November, 1987

Dear Fellow Ham,

The Crawford Amateur Radio Society is offering the CARS Repeater Controller for sale. We believe the enclosed information will show that the controller is very flexible and will add to the responsiveness and value of your repeater.

The CARS controller was designed and is being built by hams; lead design and construction is by Jim, KA3JFO; Joe, KB3EX; and Rick, WB3JDI. All income from the sale of controllers goes to the CARS treasury and is used to support club activities, notably the W3MIE repeater. This is truly a "by hams, for hams" operation.

We invite your attention to the enclosures. Your order or questions will be filled or answered promptly.

Happy hamming and 73s.

Rick

Rick Silverio, WB3JDI
President, CARS
P.O. Box 653
Meadville, PA 16335
INTRODUCTION

The CARS 2-87 TONE DECODER AND MICROPROCESSOR CONTROLLER BOARD permits economical and reliable control of remotely located devices such as amateur repeaters. It is designed around the 8748 microprocessor and SS1282 tone decoder to keep components to a minimum.

The controller is offered as a completely assembled and tested operational unit; as a Kit complete with the PC board, programmed microprocessor, decoder and all parts; or as a partial Kit including PC board and programmed microprocessor (you supply decoder and common parts). This permits the lowest possible price.

The controller is programmed to your individual requirements after you order it. It may be reprogrammed for a $15.00 fee if sent to us. The circuit board is single sided to make soldering easy for the builder and we supply a complete set of pictures, diagrams and instructions for building Kit. A 22 pin edge connector is supplied with the operational unit or the complete Kit.

EXAMPLE CONTROL SEQUENCE

To turn relay number one ON, you would press: ( * 123 * ).
To turn the same relay OFF you would press ( * 123 # ).
The last character sent toggles ON/OFF.
The ( 123 ) is the function assignment for relay one (#1). It could be any three numbers or ABCD on the tone pad.
The ( * ) is the first digit and is used to start the decode timing sequence. If (and only if) the COD is active, you are allowed 10 seconds to enter codes.

PRICE LIST

PC board, Microprocessor & building instructions $35.00
Kit - all parts except relays $65.00
CARS controller - assembled and tested $80.00
On-board relay Kit (relays, diodes, LEDs) $20.00.
*12 LATCHED FUNCTIONS
The controller board offers 12 independently controlled latched relay outputs.

*4 SPECIAL FUNCTION RELAYS
1. Carrier Operated Relay output (COR).
2. Weather Relay Output - A special function that can be activated with an external pulse from a tone controlled weather radio.
3. Pulsed Relay Output - A special function used to give a 1/2 sec. pulse to start a special function like a tape recorder.
4. Mute Relay Output - This special function will be active when control tones are sent to the controller. This eliminates tones sent over the air for control and provides security.

*CODE ID
The controller provides your individual code ID that is programmed into the 8748 when you order. For example, W3MIE/R.

*COURTESY TONE CONTROL
An over-the-air signal can be sent to the controller to change the frequency of the courtesy tone. Four tones are available and can be used as a special signal to your group that is sent with each courtesy tone.

*CODED RESPONSE TO CONTROL TONES
The decoder will respond with CW "OK" for any correct control code it receives.

*5 DIGIT CONTROL CODES
Five digits are required for control which allows greater security. See example on last page.

*SPECIAL LOCK FUNCTION CODE
For security, control codes can lock the controller in its present state of operation.

*TONE PAD TEST
This function will give a response of "OK" if the correct sequence of tones are sent to the controller. If the tones are bad, the controller will not respond.

*SINGLE-TONE AUTOPATCH
The controller uses THREE SECONDS of "*" for auto patch UP, and "#" for OFF. The weather relay output can be used for this.

*HANG TIME CONTROL
The hang time can be either short (1/2 sec.) or long (1 1/2 sec.). Used for open band conditions.

*TIME-OUT TIMER CONTROL
The controller will allow control of the time-out timer used with the COR relay. It can be either either three minutes or zero for special events.

*MULTIPLE COURTESY BEEPS
The controller has four different courtesy beeps. One, two, three or four beeps can be used for different weather conditions or whatever you want to dream up. CARS can provide a chart for suggested uses of this function.

*SPECIAL RESET CODE
A special reset code is provided to allow you to reset all controller codes to a power-up condition.

*AUTO RESET ON POWER UP
The controller will set the processor to a default condition on power-up but will not lock up on power failure.

*EMERGENCY TONE
If the touch tone "0" is sent to the controller for three seconds, the courtesy tone will change to FOUR BEEPS to alert any station monitoring of an emergency.
REPTUNE FOR __\_/\R

CODE on/off FUNCTION
#01 */## RELAY #1
#02 */## " #2
#03 */## " #3
#04 */## " #4
#05 */## " #5
#06 */## " #6
#07 */## " #7
#08 */## " #8
#09 */## " #9
#10 */## " #10
#11 */## " #11
#12 */## " #12

COMMENT
WHEN ON) COURTESY BEEP IS THREE BEEPS

*613 */## BEEP
*614 */## TIMED RLY
*615 */## HANG TIME

MAYBE USED FOR AUDIO CUTOUT ON PATCH.

MAY ALSO BE "PULSED" 1/2SEC. USING *616#

"ON" PULSES IT AFTER EACH ID AND CHANGES COURTESY BEEP TO TWO DITS, "OFF" PULSES IT EACH TIME CODED CONTROLS THE LENGTH OF HANGTIME AFTER BEEP 'DEFAULT' IS SHORT HANG TIME. * LENGTHENS THE TIME.

*616* RESET *616# PULSE R12
*617 */## "LOCK"

*617# resets processor, # pulses rly 12 for 1/2 sec.

"LOCK" DISABLS ALL CODES EXPECT UNLOCK CODE *617#

IN THERE CURRENT STATE

*600 */## HELP/WX

CAUSES THE COURTESY BEEP TO GO TO "H" 4 DITS AND TURNS ON THE WX RLY OUTPUT. PIN 21 ON THE BOARD CAN BE USED FOR THE PATCH RELAY OUTPUT IF WX NOT USED.

TONE DECODED OK IT WILL SEND A CW "OK" IF GOOD TONE

*123# PAD TEST
*456# " "
*789# " "
*001 */## TONE CHANGE

CHANGES COURTESY BEEP # APPX 750

* " 1500
* " 2250
* " 3000

*002 */## " 

*003 */## PHONE PATCH

* INTERNAL PATCH, # EXTERNAL

*004 */## TIME OUT

* TIME OUT TIMER ON 3 MIN

# " " WILL NOT TIME OUT

NOTES AND PROCEDURES

1) ALL CODES CONTAIN THREE DIGITS (0 THRU 9 AND A THRU D)

2) ALL CODES ARE PRECEEDED WITH A "#"

3) ALL CODES ARE TERMINATED WITH EITHER A "#" OR ";"

4) THE "#" TERMINATOR TURNS THE FUNCTION ON AND THE "#" TERMINATOR TURNS IT OFF (THERE ARE A FEW EXCEPTIONS)

5) CARRIAGE DROP DURING THE CODE WILL ABORT THE CODE

6) A "0" HELD FOR THREE SECONDS WILL ACTIVATE THE WEATHER/HELP RELAY JUST AS "##000#" WILL. A "H" WILL BE ON THE COURTESY TONE. A 5 VOLT VOLTAGE ON PIN 31 OF THE PROCESSOR WILL ALSO ACTIVATE THE RELAY BUT THE BEEP WILL NOW BE A "W"

RESET THESE TWO FUNCTIONS BY USING THE *000#

7) A "#" HELD FOR THREE SECONDS WILL ACTIVATE THE PHONE PATCH. THE "#" WILL DROP THE PATCH

NOTE THE OUTPUT PIN 32 OF THE PROCESSOR IS THE PATCH LINE SEIZURE RELAY OUT PUT IT NEEDS A 7406 IF YOU ARE TO USE IT.

PIN 34 IS THE PATCH THE AUDIO CUT OUT RELAY THAT IS ACTIVATED BY THE COR IN PUT TO MUTE AUDIO FROM THE LINE IT ALSO NEEDS A 7406

THESE OUTPUTS ARE MUTE IN THE INTERNAL PATCH NODE

IF THE EXTERNAL PATCH IS SELECTED THE PIN 32 SEIZURE RELAY WILL ACTIVATE A

AND THEN WILL DEACTIVATE ON THE NEXT COR ACTIVATION. IT IS ASSUMED THE YOU ARE USING A SMART PATCH FROM THERE.

8) IF THE SYSTEM IS "LOCKED" NO CODES WILL BE RECOGNIZED EXCEPT THE "UNLOCK" CODE, THREE SECONDS OF "#" OR "#" FOR PHONE PATCH AND THE HELP /WEATHER RELAY "0" THREE SEC.

9) ALL INPUTS ARE 5VOLT ZENER PROTECTED (COR OR WX) HIGHER VOLTAGES CAN BE USED
VOLTAGE PROTECTION OF BOARD
The board will not be damaged if the power supply is reversed. All inputs, COR and weather are 5 volt Zener Diode protected.

AREA FOR BOARD-MOUNTED RELAYS
The PC board is designed to accommodate four board-mounted relays for simple control operations. When installed, these relays can be used with any controller output. No relays are supplied except in the relay installation kit ($20.00).

OPEN-COLLECTOR OUTPUTS
All outputs are open collector, 40 ma. sink, rated 30 volts.

VALID TONE INDICATOR
This function uses a LED to indicate if a tone is valid and is used to set audio levels to the controller.

INDEPENDENT XTAL CONTROL STABILITY
The controller has two 3.58 MHz xtals to provide rock-solid stability. One is used to control the decoder chip and the other to control the microprocessor.

SMALL SIZE
The controller PC board is 4.5 x 4.5 inches and uses a standard 22 pin connector for all inputs and outputs.

COURTEOUS ID
The controller will wait for you to drop the carrier before it IDs and will ID if the COR is activated after that time.

CONTROL TONE MUTING
The controller can be set to mute all control tones; other tones will be normal. (*) starts the mute sequence.

MORE INFORMATION
Write to: Crawford Amateur Radio Society
P.O. Box 653
Meadville, PA 16335

Call: Rick Silverio, WB3JDI
814/724-4337
Thanks for ordering our controller. In the box you will find drawings for the controller, a parts list, relay board info, and interconnect cable info. Follow the drawings and you should have no problems. Start with the jumpers print. Before you put any of the chips on the board please do these checks first.

1. Install the 7406 reg. After all other parts are in place. Don't forget the aluminum heat sink.

2. Apply power to pin 1 +12 dc and 22 ground of the edge connector.
   With a dc volt meter set to 12 volts scale check between ground and these places on the board:
   8748 pin 40-26-5 test 5 volts
   7406#3 pin 14 " 5 "
   SSI202 pin 2-3-5-8 " 5 "

3. Remove the ground lead and clip your plus lead to 12 volts.
   With the ground lead check these pins.
   8748 pins 7-20 test 12 volts.
   7406#3 pins 7 " 12 "
   221202 pins 4-7-10-15 " 12 "

4. Remove power plus in the 7406 chips observe pin one and connect power again.
   Plus lead of you meter to plus 12 v, test all edge connector outputs.
   Edge connector pins:
   4-5-6-7-8-9-10-11-12-13-14-15-18-19-20-21 all have a 12 volt reading.
   All of the chips are turned on.

5. Remove power and plug in the 8748 and the SSI202. Observe pin one. Connect power.
   All of the output should now read 0 or very low voltage.
   All of the chips are now off.
   The valid tone led will blink when the power is connected.

6. Connect pin 16 of the edge connector to 12 volts.
THIS TAKES THE COR HIGH TO ACTIVATE. CONNECT 8 OHM SPEAKER AUDIO FROM AN HT TO PIN 2 AND 22 GND. WITH ANOTHER HT SEND TOUCH TONES TO THE FIRST HT.

    YOU SHOULD SEE THE VALID TONE LED LIGHT WITH THE TONES.

7. CONNECT YOUR METER GND LEAD TO PIN 20 THIS IS RELAY NUMBER ONE.

    SEND #501# AND YOU WILL SEE 12 VOLT ON YOUR METER.

    SEND #601# AND 12 VOLS WILL DROP.

8. RELocate YOU LEAD TO PIN 6 AND REMOVE THE WIRE ON PIN 16 AFTER A FEW SECONDS THE 12 VOLTS WILL DROP. THE BOARD WAS ID'ING. CONNECT THE WIRE TO 16 AND THE 12 WILL COME BACK. THIS IS YOUR COR OUTPUT.

9. ALL THE OTHER OUTPUTS WILL ACT THE SAME ON THESE TEST IF THE CORRECT CODE FOR EACH IS SENT TO TURN ON THEN OFF THE OUTPUT.

10. A SMALL HI Z EARPHONE CONNECTED TO PIN 3 AN 22 WILL LET YOU HEAR THE ID AND COURTESY TONES. THREE DITS WHEN RLY#1 ON.

11. TAKING PIN 15 HIGH 12V WILL CAUSE A (W) ON THE COURTESY TONE.

    THIS IS USED WITH ANY EXTERNAL WEATHER RADIO TO INDICATE WX WARNINGS.

12. WE HAVE INDICATED, ON THE DRAWING, THE JUMPERS TO GIVE YOU PATCH OUTPUT AND AUDIO OUTPUT ON THE PATCH. THE AUDIO CUT OUT WILL ACTIVATE A RELAY ON PIN 10 TO CUT OUT ANY AUDIO FROM THE PHONE LINE SO YOU HAVE COMPLETE CONTROL. THE WX RELAY IS WIRED TO BE THE PATCH LINE RELAY YOU MAY CHANGE IT IF YOU WISH.

IF YOU HAVE ANY QUESTIONS CALL OR WRITE TO US AND WE WILL HELP AS MUCH AS WE CAN.

OUR ADDRESS IS: C.A.R.S.
BOX 653
MEMPHIS, TN 38135

MY PHONE NUMBER IS 914 724 4337. CALL AFTER 6:00 PM. LEAVE A MESSAGE IF I'M NOT THERE.

RICK SILVETTO WB3J01

PRES. C.A.R.S.
RL10 used to open COR inhibit xmit.

RL4 - Other operation.

On board relay wiring chart.

(c) 1987 CARS
Simple Auto-Patch Hook up

Patch is shown activated after 3 seconds of (X) opens with (#)
"Cor" is active

+12V DC

Patch Relay to Pin # 21 Auto Patch Control on Controller Edge Connector

+Telephone Line

Audio Cutout Relay to Pin #10 Controller Sound Edge Connector Audio Cutout Relay

This Relay will open when "Cor" is active to Cut out the Audio from the Phone line to the Transmitter.
Repeater Hook up of CARS Controller

Remove (J1) if you use audio mixer.

Shown no incoming signal.
Relay #2 is on.
Relay #9 is off.
COR - off
Mute RLY - off

J2 - for in house alarm system.
* Close bypass switch opti.
rise if ADoor is opened.
The (C) will activate the repeater.
(Warning) (C) 1987 CARS.
HARDWARE

25  1- 40 PIN SOCKET   276-1996
26  1- 18 PIN SOCKET   276-1992
27  3- 14 PIN SOCKETS   272-1999
28  1- SMALL ALUMINUM HEAT SINK
29  1- FERRIT BEAD
30  1- CARS 2/87 PC BOARD  CARS SUPPLIED
31  24 INCHES #30 WIRE WRAP WIRE  276-501
32  44 PIN EDGE CARD SOCKET  276-1951

OTHER PARTS:

4-RELAY KIT     OPTIONAL FROM CARS
33  4- 12V RELAY        275-213
34  4- 1N4001          276-1431
35  4- LED (OPTIONAL)  276-026
36  4- 1K             "     271-1321
37  4- 16 PIN SOCKETS  "     276-1998
38  1- #30 WIRE WRAP WIRE  276-501

EXTERNAL RELAY BOARD & RELAYS (SPECIAL REQUEST ONLY).
39  8- 12V RELAYS       275-213
40  1- PC BOARD        276-188
41  1- 44 PIN EDGE CARD SOCKET  276-1551
42  8- 16 PIN SOCKETS (OPTIONAL)  276-1998
43  1- 7805            "     276-1770
44  1- 7404           "     276-1802
45  1- 14 PIN SOCKET   "     276-1999
46  8- LEDs           "     276-026
47  8- 1K            "     271-1321
48  8- 1N4001       "     276-1191
49  1- DIP Switch    "     275-655
50  1- #30 WIRE WRAP WIRE  276-501

C.H.R.S WILL SUPPLY ANY INDIVIDUAL PARTS ON THIS LIST AT SUGGEST LIST PRICE PLUS SHIPPING. ORDER LINE NUMBER AND QUANTITY.
WRITE TO: C.H.R.S  BOX 658  MEADVILLE, PA. 16335
CAR5 Relay Board
Jumper - Cotm A, B, C, D, E, F
Note: No patch this week.
WIRING FOR RELAY #2

NOTE: SWITCH ENABLES LEDS

ALL 2.2K R

CARS CONTROLLER
RELAY BOARD #1

(C) CARS 1987

JMH
# PARTS LIST C.A.R.S. REPTONE

Followers is a parts list for the C.A.R.S. Reptone controller.

<table>
<thead>
<tr>
<th>CAPS.</th>
<th>RADIO SHACK PART</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>2 - .1 MFD</td>
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<tr>
<td>2</td>
<td>2 - .01 MFD</td>
</tr>
<tr>
<td>3</td>
<td>2 - 20 PF</td>
</tr>
<tr>
<td>4</td>
<td>1 - 1 MFD TAHT 10VDC</td>
</tr>
<tr>
<td>5</td>
<td>2 - 47 MFU 10VDC</td>
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**RESISTORS**

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<tr>
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<tbody>
<tr>
<td>6</td>
<td>3 - 2.2K</td>
</tr>
<tr>
<td>7</td>
<td>2 - 1K</td>
</tr>
<tr>
<td>8</td>
<td>1 - 22K</td>
</tr>
<tr>
<td>9</td>
<td>1 - 10K</td>
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<tr>
<td>10</td>
<td>1 - 47 OHM</td>
</tr>
<tr>
<td>11</td>
<td>2 - 10K</td>
</tr>
<tr>
<td>12</td>
<td>1 - 4.7K</td>
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<tr>
<td>13</td>
<td>1 - 330 OHM</td>
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<tr>
<td>14</td>
<td>1 - 470 OHM</td>
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**IC**

<table>
<thead>
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<td>1 - 8748</td>
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**CAPS SUPPLIED**

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<th>RADIO SHACK PART</th>
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<tr>
<td>16</td>
<td>3 - 7406</td>
</tr>
<tr>
<td>17</td>
<td>1 - 7805</td>
</tr>
<tr>
<td>18</td>
<td>1 - 1N4001</td>
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<tr>
<td>19</td>
<td>1 - 9S1202</td>
</tr>
<tr>
<td>20</td>
<td>1 - 2N2222</td>
</tr>
<tr>
<td>21</td>
<td>2 - 1N4733 5.1 VOLT ZENER</td>
</tr>
<tr>
<td>22</td>
<td>1 - 1N4735 6.2 VOLT ZENER</td>
</tr>
<tr>
<td>23</td>
<td>2 - 3.58 MHZ XTALS</td>
</tr>
<tr>
<td>24</td>
<td>1 - LED (RED)</td>
</tr>
</tbody>
</table>
UNSELECT AUDIO AMP - LM386 AUDIO AMP

T1 - T3 NOT USED WHEN THERE IS NO PHONE LINE
A.O.R. Audio operated Relay

30K Pot Adjusted for Hang Time of Relay
1.5 sec with 33mFD.