

CAT-250 Repeater Controller

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Chapter 1 - Introduction and Specifications

Congratulations on your purchase of the CAT-250 Repeater Controller. Programming the CAT-250 is a snap, with its carefully structured uniform programming commands. The manual is easy to follow and the voice synthesizer interacts with you during control and programming operation. An optional WINDOW EDITOR is available to program the CAT-250 controller.

Voice Synthesizer

A vocabulary base of 290 words is available to ID your repeater and make voice announcements.

CW ID

The controller will switch to CW when a repeater user talks over the voice ID. Or ID in CW only, depending on how the CAT-250 is configured.

Digital Voice Clock

The digital voice clock will announce the time upon request, during repeater IDs, or on the hour through the grandfather clock feature. Back-up power for the clock is supplied by a .47 Farad capacitor. Once 12VDC is supplied to the CAT-250 three hours are required for the capacitor to reach full charge. During power failure the capacitor will power the clock for approximately six hours.

Scheduler

An advanced [20] position scheduler fully automates repeater operation. Any command that can be manually executed can also be scheduled to one-minute accuracy. Program the hours, minutes, day of week, or day of month and month of year. The CAT-250 will do the rest.

Courtesy Tone

Separate courtesy tones denote repeater and link activity. Create up to eight custom courtesy tones and assign their use by executing event macro 13 Port #1 input and macro 14 for Port #2 input.

Port Configuration

The CAT-250 is a dual port controller. Port #1 is a repeater port. Port #2 can be configured as a simplex transceiver or duplex transceiver port.

User Function Output Switches

Six open DRAIN user function output switches control equipment at your repeater site. These switches are controlled manually by DTMF commands or from within a macro. They can be made to turn OFF, ON or momentarily change state.

User Function Inputs

Four inputs activated by a voltage change from other equipment at the repeater site, causes the CAT-250 to activate a macro. Two macros are assigned to each logic input. Different macros are called when the input goes high and low.

DTMF Keypad Test

A DTMF keypad test will read back the numbers decoded in a synthesized voice. This feature is available on both ports one and two.

User Macros

The CAT-250 supports forty User Macros each containing sixteen commands. A user macro is a series of commands, defined by the repeater owner. Macros permit the owner to customize certain aspects of repeater operation. Once the CAT-250 decodes the macro number, the commands will execute in the order they were stored within the macro.

Event Triggered Macros

An event macro is a series of commands, defined by the repeater owner. Event Macros are positioned throughout the program to execute during certain prescribed operations. The CAT-250 supports fifty event macros each containing sixteen commands.

Specifications

Microprocessor	P89C668
Memory	25C640 (64K)
Voice Synthesizer	Texas Instruments MSP53C391NI2D
Voice Vocabulary	290 Words
DTMF Receivers	(2) MT8870
Operating Temperature	-15 to +55 degrees C
Call Letter ID	(4) Buffer size VOICE (15) - CW (16)
User Function Outputs	(6) Switch 40VDC @ 50mA.
Logic Inputs	(4) 10K ohm input impedance Low (0 to 0.8VDC) High (2.4 to 15VDC)
Logic Outputs	Open Collector Relay Driver (28VDC at 50mA)
Audio Input	Receiver 0.2 - 2VAC adjustable 10K ohms
Audio Output	Transmitter 2VAC adjustable 600 ohms
Power	+9 to +15VDC at 80mA
Size	4.5" X 7.0"
Warranty	Limited one year, parts and labor.

FCC Part 15 RF Interference

When installed in the RM-250 rack mount enclosure, the CAT-250 has been tested and found to meet the standards for a Class A digital device, as specified in Part 15 of the FCC Rules. These specifications are designed to provide reasonable protection against such interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation.

Chapter 2 - System Configuration

Repeater and Transceiver

In this configuration the CAT-250 supports a repeater on port #1 and a transceiver on port #2. Figure 2-1 shows the repeater connected to J2 the "25 Pin D" connector while the transceiver is connected to J1 the "9 Pin D" connector. The transceiver port is also available on the "25 Pin D" connector to be compatible with other CAT controllers.

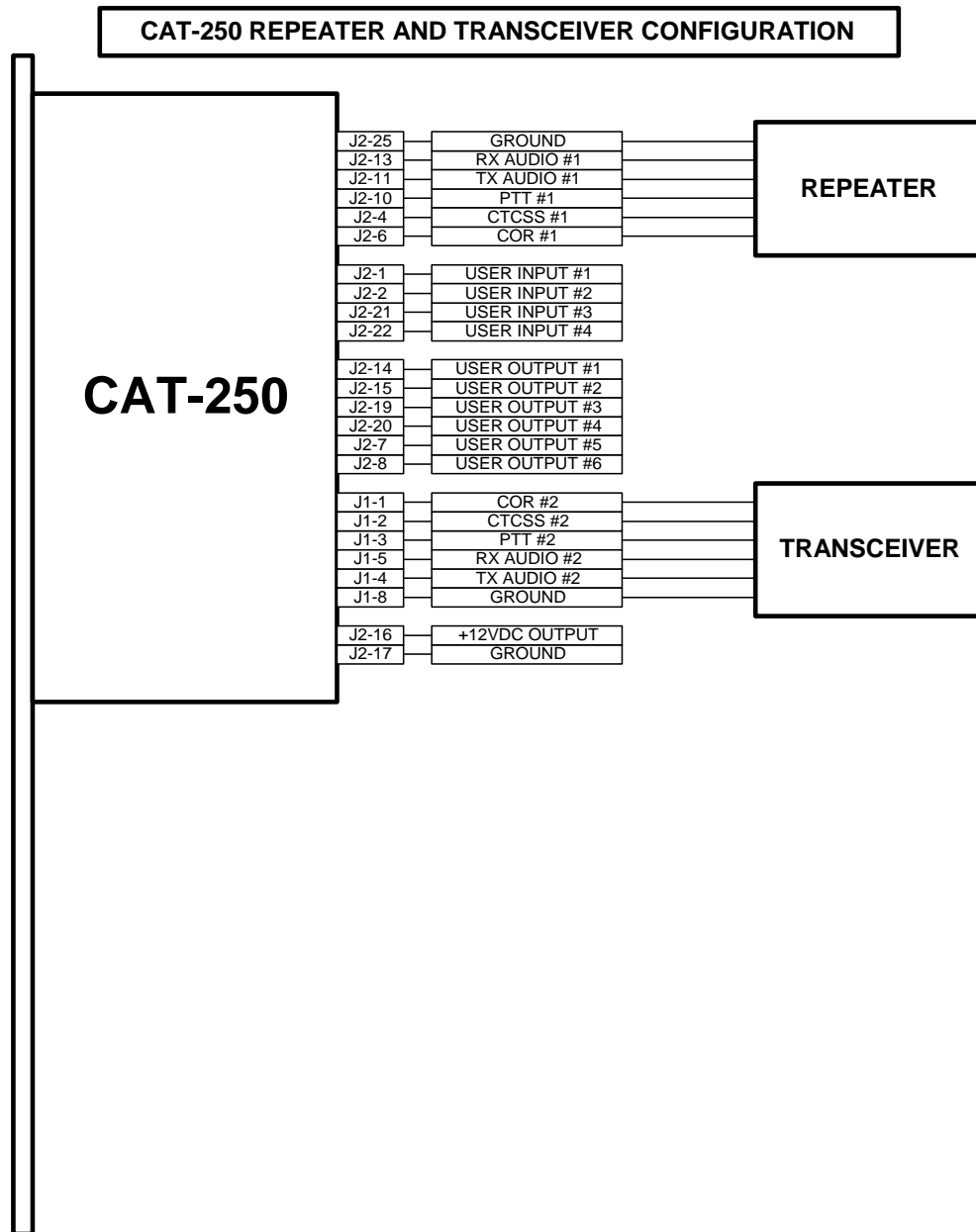


Figure 2-1

Repeater and Transceivers

In this configuration the CAT-250 supports a repeater and three transceivers. With an RLS-1000B Remote Link Switch board connected to port #2 three transceiver can be added to the repeater system. Three of the CAT-250's user function switches are assigned to control the RLS-1000B's transceiver inputs.

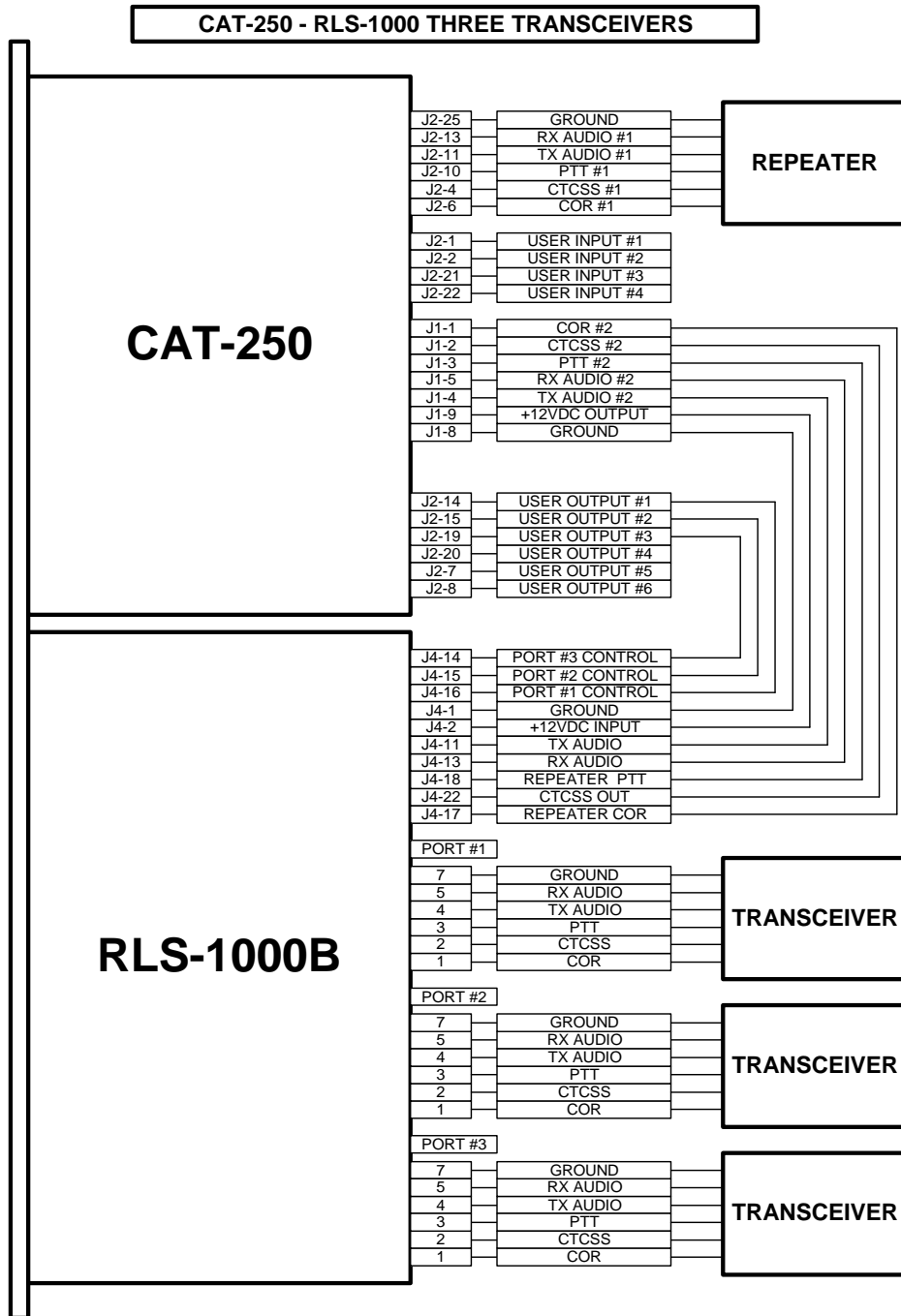


Figure 2-2

Repeater With One Transceiver And Weather Receiver

In this configuration the CAT-250 supports a repeater, transceiver and weather receiver. The WX-250 weather receiver mounts on the same 19-inch rack panel as the CAT-250. PTT and transmit audio from the CAT-250 are connected to the repeater's transmitter through the normally closed contacts of the double pole double throw relay located inside the WX-250. When a weather alert is received, the relay will switch the weather alert audio to the TX audio input and provide a PTT signal to key the transmitter.

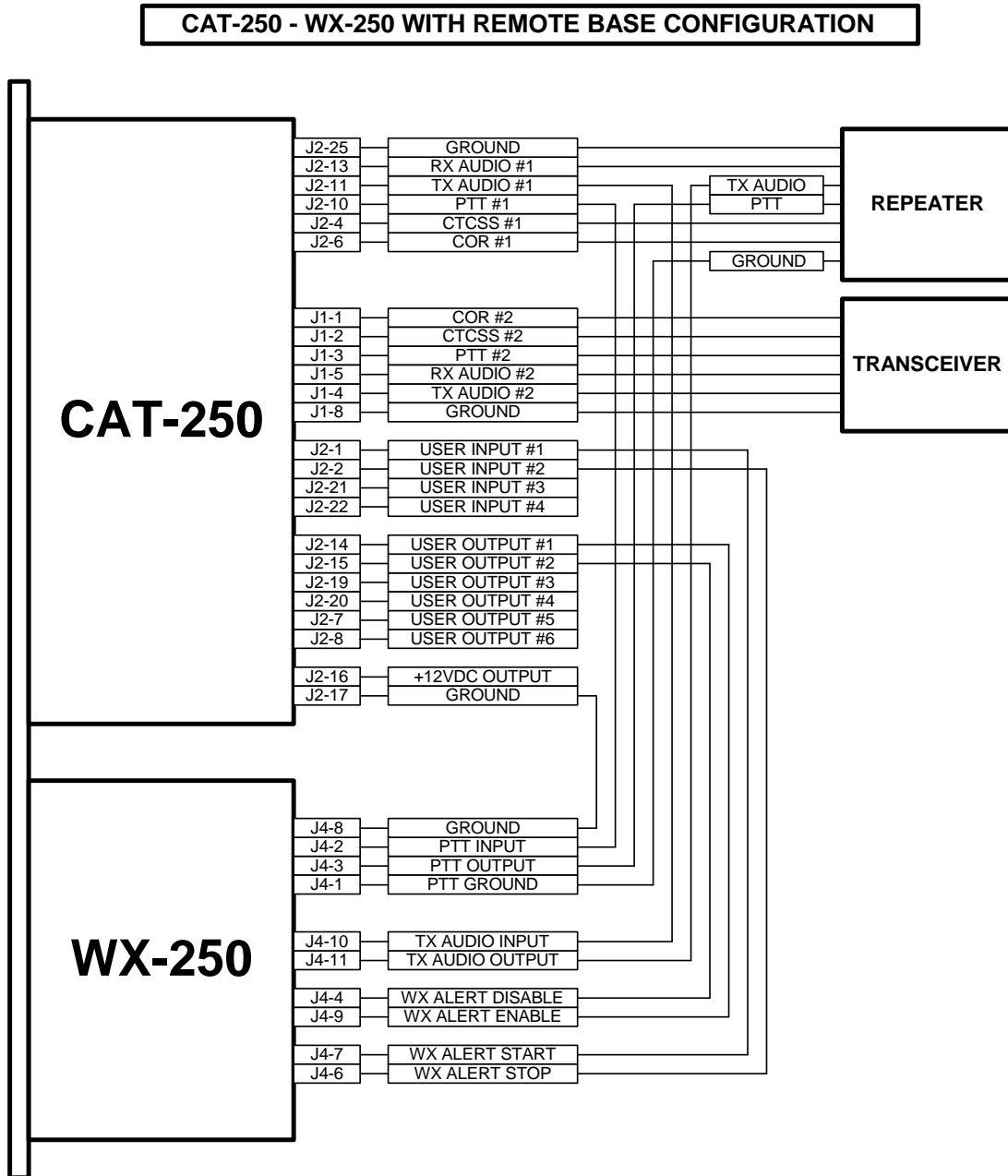


Figure 2-3

Repeater And Weather Receiver

In this configuration the CAT-250 supports a repeater and weather receiver. The WX-250 is connected to the transceiver port of the CAT-250. When a weather alert is received, a relay inside the WX-250 will switch the weather alert audio to the RX2 audio input of the CAT-250 and provide a COR input signal to activate the repeater's transmitter.

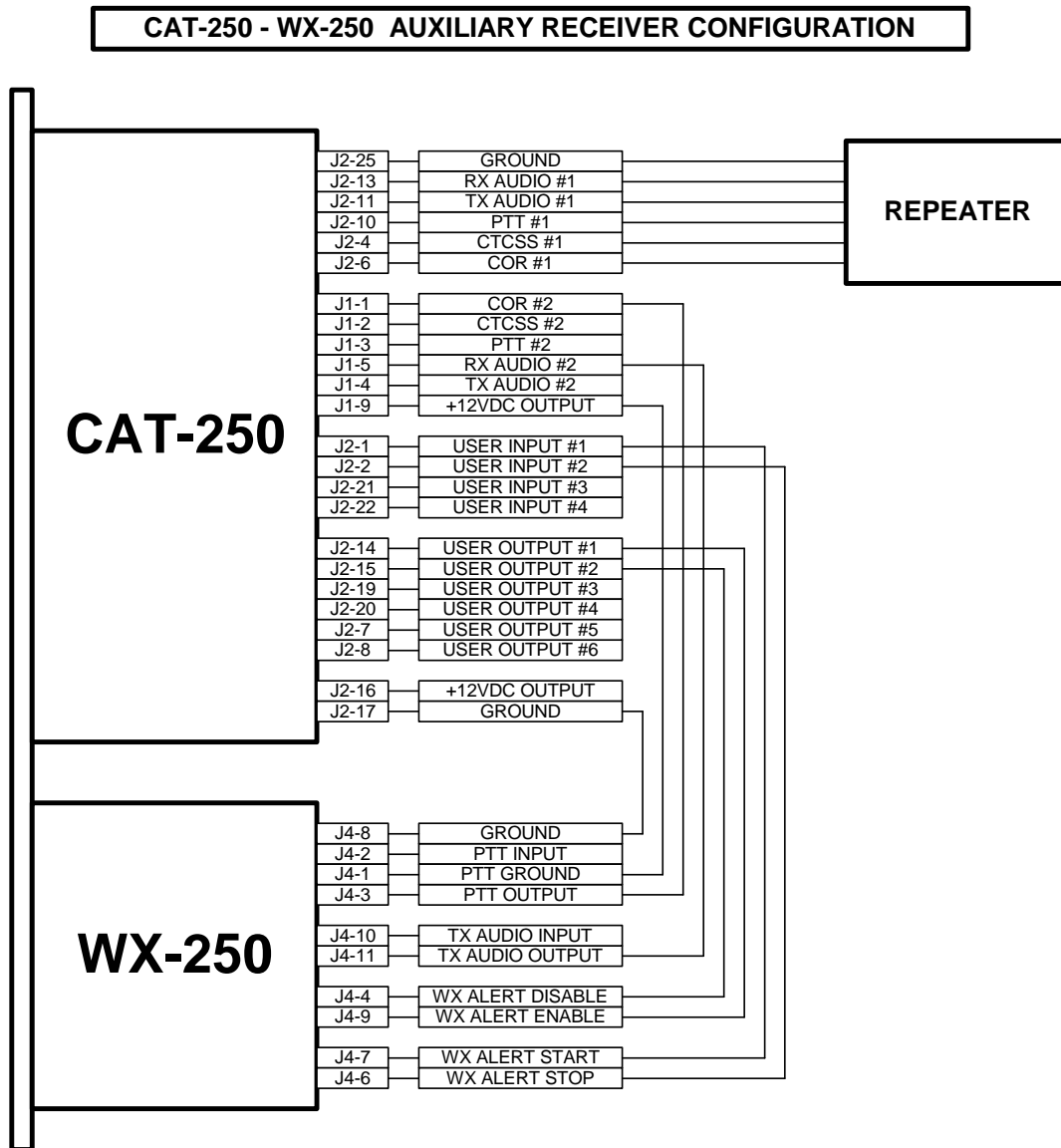


Figure 2-4

Dual Repeater

In this configuration two CAT-250 controllers have their link ports cross-coupled. By connecting PTT #2 of one CAT-250 to the COR #2 of the other CAT-250 and TX2 audio of one controller connected to the RX2 audio of the other controller the two repeaters can be linked together. When port #2 is turned off each repeater will stand-alone.

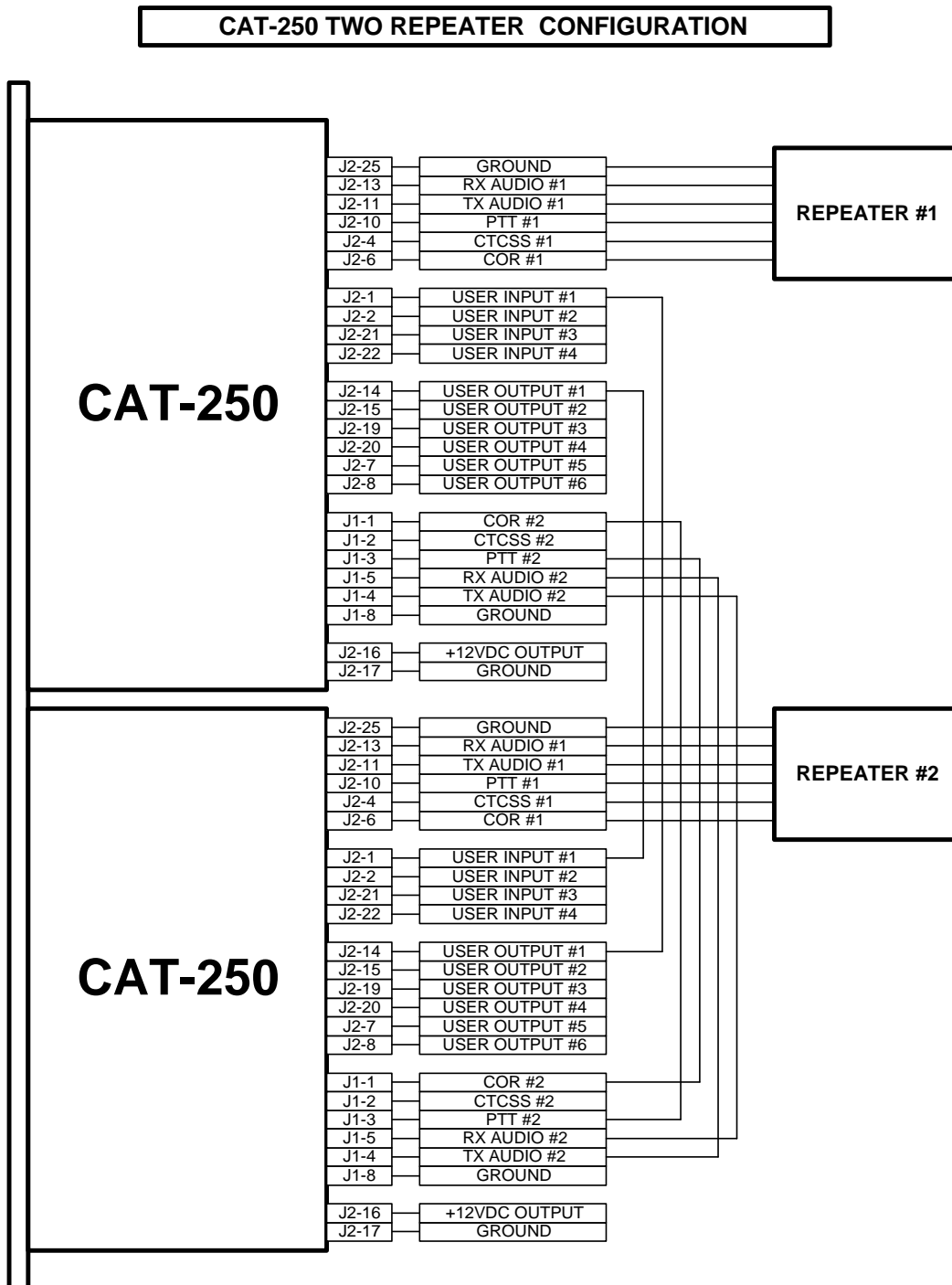


Figure 2-5

Dip Switch

An eight-position dipswitch configures various functions of the CAT-250.

Switch 1 This switch determines Repeater COR input logic. Switch #1 should be ON if the repeater receiver's COR is an active low and OFF if COR is active high.

Switch 2 This switch determines Repeater CTCSS input logic. Switch #2 should be ON if the repeater receiver's CTCSS is an active low and OFF if CTCSS is active high.

Switch 3 This switch determines Link COR input logic. This switch should be ON if the link receiver's COR is an active low and OFF if COR is active high.

Switch 4 This switch determines Link CTCSS input logic. Switch #4 should be ON if the link receiver's CTCSS is an active low and OFF if CTCSS is active high.

Switch 5 This switch determines the operation of Port #2. Switch #5 should be ON for duplex transceiver operation and OFF for simplex transceiver operation.

Switch 6 This switch places the CAT-250 in the cross band repeat mode. With transceivers on both Port #1 and Port #2, enabled the link with the [5001] command. A signal received by the Port #1 receiver will only key the Port #2 transmitter and a signal received by the Port #2 receiver will only key the Port #1 transmitter.

Switch 7 This switch is used to initialize the CAT-250. Set this switch to ON. Cycle the power OFF and back ON. During power-up, the memory will be flushed and reloaded with default values. The voice will say: "RESET SYSTEM OK." Set dipswitch #7 to the OFF position.

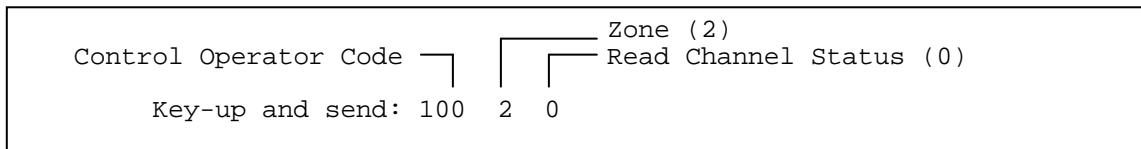
Switch 8 This switch is used to program a new MASTER un-lock number. Set switch #8 to ON. The voice will say: "ENTER CONTROL." After the seven-digit master unlock number is entered, set switch #8 to OFF. This switch is also used to activate the RS-232 port. Turn the power off set dipswitch #8 to on and apply power to the CAT-250.

Chapter 3 - Repeater Control

The CAT-250 has eight control zones. These control zones can be manually controlled by DTMF commands on the repeater input or by user and event macros.

Interrogation of Repeater Control Status

Key-up and send the control operator code [100] followed by the zone number and a zero. Un-key and the voice will read back the channels that are turned on in that zone. Example: Read Zone 2 channel status. If all the channels are turned off, the voice will say: "CLEAR."

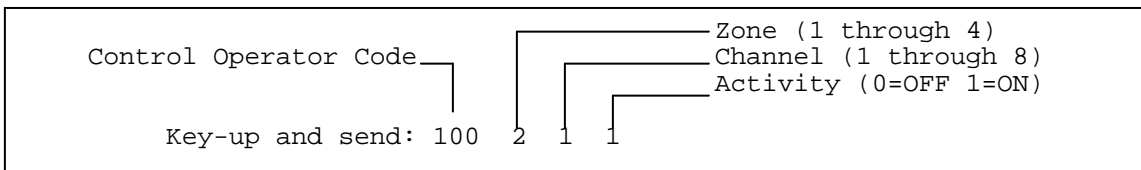


Un-key and the voice will say: "ONE FOUR EIGHT"

Changing Repeater Control Status

To change the status of a channel, key-up and send the control operator code [100] followed by the zone number, channel number and a [1] to turn the channel ON or a [0] to turn the channel OFF. Un-key and the voice will read back the zone, channel number and control activity. The voice will say: "ONE ONE ON." or "THREE FIVE OFF."

Example: With a control operator prefix of 100, turn Zone 2 Channel 1 ON.



Un-key and the voice will say: "TWO ONE ON."

Control of the CAT-250 is also available through the Port #2 receiver. The procedure is the same as above except the default control operator code for Port #2 is [200].

Repeater Control Channels

Zone 1

1	PORT #1 TRANSMIT	ENABLE*
2	PORT #1 COR AND CTCSS	ENABLE
3	PORT #1 COR OR CTCSS	ENABLE
4	PORT #1 TURN ON DELAY	ENABLE
5	PORT #1 DTMF PAD TEST	ENABLE*
6	PORT #1 COURTESY TONE	ENABLE*
7	PORT #1 DTMF MUTING	ENABLE
8	PORT #1 TIMEOUT	ENABLE*

Zone 2

1	PORT #2 TRANSMIT	ENABLE*
2	PORT #2 COR AND CTCSS	ENABLE
3	PORT #2 COR OR CTCSS	ENABLE
4	PORT #2 TURN ON DELAY	ENABLE
5	PORT #2 DTMF PAD TEST	ENABLE*
6	PORT #2 AUTO-DISCONNECT	ENABLE
7	PORT #2 DTMF MUTING	ENABLE
8	PORT #2 TIMEOUT	ENABLE*

Zone 3

1	PORT #2 CONTROL OPERATOR	ENABLE*
2	PORT #2 MACRO CONTROL	ENABLE*
3	RESERVED	ENABLE
4	RESERVED	ENABLE
5	RESERVED	ENABLE
6	RESERVED	ENABLE
7	RESERVED	ENABLE
8	RESERVED	ENABLE

Zone 4

1	USER LOGIC INPUT #1	ENABLE*
2	USER LOGIC INPUT #2	ENABLE*
3	USER LOGIC INPUT #3	ENABLE*
4	USER LOGIC INPUT #4	ENABLE*
5	SCHEDULER	ENABLE*
6	TIME OF DAY REQUEST	ENABLE*
7	GRANDFATHER CLOCK	ENABLE*
8	GRANDFATHER CLOCK SLEEP	ENABLE

Zone 5

1	USER OUTPUT SWITCH #1	ENABLE
2	USER OUTPUT SWITCH #2	ENABLE
3	USER OUTPUT SWITCH #3	ENABLE
4	USER OUTPUT SWITCH #4	ENABLE
5	USER OUTPUT SWITCH #5	ENABLE
6	USER OUTPUT SWITCH #6	ENABLE
7	DTMF ACCESS	ENABLE
8	FORCED DTMF ENTRY	ENABLE*

Zone 6

1	REPEATER ID #1 (At Rest)	ENABLE*
2	REPEATER ID #2 (Active)	ENABLE*
3	SQUELCH TAIL MESSAGE	ENABLE
4	TRANSMITTER DROP MESSAGE	ENABLE
5	TIMED MESSAGE #1	ENABLE
6	TIMED MESSAGE #2	ENABLE
7	RESERVED	ENABLE
8	RESERVED	ENABLE

Zone 7

1	FAN CONTROL	ENABLE
2	CTCSS ENCODER LOGIC	ENABLE
3	ECHOLINK® CONTROL	ENABLE
4	TRANSMITTER HANG TIME	ENABLE*
5	RESERVED	ENABLE
6	RESERVED	ENABLE
7	RESERVED	ENABLE
8	RESERVED	ENABLE

Zone 8

1	RESERVED	ENABLE
2	RESERVED	ENABLE
3	RESERVED	ENABLE
4	RESERVED	ENABLE
5	RESERVED	ENABLE
6	RESERVED	ENABLE
7	RESERVED	ENABLE
8	RESERVED	ENABLE

* During initialization these control channels are set to the enable position.

Zone 1 - Repeater Control Channels

1. Port #1 Transmitter Enable

This is the master repeater switch. This channel must be enabled for normal repeater operation. The CAT-250 will continue to respond to control operator commands even when the Port #1 transmitter is disabled. This channel will automatically be enabled after a dipswitch #7 initialization reset.

2. Port #1 COR and CTCSS Enable

When this channel is enabled, in addition to a COR input, an input from a CTCSS decoder at J2-4 must also be present before Port #1 will activate. A COR input by itself will have no affect. To prevent loss of control, DO NOT ENABLE THIS CHANNEL unless a CTCSS decoder is connected to J2-4.

3. Port #1 COR or CTCSS Enable

When this channel is enabled, the COR and CTCSS inputs will function as a (OR) logic input. This means activity on either the COR or CTCSS inputs will cause the controller to key the Port #1 transmitter.

4. Port #1 Turn on Delay Enable

When this channel is enabled, a deliberate and sustained input on Port #1 must be present before the controller will respond. A time delay of 0.1 to 9.9 seconds can be selected with the [*624*] programming command. When the CAT-250 is initialized, this timer defaults to 1.0 seconds. This channel is useful during periods when noise bursts are present on the repeater input.

5. Port #1 DTMF Pad Test Enable

When this channel is enabled, a repeater user is able to perform a test of their radio's 12 or 16-button keypad through the repeater port. As the numbers are being decoded, they are stored in memory. When the repeater user stops transmitting the controller will read back all the numbers that were decoded. The Forced DTMF Entry key is defaulted to the [D] key. It must be entered last and it will not read back during the pad test.

6. Port #1 Courtesy Tone Enable

When this channel is enabled, a courtesy tone will occur when the COR signal is lost. To eliminate the courtesy tone, turn this channel OFF. The timeout timer will continue to be reset.

7. Port #1 DTMF Muting Enable

When this channel is enabled, anytime a DTMF tone is received, the audio will be turned off to the Port #1 transmitter. The transmit audio will remain muted until a pre-determined time after the last DTMF tone is received. During the mute period, cover beeps are transmitted each second to indicate repeater activity. This feature prevents control commands from being repeated. It provides an extra measure of security. There may be times when it is desirable to pass the DTMF tones through the repeater. To temporarily disable DTMF muting, precede the DTMF string with a (#).

8. Port #1 Timeout Enable

Port #1 time-out is user programmable with the [*601*] timer programming commands. When the CAT-250 is initialized, this timer defaults to 3 minutes. When this channel is turned off, the repeater, port #1 will not timeout.

Zone 2 - Link Control Channels

1. Port #2 Transmitter Enable

This channel must be enabled for link operation. This channel will automatically be enabled after a dipswitch #7 initialization reset.

2. Port #2 COR and CTCSS Enable

When this channel is enabled, in addition to a COR input at J2-5, an input from a CTCSS decoder at J2-3 must also be present before the repeater will activate. A COR input by itself will have no affect.

3. Port #2 COR or CTCSS Enable

When this channel is enabled, the COR and CTCSS inputs will function as a (OR) logic input. This means activity on either the COR or CTCSS inputs will cause the controller to key the repeater's transmitter.

4. Port #2 Turn on Delay Enable

When this channel is enabled, a deliberate and sustained input on Port #2 must be present before the controller will activate the repeater. A time delay of 0.1 to 9.9 seconds can be selected with the [*624*] programming command. When the CAT-250 is initialized, this timer defaults to 1.0 seconds. This channel is useful during periods when noise bursts are present on the transceiver input.

5. Port #2 DTMF Pad Test Enable

When this channel is enabled, a repeater user is able to perform a test of their radio's 12 or 16-button keypad through Port #2. As the numbers are being decoded, they are stored in memory. When the repeater user stops transmitting the controller will read back all the numbers that were decoded. The Forced DTMF Entry key is defaulted to the [D] key. It must be entered last and it will not read back during the pad test.

6. Port #2 Auto Disconnect Enable

When this channel is enabled, the link will disconnect automatically after a period of repeater inactivity. The voice will say: "LINK TIME OUT". A repeater or transceiver COR will keep the link activate until the repeater returns to rest. A rest period of up to 29 minutes can be selected with the [*607*] programming command. When the CAT-250 is initialized, this timer defaults to 10 minutes.

7. Port #2 DTMF Muting Enable

When this channel is enabled, anytime a DTMF tone is received, the audio will be turned off to the Port #2 transmitter. The transmit audio will remain muted until a pre-determined time after the last DTMF tone is received. During the mute period, cover beeps are transmitted each second to indicate repeater activity. This feature prevents control commands from being repeated. It provides an extra measure of security. There may be times when it is desirable to pass the DTMF tones through the repeater. To temporarily disable DTMF muting, precede the DTMF string with a (#).

8. Port #2 Timeout Enable

Link time-out is user programmable with the [*602*] timer programming commands. When the CAT-250 is initialized, this timer defaults to 3 minutes. When this channel is turned off, the repeater link port, will not timeout.

Zone 3 - Link Control Channels

1. Port #2 Control Operator Enable

When this channel is enabled, the CAT-250 will accept control operator commands to change the settings of the zone channels from the link side. The default code is [200]. This code can be changed with the [*502*] programming command.

2. Port #2 Macro Enable

When this channel is enabled, the CAT-250 will accept user macro commands from the link side.

3. Reserved

4. Reserved

5. Reserved

6. Reserved

7. Reserved

8. Reserved

Zone 4 - Miscellaneous Control Channels

1. User Logic Input #1 Enable

When this channel is enabled, an active high logic input on connector J2-1 will execute event macro #5 while an active low logic input will execute event macro #6.

2. User Logic Input #2 Enable

When this channel is enabled, an active high logic input on connector J2-2 will execute event macro #7 while an active low logic input will execute event macro #8.

3. User Logic Input #3 Enable

When this channel is enabled, an active high logic input on connector J2-21 will execute event macro #9 while an active low logic input will execute event macro #10.

4. User Logic Input #4 Enable

When this channel is enabled, an active high logic input on connector J2-22 will execute event macro #11 while an active low logic input will execute event macro #12.

5. Scheduler Enable

When this channel is enabled, all action by the scheduler will be executed per the times programmed in the scheduler table. There may be times, during emergency net operations, when it is not desirable to have channels change automatically. To suspend scheduler operation, turn this channel off.

6. Time of Day Request Enable

When this channel is enabled, repeater users can request a time of day announcement by entering the time of day request number. This message will consist of up to 15 words selected from the voice vocabulary table and is programmed with the [*3109*] command. When the CAT-250 is initialized, this message defaults to: "THE TIME IS 7:15 PM."

7. Grandfather Clock Enable

When this channel is enabled, the CAT-250 will announce the time of day every hour on the hour. This message will consist of up to 15 words selected from the voice synthesizer vocabulary table and programmed with the [*3110*] command. When the CAT-250 is initialized, this message defaults to: "CAT-250 REPEATER THE TIME IS 7:15 PM."

8. Grandfather Clock Sleep Mode Enable

It may be desirable to suspend the grandfather clock operation during the early morning hours. When this channel is enabled, the last announcement will be at 11:00 PM. Time announcements will resume at 7:00 AM the next morning.

Zone 5 - Miscellaneous Control Channels

1. USER Output Switch #1 Enable

When this channel is enabled, switch #1 is turned on. Connector J2 pin 14 will sink 50 MA to ground.

2. USER Output Switch #2 Enable

When this channel is enabled, switch #2 is turned on. Connector J2 pin 15 will sink 50 MA to ground.

3. USER Output Switch #3 Enable

When this channel is enabled, switch #3 is turned on. Connector J2 pin 19 will sink 50 MA to ground.

4. USER Output Switch #4 Enable

When this channel is enabled, switch #4 is turned on. Connector J2 pin 20 will sink 50 MA to ground.

5. USER Output Switch #5 Enable

When this channel is enabled, switch #3 is turned on. Connector J2 pin 7 will sink 50 MA to ground.

6. USER Output Switch #6 Enable

When this channel is enabled, switch #4 is turned on. Connector J2 pin 8 will sink 50 MA to ground.

7. DTMF Access Enable

When this channel is enabled, a DTMF Access number selected by programming command [*503*] must be entered to activate Port #1. The repeater will continue to operate until a period of inactivity occurs determined by the [*606*] sleep timer. Once the timer expires the next repeater user must re-enter the DTMF Access number.

8. Forced DTMF Entry D Key

When this channel is enabled it is possible to force a DTMF command even while the port is active. To force a DTMF command, end the command with a [D]. This key can be changed with the [*29x] programming command.

Zone 6 – Voice Message Control Channels

1. Repeater ID #1 (At Rest) Enable

When this channel is enabled, repeater ID message #1 will repeat subject to the setting of the ID timer. This ID will consist of up to 15 words selected from the voice vocabulary table and is programmed with the [*3101] command.

2. Repeater ID #2 (Active) Enable

When this channel is enabled, the Repeater ID Message #2 will repeat subject to the setting of the ID timer. This ID will consist of up to 15 words selected from the voice vocabulary table and is programmed with the [*3102] command. When Repeater ID #1 and #2 are enabled, ID messages selection will be determined by whether the repeater is at rest or a QSO is in progress.

3. Squelch Tail Message Enable

When this channel is enabled, the squelch tail message occurs when a repeater user un-keys their transmitter. This message will repeat subject to the setting of the [*610*] squelch tail message timer. This message will consist of up to 15 words selected from the vocabulary table and programmed with the [*3103] command.

4. Transmitter Drop Out Message Enable

When this channel is enabled, the voice drop out message will occur just before the repeater transmitter turns off. This message will repeat subject to the setting of the [*611*] drop out message timer. This message will consist of up to 15 words selected from the voice vocabulary table and is programmed with the [*3104] command.

5. Timed Message #1 Enabled

When this channel is enabled, the timed voice message will occur on a regular schedule subject to the setting of the timed message timer. This message will consist of up to 15 words selected from the voice vocabulary table and is programmed with the [*3105] command.

6. Timed Message #2 Enabled

When this channel is enabled, the timed voice message will occur on a regular schedule subject to the setting of the timed message timer. This message will consist of up to 15 words selected from the voice vocabulary table and is programmed with the [*3106] command.

7. Reserved

8. Reserved

Zone 7 - Miscellaneous Control Channels

1. Fan Control Enable

When this channel is enabled, user output switch #6 is converted into a Fan Control output. When PTT #1 turns ON, user output #6 J2 pin 8 will turn ON. After PTT #1 turns OFF this output will remain ON for an additional period of time determined by the [*612*] Fan Control timer. This timer default is 60 seconds. Use this output to control a fan relay to cool the repeater's transmitter. When this channel is enabled, Zone 5 Channel 6 will have no effect.

2. CTCSS Encoder Switch Enable

When this channel is enabled, user output switch #5 is converted into a CTCSS Encoder Switch output. When Port #1 goes active, user output #5 J2 pin 7 will turn ON. After Port #1 goes inactive, this output will remain ON for an additional period of time determined by the [*626*] CTCSS Encoder timer. This timer default is 4.0 seconds. Use this output to control an external CTCSS encoder. When this channel is enabled, Zone 5 Channel 5 will have no effect.

3. Echolink® Control Enable

When the Link is enabled and DTMF Muting (Zone 1 Channel 7) is enabled, a DTMF command entered through Port #1 will be muted on both the Port #1 and Port #2 transmit audios. When this channel is enabled, Port #2 transmit audio will be the actual DTMF command. The DTMF command will continue to be muted on the Port #1 transmit audio.

4. Transmitter Hang Time Enable

When this channel is enabled, the transmitter will have a hang-time subject to the settings of the COR Drop to Courtesy Beep Timer [*621*] and the Courtesy Beep to PTT Drop Timer [*622*]. At default these timers are set for one second and four seconds.

5. Reserved

6. Reserved

7. Reserved

8. Reserved

Zone 8 - Miscellaneous Control Channels

1. Reserved

2. Reserved

3. Reserved

4. Reserved

5. Reserved

6. Reserved

7. Reserved

8. Reserved

Chapter 4 - Repeater Operation

Time of Day Message

Key-up, and enter [400], the time of day access code. Un-key, and the voice synthesizer will announce the time. Example: The voice will say: "THE TIME IS 7:30 PM". The time of day announcement is stored in voice message [9] and can be changed with the [*3109] programming command.

DTMF Keypad Test Port #1 and Port #2

Key-up, and enter [375], the DTMF keypad access code followed by the keypad numbers and letters to be tested. The entries can be in any order. Un-key, and the voice will read-back all numbers and letters that were decoded including the "STAR" and "POUND". The Forced DTMF Entry key is defaulted to the [D] key. It must be entered last and it will not read back during the pad test.

DTMF Access Port #1 and Port #2

When the CAT-250 is in the DTMF Access mode, you must enter the DTMF Access code to activate the repeater. The voice will say: "OK UP" and the repeater will respond to a COR and or CTCSS input. When the repeater returns to rest, for a time determined by the sleep timer, the DTMF Access code must be re-entered to activate the repeater. You can bypass the rest period and return the repeater to DTMF access mode by re-entering [325], the DTMF access code. The voice will say: "OK DOWN".

Forced DTMF Command Entry Port #1 and Port #2

During normal operation a DTMF command is entered when the port goes inactive. It is possible to force a DTMF command entry even while the port is active. The CAT-250 will accept the [D] key as an entry command. This key can be changed with the [*29X] programming command.

DTMF Muting Override Port #1 and Port #2

With DTMF muting enabled, there may be times when it is desirable to pass the DTMF tones to the repeater or link transmitter. To temporarily disable DTMF muting, precede the DTMF string with a pound [#].

Repeater ID #1 (At Rest)

If the repeater has been at rest for a period in excess of the ID timer setting, when the repeater is keyed, the CAT-250 will send ID #1. This ID should be longer than ID #2 and include additional information about the repeater or sponsoring organization. Example: "WITH ONE HUNDRED WATTS OF RF POWER AT YOUR SERVICE THIS IS THE W4XYZ REPEATER SYSTEM -- GOOD AFTERNOON".

Repeater ID #2 (Active)

If a QSO is in progress and it's time to identify the repeater, the CAT-250 will wait until COR drops to send ID #2. This ID should be short so as not to interfere with the QSO in progress. Example: "W4XYZ REPEATER." This ID is also called as the final ID of the ten-minute period.

Macro Execute

A macro is a series of commands, defined by the repeater owner. Macros permit the owner to customize certain aspects of repeater operation. Once the CAT-250 decodes the macro number, the commands will execute in the order they were stored within the macro string.

Link Disconnect

Key-up on the repeater or link input and enter the link disconnect control Macro #28 number [5000]. The CAT-250 will disconnect the link port from the repeater port, and the voice will say: "LINK OFF." See the Event Macro Data table in Chapter 5.

Link Connect

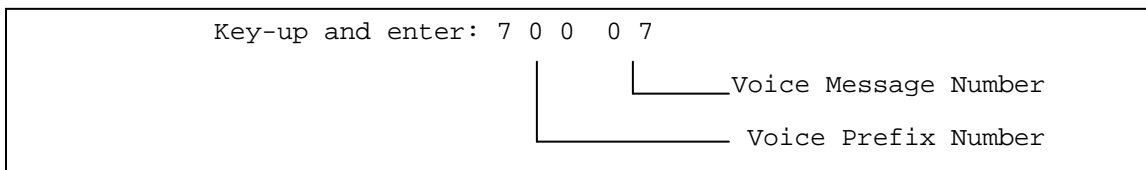
Key-up on the repeater or link input and enter the link connect control Macro #27 number [5001]. The CAT-250 will connect the link port to the repeater port, and the voice will say: "LINK ON." See the Event Macro Data table in Chapter 5.

Link Receive Only

Key-up on the repeater's input and enter the link receive only control Macro #26 number [5002]. The CAT-250 will connect the link port to the repeater port and the voice will say: "LINK RECEIVER ON." The link transmitter will be disabled. See the Event Macro Data table in Chapter 5.

Voice Message Selection

Key-up and enter the VOICE prefix followed by the message number. The CAT-250 will key the transmitter and play the message stored at that location. Example: With a VOICE prefix number of 700, play message stored at table position seven.



Chapter 5 - Repeater Programming By DTMF Tone

This section describes how the repeater owner using a DTMF keypad programs the CAT-250 controller. The various types of program commands are described in detail and examples are given in the following text.

Initialization

To initialize the CAT-250, set dipswitch #7 to on and cycle DC power. During power-up, the voice will say: "RESET SYSTEM OK." Set dipswitch #7 to off. Initialization consists of the following operations:

Dipswitch #7 Initialization

1. All memory locations are cleared.
2. The control channels marked with a [*] are enabled.
3. The master unlock number is loaded with the default value [1234567].
4. The unlock number is loaded with the default value [7654321].
5. The Port #1 control operator prefix code is loaded with [100].
6. The Port #2 control operator prefix code is loaded with [200].
7. All codes are loaded with default values.
8. All timers are loaded with default values.
9. The two voice Ids are loaded with "CAT-250 REPEATER".
10. All messages are loaded with default messages.
11. Event macros are loaded with defaults.

Programming the Master Unlock Number

To program the Master UNLOCK number, set dipswitch #8 to the on position. The voice will say: "ENTER CONTROL." Key-up and enter a seven-digit number. Un-key, if the number is accepted, the voice will say: "CONTROL OK." If the number is rejected, the voice will say: "ENTER CONTROL." Key-up and enter the seven-digit number. Set dipswitch #8 to the off position.

Unlocking the Controller By Radio From Port #1 and Port #2 [7654321]

To unlock the controller, key-up and enter the unlock number. The voice will say: "CAT 250 CONTROL."

Note: The CAT-250 can be unlocked and placed in the programming mode with either the unlock or the master unlock number. The master unlock number must be changed by using dipswitch #8. The unlock number can be changed remotely without having to go to the site. For security reasons use the unlock number because it can easily be changed. Use the master unlock number when the conditions are thought to be secure.

Locking the Controller By Radio [*0]

Key-up and send [*0]. Un-key, the controller will lockup and the voice will say: "CONTROL EXIT." The controller will lock automatically when the programming timer expires. The voice will say: "TIMER EXIT." The programming time limit is set by the programming timer [*605*]. The default time is ten minutes.

NOTE: The CAT-250 must be unlocked to perform the following programming functions.

CAT-250 Internal Command Pointer Assignments

	COMMAND	CHANNEL	ACTION
CONTROL REPEATER ZONE 1	11	1-8	0=OFF 1=ON
CONTROL REPEATER ZONE 2	12	1-8	0=OFF 1=ON
CONTROL REPEATER ZONE 3	13	1-8	0=OFF 1=ON
CONTROL REPEATER ZONE 4	14	1-8	0=OFF 1=ON
CONTROL REPEATER ZONE 5	15	1-8	0=OFF 1=ON
CONTROL REPEATER ZONE 6	16	1-8	0=OFF 1=ON
CONTROL REPEATER ZONE 7	17	1-8	0=OFF 1=ON
CONTROL REPEATER ZONE 8	18	1-8	0=OFF 1=ON
		COMMAND	COMMENTS
PLAY TIME OF DAY		2000	
PLAY DAY OF WEEK		2001	
PLAY VOICE MESSAGE (No Interruption with COR)		30XX	01-20
PLAY VOICE MESSAGE (Interruption with COR)		31XX	01-20
PLAY VOICE MESSAGE (Interruption with COR, Switch to CW)		32XX	01-20
PLAY CW BUFFER		3300	
PLAY CW CHARACTER		34XX	01-46
LOAD COURTESY TONE PORT #1		36XX	01-08
LOAD COURTESY TONE PORT #2		37XX	01-08
PLAY COURTESY TONE PORT #1		3800	
PLAY COURTESY TONE PORT #2		3900	
PULSE USER OUTPUT SWITCH #1 (PULSE RATE 100mSEC)		41XX	01-99
PULSE USER OUTPUT SWITCH #2 (PULSE RATE 100mSEC)		42XX	01-99
PULSE USER OUTPUT SWITCH #3 (PULSE RATE 100mSEC)		43XX	01-99
PULSE USER OUTPUT SWITCH #4 (PULSE RATE 100mSEC)		44XX	01-99
PULSE USER OUTPUT SWITCH #5 (PULSE RATE 100mSEC)		45XX	01-99
PULSE USER OUTPUT SWITCH #6 (PULSE RATE 100mSEC)		46XX	01-99
AUDIO SWITCH CONTROL [RX1 TO TX1]		500X	0=OFF 1=ON
AUDIO SWITCH CONTROL [RX1 TO TX2]		501X	0=OFF 1=ON
AUDIO SWITCH CONTROL [RX1 TO TX1 AND TX2]		502X	0=OFF 1=ON
AUDIO SWITCH CONTROL [RX2 TO TX1]		510X	0=OFF 1=ON
AUDIO SWITCH CONTROL [RX2 TO TX2]		511X	0=OFF 1=ON
AUDIO SWITCH CONTROL [RX2 TO TX1 AND TX2]		512X	0=OFF 1=ON
AUDIO SWITCH CONTROL [VOICE TO TX1]		520X	0=OFF 1=ON
AUDIO SWITCH CONTROL [VOICE TO TX2]		521X	0=OFF 1=ON
AUDIO SWITCH CONTROL [VOICE TO TX1 AND TX2]		522X	0=OFF 1=ON
AUDIO SWITCH CONTROL [BEEP OR CW TO TX1]		530X	0=OFF 1=ON

AUDIO SWITCH CONTROL [BEEP OR CW TO TX2]	531X	0=OFF 1=ON
AUDIO SWITCH CONTROL [BEEP OR CW TO TX1 AND TX2]	532X	0=OFF 1=ON
LOAD TIME DELAY (SECONDS)	60XX	01-99
PTT #1 CONTROL	611X	0=OFF 1=ON
PTT #2 CONTROL	612X	0=OFF 1=ON
PTT #1 AND PTT #2 CONTROL	613X	0=OFF 1=ON
PTT #1 WITH DELAY AND AUDIO SWITCH [VOICE TO TX1]	614X	0=OFF 1=ON
PTT #2 WITH DELAY AND AUDIO SWITCH [VOICE TO TX2]	615X	0=OFF 1=ON
PTT #1 WITH DELAY AND AUDIO SWITCH [VOICE TO TX1-TX2]	616X	0=OFF 1=ON
USER FUNCTION SWITCH #1 OUTPUT (PULSE 500mSEC)	621X	0=OFF 1=ON 2=PULSE
USER FUNCTION SWITCH #2 OUTPUT (PULSE 500mSEC)	622X	0=OFF 1=ON 2=PULSE
USER FUNCTION SWITCH #3 OUTPUT (PULSE 500mSEC)	623X	0=OFF 1=ON 2=PULSE
USER FUNCTION SWITCH #4 OUTPUT (PULSE 500mSEC)	624X	0=OFF 1=ON 2=PULSE
USER FUNCTION SWITCH #5 OUTPUT (PULSE 500mSEC)	625X	0=OFF 1=ON 2=PULSE
USER FUNCTION SWITCH #6 OUTPUT (PULSE 500mSEC)	626X	0=OFF 1=ON 2=PULSE
DISCONNECT PORT #2 FROM PORT #1	7000	
CONNECT PORT #2 TO PORT #1	7001	
CONNECT PORT #2 RECEIVER TO PORT #1	7002	
DTMF ACCESS REPEATER	710X	0=OFF 1=ON
DISABLE EVENT MACRO	80XX	01-50
ENABLE EVENT MACRO	81XX	01-50
DISABLE USER MACRO	82XX	01-40
ENABLE USER MACRO	83XX	01-40
SEND VOICE WORD	9XXX	001-998

Figure 5-1

Scheduled Event Macro Time (30-49) Command Memory

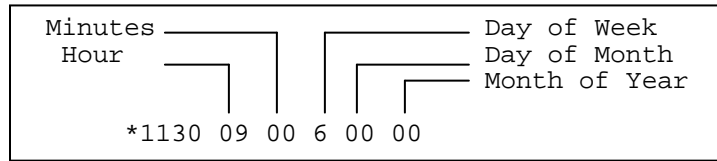
Event Macros (30-49) are linked to the scheduler. The [*10XX], [*11XX] and [*12XX] programming commands are used to read, program and erase the scheduled time the macros execute.

Read Scheduled Event Macro Time (30-49)

Key-up and send [*10XX]. Un-key and the voice will read back the status of the memory location. If there is no command stored at that memory location, the voice will say: "All CLEAR." If a command is stored at that memory location, the voice will read back the time, day, day of month and month of year.

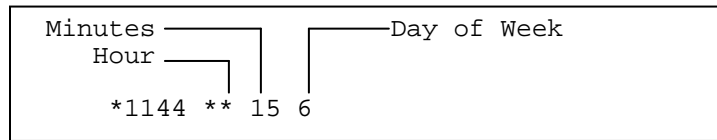
Program Scheduled Event Macro Time (30-49)

Key-up and send [*1130] followed by the hours, minutes, day of week, or day of month and month of year. Un-key and the voice will say: "CONTROL OK." Example: 9:00 AM Every Friday.



Enable - Disable Scheduled Event Macro (30-49)

Key-up and send [*1130 1] to enable scheduler macro 30 or [*1130 0] to disable macro 30. Example: Set Event Macro 44 for 15 minutes after every hour on Friday.



DAY OF WEEK SCHEDULER PROGRAMMING TABLE					
0=Daily	2=Monday	4=Wednesday	6=Friday	8=Weekdays	
1=Sunday	3=Tuesday	5=Thursday	7=Saturday	9=Weekends	

Erase Scheduled Event Macro Time (30-49)

Key-up and send [*12XX]. Un-key, the voice will say: "CONTROL OK."

User Macro Command Memory

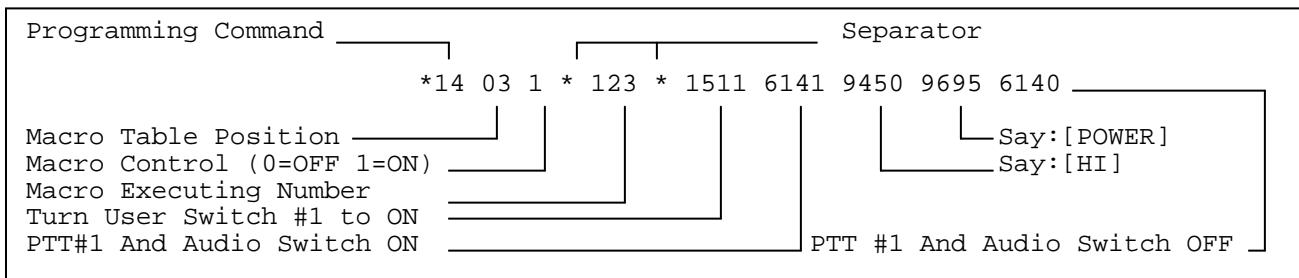
Macros are used to store custom commands of up to sixteen operations that will execute with a single DTMF entry.

Read User Macro Locations (01-40)

Key-up and send [*13XX]. Un-key and voice will read back the macro control number followed by the enable control byte followed by the macro data commands stored at that memory location. If the location is empty, the voice will say: "MACRO NUMBER XX NO CODE NO DATA."

Program User Macro Locations (01-40)

Key-up and send [*14XX] followed by the macro control number and the string of internal commands to be executed. See Figure 5-1. Un-key and the voice will say: "CONTROL OK." Example: Program macro #3 with a control number of [123] to Turn ON User Function Switch #1 and say: "HI POWER". The Macro Control number [123] is the number entered by a repeater user to execute the macro.



Program User Macro Locations (01-40)

Key-up and send [*14XX] followed by a [1] to enable the macro or a [0] to disable the macro. This feature permits the macro to be turned off without having to erasing it. Un-key and voice will say: "CONTROL OK."

Erase User Macro Locations (01-40)

Key-up and send [*15XX]. Un-key, the voice will say: "CONTROL OK."

Event Macro Command Memory

Event Macros are used to perform custom operations at pre determined times during repeater operation.

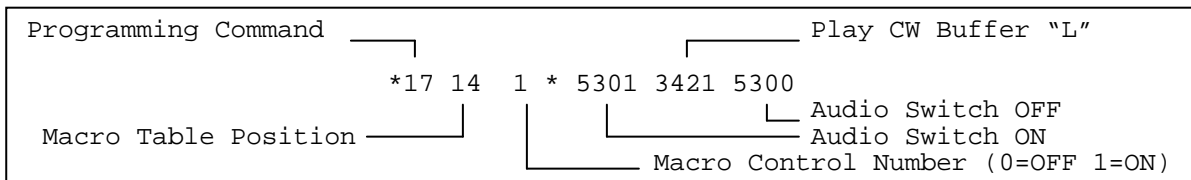
MACRO	DEFINITION	MACRO	DEFINITION
01	PORT #1 COR/CTCSS ACTIVE	26	PORT #2 RECEIVE ONLY
02	PORT #1 COR/CTCSS INACTIVE	27	PORT #2 CONNECT
03	PORT #2 COR/CTCSS ACTIVE	28	PORT #2 DISCONNECT
04	PORT #2 COR/CTCSS INACTIVE	29	PORT #2 AUTO DISCONNECT
05	LOGIC INPUT #1 ACTIVE HIGH	30	SCHEDULED EVENT MACRO #30
06	LOGIC INPUT #1 ACTIVE LOW	31	SCHEDULED EVENT MACRO #31
07	LOGIC INPUT #2 ACTIVE HIGH	32	SCHEDULED EVENT MACRO #32
08	LOGIC INPUT #2 ACTIVE LOW	33	SCHEDULED EVENT MACRO #33
09	LOGIC INPUT #3 ACTIVE HIGH	34	SCHEDULED EVENT MACRO #34
10	LOGIC INPUT #3 ACTIVE LOW	35	SCHEDULED EVENT MACRO #35
11	LOGIC INPUT #4 ACTIVE HIGH	36	SCHEDULED EVENT MACRO #36
12	LOGIC INPUT #4 ACTIVE LOW	37	SCHEDULED EVENT MACRO #37
13	PLAY COURTESY TONE #1	38	SCHEDULED EVENT MACRO #38
14	PLAY COURTESY TONE #2	39	SCHEDULED EVENT MACRO #39
15		40	SCHEDULED EVENT MACRO #40
16	SQUELCH TAIL MESSAGE	41	SCHEDULED EVENT MACRO #41
17	TRANSMITTER DROP MESSAGE	42	SCHEDULED EVENT MACRO #42
18	ID MESSAGE INITIAL	43	SCHEDULED EVENT MACRO #43
19	ID MESSAGE PENDING	44	SCHEDULED EVENT MACRO #44
20	ID MESSAGE FORCED	45	SCHEDULED EVENT MACRO #45
21	ID MESSAGE FINIAL	46	SCHEDULED EVENT MACRO #46
22	TIMED MESSAGE #1	47	SCHEDULED EVENT MACRO #47
23	TIMED MESSAGE #2	48	SCHEDULED EVENT MACRO #48
24	DTMF ACCESS UP	49	SCHEDULED EVENT MACRO #49
25	DTMF ACCESS DOWN	50	POWER UP

Read Event Macro Locations (01-50)

Key-up and send [*16XX]. Un-key and voice will read back the macro control number followed by the macro data commands stored at that memory location. If the location is empty, the voice will say: "NO MACRO."

Program Event Macro Locations (01-50)

Key-up and send [*17XX] followed by the macro control number and the string of internal commands to be executed. Un-key and the voice will say: "CONTROL OK." Example: Program the Port #2 courtesy tone to be the letter "L".



Erase Event Macro Locations (01-50)

Key-up and send [*18XX]. Un-key, the voice will say: "CONTROL OK."

Event Macro Default Data

01	PORT #1 COR/CTCSS ACTIVE									
02	PORT #1 COR/CTCSS INACTIVE									
03	PORT #2 COR/CTCSS ACTIVE									
04	PORT #2 COR/CTCSS INACTIVE									
05	LOGIC INPUT #1 ACTIVE HIGH	1511								
06	LOGIC INPUT #1 ACTIVE LOW	1510								
07	LOGIC INPUT #2 ACTIVE HIGH	1521								
08	LOGIC INPUT #2 ACTIVE LOW	1520								
09	LOGIC INPUT #3 ACTIVE HIGH	1531								
10	LOGIC INPUT #3 ACTIVE LOW	1530								
11	LOGIC INPUT #4 ACTIVE HIGH	1541								
12	LOGIC INPUT #4 ACTIVE LOW	1540								
13	COURTESY TONE PORT #1 INPUT	5301	3800	5300						
14	COURTESY TONE PORT #2 INPUT	5301	3421	5300						
15										
16	SQUELCH TAIL MESSAGE	5201	3003	5200						
17	TRANSMITTER DROP MESSAGE	5201	3004	5200						
18	ID MESSAGE INITIAL	6120	5201	3201	5220					
19	ID MESSAGE PENDING	6120	5201	3202	5220					
20	ID MESSAGE FORCED	5301	3300							
21	ID MESSAGE FINIAL	6141	3001	6140						
22	TIMED MESSAGE #1	6141	3005	6140						

23	TIMED MESSAGE #2	6141	3006	6140						
24	DTMF ACCESS UP	6141	9650	9530	9875	6140				
25	DTMF ACCESS DOWN	6141	9650	9530	9324	6140				
26	PORT #2 RECEIVE ONLY	6141	3013	6140	7002					
27	PORT #2 CONNECT	6161	3012	7001	6160					
28	PORT #2 DISCONNECT	6161	3011	6160	7000					
29	PORT #2 AUTO DISCONNECT	6161	3014	6160	7000					
30	SCHEDULED MACRO 30									
31	SCHEDULED MACRO 31									
32	SCHEDULED MACRO 32									
33	SCHEDULED MACRO 33									
34	SCHEDULED MACRO 34									
35	SCHEDULED MACRO 35									
36	SCHEDULED MACRO 36									
37	SCHEDULED MACRO 37									
38	SCHEDULED MACRO 38									
39	SCHEDULED MACRO 39									
40	SCHEDULED MACRO 40									
41	SCHEDULED MACRO 41									
42	SCHEDULED MACRO 42									
43	SCHEDULED MACRO 43									
44	SCHEDULED MACRO 44									
45	SCHEDULED MACRO 45									
46	SCHEDULED MACRO 46									
47	SCHEDULED MACRO 47									
48	SCHEDULED MACRO 48									
49	SCHEDULER MACRO 49									
50	POWER UP	6141	9275	9002	9050	9999	6001	9101	9100	6140

Check Time of Day

Key-up and send [*20]. Un-key, the voice will read the time, day of week, day of month, month and year. Example: "THE TIME IS TWELVE FIFTEEN PM MONDAY MONTH THREE DAY OF MONTH TWENTY THREE YR THREE."

NOTE: Back-up power for the clock is supplied by a .47 farad capacitor. Once 12VDC is supplied to the CAT-250 three hours are required for the capacitor to reach full charge. During power failure the capacitor will power the clock for approximately six hours. During power up the CAT-250 will announce the time. If the scheduler is used it is advisable to provide an uninterruptible power source for CAT-250.

VOICE MESSAGE ASSIGNMENT NUMBER TABLE		
01	REPEATER ID #1 (AT REST)	"CAT-250 REPEATER"
02	REPEATER ID #2 (ACTIVE)	"CAT-250"
03	SQUELCH TAIL MESSAGE	"MESSAGE 3"
04	TRANSMITTER DROP MESSAGE	"MESSAGE 4"
05	TIMED MESSAGE #1	"MESSAGE 5"
06	TIMED MESSAGE #2	"MESSAGE 6"
07	REPEATER TIME OUT EXIT	"REPEATER TIME OUT EXIT"
08	REPEATER TIME OUT CLEAR	"REPEATER TIME OUT CLEAR"
09	TIME OF DAY MESSAGE	"THE TIME IS"
10	GRANDFATHER CLOCK MESSAGE	"CAT250 REPEATER THE TIME IS"
11	REMOTE BASE OFF	"REMOTE BASE OFF"
12	REMOTE BASE ON	"REMOTE BASE ON"
13	REMOTE BASE RECEIVE ONLY	"REMOTE BASE RECEIVE"
14	REMOTE BASE AUTO CLEAR	"REMOTE BASE CLEAR"
15	MESSAGE 15	"MESSAGE 15"
16	MESSAGE 16	"MESSAGE 16"
17	MESSAGE 17	"MESSAGE 17"
18	MESSAGE 18	"MESSAGE 18"
19	MESSAGE 19	"MESSAGE 19"
20	MESSAGE 20	"MESSAGE 20"

Erase Synthesized Voice Message [*3201]-[*3220]

Key-up and send [*32XX]. Un-key and the voice will say: "CONTROL OK." The voice ID will be erased.

CW ID Memory Storage

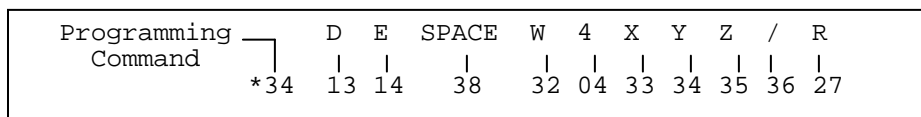
Memory space is provided for a CW identification. The buffer will accept 15 characters. During initialization, the CW buffer is loaded with "CAT200/R."

Send CW Identification [*33]

Key-up and send [*33]. Un-key and the CAT-250 will send the CW ID.

Program CW Identification [*34]

Key-up and send [*34], followed by the two digit numbers that represents the call letter identification. Memory space is provided for (15) entries. Refer to the CW ID programming table. Example: Load CW ID memory buffer with DE W4XYZ/R.



00=0	07=7	14=E	21=L	28=S	35=Z	42=[?]
01=1	08=8	15=F	22=M	29=T	36=/	43=[-]
02=2	09=9	16=G	23=N	30=U	37=AR	44=(
03=3	10=A	17=H	24=O	31=V	38=SPACE	45=SK
04=4	11=B	18=I	25=P	32=W	39=[.]	
05=5	12=C	19=J	26=Q	33=X	40=[;]	
06=6	13=D	20=K	27=R	34=Y	41=[:]	

Erase CW Identification [*35]

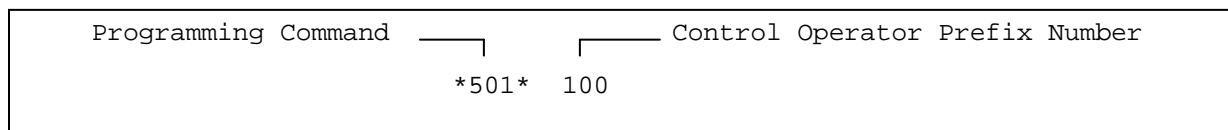
Key-up and send [*35]. Un-key and the voice will say: "CONTROL OK." If the CW ID buffer is empty and a repeater user keys-up during a voice ID, the voice ID will stop.

Control Code And Prefix Number Memory

This memory area is reserved for storage of control and prefix numbers. These numbers can be from one to seven digits and will change to a default value when the CAT-250 is powered up with dip-switch #7 set to the on position.

Control Operator Prefix Number Port #1 (Repeater) [*501*]

This programming command selects the control operator prefix number for the repeater port. This number must precede the command to change the zone control channels. Example: To program a Control Operator Prefix of [100], key-up and send:



Un-key, the voice will say: "CONTROL OK." The default number is [100].

Control Operator Prefix Number Port #2 (Link) [*502*]

This programming command selects the control operator prefix number for the link port. This number must precede the command to change the zone control channels through port #2 the link input. Example: To program a Control Operator Prefix of [200], key-up and send and send [*502*200].

DTMF Access Code [*503*]

This programming command selects the DTMF access prefix number. When the repeater is in the DTMF Access Mode it will not respond to a COR input. The repeater user must enter the DTMF access number to activate the repeater. When the repeater returns to rest for a period determined by the sleep timer, this number must be re-entered to activate the repeater. The default number is [325].

DTMF Pad Test Number [*504*]

This programming command selects the DTMF pad test prefix number. This number must be entered to initiate a DTMF keypad test. Example: To program a DTMF Pad Test Number of 375, key-up and send [*504*375]. Un-key and the voice will say: "CONTROL OK."

Port #2 Link Disconnect Control Number [*505*]

This number is used to disconnect the link. Example: To program a link disconnect control number of 5000, key-up and send [*505*5000]. Un-key and the voice will say: "CONTROL OK."

Port #2 Link Connect Control Number [*506*]

This number is used to connect the link. Example: To program a link connect control number of 5001, key-up and send [*506*5001]. Un-key and the voice will say: "CONTROL OK."

Port #2 Link Receive Only Control Number [*507*]

This number is used to activate the link receive only mode. Example: To program a link receive only control number of 5002, key-up and send [*507*5002]. Un-key and the voice will say: "CONTROL OK."

Voice Demonstration Control Number [*508*]

This number must be entered to PLAY one of the voice messages. This number must precede the voice message number. Example: To program a Voice Demonstration Control Number of 700, key-up and send [*508*700]. Un-key and the voice will say: "CONTROL OK."

Time of Day Number [*509*]

This programming command selects the time request number. This number must be entered to request a time of day announcement. The default number is [400].

Unlock Number [*510*]

This programming command selects the unlock number used to place the CAT-250 in the programming mode. This number is not restricted to a seven-digit number. The default number is [7654321].

Read Control And Prefix Numbers [*501 - *510]

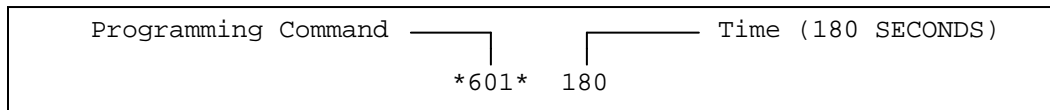
Use this programming command to read the control operator and prefix numbers. Example: Key-up and enter [*501], un-key and the voice will say: "CODE FIVE ZERO ONE IS ONE ZERO ZERO."

Timer Memory

This memory area is reserved for storage of [16] timers. These timers are user programmable. When the CAT-250 is initialized, these timers are automatically loaded with default values.

Port #1 Timeout [*601*]

This timer limits the Port #1 transmission length. This timer is programmable between 60 and 1799 seconds. Example: To program the timer for 3 minutes, key-up and enter [*601*180]. Un-key and the voice will say: "CONTROL OK." When initialize, this timer defaults to 180 seconds.



Port #2 Timeout [*602*]

This timer limits the Port #2 transmission length. This timer is programmable between 60 and 1799 seconds. Example: To program the timer for 3 minutes, key-up and enter [*602*180]. Un-key and the voice will say: "CONTROL OK." When initialize, this timer defaults to 180 seconds.

System ID Timer [*603*]

This timer sets the time between transmissions of the repeater ID. The ID occurs when a repeater user stops transmitting. This timer is programmable between 60 and 1799 seconds. The timer default is 480 seconds.

System Pending ID Timer [*604*]

The CAT-250 waits until the input is clear before generating a voice ID. If the System ID Timer expires and the input is still not clear, the CAT-250 will wait an additional period of time before a forced ID is sent. This timer sets the length of this period. This timer is programmable between 60 and 1799 seconds. The timer default is 120 seconds.

CRT and Programming Length Timer [*605*]

During the programming mode, this timer determines the maximum time the controller remains unlocked. This timer is programmable between 60 and 1799 seconds. When initialize, this timer will default to 600 second.

DTMF Access Sleep Timer [*606*]

This timer determines the time required for the repeater to be at rest before the DTMF access code is required to activate the repeater. This timer is programmable between 60 and 1799 seconds. The timer default is 60 seconds.

Link Auto Disconnect Timer [*607*]

During link operation if Zone 2 channel 6 is enabled the link will disconnect automatically after a period inactivity. This timer is programmable between 60 and 1799 seconds. The timer default is 600 seconds.

Timed Message #1 Timer [*608*]

This timer sets the timed message repeat period. This timer is programmable between 60 and 1799 seconds. The timer default is 1799 seconds.

Timed Message #2 Timer [*609*]

This timer sets the timed message repeat period. This timer is programmable between 60 and 1799 seconds. The timer default is 1799 seconds.

Squelch Tail Message Timer [*610*]

This timer sets the time between transmissions of the squelch tail message. The message occurs when a repeater user stops transmitting. This timer is programmable between 60 and 1799 seconds. The timer default is 1799 seconds.

Drop Out Message Timer *611*]

This timer sets the time between transmissions of the drop out message. The message occurs when a repeater stops transmitting. This timer is programmable between 60 and 1799 seconds. The timer default is 1799 seconds.

Fan Control Timer *612*]

When Zone 7 Channel 1 is enabled, user output switch #6 becomes a Fan Control output. When PTT #1 turns ON, User Output #6 (J2 pin 8) will turn ON. After PTT #1 turns OFF this output will remain ON for an additional period of time determined by the [*612*] Fan Control timer. This timer is programmable between 60 and 1799 seconds. The timer default is 60 seconds.

COR Drop to Courtesy Beep Timer [*621*]

This timer determines the time between loss of COR and the generation of the courtesy beep. This timer is programmable between 0.1 and 9.9 seconds. When initialize, this timer defaults to 1 second. Example: To program the timer for 2.5 seconds, key-up and enter [*621*25].

Courtesy Beep to PTT Drop Timer [*622*]

This timer determines the time between the generation of the courtesy beep and the time the repeater transmitter turns off. This timer is programmable between 0.1 and 9.9 seconds. The timer default is 4 seconds.

Pre-Voice Delay Timer [*623*]

This timer determines the time after PTT goes active and the voice synthesizer begins to speak. This timer is programmable between 0.1 and 9.9 seconds. The timer default is 0.5 seconds.

Turn on Delay Timer [*624*]

When the repeater is at rest, this timer sets the time COR must be present before the repeater will activate. This timer is programmable between 0.1 and 9.9 seconds. Example: To program this timer to 1.5 seconds, key-up and enter [*624*15]. Un-key and the voice will say: "CONTROL OK." When initialize this timer will default to 1.0 seconds. This timer also sets the turn on delay time for the Port #2 input.

DTMF Muting Timer [*625*]

This timer determines the time the transmit audio will continue to be muted after the entry of the last DTMF tone. When initialize, this timer defaults to 1 second.

CTSCC Encoder Timer [*626*]

This timer determines the time the CTCSS Encoder Logic remains on after Port #1 goes inactive. When initialize, this timer defaults to 4 second.

Read Timer Settings [*601-*665]

Key-up and send [*601]. Un-key and the voice synthesizer will read back the setting of the repeater's time-out timer. The voice will say: "TIMER 60 IS THREE MINUTES."

Audio Test Tone [*901-*902-*903]

The CAT-250 will generate a 1000Hz test tone. Use this tone as a reference when setting audio levels. To activate the tone, as TX1 audio, key-up and enter [*901]. To activate the tone, as TX2 audio, key-up and enter [*902]. To activate the tone, as TX1 and TX2 audio, key-up and enter [*903].

Courtesy Tone

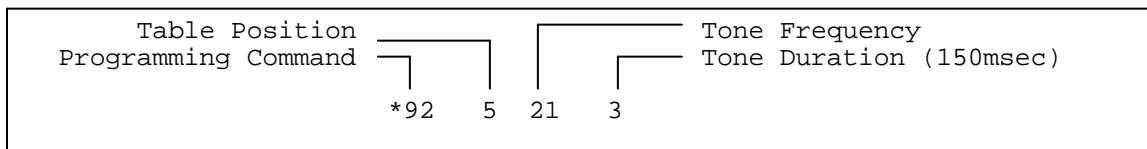
Memory space is provided for [8] custom courtesy tones. Each tone can consist of up to three different tone frequencies of various lengths and separations.

Send Courtesy Tone (1-8)

Key-up and send [*91X]. Un-key and the CAT-250 will transmit the courtesy tone. "X" represents the courtesy tone table location.

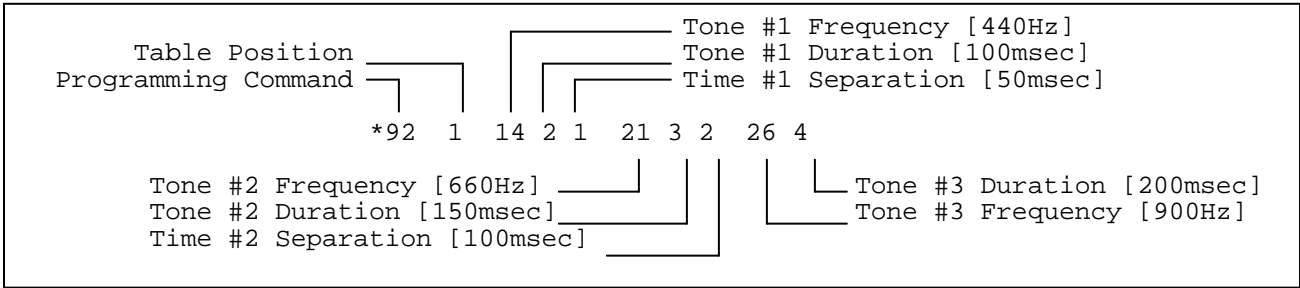
Program Courtesy Tone (1-8)

Key-up and send [*92X], followed by the frequency, duration and separation numbers from the courtesy tone table. This programming command is used to develop eight custom courtesy tones 151 through 158. The tone created with the [*925] programming command is identified as tone "155". Example: Program courtesy tone table location 5 with a tone of 660Hz and duration of 150msec.



TONE FREQUENCY TABLE						
01=207Hz	06=277Hz	11=370Hz	16=493Hz	21=660Hz	26=880Hz	31=1174Hz
02=220Hz	07=293Hz	12=392Hz	17=523Hz	22=698Hz	27=932Hz	32=1244Hz
03=233Hz	08=311Hz	13=415Hz	18=554Hz	23=740Hz	28=987Hz	
04=246Hz	09=330Hz	14=440Hz	19=587Hz	24=784Hz	29=1046Hz	
05=261Hz	10=349Hz	15=466Hz	20=622Hz	25=830Hz	30=1108Hz	
TONE TIMING (milliseconds)						
0=0	1=50	2=100	3=150	4=200		
5=250	6=300	7=350	8=400	9=450		

To program a multiple courtesy tone, key-up and send [*92X], followed by the desired tone frequency, duration and separation numbers. Example: Program courtesy tone table location 1 with a three-frequency tone.



Erase Courtesy Tone (1-8)

Key-up and send [*93X]. Un-key and the voice will say: "CONTROL OK."

Exit Programming Mode [*0]

To exit the programming mode and return to normal repeater operation, key-up and send [*0]. Un-key and the voice will say: "CONTROL EXIT." If you fail to exit the programming mode, the CAT-250 will exit the programming mode when the [*605*] timer expires. The CAT-250 will return to normal operation. The voice will say: TIMER EXIT."

DTMF Programming Commands

ENTRY	DESCRIPTION	DEFAULT
*10XX	READ SCHEDULER EVENT TIME (30-49)	
*11XX	PROGRAM SCHEDULER EVENT TIME (30-49)	
*12XX	ERASE SCHEDULER EVENT TIME (30-49)	
*13XX	READ USER MACRO COMMAND (01-40)	
*14XX	PROGRAM USER MACRO COMMAND (01-40)	
*15XX	ERASE USER MACRO COMMAND (01-40)	
*16XX	READ EVENT MACRO COMMAND (01-50)	
*17XX	PROGRAM EVENT MACRO COMMAND (01-50)	
*18XX	ERASE EVENT MACRO COMMAND (01-50)	
*20	SEND TIME OF DAY	
*21	PROGRAM CLOCK LONG TIME OF DAY (All Clock Parameters Including Year)	
*22	PROGRAM CLOCK SHORT TIME OF DAY (Hours and Minutes only)	
*29	READ FORCED ENTRY KEY	
*29X	PROGRAM FORCED ENTRY KEY	D
*30XX	PLAY VOICE MESSAGE (1-20)	
*31XX	PROGRAM VOICE MESSAGE (1-20)	
*32XX	ERASE VOICE MESSAGE (1-20)	
*33	SEND CW IDENTIFICATION	
*34	PROGRAM CW IDENTIFICATION	
*35	ERASE CW IDENTIFICATION	
*36XX	SET CW TONE FREQUENCY (01-32)	25
*37X	SET CW SPEED (1-5) (1=10 2=15 3=20 4=25 5=30WPM)	3
*38XX	SET MUTING TONE FREQUENCY (01 - 32)	20
501	PROGRAM CONTROL OPERATOR NUMBER PORT #1 (REPEATER)	100
502	PROGRAM CONTROL OPERATOR NUMBER PORT #2 (LINK)	200
503	PROGRAM DTMF ACCESS NUMBER	325
504	PROGRAM DTMF PAD TEST NUMBER	375
505	PORT #2 DISCONNECT CODE	5000
506	PORT #2 CONNECT CODE	5001
507	PORT #2 RECEIVE ONLY CODE	5002
508	PLAY VOICE MESSAGE DEMO CODE	700

509	TIME OF DAY MESSAGE CODE	400
510	UNLOCK NUMBER #2 (NOT RESTRICTED TO A 7 DIGIT CODE LENGTH)	7654321
601	PORT #1 TIME-OUT TIMER (60 - 1799 SECONDS)	180
602	PORT #2 TIME-OUT TIMER (60 - 1799 SECONDS)	180
603	SYSTEM ID TIMER (60 - 1799 SECONDS)	600
604	SYSTEM PENDING ID TIMER (60 - 1799 SECONDS)	120
605	PROGRAMMING LENGTH TIMER & CRT TIMEOUT (60 - 1799 SECONDS)	600
606	PROGRAM DTMF ACCESS SLEEP TIMER (60 - 1799 SECONDS)	60
607	PROGRAM LINK AUTO DISCONNECT TIMER (60 - 1799 SECONDS)	600
608	TIMED MESSAGE #1 TIMER (60 - 1799 SECONDS)	1799
609	TIMED MESSAGE #2 TIMER (60 - 1799 SECONDS)	1799
610	SQUELCH TAIL MESSAGE TIMER (60 - 1799 SECONDS)	1799
611	DROP OUT MESSAGE TIMER (60 - 1799 SECONDS)	1799
612	FAN CONTROL TIMER	60
621	COR DROP TO COURTESY BEEP TIMER (0.1 - 9.9 SECONDS)	1.0
622	COURTESY BEEP TO PTT DROP TIMER (0.1 - 9.9 SECONDS)	4.0
623	PRE-VOICE DELAY TIMER (0.1 - 9.9 SECONDS)	0.5
624	TURN-ON DELAY TIMER (0.1 - 9.9 SECONDS)	1.0
625	DTMF MUTING TIMER (0.1 - 9.9 SECONDS)	1.0
626	CTCSS ENCODER TIMER (0.1 - 9.9 SECONDS)	4.0
*901	TRANSMIT AUDIO TEST TONE PORT #1 (REPEATER)	
*902	TRANSMIT AUDIO TEST TONE PORT #2 (LINK)	
*903	TRANSMIT AUDIO TEST TONE PORT #1 AND PORT #2	
*91X	READ COURTESY TONE (1-8)	
*92X	PROGRAM COURTESY TONE (1-8)	
*93X	ERASE COURTESY TONE (1-8)	
*0	MANUAL EXIT OF PROGRAMMING MODE	

Chapter 6 – Interfacing to Other Equipment

Interfacing the CAT-250 to your repeater system is a simple matter. A minimum of two inputs and two outputs are required for the CAT-250 to control a repeater. They are:

1. A COR signal to indicate when a signal is being received.
2. A receive audio signal containing DTMF tones to be processed for control.
3. A Push-To-Talk signal to tell the repeater transmitter to turn ON.
4. A transmit audio signal containing a combination of receive audio, synthesized voice, and courtesy tone.

Additional connections are required to realize all features of the CAT-250.

Determining COR Logic

Locate your repeater receiver's COR output. This line has a DC voltage that changes state when a signal is being received. If the COR line is 0 volts and goes to a positive voltage when a signal is received it is said to be (positive logic) or active HIGH. If the COR line is a positive voltage, and goes to 0 volts when a signal is received it is said to be (negative logic) or active LOW. Note: 0 volts is any voltage less than 0.8VDC. A positive voltage is any voltage greater than 3.0VDC. Set dipswitch #1 on the CAT-250 to ON for (negative logic) and OFF for (positive logic).

Connection to Receiver

Connect the repeater receiver audio output to J2-13 and the COR to J2-6 of the CAT-250. Verify this line changes from less than 0.8VDC to greater than 3.0 VDC. If the COR line will not meet these limits it may be necessary to add a pull-up resistor to the COR #1 line. This may also be true for the COR #2 input. Space is provided on the CAT-250 board to add pull-up resistors.

Connection to Transmitter

Locate your repeater's Push-To-Talk input. When grounded, this line will make the repeater transmit. Connect the CAT-250 PTT #1 output (J2-10) to this line. Locate your repeater's TX audio input. This is the line where the audio signal used to modulate the transmitter is applied. Connect the TX1 AUDIO (J2-11) to this line.

Connection to CTCSS Decoder

If your repeater receiver has a CTCSS decoder output, connect it to J2-4. In addition to COR, the CAT-250 requires an active high input to represent a CTCSS input. If the CTCSS input is active low set dipswitch #2 on.

Interface Review

1. Are dipswitches #1 through #8 in their proper positions?
2. Is the PTT-1 output at J2-10 connected to the transmitter PTT input?
3. Is the TX1 Audio at J2-11 connected to the transmitter audio input?
4. Is the COR-1 at J2-6 connected to the repeater receiver COR output?
5. Is dipswitch #1 ON for active low COR or OFF for active high COR?
6. Is the COR level changing from less than 0.8 VDC to greater than 3.0 VDC?
7. Is the RX1 AUDIO at J2-13 connected to the receiver audio output?
8. Is the audio input level sufficient for the DTMF decoder?

Connector Kit

Included with the controller is a connector kit containing a 25 pin "D" connector to mate with J2, a 2.5mm power plug to mate with J3 (center pin is [+]), and two 2200 ohm resistors. If the COR inputs are active low, you may need to install the 2200 ohm resistors as pull-ups on the board at the R10 and R11 positions. If the receiver's COR circuit is not capable of pulling down the 2200 ohm resistor you may increase the value up to 10K ohms.

Power Supply

The CAT-250 is powered by an external 12VDC power supply. Connect the positive lead of the supply to the center pin of the coaxial power connector J3 and the negative lead to the outer conductor.

Audio De-Emphasis Jumpers (J8-J9)

If the controller is supplied with discriminator audio it is necessary to de-emphasize the audio. With the jumpers installed on J8 (Port #1) and J9 (Port #2), C32 and C33 will be connected across the feedback resistors of the receiver audio amplifiers. This will lower the gain at the higher frequencies and produce the necessary de-emphasis. If de-emphasize audio is supplied to the controller these jumpers should be removed.

Audio Level Adjustment

The audio mixing-switching circuits of the CAT-250 are optimized around an input and output of -10dBm (220mV).

Connect a signal generator to the repeater's receiver input. Adjust the signal generator's output for a standard test signal of 1000 Hz at 3 KHz deviation. If a signal generator is not available, select a handi-talkie that you suspect has the DTMF tone pad adjusted for approximately 3 KHz deviation.

Key-up on the repeater input and send a DTMF tone. Adjust the RX1 control R25 for 220mVAC at TP5. If a link transceiver is connected to the CAT-250, key-up and send the LINK enable command [5001]. Key-up on the LINK receiver input and send a DTMF tone. Adjust RX2 control R26 for 220mVAC at TP6.

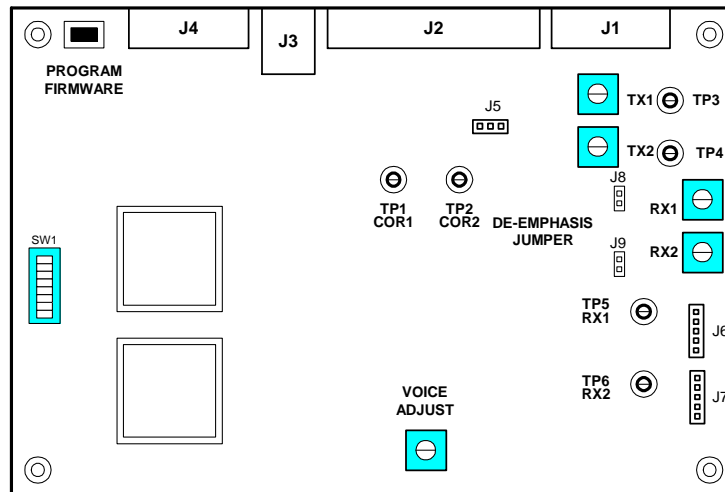


Figure 6-1

Once the RX1, and RX2 audios are adjusted, key-up on the repeater input and send a DTMF tone. Monitor the REPEATER transmitter. Adjust the TX1 Audio level control (R15) as required to set the repeater transmitter deviation to 3 KHz or as desired. If the repeaters transmit audio input is very sensitive and you find the TX1 Audio level control near minimum, it is strongly recommended that an external voltage divider be installed at the audio input of the repeater's transmitter.

If a link transceiver is connected, key-up on the repeater input and send a DTMF tone. Monitor the LINK transmitter. Adjust the TX2 Audio level control (R16) as required to set the link transmitter deviation to 3 KHz or as desired. If the link-transmit audio input is very sensitive and you find the TX2 Audio level control is near minimum, set the jumper plug at J5 between pins 1 and 2.

Compare the receive and synthesized voice audio and adjust the voice Level (R30) as desired. The synthesized voice should be slightly lower than the receive audio.

Unlock the CAT-250 by keying-up on the repeater input and entering: [1234567]. Key-up and enter the [*901] test tone programming command. Verify that the test tone provides approximately 1.5 KHz transmitter deviation. Key-up and enter [*0] to exit the programming mode.

Repeater and Link Interface (J2)

Connector J2 provides an interface to the repeater and transceiver.

1	LOGIC INPUT #1	14	SWITCH #1
2	LOGIC INPUT #2	15	SWITCH #2
3	CTCSS #2	16	+12VDC OUTPUT
4	CTCSS #1	17	GROUND
5	COR #2	18	GROUND
6	COR #1	19	SWITCH #3
7	SWITCH #5	20	SWITCH #4
8	SWITCH #6	21	LOGIC INPUT #3
9	PTT #2	22	LOGIC INPUT #4
10	PTT #1	23	TX AUDIO #2
11	TX AUDIO #1	24	RESERVED
12	RX AUDIO #2	25	GROUND
13	RX AUDIO #1		

Figure 6-2

Link Interface (J1)

Connector J1 provides an alternate interface between Port #2 of the CAT-250 and the Link transceiver. This permits the use of independent cables between the repeater and link transceiver.

1	COR #2	6	RESERVED
2	CTCSS #2	7	RESERVED
3	PTT #2	8	GROUND
4	TX AUDIO #2	9	+12VDC OUTPUT
5	RX AUDIO #2		

Figure 6-3

CTCSS Decoder

Connect the TS-64WDS CTCSS Encoder/Decoder assembly to the CAT-250 as described in Figure 6-4. The decoder must be connected to discriminator audio. Speaker or volume control audio will have insufficient low frequency CTCSS tone content.

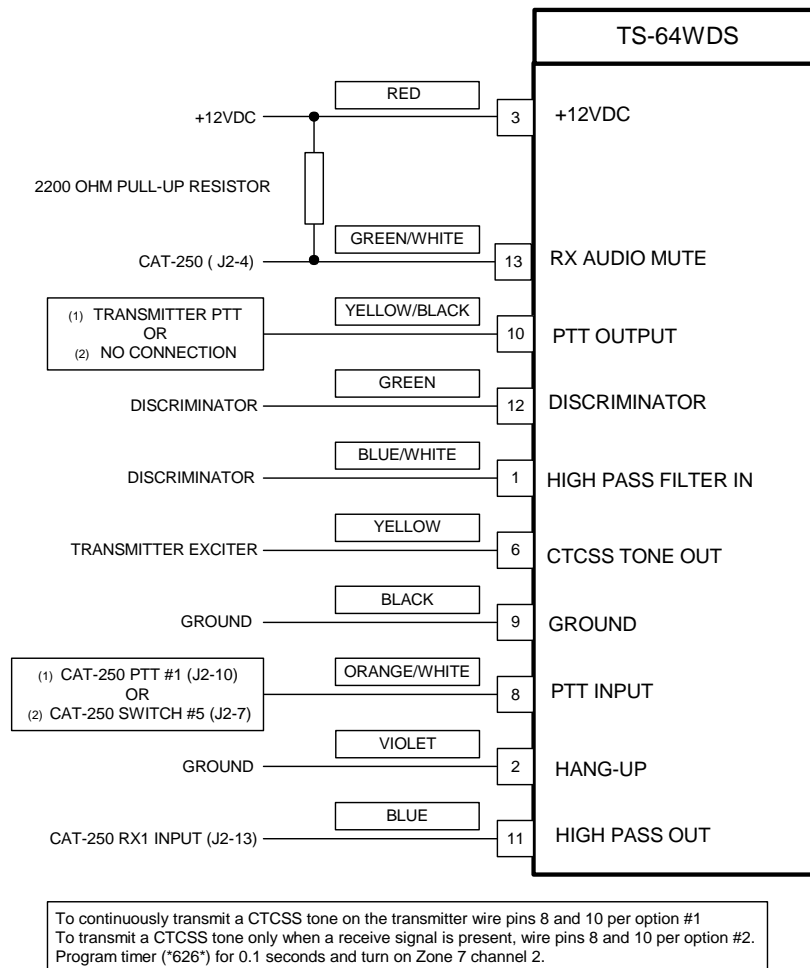


Figure 6-4

Chapter 7 – RS-232 Computer Interface

Connect your computer's COMM port to the CAT-250 at J4 as described in Figure 7-1.

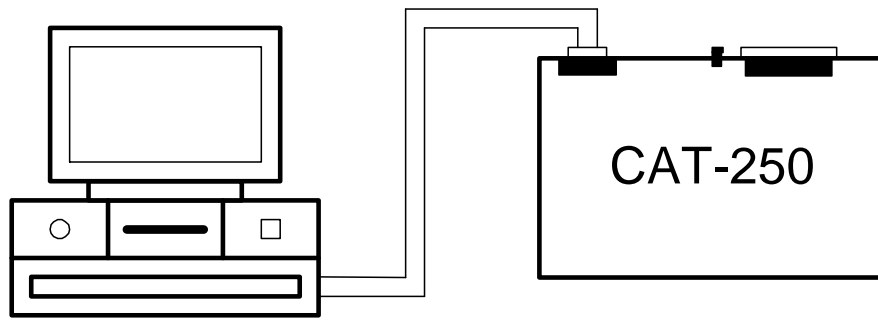
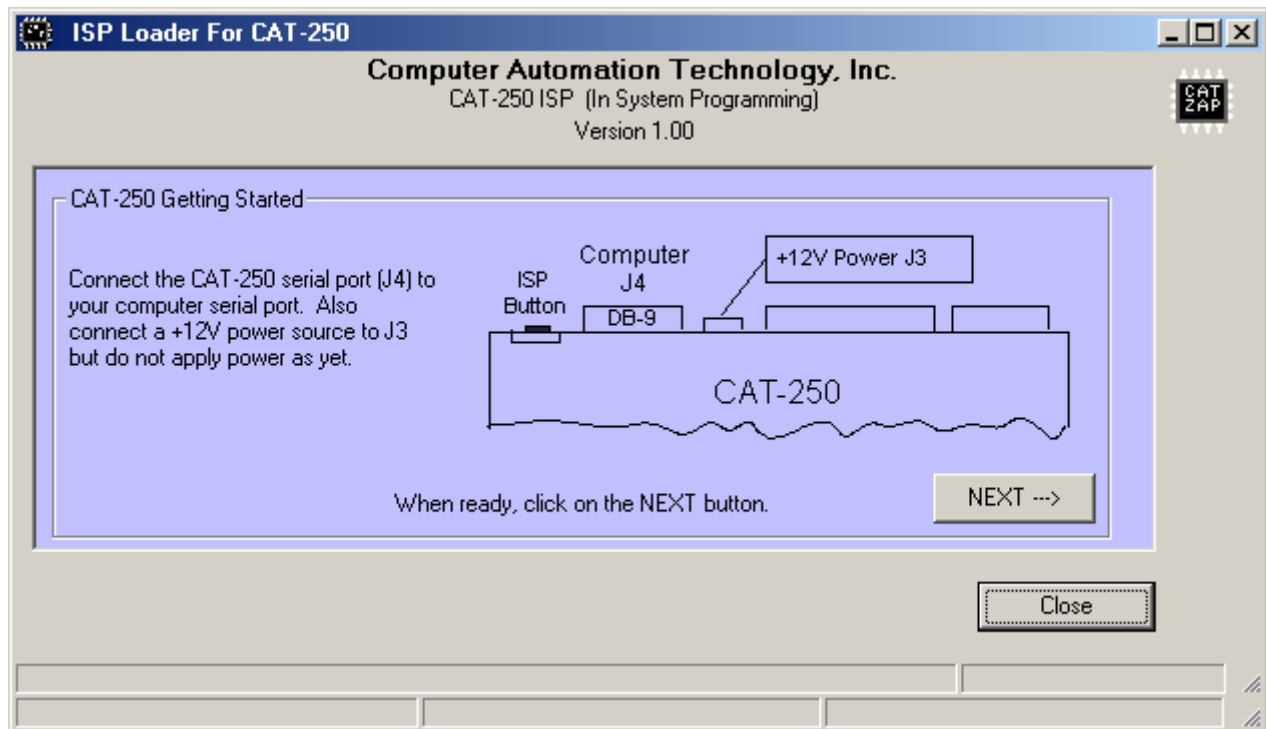


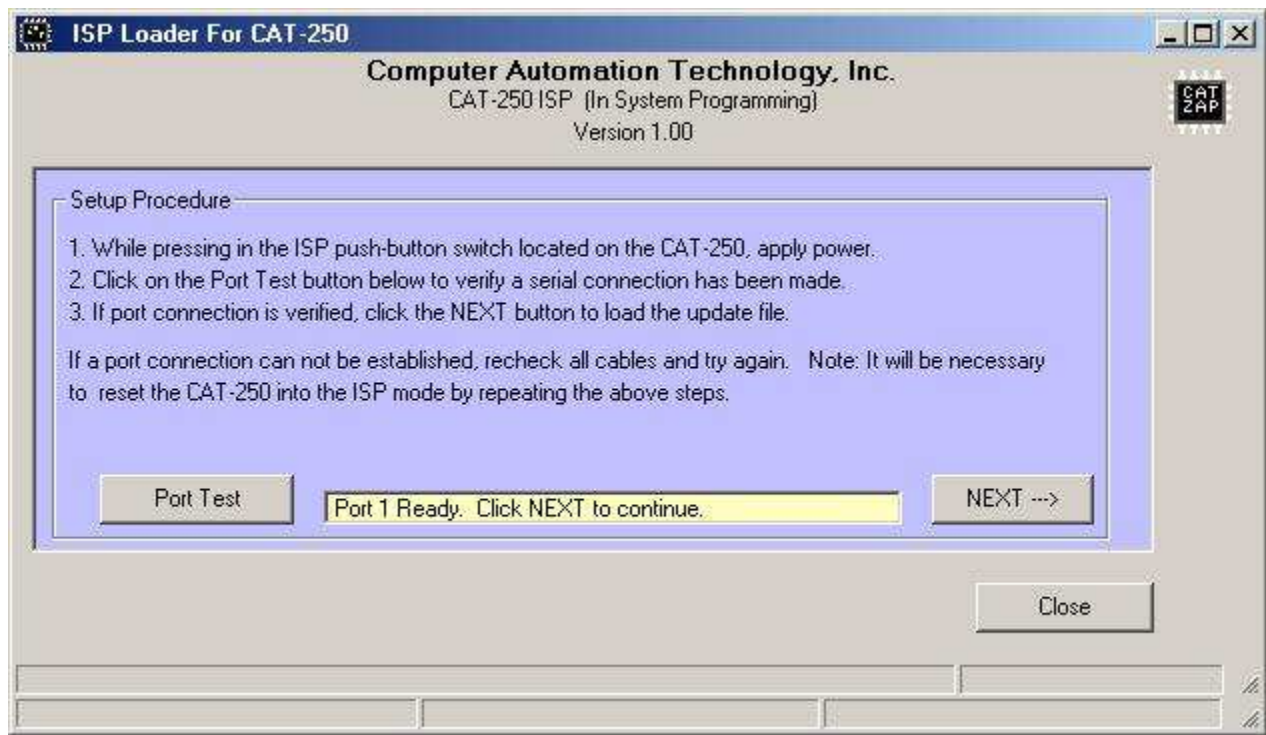
Figure 7-1

ISP Loader For CAT-250

Use the ISP Loader to upload the latest firmware version of the CAT-250 controller available at the www.catauto.com web site. Under **RESOURCES**, select **FIRMWARE UPDATES** and then **CAT-250** and the latest version. Follow the procedure described in the "CAT-250 Firmware Download Instructions".

Start the ISP Loader program to display the "**ISP Loader For CAT-250**" window. Follow the directions described in the window.





Turn on dipswitch #7 and cycle power or there will not be any PTT.

ED-250W Windows Editor

Start the windows editor program to display the "CAT-250 Repeater Controller Editor" window.

Activation Of The RS-232 Port With Dipswitch #8

To activate the RS-232 port, set the DC power to OFF. Set dipswitch #8 to ON. Turn the DC power to ON.

Activation Of The RS-232 Port By Radio

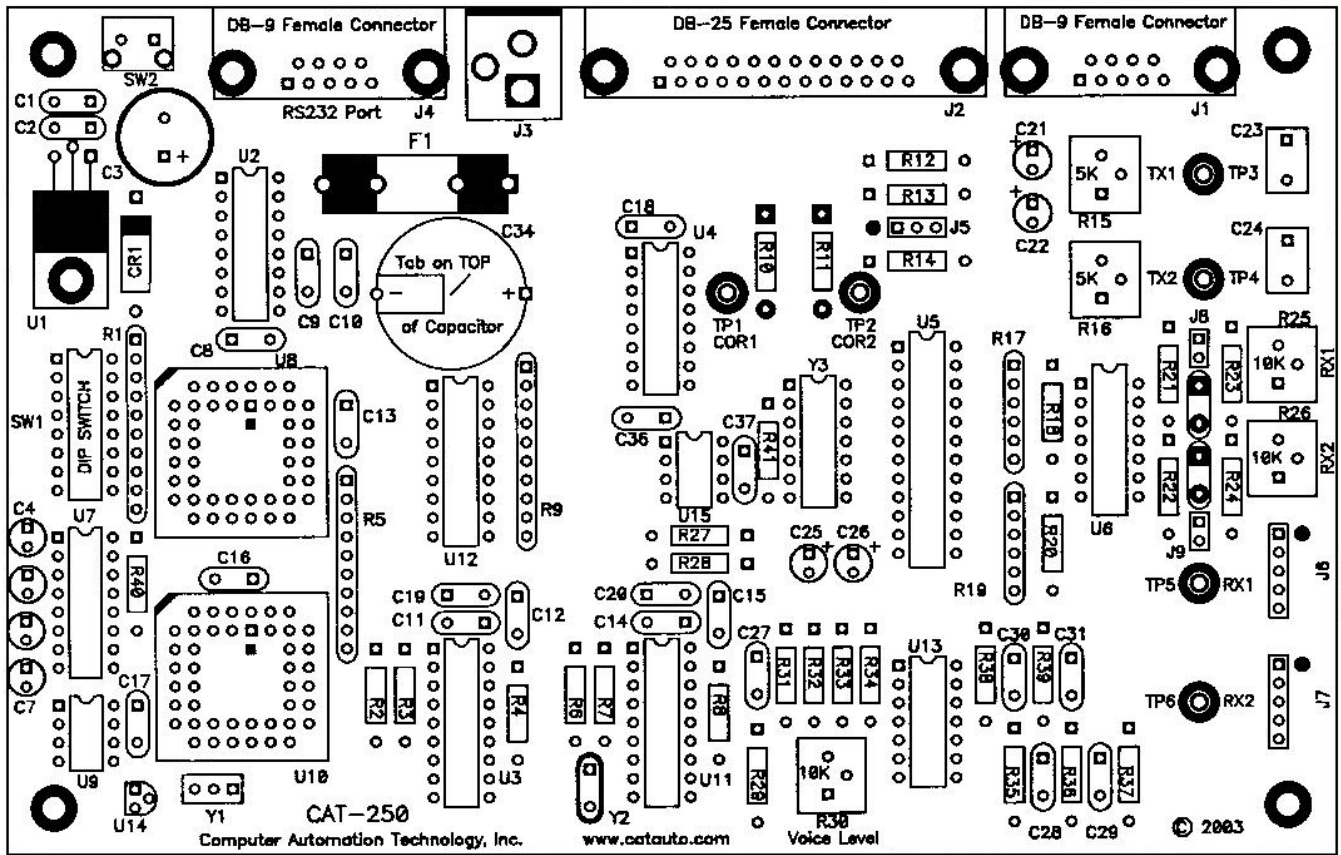
To activate the RS-232 port, key-up into Port #1 and enter the control operator prefix code [100] followed by [97]. The voice synthesizer will say: "CONNECT" and the transmitter will drop.

Chapter 8 - Voice Vocabulary

Zero	000	Change	279	Hour	454
One	001	Charlie	280	Hours	455
Two	002	Check	281	I	470
Three	003	Clear	283	Ice	471
Four	004	Closed	285	Identify	473
Five	005	Club	286	In	475
Six	006	Code	287	India	477
Seven	007	Come	288	Information	478
Eight	008	Complete	289	Ing(suffix)	479
Nine	009	Condition	292	Inputs	480
Ten	010	Connect	294	Intruder	481
Eleven	011	Contact	295	Is	482
Twelve	012	Control	296	It	483
Thirteen	013	D	310	J	500
Fourteen	014	Danger	311	Juliet	502
Fifteen	015	Data	312	K	530
Sixteen	016	Date	313	Key	531
Seventeen	017	Day	314	Keypad	532
Eighteen	018	Days	315	Kilo	533
Nineteen	019	Decrease	317	L	550
Twenty	020	Delay	319	Last	552
Thirty	030	Delta	320	Left	554
Forty	040	Direction	322	Let	556
Fifty	050	Do	323	Lima	559
Sixty	060	Down	324	Link	561
Seventy	070	E	340	Low	568
Eighty	080	Echo	342	Lower	569
Ninety	090	Ed (suffix)	343	M	580
A	210	Emergency	344	Machine	581
Above	214	End	345	Macro	582
Again	221	Enter	346	Make	583
Alert	223	Error	348	Manual	585
All	224	Exit	350	Many	586
Alpha	225	F	370	Meeting	593
Amateur	228	Failure	372	Mega	594
An	230	Fast	374	Message	595
And	231	Feet	376	Meter	596
Area	235	For	004	Meters	597
As	236	Foxtrot	386	Mike	599
Assistance	237	Frequency	388	Miles	600
At	239	Friday	389	Minus	603
Attention	241	From	390	Minute	604
B	250	Full	392	Minutes	605
Band	252	G	410	Mobile	606
Base	253	Get	412	Monday	608
Beacon	254	Go	413	Month	609
Below	255	Golf	414	Move	611
Bravo	257	Good	415	N	620
By	260	H	440	Near	621
C	270	Ham	443	Net	623
Call	272	Hamfest	444	New	624
Calling	273	Have	445	Next	625
Cancel	274	Hertz	449	Night	626
Cat	275	High	450	No	627
Caution	276	Hotel	453	Normal	628

Not	630	Temperature	824	Zed	951
November	631	Test	826	Zone	953
Now	632	Than	827	Zulu	954
Number633		Thank-You	828	Pause	
O	650	That	829	Pause 1	960
Of	653	The(shortE)	830	Pause 2	961
Off	654	The(longE)	831	Pause 3	962
On	656	Then	832	Pause 4	963
Open	657	This	833	Time Variables	
Operator	659	This-is	834	Time of Day	100
Or	660	Thunderstorms	836	Day of Week	101
Oscar	662	Thursday	837		
Out	664	Time	838		
Over	665	Timer	839		
P	680	To	002		
Papa	682	Today	840		
Per	683	Tomorrow	841		
Plan	688	Tone	854		
Please	689	Tonight	842		
Plus	690	Tornado	843		
Point	691	Traffic	845		
Pound	694	Transceiver	853		
Power	695	Transmit	846		
Preset	697	Try	848		
Q	720	Tuesday	849		
Quebec	721	Turn	850		
R	730	U	870		
Radio	731	Uniform871			
Range	735	Unit	872		
Ready	737	Until	874		
Receive	738	Up	875		
Receiver	739	Use(noun)	876		
Remote	743	Use(verb)	877		
Repeater	746	V	880		
Reset	747	Victor	884		
Right	749	W	890		
Romeo	752	Wait	891		
S	770	Warning	892		
Saturday	772	Watch	893		
Seconds	774	Watts	894		
Sent	778	Weather	896		
Service	781	Wednesday	897		
Set	782	Week	898		
Severe	783	Welcome	900		
Sierra	788	What	903		
Snow	791	Whiskey	904		
Speed	793	Will	905		
Star	795	With	908		
Start	796	X	920		
Stop	797	X-Ray	921		
Storm	798	Y	930		
Sunday	799	Yankee	931		
System	801	Yes	934		
S (plural)	802	You	936		
T	820	Your	937		
Tango	821	Z	950		

Chapter 9 - Drawings



CAT-250 Repeater Controller
Figure 9-1

Chapter 10 - Schematic

Controller Board (CAT-250)

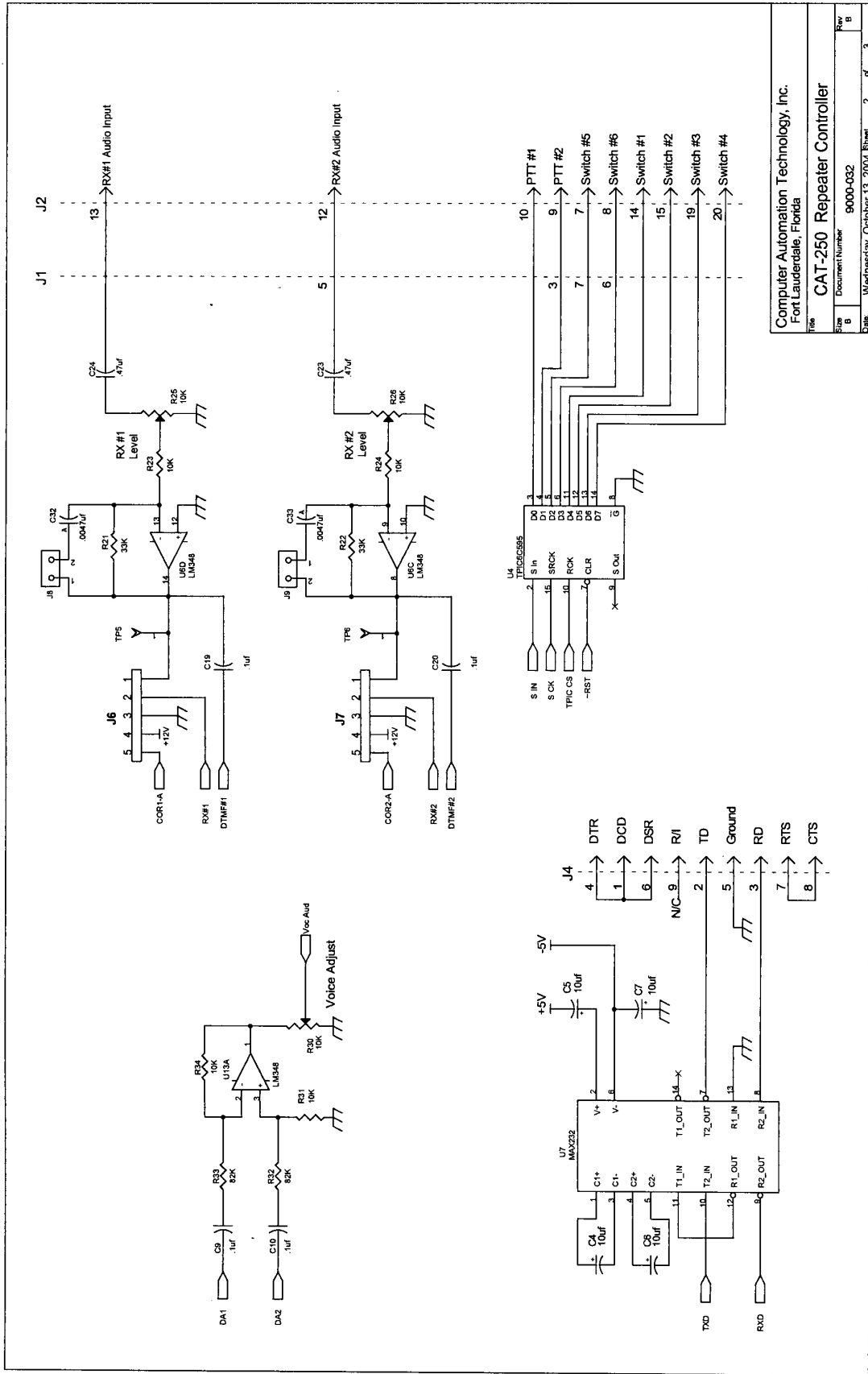
Controller Board (CAT-250)

Controller Board (CAT-250)

Sheet 1 of 3

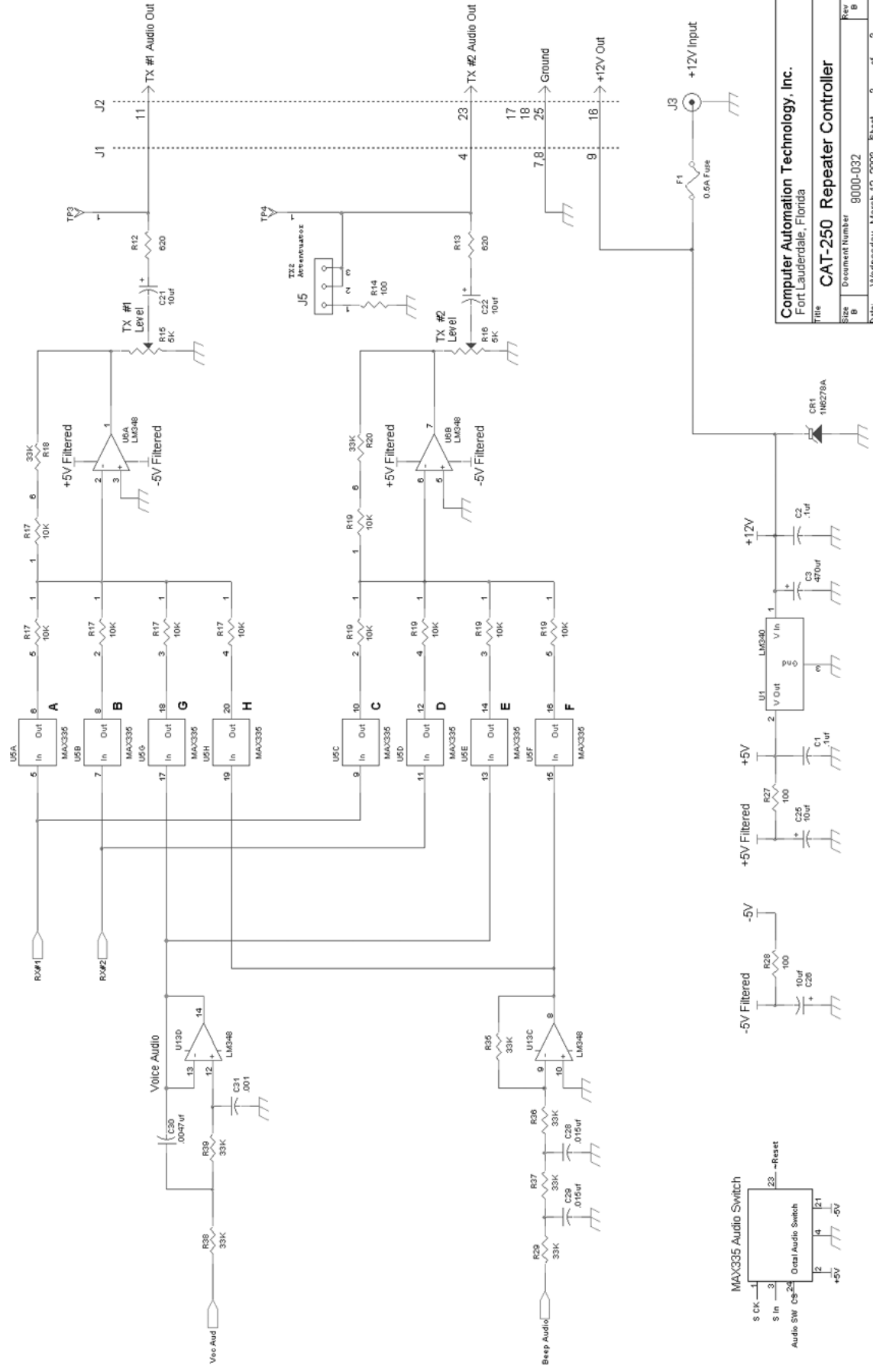
Sheet 2 of 3

Sheet 3 of 3



Computer Automation Technology, Inc.
Fort Lauderdale, Florida

File	CAT-250 Repeater Controller		
Rev	Document Number	9000-032	Rev B
Date	Wednesday, October 13, 2004	Sheet	7 of 3



Computer Automation Technology, Inc. Fort Lauderdale, Florida	
Title	CAT-250 Repeater Controller
Size B	Document Number 8000-032
Date	Wednesday, March 12, 2003 Sheet 3 of 3
Rev B	

Chapter 11 - Part List

1	Capacitor	100pf	C37
1	Capacitor	.001uf 50V	C31
4	Capacitor	.0047uf 50V	C27,C30,C32,C33
2	Capacitor	.015uf 50V	C28,C29
16	Capacitor	.1uf 50V	C1,C2,C8,C9,C10,C11,C12,C13,C14,C15,C16 C17,C18,C19,C20,C36
2	Capacitor	.47uf 50V	C23,C24
8	Capacitor	10uf 16V	C4,C5,C6,C7,C21,C22,C25,C26
1	Capacitor	470uf 50V	C3
1	Capacitor	.47 Farad – 5V	C34
2	Connector	DB9 Female	J1,J4
1	Connector	DB25 Female	J2
1	Connector	DC Power	J3
1	Connector	Header 1X3	J5
2	Connector	Header 1X5	J6,J7
1	Crystal	3.58 MHz	Y2
1	Fuse	0.5 Amp Fast	F1
1	I.C.	25C640	U9
1	I.C.	89C668HBA	U10
1	I.C.	ATF1502ASL	U8
1	I.C.	LM340-05	U1
2	I.C.	LM348	U6,U13
1	I.C.	MAX335	U5
1	I.C.	MAX232	U7
1	I.C.	MCP101	U14
1	I.C.	MSP53C391	U2
2	I.C.	MT8870D	U3,U11
1	I.C.	TPIC6C595	U4
1	I.C.	ULN2804	U12
3	Resistor	100 Ohm	R14,R27,R28
2	Resistor	620 Ohm	R12,R13
2	Resistor	5K Variable	R15,R16
3	Resistor	10K Variable	R25,R26,R30
5	Resistor	10K	R23,R24,R31,R34,R40
2	Resistor	10K 6 Pin SIP	R17,R19
3	Resistor	10K 10 Pin SIP	R1,R5,R9
1	Resistor	15K	R35
9	Resistor	33K	R18,R20,R21,R22,R29,R36,R37,R38,R39

3	Resistor	82K	R32,R33
4	Resistor	100K	R2,R3,R6,R7
2	Resistor	560K	R4,R8,R11
2	Resistor	User Option	R10,R11
1	Resonator	12 MHz	Y1
1	Switch	DIP SW 8	SW1
1	Switch	Push Button	SW2
6		Test Points	TP1,TP2,TP3,TP4,TP5,TP6
1	Transorb	1N6278A	CR1