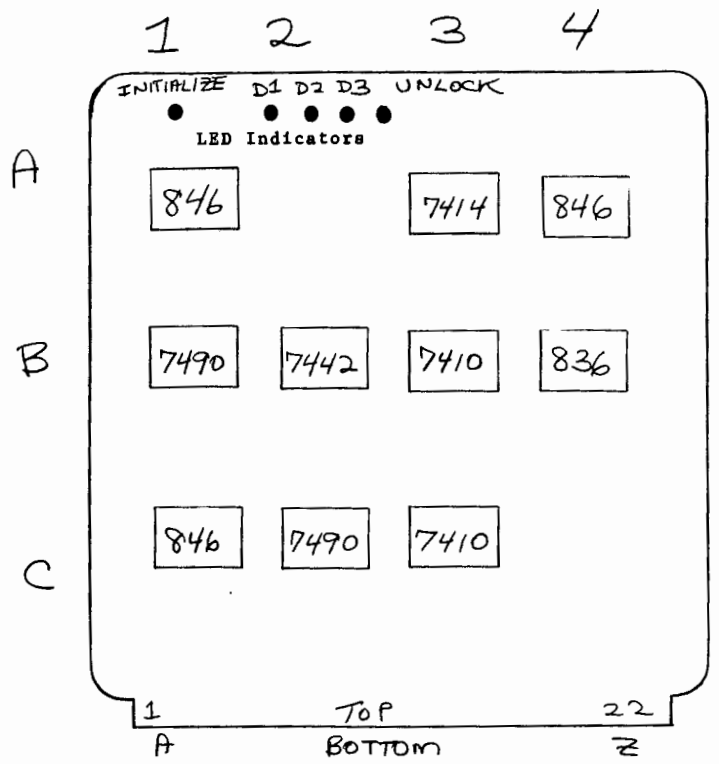
Power requirements to the board are +5V Regulated.

R. Swenton WA1LMV

7-7-78

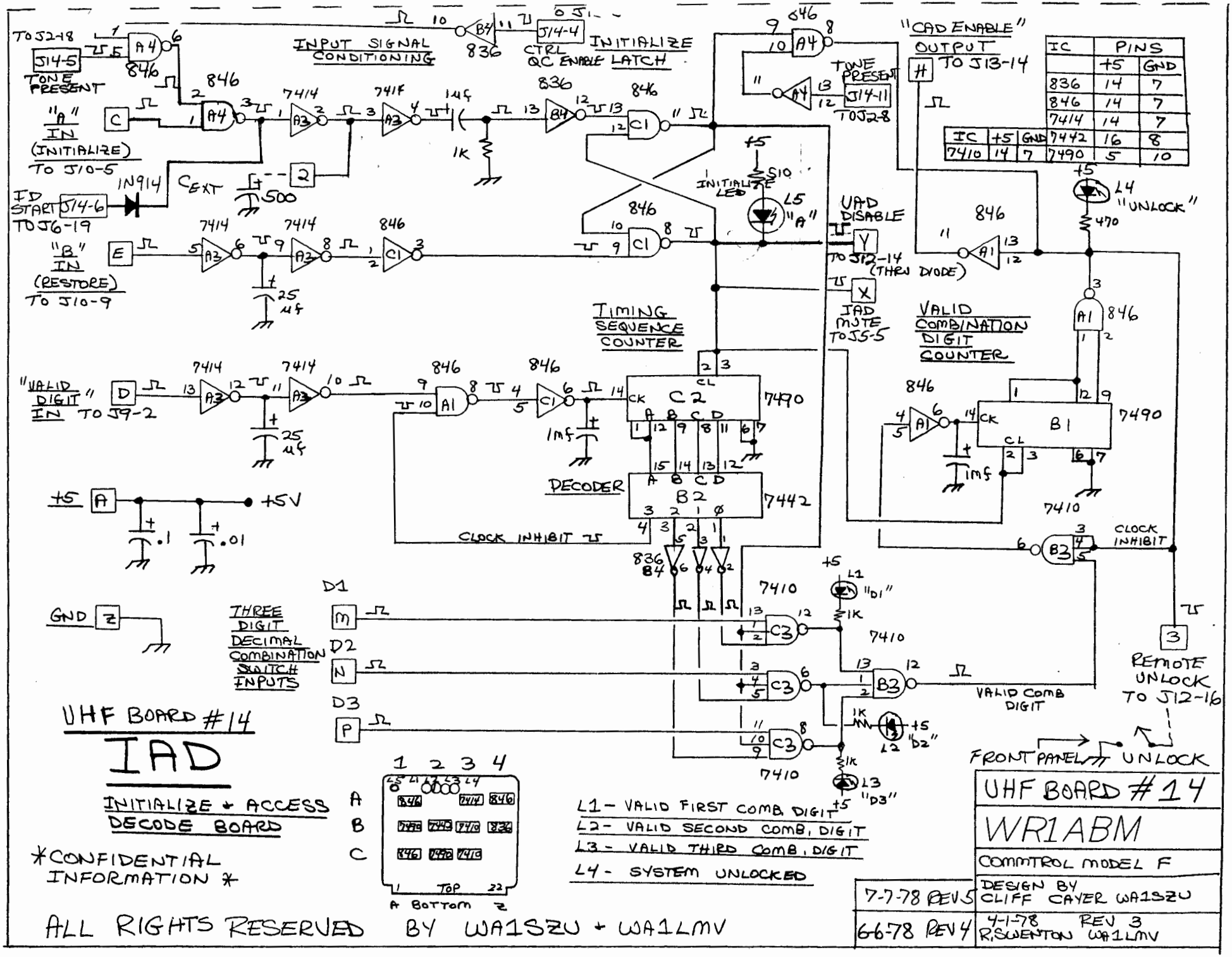
UHF BOARD #14 IAD

Initialize and Access Decode Board



R. Swenton WA1LMV

7-7-78



IC	PINS	
	+5	GND
836	14	7
846	14	7
7414	14	7
7410	14	7
7442	16	8
7490	5	10

UHF BOARD #14

IAD

INITIALIZE & ACCESS DECODE BOARD

*CONFIDENTIAL INFORMATION *

L1 - VALID FIRST COMB. DIGIT
L2 - VALID SECOND COMB. DIGIT
L3 - VALID THIRD COMB. DIGIT
L4 - SYSTEM UNLOCKED

UHF BOARD #14	
WR1ABM	
COMMTROL MODEL F	
7-7-78 REV 5	DESIGN BY CLIFF CAYER WA1SZU
6-6-78 REV 4	4-1-78 REV 3 R.SWENTON WA1LMV

WR1ABM UHF AUTOPATCH LINK SYSTEM FOR 88 (Bristol Site Equip.)

Designed by
R. Swenton WA1LMV
and
C. Cayer WA1SZU

Please Note: The information contained herein is the sole property of R. Swenton and/or C. Cayer and must not be divulged to others without permission. This information is provided to the Insurance City Repeater Club for the sole purpose of maintaining the club repeater systems.

Publication Number: A2

Publication Date: 3-8-79

WR1ABM Autopatch Link System (Bristol Site Equipment)

System design by R. Swenton WA1LMV and C. Cayer WA1SZU

The radio equipment centers around VHF Engineering. The uplink receiver, RX 432 receives on 444.675 MHz. The downlink transmitter transmits on 449.675 MHz.

The RX 432 line audio (ungated) is fed to the 88 Audio Processing unit which will gate the audio with the output of the Link Control Board. The COS output of the RX 432 is delayed by C2, 74123 to prevent chattering of the COS from keying the 88 transmitter.

The downlink transmitter, TX 432, is keyed from the signal from VHF Board #4. This signal goes low when a signal is on 28, when the ID is being sent, when the bulletin is on, or when the uplink receiver is on. Thus, the autopatch link system will self-lock during phone calls. This will eliminate double squelch tails during phone calls.

During idle times, the downlink transmitter will repeat the 28 input and the 88 ID. The transmit tail is adjustable by R1 and should be set to about one second.

Two front panel LED indicators indicate COS and Transmit.

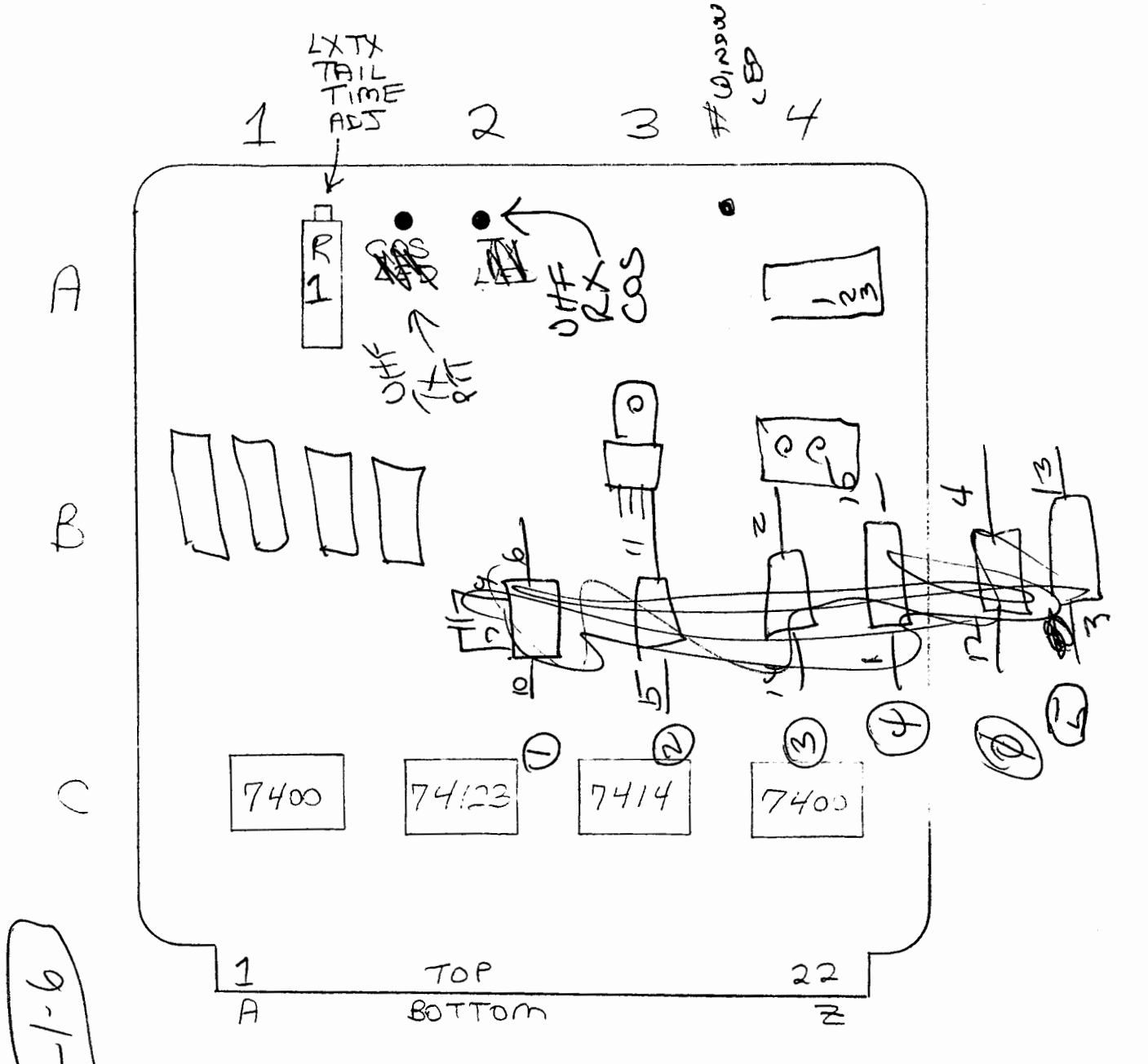
Two circuit board LED indicators indicate Delayed COS and Logic controlled Transmit.

Power requirements are +12V. Internal regulator provides +5V to the TTL logic.

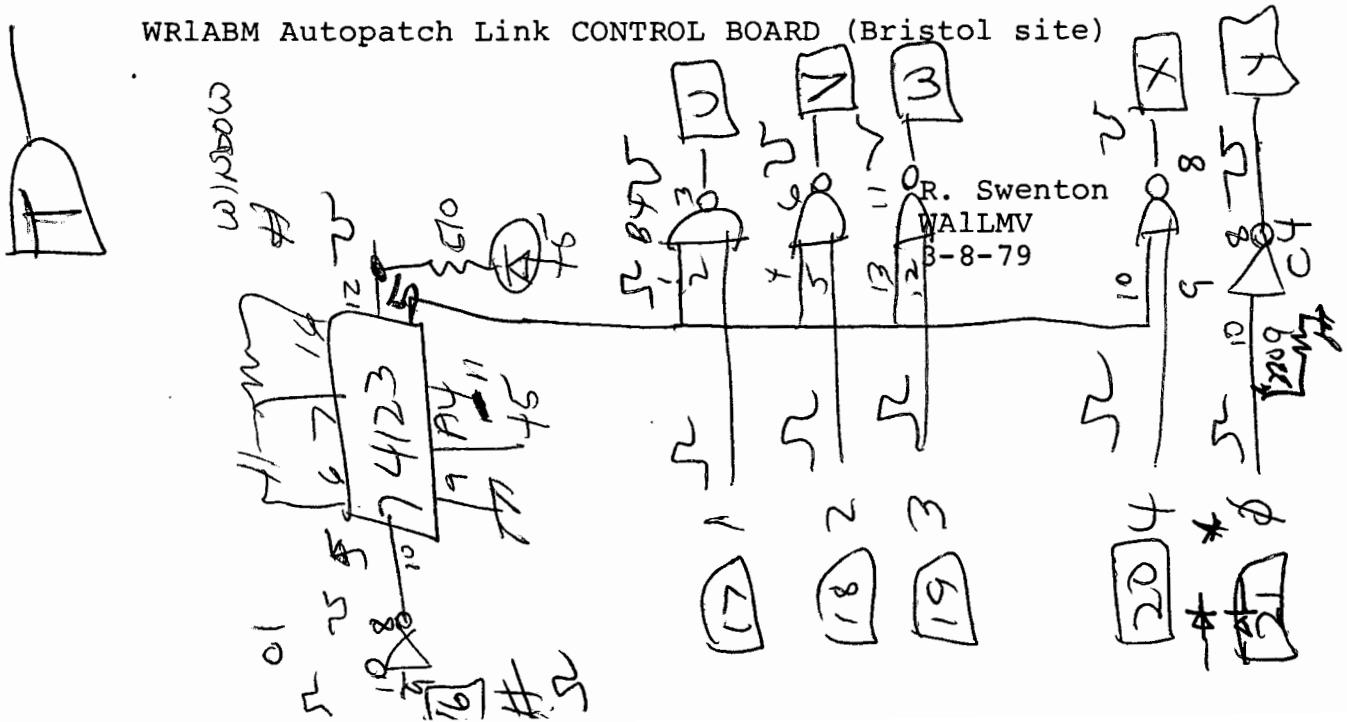
Equipment was constructed in double clad copper chassis to provide RF tight enclosures. Separate compartments are provided for the transmitter and receiver.

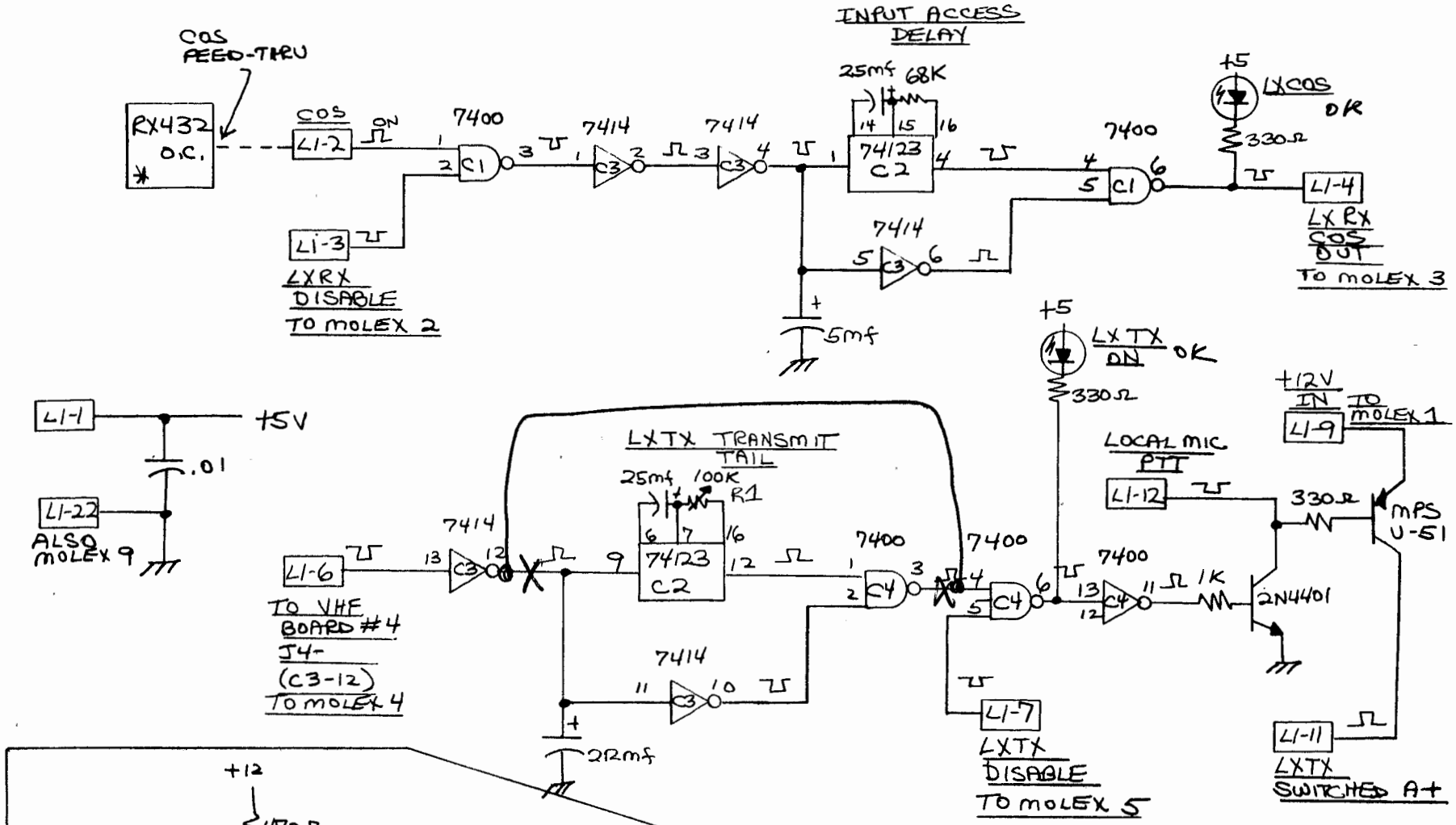
Inputs to the logic are provided for control disable for the transmitter and receiver separately.

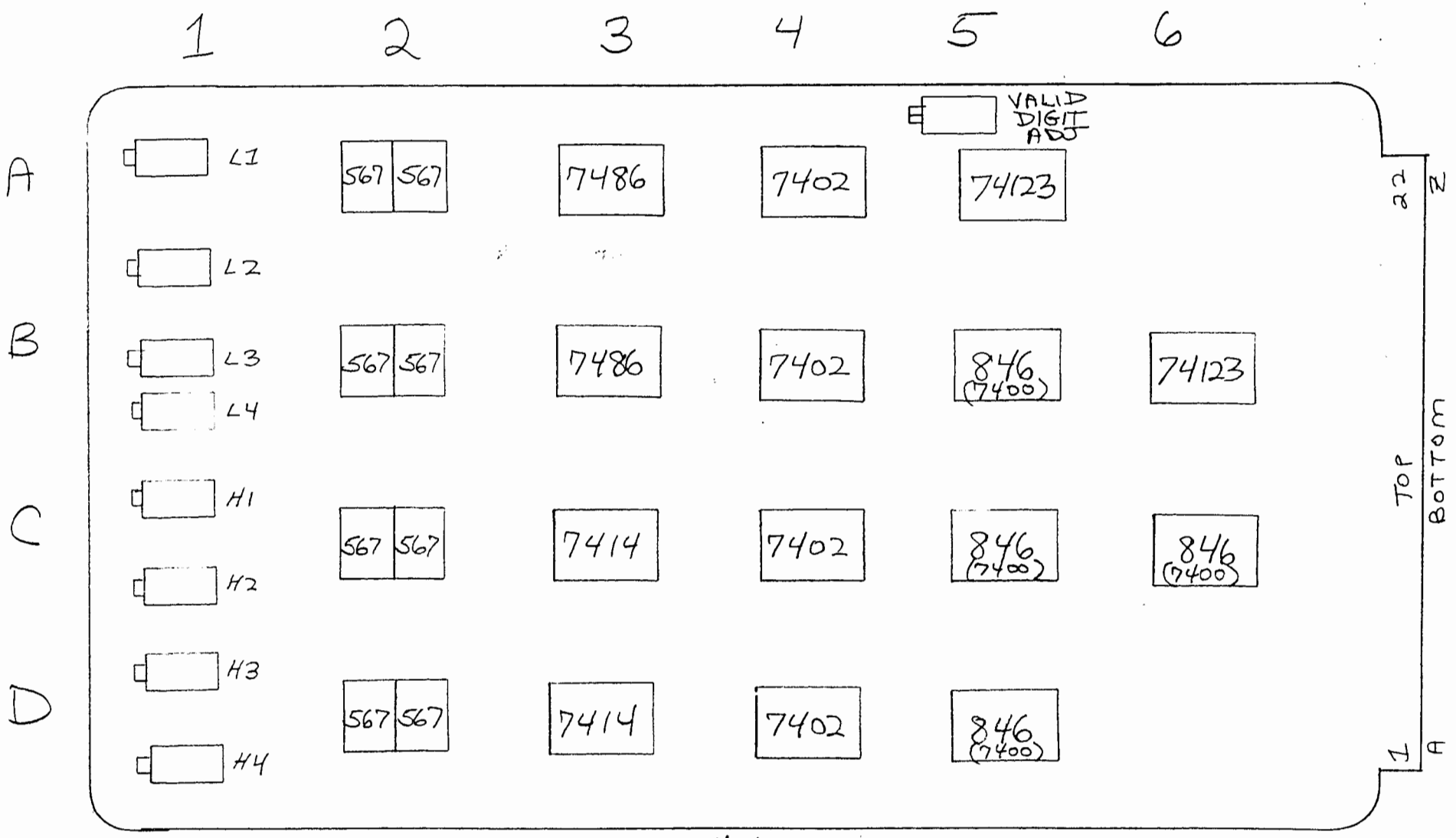
R. SWENTON WA1LMV
3-8-79



WR1ABM Autopatch Link CONTROL BOARD (Bristol site)







EDGE CONNECTOR PINS: AT-"N"

1 - +5V
2 - +5V
3 - LOW GROUP LOGIC
4 - HIGH GROUP LOGIC
5 - VALID DIGIT
6 - DELAYED *
7 - DELAYED #

19 - LOW GROUP AUDIO
20 - HIGH GROUP AUDIO
21 - +5V
22 - +5V
A - GND
B - GND
C - 1
D - 2

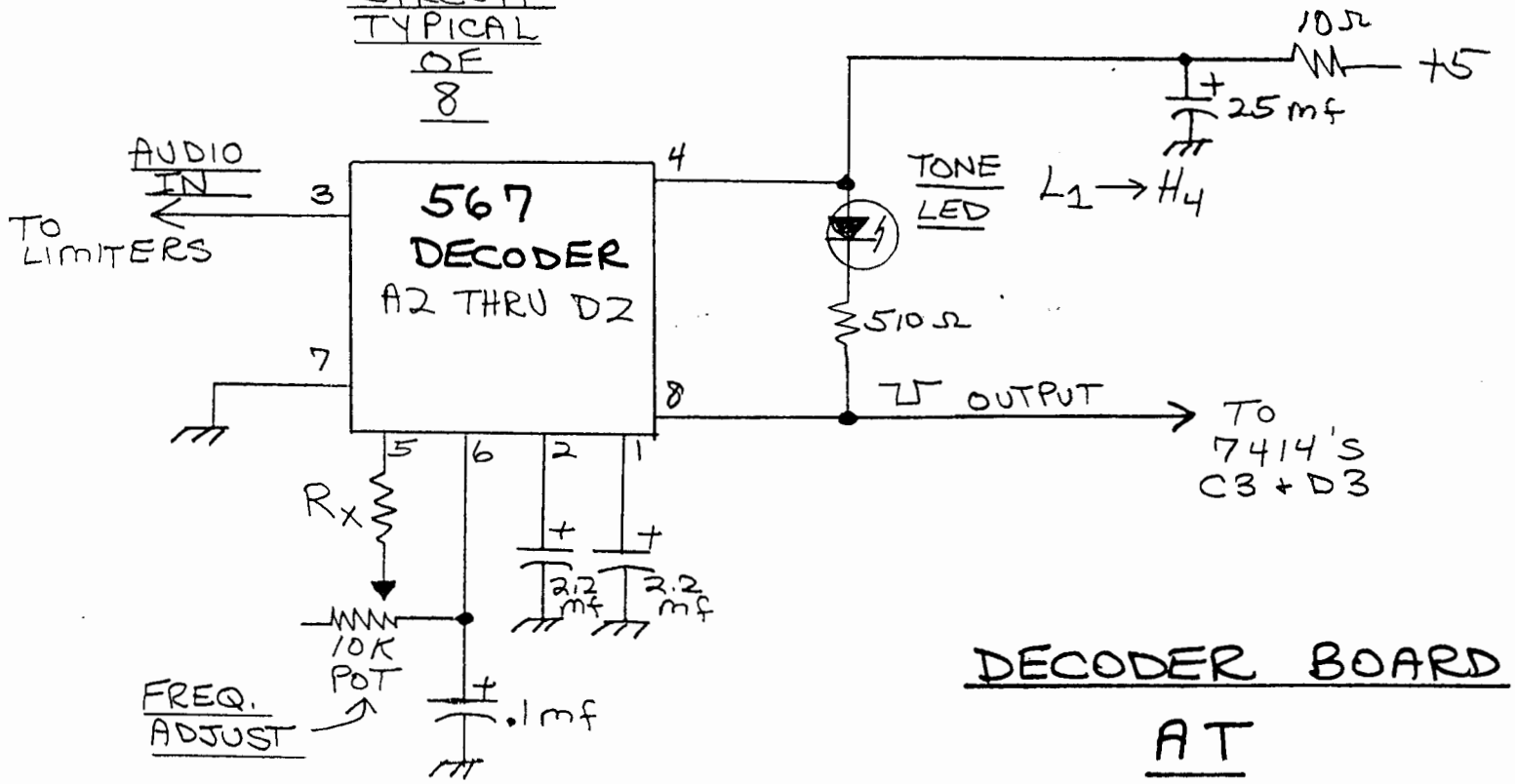
E - 3
F - A
H - 4
J - 5
K - 6
L - B
M - 7
N - 8

P - 9
R - C
S - *
T - Ø
U - #
V - D
W -
X -

Y - GND
Z - GND

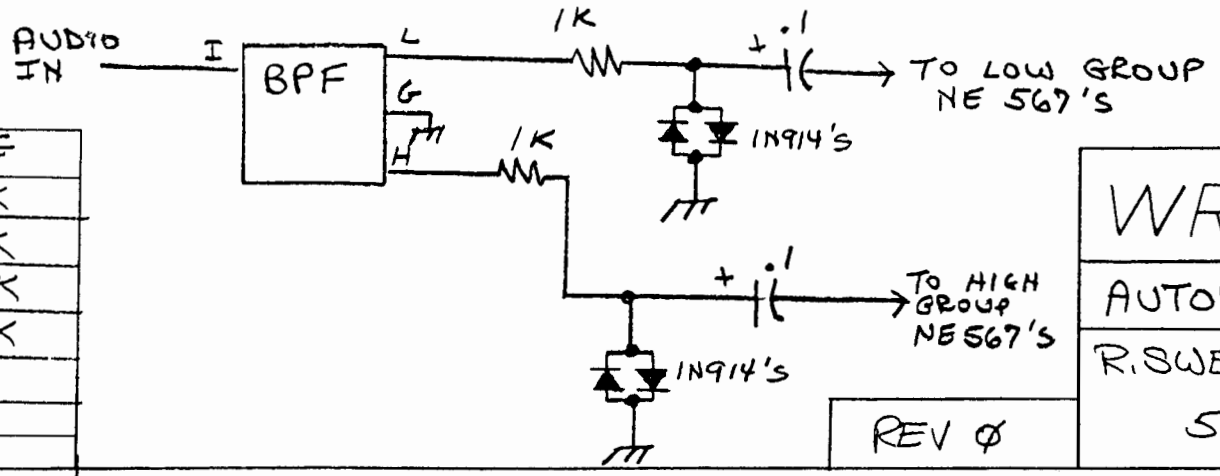
R. SWENTON
WA1LMV
6-8-79

CIRCUIT TYPICAL OF 8



DECODER BOARD AT

LIMITERS



Rx VALUES

TONE	FREQ	VALUE
L1	697	10K
L2	770	10K
L3	852	4.7K
L4	941	4.7K
H1	1209	1K
H2	1336	1K
H3	1477	1K
H4	1633	1K

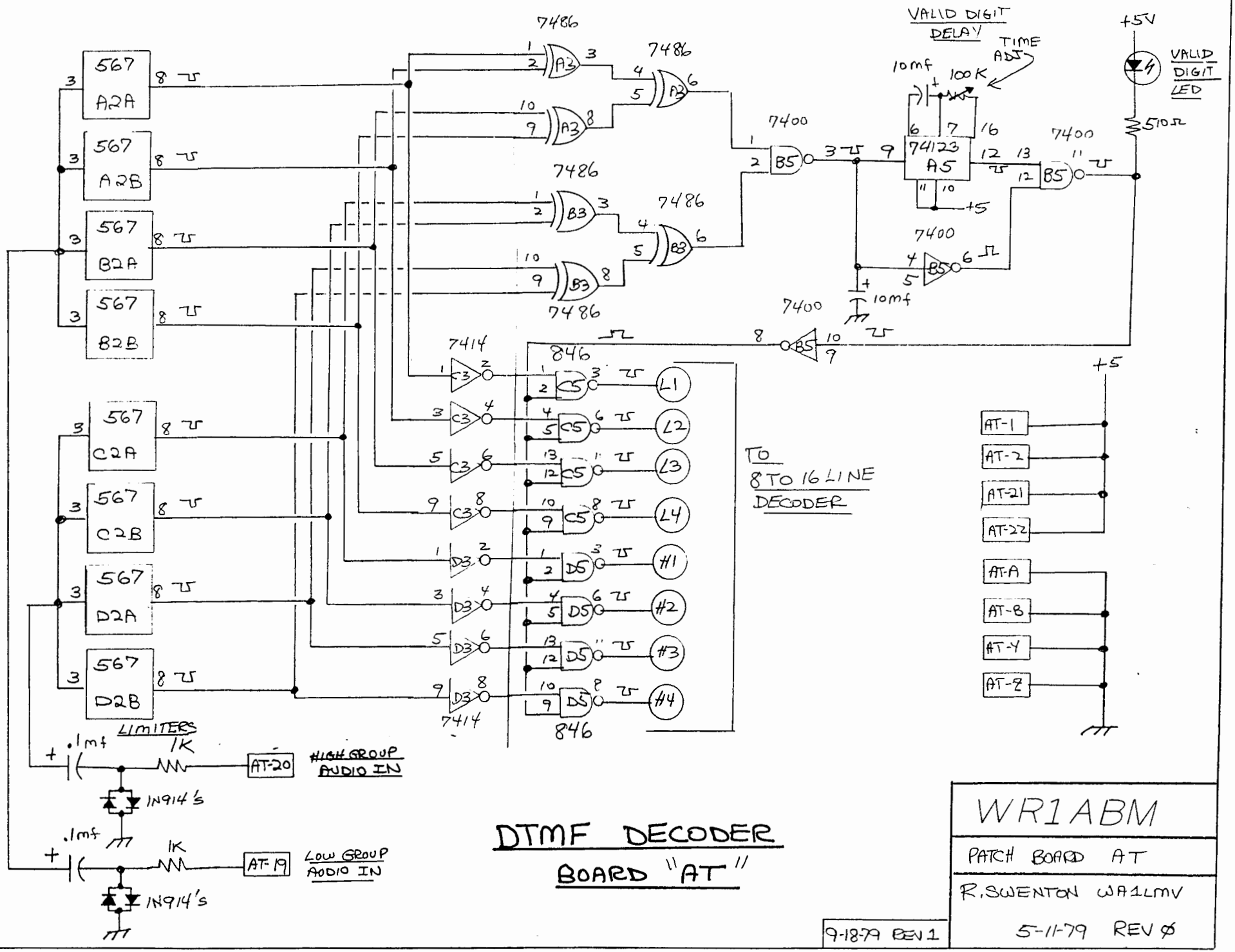
WR1ABM

AUTOPATCH (88)

R. SWENTON WA1LMV

5-10-79

REV Ø



DTMF DECODER BOARD "AT"

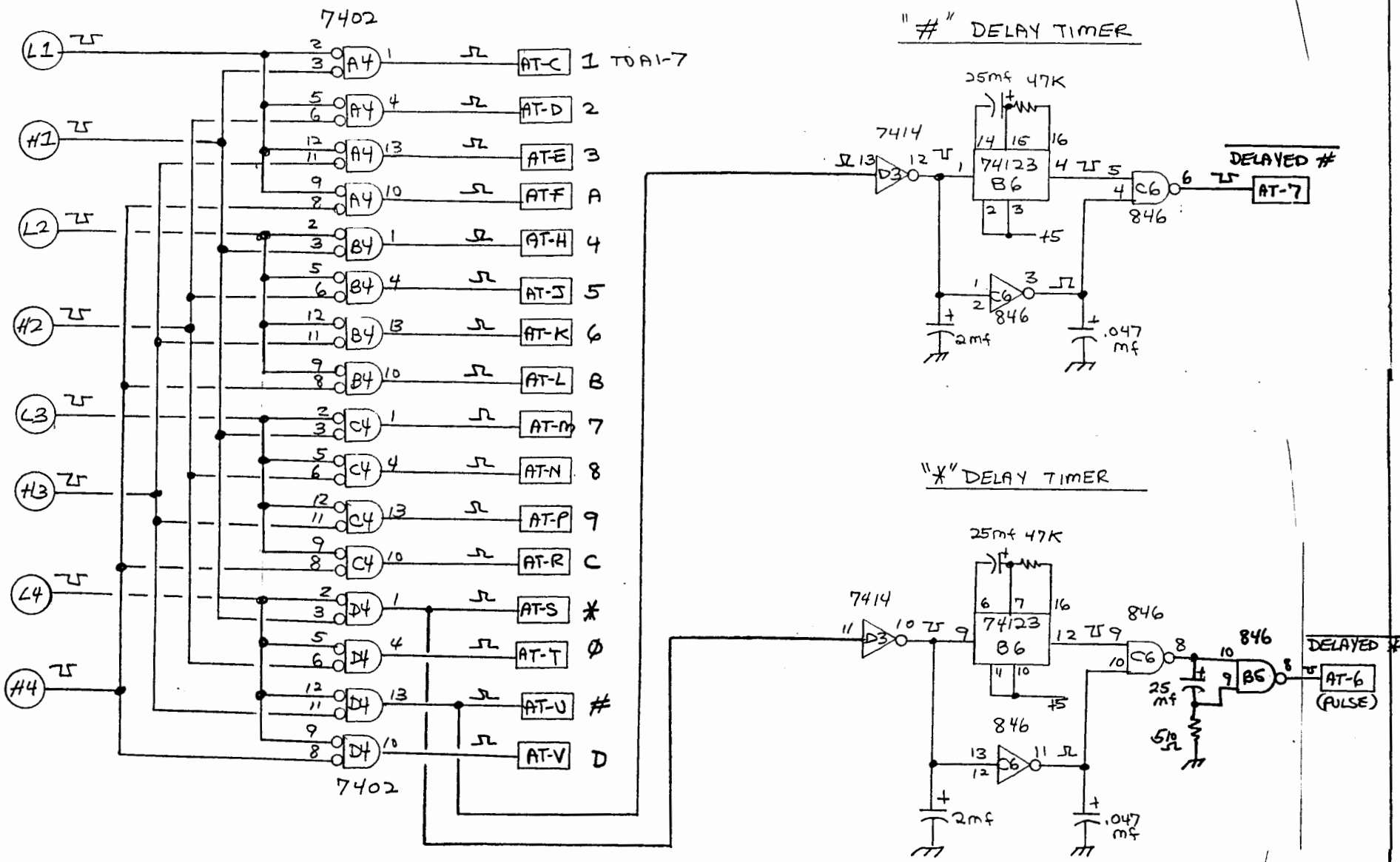
WR1ABM

PATCH BOARD AT

R. SWENTON WA1LMV

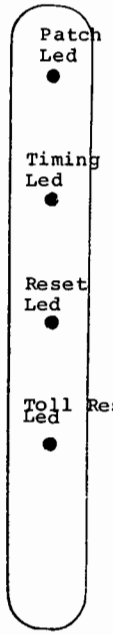
5-11-79 REV Ø

9-18-79 REV 1



AUTOPATCH DTMF
DECODER BOARD "AT"

WR1ABM	
AUTOPATCH (88)	
REV 1 10-11-81	DESIGNED BY: R. SWENTON WA1LMV 5-7-79
REV Ø	



Autopatch Board #A1

PATCH CONTROL

This board provides the primary control of the Autopatch. The logic controls the activation of the telephone interconnect (Datacoupler), keying of the link transmitter, and start of the MCW identification. It also controls toll restriction and automatic shutdown.

Access digit is the "#". This input will set the Patch Latch and activate the MCW ID. The phone line access will be delayed until completion of the ID. The link transmitter will be keyed for the ID and subsequent phone call.

Toll restriction is accomplished by using the digit one, if it is the first digit dialed, to terminate the Autopatch. Digit one will be allowed if it is any digit other than the first digit. Toll restriction will also cause MCW ID.

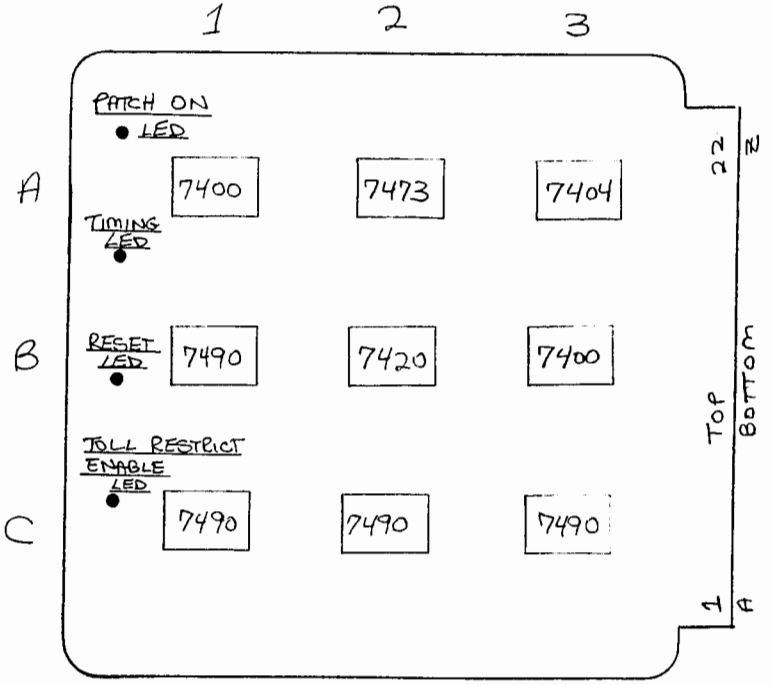
Deaccess is the "*". This will reset the Patch Latch and start the MCW ID. The Link transmitter will shut down after ID.

Duration timing is accomplished by the 65 Second timer. The timer is reset by the VOX circuit on board #A2 which listens to the Link receiver audio. If no audio comes down on the Link for 65 continuous seconds, the Patch will deaccess, start MCW ID and terminate the Link transmitter after ID.

Power requirements to the board are +5V regulated.

LED status indicators are provided on the front edge of the board.

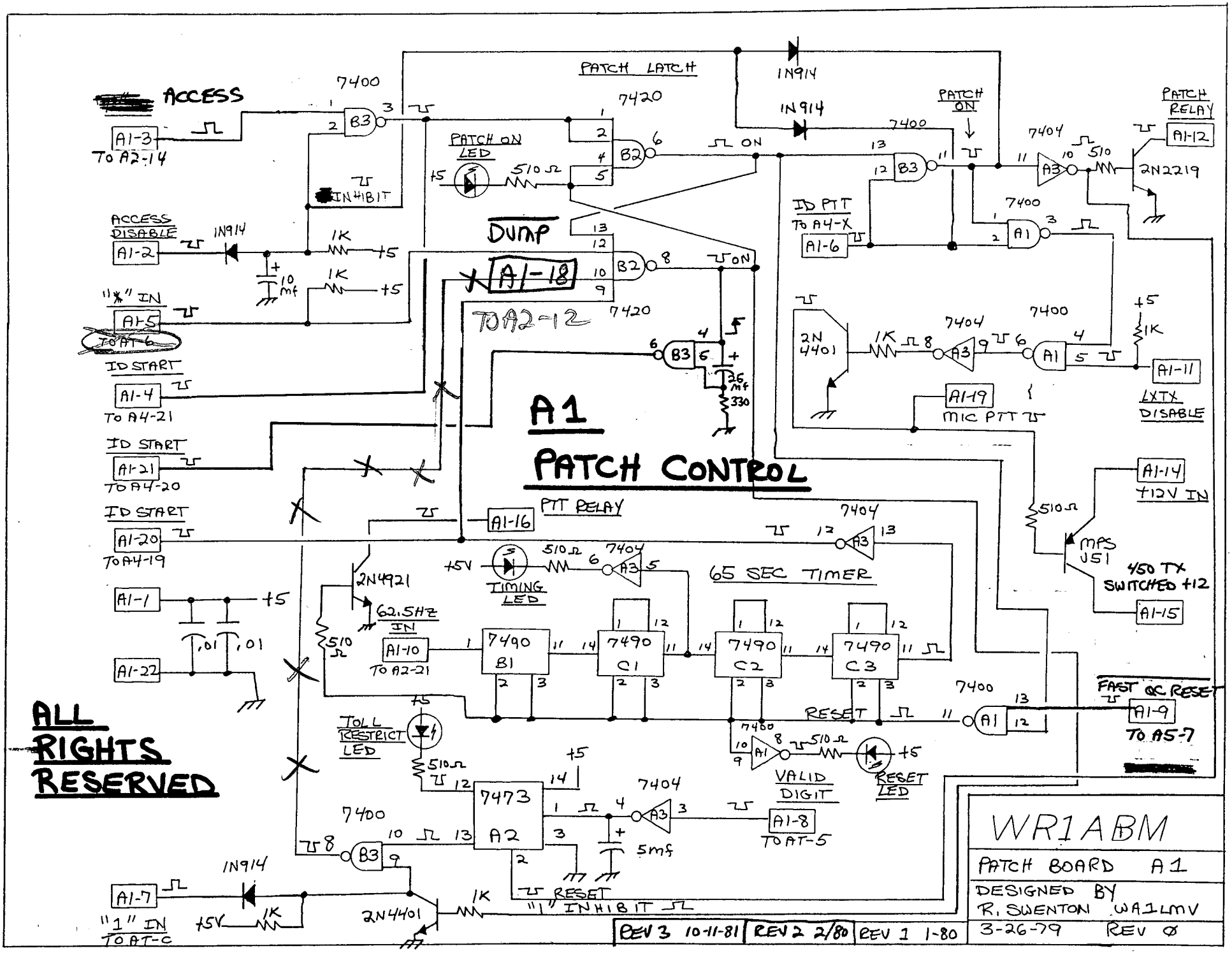
R. Swenton
WA1LMV
5-11-79

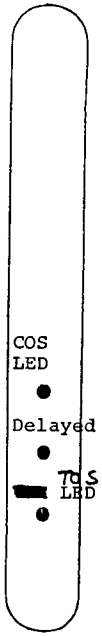


AUTOPATCH BOARD
A1

PATCH CONTROL

R. SWENTON
WA1LMV
5-10-79


A1
PATCH CONTROL
ACCESS
A1-3
TO A2-14
7400
7420
PATCH LATCH
1N914
1N914
PATCH ON
PATCH RELAY
A1-12
2N2219
PATCH ON LED
510Ω
+5
INHIBIT
ACCESS DISABLE
A1-2
1K
10 mf
DUMP
A1-18
TO A2-12
ON
ID PTT
TO A4-X
A1-6
"*" IN
A1-5
TO A1-6
ID START
A1-4
TO A4-21
ID START
A1-21
TO A4-20
ID START
A1-20
TO A4-19
2N 4401
7404
A1-19
MIC PTT
A1-11
LXTX DISABLE
A1-14
+12V IN
MPS U51
450 TX SWITCHED +12
A1-15
A1-16
PTT RELAY
TIMING LED
65 SEC TIMER
2N4921
62.5HZ IN
A1-10
TO A2-21
7490 B1
7490 C1
7490 C2
7490 C3
A1-1
A1-22
.01
.01
RESET
FAST QC RESET
A1-9
TO A5-7
TOLL RESTRICT LED
VALID DIGIT
RESET LED
7473 A2
5mf
A1-8
TO A1-5
A1-7
"1" IN
TO A1-C
2N4401
"1" INHIBIT
ALL RIGHTS RESERVED
WR1ABM
PATCH BOARD A1
DESIGNED BY
R. SWENTON WA1LMV
3-26-79 REV Ø
REV 3 10-11-81
REV 2 2/80
REV 1 1-80



Autopatch Board #A2

VOX / COS Control

This board provides three separate operations:

1) The link receiver COS line is buffered and conditioned to prevent chattering and undesired signals from opening squelch.

2) A precision 1 KHz. tuning fork oscillator provides five stable accurate frequencies used for audio tone indications and as a time base for interval counters.

3) The VOX circuit listens to the Link receiver audio to determine if the link is in use.

LED status indicators are on the front board edge.

Power requirements- +5V regulated and +12V filtered.

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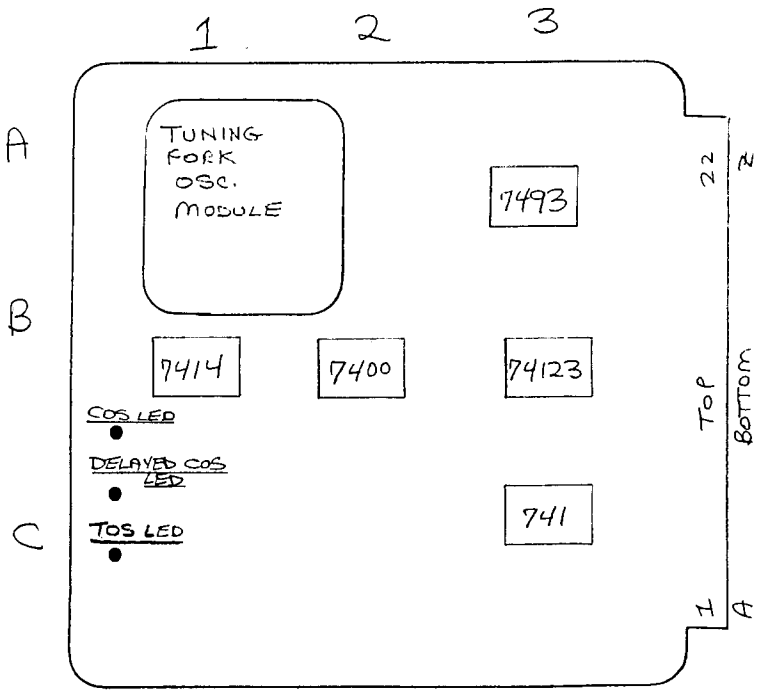
WA1LMV
5-11-79

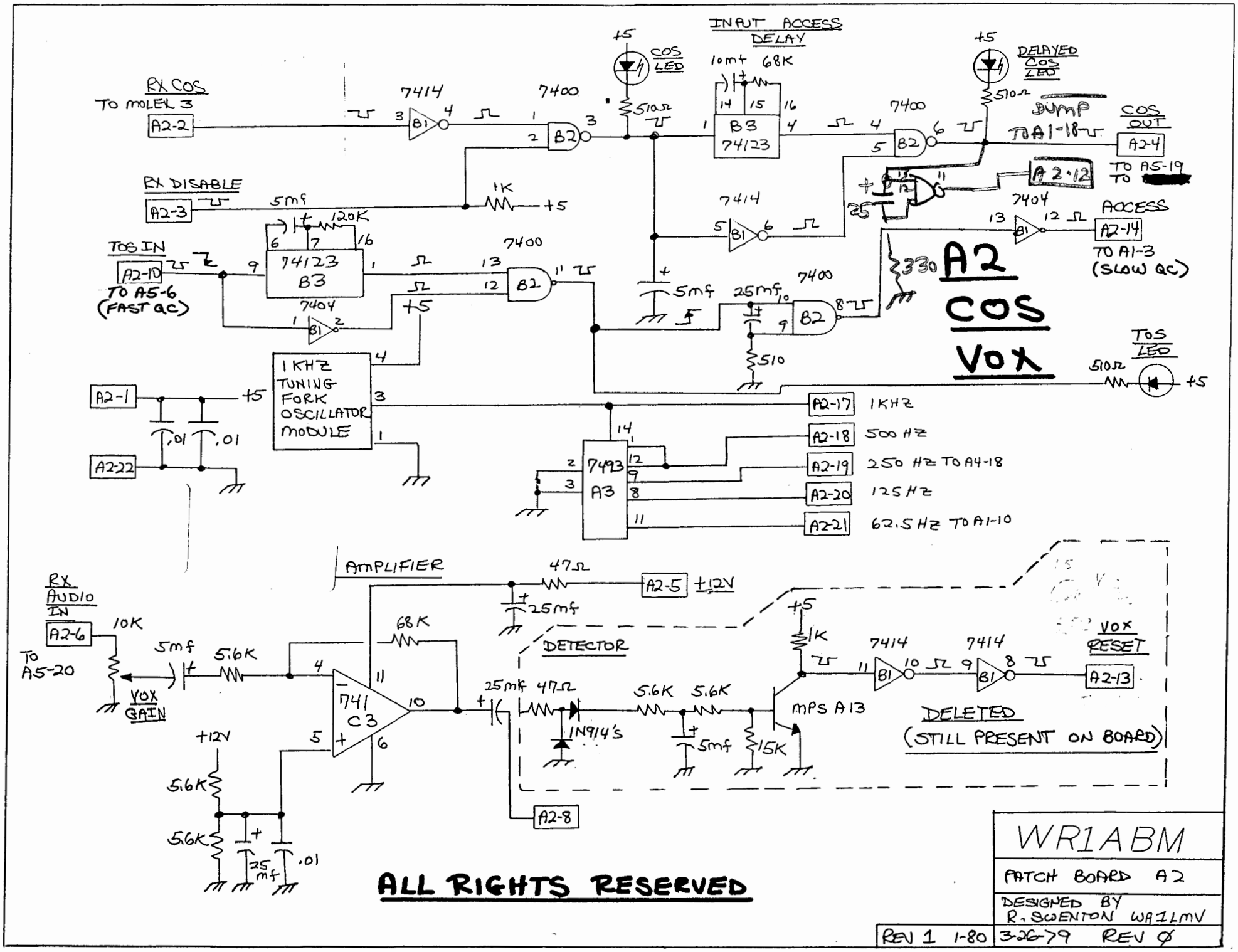


AUTOPATCH BOARD

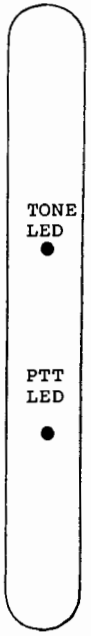
A2

COS/VOX

R. SWENTON
WA1LMV
5-10-79



WR1ABM	
PATCH BOARD A2	
DESIGNED BY R. SCENTON WA1LMV	
REV 1 1-80	3-26-79 REV Ø



Autopatch Board #A4

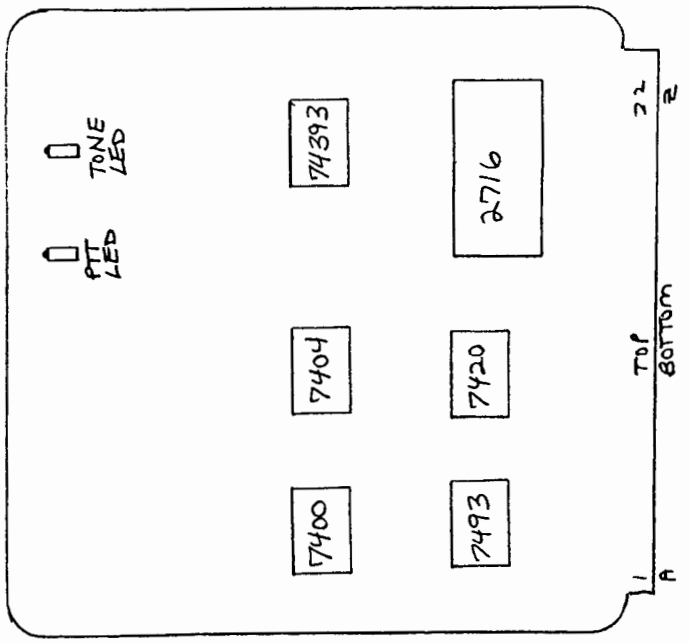
MCW ID

This board provides the MCW identification of the Link transmitter.

This ID circuit utilizes an Erasable Programmable Read Only Memory which is programmed for the desired call sign.

Power requirement is +5 Volts regulated.

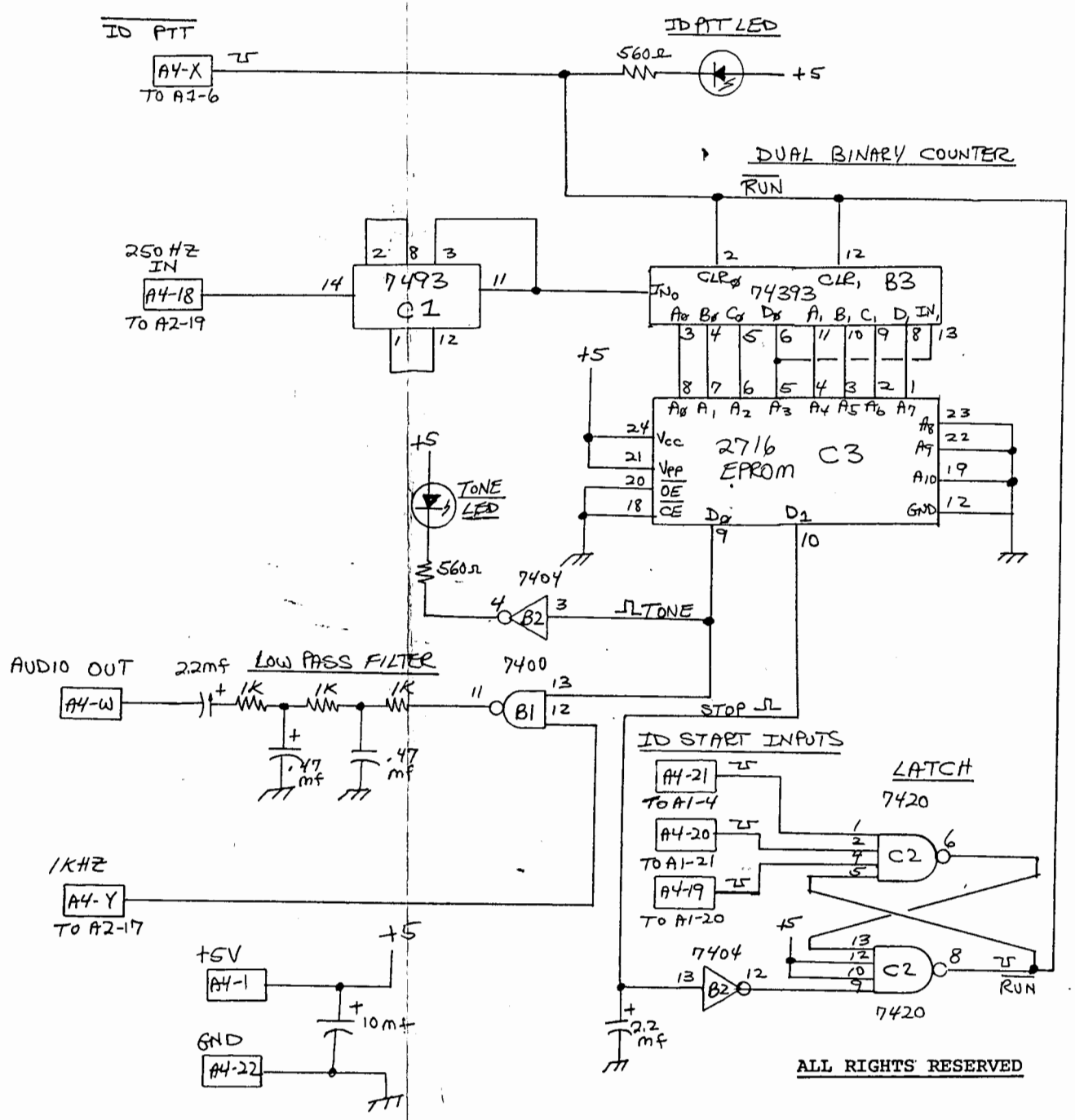
R. Swenton WA1LMV
10-11-81



AUTOPATCH BOARD #4 MCW ID

R. Swenton WA1LMV

10-11-81

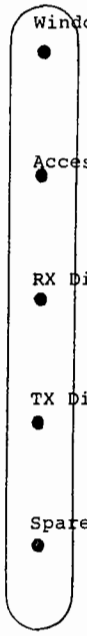


K1DFS/R

Autopatch Board A4 MCW ID

Designed by
R. Swenton WA1LMV

10-11-81 | Rev Ø



AUTOPATCH BOARD #A5

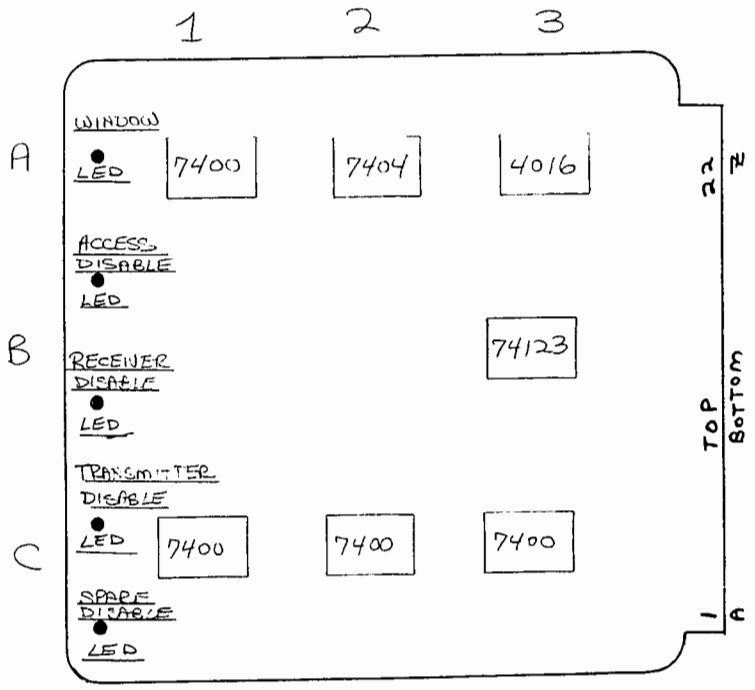
SYSTEM CONTROL

This board contains the squelch gate for the downlink receiver audio. The audio is switched by a CMOS switch.

The board also contains the secondary control circuitry for independent control of Access, Receiver, and Transmitter. Control tones to this board are received from the downlink receiver.

Power requirements- +5V regulated.

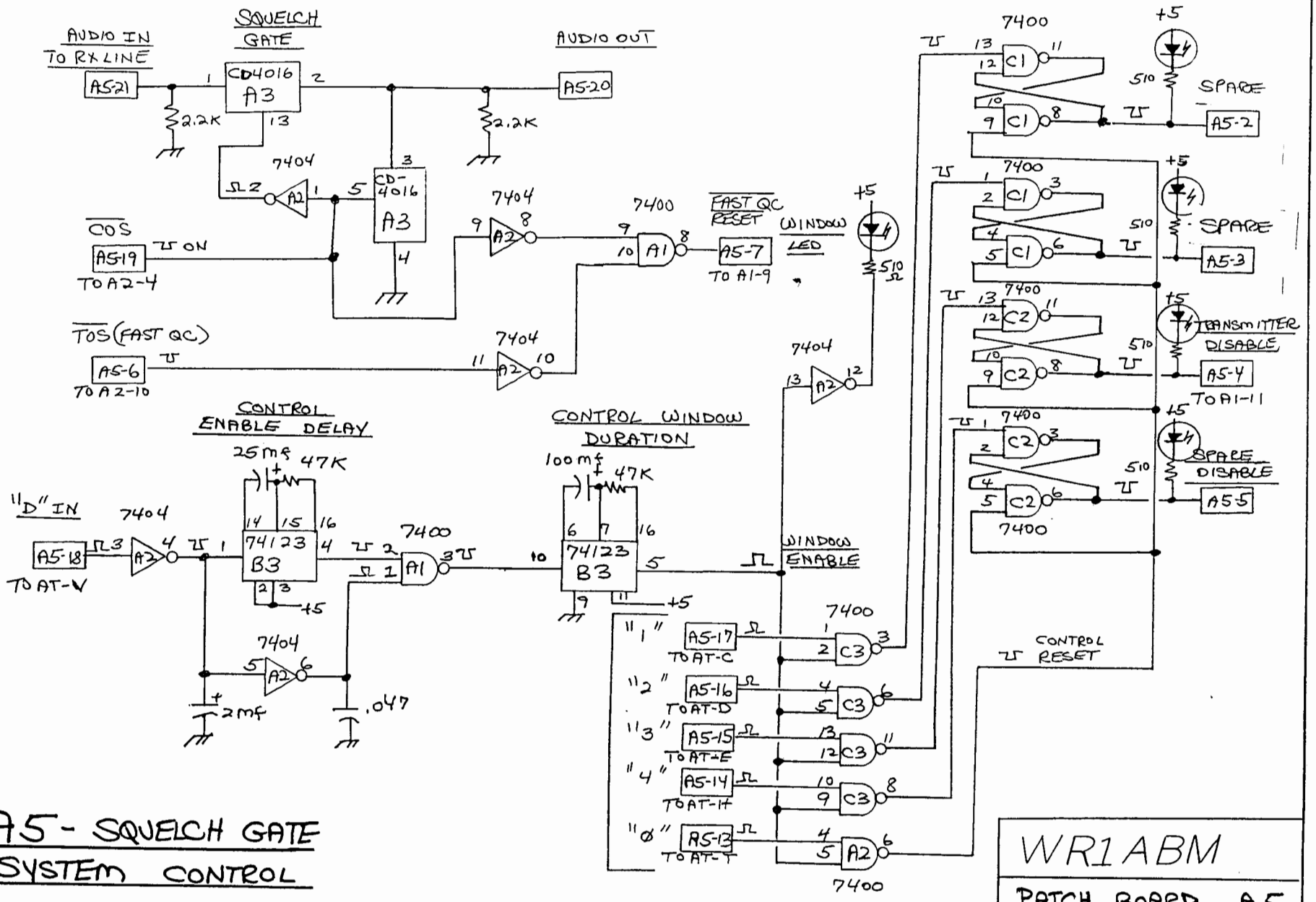
R. Swenton
WA1LMV
5-17-79



AUTOPATCH BOARD #A5

SYSTEM CONTROL

R. SWENTON
WA1LMV
5-17-79



A5 - SQUELCH GATE SYSTEM CONTROL

WR1ABM

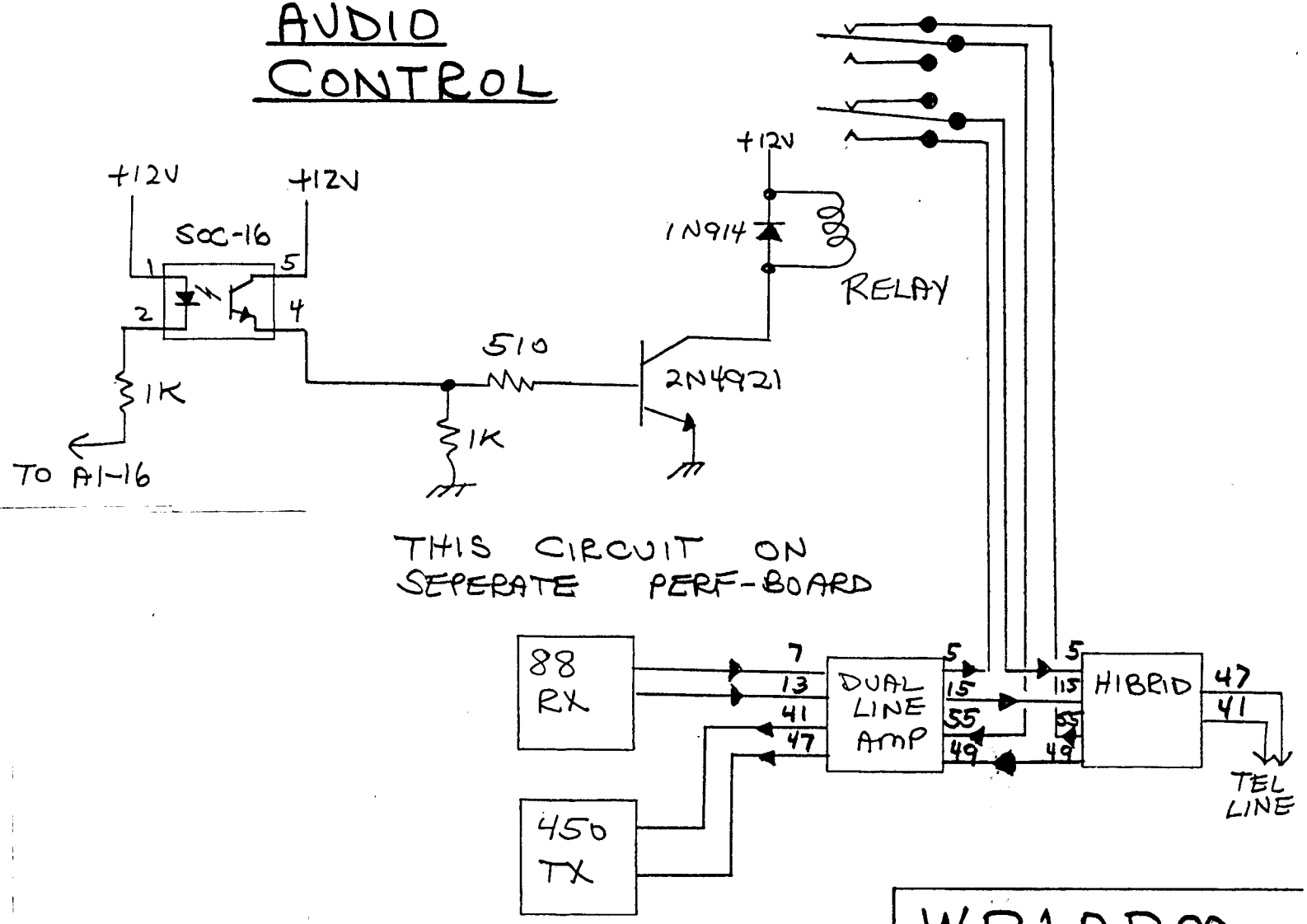
PATCH BOARD A5

DESIGNED BY R. SWENTON WA1LMV

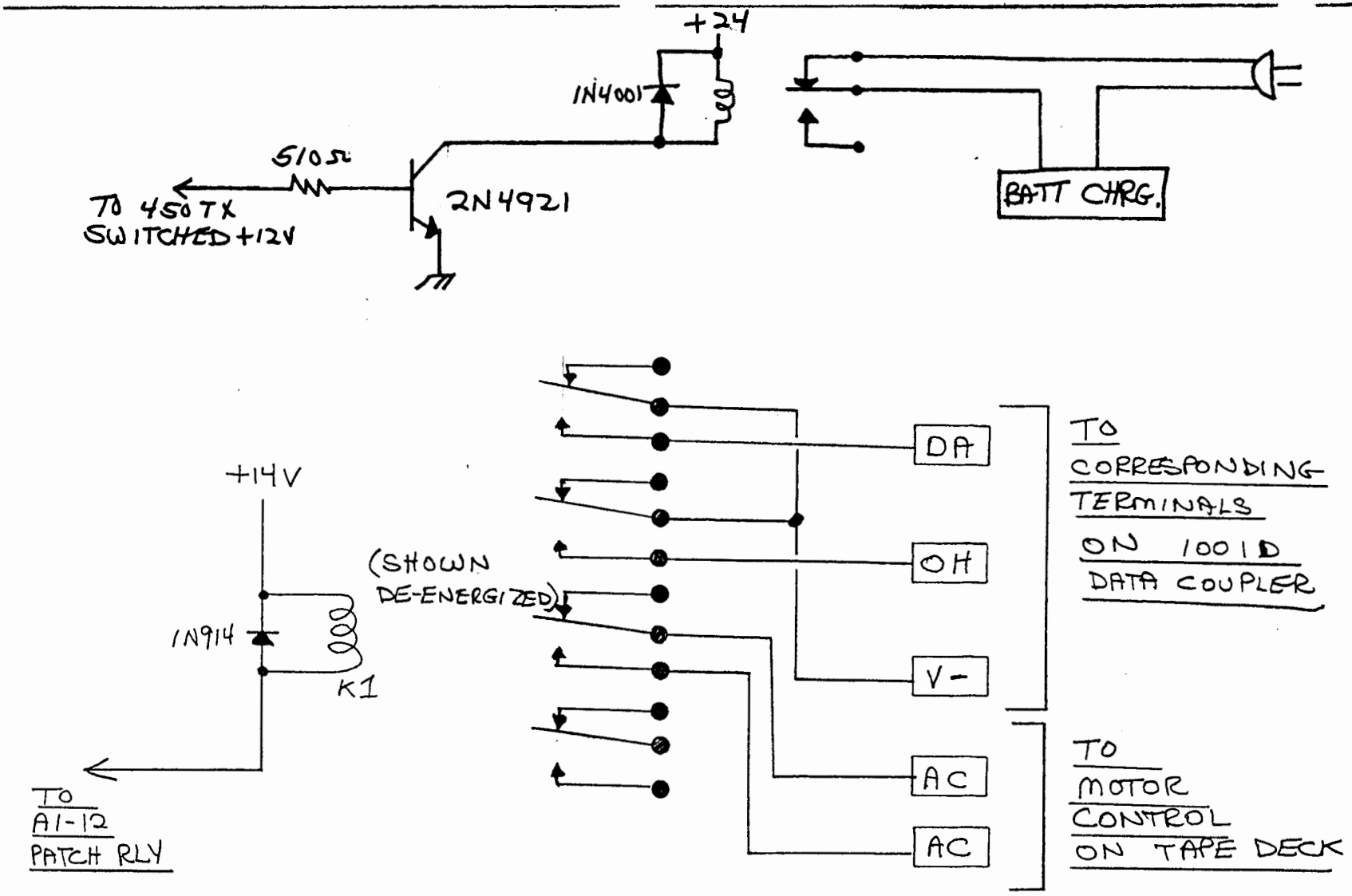
5-14-79 REV Ø

REV 1 1-80

PTT AUDIO CONTROL



WR1ABM
AUTOPATCH
R. SWENTON WA1LMV
1-10-80 REV Ø



WR1ABM

AUTOPATCH (88)

R. SWENTON
WA1LMV

5-10-79

W1TNS/R 75-15
REPEATER SYSTEM

Designed and Built
by
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
1-20-81

Please Note: The information contained in this manual is the sole property of R. Swenton and C. Cayer and is provided to the Insurance City Repeater Club for the sole purpose of maintaining the Club repeater systems. The information may not be divulged to others without permission.

Publication Number: R3

Publication Date: 1-20-81

Replaces Previous Publication Dated: _____

Includes Supplements Dated: _____

Copy: LMV___
SZU___
TNS___
15 ___

15 Logic System

Repeat Board #1: COS

This board contains three carrier operated swtich inputs. Each input is capable of being disabled seperately. The first input is the 75 RX COS. The second is the 52.525 RX COS. The third is the AUX RX which is connected to the 447.85 UHF control receiver. The first and second COS inputs cause their respective time-out timers (on Repeat Board #3) to run. The third COS input has no time-out limit.

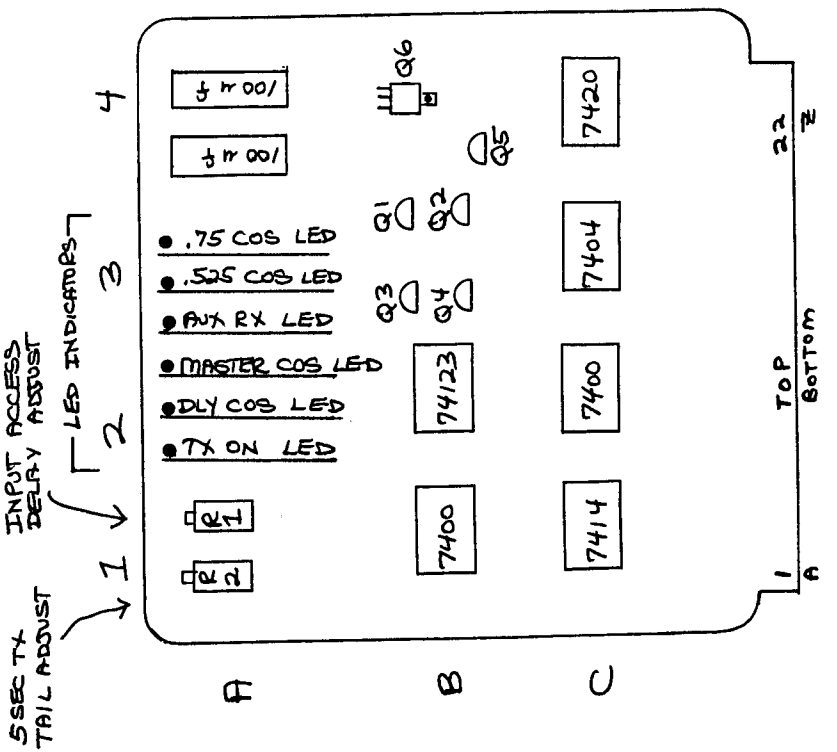
When a COS signal comes in on either the 75 input or the 525 input two things happen: a signal is fed to Repeat Board #2 to the respective Reset Delay Circuit (this will eventually feed the time-out timers on Repeat Board #3) and a signal will cause the Master COS LED to light. This will cause the Input Access Delay to begin timing. The time set by R1 (usually adjusted to one second) will have to expire before the repeat transmitter will come on. This will prevent random static or "kerchunkers" from keying the 15 TX. The Master DLY COS LED will light when the Input Access Delay timer times out. This will key the 15 TX through the 5 SEC TX Tail Timer and light the 15 TX ON LED. When the input signal is removed, the 5 SEC TX Tail Timer will keep the 15 TX on for five more seconds and then shut the TX off. Four other inputs feed the 5 SEC TX Tail Timer. These are Autopatch, MCW ID, AUX RX (UHF CTRL RX), and Voice ID. Any of these signals will key the 15 TX instantly without going through Input Access Delay, and the 15 TX will remain on for five seconds after they are removed.

This board is also wired to give the 525 receiver low priority. Three things will cause the 525 RX to be disabled: 1) If the RX is controlled off, 2) If the Autopatch is on, 3) If there is a station on the 75 input.

Emergency power operation will cause two things to happen: 1) the Input Access Delay time will be changed to 10 ms. 2) the 5 SEC TX Tail time will be changed to 1 sec. The TX Tail time is shortened to conserve battery power. The Input Access Delay is shortened because the transmitter will not be on between transmissions and the first syllable would be lost on every transmission.

The Insurance City Repeater Club

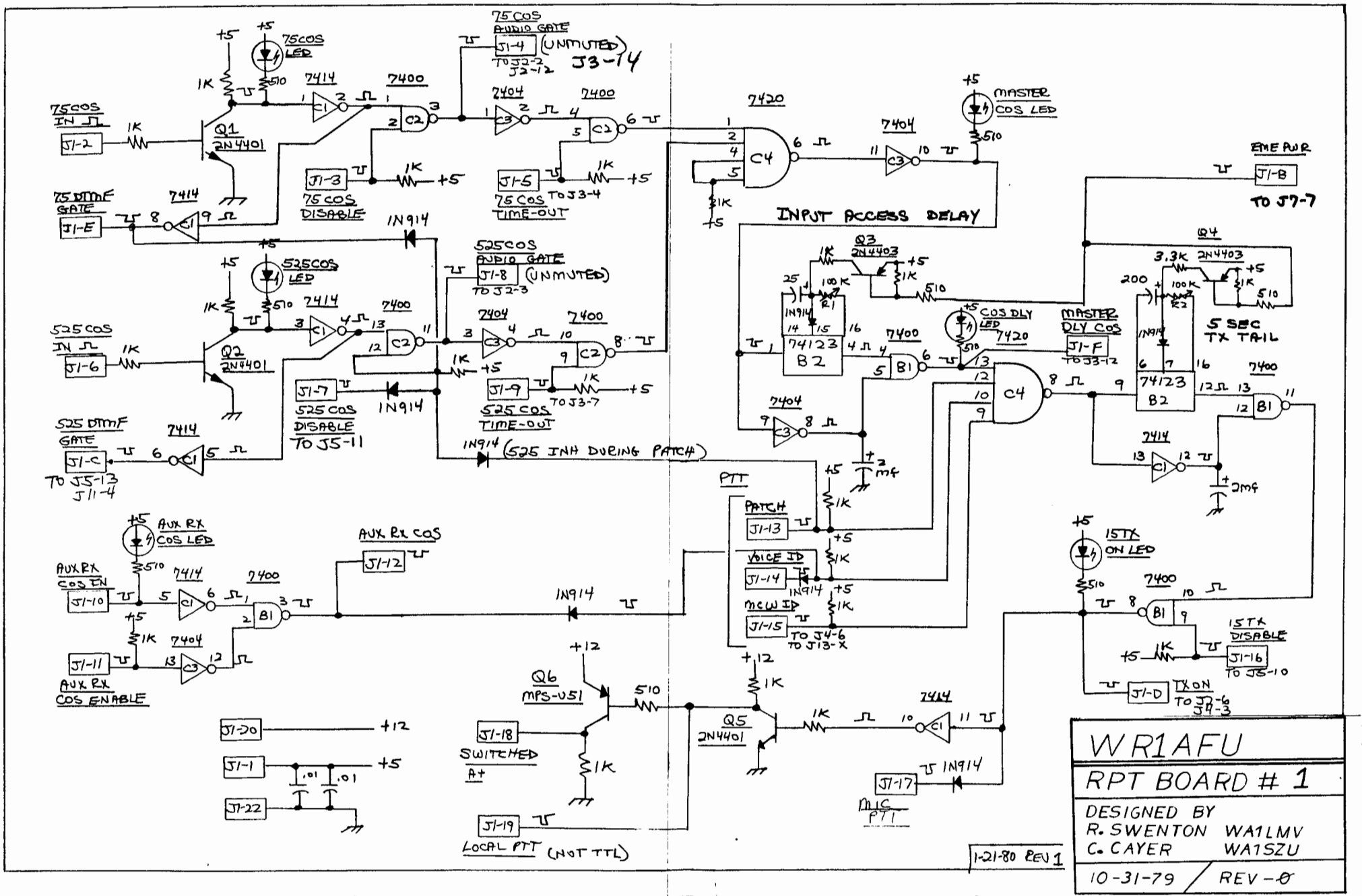
DESIGNED AND BUILT
BY
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
12-1-80



COS
AFU BOARD #1
SHEET 1 OF 1

PICTORIAL

WA1LMV 10-79


75COS AUDIO GATE
J1-4 (UNMUTED)
TO J2-2
J2-12
J3-14
75COS LED
75COS IN J1-2
Q1 2N4401
75 DTMF GATE J1-E
J1-3 75 COS DISABLE
J1-5 75 COS TIME-OUT TO J3-4
7414
7400
7404
7420
INPUT ACCESS DELAY
MASTER COS LED
EME PWR J1-B TO J7-7
1N914
525COS AUDIO GATE J1-8 (UNMUTED) TO J2-3
525COS LED
525 COS IN J1-6
Q2 2N4401
J1-7 525 COS DISABLE TO J5-11
J1-9 525 COS TIME-OUT TO J3-7
525 DTMF GATE J1-C TO J5-13 J11-4
525 INH DURING PATCH
Q3 2N4403
Q4 2N4403
3.3K
100K
R1
R2
74123 B2
COS DLY LED
MASTER DLY COS J1-F TO J3-12
5 SEC TX TAIL
2mf
PTT
PATCH J1-13
VOICE ID J1-14
MCW ID J1-15 TO J4-6 TO J13-X
AUX RX COS LED
AUX RX COS EN J1-10
AUX RX COS ENABLE J1-11
AUX Rx COS J1-12
15TX ON LED
15TX DISABLE J1-16 TO J5-10
TX ON J1-D TO J7-6 J4-3
Q6 MPS-U51
Q5 2N4401
J1-18 SWITCHED A+
J1-19 LOCAL PTT (NOT TTL)
J1-20 +12
J1-1 +5
J1-22
.01
J1-17 MIC PTT
1-21-80 REV 1
WR1AFU
RPT BOARD # 1
DESIGNED BY
R. SWENTON WA1LMV
C. CAYER WA1SZU
10-31-79 / REV-0

15 Logic System

Repeat Board #2: Reset Delay/Voice ID Control

This board contains two Reset Delay Timers. One is for the 75 Input, the other is for the 525 Input. Their function is to keep the time-out timers running for an extra amount of time after the input signal is removed. That amount of time is set by R1 for 75 and R2 for 525. The time is usually set for one second. These timers allow for uninterrupted operation of the time-out timers even when mobiles chop the input. The chopped signal must disappear for the time set by the adjustments in order to reset the time-out timer. This also discourages stations from picking it up too soon as they are running on "borrowed time".

This board also contains the DTMF Mute gating circuitry which causes audio muting of Touchtones at specific times.

The Voice ID Control consists of a counter which counts the number of times the 15 TX goes off. After the eighth time the 15 TX goes back on, the Voice ID Ready LED will light. The next time the 15 TX goes off, the Voice ID tape will start, the counter will reset to zero and the Voice ID Run LED will light. The 15 TX will be keyed for the duration of the ID. Should there be a malfunction such as a tape breakage, the PTT Limit Timer will not allow the 15 TX to be keyed longer than 30 seconds. If this timer times out, the Voice ID Tape Failure LED will light and the 15 TX can no longer be keyed by the Voice ID circuitry until the tape malfunction is manually corrected.

The Insurance City Repeater Club

DESIGNED AND BUILT
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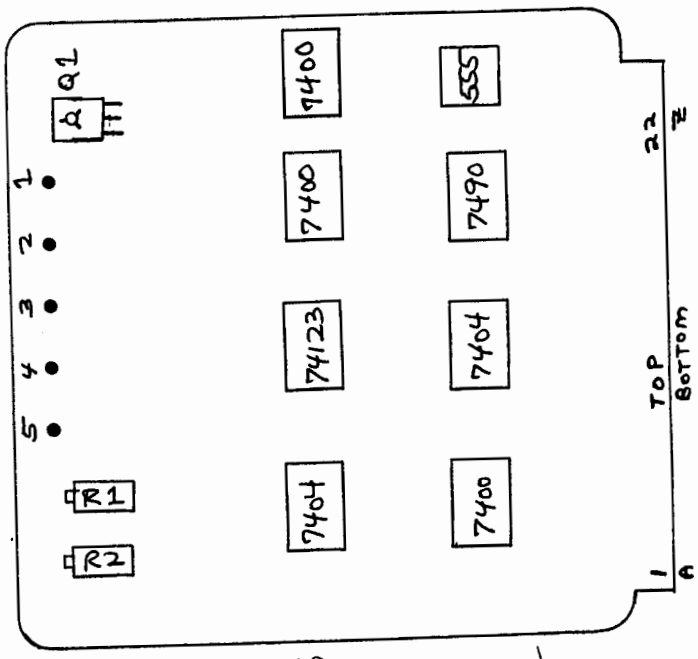
Cliff Cayer WA1SZU
12-1-80



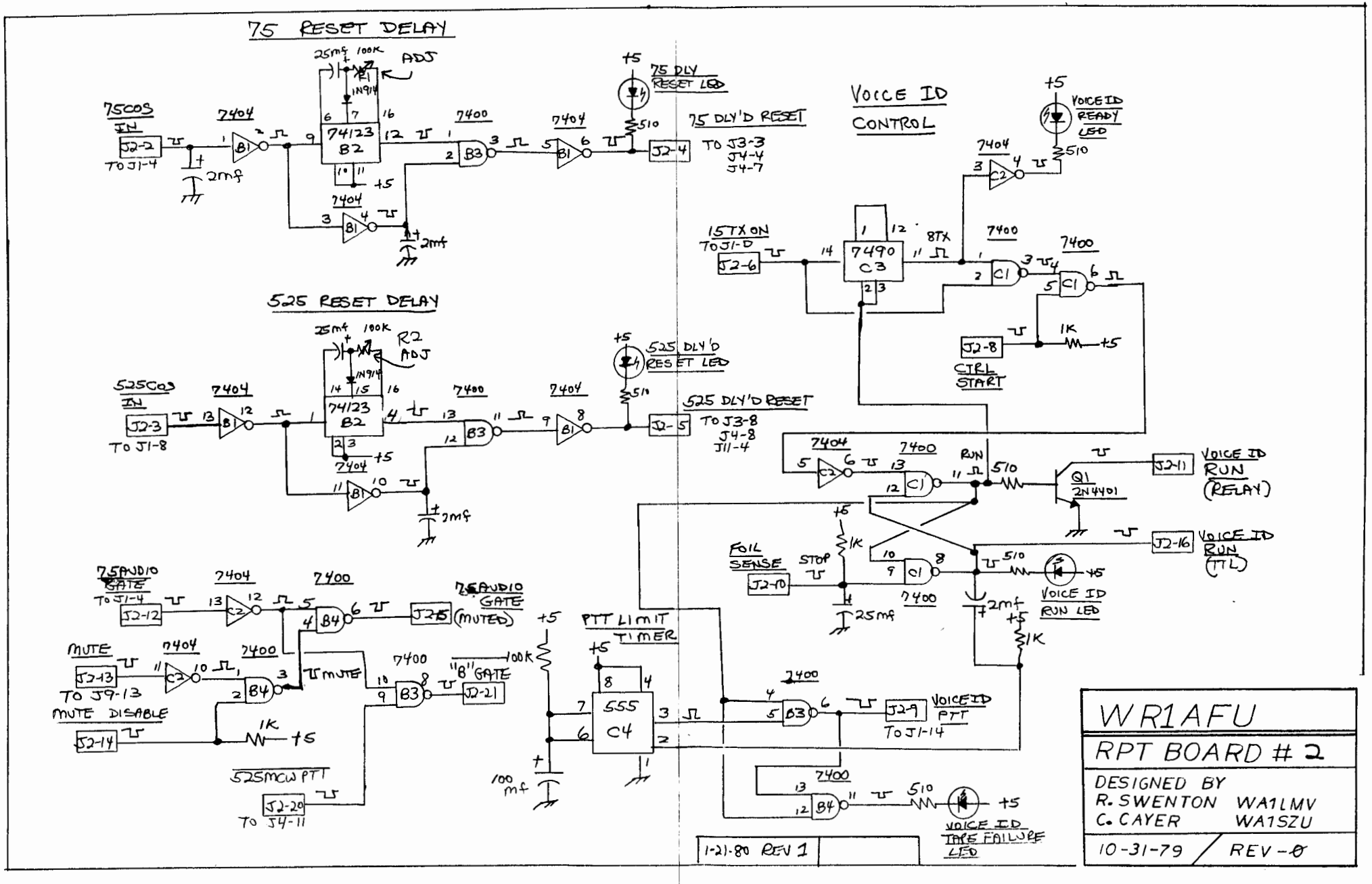
R1 - 75 COS RESET DELAY ADJ
R2 - 525 COS RESET DELAY ADJ

LED's
1 - 75 RESET DLY
2 - 525 " "
3 - VOICE ID READY
4 - " " RUN
5 - " " INHIBIT TAPE FAILURE

AFU BOARD #2
RESET DELAY
VOICE ID CONTROL

PICTORIAL

WA1LMV
10-79


75 RESET DELAY
25mf 100K
R1
ADJ
1N914
75 DLY RESET LED
510
+5
75COS IN
J2-2
TO J1-4
7404
74123 B2
7400
7404
75 DLY'D RESET
TO J3-3 J4-4 J4-7
J2-4
2mf
525 RESET DELAY
R2 ADJ
525COS IN
J2-3
TO J1-8
525 DLY'D RESET LED
525 DLY'D RESET
TO J3-8 J4-8 J11-4
J2-5
VOICE ID CONTROL
VOICE ID READY LED
15TX ON
TO J1-D
J2-6
7490 C3
8TX
J2-8
CTRL START
1K
RUN
Q1 2N4401
J2-11
VOICE ID RUN (RELAY)
J2-16
VOICE ID RUN (TTL)
VOICE ID RUN LED
FOIL SENSE
J2-10
STOP
25mf
75AUDIO GATE
TO J1-4
J2-12
75AUDIO GATE (MUTED)
J2-5
MUTE
J2-13
TO J9-13
MUTE DISABLE
J2-14
MUTE
"8" GATE
J2-21
100K
PTT LIMIT TIMER
555 C4
100 mf
VOICE ID PTT
J2-9
TO J1-14
525MCW PTT
J2-20
TO J4-11
VOICE ID TAPE FAILURE LED
1-21-80 REV 1
WR1AFU
RPT BOARD # 2
DESIGNED BY
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C. CAYER WA1SZU
10-31-79 / REV-0

15 Logic System

Repeat Board #3: Time-Out Timers

This board contains seperate time-out timers for the 75 and 525 inputs. The Timing LED's for each timer will flash when the timer is running. The Timed-Out LED's will light when the timer times-out. The 15TX will cease five seconds later. During the five second period, the Time-Out Alarm (generated on Repeat Board #11) will sound. Two signals will cause the 75 Time-Out Timer to be reset and inhibited: 1) If a RTTY signal appears on the 75 RX, or 2) if a Control Input is received. Two signals will cause the 525 Time-Out Timer to be reset and Inhibited: 1) If the 75 RX COS signal is received , or 2) if the 525 Timer Reset and Inhibit Signal is received.

If a station on 525 times-out the repeater, all that is necessary to restore the repeater is that a station on the 75 Input key-up. The 75 COS will reset the 525 Time-Out Timer.

Also present on this board is the 525 TX Delay Select Logic. The function of this circuit is to select which of two signals will key the 525 TX when the Link is enabled.

When the 15 TX is off, the 525 TX will be keyed with the Master COS signal. When the 15 TX is on, the 525 TX will be keyed with the 75 COS Audio Gate Signal. The Master COS signal comes from the Input Access Delay on Repeat Board #1. The Master COS will result in a one second delay between the time a signal appears on the 75 Input and the time the Master COS signal goes low. This will prevent both the 15 TX and the 525 TX from being keyed by random noise or "kerchunkers". However, if the Master COS signal was used to key the 525 TX during an exchange of transmissions, the Input Access Delay would cause the first syllable of each transmission to be cut off. This is why the 75 Audio Gate signal is used to key the 525 TX when the 15 TX is on. This will result in only the first syllable of the first transmission to be cut off. All subsequent transmissions will be normal because the 15 TX will not shut down between transmissions.

DESIGNED AND BUILT
BY
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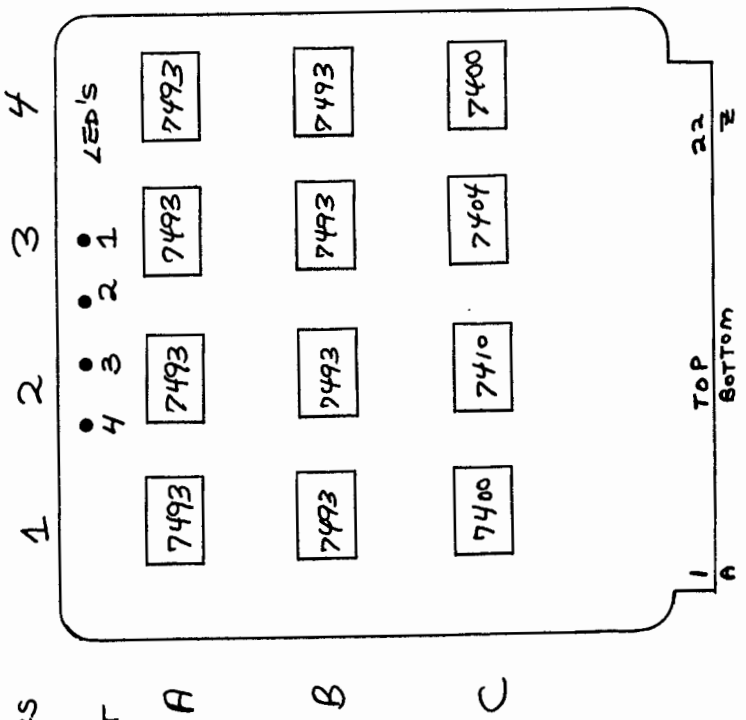
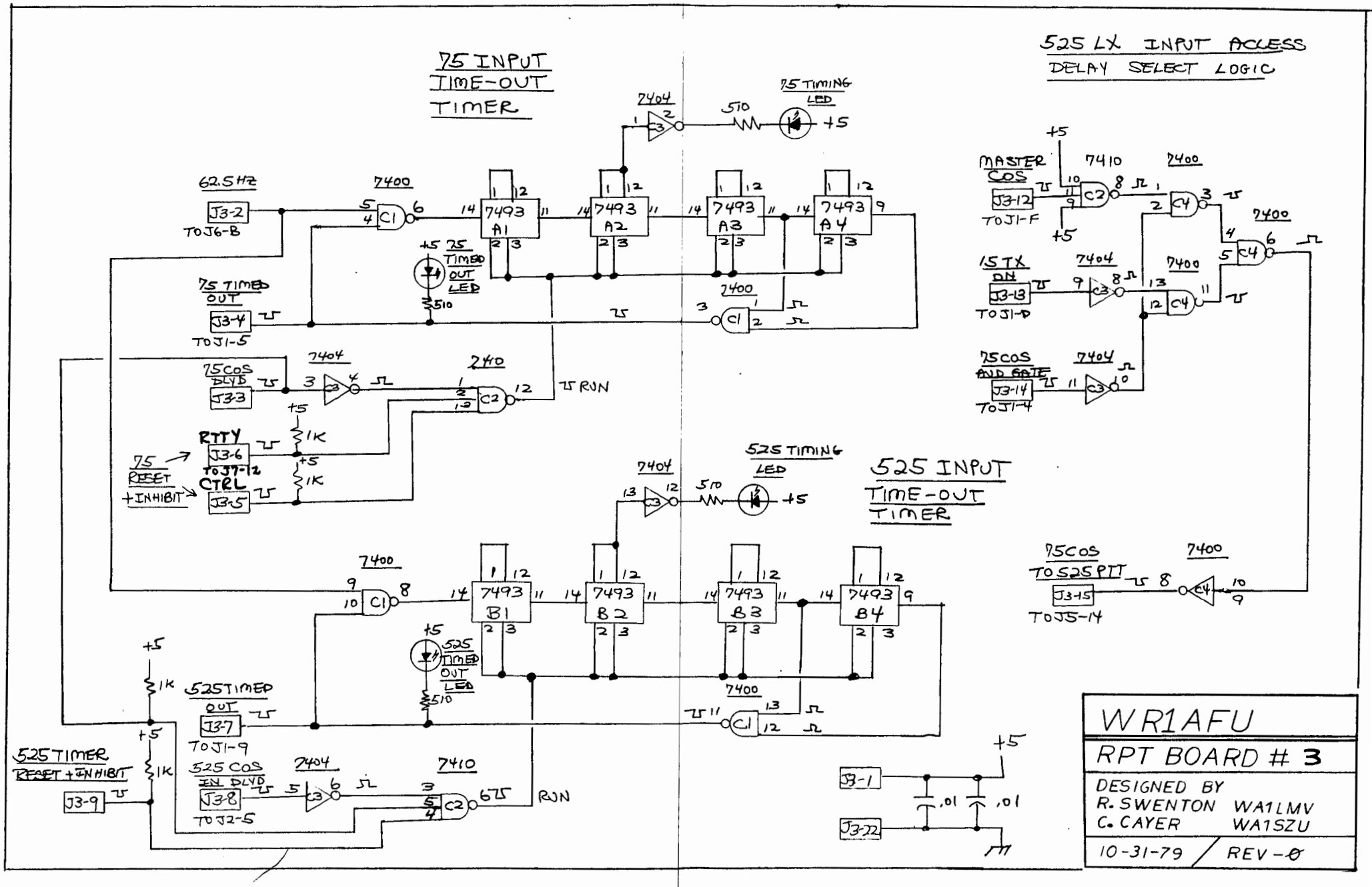


TIMER
AFU BOARD #3
SHEET 1 OF 1

PICTORIAL WA1LMV
10-79


75 INPUT TIME-OUT TIMER
525 LX INPUT ACCESS DELAY SELECT LOGIC
525 INPUT TIME-OUT TIMER
62.5HZ
J3-2
TO J6-B
7400
7493 A1
7493 A2
7493 A3
7493 A4
7493 B1
7493 B2
7493 B3
7493 B4
7404
7410
2400
510
+5
75 TIMING LED
75 TIMED OUT LED
75 TIMED OUT
J3-4
TO J1-5
75 RUN
75 COS DLYD
J3-3
RTTY
J3-6
TO J7-12
75 RESET +INHIBIT CTRL
J3-5
1K
525 TIMING LED
525 TIMED OUT LED
525 TIMED OUT
J3-7
TO J1-9
525 RUN
525 TIMER RESET +INHIBIT
J3-9
525 COS IN DLYD
J3-8
TO J2-5
MASTER COS
J3-12
TO J1-F
15 TX DN
J3-13
TO J1-D
75 COS AND GATE
J3-14
TO J1-4
75 COS TO 525 PTT
J3-15
TO J5-14
J3-1
J3-22
.01
.01
WR1AFU
RPT BOARD # 3
DESIGNED BY
R. SWENTON WA1LMV
C. CAYER WA1SZU
10-31-79 / REV-0

15 Logic System

Repeat Board #4: MCW ID Timers

This board contains seperate ID timers for 15 and 525. The 15 ID Start and the 525 ID Start come from this board. Both ID Start signals are "polite*" , that is, the ID Start signal waits for the station on the input to stop transmitting before it activates the MCW ID.

To start the 15 MCW ID, two signals must be present after the time-out: The 15 TX must be on and 2) The 75 COS must be off.

To start the 525 MCW ID, two signals must be present after the time-out: The 525 TX must be on and 2) A 75 COR Pulse must occur. The 75 COR pulse occurs when the 75 COR signal is removed from the Input.

The COR Pulse Generator provides the required pulse to activate the 525 MCW ID. The COR Pulse Generator is needed so that only the release of the 75 COS will cause a 525 ID. This keeps the 525 COS from causing a 525 ID. The COR Pulse Generator also provides the Link Tone Indicator announcing to the user that the Link RX or TX is enabled. The transistor on the C4 IC controls the length of the pulse. The pulse is short in length when only the receiver is on. The pulse is long in length when the LX TX is enabled. This gives a short tone when the RX is enabled and a long tone when both RX and TX are enabled.

The other half of C4 IC is used to generate a 525 MCW Polite ID when the 525 LX TX is disabled by the user station. This gives the final "sign-off" ID on 525.

Polite ID means that in order to cause the ID to occur, the receiver input must not be active. This means that the repeater outputs will never dual with another station using the frequency.

The Insurance City Repeater Club

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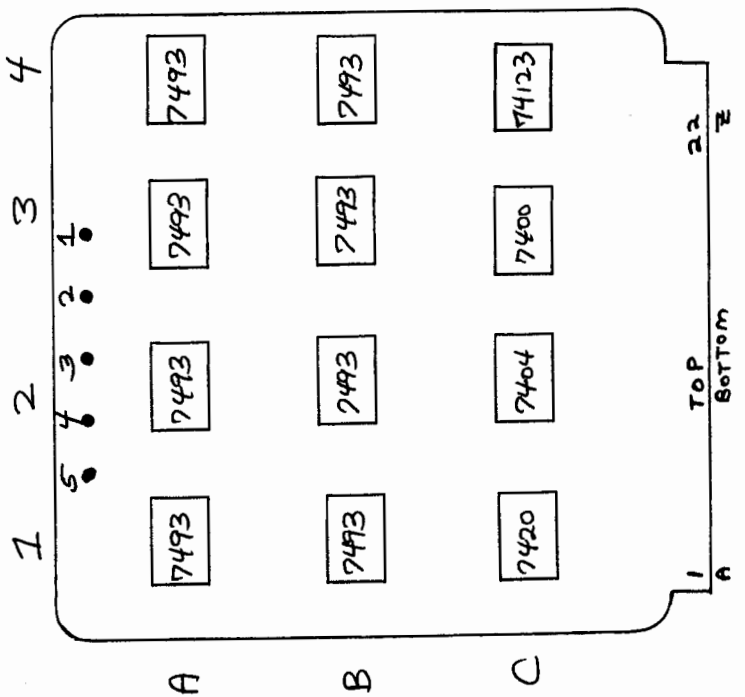
*Polite ID is a trademark of KlIIG/R, Avon, Ct.

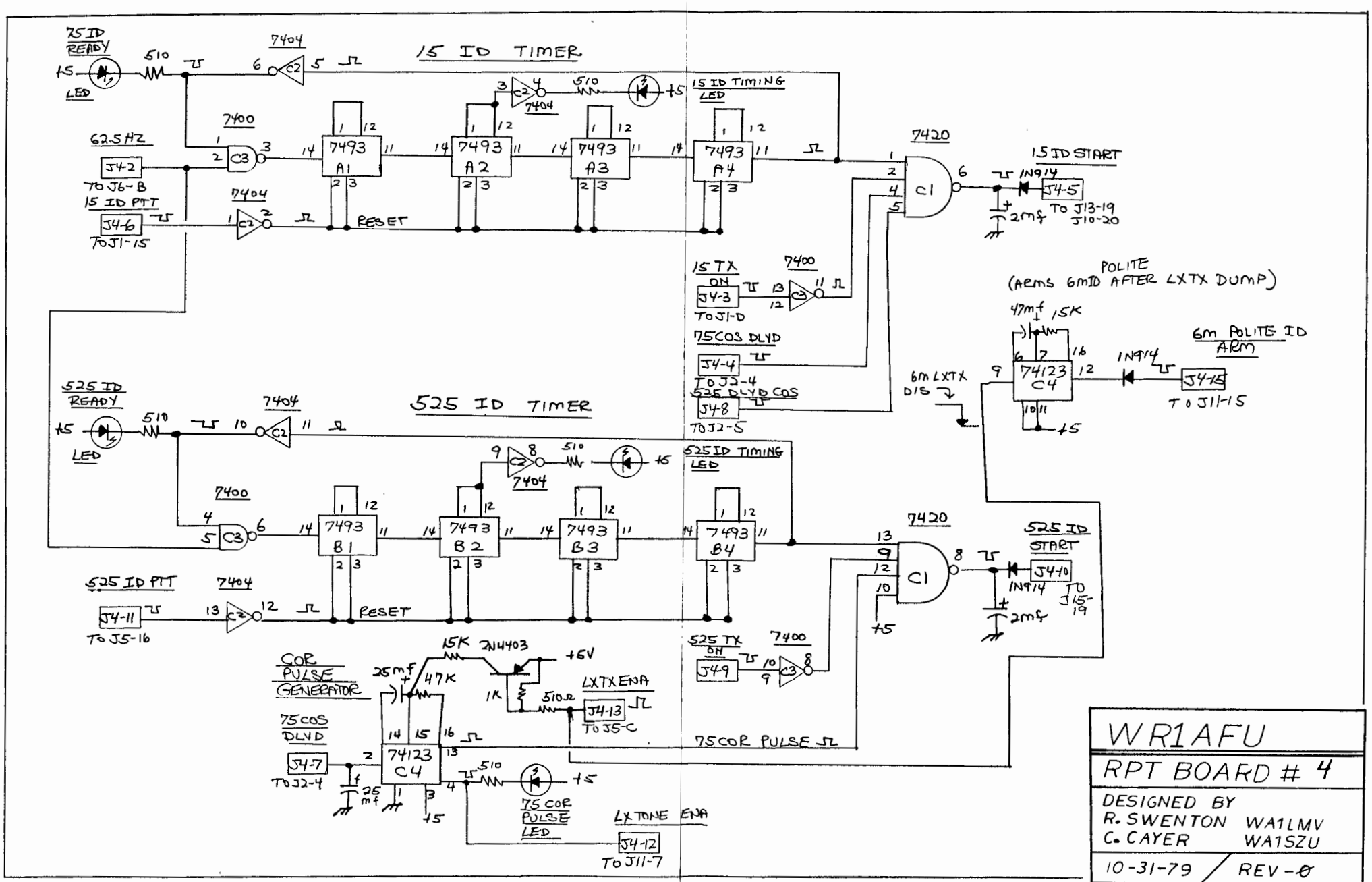


LED STATUS DISPLAY
1- 75 ID TIMING
2- 75 ID READY
3- 525 ID TIMING
4- 525 ID READY
5- 75 COS START PULSE FOR 525 ID

AFU BOARD #4
ID TIMERS

PICTORIAL

WA1LMV 10-79



WR1AFU

RPT BOARD # 4

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10-31-79 / REV-0

15 Logic System

Repeat Board #5: Six Meter Link Control

This board contains the required circuitry to control the six meter receiver and transmitter.

The # is the first digit of the two digit access code. When the # is received, the window timer provides a two second time limit to enter the second digit. The Window time is adjusted by R1. The window LED is lit whenever the # window is active. The sequence of #1 will access the 6M RX by setting the RX latch. The 525 RX ON LED will light. The sequence #2 will enable the 6M TX by setting the TX latch. The 525 TX LED will light.

There are two signals which will disable the #:
1) Patch on and 2) CTRL 15 TX off .
This means that when a patch is in progress, a speed dial number which may have the same digits as the access code of any other repeater accessory can not be accessed.
This also means that when the control system has disabled the 15 transmitter, none of the repeater accessories accessed with the # can be activated.

The CTRL LX DISABLE + DUMP signal will cause both RX and TX latches to be reset and will inhibit the digit 1. Since the RX latch has to be set in order to set the TX latch, this means that disabling the digit 1 will disbale the complete 6M LX.

The TX latch will be reset when the Patch is accessed or when either digit 5 or Ø are received. The RX latch will be reset when the digit Ø is received. The TX latch will be reset when a RTTY signal is detected in addition to the CTRL 15 TX OFF and CTRL LX DIS+DUMP signals. The RX latch will be reset when a RTTY signal is detected in addition to the CTRL LX DIS DUMP and CTRL 15 TX OFF signals.

The 525 TX will key up when a 75 COS signal is received provided that the 75 Input is not timed-out and the 525 COS is not active. The 525 TX Tail Time is controlled by the 525 TX Tail Timer and the Tail time is adjusted by R2, The 525 TX ON LED lights when the 525 TX is keyed.

The 525 TX Latch will be reset by the LXTX Auto-Off timer if the 75 input is unkeyed for six minutes.

DESIGNED AND BUILT BY
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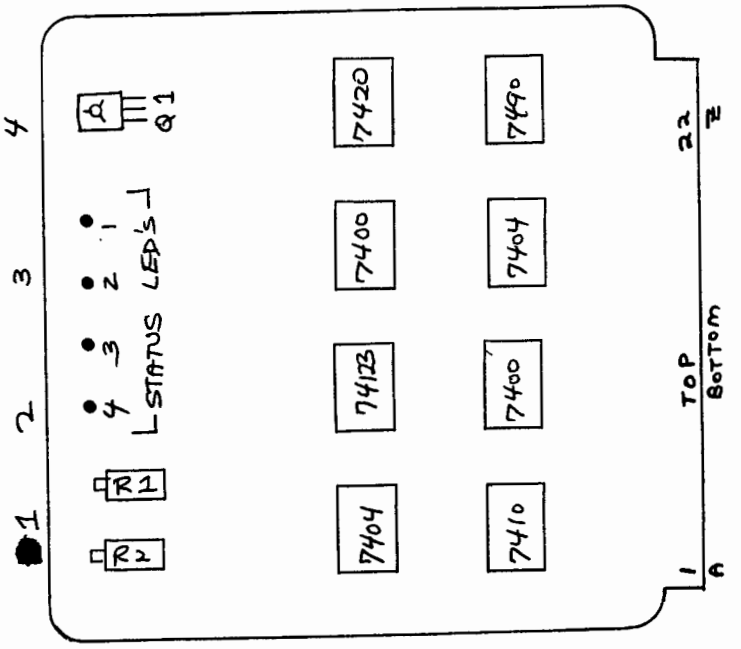
Cliff Cayer WA1SZU
12-1-80

The Insurance City Repeater Club



A

LED's
1 - WINDOW ENABLE
2 - 525 RX ENABLE
3 - 525TX ENABLE
4 - 525 TX ON

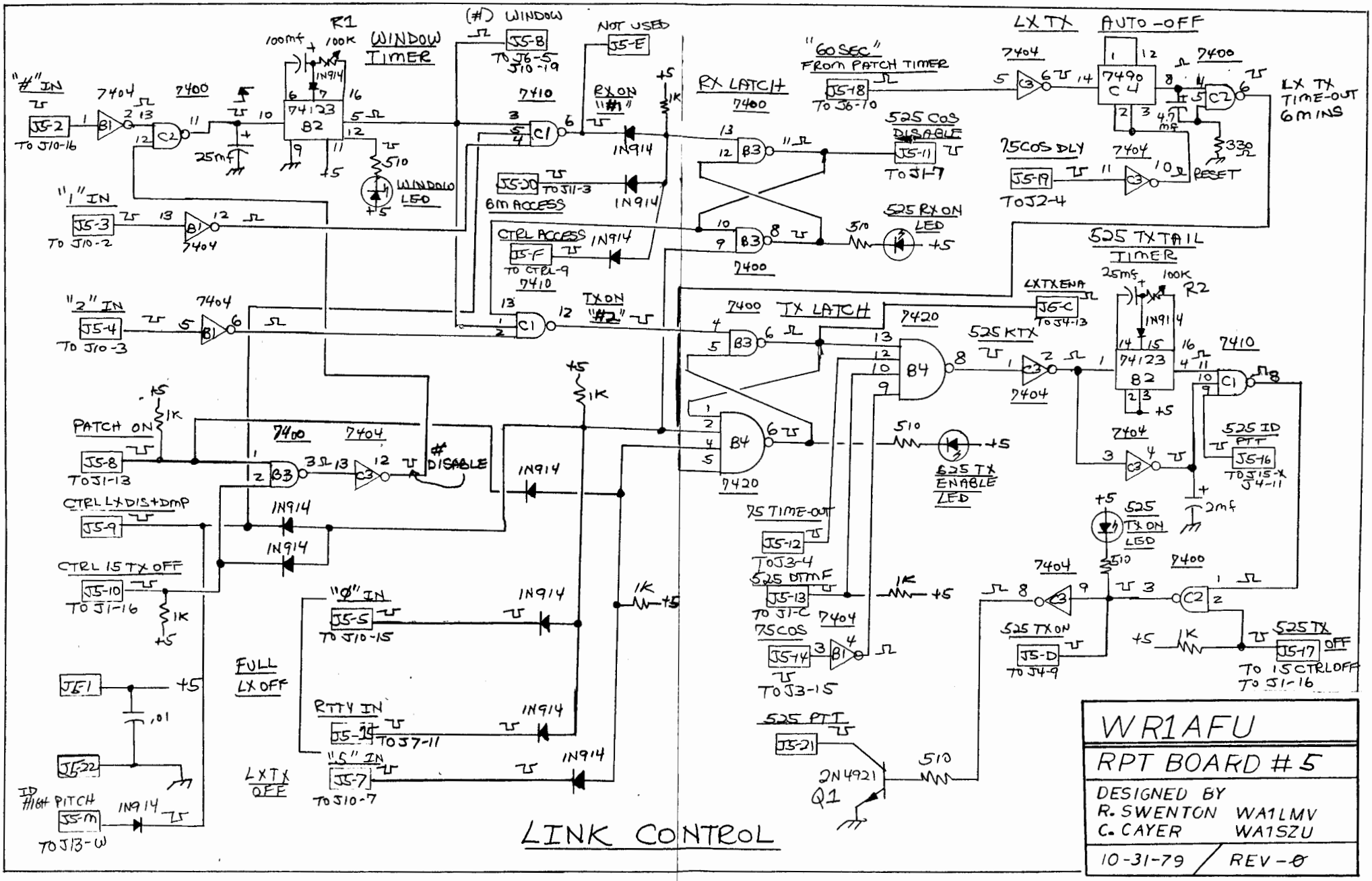
B

R1 - WINDOW TIME ADJ.
R2 - 525TX HANG TIME ADJ

C

AFU BOARD # 5
LINK CONTROL
PICTORIAL

WA1LMV
11-79


WINDOW TIMER
R1
100mf
100K
IN914
74123
82
25mf
510
WINDOW LED
(#) WINDOW
J5-B
TO J6-5
J10-19
NOT USED
J5-E
RX ON "#1"
IN914
RX LATCH
7400
7410
"#" IN
J5-2
TO J10-16
7404
7400
"1" IN
J5-3
TO J10-2
"2" IN
J5-4
TO J10-3
6m ACCESS
J5-D
TO J11-3
CTRL ACCESS
J5-F
TO CTRL-9
TX ON "#2"
PATCH ON
J5-8
TO J1-13
#DISABLE
CTRL LX DIS+DMP
J5-9
CTRL 15 TX OFF
J5-10
TO J1-16
1K
+5
"0" IN
J5-5
TO J10-15
FULL LX OFF
RTTY IN
J5-14
TO J7-11
"5" IN
J5-7
TO J10-7
LX TX OFF
JE1
.01
JE2
ID #/6# PITCH
J5-M
TO J13-W
"60 SEC" FROM PATCH TIMER
J5-18
TO J6-10
525 COS DISABLE
J5-11
TO J1-7
525 RX ON LED
75 COS DLY
J5-19
TO J2-4
LX TX AUTO-OFF
7490
C4
4.7mf
330
RESET
LX TX TIME-OUT 6 MINS
525 TX TAIL TIMER
25mf
100K
R2
LXTXENA
J6-C
TO J4-13
525 KTX
525 TX ENABLE LED
75 TIME-OUT
J5-12
TO J3-4
525 DTMF
J5-13
TO J1-C
75 COS
J5-14
TO J3-15
525 PTT
J5-21
2N4921
Q1
525 TX ON
J5-D
TO J4-9
525 ID PTT
J5-16
TO J15-X J4-11
525 TX ON LED
525 TX OFF
J5-17
TO 15 CTRL OFF
TO J1-16
LINK CONTROL
WR1AFU
RPT BOARD #5
DESIGNED BY
R. SWENTON WA1LMV
C. CAYER WA1SZU
10-31-79 / REV-0

15 Logic System

Repeat Board #6: Autopatch Control

This board contains the circuitry to control the autopatch.

The first digit (#) is derived from repeat board #5.
the second digit (7) will cause the patch to be activated after the digit is released. This will set the Patch Latch and light the Patch ON LED. The * will reset the Autopatch. The CTRL DUMP+DISABLE and the 15 CTRL TX OFF signals will also reset the Patch. The CTRL DISABLE+DUMP and 15 TX DISABLE will inhibit patch access when they are active. The CTRL DISABLE+DUMP will also set the MCW ID to high pitch.

Toll Restriction is accomplished by not permitting digit 1 to be the first digit dialed. When the Patch is accessed, the Toll Restrict LED is lit. If the next digit is a 1, that digit will cause the Patch to dump. If it is not a 1, then the Valid Digit signal will cause the Toll Restrict LED to go out and allow further digit 1's to be accepted without causing a Patch Dump.

There is a 65 second limit timer which will cause a patch dump if the 75 input is not keyed at least every 65 seconds. The Timing LED will flash when the 65 Second Timer is running and the Reset LED will light when the timer is reset.

Also present on this board is the Master Time Base. This circuit generates five different frequencies used as timing references and audio tones. A diagnostic Fast Clock Enable input is provided to speed-up the clock rate for troubleshooting purposes.

The Insurance City Repeater Club

DESIGNED AND BUILT
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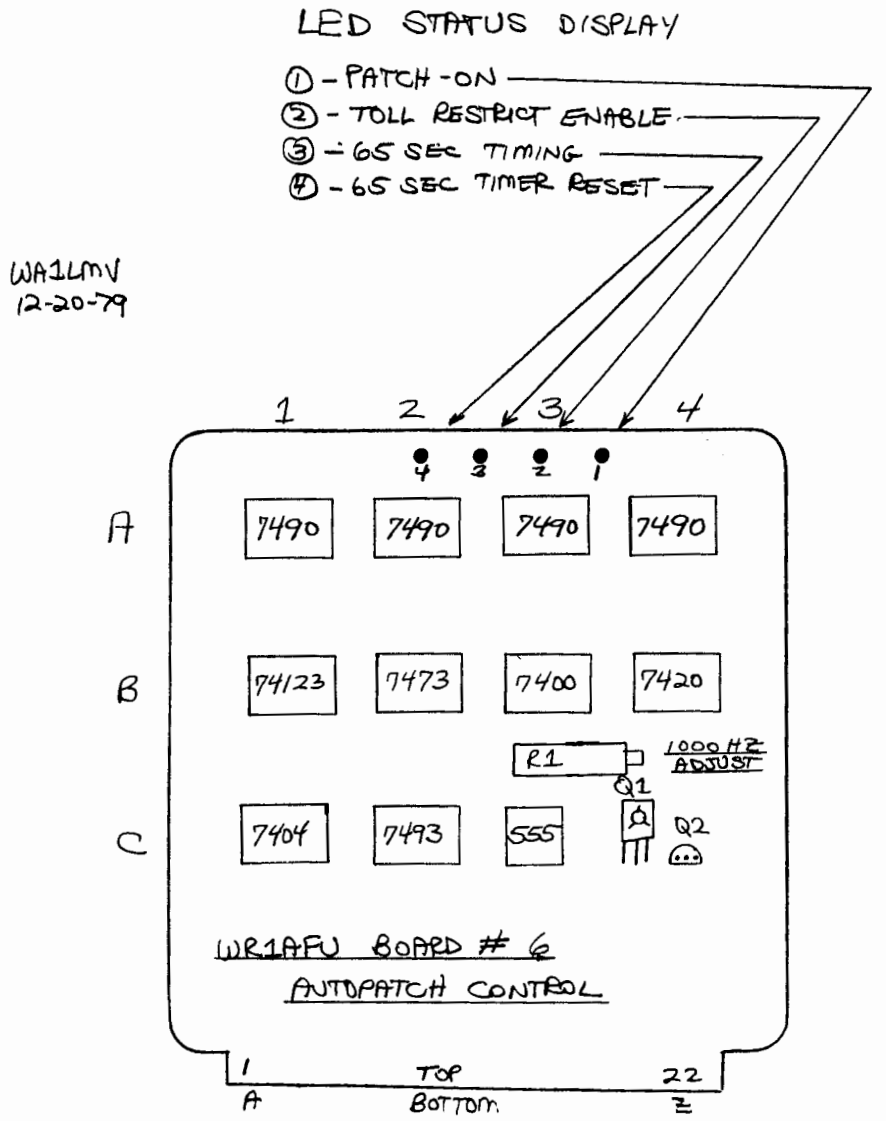
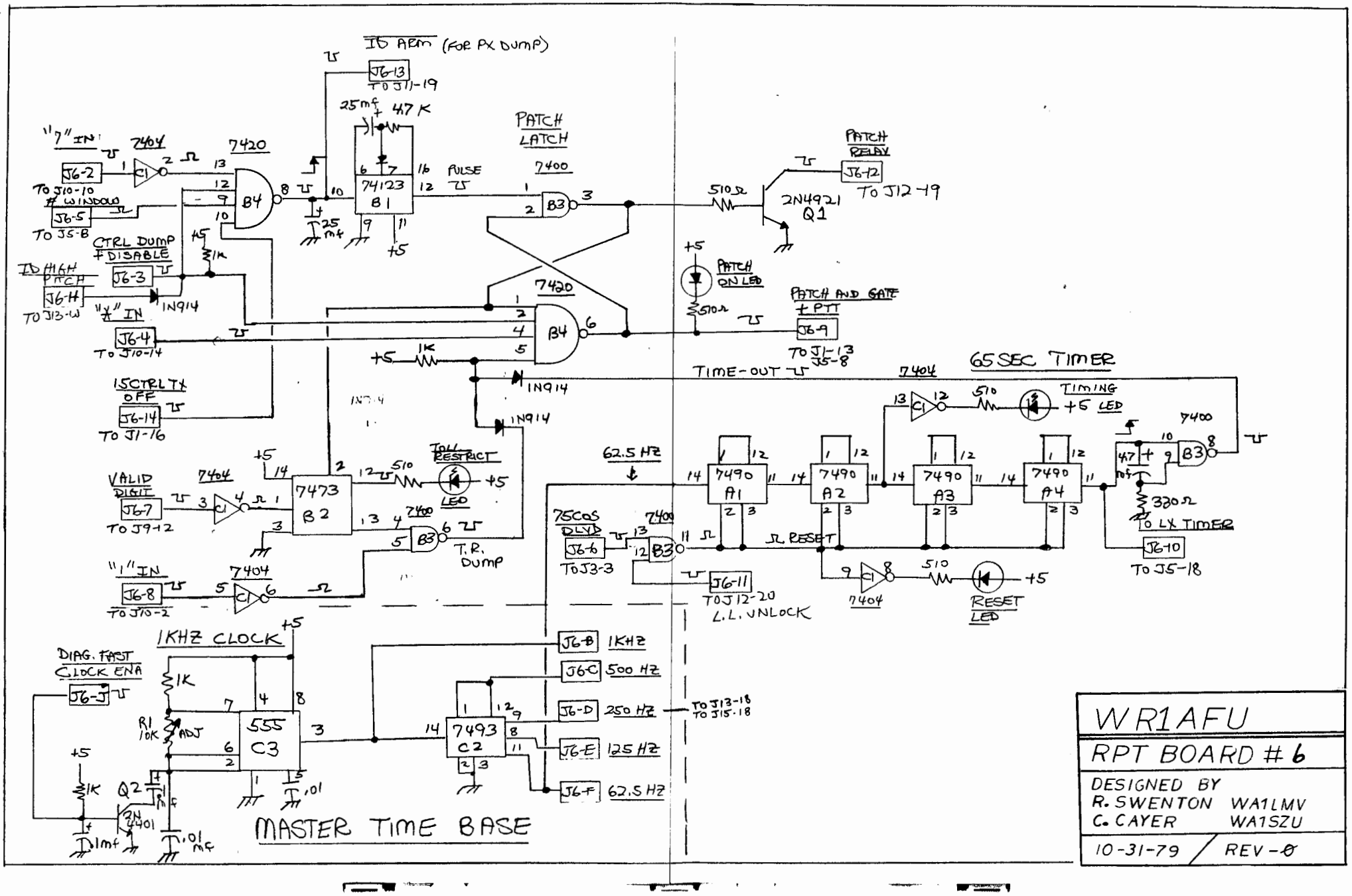
Cliff Cayer WA1SZU
12-1-80




ID ARM (FOR PX DUMP)
J6-13
TO J11-19
25mf
47K
PATCH LATCH
7400
"7" IN
7404
7420
J6-2
TO J10-10 # WINDOW
J6-5
TO J5-8
74123 B1
PULSE
510Ω
2N4921 Q1
PATCH RELAY
J6-12
TO J12-19
CTRL DUMP + DISABLE
J6-3
ID HIGH PATCH
J6-H
TO J13-W
1N914
"X" IN
J6-4
TO J10-14
PATCH ON LED
PATCH AND GATE + PTT
J6-9
TO J13-J5-8
65 SEC TIMER
TIME-OUT
TIMING +5 LED
15 CTRL TX OFF
J6-14
TO J1-16
7473 B2
TOT RESTRICT
LED
VALID DIGIT
J6-7
TO J9-12
T.R. DUMP
"1" IN
J6-8
TO J10-2
62.5 HZ
7490 A1
7490 A2
7490 A3
7490 A4
7505 DLYD
J6-6
TO J3-3
J6-11
TO J12-20
L.L. UNLOCK
RESET
RESET LED
330Ω
TO LX TIMER
J6-10
TO J5-18
1KHZ CLOCK
DIAG. FAST CLOCK ENA
J6-J
555 C3
R1 10K ADJ
Q2 2N2401
7493 C2
J6-B 1KHZ
J6-C 500 HZ
J6-D 250 HZ
TO J13-18
TO J15-18
J6-E 125 HZ
J6-F 62.5 HZ
MASTER TIME BASE
WR1AFU
RPT BOARD #6
DESIGNED BY
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C. CAYER WA1SZU
10-31-79 / REV-0

15 Logic System

Repeat Board #7: Access Restrict/RTTY/Emergency Power

This board contains the Access Restrice circuitry which inhibits the digit # for the first five seconds of 75 COS activity. This five second period is the time when the user station should be giving the appropriate ID. If any valid touchtone signals appear during the first five seconds of 75 COS, the logic will assume that the transmission is unidentified and will inhibit the # for the duration of the touchtone signals. The five second period is adjusted with R3 and the Access Enable LED will light when a user station fulfills the access requirement of having no touchtones during the first five seconds of transmission.

Also on this board is the emergency power detector. A 12V filament transformer run from the 110VAC line feeds the EP Detector. When commercial AC is available, the EME PWR LED is not lit. When power fails, the EME PWR LED lights and the circuit causes several things to happen on other boards:
The Long Message is enabled on the 15 MCW ID which sends the letters "EP" after the call sign. The Input Access Delay is shortened to about 50 MS. and the 15 TX Tail Time is shortened to about one second.

This board also contains the RTTY detector. When a RTTY mark tone of 2125 HZ appears on the 75 input, the 2125 HZ Decoder will cause the RTTY LED to light and begin the RTTY Response Delay Timer. After a period of time set by R2 (usually 3 seconds) the RTTY Response Delay Timer will cause the Valid RTTY LED to light and set the Latch. This will light the Time-Out Inhibit LED and do several other things:
The 75 Input Time-Out Timer will be inhibited for the duration of this transmission. If the Six Meter link is up, the Valid RTTY signal will cause both 6M RX and TX to be dumped. When the 75 input is released, the Latch will reset and the Time-Out Inhibit LED will go out.

The Insurance City Repeater Club

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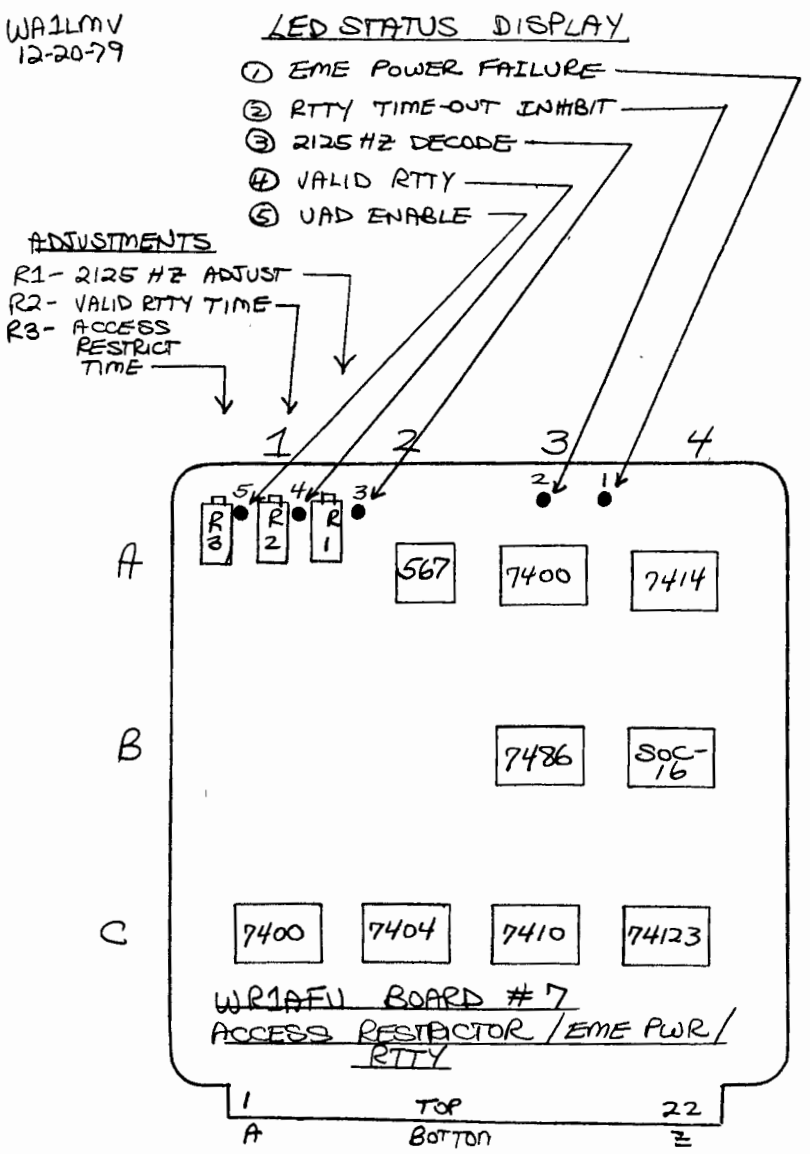
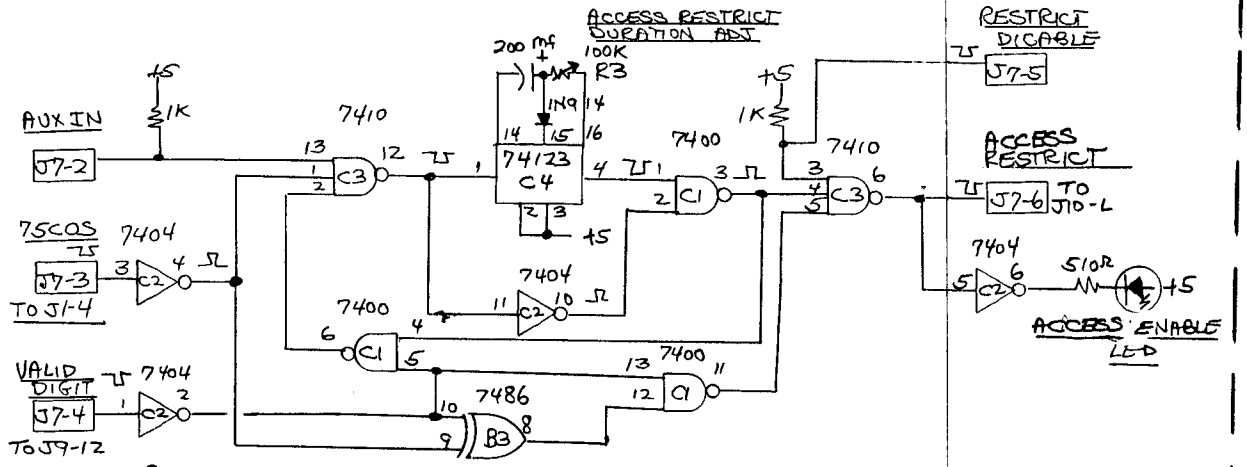
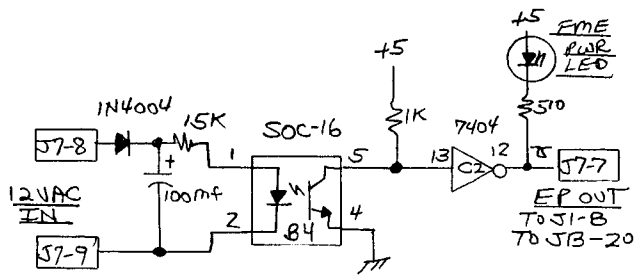
Cliff Cayer WA1SZU
12-1-80

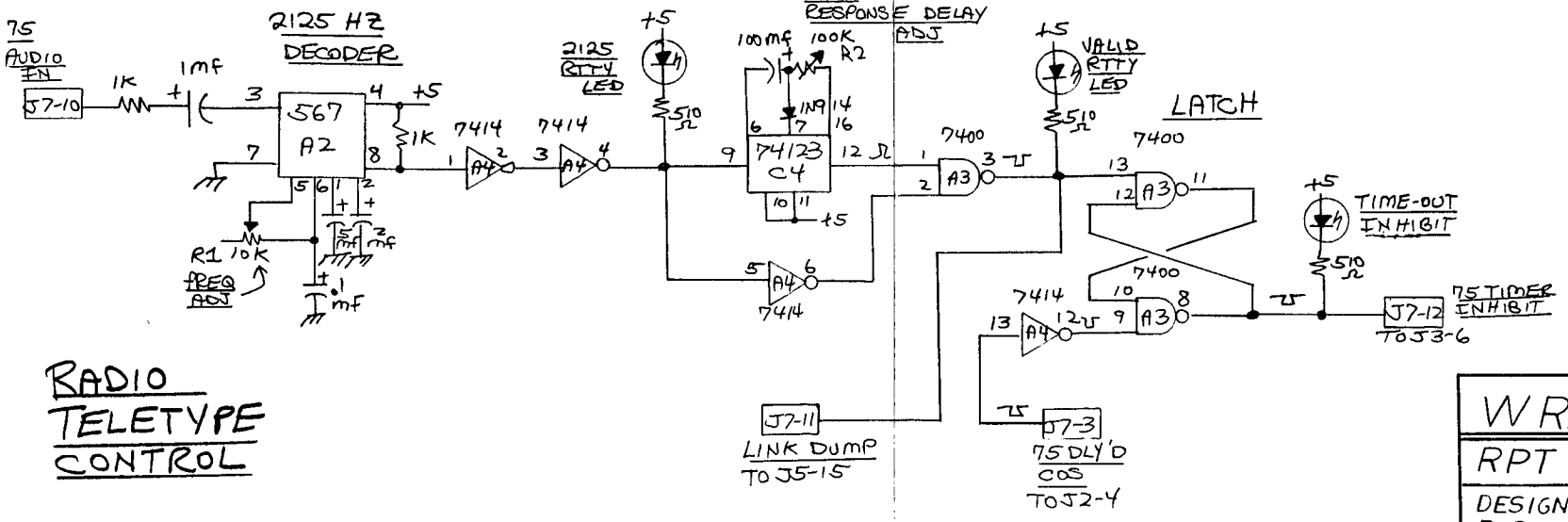




ACCESS RESTRICTOR



EMERGENCY POWER DETECTOR



RADIO TELETYPE CONTROL

WR1AFU	
RPT BOARD #7	
DESIGNED BY	
R. SWENTON	WA1LMV
C. CAYER	WA1SZU
10-31-79	REV-0

15 Logic System

WA1LMV
1-18-80

WR1AFU
BOARD #8
DTMF DECODER

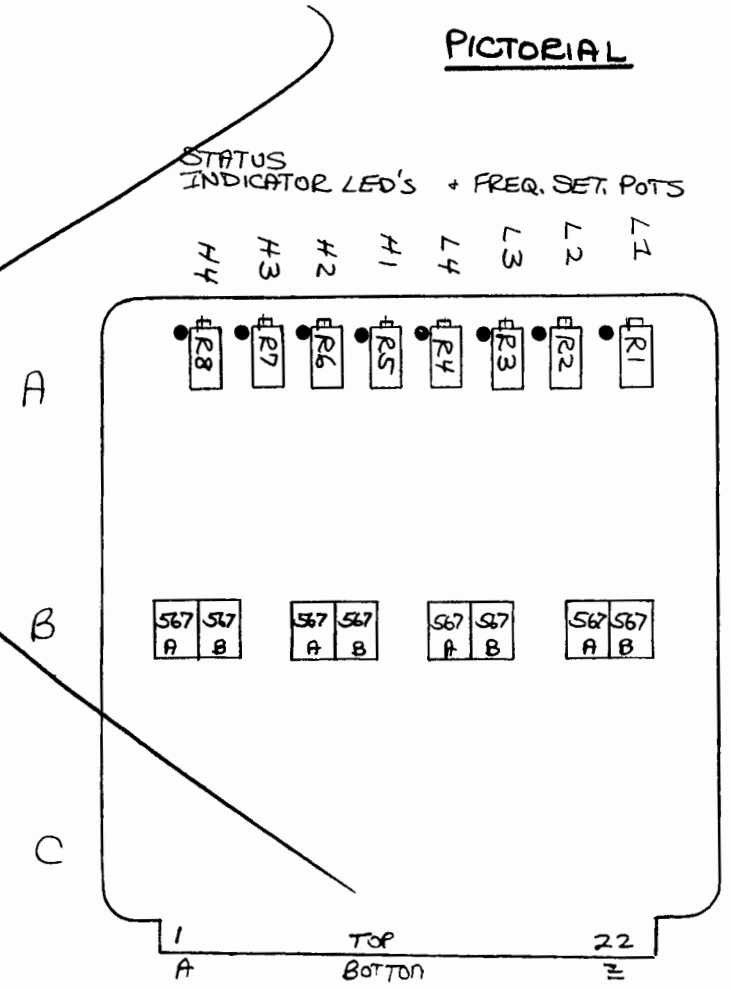
PICTORIAL

Repeat Board #8: DTMF

This board contains the eight tone decoders which are part of the DTMF Decoder (Touchtone Decoder). The eight individual 567 decoders are tuned to one of the eight frequencies which comprise the standard sixteen digit touchtone format. Eight LED status indicators are provided which simplify the tuning proceedure. Use the following table when tuning the decoder:

Tone	Freq.	Resistor
L1	697 Hz.	R1
L2	770 Hz.	R2
L3	852 Hz.	R3
L4	941 Hz.	R4
H1	1209 Hz.	R5
H2	1336 Hz.	R6
H3	1477 Hz.	R7
H4	1633 Hz.	R8

The circuit is divided into two sections: One for the Low Frequency Group of tones and one for the High Frequency Group of tones. An LC passive band pass filter is used external to the board to provide the required Low/High Group splitting.



The Insurance City Repeater Club

DESIGNED AND BUILT
BY
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
12-1-80

REPEAT LOGIC BOARD #10
DTMF DECODER AND SECONDARY CONTROL

THIS BOARD CONTAINS THE DUAL-TONE MULTI-FREQUENCY (DTMF) DECODER AND SUPPORT CIRCUITRY. THE HEART OF THE DECODER IS THE TELTONE M-947 LSI CHIP (U9). IT IS CRYSTAL CONTROLLED (3.58 MHZ. COLOR BURST TV CRYSTAL) AND HAS NO ADJUSTMENTS. THE AUDIO INPUT CAN VARY OVER A WIDE RANGE. TYPICAL RMS AUDIO INPUT VOLTAGE IS 0.5V. THE M-947 POWER SUPPLY IS CRITICAL AND MUST NEVER BE ALLOWED TO EXCEED 13.8V. THIS IS WHY THERE ARE SEVERAL PRE-FILTERING COMPONENTS ON THE 12V INPUT LINE. THE OUTPUT OF THE M-947 IS IN BINARY AND IS CMOS COMPATIBLE. A CD 4049 (U5) IS USED TO CONVERT THE CMOS LOGIC LEVEL TO TTL. THE BINARY LINES ARE FED TO TWO FOUR TO SIXTEEN LINE DECODERS (U1 AND U2). THESE IC'S PROVIDE THE ACTUAL INDIVIDUAL OUTPUTS TO DRIVE THE REPEATER FUNCTIONS. U1 PROVIDES OUTPUT DURING USER FUNCTIONS AND U2 PROVIDES OUTPUT DURING CONTROL FUNCTIONS. THE USER DIGITS # AND C ARE GATED BY THE ACCESS RESTRICT SIGNAL ON J10-L THROUGH U4. THIS MEANS THAT YOU CAN NOT ACCESS ANY FUNCTION BEGINNING WITH A # OR C UNLESS YOU PROPERLY IDENTIFY.

THE REPEATER AUDIO IS MUTED WHENEVER THE DIGITS # OR C ARE RECEIVED. THE MUTE DURATION TIMER (U7B) IS TRIGGERED BY EITHER OF THESE DIGITS. MUTE IS EXTENDED DURING CONTROL FUNCTIONS BY THE CTRL WINDOW SIGNAL COMMING IN ON U11 PIN 5. THIS IS BECAUSE THE CONTROL WINDOW IS LONGER THAN THE MUTE DURATION AND THIS WILL FORCE MUTING OF THE CONTROL DIGITS FOLLOWING THE DIGIT C.

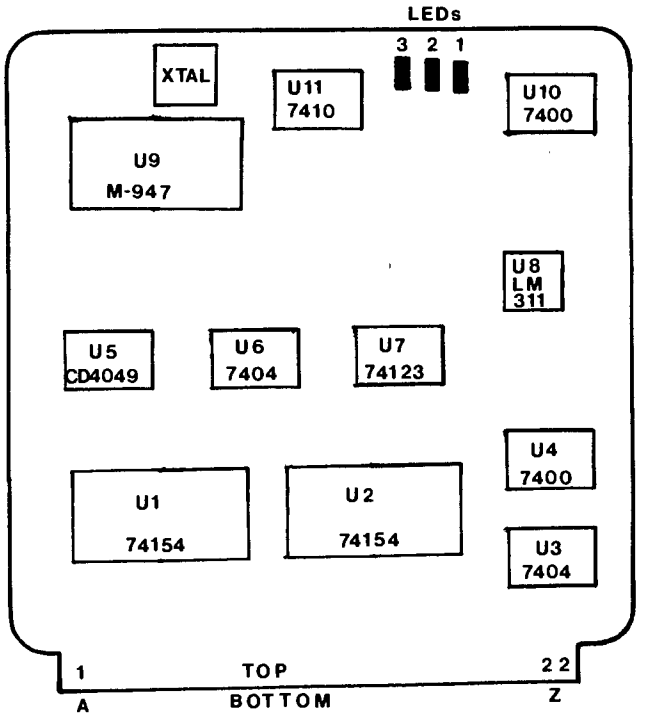
THE CONTROL MODE IS ENTERED WHEN ACCESS RESTRICTED DIGIT C TRIGGERS THE CONTROL DURATION TIMER U7A. WHEN THE NEXT DIGIT IS ENTERED (DIGIT 7), U10 PIN 3 WILL TRIGGER THE ONE-SHOT (U10 PINS 4-5) WHICH WILL PULSE THE CONTROL LATCH AND UNLOCK THE CONTROL MODE. THIS LATCH WILL DISABLE THE USER DECODER U1 AND ENABLE THE CONTROL DECODER U2 BUT ONLY AFTER THE SEQUENCE C7 IS RECEIVED. (THE DIGITS C AND 7 ARE ACTUALLY USER DIGITS RECEIVED FROM THE USER DECODER U1). ONCE THE CONTROL MODE IS ENTERED, U2 WILL OUTPUT TO THE UHF CONTROL BOARD THE COMMAND SENT BY THE CONTROL STATION ON THE 75 INPUT. AFTER THREE SECONDS, THE CONTROL DURATION TIMER (U7A) WILL TIME-OUT. THIS WILL RESET THE CONTROL LATCH AND RESTORE THE DECODER TO THE USER MODE.

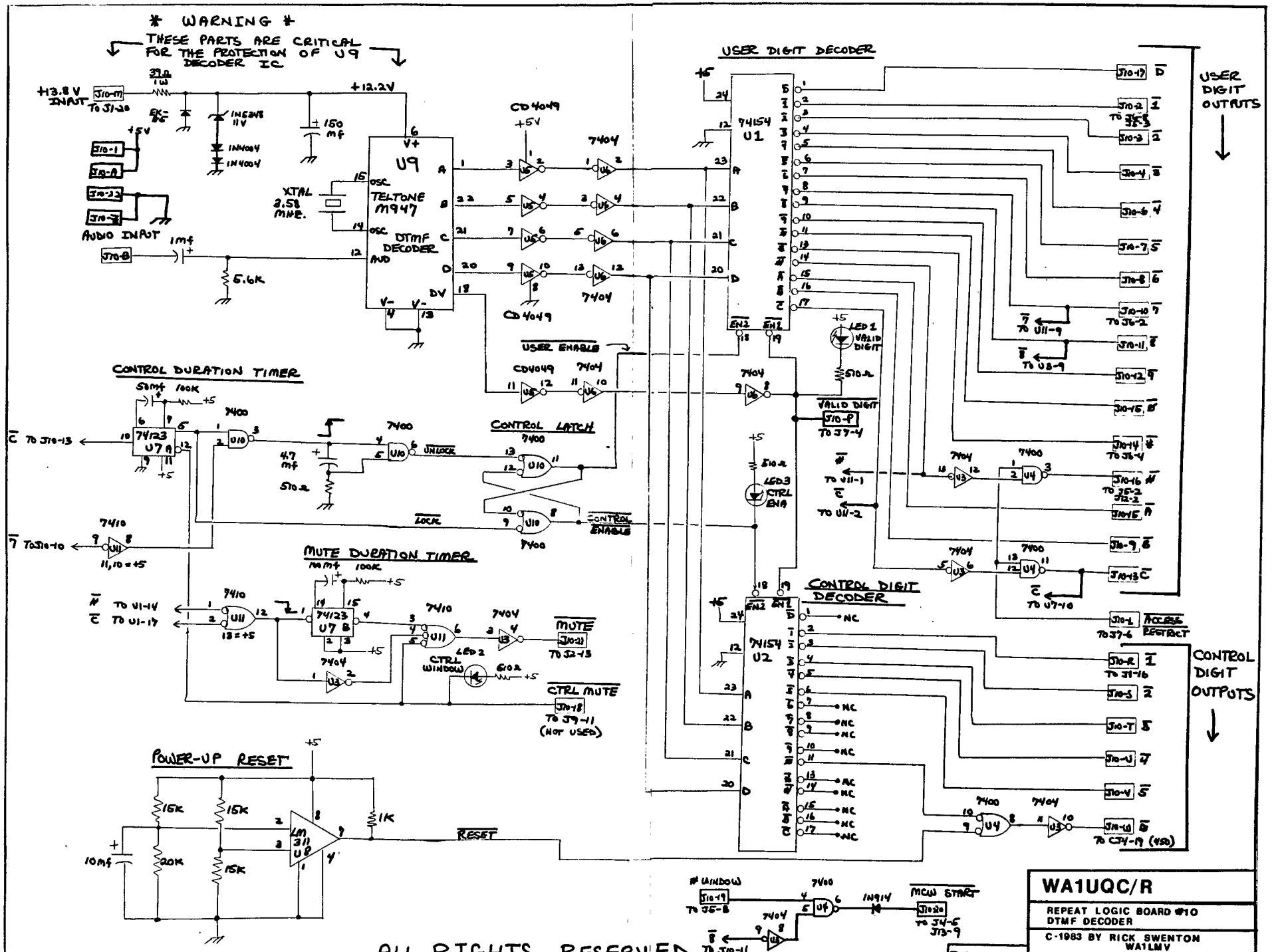
THE POWER-UP RESET CIRCUIT (U8) WILL PULSE LOW ON PIN 7 UPON INITIAL APPLICATION OF POWER OR UPON DETECTING ANY TRANSIENTS OR POWER FLUCTUATIONS. THE POWER-UP RESET SIGNAL IS OR'ED WITH CONTROL DIGIT ZERO SO THAT THE CONTROL SYSTEM WILL BE RESET WHENEVER POWER-UP RESET OCCURS. THIS WAS ADDED BECAUSE THE ORIGINAL LOGIC WAS DESIGED TO BE RUN WITH BATTERY BACK-UP. NOW, WITHOUT THE BATTERIES, POWER FLUCTUATIONS DISTURB THE 450 CONTROL LOGIC. THIS WILL RESTORE THE 450 CONTROL LOGIC WHENEVER POWER FLUCTUATIONS OCCUR.

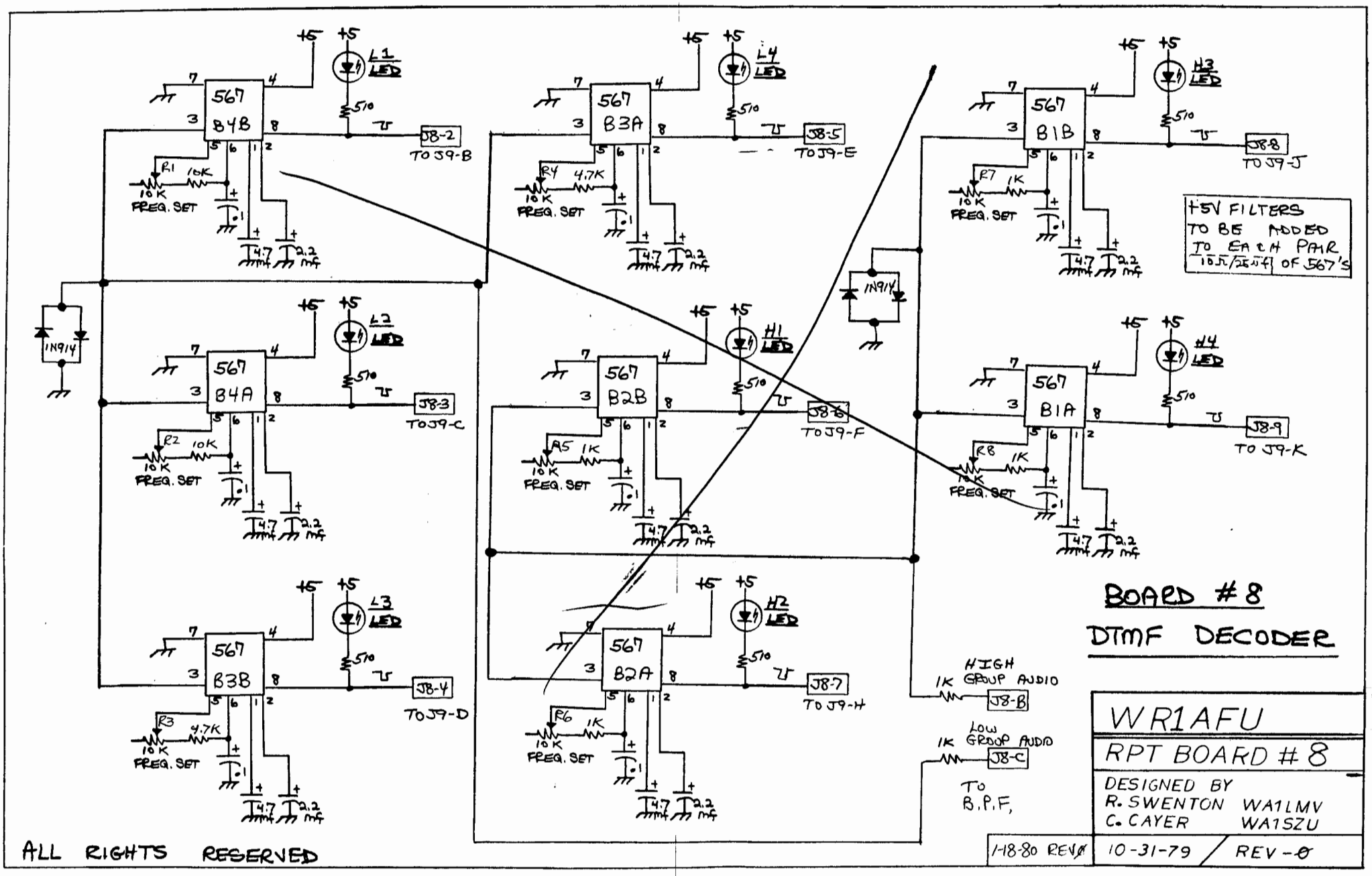
POWER REQUIREMENTS TO THE BOARD ARE +5V REGULATED AND +13.8V REGULATED

THIS ONE CIRCUIT BOARD REPLACES THE OLD THREE BOARD DTMF DECODER WHICH PREVIOUSLY OCCUPIED SLOTS 8,9 AND 10. SLOTS 8 AND 9 MAY STILL HAVE MUCH OF THE PRIOR WIRING REMAINING ON THE LOGIC BACKPLANE EDGE CONNECTOR.

REPEAT LOGIC BOARD #10




* WARNING *
THESE PARTS ARE CRITICAL FOR THE PROTECTION OF U9 DECODER IC
+13.8 V IN/OUT
+12.2V
AUDIO IN/OUT
XTAL 3.58 MHz.
TELTONE M947
DTMF DECODER
U9
74154 U1
USER DIGIT DECODER
USER DIGIT OUTPUTS
CD4049
7404
USER ENABLE
CONTROL DURATION TIMER
74123 U7A
CONTROL LATCH
VALID DIGIT
LED1 VALID DIGIT
LED3 CTRL ENA
CONTROL ENABLE
LOCK
UNLOCK
MUTE DURATION TIMER
74123 U7B
MUTE
CTRL MUTE
LED2 CTRL WINDOW
74154 U2
CONTROL DIGIT DECODER
CONTROL DIGIT OUTPUTS
ACCESS RESTRICT
POWER-UP RESET
LM 311 U8
RESET
WINDOW
MCW START
1N914
WA1UQC/R
REPEAT LOGIC BOARD #10
DTMF DECODER
C-1983 BY RICK SWENTON
WA1LMV
REV B 9-8-83
ALL RIGHTS RESERVED



15 Logic System

WA1LMV
1-18-80

WR1AFU
BOARD #9
VALID DIGIT
RECOGNIZER

PICTORIAL

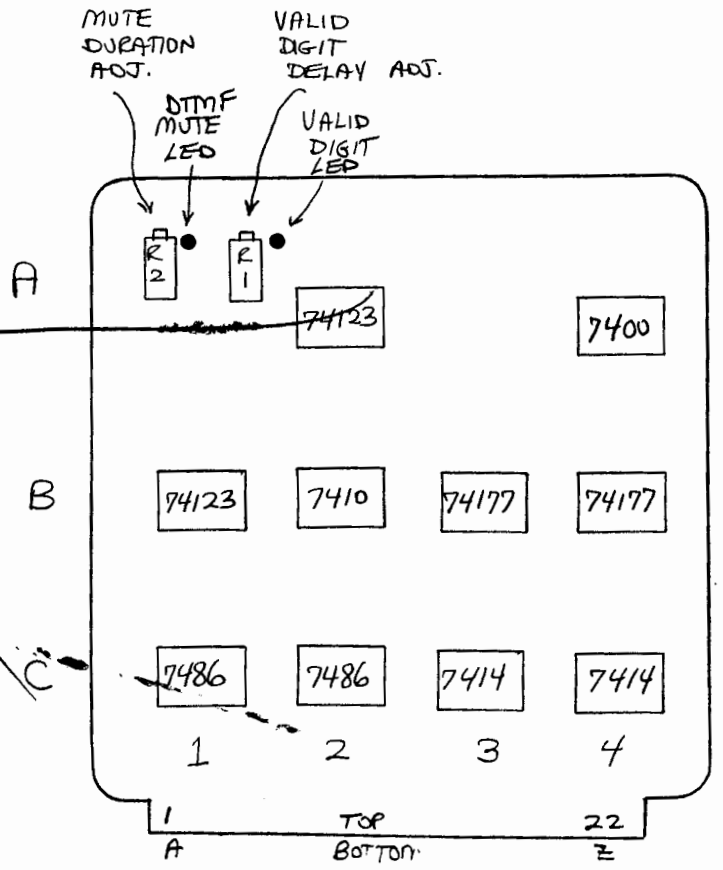
Repeat Board #9: TAF

This board contains the circuitry used to validate the decoded signals which come from Board #8. The 567 decoders on Board #8 will false on voice and noise. This board #9 will examine the data and determine whether to accept or reject it based on certain parameters.

1) There must be only one tone present from the high group and only one tone present from the low group.
2) The pair of tones must be present without interruption for the time duration set by R1, Valid Digit Delay Adjust.

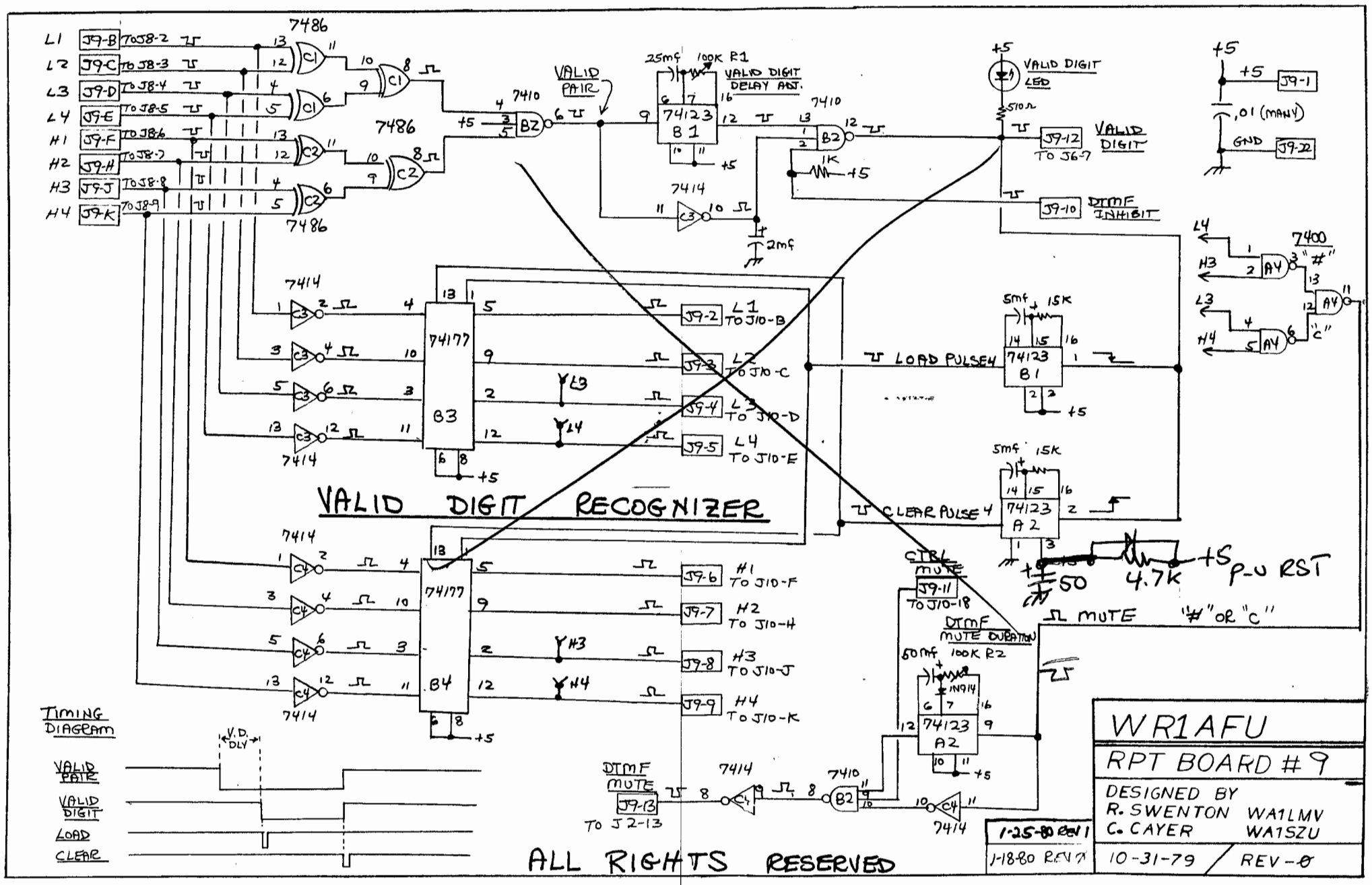
Satisfying both requirements will cause the Valid Digit LED to light. This will cause a load pulse to appear on the two latches which will "memorize" the decoded digit. Release of the digit will cause the Valid Digit LED to go out causing a clear pulse at the two latches.

Also present on this board is a seperate provision for decoding the digit # and the digit C. Either of these two digits will cause audio muting. The mute duration is set by R2 and the Mute LED will be lit when this board is causing a Mute signal.



The Insurance City Repeater Club

DESIGNED AND BUILT
BY
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
12-1-80


VALID DIGIT RECOGNIZER
L1
L2
L3
L4
H1
H2
H3
H4
J9-B
J9-C
J9-D
J9-E
J9-F
J9-H
J9-J
J9-K
7486
7414
7410
7400
74177
74123
VALID PAIR
25mf 100K R1
VALID DIGIT DELAY ADJ.
VALID DIGIT LED
510Ω
1K
2mf
.01 (MANY)
GND
J9-1
J9-12
VALID DIGIT
TO J6-7
J9-10
DTMF INHIBIT
J9-2 L1 TO J10-B
J9-3 L2 TO J10-C
J9-4 L3 TO J10-D
J9-5 L4 TO J10-E
J9-6 H1 TO J10-F
J9-7 H2 TO J10-H
J9-8 H3 TO J10-J
J9-9 H4 TO J10-K
LOAD PULSE
CLEAR PULSE
5mf 15K
50 4.7k +5 P-U RST
CTRL MUTE
J9-11 TO J10-18
MUTE "#" OR "C"
DTMF MUTE DURATION
50mf 100K R2
1N914
DTMF MUTE
J9-13 TO J2-13
TIMING DIAGRAM
V.D. DLY
VALID PAIR
VALID DIGIT
LOAD
CLEAR
ALL RIGHTS RESERVED
WR1AFU
RPT BOARD #9
DESIGNED BY
R. SWENTON WA1LMV
C. CAYER WA1SZU
1-25-80 REV 1
1-18-80 REV A
10-31-79 / REV-0

WR1AFU
BOARD # 10
USER ACCESS
DECODE

WA1LMV
1-18-80

15 Logic System

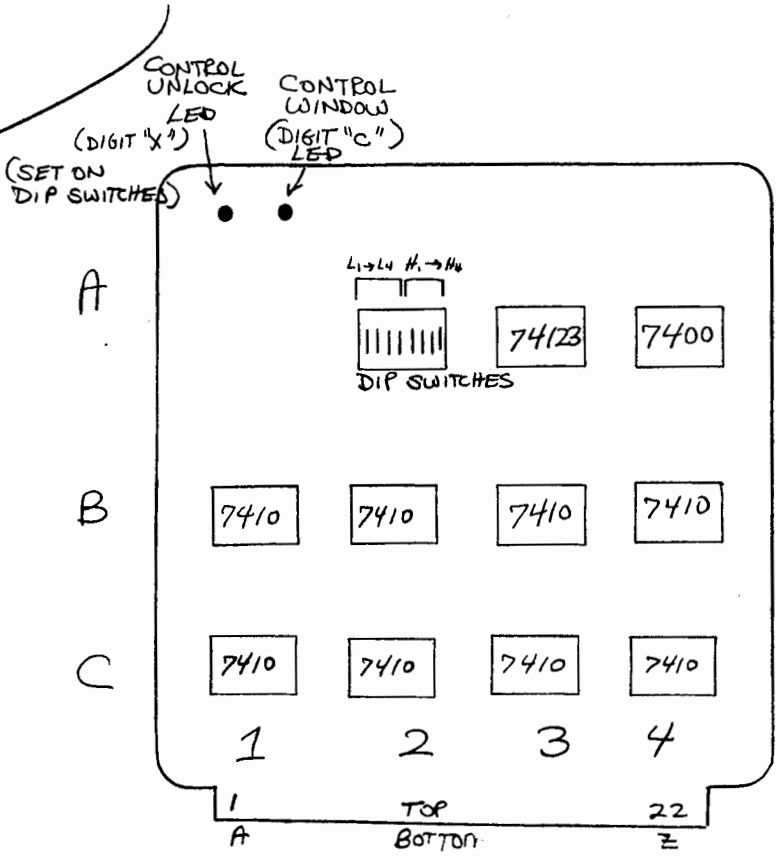
Repeat Board #10: UAD

This board contains the circuitry which converts the 2 of 8 DTMF signals into 16 discrete signals. Provisions are made for disabling three groups of the 16 digit outputs. (#ABCD) (ABCD) (0-9)
The ABCD Disable is not used. The #ABCD is used for Access Restriction (Explained on Board #7) This will not allow #,A,B,C or D unless released by the Access Restrictor. The 0-9 Disable is used during Secondary Control explained below.

The Secondary Control circuitry enables a station on the 75 input to perform control functions in an emergency.
It is initialized with the digit C. This sets the C window timer and lights the Control Window LED. Next, an unlock digit must be received. This digit is selectable with the mini DIP switch on the board. Use the table below to select the unlock digit:

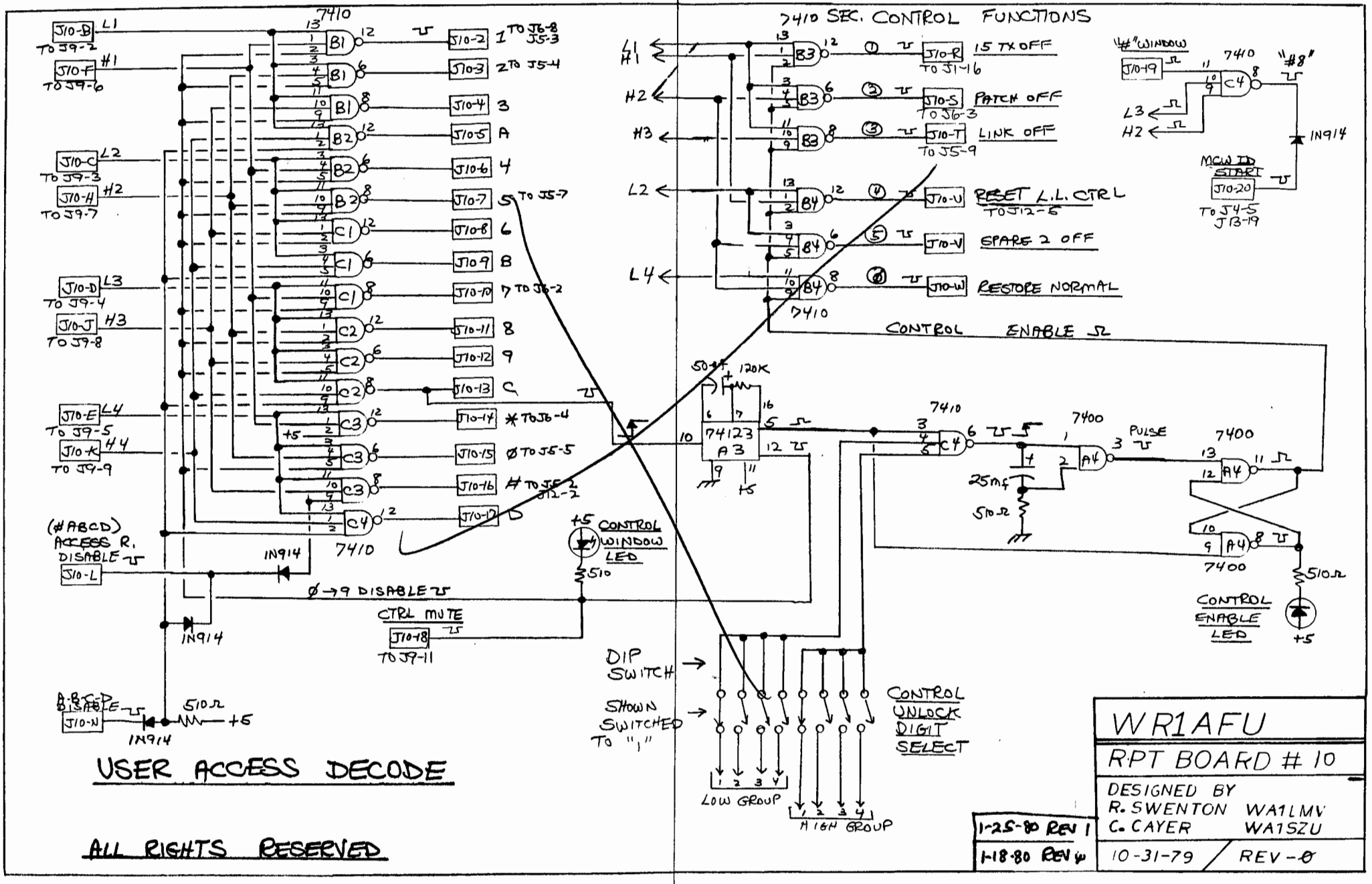
Digit	Switches ON
1	1 and 5
2	1 and 6
3	1 and 7
4	2 and 5
5	2 and 6
6	2 and 7
7	3 and 5
8	3 and 6
9	3 and 7
Ø	4 and 6

The unlock digit will light the Control Enable LED.
Next, enter the function code (0-5) to perform the function. The three digit code (Cnn) must be entered before the Control Window timer times out in three seconds. See the Control Station Manual for more information.



The Insurance City Repeater Club

DESIGNED AND BUILT
BY
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
12-1-80



15 Logic System

Repeat Board #11: LXD

This board contains the single digit tunable decoder used on the six meter RX for access of the RX from six meters. The digit must be present for the time duration set by R3, normally three seconds. When the digit is received and remains for sufficient time, the Access LED will light. This will access the 6M RX and arm the 6M ID latch. If there is no signal being received on the 6M RX, the ID will be started on 6M. The ID PTT will reset the ID latch. If there is a signal being received on 6M, the ID will wait for that station's signal to stop before allowing ID to start. This feature is called "Polite Answerback*".

This board also controls two audible tone indicators. One is the Link Tone Burst, the other is the Time-Out Alarm. The Link Tone Burst is derived from the 1 KHz. time base signal, the 6M rx on signal (525 RX Disable) and the LX Tone Enable. The LX Tone Enable is a variable length pulse generated on Board #4. The pulse length is short when only the 6M RX is enabled and long when both the 6M RX and TX are enabled. The short pulse remains even if the 6M RX is disabled. The tone gating is done with the 525 RX Disable signal on this board.

The Time-Out Alarm is generated with the 62.5 Hz. time base. The binary counter produces a pulse which changes at a rate of 4 pulses per second. When either 2M RX or 6M RX COS Times-Out, the 1 KHz. Tone will be pulsed at the 4 Hz. rate and the 2M TX will cease in five seconds. The Time-Out Alarm tone will remain even though the 2M TX is off.

This board also controls the ID start after Patch Dump. When the Patch is accessed, the Patch ID latch is set. Because this latch is set, when the digit * is received, it will cause an MCW ID Start. The digit * will also reset the Patch ID Latch so no further digit * will cause the ID to start.

The Insurance City Repeater Club

DESIGNED AND BUILT
BY
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
12-1-80

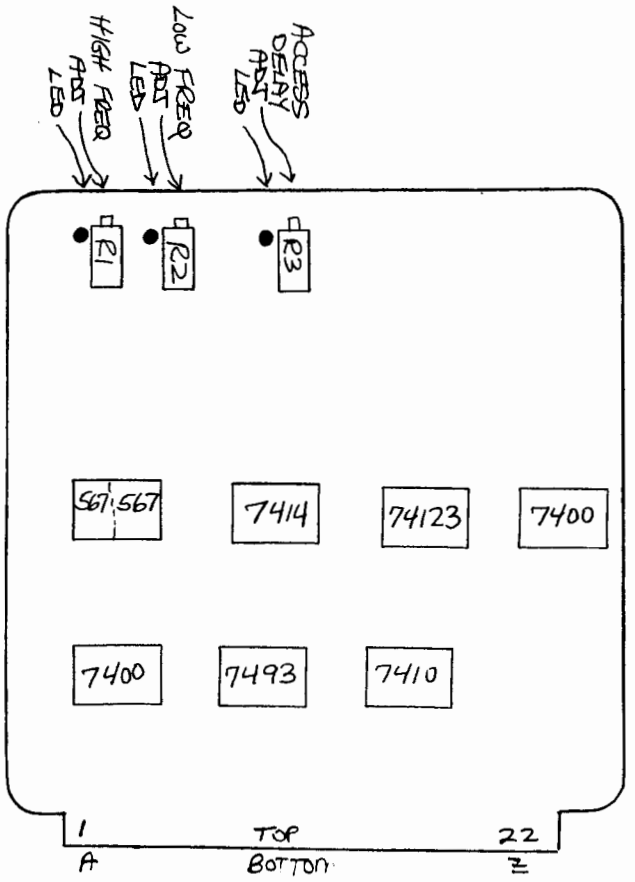
*-Polite Answerback is a Trademark of KlIIG, Stephen B. Tripp and is used here without permission.

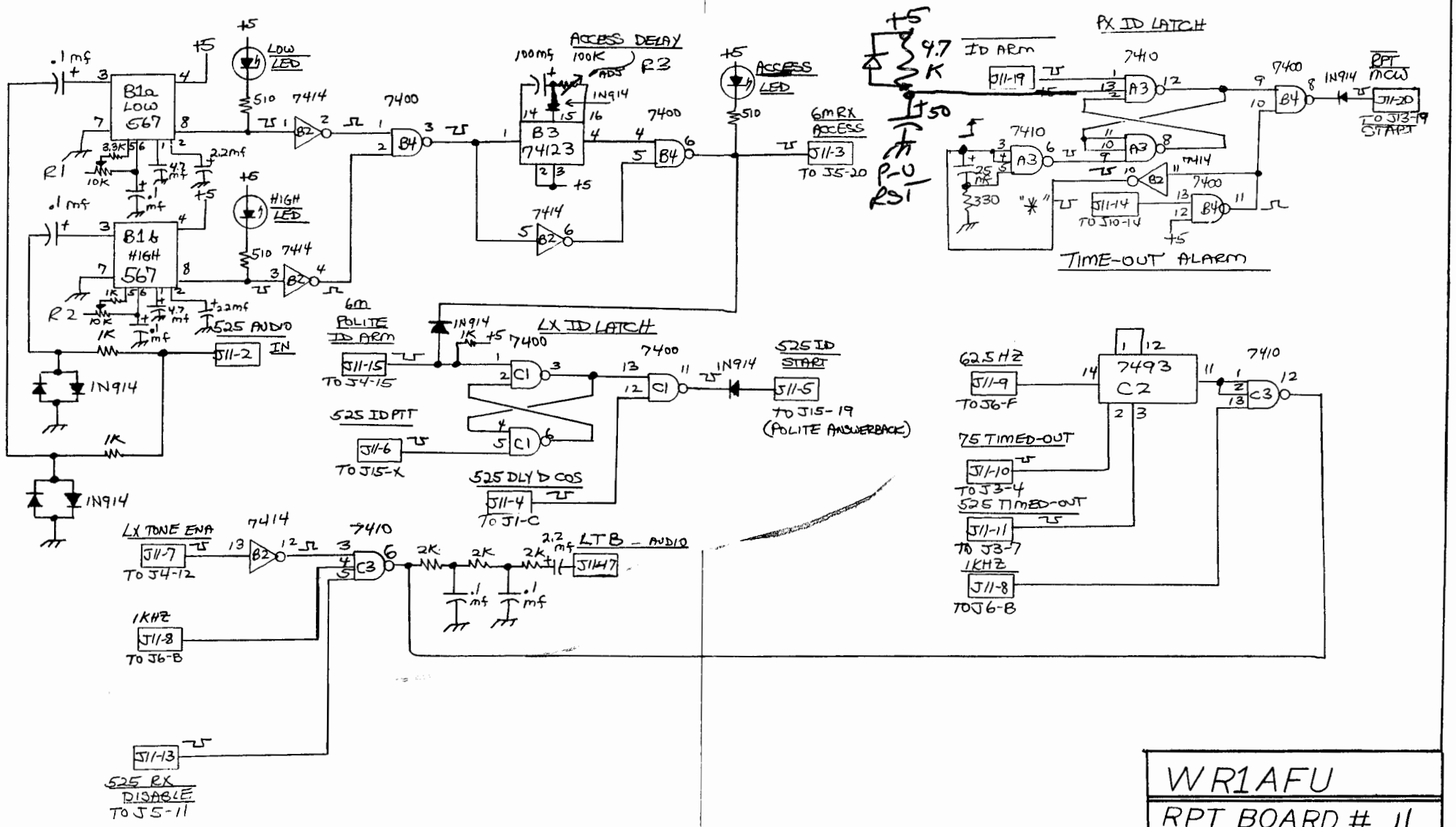
WR1AFU
BOARD #11
6m ACCESS CONTROL

PICTORIAL

WA1LMV 9-17-80

TIME-OUT ALARM
LTB AUDIO





WR1AFU

RPT BOARD # 11

DESIGNED BY
R. SWENTON WA1LMV
C. CAYER WA1SZU

10-31-79 / REV-0

15 Logic System

Repeat Board #12: LLC

This board contains the circuitry to control automatic dial-in control of the repeater system. The 1001D Data Coupler signals this board when the landline is ringing (RI) and the Ring LED will light for each ring. After the first ring the Line Latch will be set and the Line ON LED will light. K2 will pull in and seize the line from the coupler through OH and DA. The Access Window Timer begins its one second time limit. Of the digit "#" does not set the Unlock Latch within the one second Access Window limit, the Access Window Timer will reset the Line Latch and release the Data Coupler. If access is successful, the landline user will retain control for 8.75 minutes or more if reset with a control function via Reset Landline Timer. The Timing LED will flash when the timer is timimg.

When the line is seized by K2, the line audio is also routed to the 450 Control DTMF DECODER so that the landline user can perform all the controls which can be done on 450.

Also on this board is the Patch Relay. The output from the Patch Control Board #6 causes the relay K1 to pull in.

See the Telephone System Diagram for further information.

The Insurance City Repeater Club

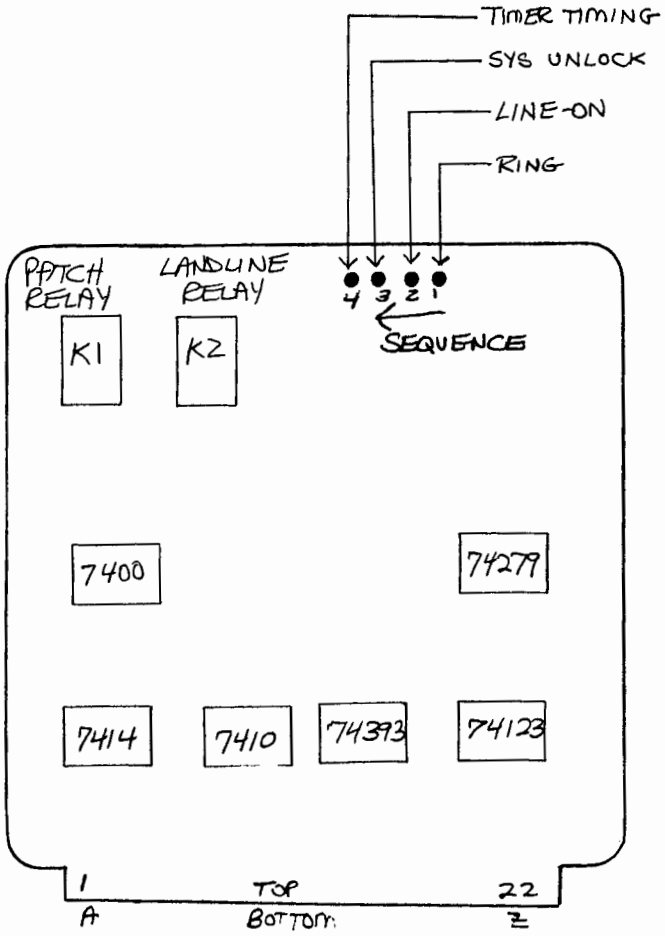
DESIGNED AND BUILT
BY
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
12-1-80

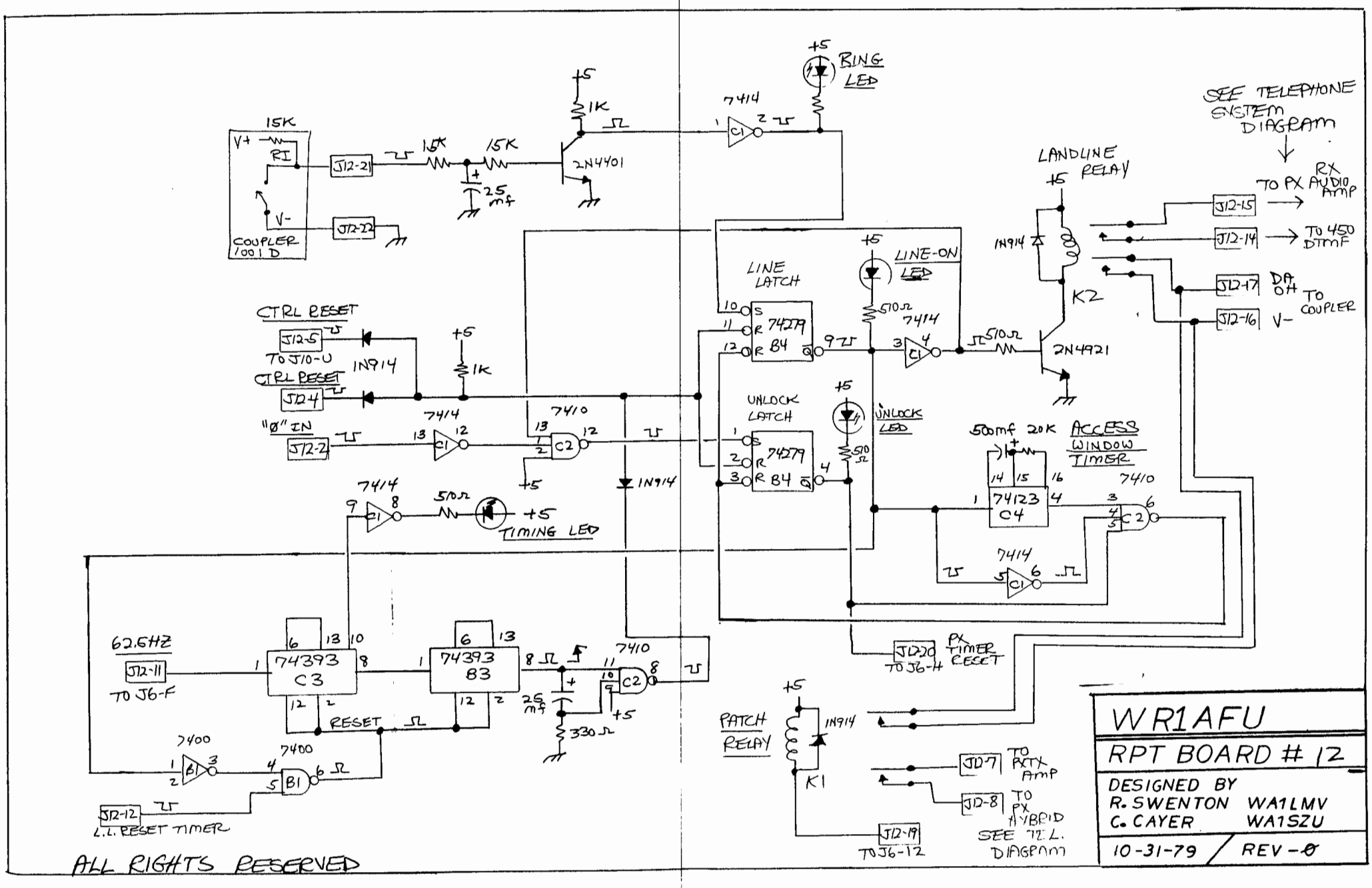
WR1AFU
BOARD #12

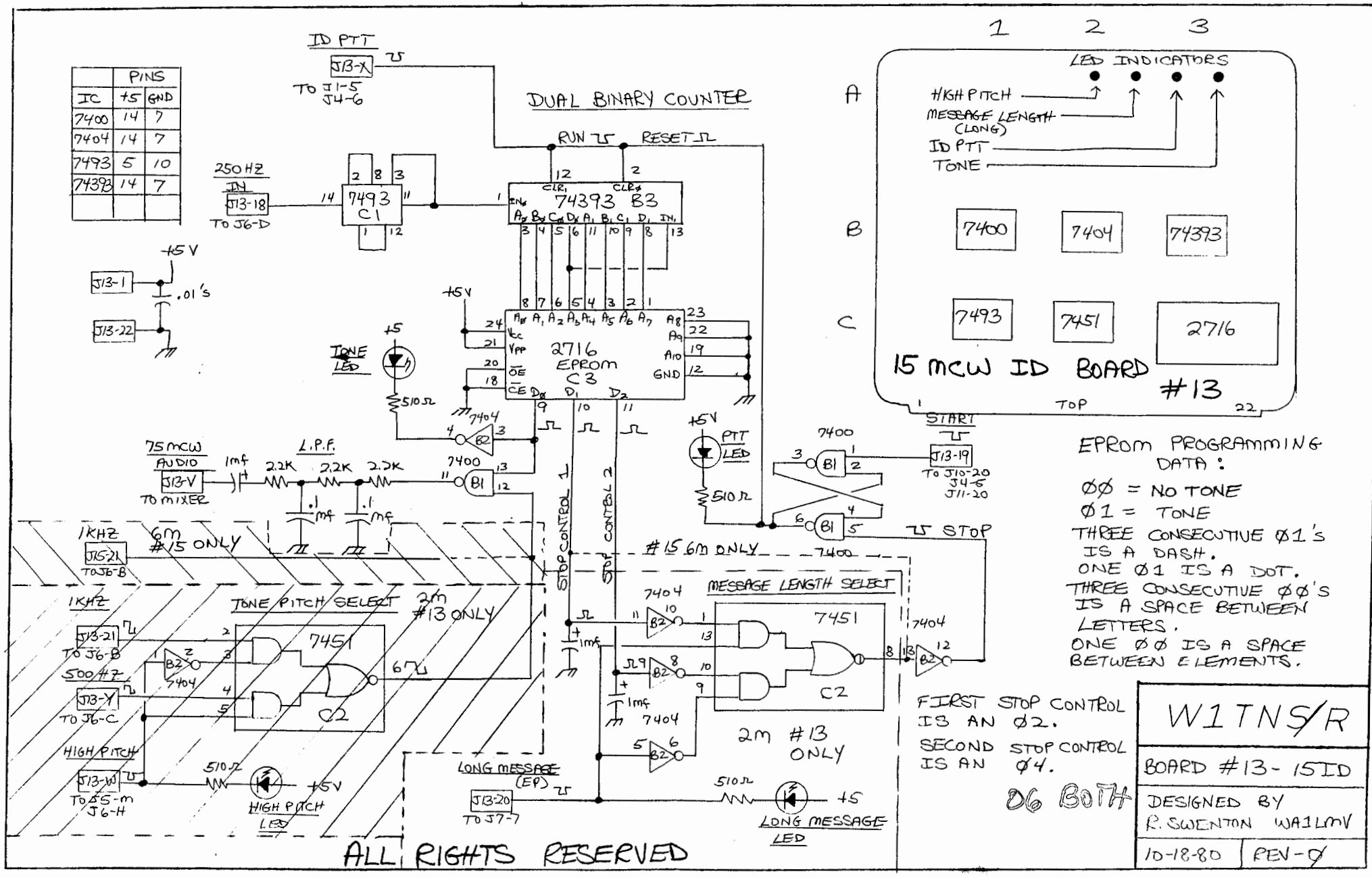
LAND LINE
ACCESS CONTROL

PICTORIAL

WA1LMV 9-17-80







15 Logic System

Repeat Boards #13 and 15: MCW

These boards are morse code ID units. Board #13 is the 15 ID and Board #15 is the 525 ID. Both boards are very similar.

Both derive speed and pitch from the Master Time Base on board #6. Both use an EPROM (Erasable Programmable Read-Only Memory) which contains the callsign of the repeater. To change the call, a special programmer is required. An ultraviolet light source will erase the current data and the new data will be electrically loaded. Bit DØ is the morse data and Bits 1 and 2 are stop selects. Bit 1 will stop for short message and bit 2 will stop for long message. Programming Data: (Hex) ØØ is a space, Ø1 is tone on, Ø2 is short message stop select 1 and Ø4 is long message stop select 2.

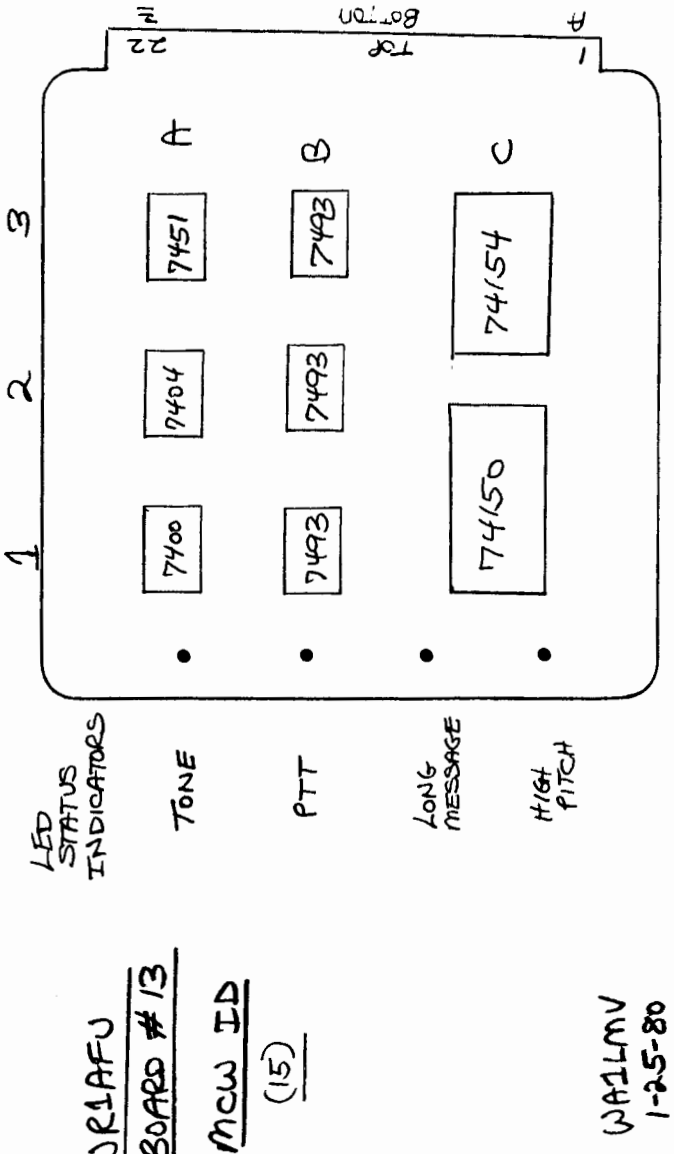
The Six Meter ID Board #15 operates by the setting of the Run Latch. This lights the PTT LED and enables the Dual Binary Counter. The Tone LED will pulse as the code is being sent.

The Two Meter ID operates the same way. In addition, the two meter ID has two different audio pitches selected by the logic. The normal pitch is 500 Hz. The 1 KHz. pitch is selected when either the Six Meter Link or Autopatch are disabled by Control Function. The Two Meter ID also has the letters "EP" after the callsign to indicate emergency power. The normal message is "DE W1TNS/R" When Long Message is enabled the message will be "DE W1TNS/R EP" LED indicators show High Pitch and Long Message.

For the sake of convenience, only one diagram for both boards is shown. Please note the minor wiring differences. Board #15 does not have IC C2 7451.

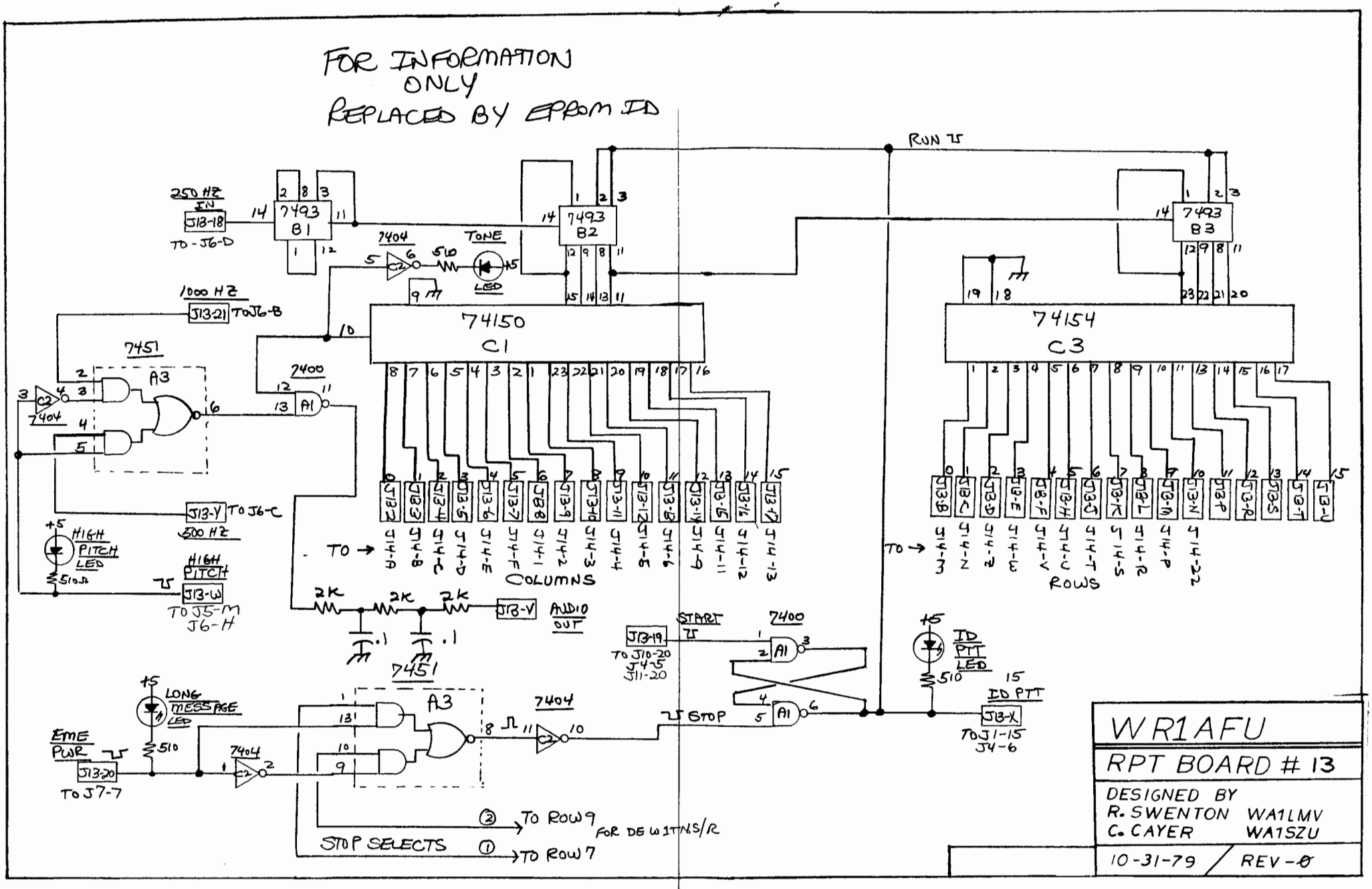
The Insurance City Repeater Club

DESIGNED AND BUILT
BY
Rick Swenton WA1LMV
Cliff Cayer WA1SZU
12-1-80



WR1AFU
BOARD #13
MCW ID
(15)

WA1LMV
1-25-80



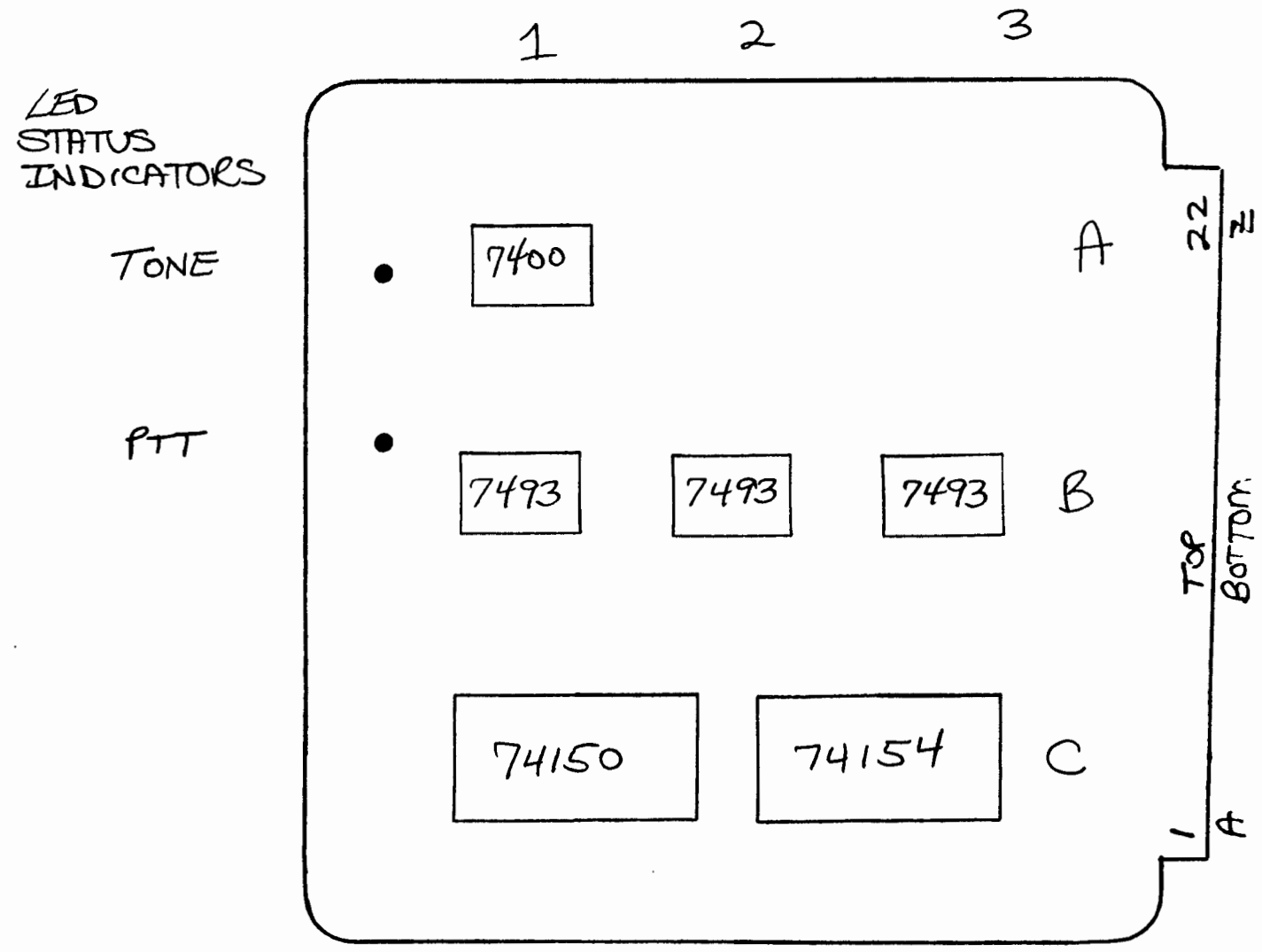
WR1AFU	
RPT BOARD # 13	
DESIGNED BY	
R. SWENTON	WA1LMV
C. CAYER	WA1SZU
10-31-79	REV - 0

WR1AFU

BOARD #15

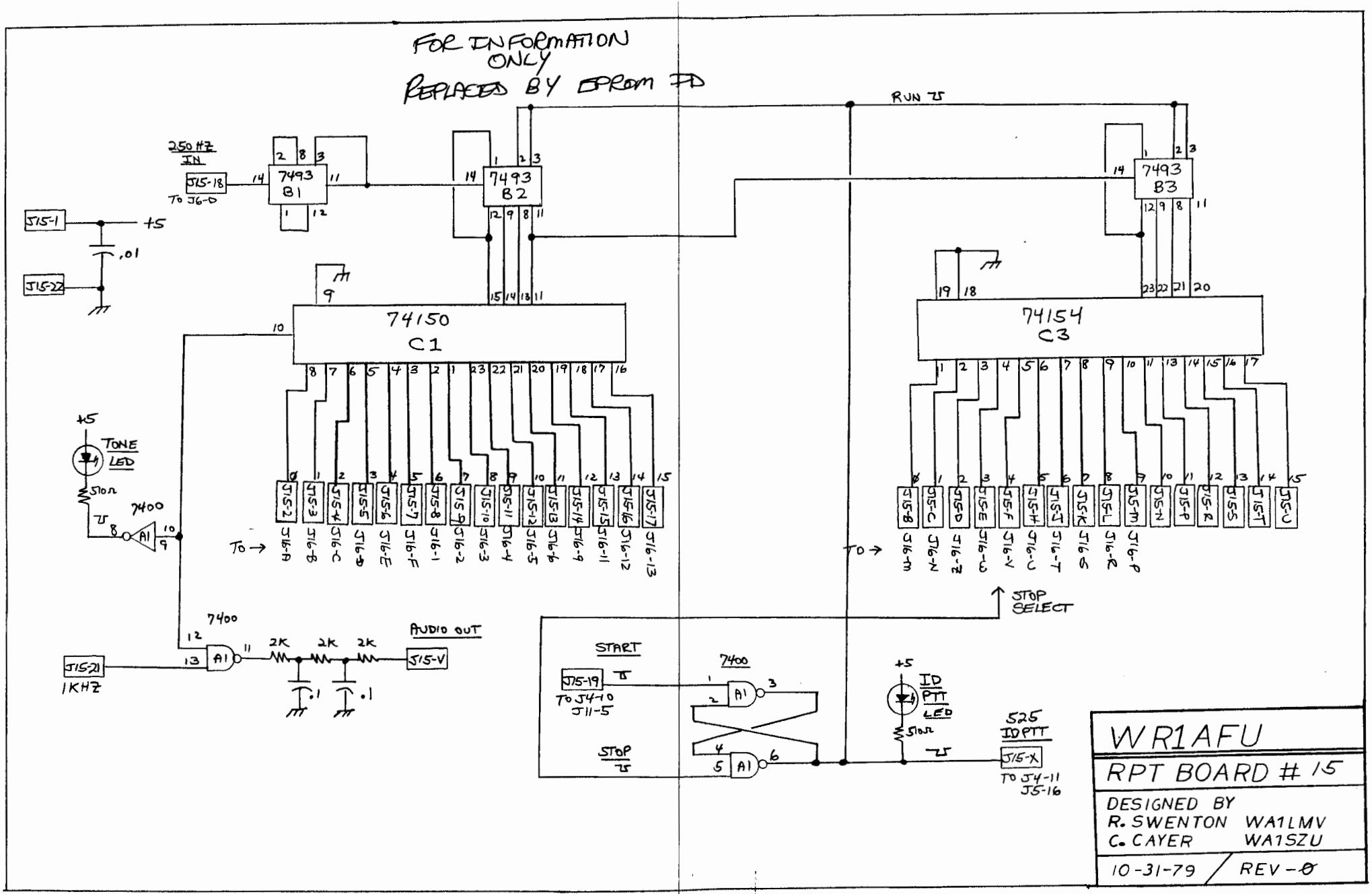
MCW ID

(525)



WA1LMV

3-13-80

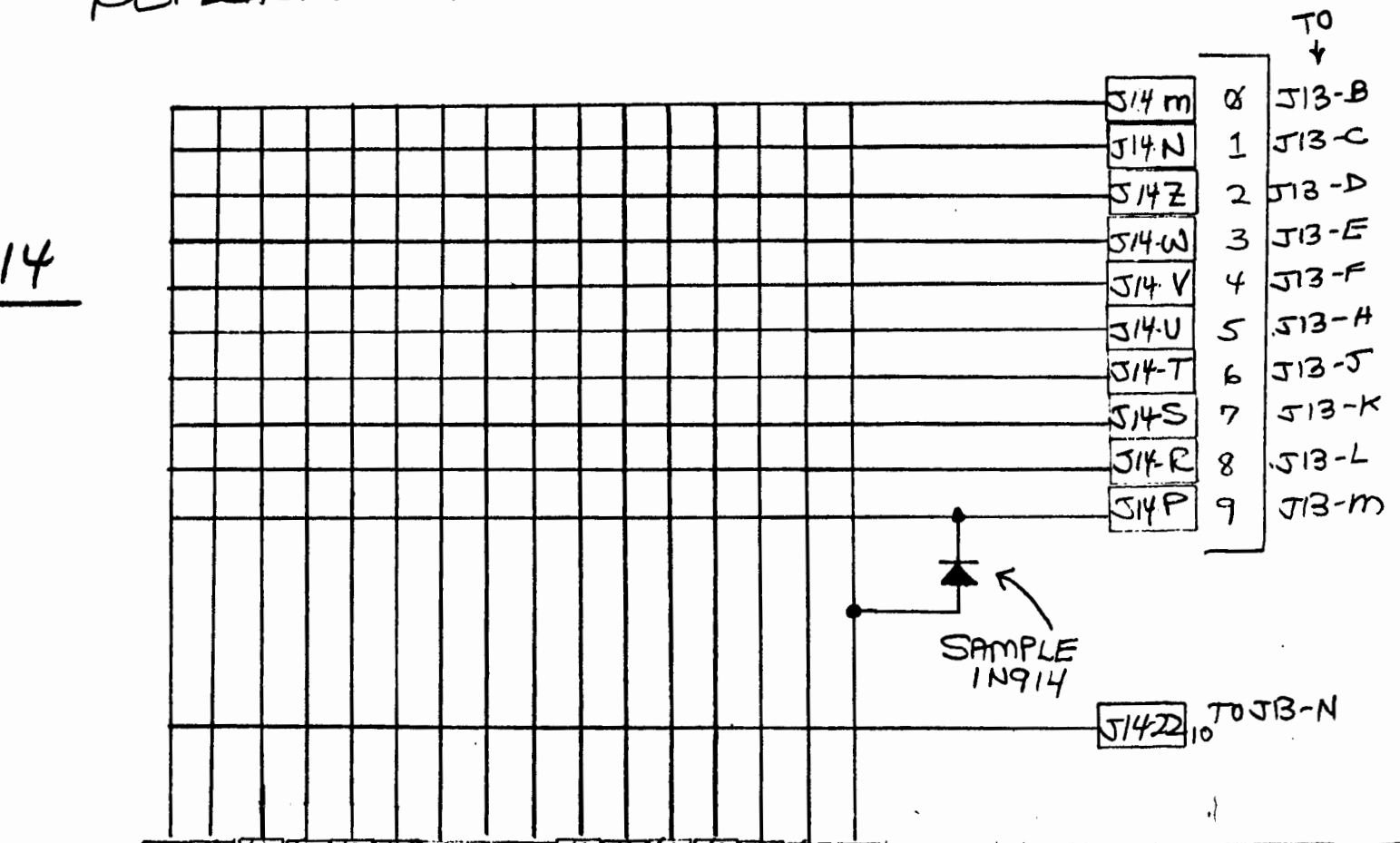

FOR INFORMATION ONLY
REPLACED BY EPROM #1
RUN TP
250 HZ IN
J15-18
TO J6-D
7493 B1
7493 B2
7493 B3
J15-1
+5
.01
J15-22
74150 C1
74154 C3
TONE LED
510Ω
7400
TO →
STOP SELECT
7400
2K
2K
2K
AUDIO OUT
J15-21
1KHZ
.1
.1
START
J15-19
TO J4-10 J11-5
STOP
7400
ID PTT LED
510Ω
525 ID PTT
J15-X
TO J4-11 J5-16
WR1AFU
RPT BOARD # 15
DESIGNED BY
R. SWENTON WA1LMV
C. CAYER WA1SZU
10-31-79 / REV-0

FOR INFORMATION ONLY

REPLACED BY EPROM ID

15 ID MATRIX

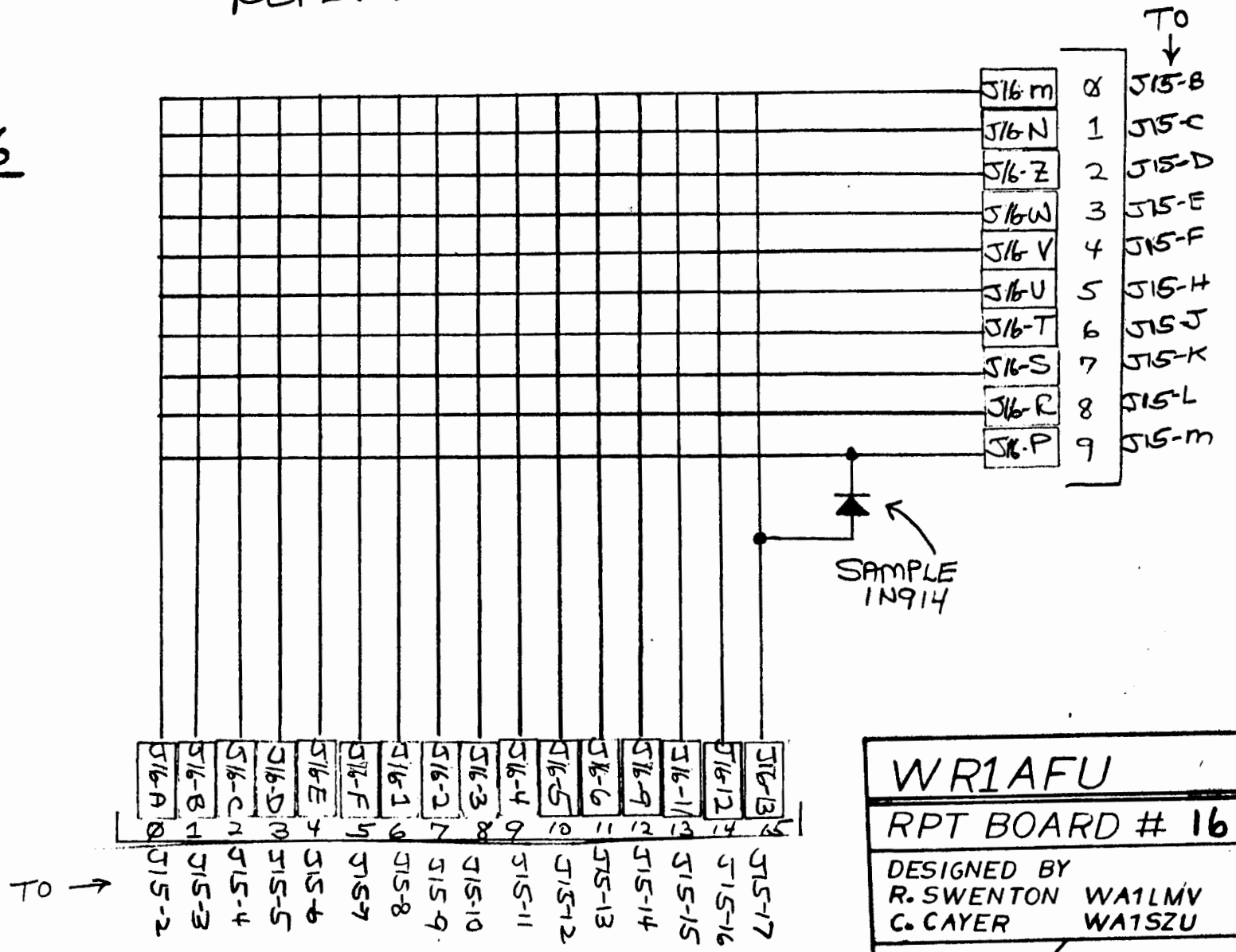
BOARD #14



WR1AFU	
RPT BOARD #14	
DESIGNED BY R. SWENTON WA1LMV C. CAYER WA1SZU	
10-31-79	REV-0

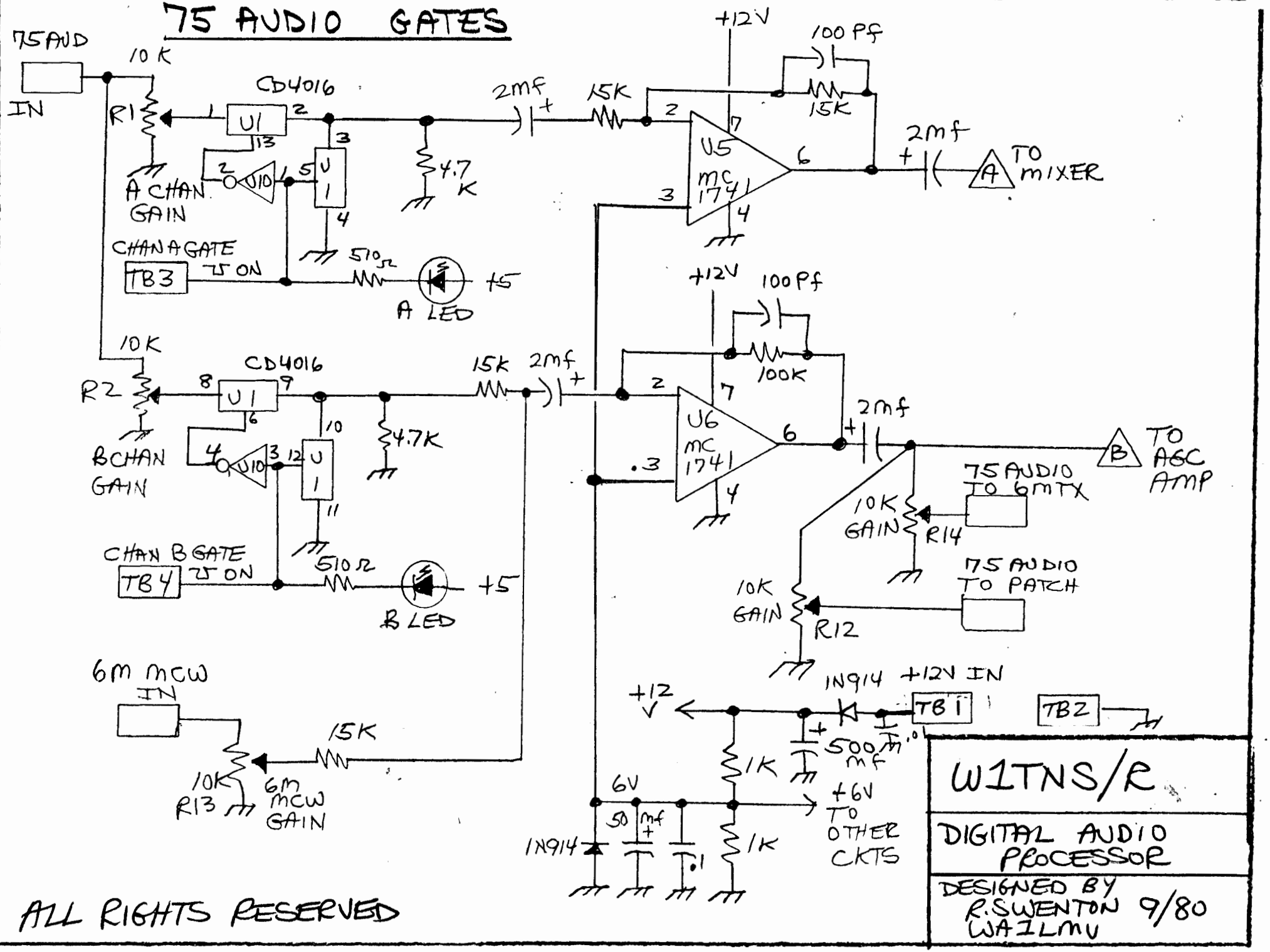
525 ID MATRIX BOARD # 16

FOR INFORMATION ONLY
REPLACED BY EPROM ID



WR1AFU	
RPT BOARD # 16	
DESIGNED BY R. SWENTON WA1LMV C. CAYER WA1SZU	
10-31-79	REV -0

75 AUDIO GATES

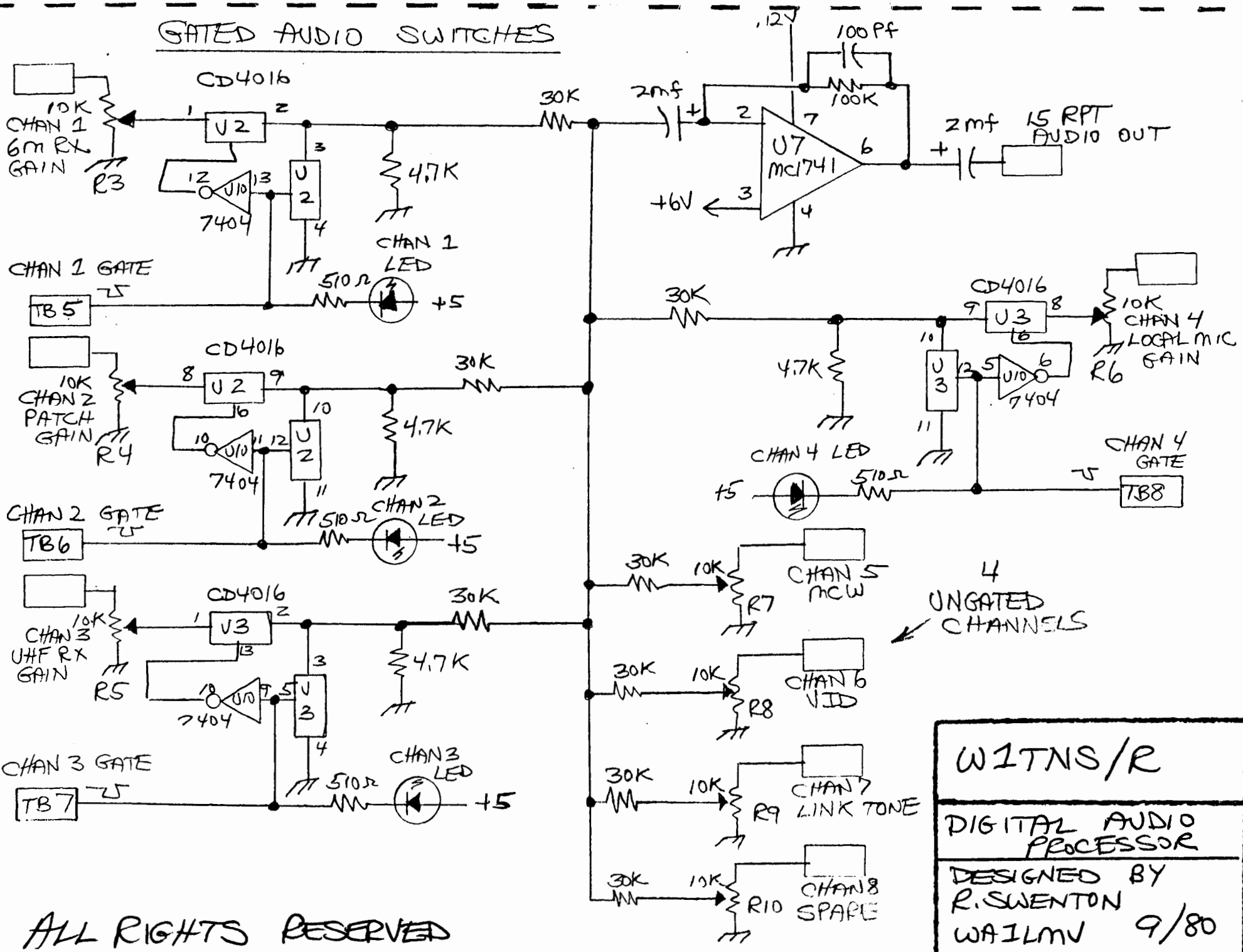


W1TNS/R

DIGITAL AUDIO PROCESSOR

DESIGNED BY R.SWENTON 9/80 WA1LMV

GATED AUDIO SWITCHES

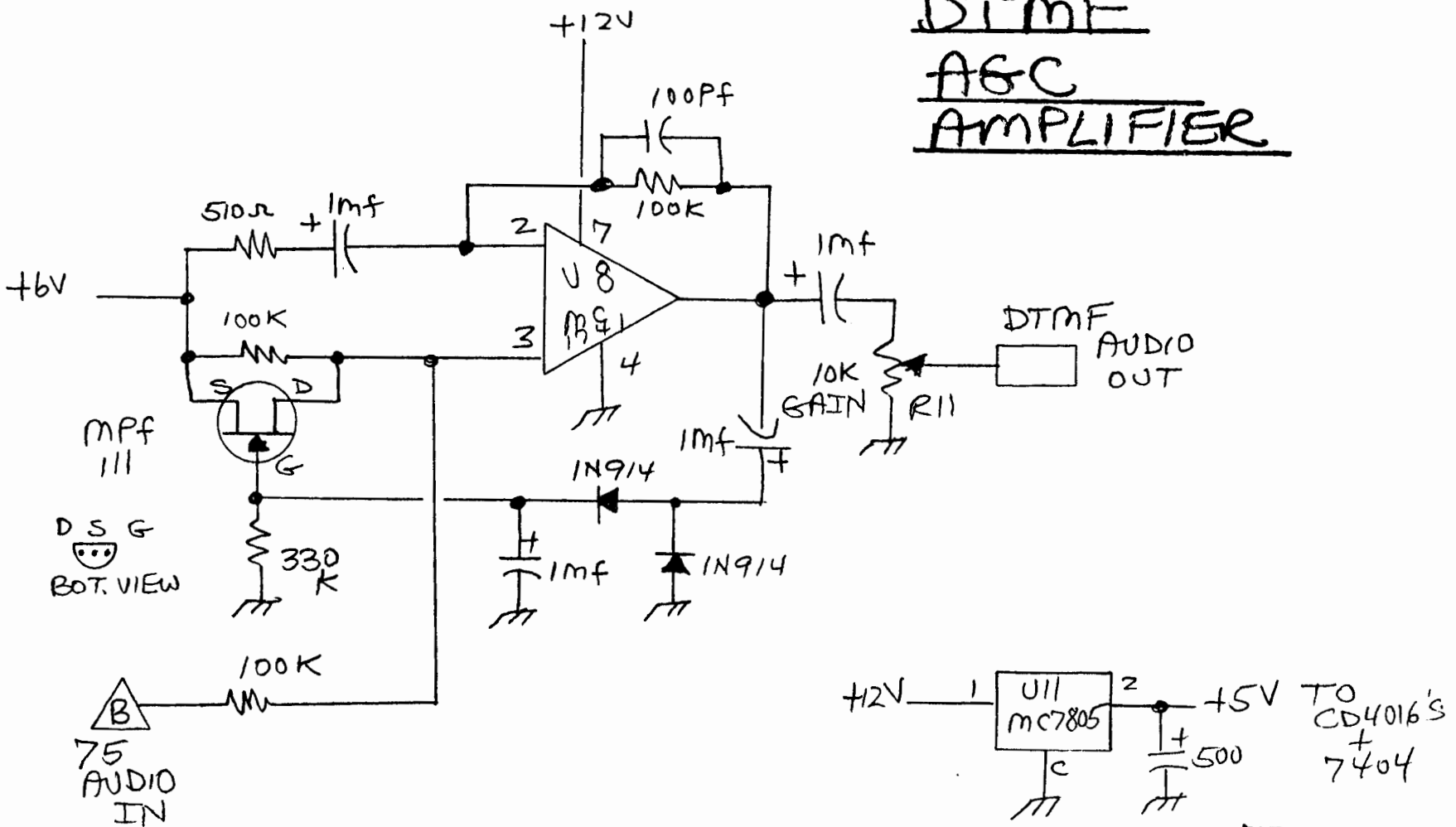


W1TNS/R

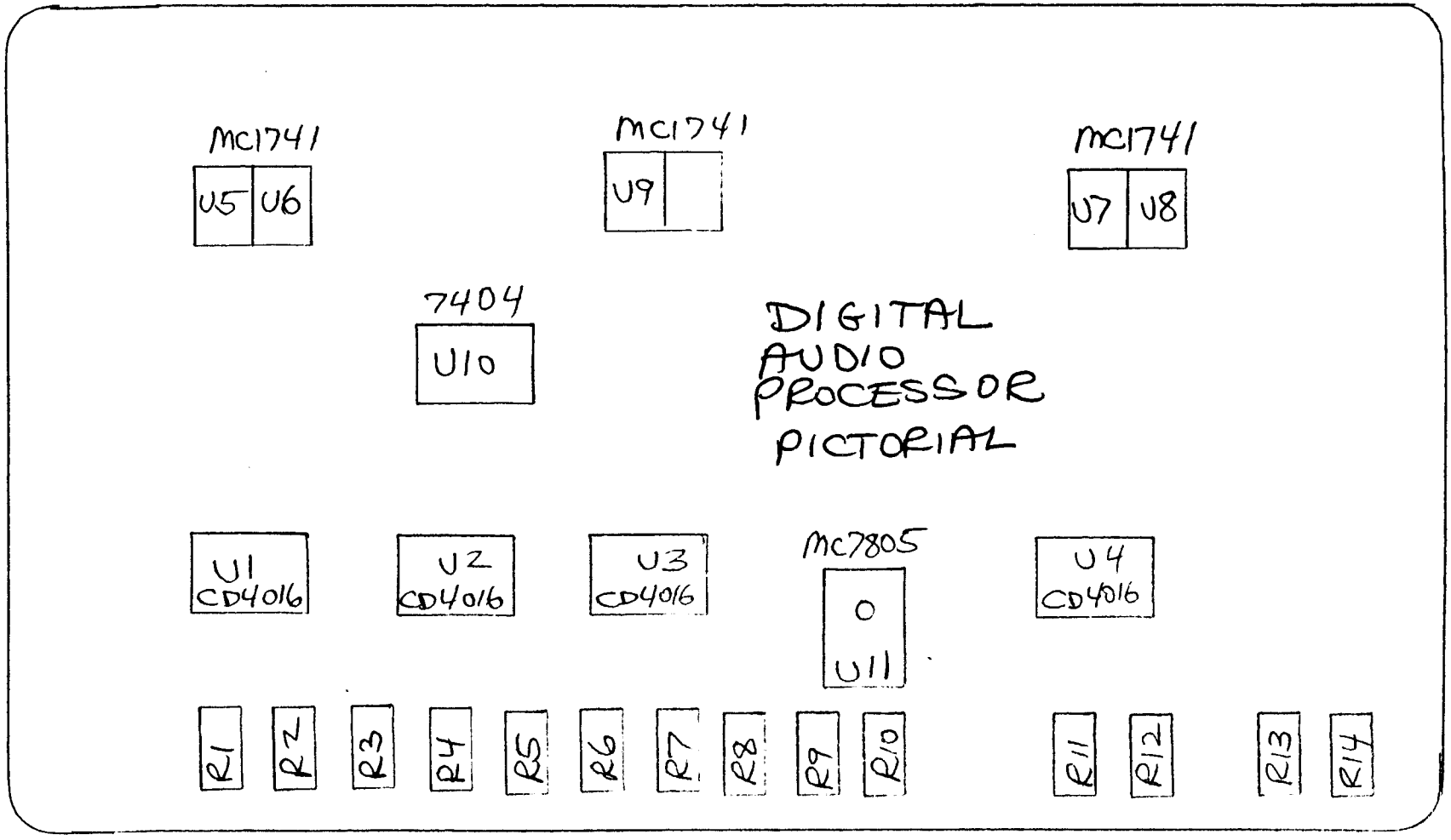
DIGITAL AUDIO PROCESSOR

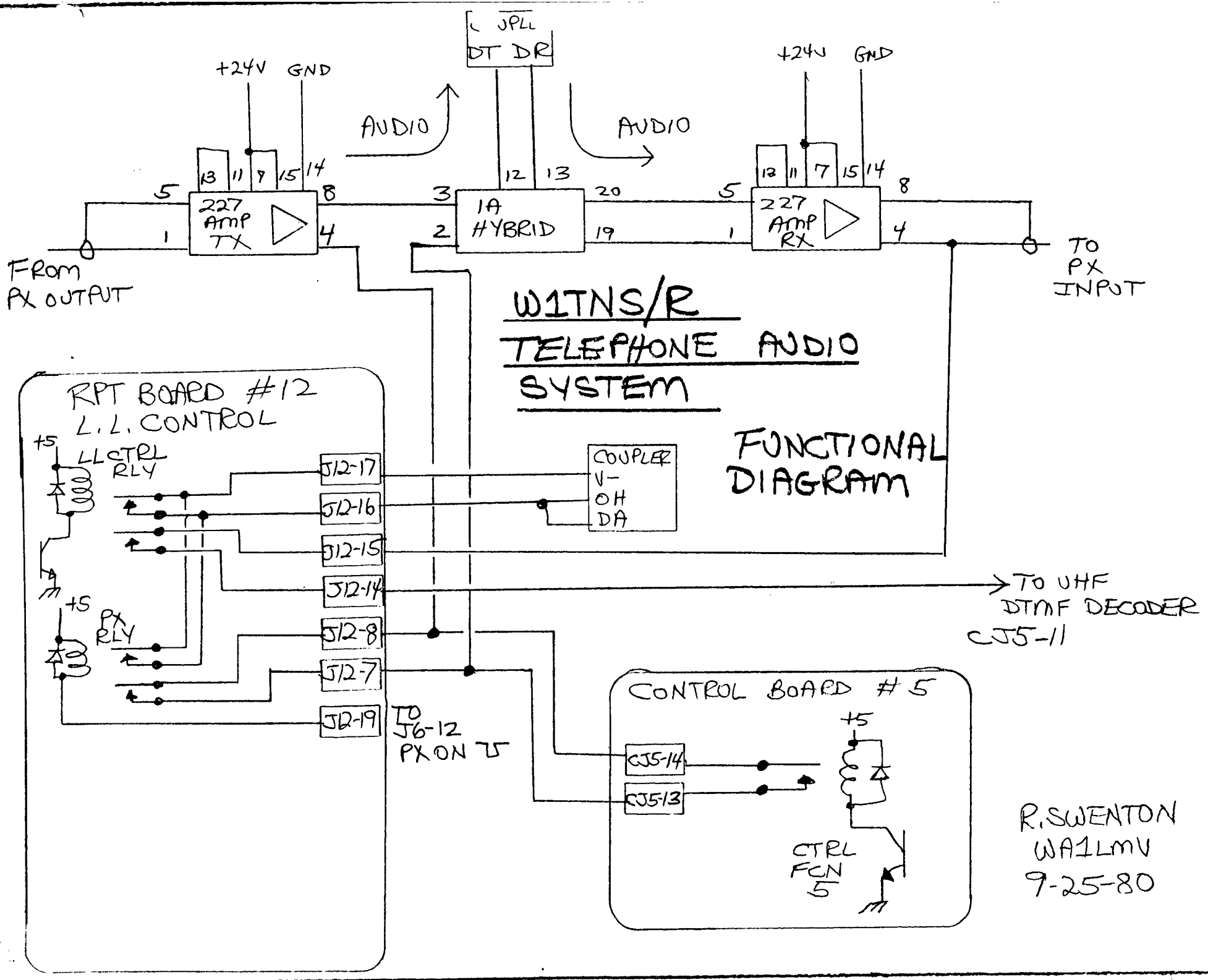
DESIGNED BY R. SWENTON WA1LMV 9/80

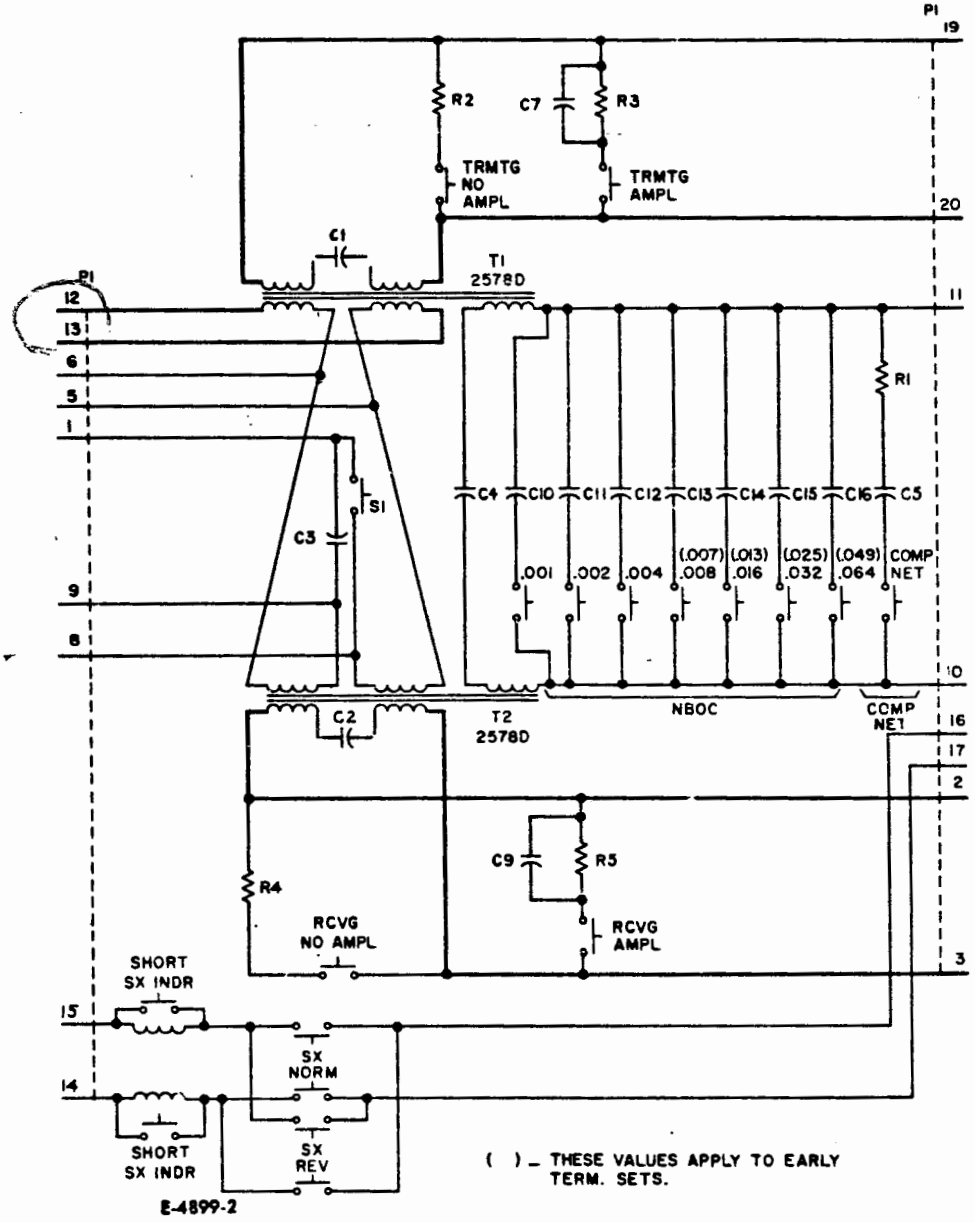
DTMF AGC AMPLIFIER

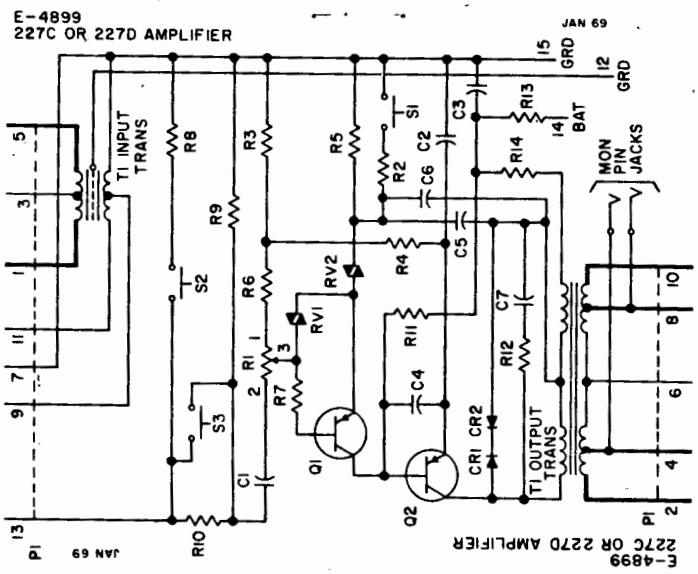


W1TNS/R
DIGITAL AUDIO PROCESSOR
DESIGNED BY R. SWENTON WA7LMV 9/80


MC1741
U5
U6
MC1741
U9
MC1741
U7
U8
7404
U10
DIGITAL AUDIO PROCESSOR PICTORIAL
U1 CD4016
U2 CD4016
U3 CD4016
MC7805
U11
U4 CD4016
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
CHAN A
CHAN B
CHAN 1 6M RX
CHAN 2 PATCH
CHAN 3 UHF RX
CHAN 4 MIC
CHAN 5 MC3
CHAN 6 VOICE ID
CHAN 7 4 TONES
CHAN 8 SPARE
DTMF OUT
PATCH OUT
6M MCU ID
6M LX 75 GAIN


JPLL
DT DR
+24V
GND
AUDIO
AUDIO
+24V
GND
227 AMP TX
1A HYBRID
227 AMP RX
FROM PX OUTPUT
TO PX INPUT
W1TNS/R
TELEPHONE AUDIO SYSTEM
FUNCTIONAL DIAGRAM
RPT BOARD #12
L.L. CONTROL
LL CTRL RLY
PX RLY
J12-17
J12-16
J12-15
J12-14
J12-8
J12-7
J12-19
COUPLER
V-
OH
DA
TO UHF DTMF DECODER CJ5-11
TO J6-12 PX ON
CONTROL BOARD #5
CJ5-14
CJ5-13
CTRL FCN 5
R. SWENTON
WA1LMV
9-25-80


P1
19
20
11
10
16
17
2
3
R2
C7
R3
TRMTG NO AMPL
TRMTG AMPL
C1
T1 2578D
P1
12
13
6
5
1
9
8
S1
C3
R1
C4
C10
C11
C12
C13
C14
C15
C16
C5
.001
.002
.004
(.007) .008
(.013) .016
(.025) .032
(.049) .064
COMP NET
C2
T2 2578D
NBOC
COMP NET
R4
C9
R5
RCVG NO AMPL
RCVG AMPL
SHORT SX INDR
15
14
SX NORM
SHORT SX INDR
SX REV
( ) – THESE VALUES APPLY TO EARLY TERM. SETS.
E-4899-2


E-4899
227C OR 227D AMPLIFIER
JAN 69
15 GRD
12 GRD
14 BAT
MON PIN JACKS
T1 INPUT TRANS
T1 OUTPUT TRANS
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
C1
C2
C3
C4
C5
C6
C7
S1
S2
S3
RV1
RV2
Q1
Q2
CR1
CR2
P1
JAN 69
E-4899
227C OR 227D AMPLIFIER

WR1AFU UHF REPEATER CONTROL SYSTEM

Designed by
C. Cayer WA1SZU
R. Swenton WA1LMV
2-26-79

PUBLICATION NUMBER C1

Publication Date 10-3-80

REPLACES 2-26-79

WR1AFU UHF CONTROL SYSTEM

Logic Connector pin designations:

Pin (TO RPT LOGIC)	Color	Function
1	White/Black	+12 V
2	White/Brown	+12 V
3	White/Red	Ground
4	White/Orange	Ground
5 J10-W	White/Yellow	CTRL ∅ RESTORE
6 J12-2	White/Green	∅
7 J12-4	White/Blue	CTRL *
8	White/Violet	CTRL #
9 J5-20	White/Gray	Control 9 (open collector)
10	White/Black/Black	
11 J1-16	White/Black/Brown	Control 1 (latch) 15TX
12 J6-3	White/Black/Red	Control 2 (latch) PX
13 J5-9	White/Black/Orange	Control 3 (latch) LX
14 J1-11	White/Black/Yellow	Control 4 (latch) UHF RX
15	White/Black/Green	Control 5 (latch) LL MON
16 J6-9	White/Black/Blue	Control 6 (pulse) PX ACCESS
17 J2-8	White/Black/Violet	Control 7 (pulse) VID
18 J4-5	White/Black/Gray	Control 8 (open collector) MCW ID

Rear Transmitter Connector:

1	COS Output
2	Discriminator Audio (DC coupled)
3	TX audio Line Input
4	RX Speaker Output
5	+12 V

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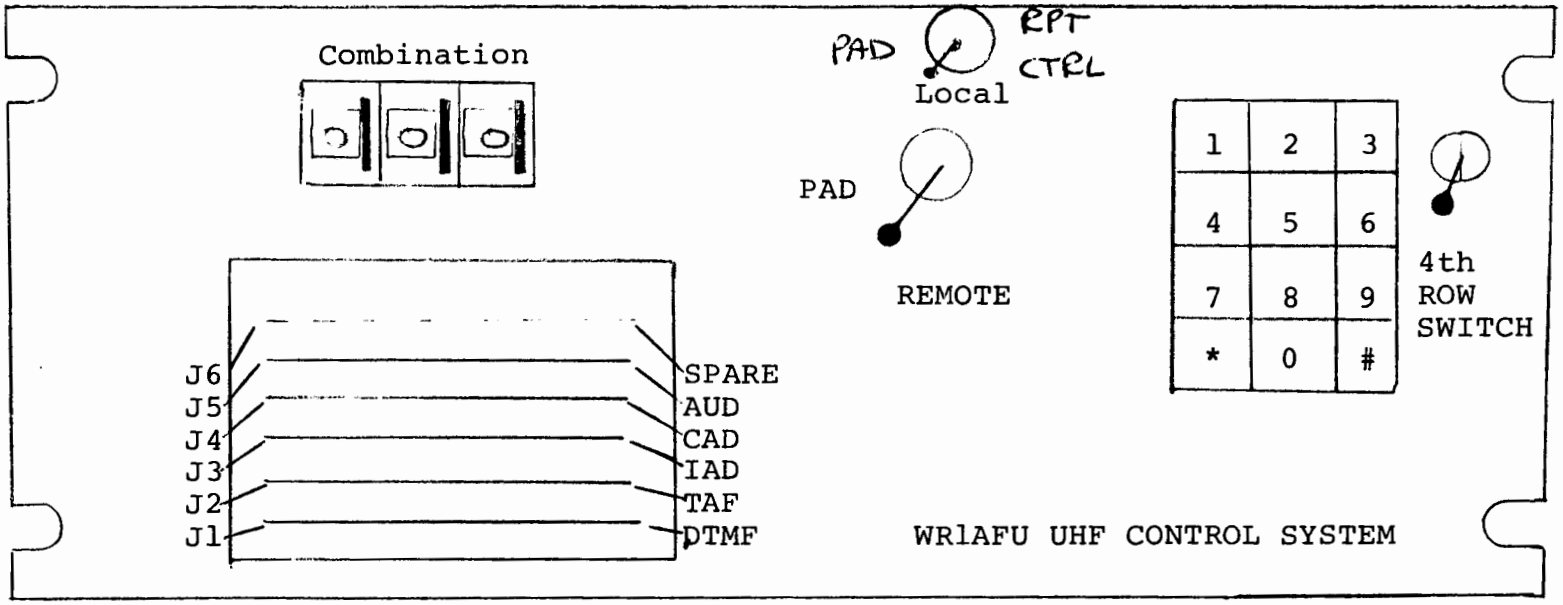
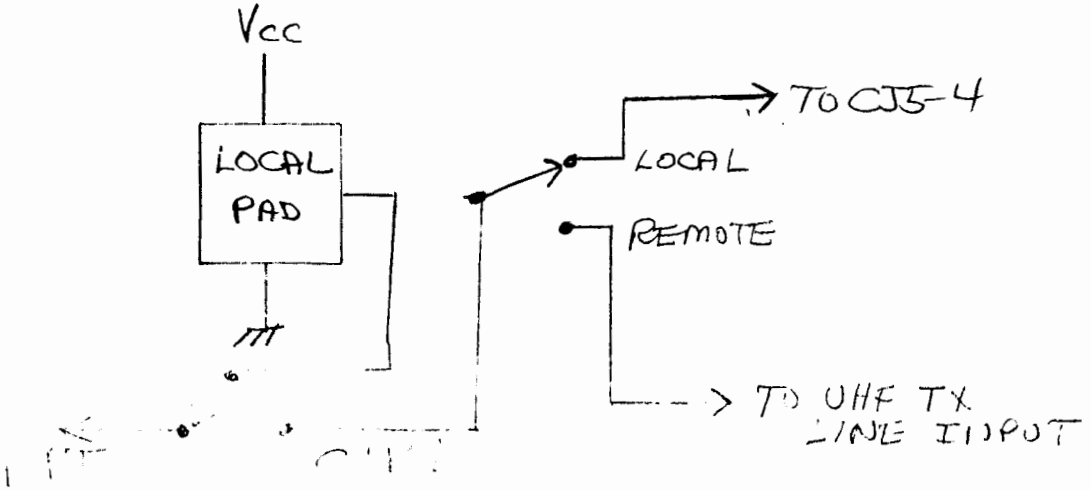
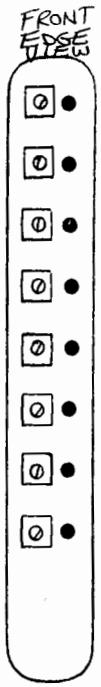
2-8-79





R. Swenton WA1LMV

2-8-79



WR1AFU UHF Control Board #1 DTMF

This board is the eight frequency decoder, the first part of the DTMF (Touchtone) decoder. It contains eight LM567 decoder IC's tuned to the eight standard DTMF frequencies. An LED indicator is provided on the output of each decoder for tune-up and operation indication. Visual two of eight output is available from the front edge view.

Also present on this board is the conversion logic to go from two of eight format to one of sixteen format.

The output of this board is fed to Board #2, TAF Valid digit recognizer.

Power requirements to the board are +5V regulated.

WR1AFU UHF Control System designed by C. Cayer, WA1SZU and R. Swenton WA1LMV
Built by C. Cayer WA1SZU

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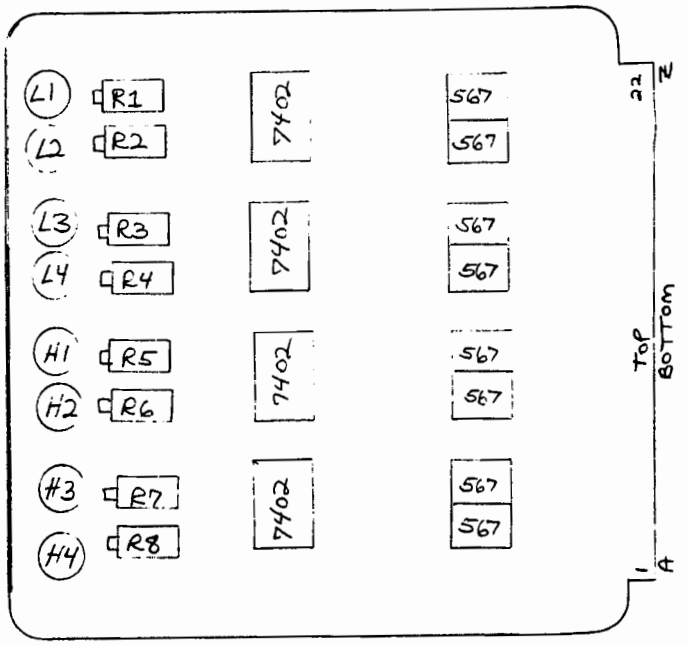
WA1LMV
2-26-79



UHF Control System WR1AFU Board #1 DTMF Decoder

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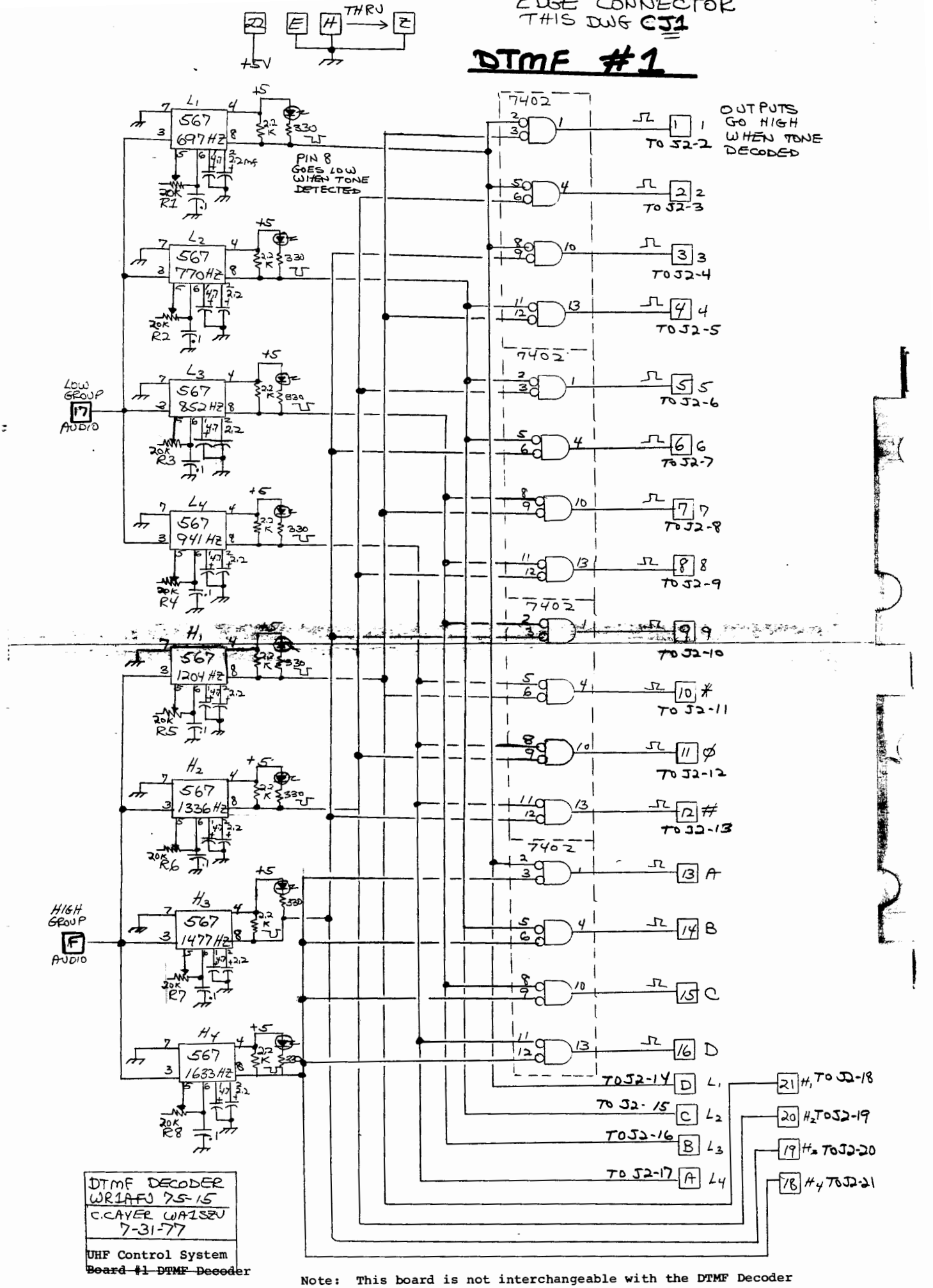
WA1LMV
2-19-79

EDGE CONNECTOR THIS DWG CJ1

DTMF #1



DTMF DECODER WR1AFJ 75-15
C.CAYER WA1SZU 7-31-77
UHF Control System ~~Board #1 DTMF Decoder~~

Note: This board is not interchangeable with the DTMF Decoder Board on the 15 chassis- The High and Low tone inputs are reversed

FRONT EDGE VIEW

Valid Digit ●

WR1AFU UHF Control System
Board #2 TAF Tone Anit-False
Valid Digit Recognizer

This board provides the logic circuitry necessary to prevent the output of the DTMF board #1 from falsely activating functions from voices on the input.

The output of the TAF Board #2 will signal the control logic if and only if the following conditions are met: There must be only one decoded low group tone AND there must be only one high group tone decoded AND BOTH tones must persist without interruption for the time duration set by the Response Time Adjustment control.

An LED indicator is provided to display Valid Digit Regognition.

Power requirements to the board are +5V regulated.

WR1AFU Control System designed by C. Cayer, WA1SZU and R. Swenton, WA1LMV
Built by C. Cayer, WA1SZU

Please Note: The information contained herein is the sole property of R. Swenton and/or C. Cayer and must not be divulged to others without permission.

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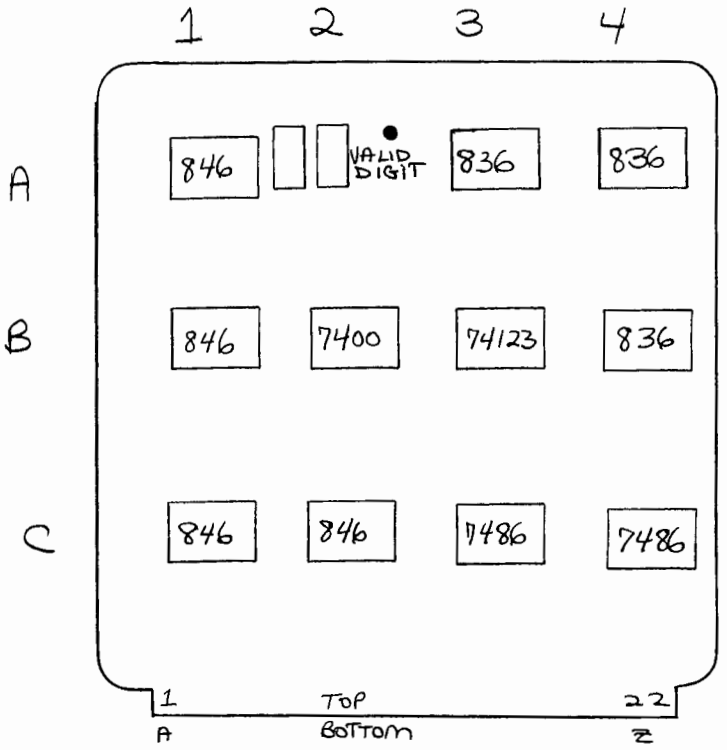
2-26-79



WR1AFU UHF CONTROL BOARD #2 TAF Tone Anti-False

VALID DIGIT RECOGNIZER

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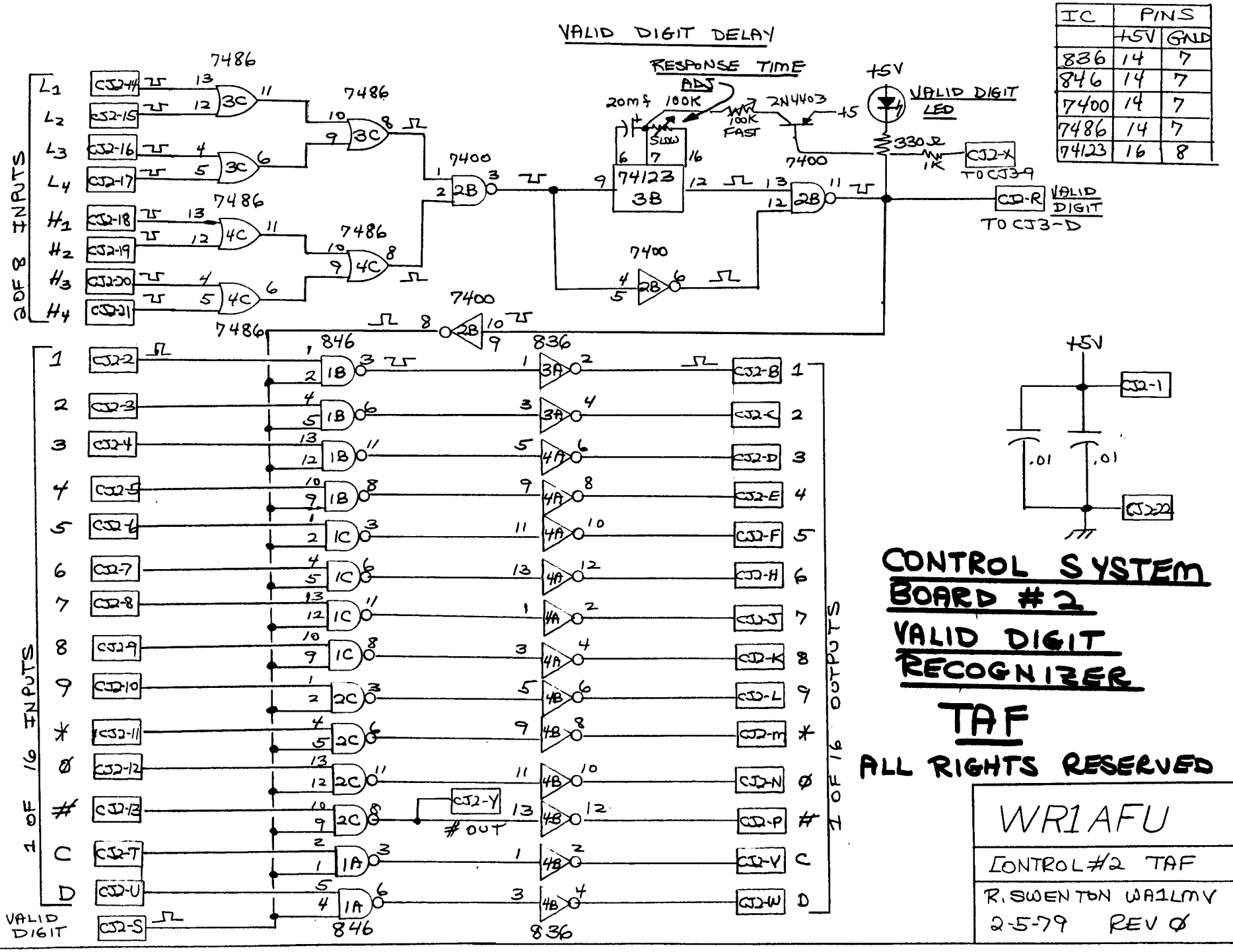
EDGE CONNECTOR THIS DWG - CJ2 - CONTROL SYSTEM BOARD



IC	PINS	
	+5V	GND
836	14	7
846	14	7
7400	14	7
7486	14	7
74123	16	8

CONTROL SYSTEM BOARD #2
VALID DIGIT RECOGNIZER

TAF

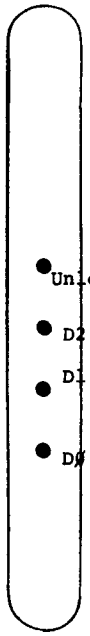
WR1AFU

CONTROL #2 TAF

R. SWENTON WA1LMV

2-5-79 REV Ø

Front
Edge
View



WR1AFU UHF Control System
Board #3 IAD
Initialize and Access Decode

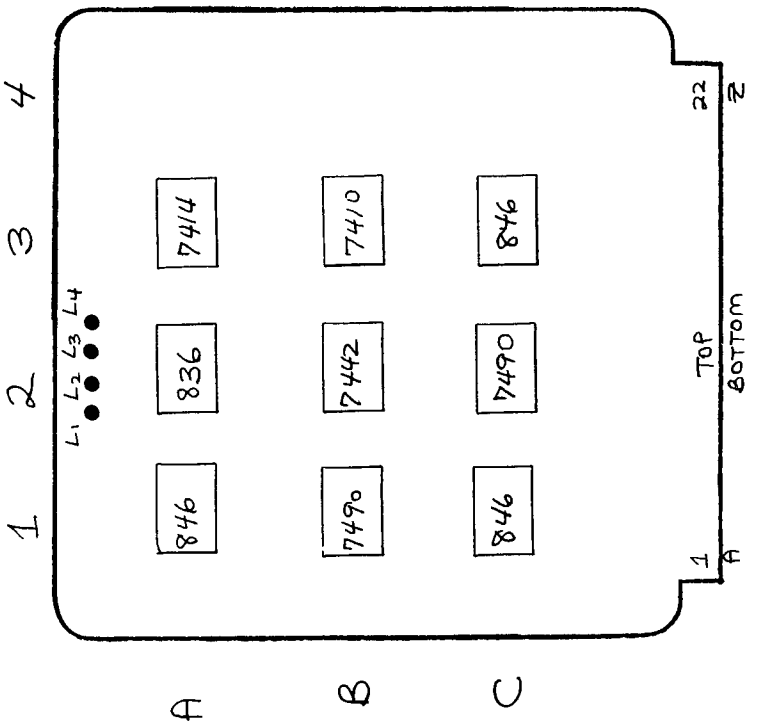
This board provides security circuitry for the control system. It is essentially an electronic "combination lock". It counts the number of digits entered and compairs that with the number of correct sequential unlock code digits. If an incorrect sequence is attempted, it will lock-up and remain until reset. If a correct sequence is entered, the circuitry will unlock and allow signalling of Board #4 CAD to perform control functions.

Four LED indicators are provided. As a correct sequence is attempted, the first three LED's will light momentairly in sequence...DØ, D1, D2, then the Unlock LED will remain lit until the system is reset.

Power requirements to the board are +5V regulated.

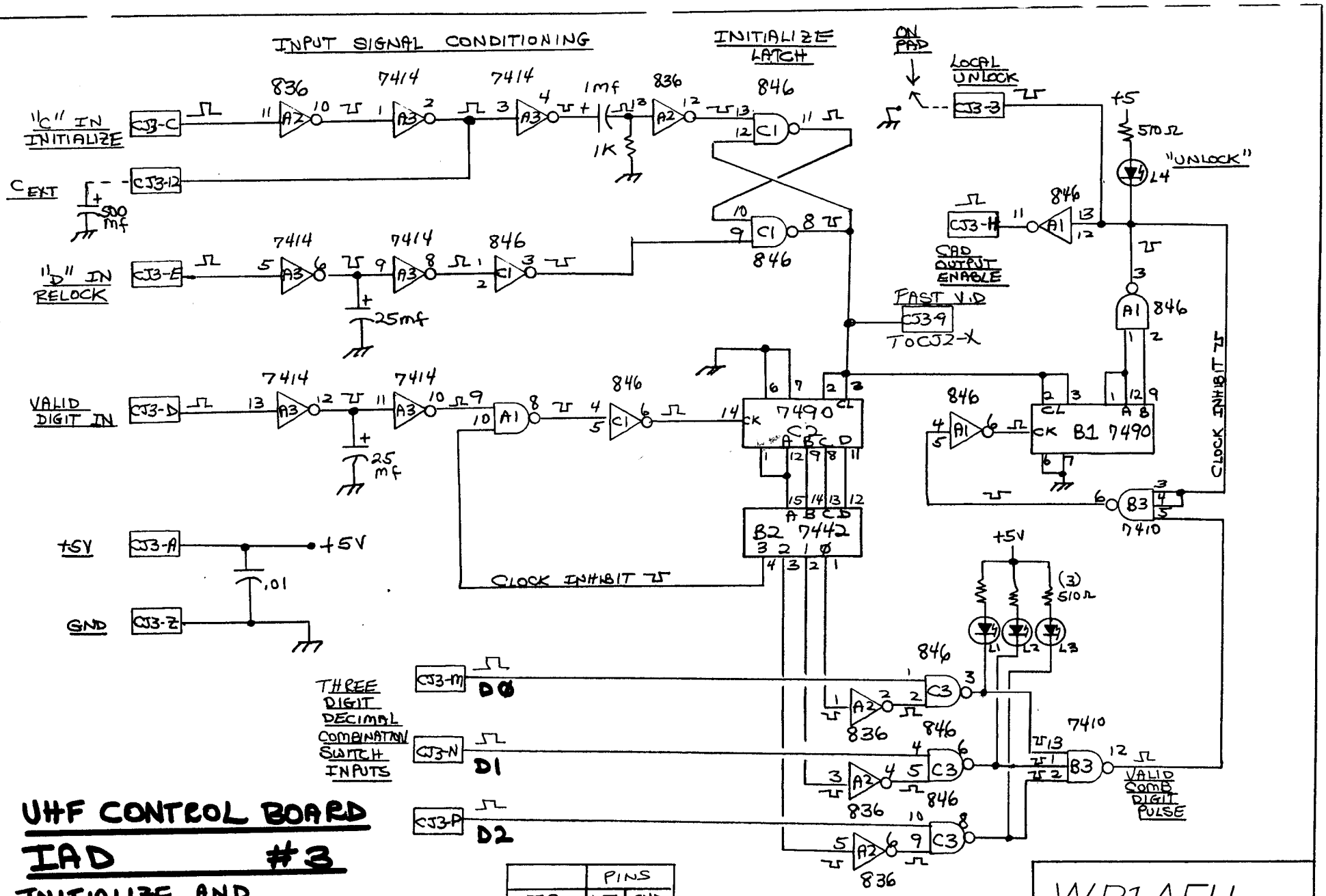
WR1AFU control system designed by C. Cayer, WA1SZU and
R. Swenton, WA1LMV.
Built by C. Cayer, WA1SZU.

R. Swenton
WA1LMV
2-26-79



WR1AFU Control Board #3 IAD Initialize Access Decode

R. Swenton WA1LMV 2-22-79



UHF CONTROL BOARD
IAD #3
INITIALIZE AND ACCESS DECODE BOARD

IC	PINS +5	GND
836	14	7
846	14	7
7410	14	7
7414	14	7
7442	16	8
7490	5	10

WR1AFU

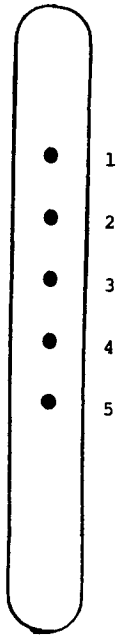
UHF CONTROL SYSTEM

BOARD #3 IAD

DESIGN BY C. CAYER WA1SZU

WA1LMV -2-19-79

Front
Edge
View



WR1AFU UHF Control System
Board #4 CAD Control Access Decode

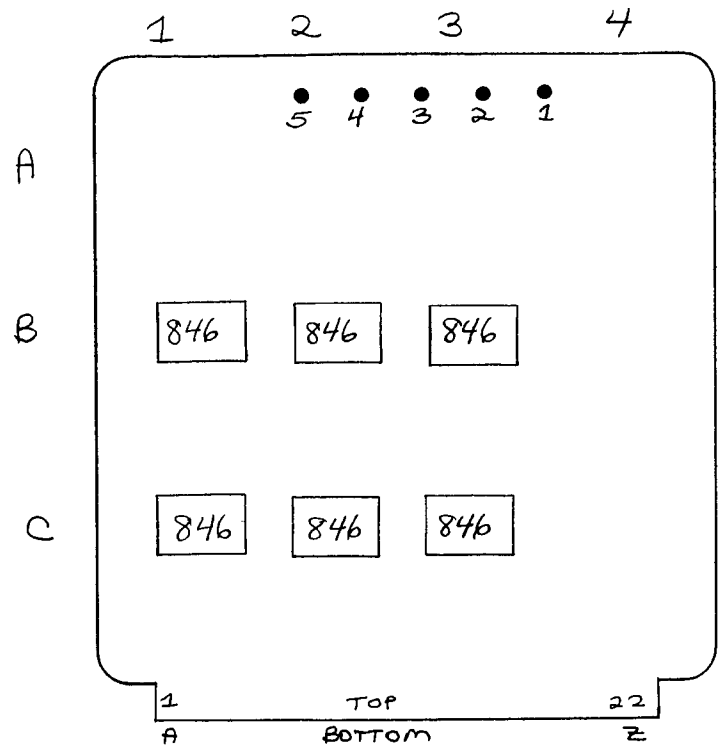
This board provides the actual control of the various repeater and accessories. It is enabled from Board #3 IAD.

Five LED indicators indicate the status of the five latched control outputs.

Power requirements to the board are +5V regulated.

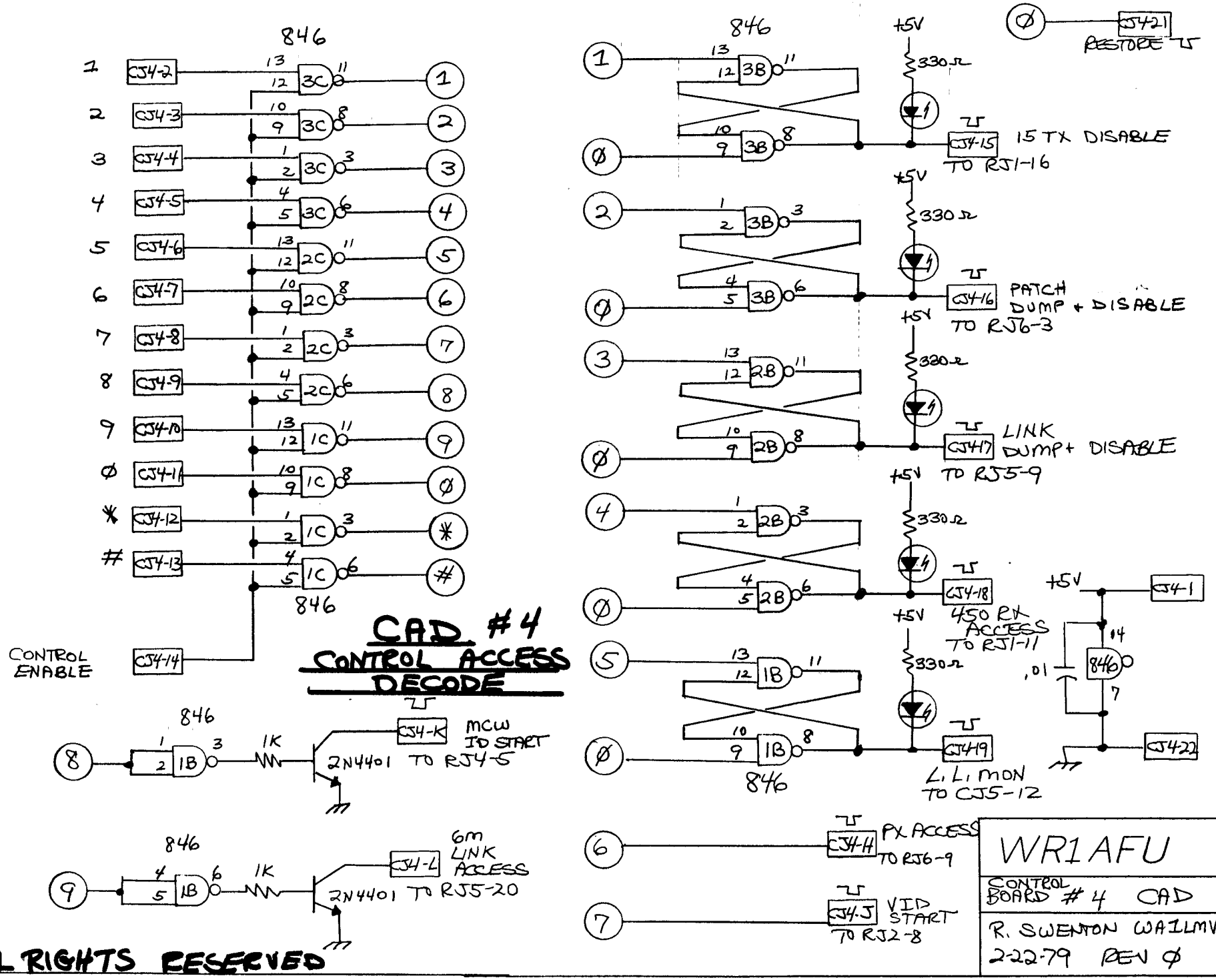
WR1AFU Control System designed by C. Cayer, WA1SZU and
R. Swenton, WA1LMV
Built by C. Cayer, WA1SZU.

R. Swenton
WA1LMV
2-26-79



WR1AFU UHF CONTROL BOARD #4 CAD Control Access Decode

R. Swenton
WA1LMV
2-26-79



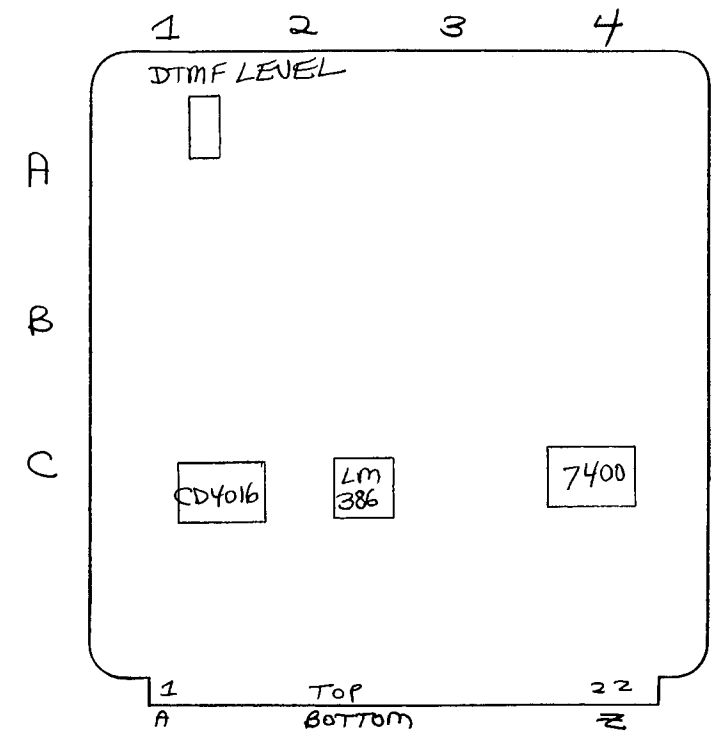
WR1AFU UHF Control System Board #5
Audio Processing

This board contains an audio gate and amplifier to drive the band-pass filter for the DTMF Decoder. The reason for this circuitry is for the ability to have separate local audio volume control for the receiver which would not change the audio fed to the DTMF decoder.

Power requirements to the board are +5V regulated.

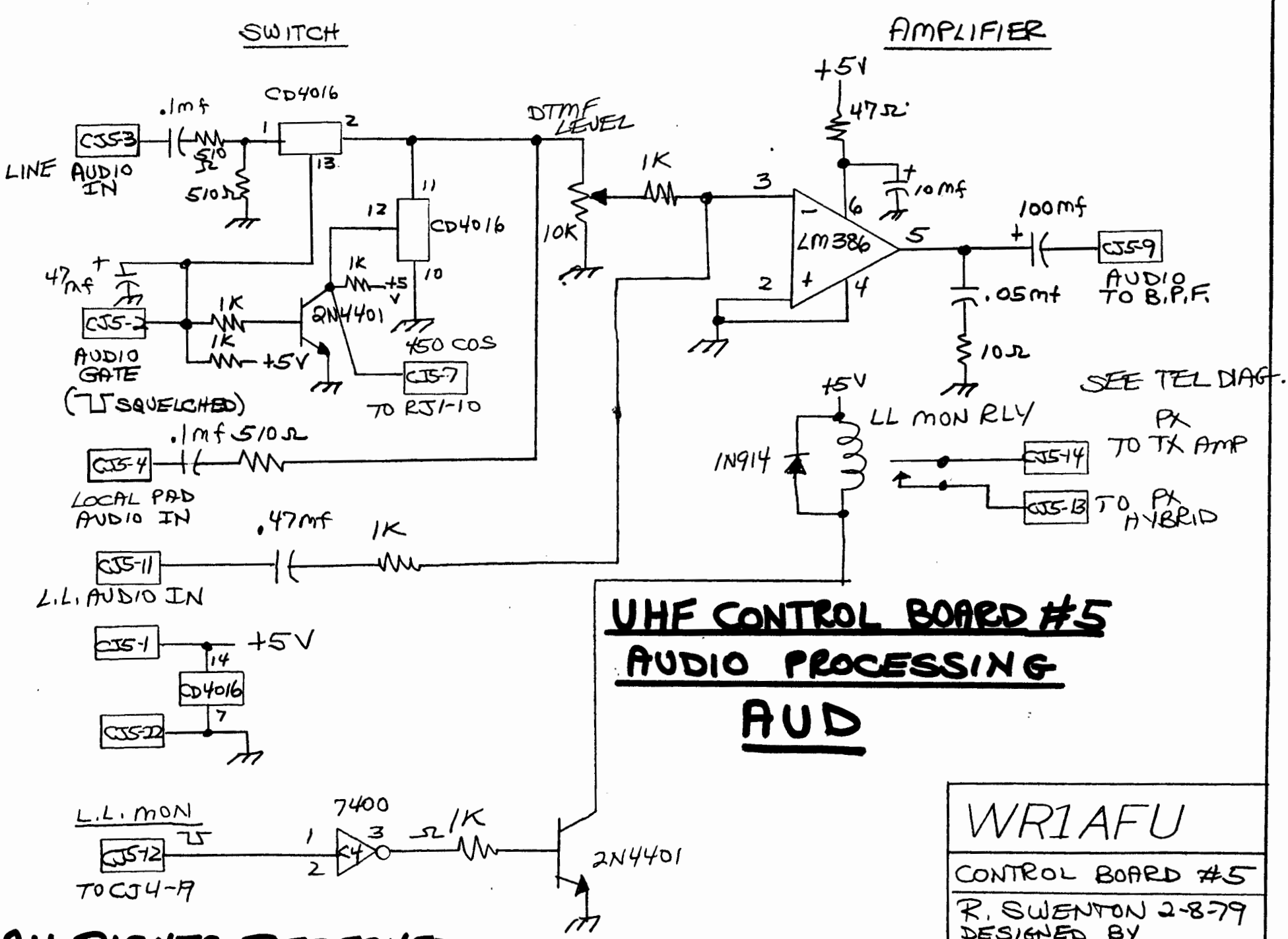
WR1AFU Control System designed by C. Cayer, WA1SZU and R. Swenton, WA1LMV.
Built by C. Cayer, WA1SZU.

R. Swenton
WA1LMV
2-26-79



WR1AFU UHF Control System Board #5 AUD Audio Processing

R. Swenton
WA1LMV
2-26-79



4011 Dual Line Amplifier

CONTENTS PAGE

1. GENERAL

1.01 This Section provides circuit description, installation and testing information for the Wescom 4011 Line Amplifier. The reverse side of the attached schematic diagram provides a history of previous schematic revisions.

1.02 The 4011 Line Amplifier (Figure 1) is a compact, solid-state, printed- circuit module used to provide from 0 to 36-dB gain in each direction on a four-wire, voice-frequency transmission facility.

1.03 Each 4011 Line Amplifier includes both a transmit and a receive integrated circuit amplifier, R.F. suppression network, impedence-matching line transformers, variable equalizer and level controls, and test jacks. The 4011 also incorporates a highly stable voltage regulating circuit allowing the amplifiers to operate from any input voltage between -21 and -55 Vdc.

1.04 Both the input and output of the receive and transmit amplifiers are provided with

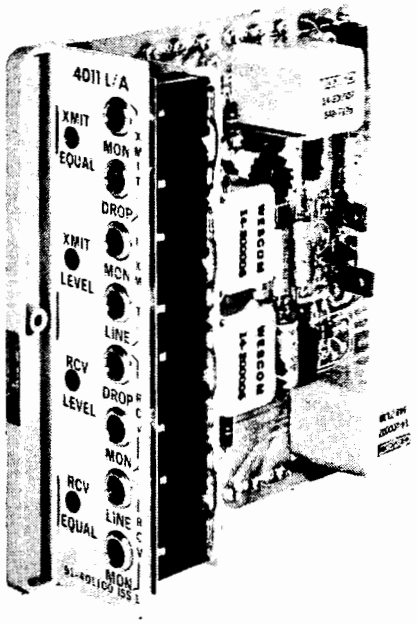


Figure 1. 4011 Line Amplifier, Front View

impedance-matching line transformers. Each transformer may be strapped for either 600- or 900-ohms impedance and is center-tapped to provide a balanced simplex (SX) signaling lead.

1.05 Variable equalizers are provided on the input of both the transmit and receive amplifiers to compensate for the inherent frequency response of the faciltiy.

1.06 The 4011 Line Amplifier is constructed as a plug-in module designed to mount in one position of a Wescom Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and allow for either KTU apparatus-case or relay-rack mounting.

1.07 The 4011 makes electrical connection to the system through one of the 56-pin,

Printed in U.S.A.

Wescom Field Service 716-385-2700

wire-wrap connectors provided as part of the mounting assembly.

2. SPECIFICATIONS

2.01 Specifications describing the electrical and physical characteristics of the 4011 Line Amplifier are as follows:

(a) MAXIMUM GAIN: +34 to -38 dB.

(b) MAXIMUM OUTPUT LEVEL: +18 dBm

(c) FREQUENCY RESPONSE: 300 to 3,000 Hz, ±1.0 dB

(d) ENVELOPE DELAY: Less than 100 us, 300 to 4000 Hz

(e) NOISE LEVEL: 23 dBrnCO, Maximum

(f) INPUT AND OUTPUT IMPEDANCE: 600 or 900 ohm, strappable ±5%

(g) TOTAL HARMONIC DISTORTION: Less than 1% at +10 dBm

NOTE: Above specifications assume no equalization or roll-off correction at 72° F

(h) POWER REQUIREMENTS: 40 mA at −21 to −55 Vdc

(i) EQUALIZATION: Gain differential between 1000 and 3000 Hz is adjustable from 0 to 5 dB

(j) SURGE PROTECTION: 1000 volts

(k) SIMPLEX RESISTANCE: 5 ohms input winding; 9 ohms, output winding

(l) SIMPLEX CURRENT: 120 mA (12 mA unbalanced)

(m) CROSSCOUPLING: −70dB (maximum)

(n) OPERATING ENVIRONMENT: Temperature, 32° to 120° F; Humidity to 95% (no condensation).

(o) STORAGE ENVIRONMENT: Temperature, −40° to 150° F; Humidity to 95%.

(p) WEIGHT: 1 lb. and 2 oz.

(q) DIMENSIONS: Height, 5-19/32 inches; Width, 1-1/2 inches; Depth, 6 inches.

(r) MOUNTING: Module occupies one position in a Type 400 Mounting Assembly which provides for either KTU apparatus case or relay rack mounting. Refer to Part 5 for mounting information.

3. CIRCUIT DESCRIPTION

3.01 This description is for the transmit amplifier only. Since these are identical amplifiers the description applies to the receive amplifier as well. The numbers and symbols used are those which appear on the transmit amplifier; refer to the attached 4011 schematic diagram.

3.02 Input signals are applied from the transmit drop to the primary of input transformer T4 which has an electrically balanced center tap to achieve longitudinal balance and to allow the device to be used in simplex operation up to 120 milliamps dc. A strapping option on the secondary of the transformer provides for matching the input impedance.

3.03 A bridging type test jack (XMIT MON) and a normal through jack (XMIT DROP) are both located across T4. The XMIT MON test jack provides for monitoring signals on the line, while the XMIT DROP test jack breaks the circuit to the amplifier and allows test tone to be injected into the transmit amplifier.

3.04 From the secondary of T4 signals are applied to potentiometer R11 (XMIT EQUAL control) in parallel with C14 providing a 0- to 5-dB adjustable equalization network at 3000 Hz referenced to 1000 Hz. After equalization, the input signal level is determined by potentiometer R10 (XMIT LEVEL) where the signal is attenuated as required. Input protection is provided by varistor CR6.

3.05 Input signals at the proper level are then applied through an RF suppression network R20 and C20. The IC amplifier then provides an adjustable gain for the filtered signal.

3.06 From the output of IC2, signals are amplified and coupled to the primary of output transformer T3 through C8 and R7. The primary winding of T3 is also provided with a strapping option to match either a 600- or 900-ohm line impedance.

3.07 Signals from the primary of T3 are induced into the secondary and applied out over the transmit line. The combination CR4, CR5, and V1 provide surge protection due to transients to 1000 volts.

3.08 The power supply is a Zener referenced series regulator which provides two emitter follower voltage outputs, one of which supplies the RCV amplifier, and the other, the XMIT amplifier. Each emitter follower provides a -20Vdc output, referenced to the level of Zener diode CR7, and highly stabel over the -21 V to -55 Vdc range of input power.

4. INSPECTION

4.01 Inspect the equipment thoroughly, as soon as possible after delivery. If the equipment has been damaged in transit, report the extent of damage to the transportation company immediately. If the equipment is to be stored, make an operational check to determine that the equipment is in proper working order as received from the factory. After an indication of satisfactory performance has been obtained, the equipment may be stored for future installation. If the System is to be installed at once, make an operational check after the installation is completed.

4.02 Wescom equipment is specifically identified by the model number and final-assembly number silk screened on the front panel of the plug-in module. At the start of production, the final-assembly number is assigned an issue number of 1 which becomes in integral part of the final-assembly number. After the start of production, this issue number is advanced each time a major engineering change occurs. Therefore, be sure to use the model number and final-assembly number when making inquiries about the equipment. The issue number of the instruction manual and schematic diagram attached should be the same as the issue number assigned to the equipment. If a one-to-one correspondence does not exist between these items, request from Wescom the instruction manual required for your equipment.

5. MOUNTING

5.01 The 4011 is designed to mount in one module position of a Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and may be equipped and prewired for any combination of modules from the Wescom product line.

5.02 **KTU apparatus case mounting**

Type 400-1 (one-module) through 400-5 (five-module) Mounting Assemblies may be installed in a 15A (equivalent to W.E.Co.31B) KTU apparatus case. Type 400-1 through 400-13 Mounting Assemblies may be installed in a 16C (equivalent to W.E.Co. 16C) KTU apparatus case.

relay rack mounting

5.03 Type 400-1 through 400-9 Mounting Assemblies require the use of mounting bars, when mounted on either a 19- or 23-inch relay rack. 400-10 and 400-11 Mounting Assemblies are provided with mounting brackets for mounting directly across 19-inch relay racks. Type 400-12 and 400-13 Mounting Assemblies are also provided with mounting brackets for 23-inch relay rack mounting.

5.04 Because Type 400-1 through 400-9 Mounting Assemblies must be installed on mounting bars, 7 inches of vertical space (four-mounting spaces) are required for relay-rack mounting. Type 400-10 through 400-13 Mounting Assemblies, however, are provided with mounting extensions located on the sides of the mounting assemblies and require only 6 inches of vertical rack space. Install the mounting assembly in a KTU apparatus case or on a relay rack (as described above) with mounting hardware provided.

6. INSTALLER CONNECTIONS

6.01 When the 4011 is installed in a Type 400 Mounting Assembly, it makes electrical connection to associated equipment through a 56-pin, wire-wrap card connector provided as part of the mounting assembly. Make all installer connections to this connector in accordance with Table 1.

4011 Dual Line Amplifier

CONTENTS PAGE

1. GENERAL

1.01 This Section provides circuit description, installation and testing information for the Wescom 4011 Line Amplifier. The reverse side of the attached schematic diagram provides a history of previous schematic revisions.

1.02 The 4011 Line Amplifier (Figure 1) is a compact, solid-state, printed- circuit module used to provide from 0 to 36-dB gain in each direction on a four-wire, voice-frequency transmission facility.

1.03 Each 4011 Line Amplifier includes both a transmit and a receive integrated circuit amplifier, R.F. suppression network, impedence-matching line transformers, variable equalizer and level controls, and test jacks. The 4011 also incorporates a highly stable voltage regulating circuit allowing the amplifiers to operate from any input voltage between -21 and -55 Vdc.

1.04 Both the input and output of the receive and transmit amplifiers are provided with

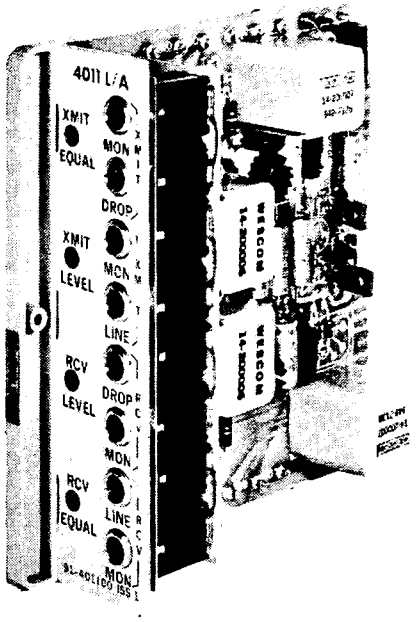


Figure 1. 4011 Line Amplifier, Front View

impedance-matching line transformers. Each transformer may be strapped for either 600- or 900-ohms impedance and is center-tapped to provide a balanced simplex (SX) signaling lead.

1.05 Variable equalizers are provided on the input of both the transmit and receive amplifiers to compensate for the inherent frequency response of the faciltiy.

1.06 The 4011 Line Amplifier is constructed as a plug-in module designed to mount in one position of a Wescom Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and allow for either KTU apparatus-case or relay-rack mounting.

1.07 The 4011 makes electrical connection to the system through one of the 56-pin,

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wire-wrap connectors provided as part of the mounting assembly.

2. SPECIFICATIONS

2.01 Specifications describing the electrical and physical characteristics of the 4011 Line Amplifier are as follows:

(a) MAXIMUM GAIN: +34 to -38 dB.

(b) MAXIMUM OUTPUT LEVEL: +18 dBm

(c) FREQUENCY RESPONSE: 300 to 3,000 Hz, ±1.0 dB

(d) ENVELOPE DELAY: Less than 100 us, 300 to 4000 Hz

(e) NOISE LEVEL: 23 dBrnCO, Maximum

(f) INPUT AND OUTPUT IMPEDANCE: 600 or 900 ohm, strappable ±5%

(g) TOTAL HARMONIC DISTORTION: Less than 1% at +10 dBm

NOTE: Above specifications assume no equalization or roll-off correction at 72° F

(h) POWER REQUIREMENTS: 40 mA at −21 to −55 Vdc

(i) EQUALIZATION: Gain differential between 1000 and 3000 Hz is adjustable from 0 to 5 dB

(j) SURGE PROTECTION: 1000 volts

(k) SIMPLEX RESISTANCE: 5 ohms input winding; 9 ohms, output winding

(l) SIMPLEX CURRENT: 120 mA (12 mA unbalanced)

(m) CROSSCOUPLING: −70dB (maximum)

(n) OPERATING ENVIRONMENT: Temperature, 32° to 120° F; Humidity to 95% (no condensation).

(o) STORAGE ENVIRONMENT: Temperature, −40° to 150° F; Humidity to 95%.

(p) WEIGHT: 1 lb. and 2 oz.

(q) DIMENSIONS: Height, 5-19/32 inches; Width, 1-1/2 inches; Depth, 6 inches.

(r) MOUNTING: Module occupies one position in a Type 400 Mounting Assembly which provides for either KTU apparatus case or relay rack mounting. Refer to Part 5 for mounting information.

3. CIRCUIT DESCRIPTION

3.01 This description is for the transmit amplifier only. Since these are identical amplifiers the description applies to the receive amplifier as well. The numbers and symbols used are those which appear on the transmit amplifier; refer to the attached 4011 schematic diagram.

3.02 Input signals are applied from the transmit drop to the primary of input transformer T4 which has an electrically balanced center tap to achieve longitudinal balance and to allow the device to be used in simplex operation up to 120 milliamps dc. A strapping option on the secondary of the transformer provides for matching the input impedance.

3.03 A bridging type test jack (XMIT MON) and a normal through jack (XMIT DROP) are both located across T4. The XMIT MON test jack provides for monitoring signals on the line, while the XMIT DROP test jack breaks the circuit to the amplifier and allows test tone to be injected into the transmit amplifier.

3.04 From the secondary of T4 signals are applied to potentiometer R11 (XMIT EQUAL control) in parallel with C14 providing a 0- to 5-dB adjustable equalization network at 3000 Hz referenced to 1000 Hz. After equalization, the input signal level is determined by potentiometer R10 (XMIT LEVEL) where the signal is attenuated as required. Input protection is provided by varistor CR6.

3.05 Input signals at the proper level are then applied through an RF suppression network R20 and C20. The IC amplifier then provides an adjustable gain for the filtered signal.

3.06 From the output of IC2, signals are amplified and coupled to the primary of output transformer T3 through C8 and R7. The primary winding of T3 is also provided with a strapping option to match either a 600- or 900-ohm line impedance.

3.07 Signals from the primary of T3 are induced into the secondary and applied out over the transmit line. The combination CR4, CR5, and V1 provide surge protection due to transients to 1000 volts.

3.08 The power supply is a Zener referenced series regulator which provides two emitter follower voltage outputs, one of which supplies the RCV amplifier, and the other, the XMIT amplifier. Each emitter follower provides a -20Vdc output. referenced to the level of Zener diode CR7, and highly stabel over the -21 V to -55 Vdc range of input power.

4. INSPECTION

4.01 Inspect the equipment thoroughly, as soon as possible after delivery. If the equipment has been damaged in transit, report the extent of damage to the transportation company immediately. If the equipment is to be stored, make an operational check to determine that the equipment is in proper working order as received from the factory. After an indication of satisfactory performance has been obtained, the equipment may be stored for future installation. If the System is to be installed at once, make an operational check after the installation is completed.

4.02 Wescom equipment is specifically identified by the model number and final-assembly number silk screened on the front panel of the plug-in module. At the start of production, the final-assembly number is assigned an issue number of 1 which becomes in integral part of the final-assembly number. After the start of production, this issue number is advanced each time a major engineering change occurs. Therefore, be sure to use the model number and final-assembly number when making inquiries about the equipment. The issue number of the instruction manual and schematic diagram attached should be the same as the issue number assigned to the equipment. If a one-to-one correspondence does not exist between these items, request from Wescom the instruction manual required for your equipment.

5. MOUNTING

5.01 The 4011 is designed to mount in one module position of a Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and may be equipped and prewired for any combination of modules from the Wescom product line.

5.02 **KTU apparatus case mounting**

Type 400-1 (one-module) through 400-5 (five-module) Mounting Assemblies may be installed in a 15A (equivalent to W.E.Co.31B) KTU apparatus case. Type 400-1 through 400-13 Mounting Assemblies may be installed in a 16C (equivalent to W.E.Co. 16C) KTU apparatus case.

relay rack mounting

5.03 Type 400-1 through 400-9 Mounting Assemblies require the use of mounting bars, when mounted on either a 19- or 23-inch relay rack. 400-10 and 400-11 Mounting Assemblies are provided with mounting brackets for mounting directly across 19-inch relay racks. Type 400-12 and 400-13 Mounting Assemblies are also provided with mounting brackets for 23-inch relay rack mounting.

5.04 Because Type 400-1 through 400-9 Mounting Assemblies must be installed on mounting bars, 7 inches of vertical space (four-mounting spaces) are required for relay-rack mounting. Type 400-10 through 400-13 Mounting Assemblies, however, are provided with mounting extensions located on the sides of the mounting assemblies and require only 6 inches of vertical rack space. Install the mounting assembly in a KTU apparatus case or on a relay rack (as described above) with mounting hardware provided.

6. INSTALLER CONNECTIONS

6.01 When the 4011 is installed in a Type 400 Mounting Assembly, it makes electrical connection to associated equipment through a 56-pin, wire-wrap card connector provided as part of the mounting assembly. Make all installer connections to this connector in accordance with Table 1.

CAUTION: The 4011 Line Amp is provided with lightning protection on both the receive and transmit lines. This protection is designed to prevent damage to the 4011 when provided with normal station protection at the line interfaces. We recommend that 3 MIL or 5 MIL carbon block protectors and or gas tube protectors be provided in the standard manner from both sides of the line to ground. This will insure protection of either the input or output terminals connected directly to an outside cable.

CAUTION: To avoid damage to voltage sensitive solid-state devices, it is recommended that the 4011 be operated from a source of well-filtered battery.

Table 1.4011Installer Connections

INSTRUCTION	56-PIN CONNECTOR ASSIGNMENT
Connect:	at:
four-wire transmit drop	55 and 49
transmit drop simplex	51 or 53
four-wire transmit line	41 and 47
transmit line simplex	43 or 45
four-wire receive line	7 and 13
receive line simplex	9 or 11
four-wire receive drop	5 and 15
receive drop simplex	1 or 3
−21 to −55 Vdc in	35
positive ground	17

CAUTION: Do not make any connections with power applied to the equipment or modules installed in the mounting assembly.

7. OPTIONS

strapping

7.01 The 4011 Line Amplifier module is provided with four, strappable impedance-matching line transformers. The impedance-matching line transformers provide for either 600 or 900 ohm input and output impedance (factory-strapped for 600 ohms). Figure 2 shows the location and identity of these strapping options.

CAUTION: When soldering straps, use insulated wire and not larger than a 30 watt iron.

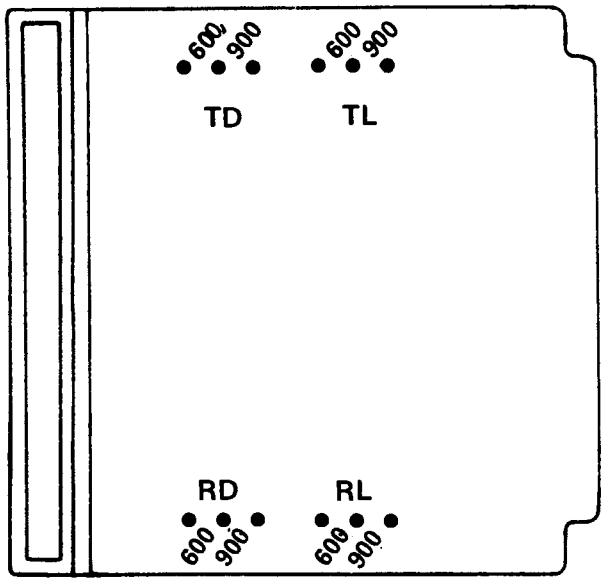


Figure 2. Strapping Post Location

7.02 Determine the required input and output impedance of both the transmit and receive lines. If the required impedance is 600 ohms, do not change the straps. If, however, the required impedance is 900 ohms, unsolder the existing straps (as required) and move them to the 900 ohm positions.

inserting modules

7.03 When all installer connections and strapping have been completed insert the 4011 module into the mounting assembly. An identification label designated 4011 is also provided on the front lower lip of the mounting assembly if the mounting assembly is factory wired.

CAUTION: Removing and installing modules should be done with care. Do not force a module into place. If excessive resistance is encountered while installing a module, remove the module and check the card guides and connector for improper alignment or the presence of foreign particles.

8. LINE-UP

8.01 The alignment procedure for the 4011 Line Amplifier consists of first injecting

1000-Hz test tone into the transmit amplifier and adjusting the transmit equalizer (XMIT EQUAL) and transmit level (XMIT LEVEL) controls. Requesting the distant terminal to send a 1000-Hz test tone through the receive amplifier is next, followed by the adjustment of the receive equalizer (RCV EQUAL) and the receive level (RCV LEVEL) controls which completes the procedure. Sufficient test jacks and variable controls are located on the equipment front panel to properly align the 4011 Line Amplifier.

test equipment

NOTE: The variable controls on the front panel of the 4011 are 4-turn potentiometers with friction clutches. (A friction clutch allows the potentiometer's shaft to continue to turn after reaching the minimum or maximum resistive stop). Before alignment, turn the front panel controls a minimum of 4 turns counterclockwise for minimum level and no equalization. Turn the front panel controls slowly clockwise until the desired level or equalization is obtained. If desired setting is exceeded, turn half turn further and then slowly return to desired setting.

8.02 The test equipment (or functional equivalent) required at both the local and distant terminals to properly align the 4011 is as follows:

(a) Transmission Test Set (TMS): Northeast Electronics TTS4C or W.E.Co. 23A.

(b) Variable Frequency Oscillator (VFO): Hewlett Packard 200 CD.

NOTE: If the Northeast Electronics TTS4C is used, the VFO is not required.

(c) Multimeter: Simpson 260 (or equivalent).

(d) Miscellaneous: Two, 10-foot, two-conductor test cords equipped with Type 310 plugs at each end; One 310 plug (open).

transmit alignment

8.03 Perform the alignment procedure for the 4011 transmit amplifier as follows:

(1) Verify that the four-wire facility is properly connected at BOTH local and distant terminals.

(2) Check that all installer connections and strapping options have been properly made.

(3) Using the multimeter, verify that power is applied to the 4011. Negative 20 ± 0.2 Vdc should be present at pins 23 (TP2) and 31 (TP1) with reference to pin 17 (GRD).

(4) Condition the local VFO to apply a 1000-Hz test tone at the required level and impedance specified on the Circuit Layout Record (CLR) and connect it to the XMIT DROP test jack on the 4011 front panel.

(5) Connect the TMS (set for the required terminated measurement) to the XMIT LINE test jack on the 4011 front panel and adjust the 4011 XMIT LEVEL control until the TMS indicates the level specified on the CLR.

(6) Remove the TMS from the XMIT LINE test jack. Request the distant terminal measure the 1000Hz test tone, and verify that the received tone is within the limits specified on the CLR card.

NOTE: If equalization is NOT required by the CLR proceed to step (12). If equalization is required, proceed as follows:

(7) Change the frequency (not the level) of the local VFO to send a 300-Hz test tone and request the distant terminal to measure the test tone level; record the 300-Hz test tone level.

(8) Change the frequency (not the level) of the local VFO to send a 2700-Hz test tone and request the distant terminal to measure the test tone level; record the 2700-Hz test tone level.

(9) Adjust the local XMIT EQUAL control clockwise and repeat steps (8) and (9) until the distant terminal reports that the difference between the 300-Hz and 2700-Hz test tone levels is 2 to 5 dB.

NOTE: For service other than voice message service, the CLR will specify the allowable difference between the 300-Hz and 2700-Hz test tone levels.

(11) Again, change the frequency (not the level) of the local VFO to send a 1000-Hz test tone and readjust, the local XMIT LEVEL control until the distant terminal reports that the received level coincides with that specified on the CLR.

(12) Disconnect the test equipment and verify circuit operation on the transmit line. This completes the transmit amplifier alignment.

receive alignment

8.04 Perform the alignment procedure for the 4011 receive amplifier as follows:

(1) Request the distant terminal to apply a 1000-Hz test tone to the local terminal receive line at the required CLR level.

(2) Insert an open plug into the RCV LINE jack on the front panel opening the receive line to the 4011.

(3) Connect the TMS (set for the required terminated measurement) to the RCV LINE MON test jack and verify that 1000 Hz test tone is at the required CLR level.

(4) Remove the TMS from the RCV LINE MON test jack and the open plug from the RCV LINE test jack.

(5) Connect the TMS (set for the correct terminated measurement) to the RCV DROP test jack; adjust the RCV LEVEL control until the local TMS indicates the proper level.

NOTE: If equalization is NOT specified on the CLR proceed to step (10). If equalization is required, proceed as follows:

(6) Request the distant terminal to change the frequency (not the level) of the distant VFO to 300-Hz. Using the local TMS, measure and record the test tone level.

(7) Request the distant terminal to change the frequency (not the level) of the distant VFO to 2700-Hz; measure and record this level.

(8) Adjust the local RCV EQUAL control clockwise and repeat steps (4) and (5) until the difference between the 300-Hz and 2700-Hz test tone levels is 2 to 5 dB.

NOTE: For services other than voice message service, the CLR will specify the allowable differences between the 300-Hz and 2700-Hz test tone levels.

(9) Request the distant terminal to send 1000-Hz test tone at the required CLR level and readjust the local RCV LEVEL control until the TMS indicates +7 dBm.

(10) Disconnect the test equipment, restore all equipment to normal and verify overall circuit operation. This completes the 4011 alignment procedure.

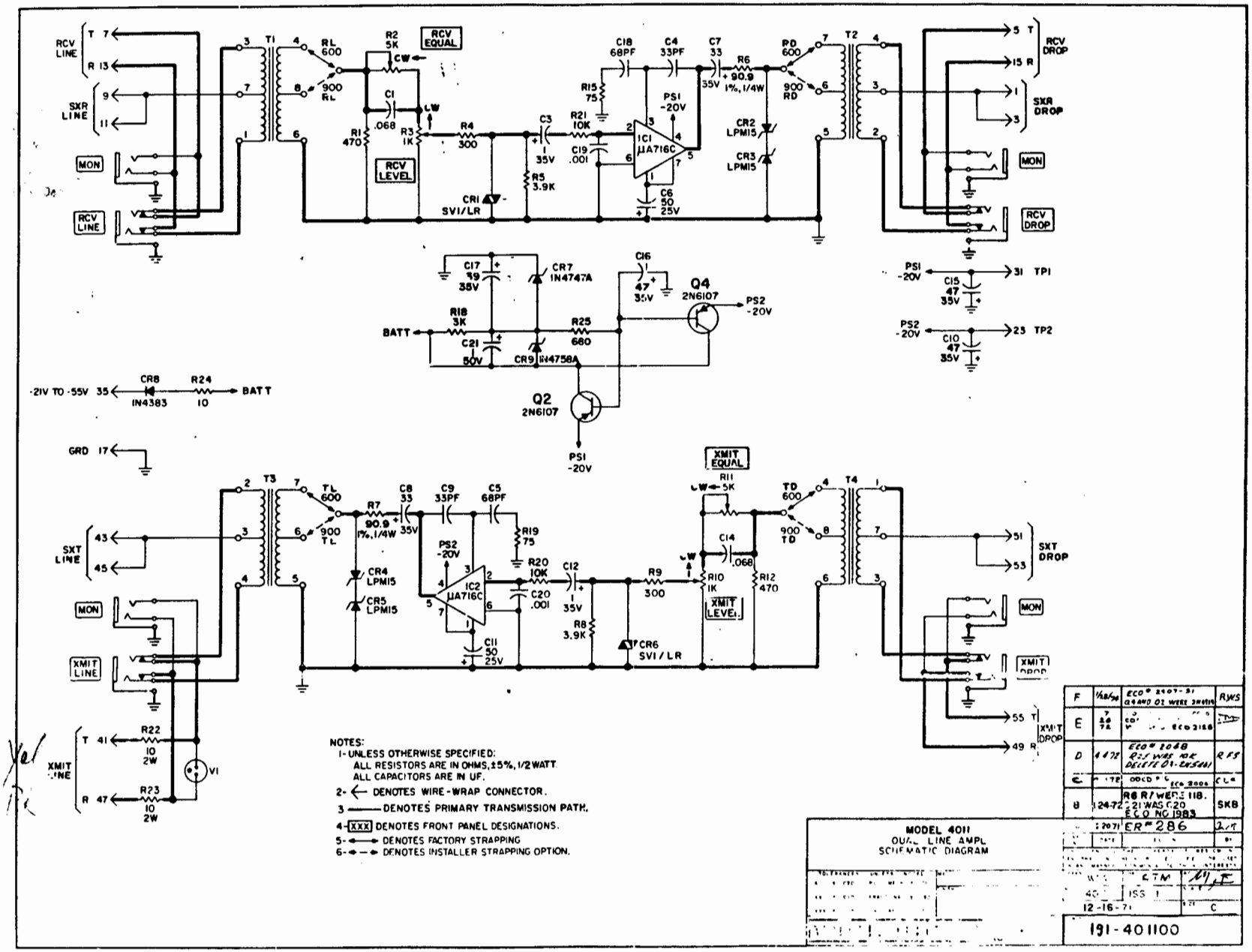
9. TESTING

9.01 If trouble is encountered with the operation of the 4011 verify that all installer connections have been properly made in accordance with Table 1 and that all options have been conditioned as required. Determine that power is applied to the 4011 step (4) of paragraph 8.03. With power removed, make certain that the module is making good connection with the mounting-assembly card connector; remove and reinsert the module.

9.02 If the trouble persists, perform the line-up procedure (Part 8) to determine that signal continuity and amplification are provided by the equipment. If technical assistance is required, contact Wescom Customer Service Department by calling 312-971-2010 or TWX 910-695-4735. If the requirements of the line-up procedure are not met, change out the 4011.

9.03 Field repairs involving the replacement of components within a module are not recommended. If a module is found to be defective, contact Wescom, Inc., by telephone or TWX, for instructions regarding replacement or repair. If a replacement module is required, it will be shipped the fastest way, or as specified by the customer. Upon receipt of a replacement module, return the defective module, using the shipping label provided, to Wescom, Inc., 501 Rogers Street, Downers Grove, Illinois 60515.

Canadian Customers: Wescom Canada, Ltd., 87 Brydon Drive, Rexdale, Ontario, Canada. 416-742-0236 or TWX 610-492-4367.



443 Terminating Set

CONTENTS PAGE

Figure 1. 443 Terminating Set

1. GENERAL

1.01 This Section provides circuit description, installation, and basic testing information for the Wescom 443 Terminating Set.

1.02 The 443 (Figure 1) is a plug-in, printed-circuit module used to provide two-wire termination of a four-wire facility.

1.03 The 443 Term Set consists of: (1) a transformer-type hybrid from which T, R, A, B, D, F, and G leads are derived, (2) a compromise balance network and network buildout (NBO) capacitors with provisions for an external precision balance network, and (3) a continuously adjustable, 0 to 30 dB, three-section "T" pad on both the transmit and receive lines to provide a nearly constant 600-ohm impedance towards the line side. This plug-in module also presents an interchangeable 900 or 600-ohm impedance in series with 2.15 microfarads to the two-wire drop. The unit is available with or without an Idle Line Termination (ILT) relay, as specified when ordering. The ILT relay, in the idle-circuit condition, provides a 600-ohm termination toward the transmit line and an open toward the two-wire drop side.

1.04 The term set is constructed as a plug-in module designed to mount in one position of the Wescom Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and allow for either KTU apparatus-case or relay-rack mounting.

1.05 The term set makes electrical connection to the system through one of the 56-pin, wire-wrap connectors provided as part of the mounting assembly. Each connector may be mechanically keyed to prevent the term set from being inserted into any position other than the proper mounting assembly position.

2. SPECIFICATIONS

2.01 Specifications describing the electrical and physical characteristics of the 443 are as follows:

(a) TWO-WIRE IMPEDANCE: 900 or 600 ohm, strappable, in series with 2.15 mF.

(b) FOUR-WIRE IMPEDANCE: 600 ohms ±5%.

(c) TRANSHYBRID LOSS: 50 dB, 200 to 4000 Hz (matched transmission).

(d) MINIMUM RETURN LOSS: 30 dB at 600 ohms or 900 ohms.

(e) HYBRID INSERTION LOSS: 4.0 dB, nominal.

(f) BALANCE NETWORK: 2.15 mF and 600 or 900 ohms.

(g) NETWORK BUILD OUT CAPACITANCE: Refer to schematic.

(h) OPERATING ENVIRONMENT: Temperature, −5° to 150°F (−20° to 65°C); Humidity, 95%.

(i) MAXIMUM A & B LEAD CURRENT: 100 mA without degradation in specifications.

(j) WEIGHT: 1.75 lbs (3.25 lbs including one-position mounting assembly).

(k) DIMENSIONS: Height, 7 inches; Width, 1−13/16 inches; Depth, 7−3/8 inches (including one-position mounting assembly).

(l) MOUNTING: KTU apparatus case or relay rack.

3. INSPECTION

3.01 Inspect the equipment thoroughly, as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately. If the equipment is to be stored for some time before installation, make an operational check at once. The purpose of this check is to make sure that the equipment is in proper working order as received from the factory. If this check indicates satisfactory performance, the equipment may be stored for future installation. If the System is to be installed at once, make an operational check after the installation is completed.

3.02 Wescom equipment is specifically identified by the model number and final-number silk screened on the front panel of the plug-in module. At the start of production, the final-assembly number is assigned an issue number of 1 which becomes an integral part of the final-assembly number. After the start of production, this issue number is advanced each time a major engineering change occurs. Therefore, be sure to use the model number and final-assembly number when making inquiries about the equipment. The issue number of the instruction manual and schematic diagram attached should be the same as the issue number assigned to the equipment. If a one-to-one correspondence does not exist between these items, request from Wescom the instruction manual required for your equipment.

4. MOUNTING

4.01 The 443 Term Set is designed to mount in one module position of a Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and may be equipped and prewired for any combination of modules in the Wescom product line.

KTU apparatus case mounting

4.02 Type 400-1 (one-module) through 400-5 (five-module) Mounting Assemblies may be installed in a 15A (equivalent to W.E.Co. 31B) KTU apparatus case. Type 400-1 through 400-13 Mounting Assemblies may be installed in a 16C (equivalent to W.E.Co. 16C) KTU apparatus case.

relay rack mounting

4.03 Type 400-1 through 400-9 Mounting Assemblies require the use of mounting bars when mounted on either a 19− or 23-inch relay rack. 400-10 and 400-11 Mounting Assemblies are provided with mounting brackets for mounting directly across 19-inch relay racks. Type 400-12 and 400-13 Mounting Assemblies are also provided with mounting brackets for 23-inch relay rack mounting.

4.04 Because Type 400-1 through 400-9 Mounting Assemblies must be installed on mounting bars, 7 inches of vertical space (four-mounting spaces) are required for relay-rack mounting. Type 400-10 through 400-13 Mounting Assemblies, however, are provided with mounting extensions located on the sides of the mounting assemblies and require only 6 inches of vertical rack space. Install the mounting assembly in a KTU apparatus case or on a relay rack (as described above) with mounting hardware provided.

universal shelf mounting

4.05 When a high degree of flexibility is required to provide for new circuit arrangements as well as circuit rearrangements, the 443 Term Set may be mounted in a Wescom Universal Shelf. The Universal Shelf permits all intermodule wiring and installer connections to be made at the front of the mounting assembly and provides maximum accessibility to these connections when changes are required. The Type 400UA-11 and 400UB-11 Universal Shelves provide mounting positions for up to 11 modules and are designed for mounting in a 19-inch relay rack. Type 400UA-13 and 400UB-13 Universal Shelves provide mounting positions for up to 13 modules and are designed for mounting in a 23-inch relay rack.

5. INSTALLER CONNECTIONS

5.01 When the 443 Term Set is installed in a Type 400 Mounting Assembly, it makes electrical connection to associated equipment through a 56-pin, wire-wrap card connector provided as part of the mounting assembly. Make all installer connections to this connector in accordance with Table 1.

5.02 Type 400UA-11 and 400UA-13 Universal Shelves provide terminal block locations above the mounting assembly, whereas Type 400UB-11 and 400UB-13 Universal Shelves provide terminal block locations below the mounting assembly. When the 443 Term Set is installed in a universal shelf, make all installer connections to these terminal blocks in accordance with Table 1.

CAUTION: Do not make any connections with power applied to the equipment or modules installed in the mounting assembly.

Table 1. 443 Term Set Installer Connections

INSTRUCTION	SCHEMATIC DESIGNATION	56-PIN CONNECTOR ASSIGNMENT
Connect:	**To:**	**At:**
transmit line T	4W XMIT T	55
transmit line R	4W XMIT R	49
receive line T & R	2W RCV T & R	5 and 15
two-wire drop T & R	2W T & R	41 and 47
A lead	A LEAD	43
B lead	B LEAD	45
D lead	D LEAD	51
F lead	F LEAD	19
G lead	G LEAD	27
*−48 or −24 Vdc	B (−)	25
*ground	SL (+)	29
external balance network	BAL NET	7 and 13
ground	GRD	17
*NOTE: Connect when using ILT relay.		

options

5.03 The 443 module is provided with internal screw-down connections to permit: (1) Idle Line Termination control, (2) operation of the Idle Line Termination relay with either a 24 or 48 Vdc supply, (3) 600 or 900 ohm 2W impedance, and (4) the addition of network build out capacitors. The 443 module is factory conditioned to include options S1, A, B, G, and H. If it is necessary to make a change in conditioning, refer to Figure 2 for screw-down option locations and perform all optional conditioning in accordance with the following paragraphs.

CAUTION: When installing an option, rotate the screw in a clockwise direction until a firm fit is made. Do not over torque screw.

CAUTION: When removing an option, rotate the screw counterclockwise two complete revolutions.

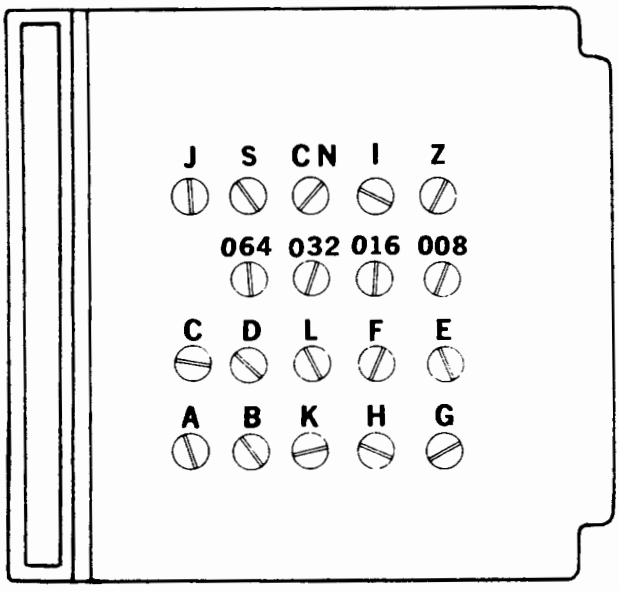


Figure 2. Screw-down Option Locations.

two wire impedance

5.04 Transformers T1 and T2 are tapped to match either a 900 or 600 ohm line impedance. For 900 ohm two wire impedance screw down options A, B, G, H and unscrew options C, D, E, F, J, K, and L. When using 600 ohm two wire impedance, screw down options C, D, E, F, J, K, and L and unscrew options A, B, G, and H. The J option is electrically parallel with R4 and is used to match impedances in the compromise balance network.

S1 option

5.05 The S1 screw-down option places a 1.08 or 1.9 microfarad capacitor across the A and B leads. For 900 ohms screw down the S1 option and remove the K option. For 600 ohms screw down the S1 option and the K option which inserts a 1.90 microfarad capacitor across the A and B leads.

NOTE: An external S1 capacitor must not be used. If the associated trunk circuit has an S1 capacitor, it must be removed and the term set capacitor used instead. When using a tie trunk circuit to open and close the B and D leads, remove the S1 option in the term set and insert the required capacitance in the external circuit.

balancing network

5.06 If an external precision balancing network is NOT specified on the Circuit Layout Record (CLR) card, the term set internal compromise network (NC) will be used; screw down option NC. If an external precision balancing network has been provided, make certain that the NC option is unscrewed.

NBO capacitors

5.07 Each of the term sets is provided with NBO capacitors which may be installed to add from 0.08 to 0.120 uF capacitance (in 0.08 uF steps) to match the capacitance of the two wire drop. Adjustments for the NBO capacitors are controlled by option screws located on the component side of the printed-circuit card. Pins 7 and 13 on the mounting assembly connector allow for connecting precision-type networks when required. After performing the Line-Up procedure for the transmit and receive levels, connect these NBO capacitors as outlined in paragraph 6.06.

idle line termination option

5.08 The 443 Terminating Set is arranged to accept the optional Idle Line Termination (ILT) relay. To determine if the term set is equip-

ped with ILT, examine the component side of the term set. If relay K1 is located near the connector in the upper right corner of the module, the ILT feature has been provided and the screw-down option procedures discussed in paragraphs 5.09 and 5.10 must be considered. If the ILT relay has not been provided, a wire will be connected between pins 53 and 55 on the component side of the board.

5.09 Perform the screw-down option procedure in accordance with step (a) 24 Vdc operation or step (b) 48 Vdc operation below.

(a) If the ILT relay is to be operated by a 24-Vdc supply, screw down options I and Z. Connect an insulated wire jumper from pin 25 B (-) at the rear term set mounting assembly to the -24 Vdc supply and connect pin 29 SL (+) to the associated trunk.

(b) If the ILT relay is to be operated by a 48-Vdc supply, screw down option I and unscrew option Z. Connect an insulated wire jumper from pin 25 B (-) at the rear term set mounting assembly to the -48 Vdc supply and connect pin 29 SL (+) to the associated trunk.

5.10 If the ILT relay has been provided, but is not required the relay must be conditioned so that it will become inoperative by unscrewing option I and jumpering pins 53 and 55.

inserting modules

5.11 When all installer connections and screw-down option conditioning have been completed, insert the 443 module into the mounting assembly. An identification label designated 443 is also provided on the front lower lip of the mounting assembly if the mounting assembly is factory wired.

CAUTION: Do not force any module into place. If you encounter excessive resistance while installing a module, remove the module and check the card guides and connector for improper alignment or the presence of foreign particles.

6. LINE-UP

6.01 The alignment procedure for the 443 Terminating Set consists of first adjusting the transmit level by injecting test tone into the 2W IN test jack and measuring it at the 4W XMIT test jack while adjusting the XMIT control to obtain the desired transmission level. The receive level is then adjusted, measuring test tone from the distant terminal at the 2W IN test jack while adjusting the RCV control to obtain the desired receive level.

6.02 The NBO capacitors should be connected for maximum return loss using the procedure in paragraph 6.06.

test equipment

6.03 Test equipment required at both the local and distant terminals to align and test the 443 Term Set is as follows:

(a) Transmission Measuring Set (TMS): Northeast Electronics TTS4AN or W.E.Co. 23A (or equivalent) capable of measuring to at least −60 dBm will be required.

(b) Variable Frequency Oscillator (VFO): Hewlett Packard 200 CD (or equivalent) capable of generating 300– to 3000-Hz signals.

NOTE: If the Northeast Electronics TTS4AN is used and is equipped with the TTS4XDV cover accessory, the VFO is not required.

(c) Associated Test Cords: Two, two-conductor test cords equipped with a 310 plug at each end.

(d) Capacitor Decade Box: General Radio 1419 or 1419A (or equivalent) capable of simulating .008 to .120 uF capacitance in .008 uF steps (optional for hybrid balance procedure).

6.04 Perform the following preliminary steps to prepare for the alignment procedure:

(1) Set the two wire impedance of the term set as outlined in paragraph 5.04.

(2) If the ILT feature has been provided on the term set, ascertain that it is connected and energized (or bypassed) to maintain circuit continuity.

(3) Verify the need for the S1 option and whether the internal COMP NET option or an external precision balance network is used. Normally the internal is used. Verify that the NBO capacitors are NOT connected in at this time.

(4) Loosen the locknuts on the XMIT and RCV controls on the term set front panel.

transmit and receive level

6.05 Adjust transmit and receive levels of the terminating set as follows:

(1) Condition the local VFO to apply a 1000-Hz test tone at the level and impedance specified on CLR card and connect it to the 2W IN test jack on the term set front panel.

(2) Connect the TMS (set for 600-ohm termination) to the 4W XMIT test jack on the term set.

(3) Rotate the XMIT control until the TMS indicates the value specified on the CLR card for the transmit level.

(4) Connect the TMS to the 4W RCV test jack.

(5) Request the distant terminal to send tone at the proper level and make adjustments as necessary to ensure proper level at the 4 Wire Receive test jack as specified on the CLR card.

(6) Remove the TMS from the 4W RCV test jack and connect to the 2W IN test jack.

(7) Adjust the RCV control until the TMS indicates the level as specified on the CLR card.

hybrid balance (return loss)

6.06 Perform the hybrid balance procedure on the 443 Terminating Set as follows:

(1) With conditions as described in paragraph 6.05 step (5) connect the capacitor decade box (set to 0 uF) to pins 7 and 13 (balance network). Connect the TMS (set for 600 ohms terminating measurement) to the 4W XMIT test jack.

(2) Increase the capacitance of the capacitor decade box (in 0.008 uF steps) until the TMS indicates the lowest level (best hybrid balance).

NOTE 1: A 415 card extender may be used if a capacitor decade box is not available. Remove the term set and connect it to the card extender. Insert the card extender with the term set into the mounting assembly. With conditions as described in paragraph 6.05 step 5, connect the TMS (set for 600 ohm terminating measurement) to the 4W XMIT test jack. Connect in the NBO capacitors, one step at a time according to the NBO capacitor screw-down option chart (Table 2), starting with 0.008. Continue until no further decrease in TMS reading is noted. (Capacitors are paralleled to increase total capacity).

NOTE 2: If a capacitor decade box or a 415 card extender are not available, remove the term set from the mounting assembly. Screw down the NBO capacitor options one step at a time according to the NBO capacitor option chart (Table 2), starting with 0.008. Replace the term set and note if TMS reading is lower. Continue until no further decrease in TMS reading is noted.

(3) Remove the term set from the mounting assembly and screw down the NBO capacitor options for the value of capacitance nearest to the value indicated on the capacitor decade box, using the NBO capacitor option chart (Table 2).

Table 2. NBO Capacitor Options.

CAPACITOR COMBINATIONS	CAPACITANCE
.008	.008 μF
.016	.016 μF
.008 + .016	.024 μF
.032	.032 μF
.008 + .032	.040 μF
.016 + .032	.048 μF
.008 + .016 + .032	.056 μF
.064	.064 μF
.008 + .064	.072 μF
.016 + .064	.080 μF
.008 + .016 + .064	.088 μF
.032 + .064	.096 μF
.008 + .032 + .064	.104 μF
.016 + .032 + .064	.112 μF
.008 + .016 + .032 + .064	.120 μF

7. CIRCUIT DESCRIPTION

7.01 The 443 Terminating Set is composed of a two-transformer hybrid circuit, a series blocking capacitor at the mid-point of the two-wire windings to derive a dc path for loop signaling, a compromise network, NBO capacitors, transmit and receive impedance matching networks and variable "T" pads. Refer to the attached schematic diagram during the following discussion.

7.02 Speech currents from the two-wire drop flow through line windings 2-3 and 4-5 of transformers T2 and T1 and the midpoint capacitors associated with the A and B leads. Since the balancing network winding 1-6 of transformer T2 is connected in series, but with a reverse poling with respect to the network winding 1-6 of transformer T1, no signal voltages appear across the compromise network and therefore, the incoming speech power will divide equally between the 7-9 and 10-8 windings of transformers T1 and T2, respectively. These windings have been tapped to match either a 900 or 600 ohm line impedance.

7.03 Speech signals that enter the receive side of the circuit are attenuated by the adjustable pad AT1 and pass through impedance matching network C1 to windings 7-9 and 8-10 of transformer T1. The transformer design is such that equal voltages appearing across the 3-2, 5-4, and 1-6 windings of transformer T1 will result in equal currents flowing through the 3-2, 5-4, and 1-6 windings of transformer T2. Network windings 1-6 have opposite poling therefore, the fluxes cancel and no signal is induced into the transmit side. In the ideal condition, the impedance of the network exactly matches the impedance of the two-wire drop in both magnitude and phase. One-half the receive power will therefore be dissipated in the compromise network and the remaining energy will be transmitted to the two-wire drop.

7.04 Capacitors C5 and C11 are inserted at the midpoint of the two-wire windings of transformer T1 and T2 to derive A and B-leads for loop signaling. A, B, F, D and G leads are brought out at the 56-pin, wire-wrap connector for developing pad control and signaling functions. In some applications, the trunk circuit opens the midpoint of the two-wire line for signaling, and closes the connection for transmission. By opening the S1 strap, a D lead is made available allowing a two-wire signaling circuit to open and close the B and D leads.

7.05 Each terminating set has a compromise network (COMP NET) to balance the office two-wire impedance, a capacitor between each of the hybrid coil network windings, and four optional NBO (Network Build-Out) capacitors in parallel to balance the two-wire line. Adjustments for these options are controlled by option screws located on the component side of the printed-circuit card.

7.06 To improve return loss performance an external precision network may be added between pins 7 and 13 on the mounting assembly connector. When using an external precision network remove the compromise network (COMP NET) option.

7.07 When the ILT option is furnished, R4 provides termination toward the XMIT LINE during the idle condition. With battery on the B (-) lead and ground on SL (+) lead, relay K1 operates, which removes the termination and provides a transmission path. Relay K1 may be conditioned to accept either a 24 or 48 volt source using screw-down option Z.

8. TESTING

8.01 If trouble is encountered with the operation of the 443, check the most obvious causes of system malfunction, first. Verify that all installer connections (Table 1) have been properly made. Make certain that the module is making good connection with the mounting-assembly card connector; snap the module out and in several times. If trouble persists, replace the term set with one of known operating condition and retest.

8.02 Field repairs involving replacement of components within a module are not recommended. All Wescom systems and component boards are warranted for 1 year from the date of purchase. Return to Wescom, Inc., 501 Rogers Street, Downers Grove, Illinois 60515. For technical assistance, call 312-971-2010 or TWX 910-695-4735.

Addendum To
443 Terminating Set

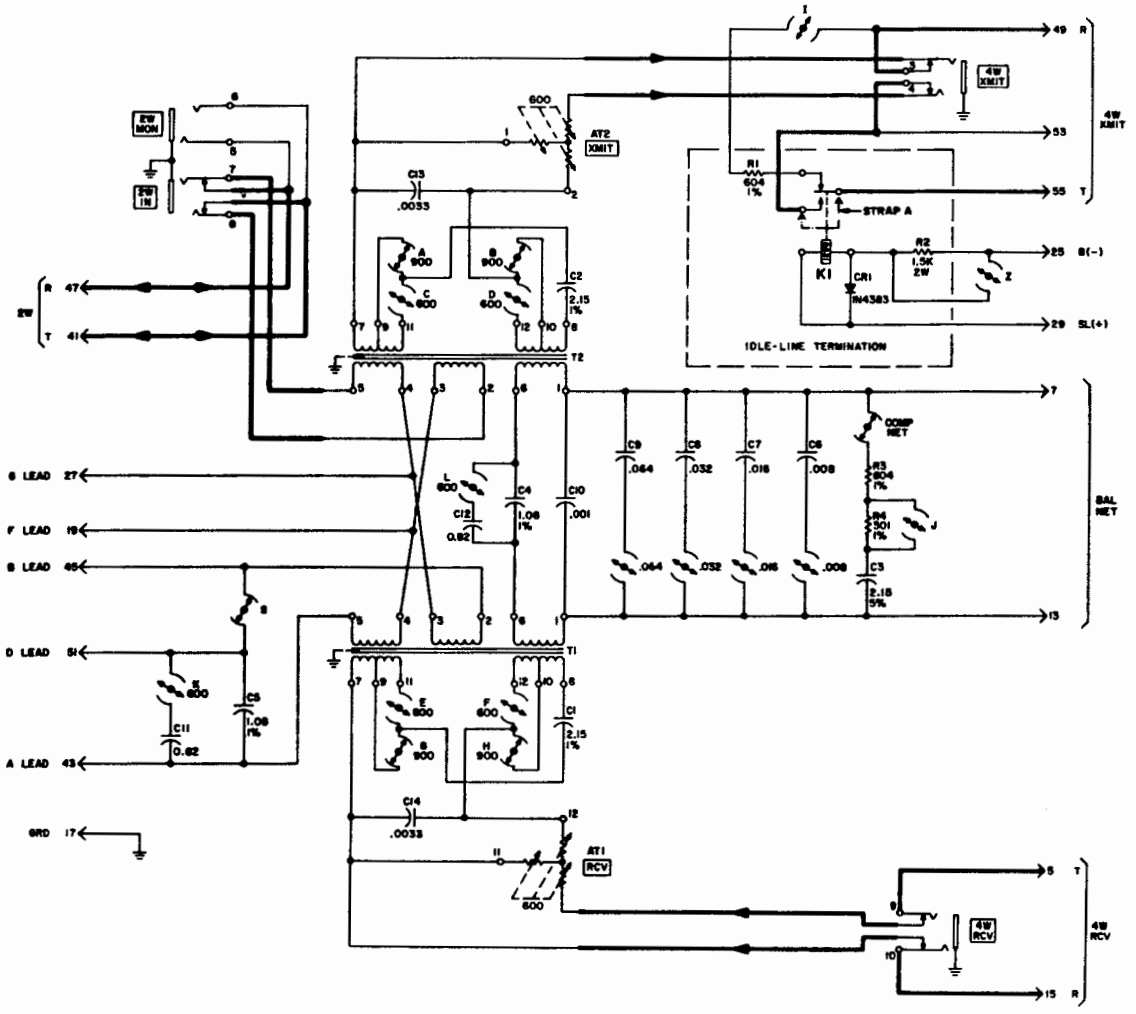
1. GENERAL

1.01 This addendum is issued to revise Section 443-101/3. Refer also to the reverse side of the attached schematic diagram 191-044300 for a history of previous schematic revisions.

1.02 In ink or red pencil, make the changes in Part 2 of this addendum in the margin adjacent to the affected copy or insert a note referring to this addendum.

2. CHANGES

2.01 In paragraphs 5.03, 5.05, 6.04 subpart (3) and 7.04, change all "S1" designations to read "S".



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTORS ARE IN OHMS, ±5%, 1/2WATT CAPACITORS ARE IN MICROFARADS
2. ← PC BOARD CONNECTOR
3. ——— PRIMARY TRANSMISSION PATH
4. XXX FRONT PANEL DESIGNATIONS
5. OPEN, CLOSED SCREW OPTIONS
   TWO C.C.W. TURNS OF SCREW OPTION ARE SUFFICIENT TO BREAK CIRCUIT
6. FOR 900Ω, TWO WIRE IMPEDANCE, CLOSE OPTIONS A, B, G, H, AND S, AND OPEN OPTIONS C, D, E, F, J, K, AND L.
7. FOR 600Ω, TWO WIRE IMPEDANCE, CLOSE OPTIONS C, D, E, F, J, K, L, AND S, AND OPEN OPTIONS A, B, G, AND H.
8. C11 AND C12 ARE SUPPLIER MATCHED TO 1%
9. WHEN UNIT IS EQUIPPED WITH IDLE LINE TERMINATION OPTION, ITEMS ENCLOSED IN DASHED BOX ARE PROVIDED.
10. WHEN UNIT IS NOT EQUIPPED WITH IDLE LINE TERMINATION OPTION, STRAP A IS PROVIDED AS INDICATED (SEE TABLE A)
11. IF K1 IS OPERATED FROM -24V, CLOSE OPTION Z.
12. TO PERMANENTLY DISABLE IDLE LINE TERMINATION WHEN PROVIDED, EXTERNALLY CONNECT PINS 53 AND 55, AND OPEN OPTION I.

TABLE A

MODEL	STRAP A	K1 RLY	IDLE LINE TERMINATION
44300	X		NO
44301		X	YES

D	12-7-72	ECO NO 2119 ADDED STRAP A, B TABLE A
C	8-4-71	1789 C13 AND C14 WERE .0022 C10 WAS .0018
B	12-7-70	1643 FINAL ASSY CH
A	11-5-70	1628-155 CHG

4W TERM SET SCHEMATIC DIAGRAM

WESCOM INC.

WPA | 445 | ISS: 2 | 10-27-70 | D

191-044300

-6 Line Loss

1001D DATA COUPLER

DESCRIPTION, INSTALLATION, MAINTENANCE, AND TESTS

CONTENTS PAGE

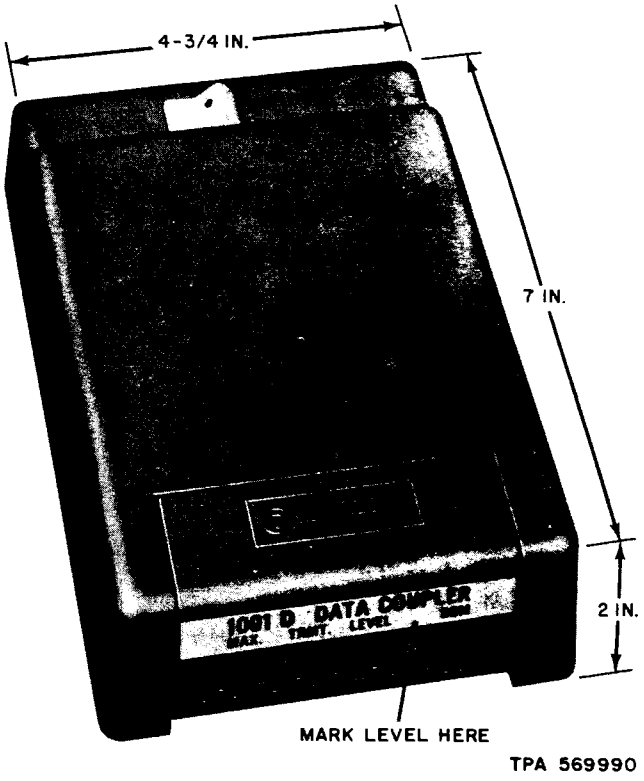


Fig. 1—1001D Data Coupler

1. GENERAL

1.01 This section provides information required for installing and maintaining the 1001D Data Coupler (Fig. 1). Detailed information is contained in SD- and CD-1D206-01.

1.02 The data coupler provides the means for connecting customer-provided automatic data equipment to the switched telecommunications network for data and voice communications. The unit provides both the Data Access Arrangement (DAA) and the Network Control Signaling Unit as described in appropriate tariffs. The uniform service order code (USOC) for the coupler is CBT.

1.03 The 1001D Data Coupler is designed to provide the following:

- Isolation of customer equipment for the protection of the telephone plant and personnel
- Protection of customer equipment from metallic and longitudinal surges occurring on the telephone facilities in excess of 50 volts
- Automatic linear control of signal level above a specified threshold
- Contact-type interface
- Detection of incoming ringing signals to permit customer to operate in unattended answering mode
- Test circuitry for manually operated remote testing
- Switchhook control which allows customer equipment to dial-pulse for call originations

- Timed delay on all calls to protect automatic message accounting
- Indication of switchhook status on associated telephone set, if provided
- Two-way transmission path.

1.04 Additional telephone functions, such as alternate voice service, may be provided with an associated telephone set as a standard option.

1.05 The data coupler requires external dc power for operation. A 20- to 28-volt dc supply, capable of supplying 100 mA, will normally be provided to the interface (+V and −V) by the customer. The telephone company will optionally furnish the power.

1.06 The customer equipment may be connected through the data coupler to local loop facilities or to Bell System PBX station lines.

1.07 The service offering in which the data coupler is used provides the customer with end-to-end transmission performance characteristics comparable to DATA-PHONE® service. Because the customer equipment, over which the Bell System has no design control, may contribute significantly to error performance, the Bell System cannot assume responsibility for the accuracy of the transmitted data. The end-to-end facilities, including the local loop, will be engineered and maintained to the equivalent DATA-PHONE service requirements. These requirements are specified in Section 314-205-501 for local loops and in Section 314-205-500 for the switched message network.

2. DESCRIPTION

A. Physical Description

2.01 The 1001D Data Coupler is a wall-mounted unit measuring 4-3/4 inches wide, 7 inches high, and 2 inches deep. The coupler weighs approximately 1-3/4 pounds and is enclosed in a gray plastic housing. The housing consists of a dark gray base and a light gray cover that snap together. One keyhole slot and one screw hole are provided in the base for mounting the unit on a wall or on other vertical surfaces.

THE COUPLER MUST BE VERTICALLY MOUNTED FOR PROPER OPERATION OF MERCURY RELAY.

2.02 The circuitry for the coupler is mounted on two printed circuit packs. Four wire leads provide the connection between the two stacked packs.

2.03 Ten screw terminals, located under the small hinged cover and on the larger circuit pack, provide the interface for connecting the customer equipment (Fig. 2). The interface control leads use contact closures for signaling. See Table A for the designation of each interface lead. The cord required for connecting the customer equipment to the interface must be supplied by the customer.

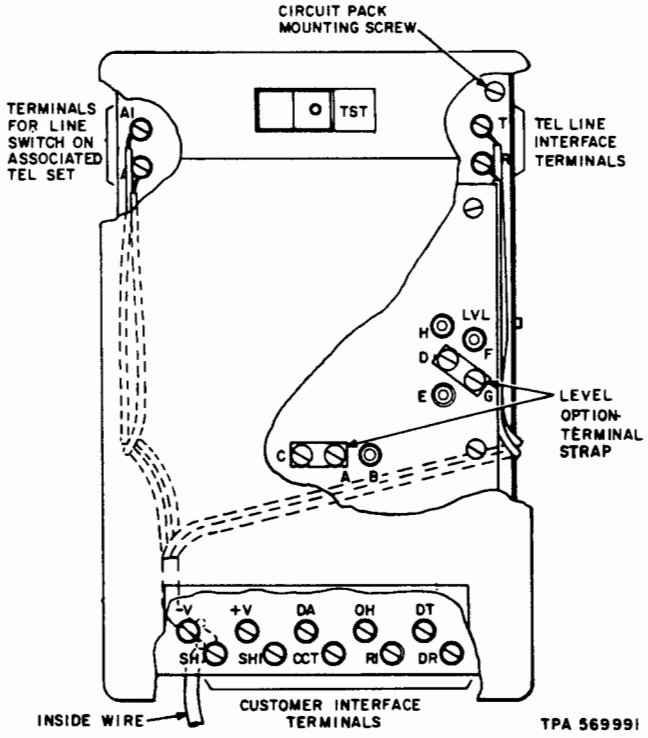


Fig. 2—Route of Station Wiring and Location of Terminals

2.04 Four additional screw terminals are provided on the larger printed circuit pack for connecting the telephone line and associated apparatus to the coupler. The housing cover must be removed to make the connections within the coupler. The installer uses D station wire to terminate the

TABLE A

INTERFACE LEAD DESIGNATIONS FOR 1001D DATA COUPLER

TERMINAL DESIGNATION	FUNCTION
DT	Data Tip — 600-Ohm Transmission Leads
DR	Data Ring — 600-Ohm Transmission Leads
OH	Off-On Hook Control
DA	Request Data Transmission Path Cut-Through
RI	Ring Indication
CCT	Coupler Cut-Through
SH	Switchhook Status of Associated Tel Set
SH1	Return for SH Lead
+V	Positive dc Power
−V	Return for dc Power and Common for OH, DA, RI, and CCT

connections. The following pairs of leads terminate on the four terminals:

- T and R—Telephone line transmission and signaling pair
- A and A1—Extension of associated telephone set switch contact to the terminal equipment.

2.05 A locking switch (TST) is located at the top of the coupler to provide control of the test mode condition.

2.06 Level option terminals located on the smaller circuit pack are strapped by the installer to adjust the threshold of the automatic level control (limiter) circuit.

2.07 The data coupler is designed to operate over an ambient temperature range of 0 to 120°F with a maximum relative humidity of 95 percent. The local loop assignment must meet the data transmission requirements as described in 1.07.

2.08 The coupler automatic level control circuit is powered from the dc telephone line current. An external power supply is required to provide a dc supply for the control circuit of the coupler. The external supply may be provided by the customer, or by the telephone company at customer request. When the telephone company is requested to provide the supply, a suitable power source is the 28A1 power unit (Section 167-445-101) or the 19B2 power unit (Section 167-440-201). The customer must provide a standard 2-pole, 3-wire grounded, 117-volt ac power receptacle for either power unit. The receptacle must not be under control of a switch.

Do not connect the power unit to local ground when the coupler – V terminal is internally grounded within the customer equipment.

B. Functional Description

2.09 ***General:*** The data coupler is a network protective unit designed to interface a customer-provided automatic data terminal. The coupler provides contact closures to the data terminal to indicate the detection of ringing signals. In response to the contact closures, the data

terminal provides signals which cause the coupler to seize the line, trip ringing, and cut through the transmission path. Prior to the transmission path cut-through, a 1- to 3-second delay is provided to allow proper operation of the automatic message accounting equipment. A polarity guard, automatic level control (ALC), and a coupling transformer are provided to protect the telecommunications network, coupler, and the customer equipment. In addition to automatic answering, the coupler circuitry permits the data terminal to automatically originate and to terminate data calls.

Note: An interface control lead closed to −V indicates an ON condition. A control lead opened to −V indicates an OFF condition.

2.10 ***Coupler Transmission Path:*** The coupler transmission path consists primarily of a coupling transformer, an automatic level control (ALC) circuit, and a polarity guard (Fig. 3). The transformer terminates the telephone loop and provides a two-way protective function (ie, hazardous voltages, surge protection, and longitudinal isolation). The ALC circuit prevents the customer signal level from exceeding the prescribed maximum limit. The polarity guard maintains the polarity of the line current and voltage required by the ALC circuit.

2.11 The ALC circuit monitors the output of the customer data signals. Optional strapping on the level adjusting network determines the voltage level at which the circuit operates to control the output signal.

2.12 The signal power level is continuously averaged for 3 seconds by the detector and integrator. When the 3-second average signal exceeds the prescribed operating level, current is driven through the thermistor. The thermistor heats up, decreases in resistance, and since the thermistor shunts the transmission path, decreases the signal level. The signal is thus prevented from exceeding the threshold.

2.13 The customer must be informed at the time the coupler is installed of the maximum permissible signal power output from his data equipment. The output level of the customer-provided equipment is the power measured at the customer interface into a 600-ohm resistive load. The maximum output level may vary between −1 and −10 dBm, in 1-dB steps, depending upon the 1000-Hz loss of the local loop including the nominal 2-dB insertion loss of the coupler.

Note: The prescribed maximum limit must be marked on the data coupler at the time of installation (see Fig. 1).

2.14 Other major components of the data coupler consist of a ring detector, interface control circuits, and a test oscillator. These components provide the coupler with two modes of operation: a data mode and a test mode. A talk mode is also available when a telephone set is provided.

DATA MODE

2.15 ***Automatic Answering:*** The ring detector (Fig. 3) is activated when the 20-Hz ringing signal is present on the line indicating an incoming call. The R relay, part of the ring detector, operates and releases in response to each half cycle of the ringing current. The contact closures of the R relay are used to close the RI interface lead to −V. ***The contact closures must be integrated by the customer data terminal to protect against false operations due to surges or to dial pulses. At least two cycles of the 20-Hz ringing signal should be detected before reacting to the signal.***

2.16 When the data terminal is ready and satisfied that ringing has been received, the OH interface lead is closed to the −V lead. Closure of the OH lead operates the OH relay. In turn, the relay performs the off-hook function by closing the loop to trip ringing. The relay also closes the operate path from the DA interface lead to the delay timer. To complete the data transmission path, the data terminal closes the DA lead to −V. (The DA lead may be closed to −V at all times except when dial pulsing on the OH lead.) The DA lead closure, or the operation of the OH relay when DA is permanently ON except during dialing, starts the timer circuit. After a 1- to 3-second interval, the CT relay operates. The CT relay removes the terminating resistor (R19) from the loop, removes the terminating resistor (R18) from the data terminal, connects the data terminal to the telephone line through the ALC, and closes the CCT interface lead to −V. The closure of the CCT lead informs the data terminal that the transmission path is now completed through the coupler from the data terminal to the local loop.

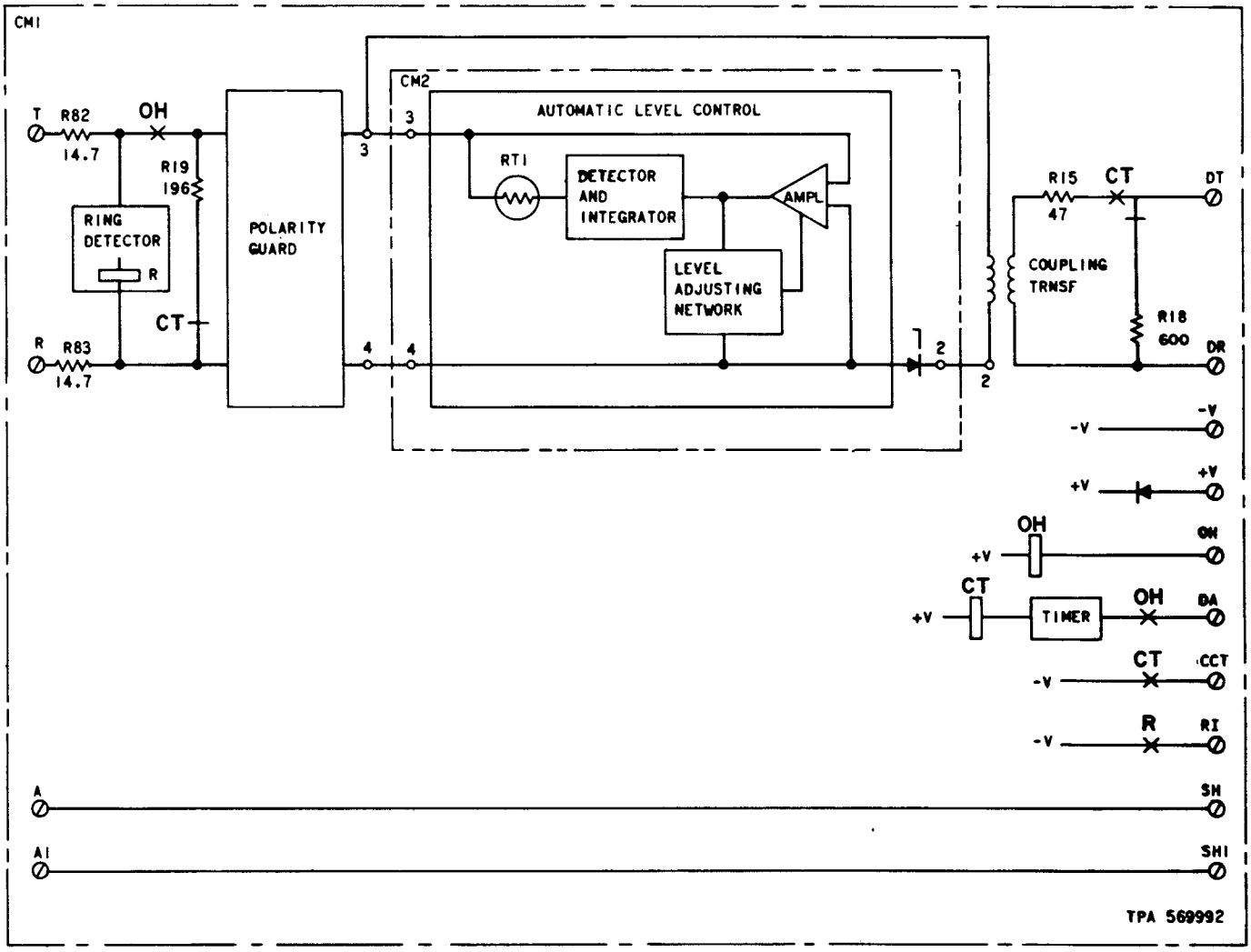


Fig. 3—1001D Data Coupler, Data Mode

The closure of the CCT interface lead does not imply that an end-to-end connection has been established.

2.17 The data coupler contains no circuitry to generate or to detect answer-tone signals. The customer must provide or detect the answer tone when required.

2.18 ***Call Origination:*** The customer closing the OH interface lead to −V, either for call origination or for transfer from a manually originated call, will cause the OH relay to provide the off-hook function as previously described. Opening the OH lead causes the OH relay to release and to open the dc path through the coupler. This sequence of operation permits the data terminal to generate dial pulses for call originations when dial tone is present. The pulsing sequence and timing requirements are as follows (see Fig. 4).

(1) Close the OH lead.

Note: The DA lead may be closed to −V to detect dial tone or, after an interval, the presence of the tone may be assumed and blind dialing initiated. If the DA lead is closed, a 1- to 3-second interval will occur before dial tone can be detected. The DA lead must be opened for the remainder of the dialing sequence after dial tone is detected. The dial speed should be a nominal value of 10 pps.

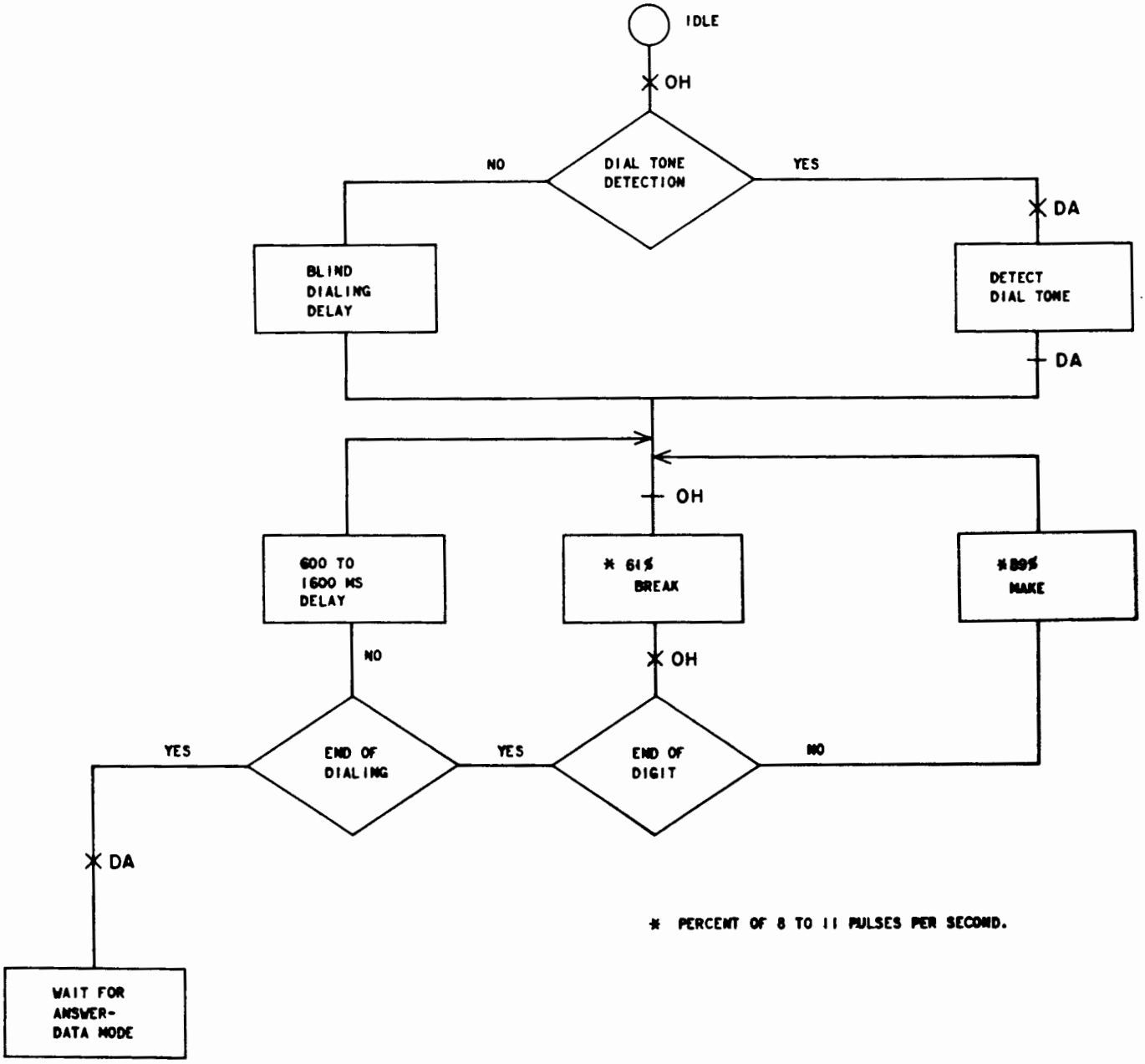


Fig. 4—Customer Automatic Calling Sequence Diagram—DC Dial Pulsing

(2) Open the OH lead for a 61% break interval.

(3) Close the OH lead for a 39% make interval.

(4) Repeat (2) and (3) for the number of pulses required, eg, a total of 5 openings of the OH lead for the digit 5.

(5) After the last pulse of a given digit, delay 600 to 1600 msec and start the first pulse of the next digit.

(6) After all digits have been generated, close the DA lead.

2.19 Closing the DA lead, either for the detection of dial tone or after the dialing sequence is completed, causes the circuit to function the same as on incoming calls when combined with the closing of the OH lead. After a 1- to 3-second interval, the CT relay operates to connect the data terminal to the telephone line and closes the CCT lead to

inform the terminal equipment that the transmission path has been cut through to the local loop.

2.20 Automatic calling may also use TOUCH-TONE® signaling for call originations (Fig. 5). As previously stated, closing the OH and DA leads to −V causes the coupler to go off-hook and provides a transmission path between the data terminal and the telephone line. When dial tone is present, multifrequency signals are generated to access the switched telecommunications network. The customer may then wait for answer tone or for a verbal answer before transmitting data.

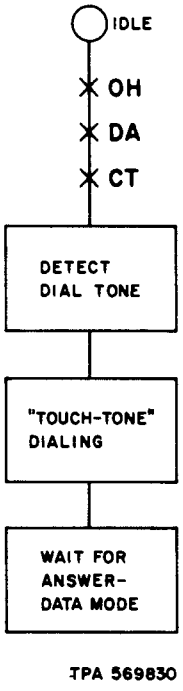


Fig. 5—Customer Automatic Calling Sequence Diagram—TOUCH-TONE Dialing

2.21 *Call Termination:* When data transmission is complete, the data coupler does ***not*** provide an automatic disconnect. The data terminal must recognize the end of the call and must open the OH interface lead. In turn, the OH and CT relays drop to open the telephone loop and to disconnect the terminal equipment from the coupler. The coupler returns to an idle state.

TEST MODE

Accidental or intentional operation of the TST switch while transmitting data will interrupt the data signals.

2.22 The data coupler test circuit provides the means for applying a test tone to the line through the ALC circuit (Fig. 6). This permits testing the level control, the local loop, and certain control functions of the coupler. The circuit is designed to be tested remotely from the local test desk, although a data test center or other designated test locations may perform the test.

2.23 The test circuit consists of a tone oscillator, test (TE) relay, and a switch (TST). The TST switch is used to condition the test circuit for operation. The switch closes a path to a relay driver for the TE relay and to the winding of the OH relay. The switch also removes part of the interface control leads (OH and RI) from the customer equipment to prevent false operation or indication.

2.24 The data coupler detects the incoming ringing signal of a test call in the same manner as previously described for the data mode. The R relay operates and releases in response to the ringing current. When the R relay operates, −V is closed to a relay driver which in turn operates the TE relay. A make contact on the TE relay provides a hold path for the TE relay and an operate path for the OH relay. In addition, the TE relay operates to: (1) remove the transmission path from the customer equipment and to connect the path to the output of the test oscillator, (2) open the remaining interface control leads (DA, CCT, and RI) to the customer equipment, and (3) close −V to the call timer via a make contact on the OH relay.

2.25 The OH relay operates to close the loop and to trip ringing. The relay also completes the start path for the call timer. After a 1- to 3-second delay, the CT relay operates to connect the output of the test oscillator to the telephone line.

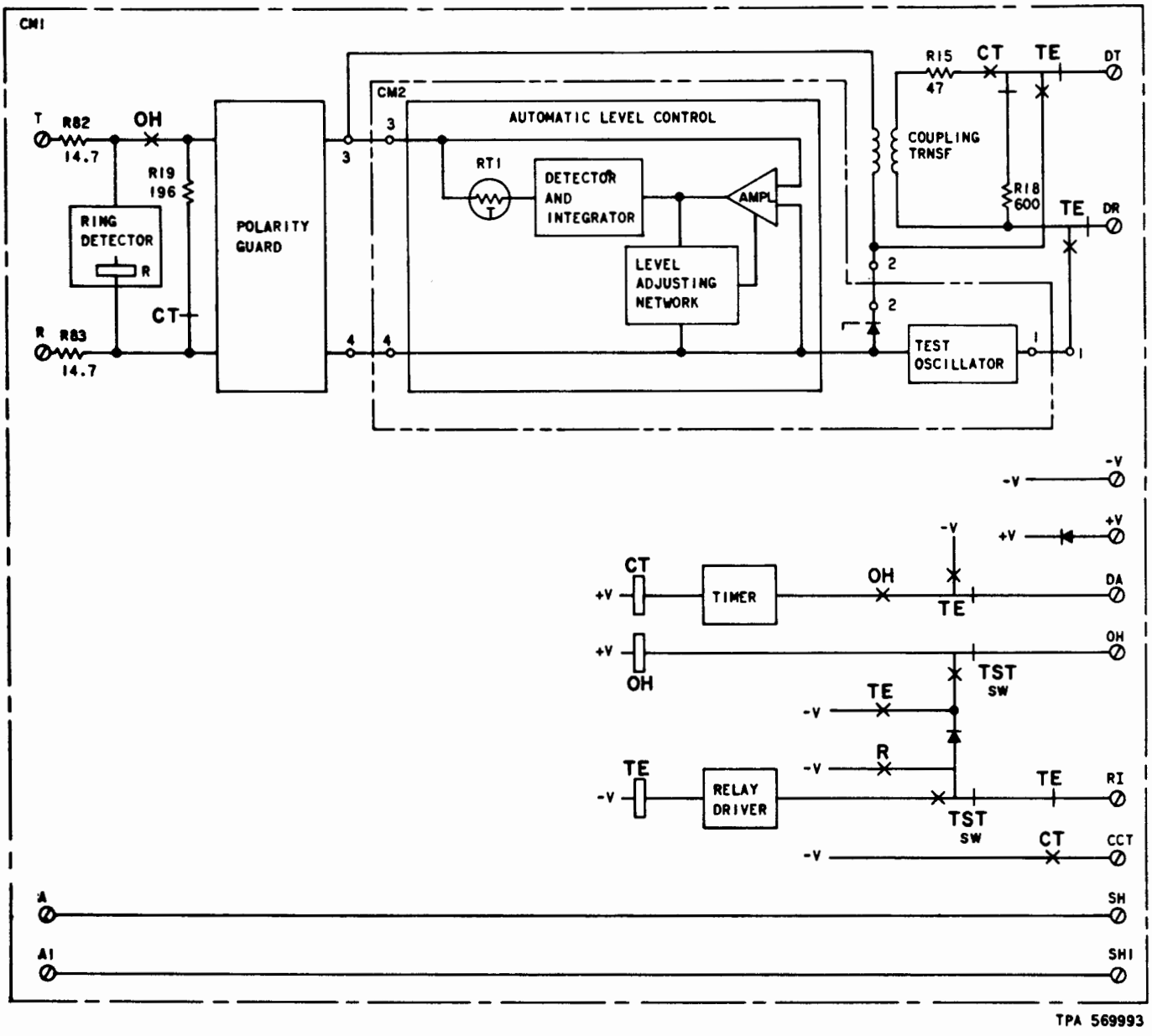


Fig. 6—1001D Data Coupler, Test Mode

2.26 The test circuit generates a 2800-Hz signal at a level which exceeds the maximum power level allowed for any coupler installation. This level causes the ALC circuit to operate and reduce the signal level to the value specified at the time of installation.

2.27 Restoring the TST switch releases the coupler from the test mode.

The TST switch must be restored at the end of the test for proper operation of the coupler.

2.28 The SH and SH1 interface leads provide the customer with the status of the line switch on an associated telephone set when used with the data coupler. The telephone set provided

must be equipped with an extra make contact that may be used to provide the line switch indication.

3. INSTALLATION AND CONNECTIONS

3.01 The 1001D Data Coupler may be used with various types of central office lines or Bell System PBX station lines that provide access to the switched telecommunications facilities.

All installation connections and tests must be performed prior to the customer making any connections to the interface.

3.02 Verify that the assigned loop facilities meet the transmission requirements for the specific data service before proceeding with the installation. The general requirements for DAA service will be covered in future revisions of Section 314-205-501. The requirements for the 1001D Data Coupler are as follows.

(a) ***Loop Loss:*** Maximum 1000-Hz insertion loss is 10 dB, excluding the coupler.

(b) ***Set Classification:*** The installation measurements to be made should have been determined by the design engineer from the type of data modem information provided by the customer and specified on the service order. When the modem type cannot be determined, high-speed requirements should be specified. When the type of modem can be obtained from the customer, the following guidelines should be used.

(1) For all analog modems, high-speed requirements should be specified.

(2) For all other modems, requirements based on the speed of modem (same as for DATA-PHONE service) should be specified.

(3) If the type of modem is known to be similar to a Bell System DATA-PHONE data set, use the requirements for that particular data set.

3.03 The installation of the coupler should comply with general practices to ensure an orderly station arrangement. Information relating to a selection of type of connecting block and electrical code requirements is given in Section 590-010-200.

3.04 When test or demonstration calls are made at the time of installation, refer to Section 010-250-001 for the proper procedure for crediting charges.

3.05 The location of the data coupler shall be determined by the following conditions:

- The coupler ***must*** be mounted vertically on the wall, or other smooth vertical surface, to ensure proper operation of OH relay.
- The coupler must be within range of the interface cord supplied by the customer. The maximum recommended value is 50 feet but is not critical.
- The location of the coupler should, if at all possible, provide easy access for operation of the TST switch by the customer attendant.

3.06 Install the coupler on the wall or vertical surfaces as follows.

Note: Earlier manufactured couplers were shipped with printed circuit board attached to the base pan. Later manufactured couplers were shipped with cover, circuit board, and base pan taped together. The following steps with the letter ***a*** suffix pertain to the earlier couplers and steps with the ***b*** suffix pertain to the latter. Steps without a suffix pertain to all couplers.

(1a) Remove the snap-off cover assembly from the coupler.

(2a) Remove the four screws securing the printed circuit board assembly to the base pan, and remove the assembly.

(3b) Remove the tape securing the cover to the base pan. Retain the screw envelope which is between the tape and cover.

(4b) Remove the snap-off cover assembly from the coupler.

(5) Position the coupler base pan vertically against the wall with the keyhole slot end up and not less than 3 inches above the top of the baseboard or other obstruction which will be below the unit. Secure the base pan with two screws.

(6) Route the D station wire through the slots and pins on the base pan as shown in Fig. 2. Attach the circuit pack to the base pan using the four screws removed in (2a) or removed from the envelope. Connect the leads as required to the terminals on each side of the printed wiring board.

Care should be taken not to overtighten screw terminals or stripping will result.

3.07 When the external dc supply is provided by the telephone company, install a 19B2 or 28A1 (or equivalent) power unit as outlined in Sections 167-440-201 and 167-445-101, respectively.

Do not connect the power unit to local ground when the coupler – V terminal is internally grounded within the customer equipment.

3.08 An associated telephone set is a standard option with the data coupler. When a telephone set is provided, the exclusion key line control and telephone set ringer options must be specified on the service order. See Table B for the designation of each option. The designations are not official circuit designations but have been arbitrarily assigned for ease of handling within this section.

3.09 The exclusion key line control options provide for either the coupler to control the line (standard option) or the telephone set to control the line (option must be specified). Different telephone set ringer options provide the desired ringing features for each of the two line control options. When the ringer option provides for both the coupler (RI) and the telephone to ring, the telephone bell will only tap when the coupler interface is conditioned for immediate answer. The various ringer options are described in the following listing. The typical connections required for each when a 502-type or a 558F telephone set is used are shown in Fig. 7 and 8. Locations of the coupler terminals are shown in Fig. 2.

Telephone Set Exclusion Key Options

(1) Coupler Controls Line—Standard option (A).

Telephone Set Ringer Options

(a) Ringer connected on telephone set side of exclusion key, only coupler (RI interface lead) rings—Standard option (C).

(b) Ringer connected on line side of exclusion key, both coupler (RI interface lead) and telephone ring—Option must be specified (D).

(2) Telephone Set Controls Line—Option must be specified (B).

Telephone Set Ringer Options

(a) Ringer connected on telephone set side of exclusion key. If exclusion key is not operated, only telephone rings—if exclusion key is operated, only coupler (RI interface lead) rings—Standard option (E).

(b) Ringer connected on line side of exclusion key. If the exclusion key is not operated, only telephone rings—if exclusion key is operated, both coupler (RI interface lead) and telephone ring—Option must be specified (F).

3.10 When the connections are completed, the data coupler must be adjusted to limit the customer signal power to a level which shall not exceed a −12 dBm signal level at the serving central office. To arrive at the maximum allowable customer level, perform the insertion loss test and the impedance matching test outlined in Part 4.

3.11 When the two tests are completed, refer to Table C, which shows the level option terminals (A through H) that may be strapped for a particular installation. The total loss of the loop and coupler measured in the insertion loss test determines the ***row*** to use in Table C under the INSERTION LOSS column. The value obtained from the impedance matching test determines the ***column*** to use under LIMITER OPTION TERMINALS in Table C. The intersection of the ***row*** and ***column*** determines the proper strapping for the option terminals.

3.12 The locations of the level option terminals are shown in Fig. 2. Insert an 840127930 option strap under the heads of each pair of screw terminals determined in 3.11. Tighten the screws to ensure good contact. Example of strapping: when the measured combined loss of the loop and coupler is 6.4 dB, and a measured value of −14.2 dBm is obtained from the impedance matching test,

TABLE B

TEL SET EXCLUSION KEY AND
RINGER OPTIONS AND DESIGNATION

TEL SET EXCLUSION KEY OPTIONS	OPTION DESIG-NATION	TEL SET RINGER OPTIONS	OPTION DESIG-NATION
COUPLER CONTROLS LINE (STANDARD)	A	RING INDICATION COUPLER ONLY (STANDARD)	C
		RING INDICATION COUPLER AND TEL SET (MUST BE SPECIFIED)	D
TEL SET CONTROLS LINE (MUST BE SPECIFIED)	B	RING INDICATION •EXCN KEY NOT OPERATED, TEL SET ONLY •EXCN KEY OPERATED, COUPLER ONLY (STANDARD)	E
		RING INDICATION •EXCN KEY NOT OPERATED, TEL SET ONLY •EXCN KEY OPERATED, COUPLER AND TEL SET (MUST BE SPECIFIED)	F

a strap should be inserted under heads of screws in terminals A and C and in terminals D and G.

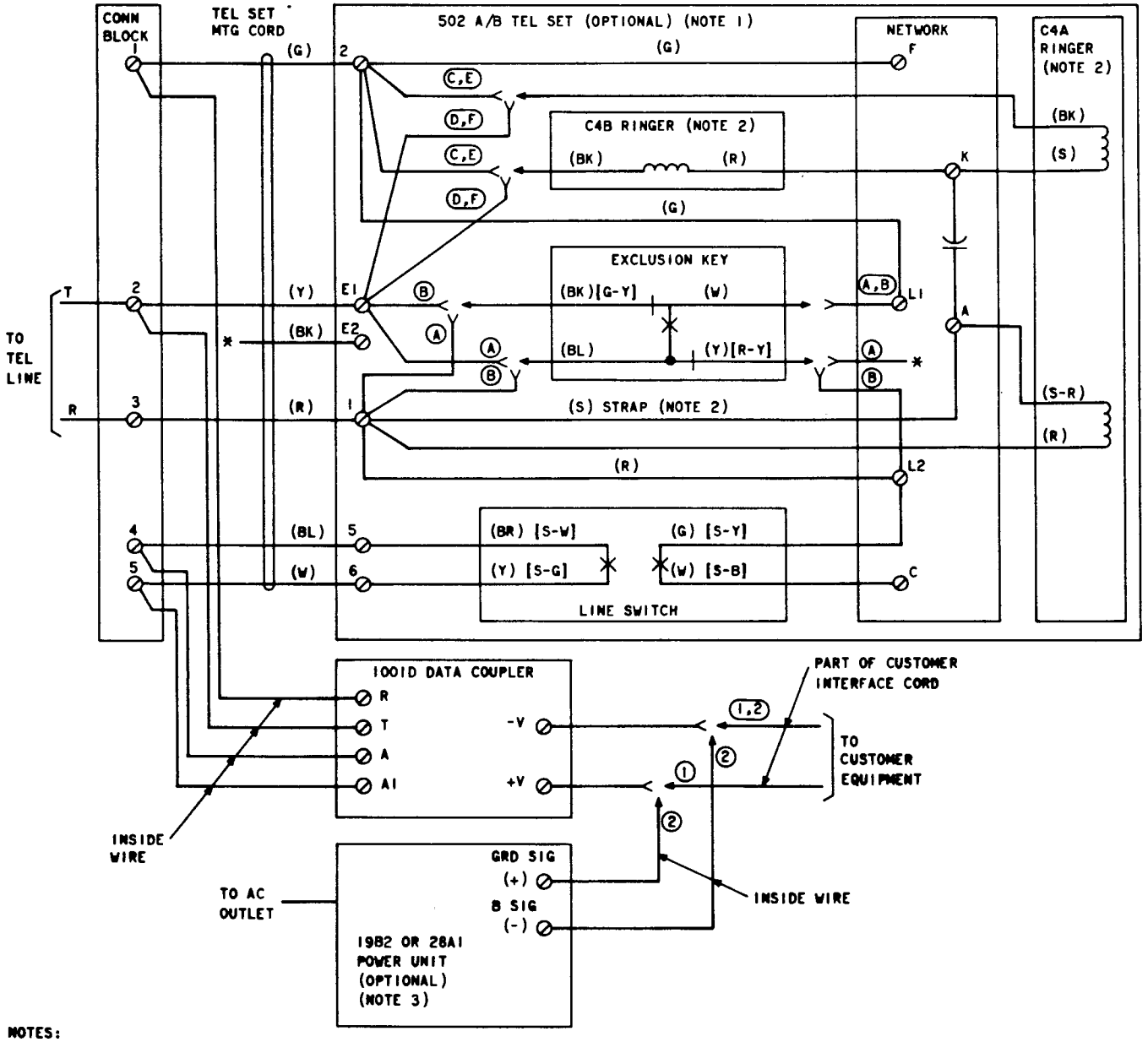
3.13 The maximum allowable customer signal level is determined by the ***row*** used in 3.11 and by the appropriate column in Table C. Record the value with pencil or ball point pen on the cover label of the coupler (Fig. 1). Using the example in 3.12, "−6" would be marked on the label.

3.14 Install the cover assembly by hooking the bottom end (end with small hinged cover) to the base pan, swinging the cover up and over the TST switch, and pressing until the cover snaps into place.

3.15 The installer should instruct the customer to raise only the hinged portion of the cover to gain access to the interface terminals. Also caution the customer that overtightening the screws may cause stripping. The installer will ***not*** connect the customer interface leads to the coupler unless requested by, and under the direction of, the customer.

Note: When the dc power supply is provided by the telephone company, the customer ***must not*** make any connections to the +V interface terminal.

3.16 After the installation has been completed, perform the remote test outlined in Part 4.



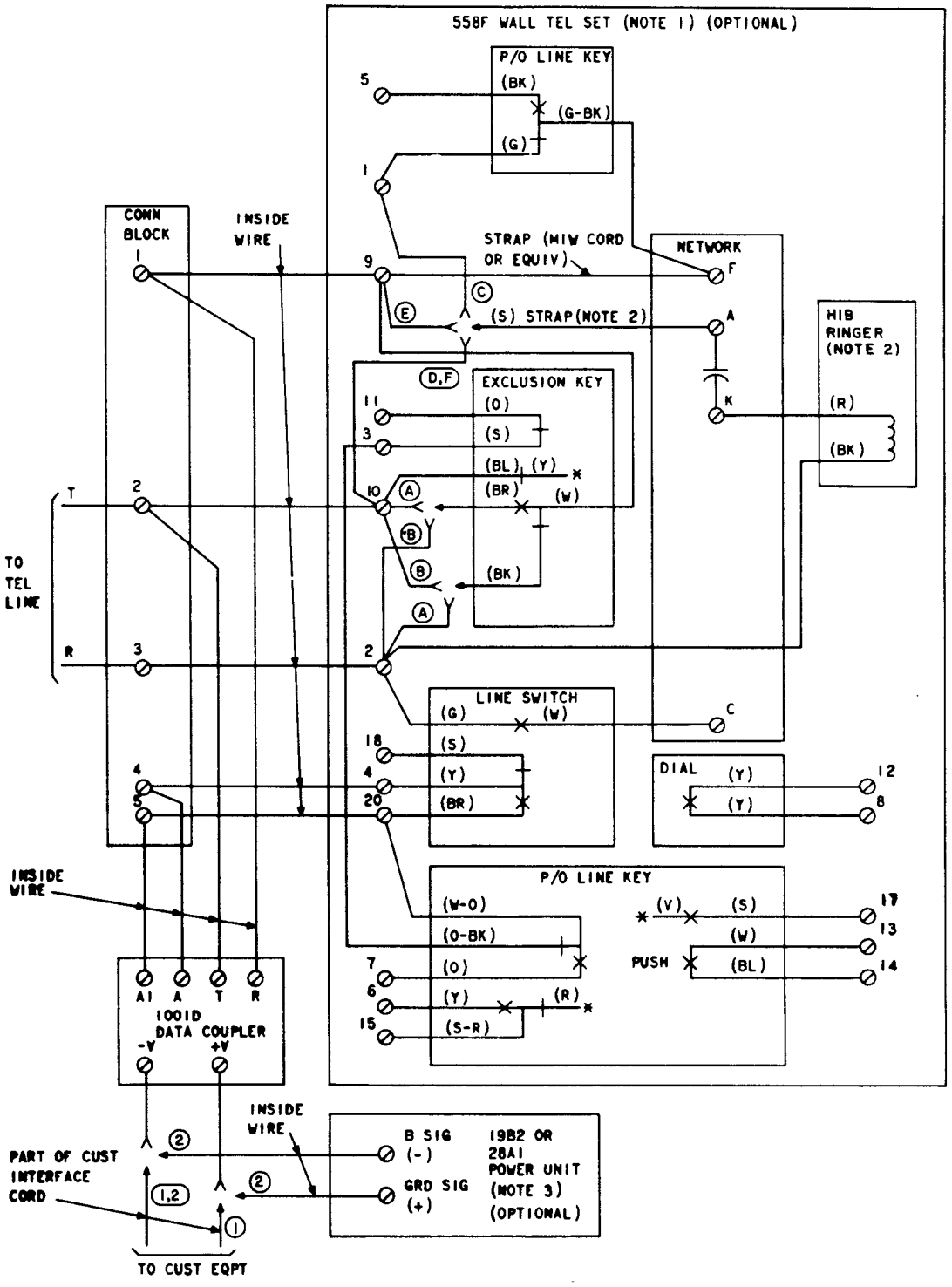
NOTES:

1. EXCLUSION KEY AND RINGER MUST BE REWIRED FOR DESIRED OPTION. SEE TABLE B.
2. CONNECTIONS FOR C4A AND C4B ARE SHOWN. WHEN C4B IS PROVIDED, (S) STRAP MUST BE CONNECTED BETWEEN TERMINALS 1 AND A. WHEN C4A IS PROVIDED, THE STRAP MUST BE REMOVED.
3. DO NOT CONNECT POWER UNIT TO LOCAL GROUND WHEN THE COUPLER -V TERMINAL IS INTERNALLY GROUNDED WITHIN THE CUSTOMER EQUIPMENT.

① POWER FURNISHED BY CUSTOMER
② OPTIONAL TEL CO FURNISHED POWER
* INSULATE AND STORE
( ) CURRENT COLOR CODE
[ ] MD COLOR CODE

TPA 569994

Fig. 7—Typical Connections for 1001D Data Coupler With 502A/B Telephone Set



NOTES:

1. EXCN KEY AND RINGER MUST BE REWIRED FOR DESIRED OPTIONS. SEE TABLE B. REWIRE TEL SET AS FOLLOWS:
   - LINE KEY- REMOVE (R) AND (V) LEADS FROM TERM. 2 AND TAPE AND STORE.
   - LINE SWITCH- REMOVE (G) LEAD FROM TERM. 15 AND CONNECT TO TERM. 2.
   - ADD STRAP BETWEEN TERMS. 9 AND F.
2. CONNECTIONS SHOWN ARE FOR TEL SETS EQUIPPED WITH HIB RINGERS. TEL SETS EQUIPPED WITH HIA RINGERS SHOULD BE REWIRED AS FOLLOWS:
   - CONNECT RINGER (BK) LEAD TO TEL SET TERMINAL 2.
   - CONNECT RINGER (S) LEAD TO NETWORK TERMINAL K.
   - CONNECT RINGER (S-R) LEAD TO NETWORK TERMINAL A.
   - CONNECT RINGER (R) LEAD TO TEL SET TERM. 1 IF OPTION C IS USED, TERM. 9 IF OPTION E IS USED, OR TERM. 10 IF OPTION D OR F IS USED.
   - REMOVE STRAP (S) BETWEEN NETWORK TERM. A AND TEL SET TERM. 1, 9, OR 10.
3. DO NOT CONNECT POWER UNIT TO LOCAL GROUND WHEN THE COUPLER -V TERMINAL IS INTERNALLY GROUNDED WITHIN THE CUSTOMER EQUIPMENT.

* TAPE AND STORE
① POWER FURNISHED
② BY CUSTOMER OPTIONAL TEL CO. FURNISHED POWER.

TPA 570176

Fig. 8—Typical Connections for 1001D Data Coupler With 558F Wall Telephone Set

TABLE C

LEVEL OPTION TERMINALS FOR 1001D DATA COUPLER

INSERTION LOSS (INSERTION LOSS TEST) dB			MAXIMUM ALLOWABLE CUSTOMER LEVEL dBm	LIMITER OPTION TERMINALS MEASURED LEVEL (IMPEDANCE MATCHING TEST)			
LOOP LOSS	COUPLER LOSS	TOTAL OR MEASURED LOSS		−13.6 OR ABOVE	NOMINAL −13.7 TO −14.6	−14.7 TO −15.6	−15.7 OR UNDER
0 - .9	2	2 - 2.9	−10	AB, DE	AC, DE	AC, DE	AC, DE
1 - 1.9	2	3 - 3.9	−9	AC, DF	AB, DE	AC, DE	AC, DE
2 - 2.9	2	4 - 4.9	−8	AB, DF	AC, DF	AB, DE	AC, DE
3 - 3.9	2	5 - 5.9	−7	AC, DG	AB, DF	AC, DF	AB, DE
4 - 4.9	2	6 - 6.9	−6	AB, DG	AC, DG	AB, DF	AC, DF
5 - 5.9	2	7 - 7.9	−5	AC, DH	AB, DG	AC, DG	AB, DF
6 - 6.9	2	8 - 8.9	−4	AB, DH	AC, DH	AB, DG	AC, DG
7 - 7.9	2	9 - 9.9	−3	AC	AB, DH	AC, DH	AB, DG
8 - 8.9	2	10 -10.9	−2	AB	AC	AB, DH	AC, DH
9 -10.0	2	11 -12.0	−1	AB	AB	AC	AB, DH

3.17 All level measurements and test results made during installation must be recorded on a line history card, or equivalent, to assist in analyzing future trouble and to detect gradual degradation of the service. The installer shall telephone the test results to the Plant Service Center, or equivalent test location, prior to leaving the customer location. The circuit design engineer should be advised when the actual measured loss (AML) of the loop deviates from the estimated measured loss (EML) by more than ± 1 dB.

4. MAINTENANCE AND TESTS

4.01 The maintenance and testing procedures described in this part are to assist the employee during installation and troubleshooting visits to a data coupler station. Several of the tests contained in this part will require disconnection of customer equipment from the interface in order to make the tests and/or to replace a defective coupler. The following precautions ***must*** be taken.

Permission to disconnect the interface leads from the coupler must be obtained from the customer.

The power to both the customer equipment and to the coupler should be turned OFF before the customer leads are disconnected.

After all tests are completed and the interface is reconnected, the customer should be asked to verify that the interface has been reconnected properly.

A. Maintenance

4.02 All repair forces should be familiar with the tariff provisions which generally provide for a "Maintenance Service Charge" for each customer-requested repair visit to a data coupler installation that is terminated with a FOK (found OK) condition. When the customer requests such

a repair visit and it is subsequently determined that the trouble is ***not*** in the telephone company equipment, the employee should advise the customer and notify the Plant Service Center (PSC) to fill out Form E-5855 in conformance with Section 660-101-312.

4.03 Maintenance of a coupler installation at the customer premises should be limited to local tests, testing with serving or test offices, or replacing a defective unit.

> ***Note:*** Do not attempt individual component repair or replacement on the printed circuit pack.

4.04 Customers using data couplers are instructed, when a trouble condition is experienced, to perform the necessary testing to sectionalize the problem. If the results of the tests indicate the trouble is in Bell System equipment, the condition should be reported to the designated PSC or equivalent testing bureau. All available information concerning the failure mode should be provided to the PSC.

4.05 The PSC must analyze the information provided by the customer to determine if a trouble condition does exist and the most probable cause. Available tests (ie, normal dc loop test and remote test of coupler) should be performed to determine if a craft employee must be dispatched to the customer premises. The conditions which could warrant a maintenance visit and the efforts which lead to each are shown in Fig. 9.

4.06 On a maintenance visit, the employee should proceed to perform the most likely necessary tests or evaluations to isolate and clear the trouble within the station as directed by the PSC. The employee may begin with the steps shown in Fig. 9 when the test results and analysis received from the PSC lead to that particular activity. If a trouble report is not available or if the report is inconclusive, it is recommended that the employee follow the suggested sequence of activities as illustrated in Fig. 10 and described in the following.

(1) The employee must be properly equipped with information (BSP documentation, line card details, etc), spare coupler and other parts, test equipment, etc, for locating trouble and effecting repairs at the customer premises.

(2) Upon arrival at the coupler station, the employee will question the customer to obtain any information relating to the trouble. The employee will then proceed to perform a visual and mechanical inspection of the installation. Check that the TST switch on the coupler is not partially operated. Check for disconnected or broken cords, inside wiring, or drop wire. Check for broken components or any other possible trouble causes. If defects are not found, make a remote test (Step 7).

(3) If any component is found defective or marginal during the check of the installation, or as directed by the PSC, the employee will repair or replace the component (ie, replacing ringer, dial, handset, etc, on associated telephone set when provided).

(4) After making the necessary repairs, the employee will request the customer to verify service restoral (ie, try to exchange data with station that caused him to report the trouble).

(5) When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.

(6) If the customer cannot exchange data or is not satisfied with the service, the employee will proceed with the investigation (Step 7).

(7) If the installation appears to be in order after the visual inspection, the employee will make the necessary preparations to have the local test desk, or equivalent test location equipped for ac testing such as a data test center, make the remote test of the coupler as outlined in 4.12.

(8) If the results of the coupler remote test are ***not*** satisfactory, the employee will proceed to replace the coupler (Step 10).

(9) If the results of the coupler remote test are satisfactory, the employee will prepare to make the coupler interface test as outlined in 4.14.

(10) If the results of the coupler remote or interface test are ***not*** satisfactory, the employee will replace the coupler with one known to be operating properly. Refer to Part 3 for the installation and connection procedures for

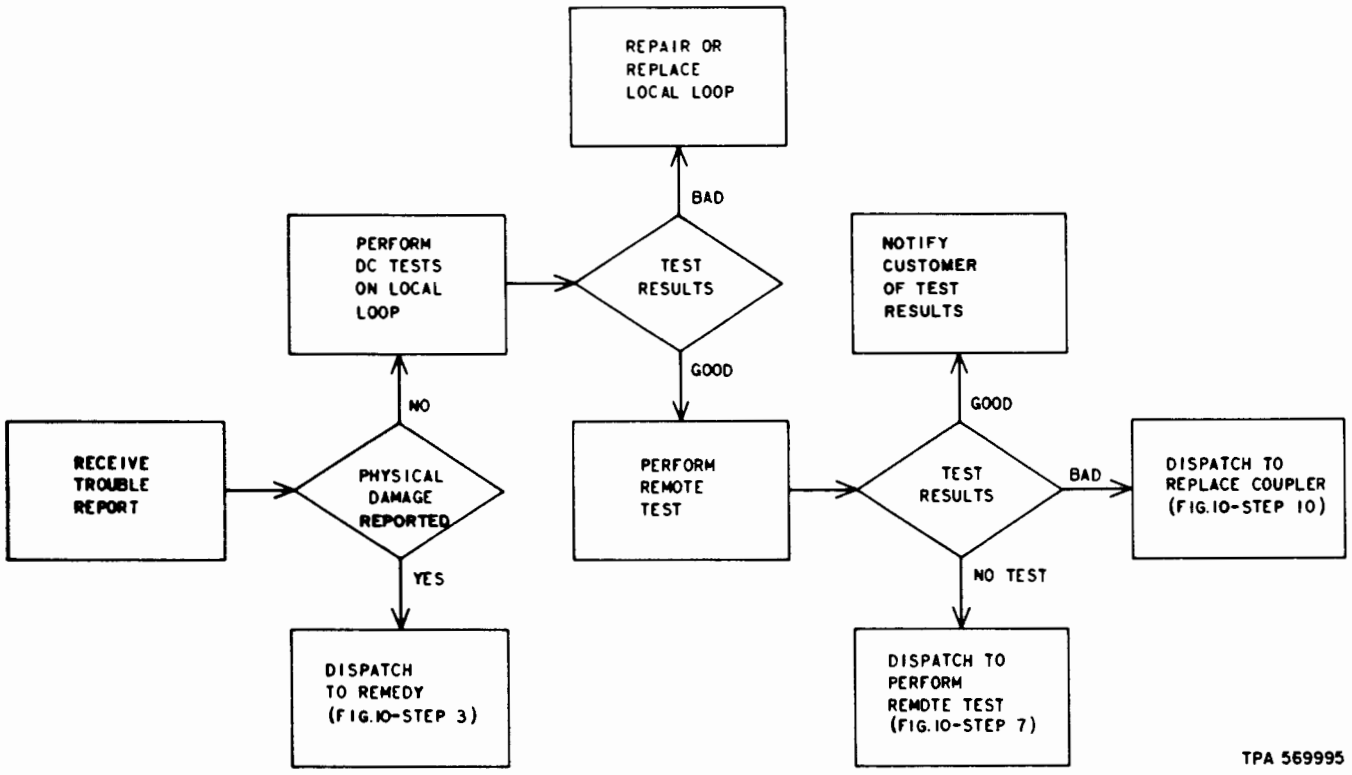


Fig. 9—Basic Activities Prior to Dispatching Employee

the new coupler. Ensure that all level measurements made during the required installation tests are properly recorded on the line history card.

(11) After the coupler has been replaced, the employee will prepare to have the remote test outlined in 4.12 made on the new unit.

(12) If the results of the new coupler remote test are ***not*** satisfactory, the employee will notify the PSC of the repair work that has been completed and request instructions before continuing investigating efforts.

(13) If the results of the new coupler remote test are satisfactory, the employee will request the customer to verify service restoral (ie, try to exchange data with the station that caused him to report the trouble).

(14) When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.

(15) If the customer cannot exchange data or is not satisfied with the service, the employee must continue the investigation to locate additional trouble. Proceed to Step (16).

(16) If the results of the coupler remote and interface tests are satisfactory or replacement of the coupler does not restore service, the employee will disconnect the coupler and prepare the test equipment for a complete transmission test of the local loop.

(17) Refer to Section 314-205-501 for requirements and perform the transmission test on the local loop.

(18) If the results of the loop test are satisfactory, the employee will notify the PSC that the results of the coupler and local loop tests are satisfactory and will wait for further instructions.

Note: The preceding investigation has eliminated the coupler and local loop as possible trouble; therefore, attention must be directed to the data terminal or facilities. The PSC

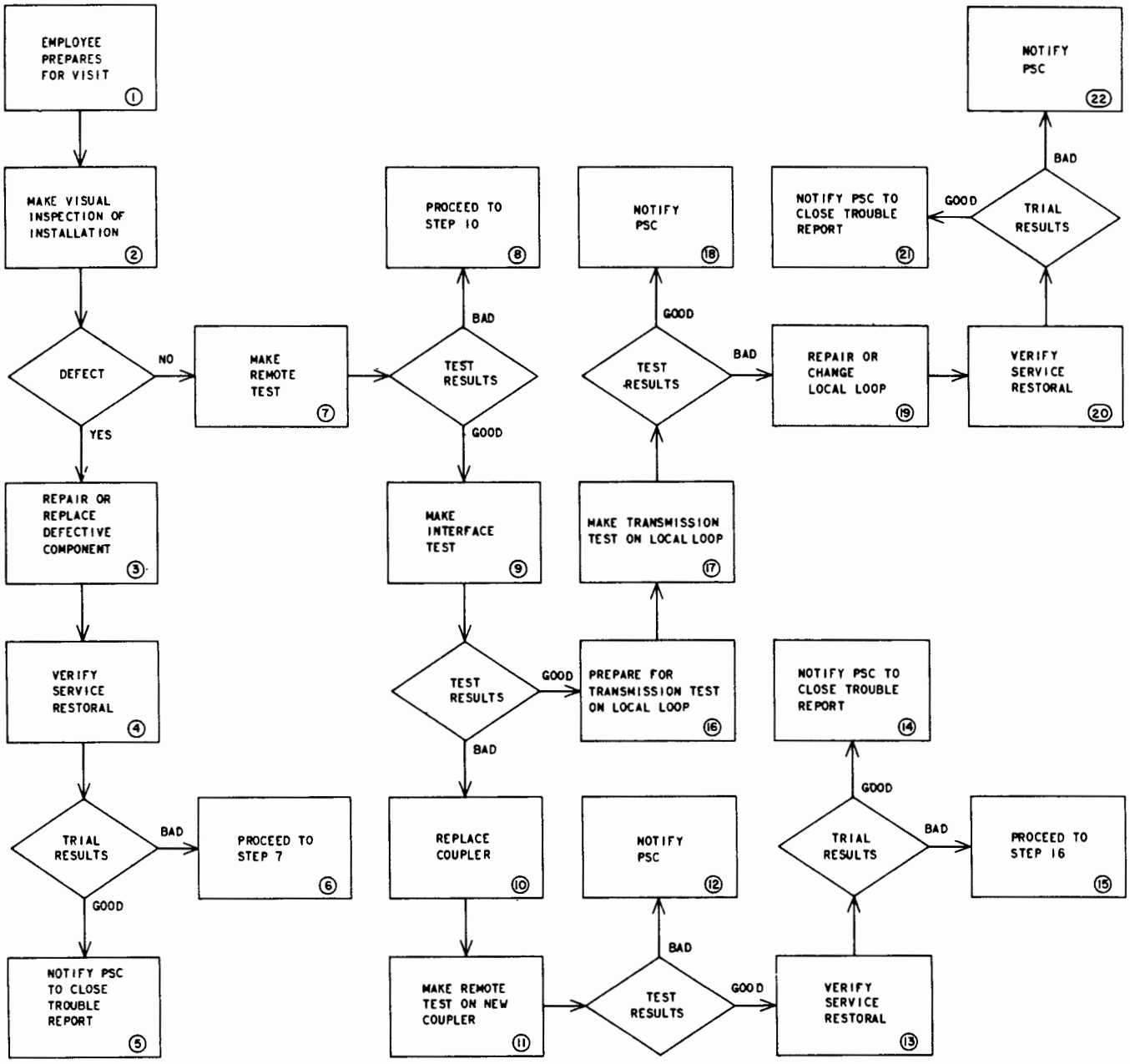


Fig. 10—Activities for Clearing or Troubleshooting Trouble at a Coupler Station

will notify the employee if further investigation is required at this time.

(19) If the results of the loop test are ***not*** satisfactory, the employee will arrange with the PSC to have the loop repaired or changed. The repaired or changed loop should meet requirements outlined in Section 314-205-501.

(20) After changing the defective loop, the employee will reconnect the coupler to the telephone line. The insertion loss (4.09) and impedance matching (4.10) tests must be performed to determine if the maximum allowable customer level has been changed. The employee will notify the customer of the level change and then request the customer to verify the service restoral

(ie, try to exchange data with the station that caused him to report the trouble).

(21) When the customer is satisfied with the service, the employee will notify the PSC to close the trouble report.

Note: Prior to leaving customer premises, the remote test outlined in 4.12 must be performed and the new level recorded on the line history card.

(22) If the customer cannot exchange data or is not satisfied with the service, trouble may still exist in another component of the system or in the data terminal, and further investigation must be pursued. The employee will notify the PSC of the repair work that has been completed and will wait for further instructions.

B. Tests

4.07 The following tests are required to ensure the proper installation of the data coupler and to determine the operating condition of the unit during a maintenance visit:

- Insertion Loss Test
- Impedance Matching Test
- Remote Test
- Interface Voltage Test.

4.08 The following test equipment is required for the tests:

- 600-ohm resistor
- Hewlett-Packard 400D vacuum tube voltmeter (VTVM), or equivalent bridging-type meter; or KS-16979-L1 volt-ohm-milliammeter (VOM), or equivalent
- 1011-type hand test set, or equivalent
- KS-19353-L4 oscillator, or equivalent
- KS-16979-L1 volt-ohm-milliammeter (VOM), or equivalent
- 19B2 power unit with the 6-foot P-40J329 power cord, or equivalent signal power source providing between 20 and 26 volts dc.

4.09 ***Insertion Loss Test:*** The insertion loss test is required to measure the combined loss of the loop and coupler. The results of the test are used to determine the level option terminals which must be strapped in the coupler. This test requires that the customer interface leads be disconnected from the coupler in accordance with procedures outlined in 4.01. The coupler must be connected to the telephone line. Proceed with the test as follows.

(1) Loosen screws and remove any existing 840127930 straps on level option terminals A through H (Fig. 2).

Note: Cover must be removed to gain access to level option terminals.

(2) Connect the 600-ohm resistor across interface terminals DT and DR.

(3) Connect strap between terminals OH, DA, and −V.

(4) Connect the positive lead (GRD SIG) of the power unit to the +V terminal, and the negative lead (B SIG) to the −V terminal. ***Do not*** connect the power unit to the ac outlet at this time.

(5) Use the telephone set associated with the coupler if provided or connect the hand test set across tip and ring of telephone line, and dial the milliwatt supply (1000 Hz) of the serving central office.

Note: If a telephone set is associated with the coupler, remove the handset and ensure that the exclusion (data) key is in the talk position before dialing the milliwatt supply.

(6) When the tone is heard, connect the power unit to a 117-volt ac power outlet. After a few seconds, remove the hand test set from the line (or operate the exclusion key to the data mode on the associated telephone).

(7) Measure the level in dBm of the signal across the 600-ohm resistor with the VTVM or VOM.

Note: The VTVM requires approximately a 5-minute warm-up for accurate readings.

(8) The loss, in dB, of the loop and coupler is determined by this measurement. Record the loss and add 0.5 dB (or the correction loss value specified on the line history card) to correct for the milliwatt test tone loss to the −12 dBm point (eg, if the measurement is −6.3 dBm, the corrected combined loss of the loop and coupler is 5.8 dB). The requirements are specified in Table C (3.11).

(9) Disconnect the power unit from the ac outlet to terminate the central office connection and remove the test equipment from the coupler. Proceed to the impedance matching test.

4.10 ***Impedance Matching Test:*** The impedance matching test is necessary to determine if the particular line impedance will require that a change be made in the nominal strapping of the level option.

4.11 This test will generally follow the insertion loss test on either an installation or maintenance visit; therefore, the level option terminals should not be strapped at this time. This test requires that the customer interface leads be disconnected from the coupler in accordance with procedures outlined in 4.01. The coupler must be connected to the telephone line and the power unit disconnected from the ac outlet. Proceed with the test as follows.

(1) Set the oscillator for a 1000-Hz frequency and a 600-ohm output impedance.

(2) Select the proper scale on the VTVM or VOM to measure −15 dBm.

(3) Connect the test equipment as shown in Fig. 11.

Note: The VTVM requires approximately a 5-minute warm-up for accurate readings.

(4) Adjust the oscillator output level to obtain a −15 dBm indication on the VTVM or VOM.

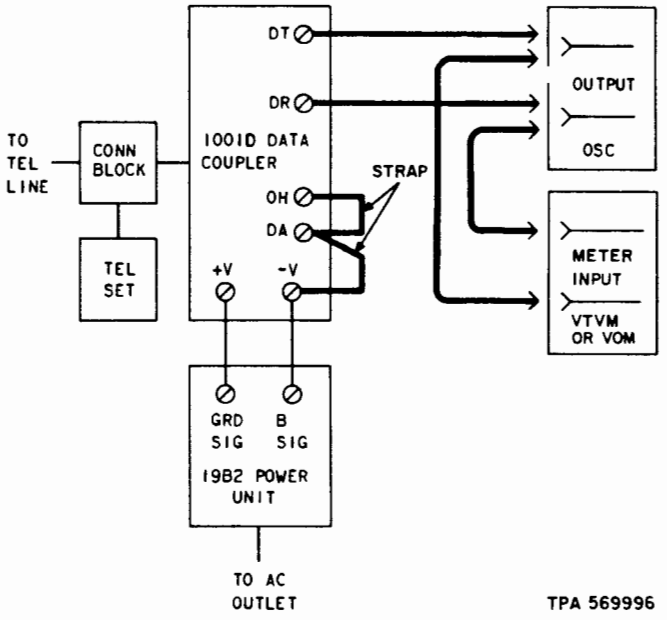


Fig. 11—Test Equipment Connections for Impedance Matching Test

Note: After the indication is obtained, do not change the frequency and level settings on the oscillator.

(5) Use the telephone set associated with the coupler if provided, or connect the hand test set across tip and ring of the telephone line and dial a quiet battery termination at the serving central office.

Note: If a telephone set is associated with the coupler, remove the handset and ensure that the exclusion (data) key is in the talk position before dialing the quiet termination.

(6) After the connection is completed, connect the power unit to a 117-volt ac power outlet. After a few seconds, remove the hand test set from the line (or operate the exclusion key to the data mode on the associated telephone).

(7) Measure, in dBm, the signal level again with the VTVM or VOM. This value is used in 3.11 to derive the level option strapping from Table C.

(8) Disconnect the power unit from the ac outlet to terminate the central office connection.

Remove the straps and test equipment from the coupler and restore the connection to normal.

4.12 ***Remote Test:*** The remote test is required to measure the test signal of the coupler at the local serving office at time of installation. The test signal provides a check of the local loop and the limiting function of the coupler. The initial reading can then be compared with subsequent readings for indications of service degradation.

4.13 The data coupler must be connected to the telephone line for this test. Proceed with the test as follows.

(1) Connect the positive lead (GRD SIG) of the power unit to the +V terminal, and the negative lead (B SIG) to the −V terminal. Connect the power unit to a 117-volt ac power outlet.

(2) Use the telephone set associated with the coupler if provided or connect the hand test set across tip and ring of the telephone line, and contact the local test desk. If the local test desk is not equipped for ac testing, contact a remote test location that is equipped or a data test center.

Note: If a telephone set is associated with the coupler, remove the handset and ensure that the exclusion (data) key is in the talk position before initiating the call to the test desk.

(3) Request the employee to call the coupler and to measure the level of the test tone (2800 Hz) received at the test desk.

(4) Agree upon length of time required to perform the test and restore the connection to an idle state (hang up).

(5) Operate the TST switch to the ON position (depress the red dot half of switch).

(6) After the agreed testing interval (Step 4), operate the TST switch to the OFF position.

(7) Call the test desk and request the level reading from the employee. This level indicates the loss of the loop and coupler at 2800 Hz. When the test is made at time of installation, the actual value of the loss ***must*** be recorded on the line history card for comparison against measurements made in subsequent tests. If the level of the 2800-Hz signal on subsequent tests varies by more than 2 dB from the original value, it is an indication of possible trouble in either the loop or coupler. If the test tone must be measured at a remote test desk or data test center over facilities of unknown or varying loss, a successful receipt of the tone indicates that there is ac continuity in the loop and coupler and that the coupler operates satisfactorily. This is estimated to provide an 80% confidence level that the coupler and loop facilities are operating satisfactorily.

(8) Disconnect the power unit and restore the telephone connection to normal.

4.14 ***Interface Voltage Test:*** The interface test reasonably assures that the interface terminals of the coupler will respond to proper signals from the customer terminal or will indicate to the terminal when the coupler is conditioned for the various operational modes.

4.15 This test requires that the customer interface leads be disconnected from the coupler in accordance with procedures outlined in 4.01. The coupler must be connected to the telephone line. Use the KS-16979-L1 meter to make the measurements during the test. Proceed as follows.

Note: When making measurements in the following steps, be careful to observe the proper polarity with the meter. The (+) and (−) signs preceding the terminal designations represent the positive and negative probes of the meter.

(1) Connect the positive lead (GRD SIG) of the power unit to the +V terminal and the negative lead (B SIG) to the −V terminal. Connect the power unit to a 117-volt ac power outlet.

(2) Originate a call to the coupler from another line or arrange to be called from the local test desk. Observe that the voltage between terminals (−) RI and +V follows the ringing cycle and swings between −10 to −26 (ON) and 0 (OFF) volts dc, the ON interval being approximately 2 seconds and the OFF interval approximately 4 seconds.

(3) Leaving the meter connected between (−) RI and +V, short terminal OH to −V with a clip lead. Observe that the voltage swings to 0 volts dc after ringing is tripped. This checks the operation of the OH relay.

(4) Leaving short between terminals OH and −V, measure the voltage between terminals (−) CCT and +V. The meter should indicate 0 volts dc to show that the interface lead (CCT) is in an OFF condition.

(5) Leaving the meter on terminals CCT and +V, connect a strap between terminals OH and DA. After 1- to 3-seconds, observe that the voltage swings to between −20 and −26 volts dc. This checks the delay timer and the operation of the CT relay. Remove short from between terminals OH and −V. Observe that voltage between terminals CCT and +V swings back to 0 volts dc.

(6) Remove handset on telephone and connect meter between terminals SH and SH1. The meter should indicate continuity between the terminals to check the switch contact status circuit.

(7) Replace handset on telephone. Continuity should not be indicated on the meter between terminals SH and SH1.

(8) Hang up the calling telephone and remove the power unit, meter, and straps from the coupler.

(9) Reconnect the customer interface leads to the coupler. Request customer to verify connections (4.01).