CREATIVE CONTROL PRODUCTS

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SRC-10 SMART REPEATER CONTROLLER

AND

PI-10/5 SYNTHESIZER BOARD

OWNERS MANUAL

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LIMITED WARRANTY

Creative Control Products warrants that any new controller manufactured by Creative Control Products will be free from defects in components and manufacture for one year from date of purchase. Any accidental damage, misuse or improper installation voids all warranties.

Rev. 2.0

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SCHEMATICS SUPPLIED WITH BOARDS

1.0 INTRODUCTION

The Creative Control Products SRC-10 smart repeater controller is a low cost, low power, self-contained microprocessor based repeater controller.

All repeater functions have been incorporated onto a four inch by six inch G-10 glass epoxy printed circuit board with one interfacing connector for quality, ease of installation and reliability.

The heart of the SRC-10 controller is a CMOS NSC800 microprocessor chip interfaced to a CMOS DTMF (Touch-Tone) decoder with a CMOS 8155 I/O chip including RAM and Timers. A CMOS 27C64 EPROM contains the controllers program.

The SRC-10 controller provides up to 7 buffered auxiliary function control outputs which are selected remotely via a three digit DTMF (Touch-Tone) command. The SRC-10 controller responds with a Function Complete tone after each valid DTMF command. Courtesy Tone Responses are also available to indicate repeater or link COS activity. There is a lock command: when selected, the controller ignores all DTMF commands until the unlock command is received. This is useful in case of repeater jammers or hackers.

In addition to the SRC-10's auxiliary outputs is a Repeater PTT (Push-To-Talk), Link PTT, CW ID, DTMF Mute and a CTCSS Mode output. Inputs consist of DTMF Audio, Repeater COS (Carrier Operated Switch), CTCSS (Sub Audible) Tone, Link COS and an Alarm input for monitoring a user installed event such as low battery current, over voltage, intrusion, etc.

With the optional PI-10/S synthesizer board, the frequency and offsets of the link radio may be programmed remotely. After a 16-bit data word is sent in serial format from the controller, it is converted into parallel outputs to interface with the link radios frequency synthesizer. A readback command verifies the link frequency.

The SRC-10's firmware incorporates most options that would be used in a repeater configuration. Customer specified command codes are available for each DTMF Function, along with customer specified CW Speed, Repeater Hang Time and Repeater Call.

2.0 SPECIFICATIONS

SIZE: 4.0" by 6.15"

POWER: +8 to 15 volts DC @ 22ma.

OPERATING TEMPERATURE.: -30 to +50 degrees C.

CONNECTOR: Two 10 pin male in-line straight headers.

REPEATER CONTROL FUNCTIONS:
Repeater COS or CTCSS operation, repeater ON/OFF, repeater courtesy tones ON/OFF, DTMF Lock/Unlock, and force CW ID.

LINK CONTROL FUNCTIONS:
Link receive/transceive operation, link courtesy tones ON/OFF, frequency and programming of the link synthesizer.

CONTROL OUTPUTS: Up to 7 remote control, repeater and link PTT, DTMF Mute and CTCSS Mode (each open collector output is buffered 100 ma at 35 volts, active low).

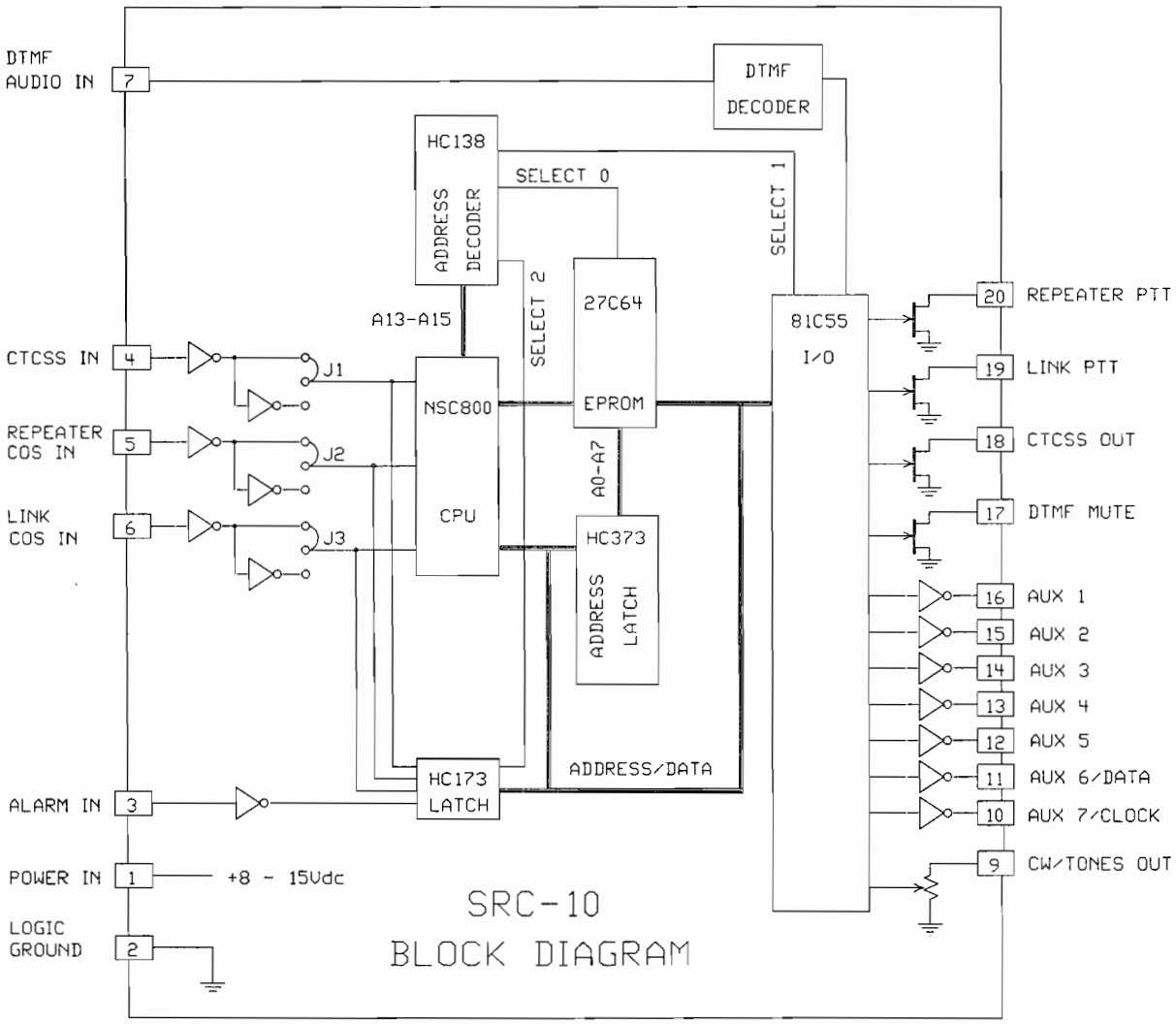
CONTROL INPUTS: Repeater COS or CTCSS, link COS and alarm. COS inputs are selectable between an active low (ground) or active high (3 to 15 volts) logic level.

ALARM CONTROL FUNCTIONS: Alarm ON/OFF and alarm acknowledge.

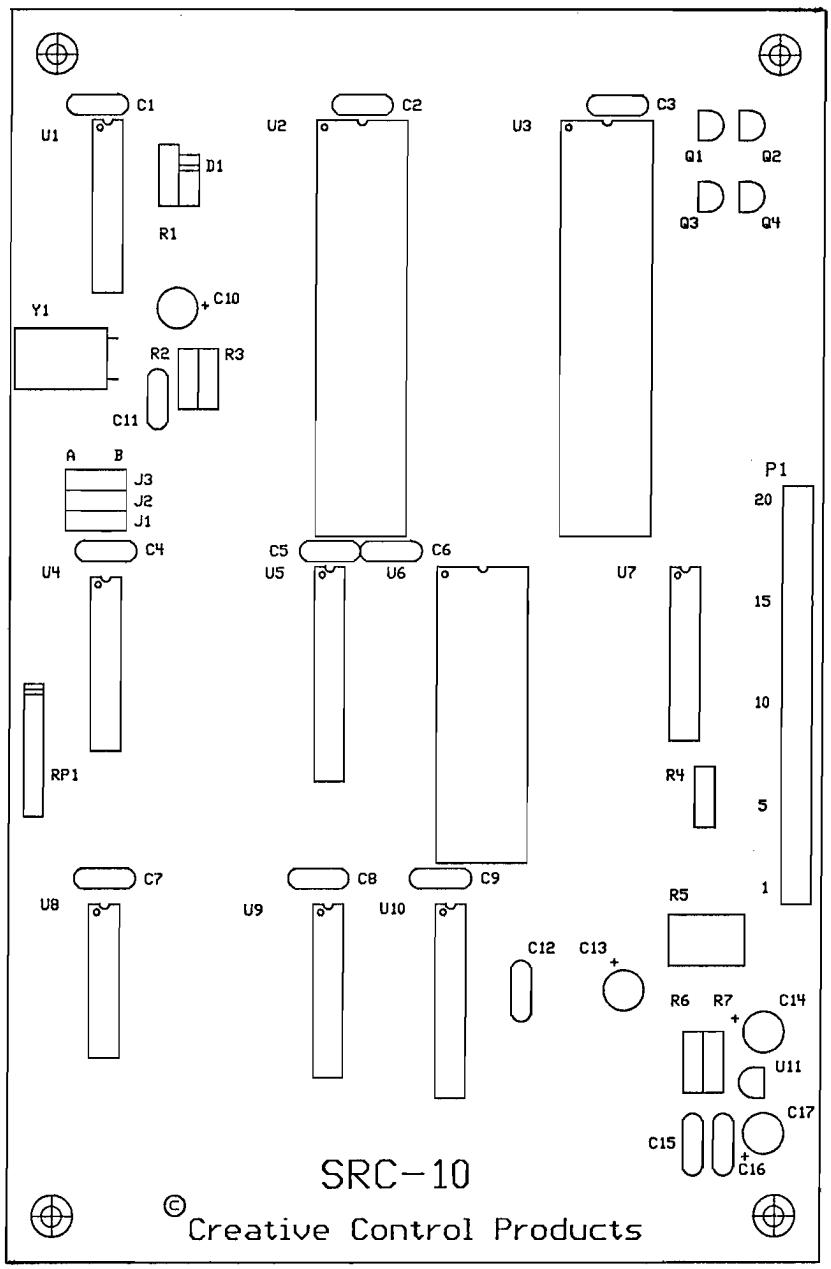
DTMF DECODER: SSI 202 or CS 202, 16 Digits, audio input impedance 100K, input level -32 to -2 DBM, twist -10 to +10 DB, decode time 40 ms.

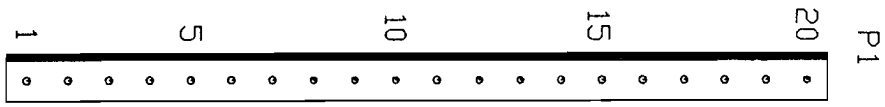
CW/TONE OUTPUT: 10K output impedance, 1 volt peak to peak.

3.0 SRC-10 BLOCK DIAGRAM



4.0 SRC-10 BOARD COMPONENT LAYOUT





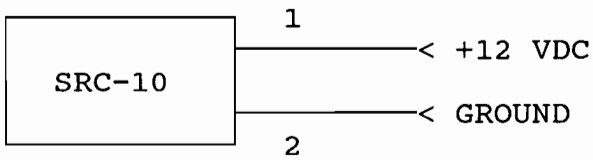
4.1 INTERFACE CONNECTOR (P1) PINOUT

1. + Volts DC Input
2. Ground
3. Alarm Input
4. CTCSS Input
5. Repeater COS Input
6. Link COS Input
7. DTMF Audio Input
8. Audio Ground
9. CW/Tone Audio Output
10. Aux #7 Output/Clock
11. Aux #6 Output/Data
12. Aux #5 Output
13. Aux #4 Output
14. Aux #3 Output
15. Aux #2 Output
16. Aux #1 Output
17. DTMF Mute Output
18. CTCSS Mode Output
19. Link PTT Output
20. Repeater PTT Output

5.0 INTERFACING

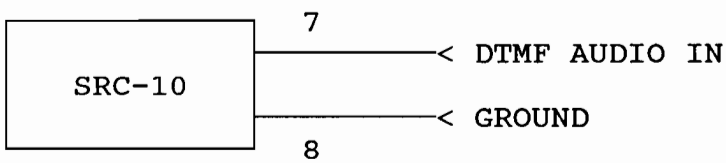
5.1 POWER

The SRC-10 input voltage, +8 to 15 volts DC is connected to pin #1 on the interface connector P1, and should be well regulated. Ground is applied to pin #2. The on-board voltage regulator reduces the input voltage down to the controller's logic operation level of +5 volts. With the controller's design based on CMOS devices, the current draw is approximately 22 ma. Because of the extremely low current draw, this design is ideal for solar powered applications. As always, be careful not to reverse the input voltage polarity or damage will occur.



5.2 DTMF AUDIO INPUT

Audio is connected to pin #7 on the interface connector P1 with ground applied to pin #8. Audio may be obtained from your repeater receiver or other audio sources. The audio input is high impedance and should be between -32 and -2 DBM or .057 to 1.74 volts peak to peak. It is important that the frequency response of the DTMF Audio input be fairly flat. Also, be careful not to overdrive the input with too much level as distortion will occur and the DTMF decoder could take longer than 40 ms to decode, or it may not decode at all.



5.3 CTCSS, REPEATER & LINK COS INPUTS

The logic connections of the SRC-10 may require some special attention depending on the type of repeater the SRC-10 Controller will be used with. The CTCSS, repeater COS, and link COS (Carrier Operated Switch) logic inputs are derived from your repeater and link receiver. They are connected to pins #4, #5 and #6 on the interface connector P1.

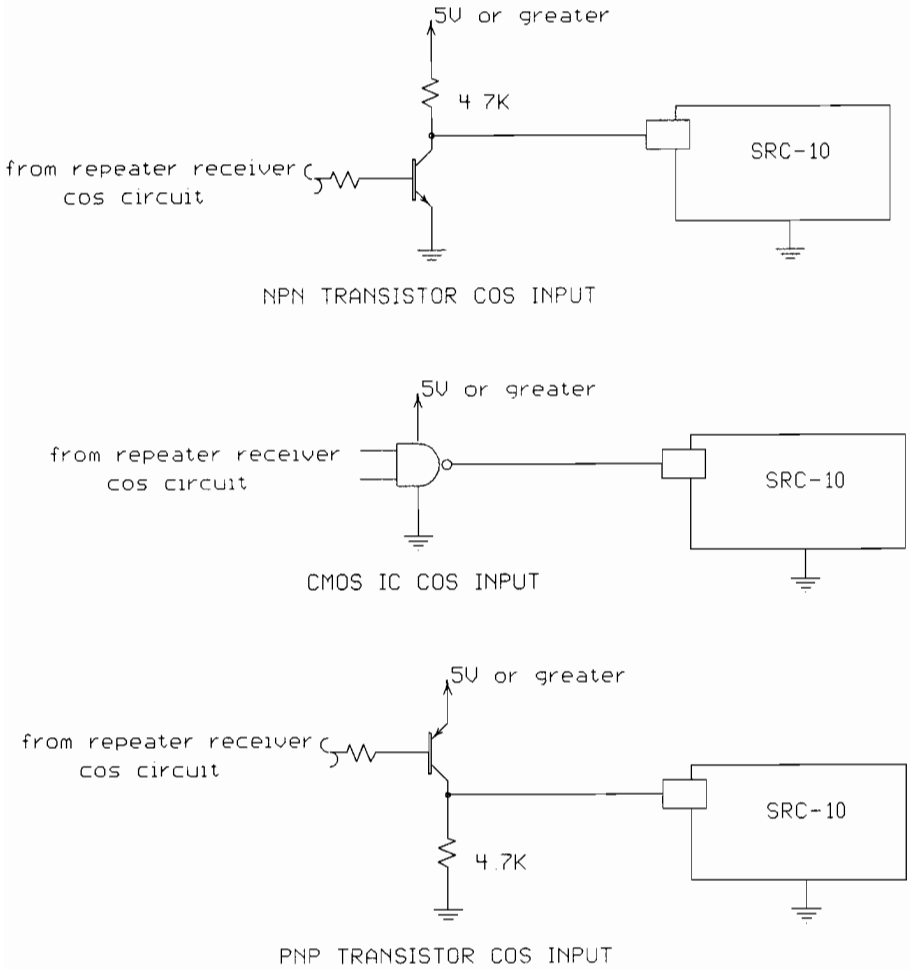
These SRC-10 inputs may be configured to operate with an active high Signal (greater than 3 volts in the active state) or an active low Signal (approximately ground or 0 volts in the active state). The only requirements on these Signals are: that the voltage levels mentioned above be adhered to, the CTCSS, repeater COS, and link COS inputs not be allowed to float, and the CTCSS, repeater COS, and link COS Signals themselfs have a risetime of less than 1ms. See Figure 5-1 for some representative Repeater and Link COS Signal input circuits.

The active logic level desired for the SRC-10 CTCSS, repeater COS, and link COS is achieved by jumpering the correct combination on the user programmable input headers J1, J2 and J3 (Figure 5-2). For a active high input signal, jumper the appropriate header to position "A" (the center jumper pin and the pin nearest to the edge of the board). In this configuration, a signal ranging from +3 to 15 volts willn activate the SRC-10. Active inputs of less than 3 volts should be avoided because they may not be high enough to consistently trigger the input.

For a active low input signal, jumper the appropriate header to position "B" (the center jumper pin, and the pin closest to the center of the board). Here the active signal level voltage needs to be a low (0 to 0.6 volts) to activate the SRC-10.

If you are not sure at which level your receiver COS operates, measure the voltage at the receive COS output with the receiver squelch open. The voltage read on your meter under these conditions will be the active COS logic level. To verify the correct voltage out of your CTCSS decoder, measure the decoder output with the correct tone applied to its audio input. Again, the voltage measured at the CTCSS decoder output under these conditions will be the active CTCSS logic level.

NOTE: If any one of the logic inputs (CTCSS, repeater COS, or link COS) are not used, be sure and jumper the unused input for an active high signal. Do **NOT** leave the unused input jumpered in the active low signal position. Otherwise, the repeater PTT will activate and remain activated indefinitely.



COS SIGNAL INPUT CIRCUITS

Figure 5-1

Programmable Input Headers

	A	B	
Link COS	.	. .	J3
Repeater COS	.	. .	J2
CTCSS In	.	. .	J1

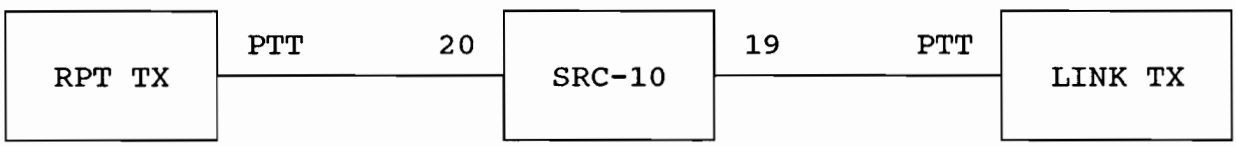
Figure 5-2

5.4 REPEATER & LINK PTT OUTPUTS

The PTT (Push-To-Talk) logic outputs are available from pins #20 and #19 on the interface connector P1. These buffered, high current, open collector VFET outputs can sink up to 100ma when ON, and can withstand up to 60 volts when OFF. When ON, these outputs provide a low (ground) signal. An output high indicates an OFF state, (open circuit). These outputs are used to turn ON the repeater and link transmitters, and can be easily interfaced to different types of logic by the addition of pull-up resistors to the desired supply voltage. When OFF these outputs assume a high impedance (open circuit) state.

For example, to interface the repeater PTT output to a TTL input, add a pull-up resistor (approximately 4.7K) from the PTT output to the 5 volt supply. For CMOS logic, add a 10K pull-up resistor the CMOS supply voltage. If a logic high (+3 to 12 volts) is needed to key the transmitter, add a PNP transistor to the PTT output. Be sure to connect the emitter of the PNP transistor to the supply voltage to operate your transmitter PTT (Figure 5-3).

An external DC relay is another means of interfacing the PTT outputs to a transmitter. Here the transmitter is keyed through the relay contacts which can sink as much current as the relay contacts can handle. The relay contacts can be configured for either a high or low output, depending on the transmitter PTT requirements. Assuming the voltage of the relay coil is 12 volts, connect one side of the relay coil to +12 volts and the other side directly to the PTT output of the SRC-10 controller. When the PTT output is activated, the relay is energized to key the transmitter. Add a reverse biased diode across the relay coil to suppress any inductive kickback voltage that could occur. (Figure 5-4)



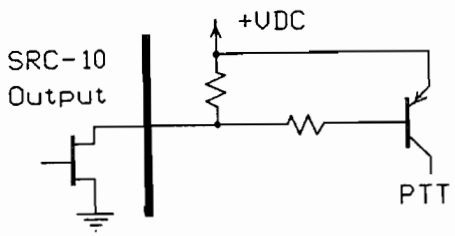


Figure 5-3

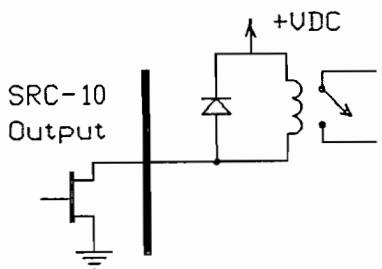


Figure 5-4

5.5 DTMF MUTE OUTPUT

The DTMF mute output is connected to pin #17 on the interface connector P1. This VFET open collector output goes low (ground) during a valid DTMF (Touch-Tone) and is used to suppress the repeater transmit audio. This output is usually connected through a capacitor to a high impedance point located within the transmitter audio stage.

5.6 ALARM INPUT

The Alarm logic input to the SRC-10 provides an over-the-air alarm message when the alarm logic input is activated. The alarm logic input is connected to pin #3 on the interface connector P1.

This input is debounced to prevent false triggering, and it is activated by a signal voltage lelel of +3 to 15 volts DC. A input voltage of less than 3 volts should be avoided.

The alarm is triggered by the active high alarm signal, and remains active as long as the alarm signal is present. Once the alarm input returns low, the alarm will reset.

Different types of Alarm sensors which can be installed at the repeater site include a normally open magnetic door switch, over temperature or smoke detector, low battery voltage indicator, etc. A normally closed switch may also be used by grounding one side of the switch and adding a pull-up resistor to the SRC-10's alarm input. Figure 5-5.

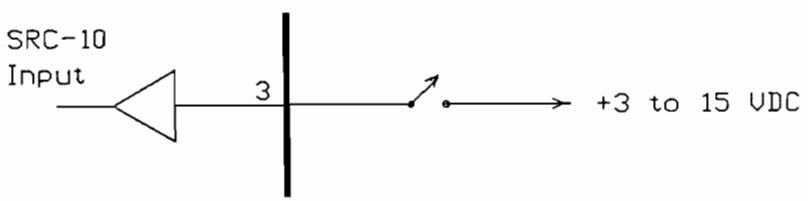


Figure 5-5

5.7 CTCSS MODE OUTPUT

The CTCSS Mode Output is available on the interface connector P1 pin #18. When connecting this output to our UAI-20 Audio Interface, simply connect the CTCSS Mode output pin from the SRC-10 to the CTCSS Mode input pin on the UAI-20. No additional circuitry is needed.

With the addition of a pull-up resistor, this VFET output indicates a high signal for repeater COS access or a low signal for CTCSS access. With the addition of external gating, this output can mute the audio passing through a user installed CTCSS decoder.

For a more detailed explanation and examples of interfacing active low outputs, refer to REPEATER & LINK PTT OUTPUTS (Section 5.4).

5.8 AUXILIARY FUNCTION OUTPUTS

There are up to seven Auxiliary Function Outputs available on the interface connector P1, pins #10 through #16. When using the optional PI-10/S synthesizer board, Auxiliaries #6 and #7 are predefined as the serial connections between the two boards.

The Auxiliary Function Outputs allow for remote control of equipment at the repeater site with the use of DTMF commands. Each output may be controlled independently of each other. Multiple commands may be strung together.

These open collector outputs are buffered for high current loads, such as relay coils. With the addition of pull-up resistors, these outputs can then be interfaced directly to a TTL or CMOS logic input. Other loads that need to be isolated because of grounding or voltage differences, can be switched by using an opto-coupler.

Each output is latched low (ground) when commanded ON and released to a high impedance when commanded OFF. In response to each Auxiliary Function Output, the controller sends an ON/OFF tone response.

Auxiliary Function ON - Ascending (low going high) tone

Auxiliary Function OFF - Descending (high going low) tone

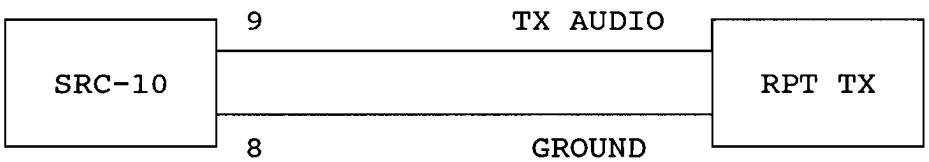
For a more detailed explanation and examples of interfacing active low outputs, refer to REPEATER & LINK PTT OUTPUTS (Section 5.4).

Some examples of Auxiliary Function Outputs include:

- Repeater high/low RF power control
- Link high/low RF power control
- Link antenna selection (beam/omni)
- Repeater squelch setting (loose/tight)
- Link squelch setting (loose/tight)
- Link radio selection (link 1/link 2)
- Link power ON/OFF
- Site heater ON/OFF
- Control digipeater ON/OFF

5.9 CW/TONE AUDIO OUTPUT

The CW/Tone audio output is connected to pin #9 with the ground applied to pin #8 on the interface connector P1. This output is connected to the repeater transmit audio input and provides Morse code, courtesy tones and function complete tone responses. The output impedance is approximately 10K and is set by adjusting R5 to the desired audio level. The CW/Tone audio output is generated in firmware by the SRC-10 controller.



5.10 RFI SHIELDING

The dedicated use of CMOS components in the SRC-10 design results in a relatively low RFI output. However, an RF-tight enclosure, with feed-through capacitors is recommended. Such enclosures are manufactured by BUD (model CU-347) and Hammond (model 1590E). Whatever the amount of shielding the controller needs, if any, will depend on how well your repeater is shielded. If there is improper RFI shielding (or no shielding at all) sporadic digital noise may be generated into the audio lines.

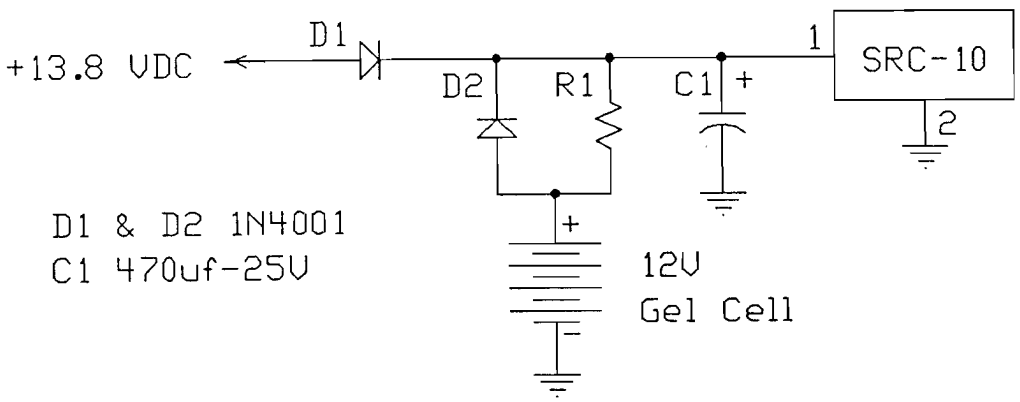
5.11 INTERFACE CONNECTOR (P1)

The interface connector (P1) is made up of two standard 10 pin straight in-line male headers. These headers use .1 inch center spacing and include a friction lock for correct polarity insertion. Two mating 10 pin female connectors are provided with the SRC-10 and are also available from GC Electronics, part # 41-130 and Molex, part # 22-01-3107.

5.12 BATTERY BACKUP

With the low SRC-10 power requirements, a 12 volt gel cell (Globe GC1245-1) can provide many hours of operation during power supply failures. The schematic below illustrates a typical battery backup circuit, with continuous trickle charging of the gel cell. Resistor R1 is the current limiter for the battery. Its value will depend on the battery's charging current. The value can be calculated from: R1=(+V-0.6-Vb)/Ic.

Where +V is the voltage input, 0.6 is the voltage drop across D1, Vb is the battery voltage and Ic is the charge current required by the battery. The value of Ic might be different for batteries from different manufacturers.



6.0 OPERATION

6.1 REPEATER TIMING

When the SRC-10 controller receives an active repeater COS input, a 3 minute Time Out Timer starts timing and the repeater PTT and link PTT outputs are keyed low. After the repeater COS signal is released a courtesy tone is generated and the repeater PTT output stays low for the duration of the specified hang time. The link PTT output will drop immediately after the repeater COS input is released. If the repeater COS input stays active continuously for over three minutes, both the Repeater and Link PTT outputs will Time Out until the repeater COS input is released. The repeater COS input must be released for approximately one second for the Courtesy Tone to be generated and only .5 seconds to restart the three minute Time Out Timer.

6.2 ID TIMING

The SRC-10 controller will identify (ID) the specified repeater call (in Morse code) every 8 to 10 minutes during repeater or link COS activity. When the COS activity stops, a end ID will occur, and no further ID will be transmitted until either COS is activated. The controller will attempt to ID in-between COS activity so that an ID will not override a conversation. If an opening cannot be found to ID in, the SRC-10 will finally force an ID over the conversation in progress.

6.3 ALARM GENERATION

When the Alarm input is activated, the repeater PTT is keyed approximately once every minute and generates the word "ALARM" (in Morse code). To acknowledge the Alarm and stop the transmission of the alarm message every minute, command the Alarm Acknowledge function using your 3 digit function code. After the Alarm has been acknowledged, the word "ALARM" will only be sent at the beginning of each ID. This indicates that there is still an Alarm condition, but that it has been acknowledged. This will continue until the Alarm input is cleared or the Alarm Off (3 digit control code) is commanded.

6.4 LINK FUNCTION

When the SRC-10 controller receives a active link COS input, the repeater PTT is keyed low and will stay low indefinitely until the link COS input is released. There is no timer between the link COS and repeater PTT. For example, when the link is listening to another repeater with a long hang time, a time out will not occur in the middle of a conversation.

It is recommended that one of the available auxiliary outputs be used to control power to your link radio. This permits the user to function the Link ON and OFF. If the link receiver gets locked up listening to an unwanted signal, command the Auxiliary function that is wired to the link radios power (with the 3 digit function code) to the OFF state and normal repeater operation will resume.

Also available is the selection between Link Receive and Link Transceive. In Link Receive, you can monitor another frequency while carrying on normal repeater activity and not be transmitting out the link.

If a link radio is not desired, an auxiliary control receiver may be connected to the link COS input to provide out-of-band control for the repeater.

6.5 MUTE CONTROL

After the first DTMF (Touch-Tone) digit is received the Mute output from the controller activates a low (ground) signal for 2 seconds during each valid DTMF touch-tone.

This output is user coupled into the repeater audio input stage and is used to prevent repetition of the DTMF audio over the air. Using the user-specified 3 digit function code, you may either allow the tones to go out over the air or Mute the DTMF touch-tones.

6.6 DTMF DECODER

The SRC-10 controllers DTMF Decoder is continuously checking its input to detect a correct 3 or 6 digit command code. The firmware is designed to detect valid command function codes while ignoring invalid ones.

The DTMF inter-digit timer is approximately 2 seconds long, and will ignore a command if more than 2 seconds elapses before the next digit is successfully entered. After the repeater COS input has been released and the correct function code has been selected, the command is executed. If an error is made while entering a DTMF code, simply re-enter your command over again.

Approximately 1 second after the COS is released, and a correct code has been detected, a Function Complete Response will be generated through the CW/Tone audio output.

6.7 DTMF LOCK/UNLOCK

When the DTMF Lock command is functioned ON, using the 6 digit function code, the SRC-10 will ignore all incoming touch-tone commands until the 6 digit Unlock command is received. This provides your repeater with security over unwanted DTMF hackers and jammers.

6.8 COURTESY TONE RESPONSE

Approximately 1 second after the repeater or link COS input has been released, a Courtesy Tone Response is generated through the CW/Tone audio output.

With the link in receive only mode, the Courtesy Tone Response to a repeater COS input is a single 1200Hz (beep) tone for a duration of .6 seconds. The Courtesy Tone Response to a link COS input is a 800Hz (boop) tone.

With the link in transceive, the Courtesy Tone Response to a repeater COS input is a single 1200Hz (beep) tone followed by a 800Hz (boop) tone. The Courtesy Tone Response to a link COS input is a 800Hz (boop) tone followed by a 1200Hz (beep) tone.

To disable either one of the Courtesy Tone Responses, command off either response by using the appropriate 3 digit function code.

6.9 COMMAND FUNCTION-COMPLETE TONE RESPONSE

Approximately one second after a 3 or 6 digit Command code has been functioned and the repeater COS has been released, a Function Complete (boop-beep-boop) tone response is generated through the CW/Tone audio output.

6.10 AUXILIARY-FUNCTION TONE RESPONSE

Approximately 1 second after a 3 digit Auxiliary function code has been commanded and the repeater COS input has been released, an ascending (low-going-high) tone is generated. This tone indicates an ON condition. A descending (high-going-low) tone indicates an OFF condition. Both tones are generated through the CW/Tone audio output.

6.11 COS/CTCSS ACCESS

Either carrier (COS) or CTCSS (Sub-Audible Tone) may be selected to activate the repeater and link PTT outputs. When in CTCSS access mode, the CTCSS input must be present for DTMF commands to activate. The CTCSS decoder may be located in or added to the repeater receiver. To select CTCSS or COS, command the 3 digit function code for the desired access.

6.12 REPEATER CONTROL

When the Repeater Enable function is commanded (using the 3 digit function code) all repeater commands operate in their normal configurations. After the 3 digit Repeater Disable function code is commanded, both the repeater and link PTT outputs are disabled. No other control function, except Repeater Enable, can be commanded ON or OFF while the repeater is disabled.

6.13 FORCE CW ID

To key only the repeater PTT and force a CW ID out the CW/Tone output, enter the Force CW ID 3 digit function code.

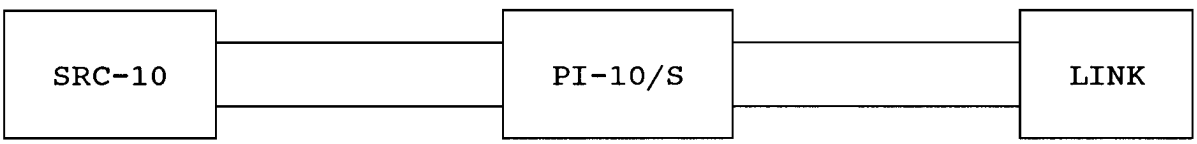
6.14 MASTER RESET

A Reset signal is applied to the microprocessor when the SRC-10 controller is powered on and when the 6 digit Reset function code is commanded. When the Reset signal is applied, all outputs return to their (default) user-defined state.

7.0 PI-10/S SYNTHESIZER OPTION

The PI-10/S synthesizer board is designed as a low cost, low power interface to the SRC-10 repeater controller. It provides the synthesizer interface for an ICOM IC-2A, IC-3A, IC-4A or IC-22U and is easily adapted to any transceiver which uses a BCD type frequency switching scheme.

The PI-10/S interface board may be mounted anywhere close to the link radio, but it was designed small enough to be mounted directly inside the IC-22U. It is recommended when using one of the ICOM handhelds as the link, that the transceiver along with the PI-10/S board, be mounted in an RF tight enclosure, such as a BUD CU-347 or Hammond 1590E. Signal inputs and outputs should be connected to feed-through capacitors mounted through the enclosure to the 26 pin header connector on the PI-10/S.



From the SRC-10 repeater controller, a 16 bit data word is sent in serial format, which includes the frequency, offset and an auxiliary function output, to the PI-10/S synthesizer board. The PI-10/S performs the serial to parallel conversion and it interfaces the logic outputs to the link radio's internal circuitry. The serial information from the SRC-10 repeater controller is obtained on pins #10 and #11 on the interface connector P1 and attached to pins #25 and #26 on the PI-10/S interface connector P2.

SRC-10	SIGNALS	PI-10/S
Pin #10	Clock	Pin #26
Pin #11	Data	Pin #25

The interface connector (P2) is made up of a 26 pin dual row in-line male IDC header. This header uses .1 inch center spacing and includes a friction lock for correct polarity insertion. A mating 26 pin female IDC connector is provided with the PI-10/S and is available from Jameco Electronics, part # S26.

7.1 ICOM IC-2A, 3A, 4A INTERFACE

The synthesizer voltage from the link transceiver is connected to P2 pin #13 on the PI-10/S and used to power the board. The IC-2A, 3A and 4A's synthesizer logic operates at +5 volts. Ground is connected from P2 pin #14 on the PI-10/S to the case of the handheld. NOTE: Do not use the 8 volt input power from the radio because damage will occur to your transceiver.

The logic outputs from the serial to parallel shift registers U1 and U2 are connected directly to the pins of the PLL IC in the IC-2A, 3A and 4A (Figure 7-1). After the connections to the PLL IC have been made, the BCD thumbwheel switches on top of the transceiver must be dialed to all 0's.

PI-10/S	SIGNALS	PLL IC
P2-1	Mhz-8	Pin #14
2	Mhz-4	13
3	Mhz-2	12
4	Mhz-1	11
5	100 Khz-8	10
6	100 Khz-4	9
7	100 Khz-2	8
8	100 Khz-1	7
9	10 Khz-8	6
10	10 Khz-4	5
11	10 Khz-2	4
12	10 Khz-1	3

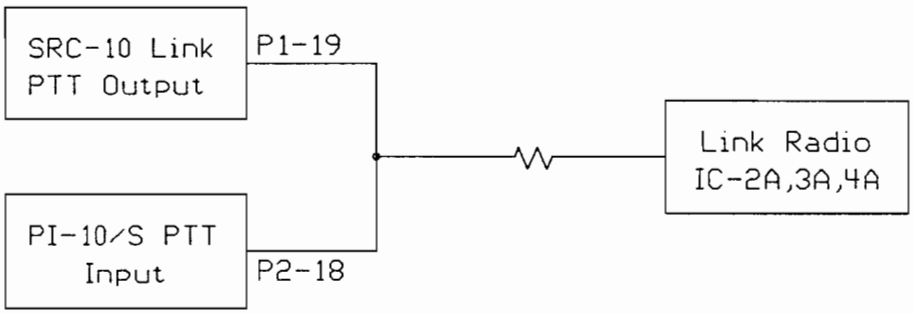
Figure 7-1

To interface the offset logic, the DUP/SIMP switch in an IC-2A, 3A and 4A, plus the -/+ switch in the IC-2A and 4A, must be removed from their circuit. With the DUP/SIMP switch removed, connect the simplex signal P2 pin #20 from the PI-10/S to the switch side of R24 on an IC-2A and R25 on an IC-4A. Connect the Duplex Signal P2 pin #19 to the switch side of R30 on an IC-3A.

With the -/+ switch removed, connect the "-" signal, P2 pin #21 from the PI-10/S to the switch side of R26 on an IC-2A and R24 on an IC-4A. Next, connect the "+" signal (P2 pin #22 from the PI-10/S) to the switch side of R25 on an IC-2A and R62 on an IC-4A. Neither the "-" or "+" signal is used on an IC-3A.

The 0/5 Khz signal is connected from P2 pin #23 from the PI-10/S directly to the 0/5 Khz switch in the handheld. There is no need to disconnect this switch from its circuit. Just set the switch in the 0 Khz position.

To interface the active low PTT signal to the handheld, connect a 2.2K resistor in series between P2 pin #18 from the PI-10/S to the base of transistor Q26 on an IC-4A and to the base of Q23 on an IC-2A or IC-3A. Also connect P1 pin #18 from the SRC-10 repeater controller to the same transistor points for the link PTT signal. This interface drives the handhelds PTT switching transistor directly. Another PTT interface could be connecting a 22K resistor in series between the PTT output from the SRC-10 and PI-10/S to the tip of the external mic jack. With this circuit, audio problems could arise depending on the audio interface between the link audio input and the repeater audio output.



The active high COS signal (from the handheld) is connected to P1 pin #6 from the SRC-10 repeater controller to the collector of transistor Q17 on an IC-4A and to the collector of Q16 on an IC-2A and IC-3A (Figure 7-2). Be sure to jumper the Link COS programmable input header to position "A" for a active high input.

PI-10/S	SIGNAL	IC-2A	IC-3A	IC-4A
P2-19	DUP	N/C	R30	N/C
20	SIMP	R24	N/C	R25
21	-	R26	N/C	R24
22	+	R25	N/C	R62
23	0/5 Khz	0/5 SW	N/C	0/5 SW
13	POWER	+5V	+5V	+5V
14	GROUND	CASE	CASE	CASE

SRC-10	Signal	IC-2A	IC-3A	IC-4A
P1-18	PTT	base Q23	base Q23	base Q26
P1-6	COS	coll Q16	coll Q16	coll Q17

Figure 7-2

An additional auxiliary function output is also available on P2 pin #24 from the PI-10/S. A logic high output is defined as a ON state. This ON voltage will depend upon the PI-10/S's input voltage. An output low (ground) indicates an OFF state. This signal can be used to control the link transceivers power (with external drivers) or gate the link radios receive audio via an external circuit.

Receive Audio from the handheld is obtained from either the top of the volume control pot, or directly from the speaker audio output. Connection choice will depend on the amount of audio needed to drive the repeater transmitter's audio.

Transmit audio from the handheld is obtained either at the tip of the external mic input or directly from the mic element, once removed. From this point add a .22 to .47 uf capacitor in series to the repeater receiver's audio output.

7.2 ICOM IC-22U INTERFACE

As with the handhelds, the synthesizer voltage from the IC-22U is used to power the PI-10/S. In the IC-22U, the synthesizer voltage of +9 volts can be obtained from J2 pin #6 on the VCO board. NOTE: Do not use the 12 volt input power from the radio because damage will occur.

When interfacing the IC-22U, the outputs of U1 and U2 on the PI-10/S board are connected to headers J2 and J3 on the VCO board inside the transceiver. Connections are easily made by removing the plugs on J2 and J3 (which are connected to the BCD thumbwheel switches) and plugging in the user-wired connectors that are attached to the PI-10/S interface board (Figure 7-4).

PI-10/S	SIGNALS	IC-22U
P2-1	Mhz-8	J3-1
2	Mhz-4	2
3	Mhz-2	3
4	Mhz-1	4
5	100 Khz-8	5
6	100 Khz-4	6
7	100 Khz-2	7
8	100 Khz-1	J2-1
9	10 Khz-8	2
10	10 Khz-4	3
11	10 Khz-2	4
12	10 Khz-1	5

Figure 7-4

To interface the offset logic, first remove the plug from J1 on the VCO board inside the IC-22U. Connect the ground signal from J1 pin #1 to P2 pin #14 on the PI-10/S.

Continue with connections for the "-" signal: P2 pin #15 from the PI-10/S to J1 pin #2 on the VCO board. Next, connect the "+" signal (P2 pin #16 from the PI-10/S) to J1 pin #3 on the VCO board. Neither the DUP or SIMP signal is used in the IC-22U.

The 0/5 Khz signal is connected from J2 pin #17 on the PI-10/S to J1 pin #4 on the VCO board.

To interface the active low PTT signal to the IC-22U, connect P2 pin #18 from the PI-10/S and P1 pin #20 from the SRC-10 repeater controller to J1 pin #5 on the VCO board and pin #5 -on the mic connector. J1 pin #6 on the VCO board is not used.

The active high COS signal (from the IC-22U) is connected to P1 pin #15 from the SRC-10 repeater controller to the collector of transistor Q12 on the main board inside the IC-22U (Figure 7-5). Be sure to jumper the Link COS programmable input header to position "A" for an active high input.

SRC-10	PI-10/S	SIGNAL	IC-22U
N/C	P2-19	DUP	N/C
N/C	20	SIMP	N/C
N/C	15	-	J1-2
N/C	16	+	3
N/C	17	0/5 Khz	4
N/C	13	POWER	J2-6
P1-2	14	GROUND	J1-1
P1-19	18	PTT	5
P1-6	N/C	COS	coll Q12

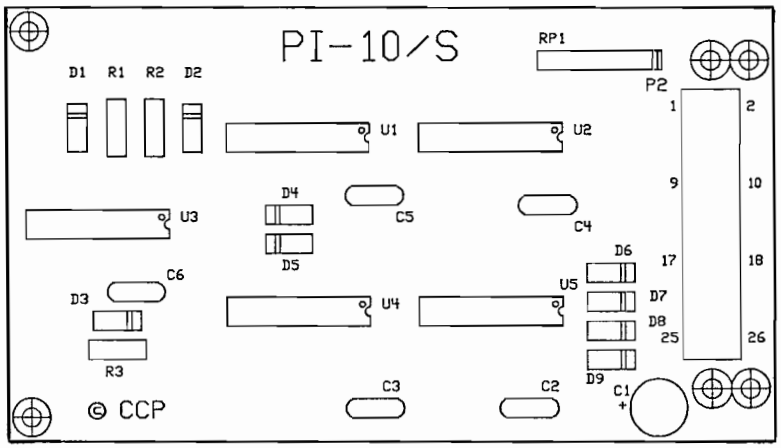
Figure 7-5

An additional auxiliary output function is also available on P2 pin #24 from the PI-10/S board. A logic high output is defined as a ON state. This ON voltage will depend upon the PI-10/S's input voltage. An output low (ground) indicates an OFF state. This signal can be used to control the IC-22U's power (with external drivers) or gate the link radios receive audio via an external circuit.

Receive Audio from the IC-22U is obtained from either the top of the volume control pot, or directly from the speaker audio output. Connection choice will depend on the amount of audio needed to drive the repeater transmitter's audio.

Transmit Audio to the IC-22U is obtained from either the front mic connector pin #1 and pin #7 for ground or from the VCO board on J6 pin #1 and pin # 4 for ground. From this point add a .22 to .47 uf capacitor in series to the repeater receiver audio output.

7.3 PI-10/S BOARD COMPONENT LAYOUT



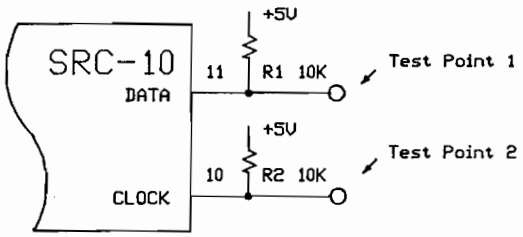
7.4 INTERFACE CONNECTOR (P2) PINOUT

Mhz 8	1	. .	2	Mhz 4
Mhz 2	3	. .	4	Mhz 1
100 Khz 8	5	. .	6	100 Khz 4
100 Khz 2	7	. .	8	100 Khz 1
10 Khz 8	9	. .	10	10 Khz 4
10 Khz 2	11	. .	12	10 Khz 1
+ Voltage	13	. .	14	Ground
- Split (IC-22U)	15	. .	16	+ Split (IC-22U)
0/5 Khz (IC-22U)	17	. .	18	PTT
Duplex	19	. .	20	Simplex
- Split (IC-2A)	21	. .	22	+ Split (IC-2A)
0/5 Khz (IC-2A)	23	. .	24	ON/OFF
Data	25	. .	26	Clock

Creative Control Products

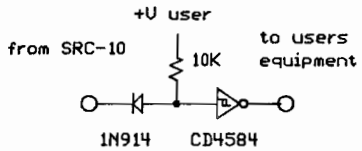
Synthesizer Signal Technical Data

TEST SETUP



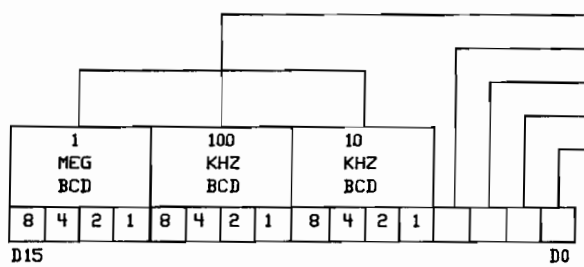
RECOMMENDED INTERFACE

For Customer Clock and Data Circuits



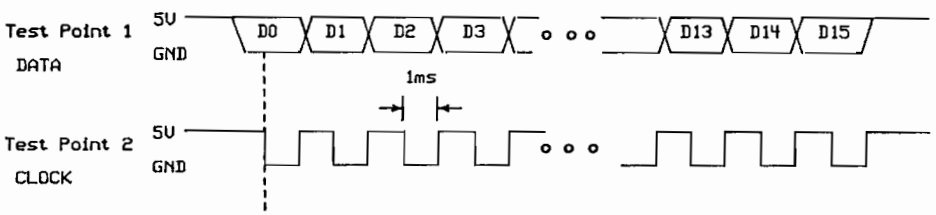
The data and clock outputs of the SRC-10 are open collector outputs. Therefore, the test setup utilizes two 10k pullup resistors on the outputs. All of the waveform and polarity data were derived using this test setup.

BIT ASSIGNMENTS AND POLARITY



GROUND	+5 VOLTS
DIGIT = 1	DIGIT = 0
+5 KHZ	+0 KHZ
SIMPLEX	DUPLEX
POSITIVE	NEGATIVE
OFF	ON

TIMING DIAGRAM



The data (Test Point 1) is valid on the falling edge of the clock pulse (Test Point 2) as indicated by the dotted line. Note D0 is transmitted first then D1 thru D15.

8.0 SYNTHESIZER OPERATION

8.1 FREQUENCY PROGRAMMING

All the link commands can be activated in link receive or link transceive. In addition, the link frequency may be entered along with transmit offset information. The link frequency and offset is programmed by first commanding the user-specified 3 digit "Frequency Program Prefix" followed by the frequency and offset desired. For example, if the link radio is an IC-2A and your Frequency Program prefix is "*14", to program the repeater frequency 146.880 would be "*146880*". The "0" entered after the 3 digit frequency is the 0/5 Khz option. The "*" is for a "-" offset, a "#" is for a "+" offset and a "0" is for simplex (Figure 8-1).

SYNTHESIZER PROGRAMMING

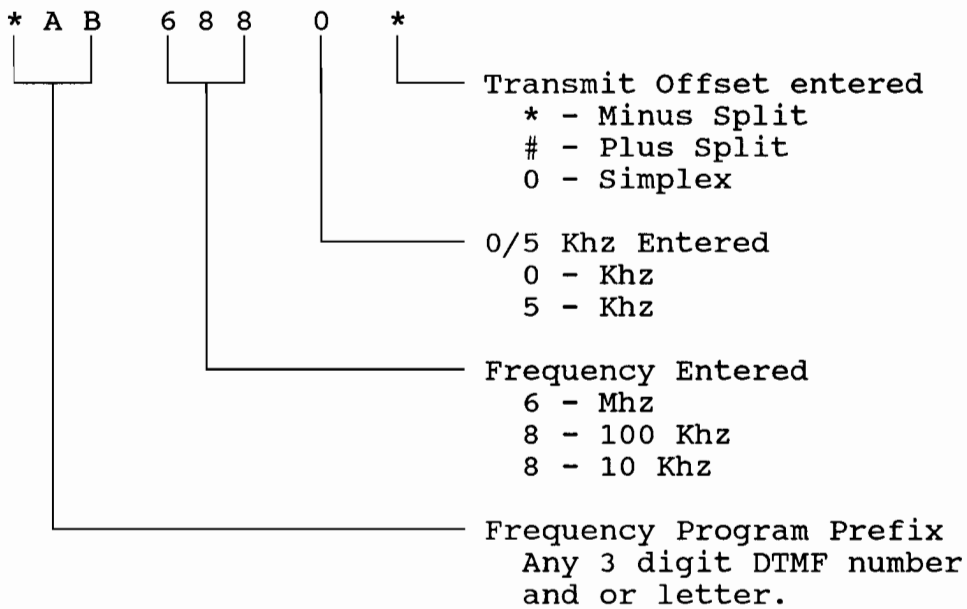


Figure 8-1

8.2 FREQUENCY READBACK

The frequency and offset entered is read back in Morse code to verify the correct frequency and offset programmed. The readback consists of the 5 digits entered (Mhz, 100 Khz, 10 Khz and 0/5 Khz), followed by an "M" for minus, "P" for plus or nothing for simplex to indicate transmit offset. For example, if the link radio was an IC-2A, the readback response to programming the frequency to 146.520 simplex would be "6520" in Morse code. The readback response to programming the 146.820 repeater would be "6820M" in Morse code. The frequency readback command can also be functioned at any time to confirm the programmed frequency. Just enter the user specified 3 digit function code "Link Frequency Readback".

8.3 FREQUENCY READBACK SPEED

The CW Link Frequency Readback speed is also user-specified on the Synthesizer Option List to allow a slower or faster speed to be entered separate from the CW ID. For example, the CW ID speed could be specified at 20 WPM with a Link Frequency Readback speed of 10 WPM.

8.4 AUXILIARY FUNCTION OUTPUT

Also available from the PI-10/S is an Auxiliary function output. With external drivers, this signal can be used to control any device like the link's power, gate the radio's receive audio path, select the Link RF power level, etc.

8.5 LINK DEFAULT FREQUENCY

A link default frequency is also user-defined in the synthesizer option list. Whenever the controller is first powered up or the Master Reset command is functioned, the default frequency and offset are sent to the link transceiver. For example, for a default frequency of 145.625, the Synthesizer Option List default frequency would be "5625#". The "5" entered after the 3 digit frequency is the 0/5 Khz option. The "*" is for a "#" offset, a "#" is for a "+" offset and a "0" is for simplex.

9.0 SERVICE

9.1 TROUBLESHOOTING

Because the SRC-10 is designed with quality components, a component failure that would take the unit out of service is unlikely. The only maintenance recommended is that the interface connector be checked periodically for any broken or frayed connections.

If the SRC-10 fails to perform specific input or output functions, ensure that the Repeater and Link COS Jumpers are installed correctly and that there are no hot components or IC's. If operation totally fails, check to see if the input voltage is adequate and that the regulated 5 volts is present. Since all IC's are socketed, troubleshooting and repair should be moderately easy. A general checklist to follow is as follows:

* Input voltage between 8 and 15VDC.
* All grounds connected.
* IC's seated in sockets.
* Interface connector firmly connected.
* No hot components.
* COS inputs operating correctly.
* COS jumpers correctly installed.
* Non used COS inputs jumpered to the HIGH position.

9.2 REPAIR SERVICE

If your controller needs to be returned for repair, contact the factory before shipping so that a Repair Authorization Number (RA#) can be issued. This will help keep track of your controller and speed repair time. Please include a letter explaining the problem in detail, along with your name, callsign, address and phone number.

9.3 REPROGRAMMING

Reprogramming of the controller's EPROM is required to alter the SRC-10's parameters such as a new call, code speed, control function codes, etc. For those needs, the SRC-10's EPROM can be sent back to the factory with a new Option List.

A fee of $15.00 is charged for the reprogram if the old EPROM is included with the new option sheet. A fee of $25.00 (which includes a $10.00 EPROM deposit) is charged for a newly programmed EPROM to be shipped to you if the old EPROM is not returned. Your $10.00 deposit will be refunded when the old EPROM is received by Creative Control Products in good condition. Reprogram time is usually less than one week from the time an order is received at the factory.

Reprogramming can also be accomplished with any EPROM programmer capable of programming a 27C64A EPROM, using a program voltage of 12.6 volts DC. See section 12.0 for EPROM address locations.

10.0 TONE RESPONSE ENCODING

Single high beep - Repeater COS with Link in receive only.

Single low beep - Link COS with Link in receive only.

High/low beep - Repeater COS with Link in transceive.

Low/high beep - Link COS with Link in transceive.

Low/High/low beep - A Repeater or Link Function Complete.

Descending (high going low) tone - Auxiliary Function OFF.

Ascending (low going high) tone - Auxiliary Function ON.

11.0 PROGRAM OPTION LIST PROCEDURE

We recommend before filling in either Program Option List that copies be made of all originals. A blank Program Option List is thereby preserved for future program changes. There are 2 different Program Option Lists to choose from: the Non Synthesizer Version and the Synthesizer Version (when used with the PI-10/S synthesizer board).

All command codes must be 3 digit codes except for Master Reset and DTMF Lock ON/OFF which are 6 digits each. All commands are entered as DTMF signals, consisting of the touch-tone set 0 through 9, A through D and *, #. When choosing command codes, keep in mind that the controller counts 3 digits at a time, so the first or last 3 digits of any command code can not be the same. For example, if DTMF Lock ON is *12345, DTMF Lock OFF or Master Reset could not start with *12 or end with 345.

REPEATER CALL

The repeater CW Call can be any group of letters and or numbers from 0 to 40 characters long. For example, your repeater call could be "XX0X/R" or "XX0X/R DENVER COLORADO". Each dash on the Program Option List represents a Morse Code space if left blank or a character if filled in. The repeater PTT keys approximately 1 second before the CW ID starts so that the repeater transmitter has time to come up to power before ID'ing.

REPEATER HANG TIME

The repeater hang time is the amount of time the repeater transmitter stays ON after the COS signal is released. This time is available from 0 to 5 seconds, with 2 or 3 seconds being most commonly selected. If 0 seconds is selected there will be no hang time noticed, however, if the repeater courtesy tone is turned on there will be enough hang time generated to allow for the tone, then immediately following the tone the transmitter will drop.

CW SPEED

The CW ID, CW Alarm/Readback speed is available in 5 minute increments from 5 to 25 words per minute, with 20 WPM being the most commonly selected. The separate CW Alarm/Readback speed allows a slower or faster speed than the CW ID speed. For example, the CW ID speed could be specified at 20 WPM with a CW Alarm/Readback speed of 10 WPM. NOTE: at 5 WPM, the CW speed appears especially lengthy, and 25 WPM might be too fast for comfortable copy by most individuals. Think carefully about how fast you want the CW speed to be.

REPEATER ENABLE/DISABLE CODES

The Repeater Enable 3 digit command code allows for the repeater PTT and functions to operate in the ON state. The Repeater Disable 3 digit command code turns off the repeater and link PTT outputs and allows for no other DTMF commands except for Repeater Enable. An example of a Repeater Enable code could be "*12", and "#12" for the Repeater Disable.

CARRIER/CTCSS ACCESS CODES

The 3 digit Carrier Access and CTCSS Access codes determine which input signal is sampled to allow repeater access. If the Carrier Access code has been commanded, the controller samples the repeater COS input signal pin #5 on the src-10. If the CTCSS Access code was last commanded the controller will then sample the sub-audible tone input signal pin #4 on the SRC-10. An example of the Access codes could be "123" for Carrier Access and "456" for CTCSS Access.

REPEATER COURTESY TONE ON/OFF CODES

The Repeater Courtesy Tone can be commanded on using the 3 digit function code, allowing a 1000 Hz tone for a duration of .6 seconds approximately 1 second after the repeater COS or CTCSS input has been released. When the 3 digit OFF function code has been commanded, no courtesy tone will be generated. An example of the Repeater Courtesy Tone ON code could be "12A" and "1B2" for OFF.

DTMF MUTE ON/OFF CODES

To mute the touch-tones signals from being transmitted over the air, the DTMF Mute ON 3 digit function code is commanded. To allow the touch-tone signals to be transmitted and heard, command the DTMF Mute OFF 3 digit function code. An example of the DTMF Mute ON code could be "AAA" and "BBB" for the OFF command.

DTMF LOCK ON/OFF & MASTER RESET CODES

When the 6 digit DTMF Lock ON code is commanded the SRC-10 ignores all incoming touch-tone signals until the 6 digit DTMF Lock OFF code is commanded. Master Reset is a 6 digit code that resets the microprocessor and returns all outputs to their default state. Remember that the controller counts 3 digits at a time, so the first or last 3 digits of any 3 or 6 digit code can not be the same. For example, if DTMF Lock ON is *12345, DTMF Lock OFF or Master Reset could not start with *12 or end with 345.

FORCE CW ID CODE

The Force CW ID 3 digit command code enables the repeater PTT output and the repeater CW ID is sent. An example Force CW ID command could be "*0#".

ALARM ENABLE/DISABLE & ACKNOWLEDGE CODES

The Alarm input is turned ON by using the 3 digit command code, Alarm Enable. The Alarm is turned OFF by the 3 digit command code, Alarm Disable. To acknowledge an Alarm condition, enter the 3 digit command code, Alarm Acknowledge. Examples could be, "B*1" for Alarm Enable, "B#1" for Alarm Disable and "***" for Alarm Acknowledge.

AUXILIARY LINK OUTPUT CODES

The Auxiliary Link output, available on the PI-10/S, (used only in the synthesizer version) can be functioned ON or OFF by using the appropriate 3 digit command code. Examples could be "D01" for the ON command and "C01" for the OFF command.

LINK RECEIVE/TRANSCEIVE CODES

The selection between Link Receive and Link Transceive is available using the desired 3 digit command code. In Link Receive you can monitor another frequency while carrying on normal repeater operation and not be transmitting out the link, while the Link Transceive command enables the Link PTT output. Examples could be, "1*0" for Link Receive and "1#1" for Link Transceive.

LINK COURTESY TONE ON/OFF CODES

The Link Courtesy Tone can be commanded on using the 3 digit function code, allowing a 800 Hz tone for a duration of .6 seconds approximately 1 second after the link COS input has been released. When the 3 digit OFF function code has been commanded, no courtesy tone will be generated. An example of the Link Courtesy Tone ON code could be "0*1" and "1#0" for OFF.

READBACK LINK FREQUENCY CODE

The Frequency Readback 3 digit command (used only in the synthesizer version) can be functioned at any time to confirm the programmed frequency and offset. For example, the Frequency Readback command code could be "ABC".

FREQUENCY PROGRAM PREFIX CODE

The Frequency Program Prefix (used only in the Synthesizer version) is the 3 digit code that is first commanded to initialize the synthesizer followed by the frequency and offset digits. For example if the link was 2 meters you could use "*14", for 220 Mhz could be "B22" and for 440 Mhz could be "C44"

LINK DEFAULT FREQUENCY

The Default Frequency (used only in the synthesizer version) is the frequency and offset that is sent to the link transceiver whenever the controller is first powered up or the Master Reset is functioned. For example, the default frequency for 146.520 simplex would be "65200". The "0" entered after the 3 digit frequency is the 0/5 Khz option. The last digit is a "*" for a "-" offset, a "#" for a "+" offset or a "0" for simplex.

AUXILIARY FUNCTION ON/OFF CODES

The Auxiliary Function ON/OFF Codes turn ON and OFF remote control equipment at the repeater site. The Non Synthesizer Version has two additional Auxiliary Functions available (Auxiliary #6 and #7). The Synthesizer Version uses Auxiliary #6 and #7 for the serial signals to the PI-10/S synthesizer board. Example of Auxiliary ON/OFF codes could be "*01" for Aux. 1 ON and "#01" for OFF, "*02" for Aux. 2 ON and "#02" for OFF, etc.

DEFAULT BRACKETS

Next to each command code is a set of brackets [ ]. In these brackets, check the default command you desire for controller power-up or command of the Master Reset function. For example, if you want the repeater to come up in the ON state when first powered up, check the brackets next to "Repeater Enable". If you want the Repeater Courtesy Tone to be OFF, check the brackets next to Repeater Courtesy Tone OFF, and so on.

NOTE: When deciding on command function codes and an external auto-patch (user provided) will be attached to the SRC-10, consider using at least one of the following digits "A,B,C,D,* or #" in all of the codes. The reason is, when dialing a phone number through the auto-patch that has the same 3 or 6 digits as a command code you could accidentally turn something on or off.

Be sure to double-check your Program Option List to verify that there are no 3 or 6 digit duplications for any of the command codes. If a Code Sheet is received with duplications, we reserve the right to make any changes necessary to eliminate any identical codes.

11.1 PROGRAM OPTION LIST - NON SYNTHESIZER VERSION

Repeater Call (up to 40 characters) _ _ _ _ _ _ _ _ _ _

- -

Repeater Hang Time (0 to 5 Sec.) ____

CW ID Speed (5, 10, 15, 20 or 25 words-per-minute) ____

CW Alarm Speed (5, 10, 15, 20, 25 WPM) ____

[ ] Repeater Enable __ __ __

[ ] Repeater Disable __ __ __

[ ] Carrier Access __ __ __

[ ] CTCSS Access __ __ __

[ ] Repeater Courtesy Tone ON __ __ __

[ ] Repeater Courtesy Tone OFF __ __ __

[ ] DTMF Mute ON __ __ __

[ ] DTMF Mute OFF __ __ __

[ ] DTMF Lock ON __ __ __ __ __ __

[ ] DTMF Lock OFF __ __ __ __ __ __

Master Reset __ __ __ __ __ __

Force CW ID __ __ __

[ ] Alarm Enable __ __ __

[ ] Alarm Disable __ __ __

Alarm Acknowledge __ __ __

PROGRAM OPTION LIST - NON SYNTHESIZER VERSION (CONT'D)

[ ] Link Receive Only __ __ __

[ ] Link Transceive __ __ __

[ ] Link Courtesy Tone ON __ __ __

[ ] Link Courtesy Tone OFF __ __ __

[ ] Auxiliary Function #1 ON __ __ __

[ ] Auxiliary Function #1 OFF __ __ __

[ ] Auxiliary Function #2 ON __ __ __

[ ] Auxiliary Function #2 OFF __ __ __

[ ] Auxiliary Function #3 ON __ __ __

[ ] Auxiliary Function #3 OFF __ __ __

[ ] Auxiliary Function #4 ON __ __ __

[ ] Auxiliary Function #4 OFF __ __ __

[ ] Auxiliary Function #5 ON __ __ __

[ ] Auxiliary Function #5 OFF __ __ __

[ ] Auxiliary Function #6 ON __ __ __

[ ] Auxiliary Function #6 OFF __ __ __

[ ] Auxiliary Function #7 ON __ __ __

[ ] Auxiliary Function #7 OFF __ __ __

11.2 PROGRAM OPTION LIST - SYNTHESIZER VERSION

(When used with the PI-10/S synthesizer board)

Repeater Call (up to 40 characters) _ _ _ _ _ _ _ _ _ _

_ _

Repeater Hang Time (0 to 5 sec.) ___

CW ID Speed (5, 10, 15, 20, 25 words-per-minute) ___

CW Frequency Read Back/Alarm Speed (5 to 25 WPM) ___

[ ] Repeater Enable __ __ __

[ ] Repeater Disable __ __ __

[ ] Carrier Access __ __ __

[ ] CTCSS Access __ __ __

[ ] Repeater Courtesy Tone ON __ __ __

[ ] Repeater Courtesy Tone OFF __ __ __

[ ] DTMF Mute ON __ __ __

[ ] DTMF Mute OFF __ __ __

[ ] DTMF Lock ON __ __ __ __ __ __

[ ] DTMF Lock OFF __ __ __ __ __ __

Master Reset __ __ __ __ __ __

Force CW ID __ __ __

[ ] Alarm Enable __ __ __

[ ] Alarm Disable __ __ __

Alarm Acknowledge __ __ __

PROGRAM OPTION LIST - SYNTHESIZER VERSION (CONT'D)

[ ] Auxiliary Link Output ON __ __ __

[ ] Auxiliary Link Output OFF __ __ __

[ ] Link Receive Only __ __ __

[ ] Link Transceive __ __ __

[ ] Link Courtesy Tone ON __ __ __

[ ] Link Courtesy Tone OFF __ __ __

Readback Link Frequency __ __ __

Frequency Program Prefix __ __ __

Link Default Frequency __ __ __ __ __

[ ] Auxiliary Function #1 ON __ __ __

[ ] Auxiliary Function #1 OFF __ __ __

[ ] Auxiliary Function #2 ON __ __ __

[ ] Auxiliary Function #2 OFF __ __ __

[ ] Auxiliary Function #3 ON __ __ __

[ ] Auxiliary Function #3 OFF __ __ __

[ ] Auxiliary Function #4 ON __ __ __

[ ] Auxiliary Function #4 OFF __ __ __

[ ] Auxiliary Function #5 ON __ __ __

[ ] Auxiliary Function #5 OFF __ __ __

12.0 EPROM ADDRESS LOCATIONS

Modifying the following ROM locations allows the customer to alter many of the parameters located within the SRC-10's firmware. Modifications to the EPROM are made in HEX and can be made with any EPROM programmer capable of programming a 27C64 or 27C64A EPROM. Factory EPROM programming is available if the customer does not have access to the proper programming equipment needed.

Addresses shown below are the hexadecimal representation of the EPROM location for each parameter listed. Numbers followed by an "H" are used to identify a hexadecimal address or number.

Located within the EPROM is not only the following option parameters but the controllers primary program which must not be modified in any way. Any address not specified must be left in it's original state. Changing the data in other locations may result in the controller not functioning properly or not at all.

REPEATER CALL Address 0043H - 006BH HEX

The repeater call is loaded into ROM in consecutive locations beginning with the first letter of the call in location 0043H, the second letter of the call in location 0044H, the third letter in 0045H, etc. Morse code characters to their HEX values are listed in the cross reference table below.

Immediately after the last character of the call is the HEX value "FF", this special character signals the end of the call.

Stored in location 006CH is the length of the call plus one digit.

Example, repeater call "N6CW/R" would appear in memory as:

Address	HEX Value	Description
0043H	5CH	"N"
0044H	2CH	"6"
0045H	46H	"C"
0046H	6EH	"W"
0047H	1EH	"/"
0048H	64H	"R"
0049H	FFH	END OF CALL
006CH	07H	LENGTH OF CALL +1

MORSE CODE CHARACTERS TO HEX VALUES

A	42H	0	20H
B	44H	1	22H
C	46H	2	24H
D	48H	3	26H
E	4AH	4	28H
F	4CH	5	2AH
G	4EH	6	2CH
H	50H	7	2EH
I	52H	8	30H
J	54H	9	32H
K	56H		
L	58H		
M	5AH		
N	5CH		
O	5EH		
P	60H	CHARACTER SPACE	00H
Q	62H	APOSTROPHE (')	0EH
R	64H	COMMA (,)	18H
S	66H	HYPHEN (-)	1AH
T	68H	PERIOD (.)	1CH
U	6AH	SLANT BAR (/)	1EH
V	6CH	COLON (:)	34H
W	6EH	SEMICOLON (;)	36H
X	70H	EQUAL (=)	3AH
Y	72H	QUESTION MARK (?)	3EH
Z	74H		

DTMF DIGITS TO HEX VALUES

1	01H
2	02H
3	03H
4	04H
5	05H
6	06H
7	07H
8	08H
9	09H
0	0AH
*	0BH
#	0CH
A	0DH
B	0EH
C	0FH
D	00H

REPEATER HANG TIME Address 00D9H HEX

00H - 05H are valid values corresponding to 0 - 5 seconds stored at ROM address 00D9H.

Example, for a hang time of 3 seconds, address location 00D9H would be 03H.

HEX Value	Description
00H	0 Seconds
01H	1 Second
02H	2 Seconds
03H	3 Seconds
04H	4 Seconds
05H	5 Seconds

CW ID SPEED Address 003FH - 0040H HEX

The HEX values located in the cross reference chart below correspond to the morse code word per minute (WPM) speed.

Example, for 20 WPM, address location 003FH would be 42H and address 0040H would be 12H.

003FH	0040H	Description
07H	49H	05 WPM
83H	24H	10 WPM
64H	18H	15 WPM
42H	12H	20 WPM
9BH	0EH	25 WPM

CW ALARM SPEED Address 0041H - 0042H HEX

The HEX values located in the cross reference chart below correspond to the morse code word per minute (WPM) speed.

Example, for 10 WPM, address location 0041H would be 83H and address 0042H would be 24H.

0041H	0042H	Description
07H	49H	05 WPM
83H	24H	10 WPM
64H	18H	15 WPM
42H	12H	20 WPM
9BH	0EH	25 WPM

DTMF COMMANDS

After determining each DTMF Command code, convert the code into HEX using the cross reference table below. Each specific DTMF command is loaded into ROM in three, five or six consecutive locations. The first DTMF digit of the command is loaded in the first address, the second digit in the second address, etc.

HEX VALUE	DTMF DIGIT	HEX VALUE	DTMF DIGIT
01H	1	09H	9
02H	2	0AH	0
03H	3	0BH	*
04H	4	0CH	#
05H	5	0DH	A
06H	6	0EH	B
07H	7	0FH	C
08H	8	00H	D

Example, the Repeater Enable Command "*5C" would appear in ROM at address 006DH as 0BH (*), address 006EH as 05H (5) and address 006FH as 0FH (C).

ROM Address	Command Function
006DH - 006FH	Repeater Enable Example "*5C" Address 006DH=0BH, 006EH=05H, 006FH=0FH
0070H - 0072H	Repeater Disable
007CH - 007EH	Carrier Access
0079H - 007BH	CTCSS Access
00B8H - 00BAH	Repeater Courtesy Tone ON
00BBH - 00BDH	Repeater Courtesy Tone OFF
007FH - 0081H	DTMF Mute ON
0082H - 0084H	DTMF Mute OFF
00C4H - 00C9H	DTMF Lock ON
00CAH - 00CFH	DTMF Lock OFF
00D3H - 00D8H	Master Reset
00D0H - 00D2H	Force CW ID

0085H - 0087H		Alarm Enable
0088H - 008AH		Alarm Disable
008BH - 008DH		Alarm Acknowledge
0076H - 0078H		Link Receive Only
0073H - 0075H		Link Transceive
00BEH - 00C0H		Link Courtesy Tone ON
00C1H - 00C3H		Link Courtesy Tone OFF
008EH - 0090H		Auxiliary Function #1 ON
0091H - 0093H		Auxiliary Function #1 OFF
0094H - 0096H		Auxiliary Function #2 ON
0097H - 0099H		Auxiliary Function #2 OFF
009AH - 009CH		Auxiliary Function #3 ON
009DH - 009FH		Auxiliary Function #3 OFF
00A0H - 00A2H		Auxiliary Function #4 ON
00A3H - 00A5H		Auxiliary Function #4 OFF
00A6H - 00A8H		Auxiliary Function #5 ON
00A9H - 00ABH		Auxiliary Function #5 OFF
00ACH - 00AEH	(#)	Auxiliary Function #6 ON
00ACH - 00AEH	(*)	Readback Link Frequency
00AFH - 00B1H	(#)	Auxiliary Function #6 OFF
00AFH - 00B1H	(*)	Link Auxiliary output ON
00B2H - 00B4H	(#)	Auxiliary Function #7 ON
00B2H - 00B4H	(*)	Link Auxiliary Output OFF
00B5H - 00B7H	(#)	Auxiliary Function #7 OFF
00B5H - 00B7H	(*)	Frequency Program Prefix

(*) = Available only with synthesized version firmware.

(#) = Not available with synthesized version firmware.

LINK DEFAULT FREQUENCY Address 00DFH - 00E3H HEX

The Link Default Frequency values are available only with the synthesized version firmware. The HEX values located in the cross reference table below correspond to the correct DTMF digit.

HEX VALUE	DTMF DIGIT	HEX VALUE	DTMF DIGIT
01H	1	09H	9
02H	2	0AH	0
03H	3	0BH	*
04H	4	0CH	#
05H	5	0DH	A
06H	6	0EH	B
07H	7	0FH	C
08H	8	00H	D

Address	HEX Value	Valid Entries
00DFH	??H	Mhz (0AH-09H HEX)
00E0H	??H	100Khz (0AH-09H HEX)
00E1H	??H	10Khz DTMF (0AH-09H HEX)
00E3H	??H	0/5 Khz DTMF (0AH,05H HEX)
00E3H	??H	Transmit Offset
		* - Minus Split (0BH HEX)
		# - Plus Split (0CH HEX)
		0 - Simplex (0AH HEX)

Example, "6820 Minus Split"

Address	HEX Value	Valid Entries
00DFH	06H	6 Mhz (DTMF 6)
00E0H	08H	800Khz (DTMF 8)
00E1H	02H	20Khz (DTMF 2)
00E3H	0AH	0 Khz (DTMF 0)
00E3H	0BH	Minus (DTMF *)

POWER ON DEFAULT LOCATIONS

The following Power On Default locations are specified in binary codes. After structuring the binary code to suit your requirements, convert the code into HEX using the cross reference table below. The HEX number that you convert will be the number entered in that specific Default address.

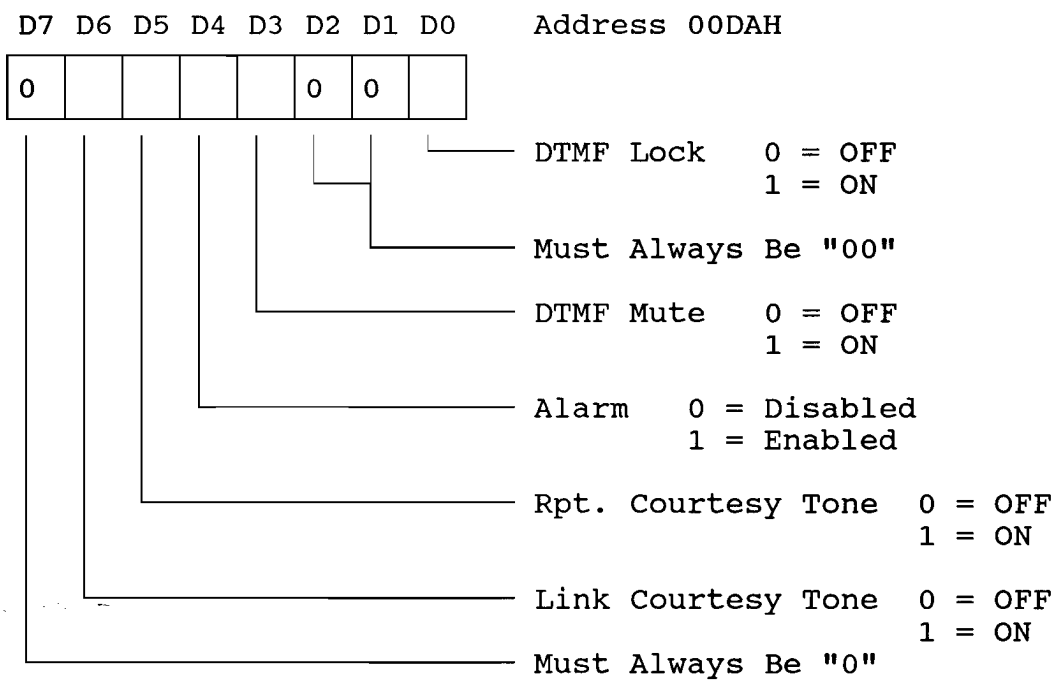
Example,

D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	0	1	0	1	1	= 4BH HEX

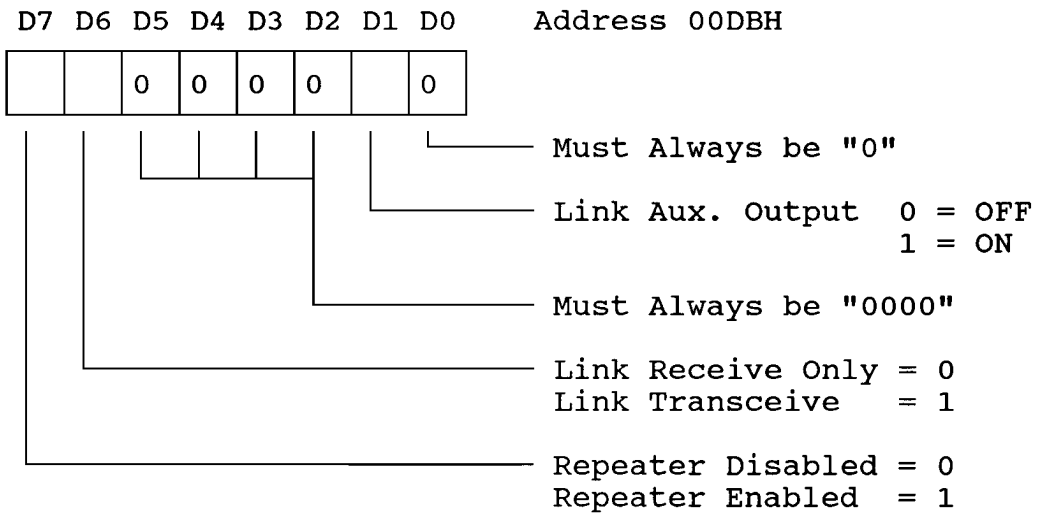
HEX TO BINARY

0	0000	A	1010
1	0001	B	1011
2	0010	C	1100
3	0011	D	1100
4	0100	E	1110
5	0101	F	1111
6	0110		
7	0111		
8	1000		
9	1001		

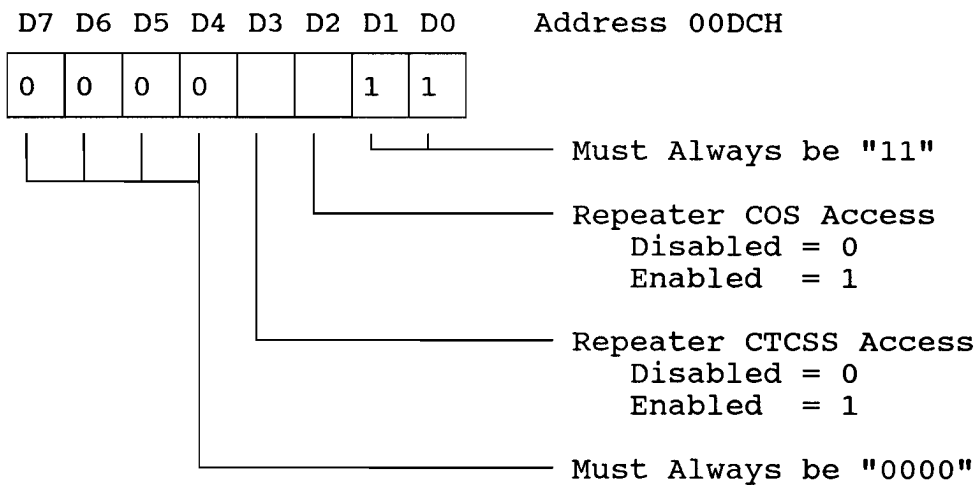
DEFAULT ADDRESS 00DAH HEX



DEFAULT ADDRESS 00DBH HEX



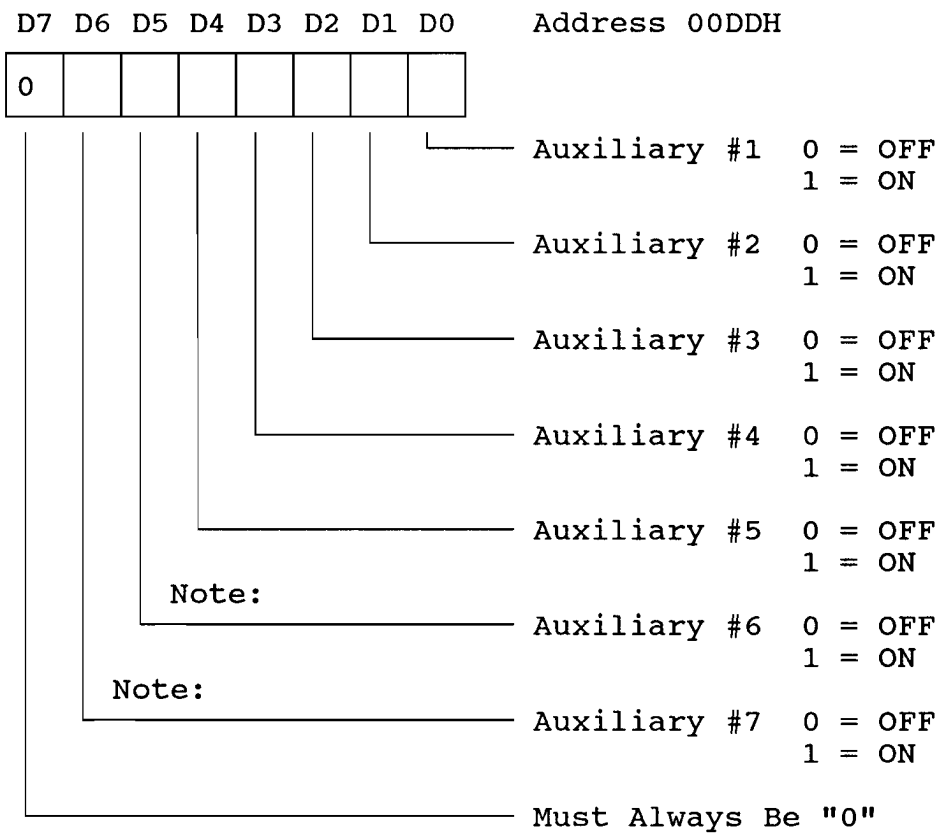
DEFAULT ADDRESS 00DCH HEX



NOTE: Concerning Repeater COS or CTCSS Access, only one of these can be enabled (1) and never should they both be disabled (0).

HEX Value	Description
07H	COS Access Default
0BH	CTCSS Access Default

DEFAULT ADDRESS 00DDH HEX



NOTE:
If synthesized version firmware is used, D6 & D5 must be"00".