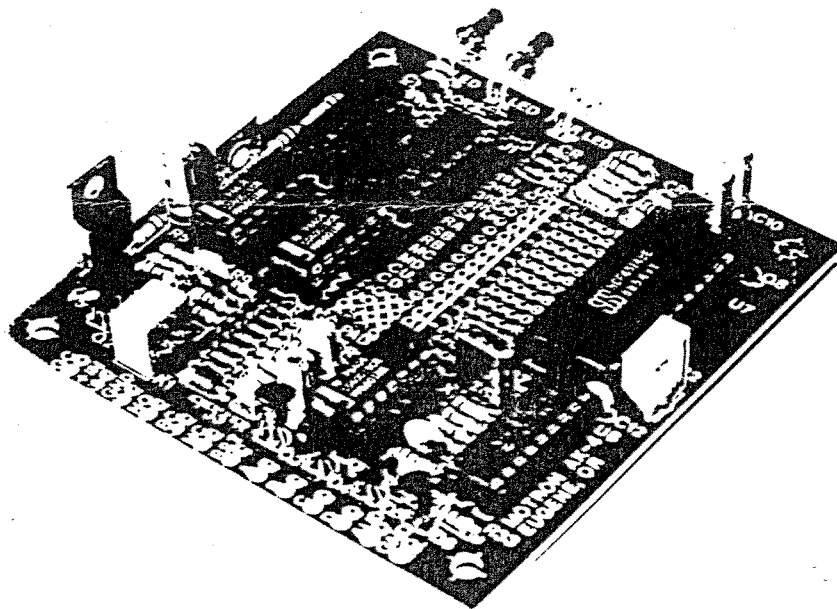


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AUTO KALL AK-4

KIT

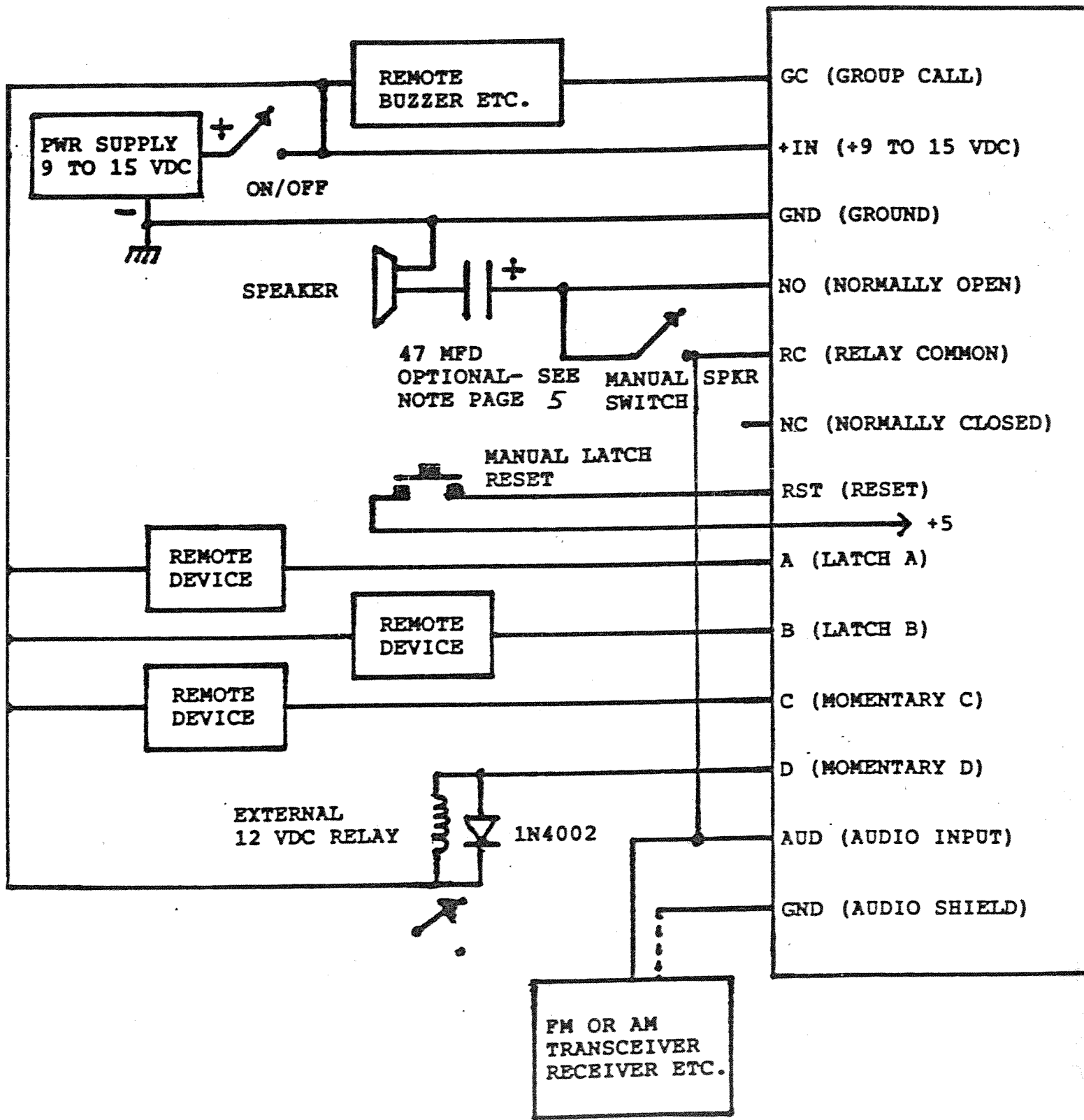


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TYPICAL HOOK-UP OF MOTRON AUTO-KALL AK-4



AUTO-KALL AK-4

The AUTO-KALL AK-4 can be used as either a DTMF selective calling system or a remote controller. No interface is required to your radio, it can be connected directly to the audio output, speaker or earphone jack. Its features include the following:

PERSONAL-CALL - 2, 3 or 4 digit sequential code. The code is user programmable with jumpers and programming diodes. All 16 DTMF digits can be used. A timed relay output is available to switch a speaker on/off. LED "Call Received" indicator lets user know if a personal call has been received. Open collector output is also provided to activate a remote alarm etc.

GROUP-CALL - 16 levels^B of group-calling. The AK-4 can be programmed to respond to any or all 16 group-call codes. The same timed relay used with the personal-call section can be used in the group call mode to turn a speaker on and off. A latched output can be used to enable a remote alarm etc. Group-calling is performed by holding down a single key for +/- .5 to 3 seconds. This value is adjustable with a trim pot.

CONTROL OUTPUTS - The AK-4 offers 2 independently settable/resettable latched outputs, 2 momentary outputs and 1 latched output in group calling mode. Latched and momentary outputs use open collector transistors capable of sinking 250ma. Timed relay output can be configured to respond to either personal-call, group-call or both. User adjustable in stages from 10 to 60 seconds (5-35 seconds with group-call). It can be increased up to about 8 minutes by changing a resistor. The relay can be wired to a latched or momentary output if preferred.

CONTROL-UP/CONTROL-DOWN CODES - If you are using the AK-4 as a remote controller, you can program different first digits into the commands for unlocking and locking the control outputs. With toggle on/off controllers, you may sometimes forget if the controller is in the locked or unlocked state and accidentally turn it off when you think you are turning it on or vice versa. Or maybe you are transmitting from a fringe area and are not sure if the controller received the command code. The AK-4 solves this problem by allowing you to program a different first digit into the control-up/control-down codes. For example program a "*" as the first digit for unlocking the AK-4 and a "#" for locking it.

POWER REQUIREMENTS + 9 to 15 VDC @ 200ma. Standby current with no control outputs active is about 20ma.

The AK-4 connects into the audio line of your radio. It will work with any FM or AM transceiver, scanner, receiver etc. The operating frequency of the radio is not important as long as it is operating on FM or AM. It will not work with SSB. The DTMF tones cannot be reproduced faithfully enough via SSB. For SSB/CW use the AUTO-KALL HF-ALERT will soon be available.

PARTS LIST - As soon as you receive your AK-4, check to see if all the parts listed below are found in your shipping container.

WARNING! BEFORE HANDLING ANY OF THE IC'S OR DIODES, TAKE CARE TO DISCHARGE ANY STATIC ELECTRICITY CHARGES ON YOUR BODY BY TOUCHING A GROUND!!

QTY	DESCRIPTION	CHECK
	RESISTORS - ALL 1/4 WATT 5%, VALUE IN OHMS	
1	100 (BROWN BLACK BROWN GOLD)	___
5	1K (BROWN BLACK RED GOLD)	___
6	4.7K (YELLOW VIOLET RED GOLD)	___
1	10K (BROWN BLACK ORANGE GOLD)	___
9	33K (ORANGE ORANGE ORANGE GOLD)	___
9	150K (BROWN GREEN YELLOW GOLD)	___
2	1M (BROWN BLACK GREEN)	___
2	1M PC MOUNT TRIM POTS (MAY BE MARKED 105)	___
	CERAMIC DISK CAPACITORS	
4	.01 (MAY BE MARKED 103)	___
3	.1 (MAY BE MARKED 104)	___
	ELECTROLYTIC CAPACITORS	
2	1 MFD	___
1	3.3 MFD	___
3	47 MFD	___
	DIODES	
2	1N4004	___
45	1N4148	___
	TRANSISTORS	
8	2N2222 (MAY BE MARKED KN2222)	___
	IC'S	
3	CD4001	___
1	CD4081	___
1	CD4514	___
1	LS7225	___
1	MC78M05 (VOLTAGE REGULATOR, TO-220 PACKAGE)	___
1	SSI-202 P	___
	MISC.	
1	3.579 MHZ CRYSTAL	___
1	AK-4 CIRCUIT BOARD	___
1	SPDT 12VDC RELAY	___
2	RED LEDS	___
1	GREEN LED	___
5	14 PIN IC SOCKETS	___
1	18 PIN IC SOCKET	___
1	24 PIN IC SOCKET	___
	WIRE FOR JUMPERS	___

KIT ASSEMBLY

Use a low power soldering iron and rosin core solder. First, place and solder all the resistors in their locations according to the silk-screening on the board. Follow the parts list below and check them off as you go. The board is plated through, so you only need solder on the bottom side. Here is a list of the resistors and their respective values (the last band on all is gold):

R1	150K	BROWN GREEN YELLOW	R17	33K	ORANGE ORANGE ORANGE
R2	150K	" " "	R18	33K	" " "
R3	1K	BROWN BLACK RED	R19	1K	BROWN BLACK RED
R4	1K	" " "	R20	1K	" " "
<i>2" →</i> <i>100</i> R5	150K	BROWN GREEN YELLOW	R21	33K	ORANGE ORANGE ORANGE
R6	4.7K	YELLOW VIOLET RED	R22	33K	" " "
R7	4.7K	" " "	R23	33K	" " "
R8	10K	BROWN BLACK ORANGE	R24	33K	" " "
R9	4.7K	YELLOW VIOLET RED	R25	1M	BROWN BLACK GREEN
<i>odif</i> <i>hardo</i> R10	4.7K	" " "	R26	4.7K	YELLOW VIOLET RED
R11	4.7K	" " "	R27	1M	BROWN BLACK GREEN
R12	150K	BROWN GREEN YELLOW	R28	150K	BROWN GREEN YELLOW
R13	150K	" " "	R29	150K	" " "
R14	150K	" " "	R30	33K	ORANGE ORANGE ORANGE
R15	150K	" " "	R31	33K	" " "
R16	33K	ORANGE ORANGE ORANGE	R32	1K	BROWN BLACK RED
			R33	100	BROWN BLACK BROWN

Now mount and solder the capacitors following the list below. Pay attention to the polarization of the electrolytics, the minus side is marked on the part and the plus on the board. Make sure they are on opposite sides of each other.

C1	.01 DISK (MAY BE MARKED 103)	C7	3.3 MFD ELECTROLYTIC
C2	.01 DISK (103)	C8	.1 (104) DISK
C3	47 MFD ELECTROLYTIC	C9	.1 (104) DISK
C4	.1 DISK (MAY BE MARKED 104)	C10	1 MFD ELECTROLYTIC
C5	.01 (103) DISK	C11	47 MFD ELECTROLYTIC
C6	1 MFD ELECTROLYTIC	C12	.01 (103) DISK

After installing the capacitors you should have one 47 MFD electrolytic capacitor left over. This will be used later.

Now install the numbered diodes. CR2 through 12 and CR14 through 18 are all the smaller 1N4148 type. CR1 and CR13 are the larger 1N4004's. VERY IMPORTANT: Take care to place the bands of the diodes on the side indicated. For your convenience the board is laid out so that all the bands are on the same side. That way you will be able to tell at a glance if you put one in backwards.

Next locate the five 14 pin IC sockets. Notice the key at one end. Align the key on the socket with the key silk screened on

CR1 = 1N4004

3

CR2 ÷ CR12 = 1N4148

CR13 = 1N4004

CR14 ÷ CR18 = 1N4148

the board for the five 14 pin IC locations: U1,2,4,5 and 6. Install the 18 pin socket at U8 and the 24 pin socket at U7. Again take care to align the keys. You will notice that all the IC keys face the same direction. Do not install the IC's in their sockets yet. The only IC without a socket is the voltage regulator U3, the MC78M05. It has three leads coming out of the bottom and a metal tab on the back. Go ahead and solder it in its place making sure you place the metal tab on the same side as indicated by the heavy line on the board. Install crystal X1 and the two trim pots, VR1 and VR2 (both are same value).

Next locate the three LED's. The red ones are used for the Personal-Call and Group-Call indicators and the green one is a power indicator. The cathode is represented by the flat edge on the lip and also by the shorter of the two leads. Match the cathodes with the bands on the board. If you intend to install the AK-4 in a chassis leave the leads as long as possible so the LED's can protrude through the panel.

The SPDT relay may be one of two different sizes, depending on availability. You will notice that there are two extra holes associated with relay K1. These are provided to accommodate either size relay. There are six pins on the relay, four of them are grouped at one end. Place the pins on this end through the four holes in the board that are closest to the output strip. These four holes are marked with small dots.

Install the 2N2222 transistors, Q1 through Q8. Match the flat side of the transistors with the pattern marked on the board. The installation of the remaining 1N4148 diodes and jumpers depends on how you wish to program the AK-4.

PROGRAMMING

The DTMF outputs from IC U1 are listed in a vertical column on the right hand side of the board; 1,2,3,4,5,6,7,8,9,0,*,#,A,B,C,D. These outputs go high when a valid DTMF signal is decoded. Jumpers will be used to program the various points such as input to the sequential lock chip and the control outputs on the left hand side labeled 1st, 2nd, 3rd, 4th, SA, RA, SB, RB, MC, MD, CU, CD. Definition of abbreviations:

1st, 2nd, 3rd and 4th are the digits of your code.	
SA - Set Latch A	MC - Momentary output C
RA - Reset Latch A	MD - Momentary output D
SB - Set Latch B	CU - Control-Up
RB - Reset Latch B	CD - Control-Down

In the middle of the programming matrix is a strip labeled US (Unselected digits). All digits that are not a part of the calling code will be wired to this bus with diodes.

Before you program the AK-4 you must first decide if you want to

primarily use it as a selective-calling unit or as a remote control device. If you are going to use it for remote control, the first digit of your code will be programmed into the CU/CD points (Control-Up/Control-Down). If your primary interest is selective calling, ignore the "remote control mode" section and skip the next two paragraphs to "selective calling mode".

51 CHOOSING YOUR CODE - REMOTE CONTROL MODE. Choose different first digits for unlocking and locking the AK-4. The most common configuration is to use a * for unlocking (Control-Up) and a # for locking (Control-Down), but you may choose any digit you wish. Choose the rest of the code: it may be one, two or three more digits. Do not repeat the same digit twice in your code. For example *454 is not a valid code as the 4 appears twice. *456 is a valid code. Place your choices in the spaces.

CU (Control-Up)	<u>C (#)</u>	2nd Digit	<u>7</u>	<u>7</u>	<u>7</u>
CD (Control-Down)	<u>A (*)</u>	3rd Digit	<u>2</u>	<u>2</u>	<u>2</u>
		4th Digit	<u>4</u>	<u>0</u>	<u>0</u>

Solder a jumper wire from the digit you chose for the first digit in your unlocking or Control-Up code to the point CU. Similarly install a jumper between the first digit in the Control-Down or locking code to point CD. Then proceed with the 2nd, 3rd and 4th digits and their respective code inputs. If you wish to use a 3 digit code place a jumper wire in the extra holes provided between the 3rd and 4th digits, the 3rd digit will be the last in your code. For a two digit code, place jumpers between both the 3rd and 4th and between the 2nd and 3rd digit locations, the 2nd digit will be the last in your code. For CU/CD operation the 1st digit should be left blank as CU/CD takes the place of the first digit.

110 SELECTIVE CALLING MODE. The control outputs will still be available in selective-call mode, but they will be alternately locked and unlocked each time the personal call code is received. In selective-call mode relay K1 will be triggered each time your personal code is received if J3 is installed. K1 can be wired to turn on a speaker so that you can hear the station calling (see the hook-up diagram). * Choose your personal code. Do not repeat the same number twice in your code. For example a code of 6121 is not valid as the 1 is repeated twice. 6125 would be an example of a valid code. Place your choices in the spaces:

1st Digit 6 2nd Digit 8 3rd Digit 2 4th Digit 5 9

For a 4-digit code solder jumper wires between the DTMF outputs you have chosen and their respective 1st, 2nd, 3rd and 4th digit points. For 3-digit codes solder jumpers from the DTMF outputs to the 1st, 2nd and 3rd digits and place a jumper between the 3rd and 4th digits. For 2-digit codes program the 1st and 2nd digits and place a jumper between both the 3rd and 4th and 2nd and 3rd

digits. For personal-call mode do not install jumper J1.

UNSELECTED DIGITS - Now that you have programmed your code, solder diodes from all the digits you have not selected to be part of your code to the US (Unselected digit) strip. Place the anode to the digit side and cathode to the US strip. By doing this the lock chip will be reset every time it receives a DTMF signal that is not part of the code. This helps to prevent false triggering.

GROUP CALLING - Group calling is accomplished by holding down a single key for a certain amount of time. This time can be set by VR-2 from about .5 to 3 seconds. To program the group calling section your group or club must decide which digits will be used for calling which groups. Some groups have decided to use the 0 key held down for at least 3 seconds to activate all units. If you have 16 different groups within your system, you can program the AK-4 to respond to whichever ones you wish. For example if the 3 key is assigned to alert all the repeater control operators and the 7 key for the emergency coordinators, and you belong to both groups, solder programming diodes between the number 3 key to the Group Call pad and from the 7 key to the Group Call pad. Be sure the anodes are on the 3 and 7 sides and the cathodes (band side) connect to the Group-Call pad. *

CONTROL OUTPUT PROGRAMMING - Choose the six digits that you would like to use to activate the control outputs. The latch-set codes should be different than the ones you are using for your locking code, otherwise, when you are locking the the AK-4, you will be setting the latches when you may not want to. Now fill in the blanks below with the digits you wish to use:

SA ^D #591 RA ³ *581 SB ⁵ #711 RB ⁶ *711 MC 021 MD 742

Note: as an option, instead of making MD active through the keypad, you can install jumper J2. This will make MD active whenever the AK-4 is unlocked. For example, use this configuration to turn a repeater on and off by unlocking and locking the AK-4. Install jumpers from the digits you have chosen to SA, RA, etc. If you are using the AK-4 for personal-call, connect a jumper from the last digit of your code to SA. This will cause the personal-call LED to latch on when your code is received.

CONTROL OUTPUTS

RELAY K1 - K1 can be used to turn a speaker on and off in selective calling mode or it can be wired to any of the other control outputs by placing a jumper from point R of J3 to the desired output. If J3 is installed for selective calling mode and you only want the relay to turn on in personal-call mode and not in group-call, remove CR5. If you want it activated in only group-call mode, remove CR4. Install jumper J3 for selective-call mode. If you would rather use the relay with one of the latched

CR4 = solo group call
tolto



CR5 = solo personal call
tolto

or momentary outputs do not install J3 but rather place a jumper from point R of J3 to whichever output you want to use. For example, if you want to turn a repeater on and off: install jumper J2 and place a jumper between output D and point R. Use RC and NO (Relay Common, Normally Open) outputs to turn the repeater on and off. The relay contacts are rated at 1 amp 125 volts. If the device you are activating draws more current, use this output to turn on a higher rated relay. Point T is provided to give an extra open collector timed output.

→ For remote control mode install jumper J1. This will cause C11 to be discharged as soon as U4, the lock chip, is locked or unlocked thereby allowing it to immediately receive another lock/unlock command. Otherwise you will have to wait until C11 discharges through the internal resistance of U4 before you can reverse its lock state. With jumper J1 installed the timing circuit controlling Q1 will not be triggered by U4. So do not install J1 if you wish to use the AK-4 in personal-call mode with a timed relay output. To use the timed output in remote-control mode the best way to do it is to use one of the momentary outputs to trigger the timer. The timer consists of C3, VR1 and R5. For example, to use the momentary output C circuit, do not install R11 or CR4. Place the anode of a diode from the point where R11 would normally go to pin 3 of U1 and the cathode to the point where the cathode of CR4 would normally go. This way you can trigger the timer by pressing the key programmed to the momentary C output. If J1 is not installed and you are using the AK-4 in remote control mode, the timed output (Q1) will be triggered each time the lock and unlock codes are received.

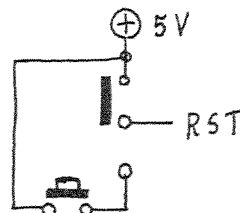
There are five open collector transistor outputs, Latch A, Latch B, Momentary C, Momentary D and Group Call. Examples of possible configurations are shown in the "Typical Hook-Up" diagram. The outputs can be used to turn external relays on and off, turn on horns, antenna rotators etc. Use 12 volt relays connected to the power input rather than overloading U3 by using 5 volt relays.

RESET - For manual reset of the latches, connect a pushbutton between the RST output and +5 V (next to Q7). For power-on-reset wire a jumper from RST to +5. This will cause the latches to always be initialized in the reset state when power is turned on.

SPEAKER CONNECTION - To use the AK-4 for selective calling connect a jumper from output RC to the Audio Input. Connect the positive side of your speaker* to output NO and the negative side

*NOTE: THERE ARE A FEW HANDHELD RADIOS THAT HAVE VCC PRESENT ON THE AUDIO LINE. IF THIS IS THE CASE WITH YOUR RADIO (MOSTLY YAESU HT'S) YOU MUST USE THE REMAINING 47 MFD CAPACITOR BETWEEN OUTPUT "NO" AND YOUR SPEAKER SO THAT VCC WON'T BE SHORTED THROUGH THE SPEAKER WHEN IT TURNS ON. THIS WILL NOT BE A PROBLEM WITH MOST RIGS, BUT IF YOU ARE IN DOUBT, CHECK YOUR RADIO'S MANUAL.

7



to ground. This way the speaker will turn on when your personal and group codes are received. Place a toggle switch between RC and NO so you can turn your speaker on manually when you want to use your radio.

Connect a power supply of between 9 and 15 volts to +IN and GND on the output strip. Check to see that the green PWR LED lights. Using a voltmeter check the +5 point to the right of Q7. It should read approximately +5 VDC. If it doesn't, go to the trouble shooting section. MAKE SURE TO DISCHARGE ANY STATIC ELECTRICITY ON YOUR BODY BEFORE TOUCHING THE IC'S. If you have +5, disconnect the power supply and insert the IC's in their respective locations. Be sure you match the key's on the IC's with the keys on the board and sockets.

U1 - CD4081	U5 - CD4001
U2 - CD4001	U6 - CD4001
U3 - 78M05 (already insalled)	U7 - CD4514
U4 - LS7225	U8 - SSI-202 P

Connect the audio from your radio to the audio input of the AK-4. Use shielded cable. Connect the center conductor to the audio input and the shield to the ground point next to it on the board. Adjust the audio level to a comfortable setting. Reconnect the power supply. Set your rig to a simplex frequency and use another radio or have a friend key in your access code on his key pad. Some HT's such as the Icom 2AT have the DTMF tones present on the receive audio while transmitting. You can use this for testing purposes without the need to use a second rig by connecting a patch cord from the "SP" jack on the 2AT to the audio input on the AK-4. Be sure to transmit into a dummy load or on an unused simplex frequency. If your AK-4 is setup in personal-call mode the relay should activate and your speaker turn on as soon as the last digit is received. The Personal-Call LED should also come on if point SA is programmed to the last digit of your code. The amount of time relay K1 stays on is adjusted by VR1. It will adjust from about 10 to 60 seconds (5-35 seconds with a group call due to a shorter trigger pulse). This value can be increased by changing R5 to a higher value. The time will increase by about 50 seconds for each megohm of resistance increase of R5.

Test the group-call feature by holding down one of your group call keys for a few seconds. Note how long it takes for the relay to click on. This time can be adjusted by VR2. A typical value is three seconds.

If your AK-4 is set up for remote control operation, key in the Control-Up code. When this code is received, the control outputs should be unlocked. Enter the digit that is programmed to SA. The personal-call LED should come on since it is tied to latch A. Key in the Control-Down code. The LED should still be lit. Enter the key programmed to RA. This should have no effect on the LED since the AK-4 has been locked. Enter the Control-Up command

and press the key for RA. This time the LED should turn off.

LIST OF ABBREVIATIONS USED

CD - Control-Down	RA - Reset Latch Output A
CU - Control-UP	RB - Reset Latch Output B
GC - Group Call	RC - Relay Common Contact
MC - Momentary Output C	SA - Set Latch Output A
MD - Momentary Output D	SB - Set Latch Output B
NC - Normally Closed Relay	US - Unselected Digits
NO - Normally Open Relay	DTMF - Dual Tone Multiple Frequency

TROUBLE SHOOTING

CAUTION: UNLESS YOU ARE CERTAIN YOUR LOGIC PROBE SINKS LESS THAN 200 MICROAMPS, DO NOT TOUCH IT TO THE OUTPUTS OF THE DECODER CHIP U8 (PINS 1, 14, 16, 17, AND 18) OR YOU WILL DESTROY THEM!

PROBLEMS AND POSSIBLE SOLUTIONS:

NO +5VDC - Check to make sure U3 was not installed backwards. Is CR1 in backwards? Does your power supply voltage appear on the input (check by measuring voltage from cathode of CR1 to ground)? If power supply voltage appears on input but no +5 on output; is regulator U3 warm or hot? If it is remove power and check for possible solder bridge shorting out the VCC.

DOES NOT RESPOND TO PROGRAMMED CODE - Make sure audio cable is not shorted and shield is connected to ground on board. Check R33, is it proper value (100 ohms)? Make sure you do not have diodes going to the US strip from digits that are supposed to be part of your code. If this is the case, the lock circuit will be reset before your code can be decoded.

RELAY IS TRIGGERED BY A GROUP-CALL CODE BUT NOT BY A PERSONAL-CALL CODE - Jumper J1 has been installed. Remove J1, this jumper is intended for remote-control mode only. If installed, the timing capacitor will not be charged when your personal-call code is received.

THEORY OF OPERATION - The DTMF tones are decoded by U8. These appear as a four bit output and drive the 1 of 16 decoder chip U7. Data Valid information is fed to the enable input of U7 pin 23. When a valid DTMF signal is decoded the corresponding pin of U7 goes high. The sequential code is programmed into the lock chip U4. When it's four inputs are brought high in sequential order U4 is unlocked. Pin 8, the lock control output goes high. This enables access to the latches and momentary outputs. When a DTMF signal is decoded that is either not part of the sequential code or is out of the proper order, a pulse will appear on pin 5 of U4 that will cause the locking or unlocking sequence to be

reset. This will not change the lock state, it will remain either locked or unlocked until the proper code is received to reverse it's condition. The group-call circuit consists of U6A, C and D and U2C and D. When a valid DTMF signal is decoded that has been programmed to the group-call pad, the one-shot timing circuit of U6A and U6D is triggered. If the signal is still present on pin 12 of U2D when the one-shot times out then a positive going pulse appears at the output of U2D pin 11 which triggers the timed relay circuit. The timing of the one-shot is adjusted by VR2. U2C is used to reset the timer if the tone is not on long enough to trigger the GC circuit. This helps prevent false triggering.

DTMF MUTED REPEATERS - Some repeaters mute DTMF signals so that repeater control codes will not appear on the output, adding extra security. In order to use the AK-4 through a repeater you must make certain the DTMF signals are being passed. Many repeater controllers will allow the tones to pass by preceding your code with the # key. Others require a certain code to be keyed in. Consult a control operator of your repeater for the proper procedure.

SUMMARY OF JUMPERS J1, J2, J3:

J1 - **INSTALLED:** Enables U4 to be locked and unlocked without having to wait for C11 to discharge. Normally installed in Remote-Control mode. When installed does not allow timed output capacitor C3 to charge through pin 9 U4.

J1 - **NOT INSTALLED:** Normally left out for personal-call mode. This will allow operation of timed output. Allows pin 9 of U4 to trigger timed output each time personal-call code is recieved.

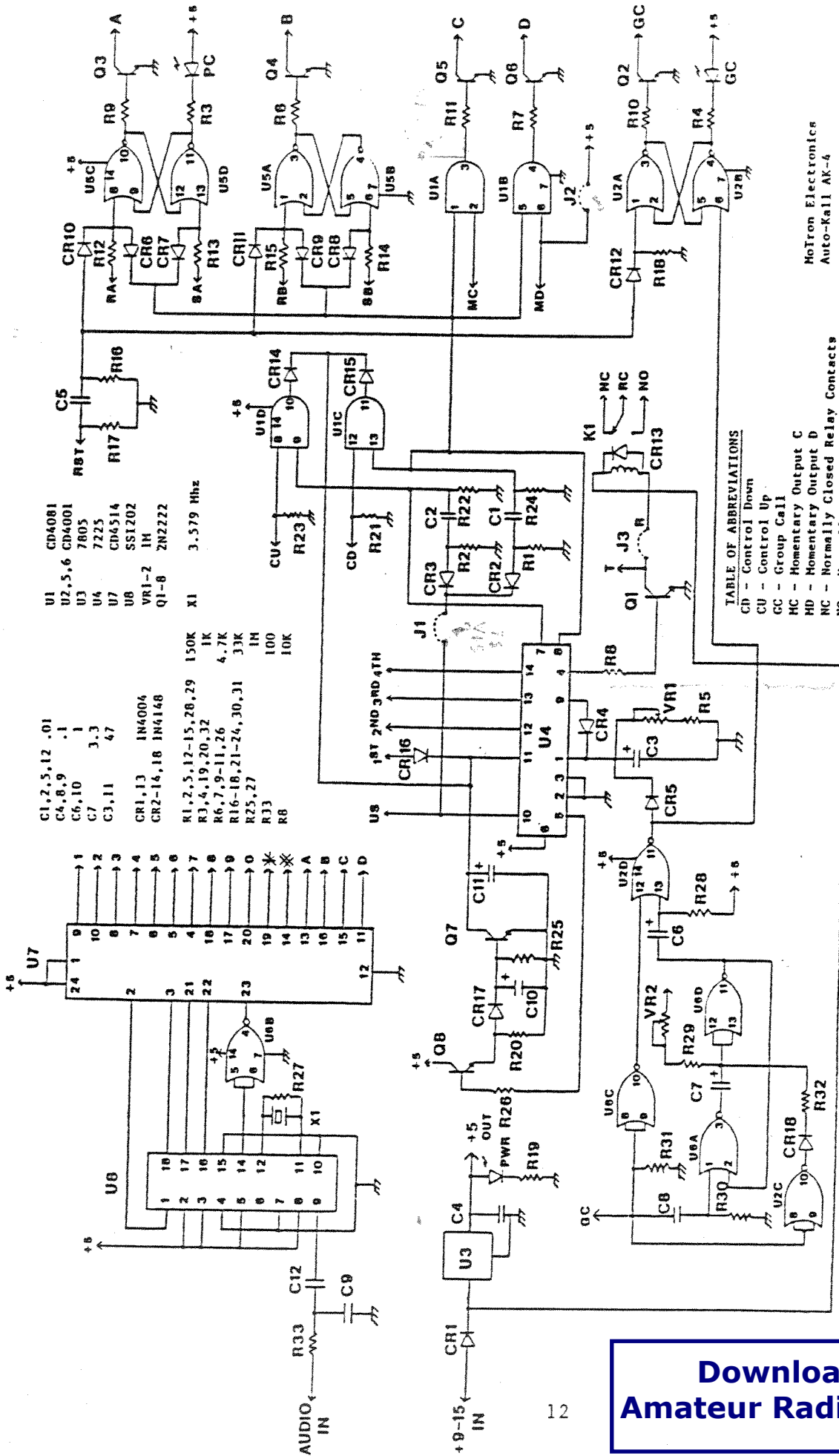
J2 - **INSTALLED:** Enables momentary output D to be turned on during the entire time the AK-4 is in the unlocked state thereby allowing this output to be used to control another device by locking and unlocking the AK-4. Do not program MD on the matrix if this jumper is installed.

J2 - **NOT INSTALLED:** Momentary output D will be controlled by the digit programmed into point MD of the programming matrix. It will only come on when that DTMF signal is received when AK-4 is unlocked.

J3 - **INSTALLED:** Connects the timed output circuit to relay K1. Normally used with personal-call mode.

J3 - **NOT INSTALLED:** Allows relay K1 to be used in conjunction with any of the other outputs.

If you have any questions or problems please call or write.



- U1 CD4081
- U2,5,6 CD4001
- U3 7805
- U4 7225
- U7 CD4514
- U8 SS1202
- VR1-2 1H
- Q1-8 2N2222
- X1 3.579 Mhz

- C1,2,5,12 .01
- C4,8,9 .1
- C6,10 1
- C7 3-3
- C3,11 47
- CR1,13 IN4004
- CR2-14,18 IN4148
- R1,2,5,12-15,28,29 150K
- R3,6,19,20,32 1K
- R6,7,9-11,26 4.7K
- R16-18,21-24,30,31 33K
- R25,27 1H
- R8 100
- R33 10K

TABLE OF ABBREVIATIONS

- CD - Control Down
- CU - Control Up
- GC - Group Call
- MC - Momentary Output C
- HD - Momentary Output D
- NC - Normally Closed Relay Contacts
- NO - Normally Open Relay Contacts
- RA - Reset Latch A
- RB - Reset Latch B
- RC - Relay Common
- SA - Set Latch A
- SB - Set Latch B
- US - UnSelected Keys

MoTron Electronics
 Auto-Kall AK-4
 Revised Schematic 3-15-88