

MRC-100

MICROPROCESSOR REPEATER CONTROLLER

Owners Manual

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The MRC-100 utilizes CMOS and NMOS integrated circuits, which can be damaged by static electricity. Be sure that you are properly and safely grounded, and are working at a static-free work station, when handling these ICs.



The MRC-100 utilizes a lithium battery to provide power to the memory system when the main power is lost. The lithium battery is a primary cell. **Do not attempt to recharge it!**

COMMANDS

• INTRODUCTION

Users and Control Operators communicate with the **MRC-100** controller by entering commands from a standard 12- or 16-button DTMF (Touch Tone [™]) pad. The controller responds by sending CW messages. Commands can be entered through the repeater, through a control receiver, or over the telephone.

• CONTROL COMMAND STRUCTURE

All control commands begin with a **password** to increase system security. Two different passwords may exist. The **master** password is used by the system supervisor or owner, and works with control commands. The **control operator** password works with only those control commands allowed by the supervisor. Both passwords have variable length and may be remotely changed.

A 2- or 4-digit **root number** follows the password and indicates the desired function to the controller. Additional **data** is required by certain commands to follow the root number. See the section titled **Security** for more information.

• AUTOPATCH ACCESS STRUCTURE

The command that accesses the autopatch begins with a password to increase security. The password length is variable, and may be remotely changed. The telephone number follows the **access password**.

• MACROS

A powerful feature of the controller is its **macro** capability. A string of commands may be stored in a macro, labeled with a **macro name**. By entering simply the macro name, the string of commands will be executed. This feature permits the building of a library of user commands, tailored to the specific needs of the organization. The short macro name is easier to enter than a long command, thus allowing "express telephone dialing" and other handy user commands. If control commands are stored in macros, then the commands can be executed over the air via macros without disclosing the password and other confidential information. See the section titled **Macros** for more information.

• DEFAULTS

Many commands are shown to have **default** conditions. These are the conditions that will exist after a **cold** start occurs. If the conditions are changed by programming, they will remain active through the **warm** starts. However, another **cold** start will force the controller to the default conditions.

COMMANDS

• ERROR MESSAGES

? **ERR 1** is a key stroke error, and indicates that the wrong number of digits were received for the command. If this message is received, the command was not executed. Look up the proper form and enter it again.

? **ERR 2** is an error in data, and indicates that the data received was not correct for that command. Examples include trying to set a timer to a value greater than that allowed, or programming a CW message with characters not found on the CW table. If this message is received, the command was not executed. Look up the proper form and enter it again.

? **RES** indicates a **warm** start.

? **RES C** indicates a **cold** start.

Many other message exist to help in troubleshooting faulty commands. These are listed with the commands.

• SPECIAL KEYS

The * key on the **DTMF** pad is always the last character of the command. This character is similar to the **carriage return** on a computer keyboard or the **equals** key on a calculator; it tells the system that the command string is complete. The repeater controller does not execute any string of **DTMF** digits until the the * character is received.

If more than **5** seconds elapses during a command entry with no **DTMF** digits received by the controller, it will abort the command. Any digits that follow will be considered part of a new command.

The # key on the **DTMF** pad is always used to abort the command. If an error is made during command entry, the # character may be used to clear the controller. The effect is the same as waiting **5** seconds, as described above. Any new digits that follow the # character will be considered part of a new command.

AUTOPATCH

• INTRODUCTION

The autopatch in your controller features **store-and-forward** operation. This means that the telephone number is stored in the controller, checked to see if it is an acceptable number, and then dialed out. As opposed to the **star up, pound down** autopatch, this controller never connects the phone line to the repeater and waits to see the digits entered. There are a number of advantages to the store-and-forward method:

- There is never a prolonged dial tone that results from someone accessing the autopatch, then not placing a call.
- The controller receives the digits, checks for accuracy, then regenerates them to the phone line. Therefore, noisy or inaccurate tones are not sent down the phone line.
- The controller is never placed in the position of waiting for a specific command; that is, there are no **modes** to become stuck in. Since each command is complete in itself, any command may be follow an autopatch access command. This includes a dump command, a re-dial command, a timer reset command, or a new access command.

A number of programmable features are supplied to allow you to customize autopatch operation to fit your needs.

AUTOPATCH

• ACCESS

COMMAND FORM

ACCESS (access password) (phone number) *

The autopatch is accessed by entering the Autopatch Access Password, followed by the telephone number, and the star (*) , all in one command. The access password may be any 2,4, or 6 digits. See **Access Password**. The phone number may contain special-purpose digits (B,C, and D). **Maximum phone number = 35 digits.**

Acknowledgment: Sends the **Dialing Message**

Errors:

OFF = Autopatch is fully **OFF**
? REJ = rejected number
? ERR = not allowed by **Call Type Table**
BZ = Land line is busy (shared land line systems)

EXAMPLES:

Assume that the access password is **10**, and that the number you wish to dial is 456-7890. To access the autopatch, enter:

10 4567890 *

When the above number is entered the controller will screen the telephone number (see the **Call Type** and **Restrictions** sections). If the number is acceptable, the controller will send the **Dialing Message**, and dial the number. If the number is not acceptable, one of the error messages will be sent.

Three special-purpose digits are available:

B = pause for 5 seconds
C = continue dialing in pulse mode
D = continue dialing in DTMF mode

A 16-button DTMF pad is needed, unless the access is stored in a macro; then the whole sequence may be defined using a 16-button pad, but actually dialed by entering a macro.

AUTOPATCH

• ACCESS (continued)

EXAMPLES (continued)

As you can see, the lettered keys are useful for instructing the controller in how to dial the number. The lettered keys are not themselves used as dialed digits. The call screening process ignores the lettered keys, so you may place **Bs**, **Cs**, and **Ds** in a number and still have it properly screened for restrictions. To allow **mixed-mode** dialing (pulse and DTMF) with the C and D keys, the proper **Dialing Option** must be selected.

The **B** key will cause a 5-second delay in the dialing process. This feature is useful when accessing systems that have a second dial tone.

The **C** key will cause all subsequent digits to be dialed in pulse (rotary dialing).

The **D** key will cause all subsequent digits to be dialed in the DTMF mode (Touch-Tone™).

When the dialing is complete, the controller will assume that the next call will be placed using the dialing mode specified by the **Dialing Mode** command. In other words, the **C** and **D** keys have temporary effect; all calls are dialed using the **Dialing Mode** specified, unless changed temporarily by the **C** or **D** keys.

Let's assume that a credit card call is placed by entering the number you wish to call, a pause for dial tone, and your credit card number:

0 414 345 6789 B 123 456 7890 1234 *

You will have to make an entry in the **Accepted Number** table that allows the controller to recognize this number. Note that the number consists of 25 digits (don't count the **B**). You may enter 25 **As** into the **Accepted Number** table, in which case all 25-digit phone numbers will be accepted. You may alternatively use 11 **As** and your credit card number for the screening process. This will only allow calls with your exact credit card number as the last 14 digits to go through.

AUTOPATCH

- **ACCESS (continued)**

EXAMPLES (continued)

As another example, assume that you are using an alternate long-distance service. Assume that you have a rotary line, and that you must call a local access number, then switch to DTMF dialing. You then must enter your account number, followed by the number you wish to dial. The command might look like this:

123 4567 B D12345 414 345 6789 *

The controller will dial **123-4567** using pulses, then pause for the second dial tone. It will switch to DTMF, then dial the remaining 15 digits.

As in the previous example, an entry will have to be made in the **Accepted Number** table for a 22-digit number. It can consist of all **As**, or can screen calls more closely by looking for particular digits. Remember, the lettered keys **B**, **C**, and **D** are ignored by the screening process, and are not counted when entering **Accepted Numbers** or **Rejected Numbers**.

NOTE: The repeater identification is never sent during autopatches. This is an FCC requirement.

During an autopatch, the mobile operator always has control of the conversation. When the receiver COR is active, the audio from the receiver is sent to the landline. Audio from the landline is not allowed to be transmitted. When the receiver COR is inactive, the landline party is connected to the transmitter. Therefore, the mobile operator may cut off anything said by the landline party by simply pressing his/her push-to-talk button.

AUTOPATCH

• ACCESS PASSWORD

COMMAND FORM:

Access Password (PASSWORD) 23 (new password) *

Replaces the old password with a new password. **New password** is a 2, 4, or 6 digit number or any combinations of 0 - 9 and A - D.

Acknowledgment: Sends OK

Error: ? ERR 1

Default Condition: Access password is set to 10

EXAMPLES:

Assume that the access password is **10**, and that you wish it changed to **A5**. (Note that this will prevent users without 16-button DTMF pads from accessing the autopatch.)

Enter the following command:

(PASSWORD) 23 A5 *

Now assume that the access password is to be changed again, this time 6146.

Enter the following command:

(PASSWORD) 23 6146

Note that (**PASSWORD**) in the above examples refers to the **Master** or **Control Operator** password. The **Autopatch Access Password** has no power to modify control functions. It is only used to access the autopatch.

AUTOPATCH

• CALL COUNTER

INTRODUCTION

The autopatch **Call Counter** keeps track of the number of autopatch calls attempted. A call is **attempted** if the controller accepts the phone number as being valid and begins to dial.

The **Call Counter** starts at 000 and increments by one for each call. After reaching 999 calls, the counter will start over at 000. The counter may be read in CW by entering the **Send Count** command. The counter may be cleared (forced to 000) by entering the **Clear Counter** command.

Uses for the **Call Counter** include monitoring autopatch activity, and reducing the activity in cases where there are monthly limits on the number of calls allowed.

• CLEAR COUNTER

COMMAND FORM:

Clear Counter (Password) 69 *

Clears the Autopatch Call Counter.

Acknowledgment: Sends **CALLS 000** in CW

Error: ? ERR 1

Default Condition: Counter is set to 000.

• SEND COUNT

COMMAND FORM:

Send Count (PASSWORD) 86 *

Sends the Autopatch **Call Count** in CW.

Acknowledgment: Sends **CALLS xxx** in CW

Default Condition: Counter is set to 000.

AUTOPATCH

- **CALL COUNTER (continued)**

SEND COUNT

EXAMPLE:

Assume that fifteen autopatch calls have been made to date. Enter the following command:

(PASSWORD) 86 *

The following CW message will be sent in response:

CALLS 015

AUTOPATCH

• CALL TYPES

INTRODUCTION

The **Call Type** command allows you to program the types of telephone calls that can be made through the autopatch.

There are eight categories of telephone numbers recognized by the controller. They are:

Accepted numbers (specifically allowed via the **Accepted Number Table**)

0	(Operator)
XXX-XXXX	(local call)
0-XXX-XXXX	(operator-assisted 7-digit call)
1-XXX-XXXX	(direct dial 7-digit call)
0-(XXX)-XXX-XXXX	(operator assisted 10-digit call)
1-(XXX)-XXX-XXXX	(direct dial 10-digit call)
1-800-XXX-XXXX	(toll free call)

The controller may be programmed to allow any or all of the above call types. In addition, it may be turned off completely.

As you can see, this is a somewhat general way of screening calls. It has the advantage of being programmed via a standard 12-button DTMF pad. To screen call types more closely, see the **Restrictions** section. Restrictions allow screening by the individual digits, shown as **Xs** in the table above. A 16-button DTMF pad is required to screen by blocks of numbers.

AUTOPATCH

• CALL TYPES (continued)

COMMAND FORM:

Call Types (PASSWORD) 60 (list 0-7/none=OFF)

Selects the types of calls permitted by the autopatch. Enter up to 8 digits from the table below:

(none)	=	no calls permitted (autopatch off)
0	=	Accepted numbers only
1	=	0 (Operator)
3	=	0-XXX-XXXX (operator-assisted 7-digit call)
4	=	1-XXX-XXXX (direct dial 7-digit call)
5	=	0-(XXX)-XXX-XXXX (operator-assisted 10-digit call)
6	=	1-(XXX)-XXX-XXXX (direct-dial 10-digit call)
7	=	1-(800)-XXX-XXXX (toll free call)
2	=	xxx-xxxx (local call)

(Entering any digit from 0 through 7 will permit **Accepted** numbers.)

Acknowledgment: Sends **OK**

Errors: ? ERR 1 = too many digits entered
 ? ERR 2 = digit above 7 entered

Default Condition: Autopatch off

NOTE: Entering this command will dump any autopatch call in progress, and clear the re-dialer memory.

EXAMPLES:

To turn the autopatch off, enter the following command:

(PASSWORD) 60 *

To permit only **Accepted** numbers, Operator calls, and local call, enter the following command:

(PASSWORD) 60 0 1 2 *

To permit all eight types of calls, enter the following command:

(PASSWORD) 60 0 1 2 3 4 5 6 7 *

AUTOPATCH

• DIALING MESSAGE

INTRODUCTION

The **Dialing Message** is a short CW message that is sent while the controller is dialing the autopatch phone number. Since the dialing process takes a few seconds (especially when pulse dialing, it may be useful to let the user know that his command was accepted. This same message is sent every time the autopatch is accessed.

COMMAND FORM:

Dialing Message (PASSWORD) 66 (message) *

Programs the message that is sent when the telephone number is being dialed. The **message** is any string of CW characters, up to 25 characters long.

Acknowledgment: Sends the **Dialing Message** or **OK**

Errors: ? **ERR 1** = too many digits entered

? **ERR 2** = illegal CW characters entered

Default Condition: Dialing message is CW wait (**AS**)

EXAMPLES:

To change the **Dialing Message** to five **beeps**, enter the following:

(PASSWORD) 66 29 29 29 29 29 * (send 5 letter **Ts**)

To delete the **Dialing Message** entirely, enter the following:

(PASSWORD) 66 *

AUTOPATCH

• DIALING MODE

INTRODUCTION

The autopatch is capable of dialing the telephone number in three ways:

1. Ten pulses per second (PPS), rotary
2. Twenty pulses per second (PPS), rotary
3. DTMF (Touch Tone™)

Ten PPS is the standard method. Twenty PPS works with some exchanges. Touch Tone™ if you have the service and have a Touch Tone™ line at the repeater site.

COMMAND FORM:

Dialing Mode (PASSWORD) 61 (1=10 PPS / 2=20 PPS / 3=DTMF) *

Programs the type of autopatch dialing. Enter one digit representing the dialing mode from the table below:

- 1 = 10 pulses per second
- 2 = 20 pulses per second
- 3 = DTMF (Touch Tone™) dialing (5 digits per second)

Acknowledgment: Sends **OK**

Errors: ? **ERR 1** = wrong number of digits entered
? **ERR 2** = illegal digit entered

Default Condition: dialing mode is 10 PPS rotary

EXAMPLES:

To change the dialing mode to 10 pulses per second, enter the following:

(PASSWORD) 61 1 *

To change the dialing mode to 20 pulses per second, enter the following:

(PASSWORD) 61 2 *

To change the dialing mode to DTMF (Touch Tone™), enter the following:

(PASSWORD) 61 3 *

AUTOPATCH

• DIALING OPTIONS

COMMAND FORM:

Dialing Options (PASSWORD) 63 (list options) *

This command programs the dialing options allowed by the autopatch. Enter a **1** to allow **mixed-mode** dialing. Enter no digits if **mixed-mode** dialing is not allowed.

Acknowledgment: Sends OK

Errors: ? ERR 1 = too many digits entered
? ERR 2 = illegal digit entered

Default Condition: Mixed-mode dialing disabled

• DUMP

INTRODUCTION

The **DUMP COMMAND** terminates an autopatch call. Since the repeater identifier is suspended during an autopatch, it will become active again after the dump command.

It is not necessary to dump an autopatch call if a second call is made immediately following the first one. Simply enter the second command to access the autopatch and the first call will automatically be dumped.

COMMAND FORM:

Dump (PASSWORD) 83 *

Dumps any autopatch call in progress.

Acknowledgment: None

AUTOPATCH

- **ACCESS-TRIGGERED MACRO**
- **DUMP-TRIGGERED MACRO**

INTRODUCTION

The **ACCESS-TRIGGERED** and **DUMP-TRIGGERED** macro command make the autopatch much more flexible. For example, a tape recorder can be turned on and off by connecting it to a logic output. The tape recorder could then be activated or de-activated by the **Autopatch Access** and **Dump** macros. The tape recorder can be located at a remote site connected to a **CTCSS** decoder and receiver on the repeaters output frequency. The **Autopatch Access** and **Dump** macros can turn the controllers **CTCSS** encoder on and off, and change its frequency.

COMMAND FORM:

Access-Triggered Macro (Password) 26 12 (macro name) *
Dump-Triggered Macro (Password) 26 13 (macro name) *

These commands assign macros to be executed upon accessing or dumping the autopatch. Enter the 4 digit macro name, using leading 0s if the macro name is less than 4 digits. To delete the assignment, enter the command with no macro name specified.

Acknowledgment: Sends **OK**

Errors: ? **ERR 1** = wrong number of digits entered
 ? **ERR 2** = illegal digit entered

NOTE: The **Autopatch Dump Macro** will be executed if the autopatch times out. If a series of calls are made without dumping the autopatch between the calls, the **Dump Macro** will be executed at the end of the last call.

AUTOPATCH

• PRIVACY

INTRODUCTION

The **Privacy** command turns the **Mobile Privacy** feature ON or OFF. When ON, the audio from the repeater receiver **is not** transmitted (repeated) during an autopatch. When OFF, the audio **is** transmitted (repeated) similarly to the normal operation of the repeater.

COMMAND FORM:

Mobile Privacy (PASSWORD) 74 (0=OFF / 1=ON) *

Acknowledgment: None

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal digit entered

Default Condition: Privacy feature is turned off

EXAMPLES:

This feature is temporary and is in effect for the duration of one autopatch call. At the end of the call it is automatically turned **OFF**. This command can be placed in a macro with the autopatch access command, thus making that macro a **privacy speed dial**.

It is important for control operators to ensure that amateur autopatches do not involve business calls. This should be considered when allowing the use of the privacy feature, as the content of the conversation is not easily determined.

AUTOPATCH

• REDIAL

INTRODUCTION

The **Redial** feature allows you to redial an autopatch call without entering the entire command over again. This is particularly useful if the number you called was busy, or a no-answer, or if you forgot to mention something to the called party.

The **Redial Last Number** command works up to 30 minutes from the time the last called was placed. If more than 30 minutes has elapsed, the controller will send **CLR** (dialer cleared). The 30 minute timer will be reset at each redial attempt.

It is recommended that users do not use the **Redial Last Number** command if they have not been monitoring the repeater for a while, since another call may have been placed since their call.

The **Clear Redialer** command may be used after the autopatch call is made to clear the dialer memory. This ensures that no user can redial the number, and protects the original caller (and called party) from potential troublemakers.

The dialer memory is also cleared during either a warm or cold start, and when the autopatch **Call Type** command is used.

Macros that have been created for autopatch **express dialing** also leave a number in the dialer memory. Therefore, entering a **Redial Last Number** command following one of these macros will result in a call to the **express dialed** party.

An attempt to access the autopatch that is not successful such as dialing a long-distance number that is rejected, will not clear the redialer. It also will not affect the redial timer.

COMMAND FORM:

Redial Last Number (PASSWORD) 84 *

Redials the last valid number entered into the autopatch

Acknowledgment: None

Errors: None

Default: Dialer memory is cleared

AUTOPATCH

- **CLEAR REDIALER**

INTRODUCTION

The **Clear Redialer** command clears the autopatch redialer memory. After this command is executed, entering the **Redial Last Number** command causes the controller to send **CLR**. The number will not be dialed.

COMMAND FORM:

Clear Redialer (PASSWORD) 85 *

Acknowledgment: None

Errors: None

Default Condition: Dialer memory is cleared.

AUTOPATCH

• RESTRICTIONS

INTRODUCTION

A feature of the autopatch is the ability to restrict calls to certain groups of telephone numbers. This is done by building two tables in the controllers memory; a table of **Accepted** numbers, and a table of **Rejected** numbers. Each time an autopatch call is placed, the telephone number is compared to both tables. A decision is made to allow, or not allow, the call to go through.

The **Accept** and **Reject** tables may contain specific telephone numbers, or they may contain telephone numbers with **wild card** characters. This last feature allows groups of accepted or rejected numbers to be compared to the number being dialed.

There are many uses for call restrictions. Certain troublesome numbers can be placed in the **Reject** table, and will not be dialed by either entering the number via command or via macros. This could include commercial phone numbers, or even a hint to unpaid members.

In major cities, it is possible to place a long-distance call to another exchange by dialing a simple 7-digit number. To prevent the repeater phone line from accumulating monthly long-distance charges, simply place the local exchange numbers in the **Accept** table. Program the **Call Types** for only **Accepted** numbers.

In some areas, important numbers (such as police or ambulance) require a long-distance call. Since the owner may not want to open the repeater to all long-distance calls, he may simply program those few important numbers into the **Accept** table. Other long-distance calls will not be permitted if the **Call Types** list does not include them.

Since the **Call Types** table does not include all types of calls that exist, the **restrictions** feature may be used again. For example, some areas of the country have **911** emergency service. The **Call Types** command does not have a category for three-digit number, so 911 may be placed into the **Accept Table**.

AUTOPATCH

- **RESTRICTIONS (continued)**

ACCEPTED NUMBERS

COMMAND FORM:

Clear **All Accepted Numbers** from table (PASSWORD) 68 *

Enter an **Accepted Number** into table (PASSWORD) 68 (phone number) *

Enter nothing after the 68 to clear the **Accepted Number Table**.

Enter the phone number after the 68 to insert it into the **Accepted Number** table. Up to **20** entries are permitted. The phone number may be a specific number or it may contain the **A** character as a **wild card**. One phone number may be entered in each command.

Acknowledgment: Sends **OK**

Errors: ? **ERR 1** = too many digits entered

? **ERR 2** = illegal character entered (B, C, or D)

? **FULL** = table is full

Default Condition: table is empty

AUTOPATCH

• RESTRICTIONS (continued)

ACCEPTED NUMBERS (continued)

EXAMPLES

Two telephone numbers, 911 and 234-5678, are to be **Accepted Numbers**. To add them to the **Accepted Number** table, enter the following:

```
(PASSWORD) 68 911 *  
(PASSWORD) 68 234 5678 *
```

Note that only the phone number goes into the table, not the autopatch access code plus the phone number. Two commands are needed, since only one phone number may be entered at a time. These numbers will *not* be permitted if the autopatch is completely off. At least one of the **Call Types** must be selected if **Accepted Numbers** are to be permitted.

Now assume that all numbers in are code 414 are to be accepted. To accomplish this enter the following:

```
(PASSWORD) 68 1 414 AAA AAAA *
```

NOTE: The **A** is used as a wild card to specify any number 0 through 9 is **Accepted**.

The autopatch will now accept 1-(414)-000-0000 through 1-(414)-999-9999.

AUTOPATCH

• RESTRICTIONS (continued)

REJECTED NUMBERS

COMMAND FORM:

Clear **All Rejected Numbers** from **Table** (PASSWORD) 67 *

Enter a **Rejected Number** into **Table** (PASSWORD) 67 (phone number) *

Enter nothing after 67 to clear the **Rejected Number** table.

Enter the phone number after the 67 to insert it into the **Rejected Number** Table. Up to **20** entries are permitted. The phone number may be a specific number, or it may contain the **A** character as a **wild card**. One phone number may be entered in each command.

Acknowledgment: Sends **OK**

Errors: ? **ERR 1** = too many digits entered

? **ERR 2** = illegal character entered (B, C, or D)

? **FULL** = table is full

Default Condition: table is empty

EXAMPLES

Two telephone numbers, 345-6789 and 987-6543, are not permitted to be dialed. To add them to the **Rejected Number** table, enter the following:

(PASSWORD) 67 345 6789 *

(PASSWORD) 67 987 6543 *

Note that only the phone number goes into the table, not the autopatch access code plus the phone number. Two command entries are needed, since only one phone number may be entered at a time.

Now assume that all numbers in the 246 exchange are to be rejected. To accomplish this enter the following:

(PASSWORD) 67 246 **AAAA** *

NOTE:The **A** is used as a wild card to specify any number 0 through 9 is **Rejected**. After this command is entered, the autopatch will reject any call to a 7-digit number with a 246 exchange (246-0000) through (246-9999).

AUTOPATCH

• REVERSE PATCH

INTRODUCTION

The **Reverse Patch** feature allows users to dial a number at the repeater site, and be connected to a repeater user. The **Reverse Patch** can be used in two ways. The controller can signal via a CW message that a user has dialed the site, or the controller can wait for a command from the telephone party before signalling via CW. In the first mode, the telephone party never has access to the DTMF decoder. The only function that a call to the site number has is to trigger a reverse patch signal. In the second mode, the telephone party is similar to a control operator. He will be able to enter any command. To trigger a reverse patch, the proper command will have to be entered from a Touch Tone™ telephone.

The first mode may be necessary in several situations. For example, in areas without Touch Tone™ service, the controller will have to be configured to trigger a reverse patch without requiring a command. Other exchanges reverse the polarity of the telephone line loop voltage going to the telephone set after the dialing process; this disables the DTMF encoder in the telephone. These situations can be fixed by using a separate DTMF encoder in the first case, and using a bridge rectifier, to feed unipolar DC to the DTMF encoder in the second case. However, it will still be difficult to trigger the reverse patch from a pay phone, or a phone not equipped with DTMF capability, in rotary exchanges.

• TRIGGER

COMMAND FORM:

Trigger (PASSWORD) 87 *

When entered from the landline, this command causes the reverse patch sequence to start. The DTMF decoder is switched from the landline back to the repeater receiver.

Acknowledgment: None

AUTOPATCH

- **ANSWER**

COMMAND FORM:

Answer (PASSWORD) 88 *

When entered from the repeater receiver, this command connects the telephone party to the repeater. The call progresses the same way as a standard autopatch.

AUTOPATCH

- **TIMEOUT TIMER**

INTRODUCTION

The autopatch **Timeout Timer** controls the duration of the call. If the call exceeds the time limit, it will be terminated by the controller.

When the timer is within **30** seconds of timing out, it will start sending short **warning messages** in CW. These messages are sent every **5** seconds, and are programmable.

A user may extend the duration of his/her call by entering the autopatch **Reset Timer** command. If the repeater owner does not want to make this command available to users, simply do not create a macro containing this command. It will remain a control command, protected by its password.

- **RESET TIMER**

COMMAND FORM:

Reset Timer (PASSWORD) 81 *

Resets the autopatch timeout timer. Allows call to proceed for another period of time set by the **Time Limit** command.

Acknowledgment: None

AUTOPATCH

• TIME LIMIT

COMMAND FORM:

Time Limit (PASSWORD) 65 (0.5-9.9 min. / 00 = infinity)

Programs the maximum duration of an autopatch call. Enter the two digits representing the duration in minutes and tenths of minutes. Range of timer is **0.5** minutes to **9.9** minutes. Enter 00 if the timer is to be infinity (no timeout limit).

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal digit or out of limit

Default Condition: Time limit is **3.0** minutes

EXAMPLES

To set the timeout timer to 4.5 minutes, enter the following:

(PASSWORD) 65 45 *

To set the timeout timer to infinity, enter the following:

(PASSWORD) 65 00

AUTOPATCH

• WARNING MESSAGE

COMMAND FORM:

Warning Message (PASSWORD) 62 (message) *

Programs the message that is sent during the last **30** seconds, before timeout, of the autopatch call. Maximum message length is **25** characters.

Acknowledgment: Sends the warning message, or OK, or none

EXAMPLES

To change the warning message to five beeps, enter the following:

(PASSWORD) 62 75 85 95 85 75 *

This command will create a noticeable rising and falling beep sequence. If the mobile station releases his/her push-to-talk button for at least **5** seconds during the last **30** seconds, before timeout of the autopatch timer, he/she is sure to recognize the timeout timer message.

CLOCK

• INTRODUCTION

The controller features a software clock and calendar. As long as power is supplied to the controller, it will keep proper time. A **correction** command allows you to 'tweak' the clock for precise accuracy. The calendar will change months after the correct number of days have elapsed, although it will not correct for leap year.

• CORRECTION

COMMAND FORM:

Correction (PASSWORD) 19 (00-59 sec., 0=slower / 1=faster) *

Acknowledgment: Sends **OK**

Errors: ? ERR 1

? ERR 2

Default Condition: No correction is assumed

EXAMPLES

Assume that the clock is running one minute fast per month. The daily correction would be 60 seconds divided by 30 days, or 2 seconds per day. The clock should be running 2 seconds per day slower. The command would be:

(PASSWORD) 19 02 0 *

As a second example, assume that the clock is running 5 seconds slow per day. The correction command would be:

(PASSWORD) 19 05 1 *

It will require several days to note the amount of correction needed, since it will become obvious only after at least 1 minute of error accumulates. Therefore, you should divide the number of seconds of error by the number of days over which it accumulated: this will yield the daily correction. Note that corrections are not cumulative; a correction of 2 seconds fast, followed by a correction of 4 seconds fast does not result in 6-second fast correction. So, if subsequent checks show the need for additional correction, the old correction value should be replaced with a slightly larger or smaller correction value. Setting the clock and calendar does not affect the correction. If the clock is changed for daylight savings time, for example, its accuracy will not be affected.

CLOCK

• SET TIME AND DATE

COMMAND FORM:

Set Time and Date (PASSWORD) 18 (hours, minutes, months, day) *

Sets the clock and the calendar. Enter the two digits for the hours in 24-hour format, two digits for the minutes, two digits for the month, and two digits for the day. The acceptable ranges are as follows:

hours	= 00 - 23
minutes	= 00 - 59
month	= 01 - 12 (January is 01)
day	= 01 - 31

Acknowledgment: Sends the time and date in CW

Errors: ? **ERR 1** = wrong number of digits entered
? **BAD HRS** = hours were over 23
? **BAD MIN** = minutes were over 59
? **BAD MONTH** = month was 00 or over 12
? **BAD DAY** = day was 00 or over 31

Default Condition: Time and date are not set.

EXAMPLES:

Assume that the time is 3:21 PM, and the date is June 10. To set the clock, you must use 24-hour format; so, the time is 15:21. To set the calendar, the month must be converted to a number; so, the month is 06. The command would look like this:

(PASSWORD) 18 15 21 06 10 *

As a second example, assume that the time is 9:45 AM, and the date is December 3. The command would look like this:

(PASSWORD) 18 09 45 12 03 *

Leading zeroes are necessary for single-digit numbers, so the hours are expressed as **09** in the above example.

CLOCK

• SEND TIME OR DATE

COMMAND FORM:

Send Time or Date (PASSWORD)14 (1=time12hr / 2=time 24hr/3=date) *

Sends the current time in CW. Enter one digit for the format:

- 1 = time of day, 12-hour format
- 2 = time of day, 24-hour format
- 3 = month and day

Acknowledgment:

Format 1: **Time** xx xx **AM or Time** xx xx **PM** (1:00-12:59)

Format 2: **Time** xx xx (00:00 - 23:59)

Format 3: xxx xx (**Jan 1 - Dec 31**)

Errors: ? NOT SET is sent in CW if clock has not been set.

Default Condition: Time and date are not set

EXAMPLES:

In these examples, assume that the time is 1:35 PM and the date is March 5.

To get the 12-hour time, enter: (PASSWORD) 14 1 *

The controller will send: **TIME 1 35 PM**

To get the 24-hour time, enter: (PASSWORD) 14 2 *

The controller will send: **TIME 13 35**

To get the date, enter: (PASSWORD) 14 3 *

The controller will send: **MAR 5**

CTCSS

- **CTCSS ENCODER**

- **INTRODUCTION**

The **CTCSS** (Continuous Tone Controlled Squelch System) encoder is capable of generating 37 standard tones. The tone is transmitted continuously during the time the transmitter is keyed.

CTCSS ENCODER ENABLE/DISABLE

COMMAND FORM:

Encoder Disable (PASSWORD) 03 *
Encoder Enable (PASSWORD) 02 *

Note: Encoder is turned off (disabled) or turned on (enabled).

Acknowledgment: OK

Default Condition: Disabled

CTCSS ENCODER FREQUENCY

COMMAND FORM:

Encoder Frequency (PASSWORD) 05 (frequency number) *

Programs new **CTCSS** encoder frequency. Enter the frequency number from **CTCSS Frequency Table**.

Note: Programming a new frequency does not enable, nor disable, the encoder.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = invalid digit entered

Default Condition: 67 Hz.

CTCSS FREQUENCY TABLE

1 - 67.0 Hz.	XZ	20 - 136.5 Hz.	4Z
2 - 71.9	XZ	21 - 141.3	4A
3 - 74.4	UA	22 - 146.2	4B
4 - 77.0	XB	23 - 151.4	5Z
5 - 79.7	SP	24 - 156.7	5A
6 - 82.5	YZ	25 - 162.2	5B
7 - 85.4	YA	26 - 167.9	6Z
8 - 88.5	YB	27 - 173.8	6A
9 - 91.5	ZZ	28 - 179.9	6B
10 - 94.8	ZA	29 - 186.2	7Z
11 - 100.0	1Z	30 - 192.8	7A
12 - 103.5	1A	31 - 203.5	M1
13 - 107.2	1B	32 - 210.7	M2
14 - 110.9	2Z	33 - 218.1	M3
15 - 114.8	2A	34 - 225.7	M4
16 - 118.8	2B	35 - 233.6	M5
17 - 123.0	3Z	36 - 241.8	M6
18 - 127.3	3A	37 - 250.3	M7
19 - 131.8	3B		

CW

• INTRODUCTION

CW is the method by which the controller communicates with repeater users. Many of the messages sent by the controller are programmable, such as IDs, timeout warnings, etc. This section discusses the use of the **CW CHARACTER SET** in programming these messages.

Note that **CW** characters require at least two keystrokes to be represented in the controller. When a command description indicates that you may enter **up to 25 characters**, for example, it means that the message may contain up to 25 normal **CW** characters (50 keystrokes). **Custom Beeps** and other special characters require more than two keystrokes each; therefore, they will take up more space and fewer characters may be programmed into a message.

ALPHANUMERICS

The **alphanumeric** portion of the **CW CHARACTER SET** consists of codes 00 through 53. This includes the numerals 0 through 9, the letters A through Z, punctuation, and standard Morse abbreviations (**wait** and **break** for example). Codes 54, 55, and 56 are unused and will result in a wordspace if programmed.

CUSTOM BEEPS

Code 57, followed by 6 more digits, is a **custom beep** character. If we represent the code 57xxxxyy, then **xxxx** is the frequency of the beep and **yy** is the duration. The frequency must be four digits and is taken from the **Tone Code** table. The duration must be two digits between 01 and 99, representing 0.01 to 0.99 seconds (10 to 990 milliseconds). Custom beeps allow the flexibility in creating the sound you want for a particular message.

CUSTOM DELAYS

Code 58, followed by two more digits, is a **custom delay** character. If we represent the code by 58xx, the **xx** is the duration. The duration must be two digits between 01 and 99, representing 0.01 to 0.99 seconds (10 to 990 milliseconds). Custom delays may be introduced between beeps or other characters to create the sound you want for a particular message.

CW

FREQUENCY CHANGES

Code 59, followed by four more digits, is a **frequency change** character. If we represent the code by 59xxxx, then **xxxx** is the frequency of the **CW** characters that follow. The frequency must be four digits and is taken from the **Tone Code** table. **Note:** The new **CW** frequency will be temporary; it is in effect until all remaining **CW** messages in the buffer are sent. The purpose of the **frequency change** character is to draw attention to the message or part of a message. (You may wish to place another **frequency change** character after the highlighted message to force the remaining characters to be sent at normal frequency, in case another message becomes queued before the buffer empties.) If you want to permanently change the **CW** frequency, see the **CW FREQUENCY** control command.

SPEED CHANGES

Codes 60-69 are **speed change** characters, and are used to temporarily modify the **CW** speed. The speed may be varied from 5 to 40 WPM (words per minute) in ten steps. The speed change will be in effect until all remaining **CW** messages in the buffer are sent. The purpose of the **speed change** character is to draw attention to the message or make it more easily copied by those with modest **CW** skills. (You may wish to place another **speed change** character after the highlighted message to force the remaining characters to be sent at normal speed, in case another message becomes queued before the buffer empties.) If you want to permanently change the **CW** speed, see the **CW SPEED SELECT** control command. If you want to slow the speed of a non-programmable message, use the **SEND NEXT MESSAGE SLOWLY** control command. (To send the time-of-day slowly, for example, create a macro that contains the **SEND NEXT MESSAGE SLOWLY** command followed by the send time command.)

CW

BEEPS

Codes 70 through 99 are **beep** characters, and are used to create informational messages. One or two beeps may be use for a Courtesy Message, while a series of beeps may be used to indicate an upcoming autopatch timeout. Unlike **custom beeps**, these beeps require only two keystrokes each. However, your choices are limited to ten durations and three frequencies. The frequency is controlled by the first digit of the beep code; that is, a beep code starting with a **7** has a different frequency than beep codes starting with an **8** or **9**. Beep frequencies may be changed with the **FREQUENCY OF BEEP** control command. The duration is controlled by the second digit of the beep code; that is, a code 70 beep is 20 milliseconds long, while a code 79 beep is 200 milliseconds long. Beeps may be freely mixed with other CW characters, although they are different in one way: there is no space placed between beeps when they are programmed in a group. This means that a multiple-beep message sounds quite pleasant.

CW CHARACTER SET

(The character is given first, followed by the code)

0 - 00	9 - 09	I - 18	R - 27
1 - 01	A - 10	J - 19	S - 28
2 - 02	B - 11	K - 20	T - 29
3 - 03	C - 12	L - 21	U - 30
4 - 04	D - 13	M - 22	V - 31
5 - 05	E - 14	N - 23	W - 32
6 - 06	F - 15	O - 24	X - 33
7 - 07	G - 16	P - 25	Y - 34
8 - 08	H - 17	Q - 26	Z - 35

Period .	36	End-of-Work (SK)	45
Comma ,	37	Hyphen -	46
Fraction /	38	Colon :	47
Question ?	39	Semicolon ;	48
Space _	40	Parenthesis ()	49
End-of-Msg (AR)	41	Apostrophe '	50
Wait (AS)	42	Exclamation !	51
Break (BK)	43	Quotation "	52
Double Dash (BT)	44	Understood	53

Custom Beep 57xxxxyy
 Custom Delay 58xx
 Frequency Change 59xxxx

SPEED CHANGE

5 WPM	60	17 WPM	65
7 WPM	61	20 WPM	66
10 WPM	62	24 WPM	67
13 WPM	63	30 WPM	68
15 WPM	64	40 WPM	69

BEEPS

<u>DURATION</u>	<u>BEEP 1</u>	<u>BEEP 2</u>	<u>BEEP 3</u>
20 ms	70	80	90
40 ms	71	81	91
60 ms	72	82	92
80 ms	73	83	93
100 ms	74	84	94
120 ms	75	85	95
140 ms	76	86	96
160 ms	77	87	97
180 ms	78	88	98
200 ms	79	89	99

CW

- **DISABLE/ENABLE**

COMMAND FORM:

Disable/Enable (PASSWORD) 04 (0=disable/1=enable) *

Disables or enables the CW sending function. Enter one digit, **0** to disable or **1** to enable.

Acknowledgment: sends nothing if disabled; sends **OK** if enabled

Errors: ERR 1 = wrong number of digits entered (disable only)
ERR 2 = illegal digit entered (disable only)

Default Condition: Enabled

CW

• FREQUENCY

COMMAND FORM:

Frequency (Beep 1)	(PASSWORD) 07 (tone code) *
Frequency (Beep 2)	(PASSWORD) 08 (tone code) *
Frequency (Beep 3)	(PASSWORD) 09 (tone code) *
Frequency (CW)	(PASSWORD) 06 (tone code) *

Changes the tone frequency of beep 1, 2, or 3, or the tone frequency of the CW message. Enter the 4-digit tone code number for the desired frequency. Range is 100 Hz. to 5000 Hz.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal tone code entered

Default Condition: Beep 1 defaults to 500 Hz.
Beep 2 defaults to 700 Hz.
Beep 3 defaults to 900 Hz.
CW defaults to 1500 Hz.

EXAMPLES:

Let's change the frequency of Beep 1 to 600 Hz. From the **Tone Code Tables**, pages 85-88, you will see that the code for 600 Hz. is 1667. The command is:

(PASSWORD) 07 1667 *

As a second example, change the the CW frequency to 1200 Hz. The tone code for 1200 Hz. is 0833, so the command is:

(PASSWORD) 06 0833 *

CW

• SEND MESSAGE

COMMAND FORM:

Send Message (PASSWORD) 15 (message) *

Sends a message, up to 40 characters long, in CW. This command is most useful when placed into a macro, such as an accompanying message for the fast-dial autopatch macro.

Acknowledgment: Sends the message

Errors: ? ERR 1 = too many digits entered
? ERR 2 = illegal CW character code entered

EXAMPLES:

To send the message **TEST** in CW, enter this command:

(PASSWORD) 15 29 14 28 29 *

To send the beeps in an interesting pattern, enter:

(PASSWORD) 15 75 85 95 85 75 *

To send **HELLO** at 7 WPM, then change the default speed (20 WPM), enter:

(PASSWORD) 15 61 17 14 21²¹ 24 66 *
 ^

CW

• SLOW NEXT MESSAGE

COMMAND FORM:

Slow next message (PASSWORD) 11*

Entering this command before entering a command with a CW message causes the CW message to be sent slowly. The actual speed is set by the **Speed Select (SLoW)** command. This command is most useful when placed into a macro for users. Cw speed returns to normal after the CW memory empties.

Acknowledgment: none

Errors: none

Default Condition: CW is sent at the normal rate

EXAMPLE:

Assume that a macro, **3 ***, exists which sends the 12-hour time. Assume also that a macro, **2 ***, exists which contains the **slow next message** command. Then a user could enter:

2 *
3 *

This will cause the time-of-day to be sent at a slower rate than normal.

Note that the repeater **courtesy message** is also a CW message. If a user enters **2 *** and then releases the mike, the courtesy message will be sent slowly. Since the speed then changes back to normal, entering a **3 *** will cause the time to be sent at normal. Therefore, the user must enter the **2 *** and **3 *** in the same transmission.

CW

• SPEED SELECT

COMMAND FORM:

Speed Select (Normal) (PASSWORD) 12 (0-9) *
Speed Select (Slow) (PASSWORD) 13 (0-9) *

Speed Select (Normal) changes the speed at which CW messages are normally sent. **Speed Select (Slow)** changes the speed at which CW messages are sent when preceded by the **Slow Next Message** command. A single digit from **0** through **9** programs the desired speed. See the table below.

<u>CW SPEED</u>	<u>SPEED CODE</u>	<u>CW SPEED</u>	<u>SPEED CODE</u>
5 WPM	0	17 WPM	5
7 WPM	1	20 WPM	6
10 WPM	2	24 WPM	7
13 WPM	3	30 WPM	8
15 WPM	4	40 WPM	9

Note: The above speed code table was based on the number of milliseconds duration of an **element** of CW (a dit = 1 element, a dah = 3 elements). Five WPM corresponds to 240 mS/element, 7 WPM corresponds to 170 mS/element, 10 WPM corresponds to 120 mS/element, and so on.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default Condition: Normal CW speed defaults to 20 WPM
Slow CW speed defaults to 15 WPM

CW

- **SPEED SELECT (continued)**

EXAMPLES:

To change the normal CW sending speed to 17 words per minute, enter:

(PASSWORD) 12 5 *

To change the slow CW sending speed to 10 words per minute, enter:

(PASSWORD) 13 2 *

Note that there are two ways to change the speed of a CW message. One way is to use the commands shown above; this is usually done upon installation. The other method is to insert a **speed change** character into the message. That is a temporary method, since the speed returns to normal after the message is sent.

DTMF DECODER

• MUTE DELAY

COMMAND FORM:

Mute Delay (PASSWORD) 96 (0-9) *

This command selects the amount of muting that occurs after a **DTMF** digit is received by the controller. Enter one digit representing the delay duration .0 through .9 seconds.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default Condition: 0.5 seconds

EXAMPLES:

When a **DTMF** digit is recognized by the controller, it mutes the audio so that the digit is not re-transmitted. (Since some time is required by the controller to decode the digit, a short burst of tone is re-transmitted.) A timer is started for the purpose of delaying the muting. This allows a string of **DTMF** digits to be entered, with all but the first one fully muted. The command show above controls this timer. If set to zero, the muting will end when the **DTMF** digit is released. If set to 9, the muting will last 0.9 seconds beyond the release of the **DTMF** digit. Since a voice will occasionally trip the **DTMF** decoder, a long mute delay may not be desired.

If a **DTMF** digit is held down for a continuous period of time, the controller will stop muting after 1.0 seconds.

To change the mute delay to 0.3 seconds, for example, enter the following command:

(PASSWORD) 96 3 *

DTMF DECODER

- **MUTE ON/OFF**

COMMAND FORM:

Mute ON/OFF (PASSWORD) 97 (0=OFF/1=ON) *

This command turns ON or OFF the controller's ability to mute **DTMF** tones from the repeater receiver.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal digit entered

Default Condition: Muting is turned ON

EXAMPLES:

Muting is usually left ON to prevent annoying **DTMF** digits from being repeated, and to prevent listeners from learning macro and command codes. Sometimes it is necessary to signal devices through the repeater, and during these occasions the muting may be turned OFF.

IDENTIFIER

• INTRODUCTION

The first signal to be received will start an **ID cycle**. The ID-er is polite, and will wait for the signal to disappear.. It then sends the **INITIAL ID** call sign in CW, and executes the **INITIAL ID MACRO**. (If, however the signal is received continuously until the **ID** timer timeout is reached, then the controller will send the **INITIAL ID** callsign in CW and execute the **IMPOLITE MACRO**.)

During the conversation, the controller will keep looking for a carrier drop during the 30 seconds prior to the **ID** timer timeout. If it finds such a point, it sends the **NORMAL ID** callsign in CW and executes the **POLITE ID MACRO**. If it cannot find such a break, it will send the **NORMAL ID** callsign in CW and execute the **IMPOLITE ID MACRO**. (When selecting the the **ID** time interval, keep in mind that the selected interval is the maximum interval between **IDs**, and that **ID**'s may occur up to 30 seconds early.)

If the QSO is over and the **ID** timer times out, the controller will send the **NORMAL ID** callsign in CW and execute the **POLITE ID MACRO**. It will not **ID** again until a new cycle si begun.

Several possibilities are open to the repeater trustee. You may wish to delete the **NORMAL** and **INITIAL** CW callsigns, and operate the ID-er from three macros. In this way, a synthesized voice message might greet the initial user with callsign and frequency information; or, you may pulse an external tape cartridge machine. The **POLITE ID** macro may contain a short synthesized or CW message. The **IMPOLITE ID** macro should probably be a short CW message, since it will be sent "on top" of the transmitting station.

IDENTIFIER

- **CALLSIGN**

COMMAND FORM:

Callsign (Initial ID) (PASSWORD) 53 (message) *

Callsign (Normal ID) (PASSWORD) 52 (message) *

These commands program the messages to be use for the initial and normal indentifications. Each message may consist of up to 40 characters.

Acknowledgment: Sends the ID message, or OK, or none

Errors: ? ERR 1 = too many digits entered

? ERR 2 = illegal digit entered

Default Condition: Both call signs default to ID

EXAMPLES:

The initial ID callsign should be programmed after the normal callsign, because programming the normal callsign causes the initial callsign to be the same.

To program the normal callsign **W9XYZ/R**, enter the following:

(PASSWORD) 52 32 09 33³⁴ 35 38 27 *

To program the initial callsign **DE W9XYZ/R CGO** (Chicago), enter the following:

(PASSWORD) 53 13 14 40 32 09 33³⁴ 35 38 27 40 12 16 24 *

Note that spaces (40) were inserted between the **DE** and the callsign, and between the callsign and the city.

Initial callsigns, because they are less frequent than normal callsigns, might contain some pertinent information about the repeater. Examples include the name of the club, the location, or just the greeting (**HI** or **HELLO**).

IDENTIFIER

• ID-TRIGGERED MACROS

COMMAND FORM:

Impolite ID Macro	(PASSWORD) 2605 (macro name) *
Initial ID Macro	(PASSWORD) 2603 (macro name) *
Polite ID Macro	(PASSWORD) 2604 (macro name) *

These commands assign macros to be triggered at the appropriate ID times. Enter the 4-digit macro name desired. To delete the assignment, enter no macro name.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal digit entered

Default Condition: No macros assigned

EXAMPLES:

ID-triggered macros may be used when it is desirable to play a cartridge tape or a voice synthesized message for an ID. For example, a macro may be created that pulses one of the logic outputs; this is wired to the start line of a cartridge machine. That macro may be programmed into the **Initial ID Macro**, so that the taped message occurs only on initial IDs. Voice synthesized messages can be used in the same way.

Assume that a macro 1000* is to be executed for an initial ID; macro 1001* is to be executed for a polite ID; and macro 1002* is to be executed for an impolite ID. The following command would be entered:

```
(PASSWORD) 2603 1000 *  
(PASSWORD) 2604 1001 *  
(PASSWORD) 2605 1002 *
```

IDENTIFIER

• INTERVAL

COMMAND FORM:

Interval (PASSWORD) 51 (0.5-9.9 min) *

This command programs the maximum interval at which IDs occur. Because of the **polite** nature of the identifier, an ID may be earlier if there is a recent carrier drop.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default Condition: Interval = 3.0 minutes

EXAMPLES:

To change the ID interval to 4.5 minutes, enter the following:

(PASSWORD) 51 45 *

To change the ID interval to maximum (9.9 minutes), enter:

(PASSWORD) 51 99 *

Note: As required by the FCC, the controller will not indentify during autopatches.

IDENTIFIER

• RESET INITIAL TO NORMAL

COMMAND FORM:

Reset Initial to Normal (PASSWORD) 54 *

This command causes the Initial ID message to be the same as the Normal ID message

Acknowledgment: Sends the ID

Errors: ? ERR 1 = wrong number of digits entered

Default Condition: Both ID messages are ID

EXAMPLES:

On occasion, you may want to change the **Initial ID** message to something special. For example, you could program **W8ABC/R MRY XMAS**, or **W2XYZ/R SWAPFEST SAT**, etc. When the season or event is over simply enter:

(PASSWORD) 54 *

The **Initial ID** will now become the same as the **Normal ID**, which is probably a short message. When another special message is desired for the **Initial ID**, reprogram the **Initial ID** using the **Callsign** (Initial ID) command.

IDENTIFIER

- **SEND ID**

COMMAND FORM:

Send ID (PASSWORD) 55 *

This command forces the identifier to send the **Initial ID**, along with any tail message that may be selected.

Acknowledgment: Sends ID

Errors: ? ERR 1 = wrong number of digits entered

IDENTIFIER

• TAIL MESSAGE

COMMAND FORM:

Tail Message (PASSWORD) 50 (message no. 0-9) *

This command appends a short **tail message** to the **Initial ID** message. Enter one digit from the table below.

0 = (none)	5 = HI
1 = FEST	6 = WX
2 = DUES	7 = ALERT
3 = MEET	8 = WATCH
4 = NET	9 = WARN

Acknowledgment: Sends the **Initial ID** with tail message

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default Condition: (none)

EXAMPLES:

Assume that the weather is predicted to turn poor, and that you want to create a simple notification. If you enter:

(PASSWORD) 50 6 *

then the **Initial ID** will be followed by **WX**. The other tail messages work the same way. If you want to delete the tail message, enter:

(PASSWORD) 50 0 *

Naturally, this short list will not fill all of the special event messages you may need. To create a special message, simply reprogram the ID callsign, including the message after the callsign.

LANDLINE CONTROL

• ANSWER MODE

COMMAND FORM:

Answer Mode (PASSWORD) 64 (mode 0-2) *

Three answer modes are possible. Enter one digit from the table below:

- 0 = **Do Not Answer** (landline may still dial out for autopatches)
- 1 = **Trigger Reverse Patch** upon answering
- 2 = Landline is used as **Control Line**

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal digits entered

Default Condition: Landline defaults to Mode 2 (control line)

EXAMPLES:

This command does not affect the use of the landline for dialing out from the repeater site (autopatches). It controls the behavior of the **MRC-100** when an incoming ring signal is detected.

To prevent the landline from being answered by the controller, enter:

(PASSWORD) 64 0 *

In mode 1, the controller will answer the landline and trigger the reverse patch sequence. The caller is not given access to the controller's DTMF decoder, and is not able to control the repeater. To put the landline in mode 1, enter:

(PASSWORD) 64 1 *

In mode 2, the controller will answer the landline and connect the caller to the controller's DTMF decoder. If the repeater is in use, the users will not be aware of the landline control, except that CW messages will be diverted to landline, and they will not be able to send DTMF command to the controller. To put the landline into mode 2, enter:

(PASSWORD) 64 2 *

LANDLINE CONTROL

- **RING COUNT**

COMMAND FORM:

Ring Count (PASSWORD) 95 (number of rings 1-49) *

This command selects the number of rings the landline must receive before it is answered. The range is 1 to 49 rings. Enter one or two digits.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal digit entered

Default Condition: Landline answers after 2 rings.

EXAMPLE:

Assume that you want the landline to answer after 8 rings. Enter the following command:

PASSWORD) 95 8 *

LOGIC INPUT

• INTRODUCTION

The **MRC-100** controller provides a logic input on pin 3 of the **Input/Output** connector. This input may be connected to a device at the repeater site. The device will be continually monitored by the controller for a change in state. If a change occurs, one of two macros will be executed.

The logic input feeds the base of an NPN transistor through a resistor divider network, requiring three "diode drops", or 2.1 volts, to be considered a logic "1" (HIGH). A pullup resistor, R82, ensures a HIGH level in the event the input is open. This resistor may be removed (a soldering pencil is required) if the monitored device is not TTL compatible.

LOGIC INPUT

• INPUT DETECTS HIGH-TO-LOW

COMMAND FORM:

Input Detects High-to-Low (PASSWORD) 26 06 (macro name) *

• INPUT DETECTS LO-TO-HIGH

COMMAND FORM:

Input Detects Low-to-High (PASSWORD) 26 07 (macro name) *

These commands indicate to the controller which macros are to be executed by transistions detected by the logic input. Enter four digits for the macro name, using leading zeroes if the macro name is fewer than four digits long. To prevent any macro from being executed by the logic input, enter nothing for the macro name.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered

Default Condition: Defaults to having no macros assigned to either state change. Upon power up (reset), controller expects the logic input be **HIGH**; if **LOW**, it will execute the **High-to-Low** transition macro.

EXAMPLES:

Assume that a "burglar" alarm switch has been wired from the logic input to ground. When the switch is tripped, the logic input goes **LOW**. This should cause the CW pitch to change to a high frequency.

To accomplish this, you must create two macros. Let's call the first macro **50**, and it raises the CW pitch. The second macro is **51** and it restores the the CW pitch to its original value. Now enter the following commands:

(PASSWORD) 26 06 0050 *

(This causes macro 50 to be executed when the input goes LOW.)

(PASSWORD) 26 07 0051 *

(This causes macro 51 to be executed when the input goes HIGH again)

Many other uses may be found for the logic input, including over-temperature or under-temperature indications; high-water detectors; voltage monitors; high SWR indicators; and so on.

LOGIC OUTPUTS

• INTRODUCTION

Two logic outputs are provided on the **MRC-100** for controlling devices at the repeater site. The switching device is a power MOSFET that can sink over 100 ma in the ON state, and withstand 40 volts in the OFF state. If TTL-compatible outputs are desired, a 3K 1/4-watt pull resistor may be soldered into the board at locations **RB** for logic output 1, and **RC** for logic output 2. When in the ON state, logic outputs appear as 5-ohm resistances to ground. This ensures a very low voltage to be present for the logical **low** level (under 0.1 volts).

Each logic output may be commanded to be latched ON or OFF, or momentarily turned ON or OFF for 0.5 seconds.

The status of the outputs will be remembered during power outages. When the power returns, the controller will turn the outputs ON or OFF to match their earlier states.

LOGIC OUTPUTS

- **MOMENTARY OFF**
MOMENTARY ON
OFF
ON

COMMAND FORM:

Momentary Off	(PASSWORD) 73 (list the outputs) *
Momentary On	(PASSWORD) 72 (list the outputs) *
Off	(PASSWORD) 71 (list the outputs) *
On	(PASSWORD) 70 (list the outputs) *

List the outputs to be controlled by entering **1**, **2**, or **12** (both outputs)

Acknowledgment: OK

Errors: ? ERR 2 = illegal digit entered

Default Condition: Both outputs default to the OFF state

EXAMPLES:

To turn ON logic output 1, enter:

(PASSWORD) 70 1 *

To turn ON logic 2, enter:

(PASSWORD) 70 2 * (logic output 1 is still ON)

To turn OFF both logic outputs, enter:

(PASSWORD) 71 1 2 *

To momentarily turn ON logic output 1, enter:

(PASSWORD) 72 1 *

To momentarily turn ON both logic outputs, enter:

(PASSWORD) 72 1 2 *

If logic output 2 is ON, you may momentarily turn it OFF by entering:

(PASSWORD) 73 2 *

MACROS

• INTRODUCTION

A very powerful feature of the controller is its ability to store strings of commands in memory locations called **macros**. Macros do not exist until defined by the owner. The names of the macros and their contents are fully programmable.

The advantages in using macros include.

- The ability to store long commands, then execute them using a much shorter string.
- Time savings for commands that are used often.
- Lower likelihood of making an error when entering a lower number of digits.
- Higher system security by not disclosing the actual commands to users.

Note that the controller does not check the validity of the commands stored in macros. If an error is made in the command stored in a macro, or if a password is changed after a command is stored, the macro will appear not to execute properly.

• QUANTITY OF MACROS

The controller supports a total of 200 macros.

• NAMES OF MACROS

The owner defines the name of a macro when he creates it. The name may be one, two, three, or four digits plus the * character. All 14 digits (0 through 9, A through D) may be used for names.

• LENGTH OF MACROS

Each macro may contain a maximum of 44 digits. This number is decreased by two for each additional command stored in a macro, and decreased by one more if the command contains an odd number of digits. Thus, a macro may contain one command of 44 digits, or two commands totaling 42 digits, or three command totaling 40 digits, etc. If this amount of memory is insufficient for a particular application, you may simply place the name of another macro in the macro being created. This extends the storage capacity to another 44 digits. The process may be repeated, thus **chaining** together a series of macros which will be executed together.

MACROS

- **CAUTIONS**

Do not create a macro that contains itself. In other words, macro **65*** must not have **65*** stored in it. It is similarly illegal to create a continuous ring of macros; that is, macro **65*** should not call **66*** if **66*** can find a path back to **65*** (perhaps via several other macros).

- **MACRO EXECUTION**

When a macro is executed, the individual commands within that macro are executed in the order they were stored. For example, if a macro contains three commands that send CW messages, then the messages will be sent in the order they appear in the macro. If this macro contains another macro, then the **nested** macro will be fully executed before the controller continues on with the remaining commands in the original macro.

- **LEADING ZEROES**

Control commands that CREATE, APPEND, etc., require you to enter the macro name in four digits. If you wish to give the macro a shorter name, then you must enter leading zeroes. Thus, the digits **5***, **05***, **005***, and **0005*** all refer to the same macro. When executing a macro, the leading zeroes are not needed. Therefore, simply entering **5*** is sufficient to execute macro **0005***. When placing macros within other macros, the leading zeroes are not necessary.

MACROS

• USES FOR MACROS

There are many uses that may be found for macros. Here are some suggestions:

1. **Autodial**: Create macros that access the autopatch. A second command within the macro sends back and acknowledgment, such as **Fred, Police or Fire**. A third command might extend the autopatch timeout timer, if the macro is used for an emergency number. Make the macro name easy to remember, such as **911*** or **1000*** for important numbers. Use names that combine the lettered DTMF digits for more security. Custom autodial numbers can be created for your club members in exchange for an annual fee, creating extra club revenue.
2. **Restricted Autopatch**: Change the autopatch password to a 6-digit number. Do not disclose the password to users. Create autodial macros for only those phone numbers permitted. Release the macro names to users. Rename macros that become too heavily used or troublesome.
3. **User Features**: Create short macros that users will enjoy, such as **1*** to send the time-of-day in CW. **2*** could send the date; **3*** could dump the autopatch; **50*** could energize a logical output that causes a tape cartridge machine to give the latest club announcements.

MACROS

• APPEND TO MACRO

COMMAND FORM:

Append to Macro (PASSWORD) 29 (macro name, command)

This command is used to attach additional commands to a macro. The **macro name** must already exist in the directory. The stored information, shown above as **command**, may be a control command or another macro name (if you wish to chain together several macros).

Acknowledgment: OK

Errors: ? **ERR 1** = too few digits entered
? **NOT FOUND** = macro name does not exist in directory
? **TOO BIG** = command being entered exceeds the
storage area remaining for this macro

EXAMPLES:

Assume that a macro has been created to place an autopatch call, and that its name is **6A**. We wish to append a command that sends the CW message **BOB**, so that we will know who has been dialed when the macro is executed. To send **B O B** in CW, the command is (PASSWORD) 15 11 24 11*. Therefore enter the following command to do the append.

(PASSWORD) 29 006A (PASSWORD) 15 11 24 11 *

Note that a macro must already exist before the additional command may be appended to it. See the **Create New Macro** command.

Commands may be appended to a macro until the storage space for that macro is used up. If more commands must be added, append a new macro to the old macro and continue appending commands to the new macro.

Note that the message **OK** simply indicates that the **Append to Macro** command was entered correctly, and that some digits were appended to the macro. It does not guarantee that the stored digits represented an executable command. Therefore, it is possible to store **garbage** digits in a macro as easily as legitimate commands.

MACROS

• CREATE NEW MACRO

COMMAND FORM:

Create New Macro (PASSWORD) 20 (macro name, command) *

This command is used to create a new macro. A **new** macro is a macro with a name that has not been used before. This command places the digits following the **macro name** into a storage area in the controllers memory. It places the **macro name** into a directory. The digits that are stored, shown above as **command**, may be a control command or another macro name (if you wish to chain together several macros).

Acknowledgment: OK

Errors: ? ERR 1 = too few digits entered

? NAME USED = macro name already exists in directory

? DIR FULL = directory is filled with maximum number of macros

? TOO BIG = command being entered exceeds the storage area allowed for a macro

Default Condition: no macros exist

EXAMPLES:

Assume that we wish to place an autopatch call using a macro to save time. The telephone number is 987-6543, the autopatch access password is 10, and the desired macro name is 6A (our imaginary operator has a 16-button tone pad). Enter the following command:

(PASSWORD) 20 006A 10 9876543 *

After this has been accomplished, the operator has only to enter **6A*** to place the call.

If a CW message is desired to accompany the autopatch access, use the **Append to Macro** command to add and additional command to macro **6A**.

Note that the message **OK** simply indicates that the **Create New Macro** command was entered correctly, and that some digits were stored under the desired macro name. It does not guarantee that the stored digits represented and executable command. Therefore, it is possible to store **garbage** digits in a macro as easily as legitimate command.

MACROS

• ERASE MACRO

COMMAND FORM:

Erase Macro (PASSWORD) 21 (macro name) *

This command is used to erase an existing macro. The **macro name** must be entered using 4 digits. If the macro you are erasing has a shorter name, enter leading zeroes.

Acknowledgment: OK

Errors: ? ERR 1= wrong number of digits entered

? NOT FOUND = macro name does not exist in the directory

EXAMPLES:

Assume that a macro exists under the name **6A**, and that it contains two commands. One command places an autopatch call, and the other sends a CW message. To erase the macro enter the following:

(PASSWORD) 21 006A *

After this has been done, macro **6A** will no longer exist. The storage area used for the two commands within the macro will be released, and another macro may be created to take its place. The macro, **6A**, may be used as the name of a new macro, if desired; erasing the old macro removed its name from the directory.

MACROS

- **ERASE ALL MACROS**

COMMAND FORM:

Erase All Macros (PASSWORD) 22 00 *

This command is used to erase all existing macros. **USE WITH CARE!!** If accidentally entered all macros will be lost! The zeroes in the command must be entered as a precaution to avoid accidents.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = zeroes were not entered

MACROS

• LIST MACRO

COMMAND FORM:

List Macro (PASSWORD) 33 (macro name)

This command is used to examine the contents of a macro. Entering the command causes the controller to list all digits stored in CW, with (*) sent as a fraction bar (/).

The **macro name** must be entered using 4 digits. If the macro you wish to list has a shorter name, enter the leading zeroes.

Acknowledgment: sends the contents of the macro in CW

Errors: ? ERR 1 = wrong number of digits entered
? NOT FOUND = macro name does not exist in directory.

EXAMPLES:

Assume that a macro has been created with the name **6A**, and that it contains two commands: one command places an autopatch call (10 9876543 *), and the other command sends a CW message ((PASSWORD) 15 11 24 11 *). To make the example clearer, assume that the password is 99. If we wish to examine macro **6A**, we would enter:

(PASSWORD) 33 006A *

The controller would send:

1 0 9 8 7 6 5 4 3 / 9 9 1 5 1 1 2 4 1 1 /

MACROS

• RENAME MACRO

COMMAND FORM:

Rename Macro (PASSWORD) 27 (old name, new name) *

This command is used to change the name of an existing macro. The digits stored under the macro's name are not affected. The macro names must be entered using 4 digits. If either (or both) is shorter than 4 digits, enter leading zeroes.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered

? NOT FOUND = the **old name** does not exist in the directory

? NAME USED = the **new name** already exists in the directory

EXAMPLES:

Assume that a macro exists under the name **6A**, and that we wish to change its name to **1000**. Enter the following command:

(PASSWORD) 27 006A 1000 *

Assume that we now wish to change its name to **789**. Enter the following command:

(PASSWORD) 27 1000 0789 *

Finally, let's change its name once more to simply **D**. Enter the following command:

(PASSWORD) 27 0789 000D *

Here is a wrapup of what we have done: Before its name was changed, the macro was executed by entering **6A**. After the first name change, it was executed by entering **1000 ***. After the second name change, it was executed by entering **789***. After the third name change, it was executed by entering **D**. You can see that a macro can have a short or a long name, and its name can be made up of numerals or letters (A, B, C, or D).

PAGING

• PAGING

COMMAND FORM:

Single-Tone Page (PASSWORD) 90 (tone code, duration) *
Two-Tone Page (PASSWORD) 90 (2 sequences as above) *

This command sends either a single-tone page or a two-tone page. Enter the 4-digit tone code, followed by the duration of the page in two digits representing 0.1 to 9.9 seconds. See pages 85-88 for the Tone Code Tables.

Acknowledgment: Sends the message

ERRORS: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal number of digits entered

EXAMPLES:

A convenient way to page repeater users in an emergency situation is to modify weather-band (162 MHz) receivers for 2 meters. These units are inexpensive and can remain ON in the users' shacks without tying up expensive equipment. To create the 1050-Hz tone needed, the tone code is 0952. Enter this command to send the tone for 8.0 seconds.

(PASSWORD) 90 0952 80 *

A two-tone page is sent similarly. Assume that we wish to send a tone of 349.0 Hz for 1.0 seconds, followed by a 433.7 Hz. tone for 3.0 seconds. The tone code for 349.0 Hz is 2865, and the tone code for 433.7 Hz is 2306. Enter this command.

(PASSWORD) 90 2865 10 2306 30 *

Since these commands are long, it would be more convenient to create macros with the most often used pages.

POWER ON

• EVENT-TRIGGERED MACRO

COMMAND FORM:

Event-Triggered Macro (PASSWORD) 2600 (macro name) *

This command assigns a macro to be executed when the controller goes through a warm startup. Enter a 4-digit macro name, using leading zeroes if the macro name is less than 4 digits long. To delete the assignment, enter no macro name.

Acknowledgment: OK

Errors: ERR 1 = wrong number of digits entered
ERR 2 = illegal digit entered

Default Condition: No macro is assigned

EXAMPLES:

This command is useful for initializing hardware at the repeater site following a power interruption. A macro can be created that momentarily switches on of the logical outputs; this macro is then triggered by a restart.

The command has no effect after a cold restart, since all macros are deleted anyway.

As an example of how this command may be used, assume that macro 3456* has been created. This command changes the CW frequently to a high pitch. To trigger this macro from a restart enter:

(PASSWORD) 2600 3456 *

If power at the repeater site should fail and return later, the controller will notify you since the CW pitch is now higher. You may enter a macro or a control command that changes the CW pitch back to normal, awaiting the next power "glitch".

SECURITY

• INTRODUCTION

One of the security features used by the controller is a **dual-password** system.

There are two levels of command privileges. The operators holding the **Master** password are the higher level group, since the **Master** password may be used with all control commands. The operators holding the **Control Operator** password are the lower level group, since their password only works with certain designated control commands. You may select the commands that are available to the **Control Operators**, which range from none to all commands.

The **Master** password and the **Control Operator** password may be 2, 4, or 6 digits long. The passwords may contain the numbers zero through nine, and the lettered keys A, B, C, and D.

Note: A third password used for autopatch access, is discussed in the **Autopatch** section.

SECURITY

COMMAND FORM:

Password (Control Operator) (PASSWORD) 92 (new password) *

This command assigns a new password for Control Operators. The **new password** may be 2, 4, or 6 digits in length, and may be any combination of the numbers 0 - 9 and the letters A - D.

Acknowledgment: OK

Errors: ? ERR 1

Default Condition: No password is assigned to Control Operators.

Password (Master) (PASSWORD) 93 (new password) *

This command assigns a new **Master** password. The **new password** may be 2, 4, or 6 digits in length, and may be any combination of numbers 0 - 9 and the letters A - D.

Acknowledgment: OK

Errors: ? ERR 1

Default Condition: The password defaults to 99.

Privilege Level (PASSWORD) 94 (root no., level) *

This command assigns a **privilege level** to a control command.

Enter the **root number** of the command, then a 0 or a 1:

0 = Command may be used by either password

1 = Command may be used only by the **Master** password

Acknowledgment: OK

Errors: ? ERR 1, ERR 2

Default Condition: All command may be used by either password

SECURITY

EXAMPLES

Assume that the present **Master** password is **99**, the default password. To change it to **1234**, enter this:

99 93 1234 *

The new password is 1234 at this time. To change it to 2A3B4C, enter this:

1234 93 2A3B4C *

Assume that there is no **Control Operator** password, the default condition. To assign it to **95**, enter this:

(PASSWORD) 92 95 *

(If the **Master** password is 2A3B4C, enter 2A3B4C92 95 *.)

Assume the **Control Operators** have full privileges, the default condition. To prevent control operators from changing either the **Master** password or the **Control Op** password, enter the following:

(PASSWORD) 94 92 1 * Root 92 is the **Control Op** password command.

(PASSWORD) 94 93 1 * Root 93 is the **Master** password command.

The **Privilege Level** command allows **Control Operators** limited access to repeater functions. The password may be changed as often as desired.

Note that since most telephones have 10- or 12-button DTMF pads, it will not be possible to control the repeater via landline if lettered characters are used for the passwords.

SQUELCH & CARRIER

- **INTRODUCTION**

There are a number of commands that control the repeater's squelch and carrier **personality**. We will define here the terms used in these commands.

- **COURTESY TIMER & MESSAGE**

When a transmitting station unkeys his/her microphone, a **COURTESY TIMER** starts. When his timer times out, a **COURTESY MESSAGE** is sent. At the same time, the repeater **TIMEOUT TIMER** is reset. The purpose of the courtesy message is to inform the next station that he may now transmit for the full duration of the timeout timer. The courtesy timer encourages stations to allow a short break in their transmissions, allowing other stations to break in.

- **DROPOUT TIMER & MESSAGE**

After the courtesy timer resets, another timer, the **DROPOUT TIMER**, starts. The **DROPOUT MESSAGE** will be sent, and the repeater transmitter will drop, when the dropout timer times out. This time is sometimes referred to as **hang time**.

- **TIMEOUT TIMER & MESSAGE**

If a station transmits for a period longer than the **TIMEOUT TIMER** is set for, the **TIMEOUT MESSAGE** will be sent and the repeater transmitter will drop. If a station can override the offending station and enter the **RESET TIMEOUT TIMER** command, the transmitter will return to the air and the timer will be reset. When the offending station releases his/her push-to-talk button (and no one has reset the timer for them), the **TIMEOUT MESSAGE** will be sent again to inform them that part of their transmission may have been lost.

All three timers, and all three messages, are fully programmable by the trustee. If, for example, the trustee does not wish to have any courtesy delay or courtesy message, he may delete both. In this case, the timer used for **TIMEOUT TIMER** will reset immediately upon the user dropping their carrier. See figure1 for a graphic representation of the timers.

MRC-100 TIMEOUT TIMERS

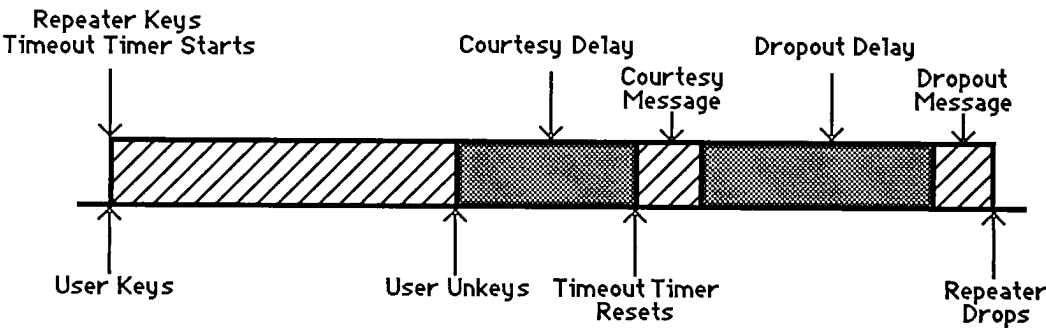


Figure 1

SQUELCH & CARRIER

• COURTESY MESSAGE

COMMAND FORM:

Courtesy Message (PASSWORD) 31 (message) *

This command assigns the courtesy message. The courtesy message is sent after the courtesy delay has elapsed. The message may be up to 25 CW characters in length.

Acknowledgment: Sends the courtesy message or **OK** if none

Errors: ? **ERR 1** = too many digits entered
 ? **ERR 2** = illegal digit entered

Default Condition: Courtesy message = beep 1, 60 mS

Examples:

Since courtesy messages are sent on every transmission, it may be best to keep them short and unobtrusive. Here is a triple "beep" courtesy message:

(PASSWORD) 31 75 85 95 *

Some repeater groups prefer the single letter "K":

(PASSWORD) 31 20 *

To delete the courtesy message completely, enter no message:

(PASSWORD) 31 *

SQUELCH & CARRIER

• COURTESY TIMER

COMMAND FORM:

Courtesy Timer (PASSWORD) 32 (0.0-5.0 seconds)

This command programs the courtesy time. The courtesy time is the delay from COR drop to the timer reset (and courtesy message). Enter two digits from 00 to 50 representing a delay from 0.0 to 5.0 seconds.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default Condition: Courtesy timer = 0.5 seconds

EXAMPLES:

A generous amount of courtesy time forces repeater users to delay their transmissions, thus allowing other stations to break into the conversation. This is something referred to as an **anti-tailgating** measure. A station that ignores the courtesy message (indicating that the timeout timer has been reset) runs the risk of timing out the repeater. He will have to repeat the portion of his transmission that was lost.

To program the courtesy timer for 1.4 seconds, for example, enter this command:

(PASSWORD) 32 14 *

Some repeater groups prefer no courtesy time; that is, the timeout timer resets as soon as the COR drops. The courtesy message may also be erased.

To program the courtesy timer for zero delay, enter this command:

(PASSWORD) 32 00 *

SQUELCH & CARRIER

• DROPOUT MESSAGE

COMMAND FORM:

Dropout Message (PASSWORD) 34 (message) *

This command assigns the dropout message. The dropout message is sent just before the transmitter is unkeyed. The message may be up to **25** CW characters in length.

Acknowledgment: Sends the dropout message, or OK if none

Errors: ? **ERR 1** = too many digits entered
 ? **ERR 2** = illegal digit entered

Default Condition: No message

EXAMPLES:

Dropout messages are sent just before the repeater transmitter is unkeyed. Thus, they are not sent as often as courtesy messages, which are sent at the end of each transmission. Dropout messages may be short announcements, such as a weather reminder.

To program the message **WX** (weather alert) into the dropout message, enter the following command:

(PASSWORD) 34 32 33 *

To delete the dropout message completely, enter no message:

(PASSWORD) 34 *

SQUELCH & CARRIER

• DROPOUT TIMER

COMMAND FORM:

Dropout Timer (PASSWORD) 30 (0.0-5.0 seconds) *

This command programs the dropout timer. The dropout time is the delay from the end of the courtesy timer/courtesy message (and timeout timer reset) to the moment the transmitter is unkeyed. Enter the two digits from 00 to 50 representing a delay from 0.0 to 5.0 seconds.

Acknowledgment: OK

Errors: ? ERR 1 = wrong number of digits entered
 ? ERR 2 = illegal digit entered

Default Condition: Dropout timer = 3.0 seconds

EXAMPLES:

Owners of tube-type repeater sometimes use long dropout timer to lengthen the lives of tubes and relays. Fewer transmitter keying transitions occur, since the users will keep the transmitter up for the duration of the conversation. The dropout time for solid-state repeaters is mostly up to personal preference.

To program the dropout timer for 2.1 seconds, for example, enter this command:

(PASSWORD) 30 21 *

To program the dropout timer for minimum time, enter the following:

(PASSWORD) 30 00 *

SQUELCH & CARRIER

- **PRE-TIMEOUT MESSAGE**
- **POST TIMEOUT MESSAGE**

COMMAND FORM:

Pre-Timeout Message (PASSWORD) 41 (message) *
Post-Timeout Message (PASSWORD) 44 (message) *

These command assign the COR **Pre-Timeout** and **Post-Timeout Messages**. Each message may contain up to 25 CW characters.

Acknowledgment: sends the programmed message, or **OK** if none

Errors: ? ERR 1 = too many digits entered
 ? ERR 2 = illegal digit entered

Default Condition: both messages default to **TO** (Time Out)

• **EXAMPLES**

The **Pre-Timeout Message** is sent just before the repeater transmitter is taken off the air due to an incoming signal that exceeds the **Timeout**. The purpose of the message is to inform the listening stations of the reason for the repeater dropping out. The offending station cannot hear the message, since he is operating in half-duplex.

The **Post-Timeout Message** is sent after the offending station is unkeys. The purpose of the message is to inform the station the he has timer-out the repeater, and that some of his comments have been lost.

To program **8 beeps** as the **Pre-Timeout Message**, enter:

(PASSWORD) 41 75 95 75 95 75 95 75 95 *

To program **WINDY** as the **Post-Timeout Message**, enter:

(PASSWORD) 44 32 18 23 13 34 *

Other possible messages include **??**, **TIME**, and various beeps, and CW messages with frequency and speed changes.

SQUELCH & CARRIER

• TIMEOUT TIMER

COMMAND FORM:

Timeout Timer (PASSWORD) 40 (0.1-9.9 min/00=infinity)

This command programs the **Timeout Timer**. The timeout timer starts when the COR signal is received, and continues to run until reset. It can be reset either by command, or by releasing the COR signal until the courtesy time elapses. Enter two digits from 01 to 99 representing the desired time from 0.1 to 9.9 minutes. Enter **00** to eliminate the timer (time = infinity).

Acknowledgment: OK

Errors: **ERR 1** = wrong number of digits entered
 ERR 2 = illegal digit entered

Default Condition: Timeout timer = 3.0 minutes

EXAMPLES:

To set the timeout timer to 4.5 minutes, enter this command:

(PASSWORD) 40 45 *

To disable the timeout timer, enter this command:

(PASSWORD) 40 00 *

SQUELCH & CARRIER

• TIMEOUT TIMER RESET

COMMAND FORM:

Timeout Timer Reset (PASSWORD) 10 *

This command resets the timeout timer. If the timeout timer has been exceeded, this command will allow the transmitter to be keyed by the COR.

Acknowledgment: none

Errors: none

EXAMPLES:

If the transmitting station has caused a timeout to occur, the receiving station may be able to bring the transmitter back up. It would require the receiving station to be able to override the offending station at the repeater site.

Entering this command will reload the timer as well as return the repeater transmitter to the air.

TRANSMITTER

• TRANSMITTER

COMMAND FORM:

Disable	(PASSWORD) 00 *
Enable	(PASSWORD) 01 *

These commands enable or disable the repeater transmitter. If the transmitter is disabled, the receiver may still receive commands.

Acknowledgment: none

Errors: wrong number of digits entered (disable only)

Default Condition: enabled

MISCELLANEOUS

• PAUSE

COMMAND FORM:

Pause (PASSWORD) 98 (1-255 seconds) *

This command causes the controller to stop the execution of the commands that follow for the programmed amount of time. This causes a delay to occur between commands.

Acknowledgment: none

Errors: ERR 1 = wrong number of digits entered
ERR 2 = illegal digit entered

Default Condition: no pause

EXAMPLES:

A pause may be useful for certain occasions. For example, the autopatch access macro may turn on a tape recorder via one of the logic outputs; the autopatch dump macro may turn the tape recorder off. If a **PAUSE** command is inserted into the autopatch dump macro before the logic output command, then the recorder will be turned off some time after the autopatch is dumped. The tape recorder will then record the autopatch user's identification.

To delay command execution 2 seconds, enter:

(PASSWORD) 98 2 *

To delay command execution 10 seconds, enter:

(PASSWORD) 98 10 *

Very long delays are not recommended, as the controller will not store commands input via the repeater or control receiver during this time. However, macro execution will not be affected, and pause commands may be stored as desired strings of macros.

MISCELLANEOUS

• COMMAND RESPONSES

COMMAND FORM:

Command Responses (PASSWORD) 91 (0=OFF/1=ON) *

This command turns **ON** or **OFF** the CW response messages.

Acknowledgment: OK

Errors: ERR 1 = wrong number of digits entered
ERR 2 = illegal digit entered

Default Condition: command responses are on

EXAMPLES:

Command Responses are the CW messages that are sent to assist the programmer. Most commands send **OK** when properly entered, although some send back the actual message that was entered. Other responses include the various error messages that indicate bad data or incorrect number of keystrokes.

When commands are placed into macros, these response messages may be undesirable. To turn them **OFF**, enter:

(PASSWORD) 91 0 *

To turn them back **ON**, enter:

(PASSWORD) 91 1 *

MISCELLANEOUS

• COMMAND TERMINATION

COMMAND FORM:

Command Termination (PASSWORD) 99 (00=*)/0.1-9.9 seconds) *

This command allows commands to be terminated by requiring the * character, or by releasing the push-to-talk button (COR drop). The * character will terminate a command in either case. If the COR drop method is desired, enter two digits representing the amount of time after COR drop is sensed that the command will be executed. If the * character method is desired, enter 00.

Acknowledgment: OK

Errors: ERR 1 = wrong number of digits entered
ERR 2 = illegal digit entered

Default Condition: * character required to terminate all commands

EXAMPLES:

If desired, users can simply enter a command and release the push-to-talk button instead of entering the * character after every command. If a time delay of 1.0 seconds after COR drop is required, enter:

(PASSWORD) 99 10 *

Remember, the * character can still be used to terminate a command. This is important if weak signals are holding the COR up.

At the present, delays greater than a few seconds are not possible in the COR drop mode. Since some time delays are involved in dropping the user's transmitter, the controller may time out the command since no DTMF digits were received in the 5 seconds allowed.

• TONE CODES

• INTRODUCTION

When programming tone frequencies for CW message, beeps, or tone paging, a **tone code** is entered to represent the frequency. The **TONE CODE TABLE** lists frequencies from 100 Hertz through 3000 Hertz in 5 Hertz increments, and the appropriate code for each one. The **PAGE TONE CODE TABLE** lists the standard Motorola 2-tone sequential page tone frequencies, and the appropriate code for each one.

• APPLICATIONS NOTE

The tone codes are actually 4-digit numbers representing the period of the tone waveform in microseconds. To determine the tone codes for the frequencies not listed in the tables, simply divide 1,000,000 by the frequency in Hertz. The quotient, rounded to 4 digits, is the tone code. Digits after the decimal point are ignored. Leading zeroes must be inserted if the quotient is 999 or less. Here are some examples:

Example 1. The desired frequency is 1200 Hertz. What is the tone code?

Dividing 1,000,000 by 1200 yields 833.3, so the code is 0833.

Example 2. The desired single-tone page frequency is 1050 Hertz. What is the tone code?

Dividing 1,000,000 by 1050 yields 952.4, so the code is 0952.

Example 3. The desired paging tone is 398.1 Hertz. What is the tone code?

Dividing 1,000,000 by 398.1 yields 2511.9, so the code is 2512.

The system allows the programming of many different tone frequencies. The resolution (ability to program an exact frequency) is higher at the lower frequencies, where it is needed. At 3000 Hertz, the resolution is about 10 Hertz.

TONE CODE TABLE

<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>
100	9999	300	3333	500	2000	700	1429	900	1111
105	9524	305	3279	505	1980	705	1418	905	1105
110	9091	310	3226	510	1961	710	1408	910	1099
115	8696	315	3175	515	1942	715	1399	915	1093
120	8333	320	3125	520	1923	720	1389	920	1087
125	8000	325	3077	525	1905	725	1379	925	1081
130	7692	330	3030	530	1887	730	1370	930	1075
135	7407	335	2985	535	1869	735	1361	935	1070
140	7143	340	2941	540	1852	740	1351	940	1064
145	6897	345	2899	545	1835	745	1342	945	1058
150	6667	350	2857	550	1818	750	1333	950	1053
155	6452	355	2817	555	1802	755	1325	955	1047
160	6250	360	2778	560	1786	760	1316	960	1042
165	6061	365	2740	565	1770	765	1307	965	1036
170	5882	370	2703	570	1754	770	1299	970	1031
175	5714	375	2667	575	1739	775	1290	975	1026
180	5556	380	2632	580	1724	780	1282	980	1020
185	5405	385	2597	585	1709	785	1274	985	1015
190	5263	390	2564	590	1695	790	1266	990	1010
195	5128	395	2532	595	1681	795	1258	995	1005
200	5000	400	2500	600	1667	800	1250	1000	1000
205	4878	405	2469	605	1653	805	1242	1005	0995
210	4762	410	2439	610	1639	810	1235	1010	0990
215	4651	415	2410	615	1626	815	1227	1015	0985
220	4545	420	2381	620	1613	820	1220	1020	0980
225	4444	425	2353	625	1600	825	1212	1025	0976
230	4348	430	2326	630	1587	830	1205	1030	0971
235	4255	435	2299	635	1575	835	1198	1035	0966
240	4167	440	2273	640	1563	840	1190	1040	0962
245	4082	445	2247	645	1550	845	1183	1045	0957
250	4000	450	2222	650	1538	850	1176	1050	0952
255	3922	455	2198	655	1527	855	1170	1055	0948
260	3846	460	2174	660	1515	860	1163	1060	0943
265	3774	465	2151	665	1504	865	1156	1065	0939
270	3704	470	2128	670	1493	870	1149	1070	0935
275	3636	475	2105	675	1481	875	1143	1075	0930
280	3571	480	2083	680	1471	880	1136	1080	0926
285	3509	485	2062	685	1460	885	1130	1085	0922
290	3448	490	2041	690	1449	890	1124	1090	0917
295	3390	495	2020	695	1439	895	1117	1095	0913

TONE CODE TABLE

<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>
1100	0909	1300	0769	1500	0667	1700	0588	1900	0526
1105	0905	1305	0766	1505	0664	1705	0587	1905	0525
1110	0901	1310	0763	1510	0662	1710	0585	1910	0524
1115	0897	1315	0760	1515	0660	1715	0583	1915	0522
1120	0893	1320	0758	1520	0658	1720	0581	1920	0521
1125	0889	1325	0755	1525	0656	1725	0580	1925	0519
1130	0885	1330	0752	1530	0654	1730	0578	1930	0518
1135	0881	1335	0749	1535	0651	1735	0576	1935	0517
1140	0877	1340	0746	1540	0649	1740	0575	1940	0515
1145	0873	1345	0743	1545	0647	1745	0573	1945	0514
1150	0870	1350	0741	1550	0645	1750	0571	1950	0513
1155	0866	1355	0738	1555	0643	1755	0570	1955	0512
1160	0862	1360	0735	1560	0641	1760	0568	1960	0510
1165	0858	1365	0733	1565	0639	1765	0567	1965	0509
1170	0855	1370	0730	1570	0637	1770	0565	1970	0508
1175	0851	1375	0727	1575	0635	1775	0563	1975	0506
1180	0847	1380	0725	1580	0633	1780	0562	1980	0505
1185	0844	1385	0722	1585	0631	1785	0560	1985	0504
1190	0840	1390	0719	1590	0629	1790	0559	1990	0503
1195	0837	1395	0717	1595	0627	1795	0557	1995	0501
1200	0833	1400	0714	1600	0625	1800	0556	2000	0500
1205	0830	1405	0712	1605	0623	1805	0554	2005	0499
1210	0826	1410	0709	1610	0621	1810	0552	2010	0498
1215	0823	1415	0707	1615	0619	1815	0551	2015	0496
1220	0820	1420	0704	1620	0617	1820	0549	2020	0495
1225	0816	1425	0702	1625	0615	1825	0548	2025	0494
1230	0813	1430	0699	1630	0613	1830	0546	2030	0493
1235	0810	1435	0697	1635	0612	1835	0545	2035	0491
1240	0806	1440	0694	1640	0610	1840	0543	2040	0490
1245	0803	1445	0692	1645	0608	1845	0542	2045	0489
1250	0800	1450	0690	1650	0606	1850	0541	2050	0488
1255	0797	1455	0687	1655	0604	1855	0539	2055	0487
1260	0794	1460	0685	1660	0602	1860	0538	2060	0485
1265	0791	1465	0683	1665	0601	1865	0536	2065	0484
1270	0787	1470	0680	1670	0599	1870	0535	2070	0483
1275	0784	1475	0678	1675	0597	1875	0533	2075	0482
1280	0781	1480	0676	1680	0595	1880	0532	2080	0481
1285	0778	1485	0673	1685	0593	1885	0531	2085	0480
1290	0775	1490	0671	1690	0592	1890	0529	2090	0478
1295	0772	1495	0669	1695	0590	1895	0528	2095	0477

TONE CODE TABLE

<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>	<u>FREQ</u>	<u>CODE</u>
2100	0476	2300	0435	2500	0400	2700	0370	2900	0345
2105	0475	2305	0434	2505	0399	2705	0370	2905	0344
2110	0474	2310	0433	2510	0398	2710	0369	2910	0344
2115	0473	2315	0432	2515	0398	2715	0368	2915	0343
2120	0472	2320	0431	2520	0397	2720	0368	2920	0342
2125	0471	2325	0430	2525	0396	2725	0367	2925	0342
2130	0469	2330	0429	2530	0395	2730	0366	2930	0341
2135	0468	2335	0428	2535	0394	2735	0366	2935	0341
2140	0467	2340	0427	2540	0394	2740	0365	2940	0340
2145	0466	2345	0426	2545	0393	2745	0364	2945	0340
2150	0465	2350	0426	2550	0392	2750	0364	2950	0339
2155	0464	2355	0425	2555	0391	2755	0363	2955	0338
2160	0463	2360	0424	2560	0391	2760	0362	2960	0338
2165	0462	2365	0423	2565	0390	2765	0362	2965	0337
2170	0461	2370	0422	2570	0389	2770	0361	2970	0337
2175	0460	2375	0421	2575	0388	2775	0360	2975	0336
2180	0459	2380	0420	2580	0388	2780	0360	2980	0336
2185	0458	2385	0419	2585	0387	2785	0359	2985	0335
2190	0457	2390	0418	2590	0386	2790	0358	2990	0334
2195	0456	2395	0418	2595	0385	2795	0358	2995	0334
2200	0455	2400	0417	2600	0385	2800	0357	3000	0333
2205	0454	2405	0416	2605	0384	2805	0357		
2210	0452	2410	0415	2610	0383	2810	0356		
2215	0451	2415	0414	2615	0382	2815	0355		
2220	0450	2420	0413	2620	0382	2820	0355		
2225	0449	2425	0412	2625	0381	2825	0354		
2230	0448	2430	0412	2630	0380	2830	0353		
2235	0447	2435	0411	2635	0380	2835	0353		
2240	0446	2440	0410	2640	0379	2840	0352		
2245	0445	2445	0409	2645	0378	2845	0351		
2250	0444	2450	0408	2650	0377	2850	0351		
2255	0443	2455	0407	2655	0377	2855	0350		
2260	0442	2460	0407	2660	0376	2860	0350		
2265	0442	2465	0406	2665	0375	2865	0349		
2270	0441	2470	0405	2670	0375	2870	0348		
2275	0440	2475	0404	2675	0374	2875	0348		
2280	0439	2480	0403	2680	0373	2880	0347		
2285	0438	2485	0402	2685	0372	2885	0347		
2290	0437	2490	0402	2690	0372	2890	0346		
2295	0436	2495	0401	2695	0371	2895	0345		

INITIALIZE PUSHBUTTON

The **Initialize** pushbutton is used to force the **MRC-100** into the **default** state. Pin 5 of the Input/Output connector may be wired to an external **INITIALIZE** Switch, as it is wired in parallel to the board-mounted pushbutton. The switch should appear between pin 5 and digital ground.

The controller checks the state of the **INITIALIZE** pushbutton every time it is powered up (reset). If the button is pressed during power-up, the controller will do a **cold** start and force the default conditions. If the button is not pressed (and the external switch is open), the controller will do a **warm** start and retain previous memory contents.

It is important to **INITIALIZE** the controller when it is installed for the first time, and any time either the RAM IC or EPROM IC has been changed.

Why are there two start modes? One reason is that the controller must assume many things when it is initially installed, or a lot of programming will have to be done at the site. Therefore, it will assume that the ID callsign is simply **ID**. It assumes that there are no macros; that the autopatch should be turned off; that the timeout timer should be 3.0 minutes; and so on. Pressing the **INITIALIZE** button during power-up ensures these conditions. After installation, you will **customize** the repeater operation by entering commands into the controller. The default information will be replaced by your command information.

To keep this customized information intact, the controller will not use default information after initialization. Be sure the external **INITIALIZE** switch, if used, is left in the open position when you are not actually performing an initialization.

Another reason for initializing the controller might occur if the control operator loses track of what he has entered, or forgets the passwords. An initialization always forces the default conditions indicated in the command descriptions.

When powered up, the controller will send a CW message. If an initialization (cold start) is being done, the message will be:

? RES C

? RES means reset, and **C** means cold. If no initialization is being done, the message will be:

? RES

LANDLINE BUSY INPUT/OUTPUT

The **LANDLINE BUSY** input (pin 17) and **LANDLINE BUSY** output (pin 15) are used to communicate the telephone line status to the external devices at the repeater site, and to communicate telephone line status from the external devices to the controller.

When an autopatch command is received by the **MRC-100**, it will check the **LANDLINE BUSY INPUT** before dialing the phone number. If this input is low, the call is not allowed. Therefore, the autopatch phone line may be shared between the controller and another device, or among several controllers.

If the autopatch call is permitted, the controller will force the **LANDLINE BUSY OUTPUT** to go low. This signals other devices that the landline is in use. When the autopatch call is dumped, the output returns high. Another device may now use the line.

The **LANDLINE BUSY INPUT** has a pullup resistor and is diode protected from reverse polarity. The **LANDLINE BUSY OUTPUT** switching device is a power MOSFET connected as an open-drain output. A pullup resistor may be soldered into the board at location **RA** if TTL compatibility is desired.

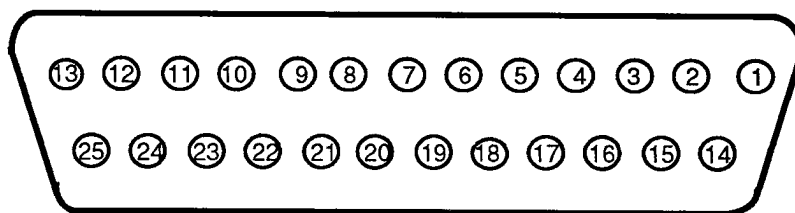
To share the one phone line with several controllers, connect all **LANDLINE BUSY INPUTs** and **LANDLINE BUSY OUTPUTs** together.

The **LANDLINE BUSY OUTPUT** will go low for reverse autopatches as well as standard autopatches.

POTENTIOMETER ABBREVIATIONS

SQL	Squelch
LLAGC	Landline AGC
PG TX	Page-to-Transmitter level
CW LL	CW-to-Landline level
CT TT	Control Receiver-to-Touch Tone™ Decoder level
CTCSS	Tone-Controlled Squelch System (Subaudible) Encode level
LL TX	Landline-to-Transmitter level
CW TX	CW-to Transmitter level
TT LL	Touch Tone™-to-Landline (DTMF Encoder) level
LL TT	Landline-to-Touch Tone™ Decoder level
RX TX	Receiver-to-Transmitter (repeat) audio level
TT TX	Touch Tone™-to-Transmitter level (DTMF) paging
RX LL	Receiver-to-Landline level
RX TT	Receiver-to-Touch™ decoder level

INPUT/OUTPUT CONNECTOR



A 25-position female **D** subminiature connector is mounted on the MRC-100 controller. The pin positions are illustrated above. Use a mating 25-position male **D** subminiature connector on the cable.

The chart below indicates the connector pinout.

PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	Logic Output Number 1	14	Transmitter Push-To-Talk
2	Logic Output Number 2	15	Landline Busy Output
3	Logic Input	16	Rptr. Receiver C.O.R.
4	Control Receiver C.O.R.	17	Landline Busy Input
5	External Initialize Switch	18	Digital Ground
6	Digital Ground	19	Analog Ground
7	Analog Ground	20	CTCSS Encoder Output
8	Control Receiver Audio	21	CTCSS Decoder Input
9	Rptr. Receiver Audio (-)	22	Rptr. Receiver Discrim. (-)
10	Analog Ground	23	Rptr. Rcvr. 600 Ω Common
11	Repeater Receiver 600 Ω	24	Analog Ground
12	Transmitter Audio HI-Z	25	Transmitter Audio 600 Ω
13	Transmitter Audio Common		

TRANSMITTER AUDIO CONNECTION

If the transmitter requires 600-ohm balanced audio, connect the transmitter audio to pins 13 and 25 of the **MRC-100** via shielded twisted pair cable. The lower potential should go to pin 13. If unbalanced (single-ended) audio is required, connect pin 13 to one of the analog ground pins nearby (pins 10 or 24).

TRANSMITTER P.T.T CONNECTION

The transmitter P.T.T. (Push-to-Talk or **keyline**) circuit is brought out to pin 14 of the controller. The switching device is a power MOSFET capable of sinking over 1 Amp in the ON state, and withstanding 75 volts in the OFF state. The device appears as a 2-ohm resistance to ground in the ON state, allowing a very low on-state voltage compatible with logic-controlled transmitters. The output is supplied as an open-drain connection to the MOSFET, which goes low to key the transmitter. If TTL compatibility is desired, a pullup resistor may be soldered to the board at points labeled **RD**.

POWER SUPPLY

The **MRC-100** can operate from 8 to 15 volts DC, and draws approximately 290 mA. A wall mounted power supply, included in some **MRC-100** configurations, fulfills this requirement.

• OPERATION FROM OTHER POWER SUPPLIES

If the wall-mount power supply is not used, the on-board regulator may have to be jumpered out. The jumper is labeled **REG IN OUT**.

1. If the external voltage to be applied is 12.5 to 15 volts DC, no changes are required. The on-board regulator will be used, and the jumper will stay in the **IN** position. The unit is supplied from the factory with the jumper in this position.
2. If the external voltage to be supplied is 8 to 12.5 volts, remove The jumper from the **IN** to the center hole. Move it so that it connects the center hole to **OUT**. A soldering pencil is required.
3. If the external voltage to be supplied is under 9 volts DC, the regulator on the optional CTCSS Decoder Module will have to be bypassed. See the instruction sheet supplied with this option.



Do not operate the controller from power supplies exceeding 15 volts DC. The on-board transient suppressor may conduct and cause excessive power supply current to flow.

EMERGENCY BATTERY BACK-UP

An external battery may be connected to the **BATT** jack using a 2.1-mm plug. The battery is diode isolated from the **POWER** jack connection. A smooth switchover will occur when the main power is lost.

The wall-mount supply, included with some **MRC-100** configurations, delivers approximately 13.8 volts under the typical 290 mA load presented by the board. Since the isolation diode has a 0.7-volt drop, the external battery voltage may be 14.5 volts or less. A voltage greater than this value will cause the battery to be discharged even during non-emergency conditions.

PARTS LIST

1/2-WATT RESISTORS

22 ohms	2	R1,R2
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1/4-WATT RESISTORS

68 ohms	1	R63
100 ohms	1	R18
390 ohms	1	R91
560 ohms	2	R11,R100
620 ohms	1	R101
1K ohms	7	R37,R39,R59,R60,R64,R65,R97
1.5K ohms	1	R5
2.2K ohms	3	R3,R4,R29
3.3K ohms	1	R46
4.7K ohms	10	R6,R81,R82,R84,R85,R87,R88,R94,R95,R96
8.2K ohms	2	R31,R33
10K ohms	15	R40,R43,R44,R45,R49,R50,R53,R61,R62,R80,R83, R86,R89,R90,R93
18K ohms	8	R9,R10,R23,R24,R25,R26,R27,R28
22K ohms	4	R7,R12,R20,R41
27K ohms	3	R22,R32,R34
36K ohms	2	R15,R16
33K ohms	1	R68
47K ohms	8	R21,R38,R42,R52,R70,R73,R74,R75
68K ohms	1	R8
100K ohms	19	R13,R17,R19,R30,R35,R36,R48,R51,R54,R55,R56, R57,R58,R66,R71,R72,R76,R77,R78
220K ohms	4	R47,R69,R79,R92
300K ohms	1	R67
680K ohms	1	R14

RESISTOR NETWORKS

4.7K ohms 10-pin	4	RN1,RN2,RN3,RN4
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POTENTIOMETERS

5K ohms	1	P1
50K ohms	12	P3,P4,P5,P6,P7,P8,P9,P10,P11,P12,P13,P14

CAPACITORS

18 pF ceramic	2	C86,C87
27 pF ceramic	1	C61
47 pF ceramic	2	C28,C41
220 pF ceramic NPO	1	C29
390 pF ceramic NPO	3	C6,C10,C11

0.001 uF film	7	C9,C12,C13,C16,C17,C26,C27
0.0015 uF film	1	C5
0.0047 uF film	3	C7,C36,C37
0.01 uF film	2	C8,C19
0.047 uF film	2	C18,C43
0.1 uF film	6	C25,C38,C39,C42,C45,C49
0.1 uF ceramic	38	C14,C15,C22,C23,C24,C30,C31,C34,C40,C44,C50, C51,C55,C56,C57,C58,C60,C64 thru C70,C72 thru C82,C85,C88,C89
0.22 uF film	1	C35
0.47 uF film	5	C52,C53,C54,C83,C84
0.47 uF film 250V	1	C1
1.0 uF tantalum	3	C21,C47,C59
4.7 uF tantalum	5	C32,C33,C46,C62,C63
10 uF tantalum	5	C3,C4,C20,C48,C71
10 uF elect'c 50V	1	C2

DIODES

1N914/1N4148	17	D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12,D18, D19,D20,D21,D22
1N4002	1	D15
1N4732 4.7V 1 W zener	2	D24,D25
1N5228B 3.9V ½W zener	1	D13
HSCH1001/1N6263	3	D14,D16,D17
Red LED	1	LED1

SURGE ARRESTORS

DSA-301LS gas tube	1	GT1
MPTE-15	1	TZ1
SA40A	3	TZ4,TZ5,TZ6
SA75A	1	TZ7

TRANSISTORS

2N3904	9	Q2,Q5,Q7,Q8,Q10,Q11,Q16,Q17,Q18
MPS2907A	1	Q9
RFP2N12L power MOSFET	1	Q15
VN10KM/MPF10LM " "	3	Q12,Q13,Q14

VOLTAGE REGULATORS

LM320LZ-5.0	1	Q1
LM340T-5/7805	1	Q6
LM340T-10/7810	1	Q3

INTEGRATED CIRCUITS

LCA110	1	IC1
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OCI871	1	IC2
TCM1520A	1	IC3
Si7661	1	IC4
MF6CN-50	1	IC5
LM13080	1	IC6
LF444	3	IC7, IC8, IC9
74C906	1	IC10
74HC374	2	IC11, IC20
MT8870B	1	IC12
CD4051	2	IC13, IC15
CD4053	2	IC14, IC16
MT5089	1	IC17
74HC138	2	IC18, IC21
74HC259	2	IC19, IC24
74HC10	1	IC22
HM6264LP-15	1	IC23
74HC00	2	IC25, IC28
27128	1	IC26
74HC251	1	IC27
6340/68SC40	1	IC29
74HC423	1	IC30
6809	1	IC31
CLM-6500	1	CLM6500

CONNECTORS

6-pin IC socket	2	
8-pin IC socket	3	
14-pin IC socket	8	
16-pin IC socket	11	
18-pin IC socket	1	
20-pin IC socket	2	
28-pin IC socket	3	
40-pin IC socket	1	
2-pin male header	3	BATT, RX DE-EM, 600
3-pin male header	4	CTCSS IN, FILTER IN/OUT, COR INT/EXT, CTCSS DECODE
modular telephone	1	PHONE
DB-25S right angle PC	1	I/O CONN
2.1 mm power jack	2	BATT, DC POWER
header jumpers	4	

TRANSFORMERS

13645	1	TR1
13649	2	TR2, TR3

CRYSTALS

3.579545 MHz	1	Y1
4.0000	1	Y2

HARDWARE

#4-40 x 3/8 mach screw	2	DB25-to-PCB mounting
#4-40 x 1/4 mach screw	6	cabinet cover (black or plated)
#4 internal lockwasher	6	front panel-to-cabinet, DB25 mounting
#4-40 hex nut	6	front panel to cabinet, DB25 mounting
#6-32 x 3/8 mach screw	3	heat sinks for regulators
#6-32 x 1/4 mach screw	6	PCB-to-cabinet mounting
#6 internal lockwasher	4	heat sinks, chassis ground
#6-32 hex nut	3	heat sinks

MISCELLANEOUS

PC board	1	
Large ferrite bead	4	FB1,FB2,FB4,FB5
Small ferrite bead	22	FB8,FB9,FB10,FB11,FB12,FB13,FB14,FB15,FB16, FB17,FB18,FB19,FB20,FB21,FB22,FB23,FB24,FB25, FB26,FB27,FB28,FB29
Pushbutton	1	SW1
Lithium battery	1	BATTERY
Heat sink	3	for Q3,Q6,Q15
Mounting pad	1	for LED1
Cabinet	1	desktop or rackmount
Wire jumper	1	REG IN

COR SENSE REVERSAL

The MRC-100's repeater receiver COR input and control receiver COR input require "low true" signals. "Low true" means that the input must see a low-level voltage (less than 2.1 volts) when a carrier is present (unsquelched condition). The input must see a high-level voltage (over 2.1 volts) when no carrier is present (squelched condition).

Some receivers provide "high true" COR signals, which is the reverse of the above description. This applications note explains the change that must be made to the MRC-100 to accomodate "high true" COR circuits.

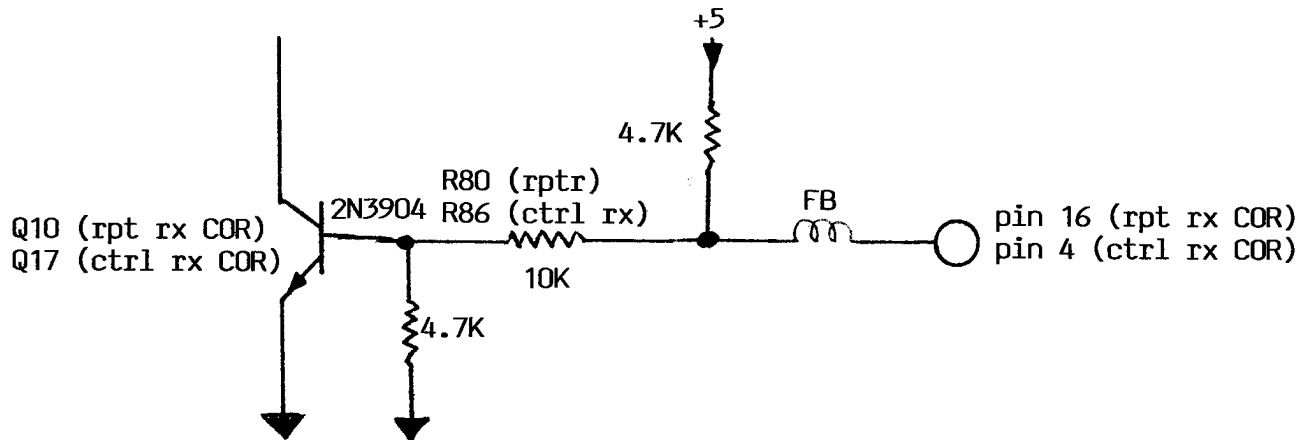
A. To reverse the sense of the repeater receiver COR:

1. Remove Q10, a 2N3904 NPN transistor. Replace it with a 2N3906 or MPS2907 PNP transistor, swapping the emitter & collector.
2. Remove R80, a 10K $\frac{1}{4}$ -watt resistor. Replace it with a 1K $\frac{1}{4}$ -watt resistor.
3. The repeater receiver COR must be capable of driving a 6K ohm load. Do not apply COR signals greater than 12 volts to the controller's COR input.

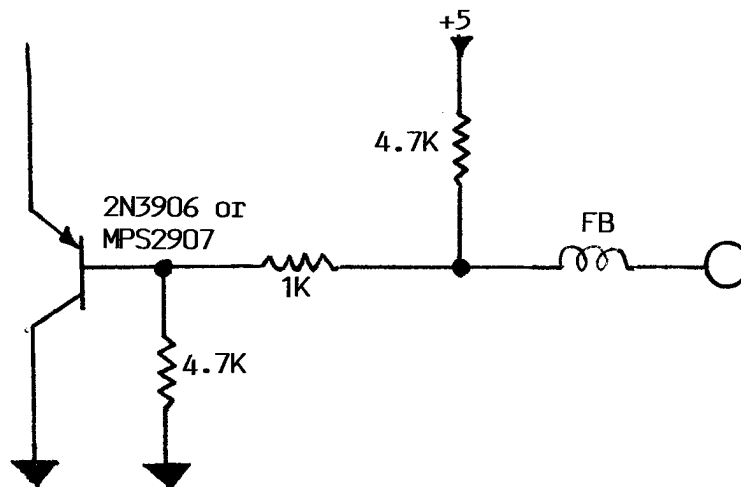
B. To reverse the sense of the control receiver COR:

1. Remove Q17, a 2N3904 NPN transistor. Replace it with a 2N3906 or MPS2907 PNP transistor, swapping the emitter & collector.
2. Remove R86, a 10K $\frac{1}{4}$ -watt resistor. Replace it with a 1K $\frac{1}{4}$ -watt resistor.
3. The control receiver COR must be capable of driving a 6K ohm load. Do not apply COR signals greater than 12 volts to the controller's COR input.

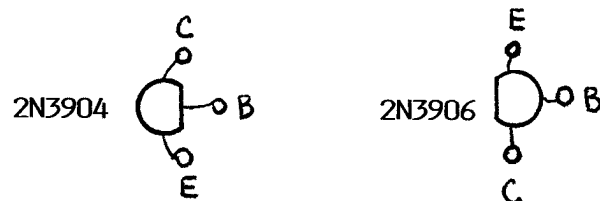
COR SENSE REVERSAL



ORIGINAL CIRCUIT



MODIFIED CIRCUIT



(TOP VIEW)

When replacing the NPN 2N3904 with the PNP 2N3906, observe the diagram above. The emitter and collector leads must be swapped, which can be accomplished by rotating the 2N3906 180° before inserting it into the board.

TS-32 CTCSS ENCODER/DECODER INSTALLATION

1. Cut the two jumpers on the TS-32 labeled **JU-1** and **JU-2**. Remove the MRC-100 board.
2. If you want to remotely control the CTCSS frequency:

- A. Remove the TS-32's dip switch.
- B. Take 5 wires from the TS-32's wire kit and cut to the lengths shown below, cutting from the factory-stripped ends.
- C. Strip the insulation 1/8" from the freshly-cut ends and tin.
- D. Solder the factory-stripped ends to the 5 dipswitch holes in the TS-32.
- E. Solder the tinned ends to the holes labeled F1 thru F5 in the MRC-100.

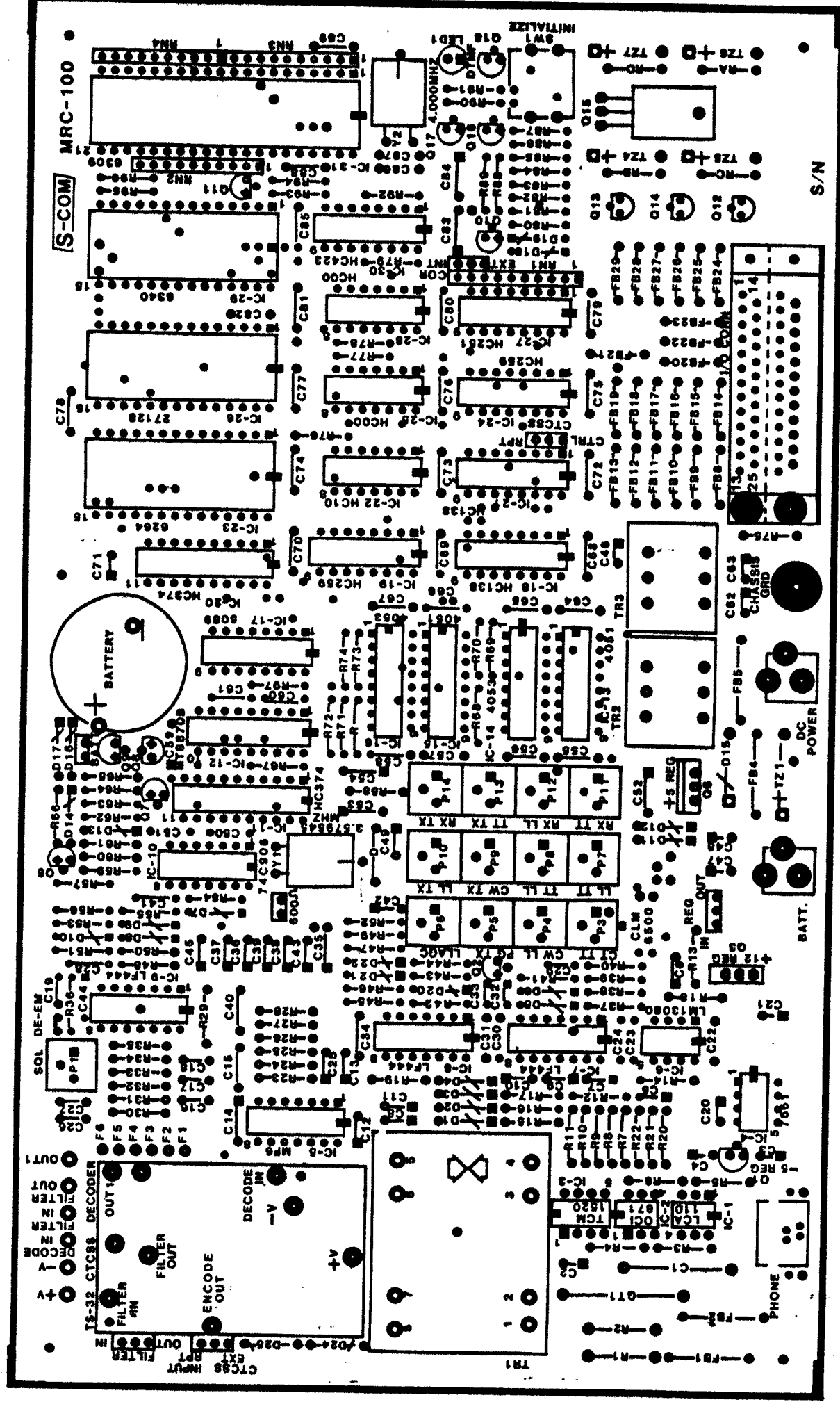
<u>Switch No.</u>	<u>Color</u>	<u>Length</u>	<u>MRC-100 Connection</u>
1	Red	2-7/8"	F1
2	Orange	3"	F2
3	Yellow	3-1/8"	F3
4	Green	3-1/4"	F4
5	Blue	3-3/8"	F5

3. The following connections must be made in all installations:

- A. Take the 7 wires shown in the table below from the TS-32's wire kit. Cut to the lengths indicated, and include the small female connector in the measurement.
- B. Strip the insulation 1/8" from the freshly-cut ends and tin.
- C. Solder the tinned ends to the holes provided in the MRC-100.
- D. Mount the TS-32 module on the MRC-100 board using the standoffs and screws provided with the TS-32.
- E. Push the female connectors of the 7 wires onto the corresponding male pins of the TS-32.

<u>MRC-100 Connection</u>	<u>Color</u>	<u>Length</u>
+V	Red	4"
GROUND	Black	3-1/2"
DECODER INPUT	Orange	3-1/2"
FILTER INPUT	Yellow	2-1/4"
FILTER OUTPUT	Green	2-1/4"
OUT-1	Blue	2-1/4"
ENCODE OUTPUT	White	2-1/4"

NOTES: Use small wire ties to bundle the wiring when you are done.
MRC-100s with serial number 156 or below do not have the driver needed to remotely control the TS-32's frequency built-in. However, it may be added externally. Ask for the TS-32 Applications Note.



SHORT FORM COMMAND LIST

(PW) = PASSWORD

AUTOPATCH

Access	(access password) (phone number) *
Access Password	(PW) 23 (new access password) *
Call Counter	
Clear the Counter	(PW) 69 *
Send Count	(PW) 86 *
Call Types	(PW) 60 (list 0-7/none=OFF) *
Dialing Message	(PW) 66 (message) *
Dialing Mode	(PW) 61 (1=10 PPS/2=20 PPS/3=DTMF) *
Dialing Option	(PW) 63 (1=mixed mode/none=OFF) *
Dump	(PW) 83 *
Macros	
Access-Triggered	(PW) 26 12 (macro name) *
Dump-Triggered	(PW) 26 13 (macro name) *
Privacy	(PW) 74 (0=OFF/1=ON) *
Redial	
Redial Last Number	(PW) 84 *
Clear the Redialer	(PW) 85 *
Restrictions	
Clear All Accepted No's.	(PW) 68 *
Enter an Accepted No.	(PW) 68 (phone number) *
Clear All Rejected No's.	(PW) 67 *
Enter a Rejected No.	(PW) 67 (phone number) *
Reverse Patch	
Trigger	(PW) 87 *
Answer	(PW) 88 *
Timeout Timer	
Reset Timer	(PW) 81 *
Time Limit	(PW) 65 (0.5-9.9 min/00=infinity) *
Warning Message	(PW) 62 (message) *

CLOCK

Correction	(PW) 19 (00-59 sec, 0=slower/1=faster) *
Send Time or Date	(PW) 14 (1=12 hr time/2=24 hr time/3=date) *
Set Time and Date	(PW) 18 (hours,minutes,month,day) *

CTCSS

Encoder Disable	(PW) 03 *
Encoder Enable	(PW) 02 *
Encoder Frequency	(PW) 05 (frequency number 1-37) *

CW

Disable/Enable	(PW) 04 (0=disable/1=enable) *
Frequency of Beep 1	(PW) 07 (tone code) *
Frequency of Beep 2	(PW) 08 (tone code) *
Frequency of Beep 3	(PW) 09 (tone code) *
Frequency of CW	(PW) 06 (tone code) *
Send CW Message	(PW) 15 (message) *
Send Next Message Slowly	(PW) 11 *
Speed Select - Normal Rate	(PW) 12 (0-9 = 5-40 WPM) *

Speed Select - Slow Rate	(PW) 13 (0-9 = 5-40 WPM) *
DTMF DECODER	
Mute Delay	(PW) 96 (.0-.9 seconds) *
Mute ON/OFF	(PW) 97 (0=OFF/1=ON) *
IDENTIFIER	
Callsign - Initial ID	(PW) 53 (message) *
Callsign - Normal ID	(PW) 52 (message) *
ID-Triggered Macros	
Impolite ID	(PW) 26 05 (macro name) *
Initial ID	(PW) 26 03 (macro name) *
Polite ID	(PW) 26 04 (macro name) *
Interval	(PW) 51 (0.5-9.9 minutes) *
Reset Initial to Normal	(PW) 54 *
Send ID	(PW) 55 *
Tail Message Select	(PW) 50 (tail number 0-9) *
LANDLINE CONTROL	
Answer Mode	(PW) 64 (mode 0-2) *
Ring Count	(PW) 95 (number of rings 1-49) *
LOGIC INPUT	
High-to-Low-Triggered Macro	(PW) 26 06 (macro name) *
Low-to-High-Triggered Macro	(PW) 26 07 (macro name) *
LOGIC OUTPUTS	
Momentary Off	(PW) 73 (list the outputs) *
Momentary On	(PW) 72 (list the outputs) *
Off	(PW) 71 (list the outputs) *
On	(PW) 70 (list the outputs) *
MACROS	
Append to Macro	(PW) 29 (macro name, command) *
Create New Macro	(PW) 20 (macro name, command) *
Erase Macro	(PW) 21 (macro name) *
Erase All Macros	(PW) 22 00 *
List Macro in CW	(PW) 33 (macro name) *
Rename Macro	(PW) 27 (old name, new name) *
PAGE	
Single-Tone Page	(PW) 90 (tone code, 0.1-9.9 seconds) *
Two-Tone Page	(PW) 90 (two sequences as above) *
POWER ON	
Power-On-Triggered Macro	(PW) 26 00 (macro name) *
SECURITY	
Control Operator Password	(PW) 92 (new control op password) *
Master Password	(PW) 93 (new master password) *
Privilege Level	(PW) 94 (root no., 0=Ctrl Op/1=Master Only) *
SQUELCH & CARRIER	
Courtesy Message	(PW) 31 (message) *

Courtesy Timer	(PW) 32 (0.0-5.0 seconds) *
Dropout Message	(PW) 34 (message) *
Dropout Timer	(PW) 30 (0.0-5.0 seconds) *
Pre-Timeout Message	(PW) 41 (message) *
Post-Timeout Message	(PW) 44 (message) *
Timeout Timer	(PW) 40 (0.1-9.9 minutes/00=infinity) *
Timeout Timer Reset	(PW) 10 *

TRANSMITTER

Disable	(PW) 00 *
Enable	(PW) 01 *

MISCELLANEOUS

Pause	(PW) 98 (1-255 seconds) *
Command Responses	(PW) 91 (0=OFF/1=ON) *
Command Termination	(PW) 99 (00="*" req'd/0.1-9.9 sec after COR) *

VERSION 1.1 SOFTWARE IMPROVEMENTS

- 1) BUG FIXED: Version 1.0 did not mute touch-tones when autopatch was up, or when repeater timeout timer was set to infinity. Version 1.1 mutes touch-tones regardless of autopatch or timeout timer.
- 2) The maximum mute time was 1.0 seconds for version 1.0. Version 1.1 turns off mute after 10.0 seconds of touch-tone.

- 3) CW messages are now much bigger:

<u>Message</u>	<u>Version 1.0 length (max.)</u>	<u>Version 1.1 length (max.)</u>
Courtesy Msg	5 characters	25 characters
Dropout Msg	10 characters	25 characters
Timeout Msg	5 characters	25 characters
Autopatch Timeo	5 characters	25 characters
Autopatch Dial	5 characters	25 characters
Initial ID	32 characters	40 characters
Normal ID	32 characters	40 characters

These message sizes were increased to take advantage of "custom beeps", "custom delays", and "frequency change characters", which require many keystrokes.

- 4) New CW characters:

CUSTOM BEEP	57 xxxx yy	xxxx = tone code, yy = duration
CUSTOM DELAY	58 xx	xx = duration
FREQUENCY CHANGE	59 xxxx	xxxx = tone code

Enter these characters just like the other CW characters, but you need more keystrokes (for example, 8 keystrokes for a "custom beep"). Tone code means the same as for paging, CW freq, etc. Duration is specified in 2 digits, 01 to 99, meaning 10 to 990 millisec.

- 5) To DEFEAT DTMF MUTING: (PASSWORD) 97 (0=do not mute/1=mute) *
Default condition: Muting is turned on.
- 6) To INSERT A PAUSE IN COMMAND EXECUTION: (PASSWORD) 98 (1 to 255 seconds) *
Use this command in a macro to delay the commands that follow. For example, it could keep a tape recorder going after an autopatch is dumped.
- 7) "*" ON CARRIER DROP: (PASSWORD) 99 (00=* required/01-99=cmd executed 0.1-9.9 sec after COR drops) *
Defaults to: "*" required to execute commands
- 8) Version 1.1 supports a control receiver as the highest priority command source. Second priority = phone line. Third priority = repeater receiver.
- 9) MOBILE PRIVACY: (PASSWORD) 74 (0 = OFF/1 = ON) *
When ON, will not repeat mobile's audio during autopatch. Defaults to OFF.
- 10) Version 1.1 inhibits repeater audio from being sent to the transmitter during tone pages, and any time the COR is inactive.

VERSION 1.2 SOFTWARE IMPROVEMENTS

SEPARATE PRE-TIMEOUT AND POST-TIMEOUT MESSAGES:

Version 1.2 supports two different messages for indicating COR timeout. Use:

(PASSWORD) 41 (Pre-Timeout Message) * and

(PASSWORD) 44 (Post-Timeout Message) *.

Each message can contain up to 25 CW characters, and each message defaults to "TO" on a cold startup.

AUTOPATCH EVENT-TRIGGERED-MACROS:

Version 1.2 supports two additional event-triggered macros. Use:

(PASSWORD) 26 12 (Macro Name) *

to have a macro executed upon autopatch access (including redial commands), and use:

(PASSWORD) 26 13 (Macro Name) *

to have a macro executed upon autopatch dump (including autopatch dump caused by autopatch timeout).

Additionally, the autopatch is now suspended while the repeater is timed out.

VERSION 1.3 SOFTWARE IMPROVEMENTS

1. The "CW Send Message" command, "(PW) 15 (message) *", now allows up to 40 CW characters. The previous software allowed up to 25 characters.
2. A new command has been created: "(PW) 91 (0=OFF/1=ON) *" controls "response messages". Turn the messages on when you are programming, turn them off when you are done. This keeps the "OK"s and error messages from being sent when commands are placed in macros. The default condition is "response messages ON".
3. The landline Ring Count command, "(PW) 95 (no. of rings) *", now allows a range of 1 to 49 rings. The previous software allowed a range of 1 to 9 rings.

VERSION 1.4 SOFTWARE IMPROVEMENTS

1. NEW CW CHARACTER: A new CW character, "54" (formerly unused), now tells the controller to use a very short delay (200 mS) before sending the message that follows. Normally, the controller puts in a long delay (1.5 sec) before sending a CW message; this gives the mobile a chance to unkey his transmitter before the CW response comes back. However, some messages should be sent without delay. This includes callsigns that are in macros for the "polite" ID'er. Remember, "54" only works at the beginning of a message; once the CW has started, any "54"'s will be ignored by the software.

2. AUTOPATCH TIMER EXTENDED RANGE: The autopatch timer command was:

(PW) 65 (0.5-9.9 min/00=infinity) *

Customers have suggested a longer time limit for Westlink broadcasts, teleconferences, and so on. So, we changed the command to:

(PW) 65 (.1-54.6 min/000=infinity) *

Enter 1, 2, or 3 digits representing tenths of minutes. For example, "1" = 0.1 minute; "30" = 3.0 minutes; "546" = 54.6 minutes. (54.6 minutes is the longest timer in a 16-bit number using our internal scheme.) Enter three zeroes for infinity (timer disabled). You may ignore leading zeroes if you wish. The timer still defaults to 3.0 minutes.

3. "START-OF-ACTIVITY" & "POST-ACTIVITY" MACROS: Here's another customer's suggestion that became a standard feature. The "start-of-activity" macro is executed when a fresh key-up of the repeater occurs. This event creates a cycle of activity that ends a certain time after the tail finishes. A second "POST-ACTIVITY" macro is then executed. The post-activity timer is programmable, and so is the number of times the cycle runs before the macro executes. Once the cycle runs, regardless of whether the post-activity macro was actually executed or not, the start-of-activity macro is "armed" and ready for the next key-up. If the repeater is constantly used and the post-activity timer never expires, the cycle is not completed and the "post-activity" macro is not executed. Once the timer expires, the controller looks at the counter and decides to execute (or not execute) the post-activity macro. Uses include turning on or off a tape recorder; or sending a cartridge message (or CW message) every 5th time the repeater is used, for example.

(PW) 26 14 (macro name) * = "Start-of-Activity"-triggered macro

(PW) 26 15 (macro name) * = "Post-Activity"-triggered macro

(PW) 45 (0-9 event count, 0.0-9.9 min delay) * = "post-activity" counter/timer
(0 count=every time; 9 count=every tenth time) (delay starts at dropout msg)

4. CTCSS ENCODER IMPROVEMENTS: The CTCSS encoder now has 3 modes: OFF, CONTINUOUSLY ON, and TIMED ON. The "timed on" mode means the encoder is on for 2 to 9 seconds (programmable) at the beginning of each repeater transmitter key-up. This allows monitoring stations to hear the beginning of QSOs and find out who's on, but mutes the rest of the conversation.

(PW) 02 (0=OFF/1=continuous/2-9=2-9 sec timed) *

You may delete command "(PW) 03 *" in your manual.

VERSION 1.41 SOFTWARE IMPROVEMENTS

1. SELECT COMMAND SOURCE(S): A new command has been created to select which devices may send commands to the DTMF decoder.

The Control Receiver and the Landline may not be turned off; they are always allowed access to the DTMF decoder. The Control Receiver has the highest priority; the Landline has second priority; and the repeater receiver (if selected) has lowest priority.

The command is:

(PASSWORD) 89 (Ø = Repeater Receiver to DTMF disabled/1 = enabled) *

If the repeater-to-DTMF is disabled, then no touch-tones will be muted. Note that there is a command that also prevents DTMF muting: DEFEAT DTMF MUTING, (PW)97(*). The difference is that DEFEAT DTMF MUTING still allows the controller to execute incoming commands, but the tones are not muted. The SELECT COMMAND SOURCES command causes the repeater touch-tones to be completely ignored by the controller.

VERSION 1.42 - 1.43 SOFTWARE IMPROVEMENTS

1. ID INTERVAL LENGTHENED: The interval between IDs has been limited to 9.9 minutes in the past. For our commercial customers, the interval can now be set up to 30.0 minutes. NOTE: The maximum ID interval for amateurs is 10 minutes.

The old command was: (PW) 51 (0.5 - 9.9 min) *

The new command is: (PW) 51 (5 - 300) *, meaning 0.5 - 30.0 minutes.

2. CTCSS LATCH: A new command exists that writes any combination of 6 bits to the CTCSS Encoder latch (IC-11). There are two uses for this command: the owner may remotely control the frequency of a TS-32 CTCSS module (contact S-COM for applications note), or he may remotely control up to six other devices at the repeater site. The MX-315 CTCSS Encoder (IC-10) will be eliminated by those making other use of the latch. Unless external buffering is used, the latch may only drive 5-volt HC logic.

The command is: (PW) 03 (0 - 63) *

IC-10 Pin No.:	(1)	(2)	(3)	(4)	(5)	(6)
Decimal Value:	32	16	8	4	2	1

Commanded value = 0:	0	0	0	0	0	0
Commanded value = 1:	0	0	0	0	0	1
Commanded value = 2:	0	0	0	0	1	0
Commanded value = 3:	0	0	0	0	1	1
.						
.						
.						
Commanded value = 63:	1	1	1	1	1	1

Note: "0" on a pin means logical zero, or about 0.1 volts.
"1" on a pin means logical one, or about 4.9 volts.

VERSION 1.44 SOFTWARE IMPROVEMENTS

1. ADJUSTABLE DTMF INTERDIGIT TIMER: The "interdigit timer" controls the maximum amount of time allowed between received DTMF (Touch-Tone) digits. If a delay greater than the timer value occurs, then the command buffer is cleared. Formerly, this value was fixed at 5.0 seconds. It is now variable from 0.1 to 9.9 seconds. The reason for the new feature is to allow a longer period than 5 seconds between digits for those organizations using the "COR drop" method of terminating commands. The timer defaults to 5.0 seconds on a cold start.

The command format is:

(PASSWORD) 82 (Ø1-99) *, where Ø1-99 means Ø.1 to 9.9 seconds.

2. "POUND DOWN" AUTOPATCH: Some customers have requested the ability to dump the autopatch by entering only the "#" key. This feature now exists, and may be turned on or off with a new command. The "#" key still retains its original meaning (clear the command) whether or not the "pound down" function is active. Since the "#" key is pressed for only a short time, remember that it is very easy for troublemakers to maliciously dump a call in progress. (Incidentally, the "#" symbol is known as the "octothorpe", but most of us call it the "pound" key!) This feature defaults to "off".

The command key is:

(PASSWORD) 75 (Ø = off, 1 = on) *

Both of the above commands are acknowledged by "OK".
Both commands will respond with "? ERR 1" or "? ERR 2" if entered improperly.

VERSION 1.45 SOFTWARE IMPROVEMENTS

Version 1.45 improves the operation of the "pound down" feature. If characters are found in the command buffer, then the "#" key will only clear the buffer. The autopatch/reverse patch in progress will not be affected. If no characters are in the command buffer, the MRC-100 assumes that the patch is to be dumped. It will terminate the call in progress, and also clear the command buffer. Version 1.44 software would dump the landline if a control operator entered a "#" key to clear erroneous commands.

1. LANDLINE ANSWER MESSAGE: (PW) 76 (message) *, up to 50 characters max.
This is a new command. Defaults to 3 beeps. Acknowledgement: Sends the actual message, or "OK" if none. Errors: "? ERR 1" and "? ERR 2".
2. "Software Switches" introduced. This is a set of commands all using the same root number, "63", but followed by two digits to determine the "switch" being addressed. It will be used for future on/off functions, and has replaced some older commands, thus releasing some root numbers for future use.

 (PW) 63 00 (0=off/1=on) * Transmitter Enable/Disable, replaces (PW) 00, 01.
 (PW) 63 01 (") * CW Enable/Disable, replaces (PW) 04 () *.
 (PW) 63 02 (") * Command Responses, replaces (PW) 91 () *.
 (PW) 63 03 (") * DTMF Mute, replaces (PW) 97 () *.
 (PW) 63 04 (") * Mixed-Mode Dialing, replaces (PW) 63 () *.
 (PW) 63 05 (") * Pound Down autopatch, replaces (PW) 75 () *.
 (PW) 63 06 (") * Privacy autopatch, replaces (PW) 74 () *.
 (PW) 63 07 (") * Full Duplex autopatch. Defaults to off. New cmd.
 (PW) 63 08 (") * Rptr-to-phone line DTMF mute. New command.
3. " Custom Delay" bug has been fixed.
4. When the "Landline Busy" hardware input is asserted, the controller will ignore any ringing on the phone line. Formerly it did not. The change was needed because the controller may share a phone line with a rotary-type phone, and dialing the phone can cause interruptions that look like ringing to the controller. Use a line relay in series with the rotary phone, with its contacts grounding the Landline Busy input when the phone is in use.
5. Audio is now muted from the repeater RX to the repeater TX when the COR timeout timer expires.
6. All programmable CW messages have been increased in size to 50 characters.
7. New Landline Answer Mode command. See separate sheet.
8. Reverse Patch Ringout Message is now programmable: (PW) 78 (message) *.
Maximum size is 50 chars.
9. New command: TX KEY (PW) 00 (.1-54.6 min/nothing= cancel/000=infinity) *.
Will not key the transmitter if the transmitter has been disabled.
10. New command: Control Line Timer. Buys time on the phone line when in the control mode. (PW) 79 (.1-54.6 min/~~000=infinity~~) *.
~~000=infinity~~
11. Old command improved: COR Timeout Timer can be extended further.
(PW) 40 (.1-54.6 min/000=infinity) *.

INTRODUCTION

We have completely rewritten the reverse patch/telephone line control software for the MRC-100, giving it more power and flexibility. The following discussion applies to software versions V1.46 and later.

Delete the old "Ring Count" command, (PW)95()*, from your manual. The ring count feature is now built into the new "Answer Mode" command.

The old "Answer Mode" command has been modified; the discussion below explains the new operation of this command.

LANDLINE ANSWER MODES

There are five modes for the landline, replacing the three earlier modes. Mode 0, "Do Not Answer", has the simplest format:

(PW) 64 0 *

The other four modes all have the following format:

(PW) 64 (mode 1-4, ring-in delay 00-99, ringout limit 00-99) *

The **mode** is a single digit number from 1 to 4, telling the controller how it is to behave upon receiving incoming ringing.

The **ring-in delay** is a two-digit number telling the controller how many rings to ignore before performing a job. One of the benefits of having ring-in delay is that it allows someone to pick up the phone if there is a phone in parallel with the controller. For example, some repeaters share a phone line with the maintenance crew at a radio or TV site; if no one picks up the phone after, say, 8 rings, then the controller can assume the call is for it.

The **ringout limit** is a two-digit number telling the controller how many times it may send the reverse patch ringout message. If a control operator is programming the controller, for example, and then triggers the reverse patch by command, the number of ringouts will be set by the ringout limit value previously commanded.

We have made a fundamental change in the way the control line software works. The previous software arranged to keep the phone line connected for 20 seconds each time a DTMF digit was received. The new software allows commands to be entered for a maximum of 10 seconds when in control line mode. Therefore, a short command can be entered before the line disconnects. If more time is required, then you may enter the Control Line Timer command to buy more programming time. The timer can be re-loaded at any time. However, remember that the phone line will be active for the duration of the timer; be sure to dump the phone line when your programming is finished. Otherwise, the line will be busy for the remaining time of the Control Line Timer.

The controller defaults to MODE 3, ring-in delay = 2, ringout limit = 10.

MODE 1 After a delay of 00 - 99 incoming rings, begin ringout for reverse patch at a rate of 1 ringout message for each incoming ring. If answered by a mobile, connect. If unanswered by the ringout limit of 00 - 99 rings, ignore further incoming ringing.

NOTES: In MODE 1, the controller does not connect the calling party to the mobile until the mobile answers the call. The calling party hears only the ringback until actually connected to a mobile. Setting the Ring Delay to zero means that the ringout begins on the first incoming ring; a delay of 1 means that the ringout begins after delaying one ring, or at the beginning of the second incoming ring. Setting the Ringout Limit to zero is the same as putting the controller into Mode 0; it can't ring out with a zero limit, so it will appear to ignore incoming ringing.

MODE 2 After a delay of 00 - 99 incoming rings, begin ringout for reverse patch at a rate of 1 ringout message for each incoming ring. If answered by a mobile, connect. If unanswered by the ringout limit of 00 - 99 rings, connect and go into Control Line mode. Commands may be entered for 10 seconds. The line will then disconnect unless the Control Line Timer command is used to extend the timer.

NOTES: This mode behaves the same as MODE 1, except that the controller will allow access to Control Line mode when the ringout limit is reached. While in control line mode, another reverse patch command could be entered if desired. Setting the RingoutLimit to zero is the same as putting the controller into Mode 3; it can't ring out with a zero limit, so it will go into control line mode after the delay is finished.

MODE 3 After a delay of 00 - 99 incoming rings, connect and go into Control Line mode. Commands may be entered for 10 seconds. The line will then disconnect unless the Control Line Timer command is used to extend the timer.

NOTES: Setting the delay to zero means that the controller will answer on the first incoming ring; a delay of 1 means that the controller will answer after delaying one ring, or on the second incoming ring. The Ringout Limit serves to set the number of ringouts if the reverse patch trigger command is entered. If the limit is set to zero, the line will disconnect when a reverse patch trigger command is entered.

MODE 4 After a delay of 00 - 99 incoming rings, connect and go into Control Line mode. The controller will look for DTMF digits; if no digits are received in 10 seconds, begin ringout for reverse patch at the rate of one ringout message every 6 seconds. If answered by a mobile, connect. If unanswered by the ringout limit of 00 - 99 rings, disconnect. If DTMF digits are received in the first 10 seconds, go into Control Line mode. The controller will not ring out for reverse patch. Commands may be entered for 10 seconds. The line will then disconnect unless the Control Line Timer command is used to extend the timer.

S-COM MRC-100 SOFTWARE MODIFICATIONS

V1.47

Version 1.47 software replaces V1.46 and adds three new commands.

The first new command is "Command Termination for Control Receiver". This command allows you to terminate a command entered via the control receiver by simply releasing the push-to-talk button. The command will be executed by the MRC-100 a short time after the COR has dropped. This delay is programmable.

A similar command already exists for command termination for the repeater receiver. Due to customer requests, this feature is now available on the control receiver channel as well. Note that this feature can be commanded ON or OFF as desired. If commanded OFF, then the star ("*") character must follow all commands as the terminator.

The other two new commands are similar to each other. The two commands are "Repeater Access Mode" and "DTMF Access Mode", and they allow you to decide the type of access desired (Carrier, PL, AND-PL, OR-PL, Anti-PL, and NO ACCESS). Since "Repeater Access" and "DTMF Decoder Access" are handled separately now, you have much more flexibility in the operation of your repeater. For example, the repeater can remain on carrier access while PL is required to enter commands. Or, you can require full PL for both accesses. An interesting possibility is the OR-PL mode, where both carrier and PL users are allowed access; PL users will benefit from increased range, while carrier users will operate the same as before. For repeater operators that rebroadcast Westlink, the NO ACCESS mode means users on the repeater input are ignored and cannot interfere with the broadcast. If the broadcast is started and ended via DTMF on the input, then make the DTMF Access mode different from the usual mode (such as AND-PL) for the duration of the broadcast, while keeping the repeater in NO ACCESS.

Please note that a command was obsoleted by the new software, and should be eliminated from your manual. It is "Repeater Receiver as Command Source", (PW) 89 () *, and it simply allowed or disallowed audio from the repeater receiver to the DTMF decoder. The new "DTMF Decoder Access Mode" command gives you this capability, plus additional access modes.

We hope you will enjoy these latest improvements. If any questions or comments arise, please call us at ~~(303) 493-8316~~.

~~663-6000~~
970-416-6505

The S-COM Staff

UTILITIES

COMMAND TERMINATION for CONTROL RECEIVER

COMMAND FORM:

Command Termination (PASSWORD) 56 (00=* req'd/0.1-9.9 sec after COR) *

This command allows commands to be terminated by requiring the "*" character, or by releasing the push-to-talk button (COR drop). The "*" character will terminate a command in either case. If the COR drop method is desired, enter two digits representing the amount of time after COR drop is sensed that the command will be executed. If the "*" character only method is desired, enter 00.

Acknowledgement: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default Condition: "*" character required to terminate all commands

EXAMPLES:

If desired, control operators can simply enter a command on the control receiver channel and release the push-to-talk button instead of entering the "*" character. If a time delay of 1.0 seconds after COR drop is desired, enter:

(PASSWORD) 56 10 *

The purpose of the 1.0-second delay is to prevent short, accidental COR drops from triggering command execution. The COR drop must be sustained for 1 second in this example, after which the command will be executed. Remember, the "*" character can still be used to terminate the command. This can be important if weak, on-frequency signals are holding the COR up.

To return the controller to the "*" -only mode, enter:

(PASSWORD) 56 00 *

Do not use long delays with this command, since the Interdigit Timer may expire before the COR drop timer. An excessive delay between DTMF digits causes the command just entered to be cleared.

REPEATER OPERATION

ACCESS MODE

COMMAND FORM:

Repeater Access Mode (PASSWORD) 57 00 (mode 0-5) *

This command selects one of six possible repeater access modes.
The six modes are:

- Mode 0 = No Access. Activity on the COR and PL inputs is ignored.
- Mode 1 = Carrier Access. Activity on the COR input will key the transmitter. Activity on the PL input is ignored.
- Mode 2 = PL Access. Activity on the PL input will key the transmitter. Activity on the COR input is ignored.
- Mode 3 = AND-PL Access. Activity on both the COR and PL inputs simultaneously will key the transmitter.
- Mode 4 = OR-PL Access. Activity on either the COR or PL inputs will key the transmitter.
- Mode 5 = ANTI-PL Access. Activity on the COR input simultaneously with no activity on the PL input will key the transmitter.

Note that Repeater Access may be made different from DTMF Decoder access, if desired.

Acknowledgement: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default Condition: Mode 1 (Carrier Access)

EXAMPLES:

Assume that the repeater is in carrier access, and that PL access is desired.
The proper command would be:

(PASSWORD) 57 00 2 *

A better mode for many repeater installations is Mode 3, AND-PL Access. (This mode has better rejection of adjacent-channel interference than Mode 2, since noise falsing from unquelled audio is eliminated. Also, COR drops out more quickly than PL, allowing a quick dropout result. Enter this command:

(PASSWORD) 57 00 3 *

Mode 4 allows both carrier access and PL operation. Since PL is more easily detected, PL users will find increased range. Carrier access users are unaffected. The squelch may be tightened to suppress band opening problems. ANTI-PL is used when the repeater is co-channel with another, PL-accessed repeater. Users of the second system are kept out of the ANTI-PL system.

DTMF DECODER

ACCESS MODE

COMMAND FORM:

DTMF Decoder Access Mode (PASSWORD) 57 06 (mode 0-5) *

This command selects one of six possible DTMF decoder access modes. The six modes are:

- Mode 0 = No Access. Activity on the COR and PL inputs is ignored; only the control receiver may be used to send commands to the unit.
- Mode 1 = Carrier Access. Activity on the PL input will allow access to the DTMF decoder. Activity on the COR input is ignored.
- Mode 2 = PL Access. Activity on the PL input will allow access to the DTMF decoder. Activity on the COR input is ignored.
- Mode 3 = AND-PL Access. Activity on both the COR and PL inputs simultaneously will allow access to the DTMF decoder.
- Mode 4 = OR-PL Access. Activity on either the COR or PL inputs will allow access to the DTMF decoder.
- Mode 5 = ANTI-PL Access. Activity on the COR input simultaneously with no activity on the PL input will allow access to the DTMF decoder.

Note that DTMF Decoder Access may be made different from Repeater Access, if desired.

Acknowledgement: OK

Errors: ? ERR 1 = wrong number of digits entered
? ERR 2 = illegal digit entered

Default condition: Mode 1 (Carrier Access)

EXAMPLES:

Assume that the DTMF decoder is in carrier access, and that PL access is desired. The proper command would be:

(PASSWORD) 57 06 2 *

A better mode for many repeater installations is Mode 3, AND-PL Access. (This mode has better rejection of adjacent-channel interference than Mode 2, since noise falsing from unsquelched audio is eliminated. Enter this command:

(PASSWORD) 57 06 3 *

Mode 4 allows both carrier access and PL operation. Since PL is more easily detected, PL users will find increased range. Carrier access users are unaffected. The squelch may be tightened to suppress band opening problems. ANTI-PL is used when the repeater is co-channel with another, PL-accessed repeater. Users of the second system are kept out of the ANTI-PL system.



INSTALLING THE ADM/U IN THE MRC-100 CONTROLLER

The ADM/U is supplied with a 12" 4-conductor ribbon cable. The connector end goes to the ADM/U, and the cut end goes to the MRC-100.

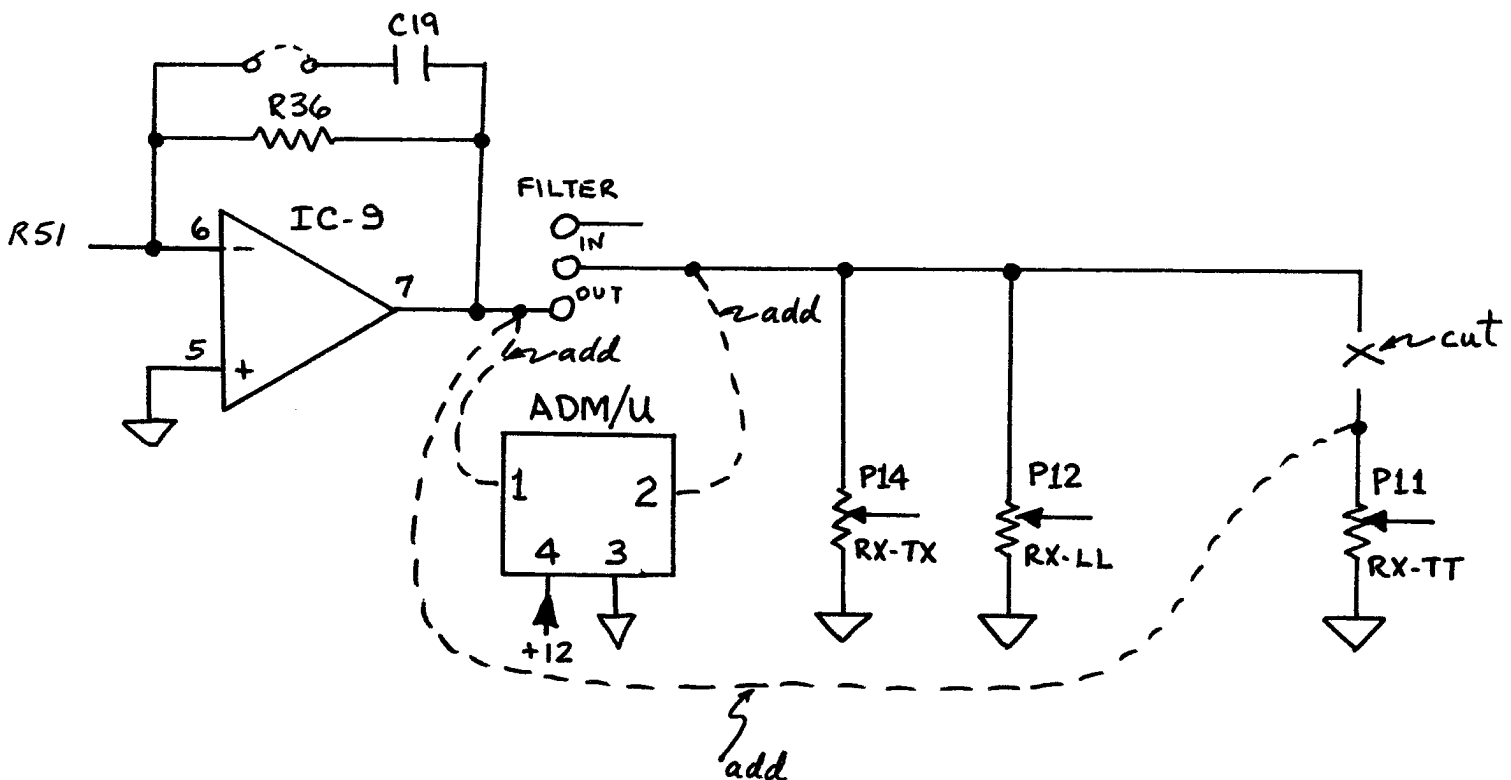
The ADM/U should be connected in a way that allows it to delay the audio going to the transmitter and phone line, but not the audio going to the DTMF decoder. This provides DTMF muting and squelch tail elimination for both repeater users and the called parties (autopatch).

PIN 1 (AUDIO IN): Connect to pin 7 of IC-9. Suggest connecting to the OUT pin of the 3-pin "FILTER" header. Remove the header jumper to interrupt the normal audio path.

PIN 2 (DELAYED AUDIO OUT): Connect to the RX-TX pot and the RX-LL pot, but not to the RX-TT pot.

PIN 3 (COMMON): Connect to ground. Suggest "-V" connection for TS-32.

PIN 4 (+12V): Connect to +12 power supply. Suggest "+V" connection for TS-32, or cathode of D15, etc.



TS-32 CTCSS ENCODER/DECODER INSTALLATION

o. Cut R22 47K to disable hang up

1. Cut the two jumpers on the TS-32 labeled JU-1 and JU-2. Remove the MRC-100 board.
2. If you want to remotely control the CTCSS frequency:
 - A. Remove the TS-32's dip switch.
 - B. Take 5 wires from the TS-32's wire kit and cut to the lengths shown below, cutting from the factory-stripped ends.
 - C. Strip the insulation 1/8" from the freshly-cut ends and tin.
 - D. Solder the factory-stripped ends to the 5 dipswitch holes in the TS-32.
 - E. Solder the tinned ends to the holes labeled F1 thru F5 in the MRC-100.

<u>Switch No.</u>	<u>Color</u>	<u>Length</u>	<u>MRC-100 Connection</u>
1	Red	2-7/8"	F1
2	Orange	3"	F2
3	Yellow	3-1/8"	F3
4	Green	3-1/4"	F4
5	Blue	3-3/8"	F5

3. The following connections must be made in all installations:

- A. Take the 7 wires shown in the table below from the TS-32's wire kit. Cut to the lengths indicated, and include the small female connector in the measurement.
- B. Strip the insulation 1/8" from the freshly-cut ends and tin.
- C. Solder the tinned ends to the holes provided in the MRC-100.
- D. Mount the TS-32 module on the MRC-100 board using the standoffs and screws provided with the TS-32.
- E. Push the female connectors of the 7 wires onto the corresponding male pins of the TS-32.

<u>MRC-100 Connection</u>	<u>Color</u>	<u>Length</u>
+V	Red	4"
GROUND	Black	3-1/2"
DECODER INPUT	Orange	3-1/2"
FILTER INPUT	Yellow	2-1/4"
FILTER OUTPUT	Green	2-1/4"
OUT-1	Blue	2-1/4"
ENCODE OUTPUT	White	2-1/4"

NOTES: Use small wire ties to bundle the wiring when you are done.
MRC-100s with serial number 156 or below do not have the driver needed to remotely control the TS-32's frequency built-in. However, it may be added externally. Ask for the TS-32 Applications Note.



P.O. Box 8921
FL Collins, CO 80525

MRC-100 APPLICATIONS NOTE

Remote Control of TS-32 Encode/Decode Frequency

12/2/85

The Communications Specialists TS-32 is a module capable of encoding and decoding 32 CTCSS frequencies. The S-COM MRC-100 repeater controller will accomodate the TS-32 module for those users desiring CTCSS capabilities on their repeater. Since the TS-32 frequency is programmed by means of a 5-pole dip switch, changing the frequency means a trip to the repeater site. This application note details a technique that can be used to remotely control the TS-32 frequency.

The MRC-100 contains a 74HC374 latch (IC-11) and an MX-315 CTCSS Encoder (IC-10). These parts are inserted into sockets on the board if you have purchased the CTCSS ENCODE option. If you do not have this option, you will need the 74HC374 (available from S-COM for \$3.00 postpaid). The MX-315 will be removed from socket IC-10.

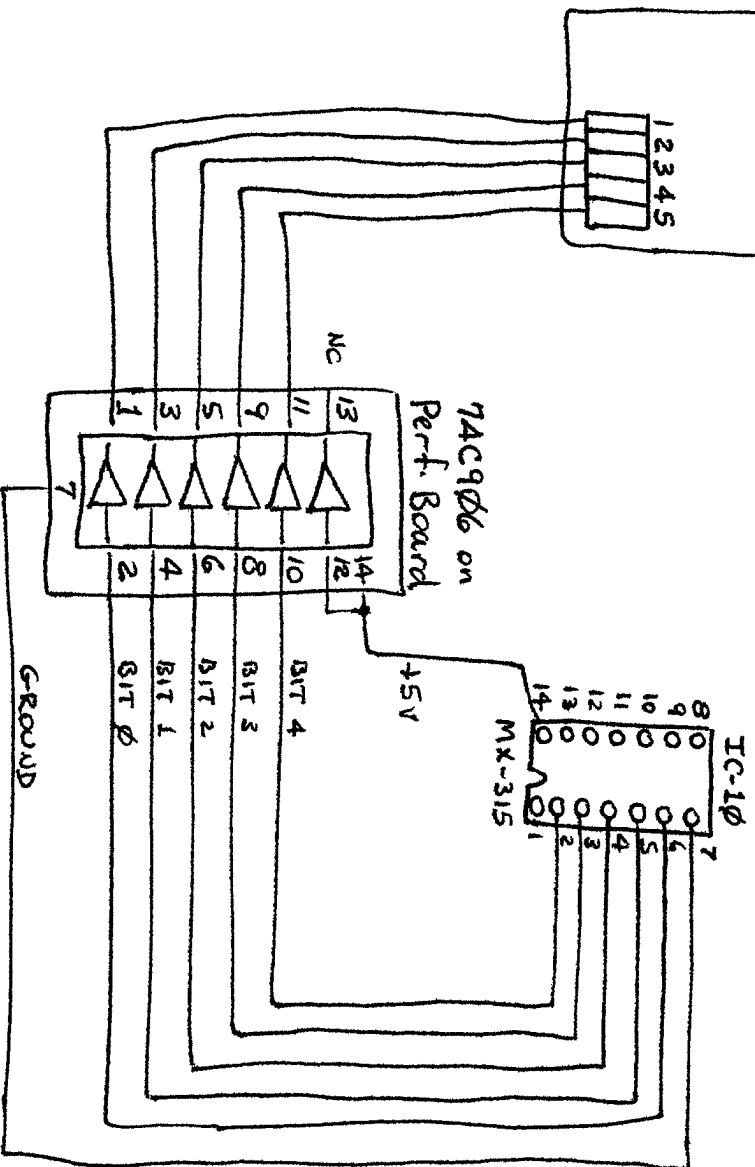
An interface IC is needed to allow the 5-volt control signals from the MRC-100 to manipulate the TS-32. The National Semiconductor 74C906 will be used here as an example.

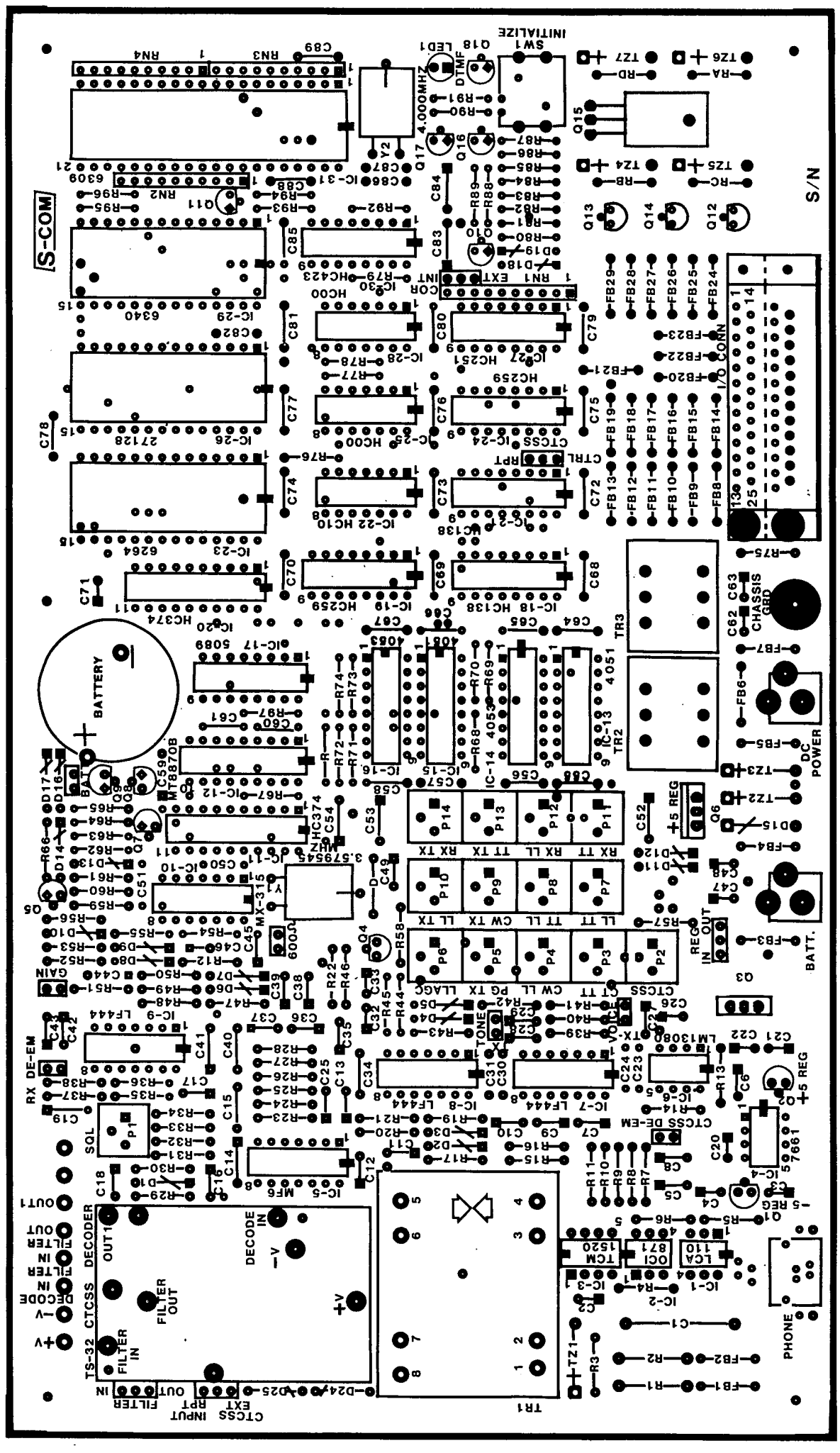
Wire a 14-pin header plug to plug into socket IC-10. You will need wires on pins 2 through 7 and 14. Connect these wires to the 74C906 as shown. Connect the outputs of the 74C906 to the pins of the TS-32 dip switch closest to the edge of the board. Open all five switches on the TS-32. It is not necessary to remove the dip switch from the TS-32.

Firmware version 1.43 and later support a new command to control the TS-32. Enter (PW)03(0-31)* to change the frequency of the TS-32. Note that the encode and decode frequencies will be the same.

<u>ENTER</u>	<u>FREQ.</u>	<u>CODE</u>	<u>ENTER</u>	<u>FREQ.</u>	<u>CODE</u>	<u>ENTER</u>	<u>FREQ.</u>	<u>CODE</u>
0	67.0	XZ	11	100.0	1Z	22	146.2	4B
1	71.9	XA	12	103.5	1A	23	151.4	5Z
2	74.4	WA	13	107.2	1B	24	156.7	5A
3	77.0	XB	14	110.9	2Z	25	162.2	5B
4	79.7	SP	15	114.8	2A	26	167.9	6Z
5	82.5	YZ	16	118.8	2B	27	173.8	6A
6	85.4	YA	17	123.0	3Z	28	179.9	6B
7	88.5	YB	18	127.3	3A	29	186.2	7Z
8	91.5	ZZ	19	131.8	3B	30	192.8	7A
9	94.8	ZA	20	136.5	4Z	31	203.5	M1
10	97.4	ZB	21	141.3	4A			

TS-32





S-COM

N/S

RX DE-EM

OUT1

OUT2

OUT3

OUT1

OUT2

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PARTS LIST

1/4-WATT RESISTORS

68 ohms	1	R63
270 ohms	1	R51
390 ohms	1	R91
560 ohms	1	R11
1K ohms	8	R12,R52,R57,R59,R60,R64,R65,R97
1.5K ohms	2	R5,R37
2.2K ohms	3	R3,R4,R46
4.7K ohms	13	R6,R20,R21,R30,R81,R82,R84,R85, R87,R88,R94,R95,R96
10K ohms	14	R31,R45,R47,R49,R50,R53,R61,R62, R80,R83,R86,R89,R90,R93
18K ohms	11	R9,R10,R22,R23,R24,R25,R26,R27, R28,R68,R70
36K ohms	2	R15,R16
39K ohms	4	R13,R17,R19,R34
51K ohms	7	R39,R40,R41,R42,R73,R74,R75
56K ohms	1	R43
100K ohms	13	R7,R8,R33,R35,R44,R58,R66,R69, R71,R72,R76,R77,R78
180K ohms	1	R36
200K ohms	6	R48,R54,R55,R56,R79,R92
220K ohms	2	R32,R38
300K ohms	1	R67
680K ohms	1	R14

1/2-WATT RESISTORS

22 ohms	2	R1,R2
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POTENTIOMETERS

5K ohms	2	P1,P2
50K ohms	12	P3 thru P14

RESISTOR NETWORKS

4.7K ohms 10-pin	4	RN1 thru RN4
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CAPACITORS

18 pF MLC	2	C86,C87
27 pF MLC	1	C61
0.001 uF FILM	10	C6,C9,C10,C11,C12,C13,C16,C17, C27,C29
0.0022 uF FILM	1	C5
0.0047 uF FILM	4	C7,C36,C37,C43
0.01 uF FILM	2	C28,C42
0.047 uF FILM	2	C8,C18
0.1 uF FILM	6	C25,C35,C38,C39,C45,C49

0.1	uF MLC	37	C14,C15,C23,C24,C30,C31,C34,C40, C44,C50,C51,C55,C56,C57,C58,C60, C64 thru C70,C72 thru C82,C85, C88,C89
0.33	uF FILM	1	C41
0.47	uF FILM	5	C52,C53,C54,C83,C84
0.47u/250V	FILM	1	C1
1.0	uF MLC	1	C59
1.0	uF TANT	2	C21,C47
4.7	uF TANT	5	C26,C32,C46,C62,C63
10	uF TANT	7	C3,C4,C20,C22,C33,C48,C71
10uF/50V	ELECTRO	1	C2

DIODES

1N914/1N4148	12	D1,D4 thru D12,D18,D19,R29 (cathode toward C18)
1N4002	1	D15
1N5228B	3	D13,D24,D25
1N6263/HSCH1001	3	D14,D16,D17
RED LED	1	LED1

TRANZORBS

1.5KE160C	1	TZ1
MPTE-15	1	TZ3
SSA40A	3	TZ4,TZ5,TZ6
SSA75A	1	TZ7

TRANSISTORS & VOLTAGE REGULATORS

2N3904	8	Q5,Q7,Q8,Q10,Q11,Q16,Q17,Q18
2N4391	1	Q4
LM320LZ-5.0	1	Q1
LM340T-5	1	Q6 (mounted vertically w/heat sink)
LM340T-10/7810	1	Q3 (mounted vertically w/heat sink)
MPS2907A	1	Q9
RFP2N12L	1	Q15 (mounted horizon. w/heat sink)
VN10KM/MPF10LM	3	Q12,Q13,Q14

CONNECTORS

6-pin IC socket	2	for IC1,IC2
8-pin IC socket	3	for IC3,IC4,IC6
14-pin IC socket	8	for IC5,IC7,IC8,IC9, IC10,IC22,IC25,IC28
16-pin IC socket	11	for IC13 thru IC19,IC21, IC24,IC27,IC30
18-pin IC socket	1	for IC12
20-pin IC socket	2	for IC11,IC20
28-pin IC socket	3	for IC23,IC26,IC29
40-pin IC socket	1	for IC31
2-pin male header	6	for CTCSS DE-EM, TX VOICE, TX TONE, RE DE-EM, 600 OHM, BATT

3-pin male header	4	for CTCSS INPUT, FILTER, CTCSS, COR
modular phone	1	PHONE
DB-25 female	1	I/O CONN (right-angle PCB mount)
2.1-mm jack	2	BATT, DC POWER
header jumpers		(as req'd for 0.025" square post headers)

TRANSFORMERS

13645	1	TR1
13649	2	TR2,TR3

CRYSTALS

3.579545 MHz	1	Y1 (flat to board, case grounded)
4.000 MHz	1	Y2 (flat to board, case grounded)

MISCELLANEOUS

PC board	1	
ferrite beads	29	FB1 thru FB29
pushbutton	1	SW1
lithium battery	1	BATTERY
heat sink	3	for Q3,Q6,Q15
mounting pad	1	for Q4
cabinet	1	
wire jumper	1	REG IN

HARDWARE

#4-40x3/8 screw	2	for DB-25-to-PCB
#4-40x1/4 screw	6	for cabinet cover
#4 int lockwasher	12	for cabinet cover, rack panel,DB-25
#4-40 nut	6	for DB-25, rack panel
#6-32x3/8 screw	3	for heat sinks
#6-32x1/4 screw	6	for PCB-to-cabinet mounting
#6 int lockwasher	9	for heat sinks,PCB-to-cabinet
#6-32 nut	3	for heat sinks

INTEGRATED CIRCUITS

LCA110	1	IC1
DC1871	1	IC2
TCM1520A	1	IC3
Si7661	1	IC4
MF6CN-50	1	IC5
LM13080	1	IC6
LF444	3	IC7,IC8,IC9
MX-315	1	IC10
74HC374	2	IC11,IC20
MT8870	1	IC12
CD4051	2	IC13,IC15
CD4053	2	IC14,IC16
MT5089	1	IC17

74HC138	2	IC18, IC21
74HC259	2	IC19, IC24
74HC10	1	IC22
HM6264LP-15	1	IC23
74HC00	2	IC25, IC28
27128	1	IC26
74HC251	1	IC27
6340/68SC40	1	IC29
74HC423	1	IC30
6809	1	IC31

PARTS LIST

<u>VALUE</u>	<u>QTY.</u>	<u>LOCATION</u>
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1/4-WATT RESISTORS

68 ohms	1	R63
270 ohms	1	R51
390 ohms	1	R91
560 ohms	1	R11
1K ohms	8	R12,R52,R57,R59,R60,R64,R6, R97
1.5K ohms	2	R5,R37
2.2K ohms	3	R3,R4,R46
4.7K ohms	13	R6,R20,R21,R30,R81,R82,R84, R85,R87, R88,R94,R95,R96,
10K ohms	14	R31,R45,R47,R49,R50,R53, R61,R62, R80,R83,R86,R89,R90,R93
18K ohms	11	R9,R10,R22,R23,R24,R25,R26, R27,R28,R68,R70
36K ohms	2	R15,R16
39K ohms	4	R13,R17,R19,R34
51K ohms	7	R39,R40,R41,R42,R73,R74,R75
56K ohms	1	R43
100K ohms	13	R7,R8,R33,R44,R58,R66,R69, R71,R72,R76,R77,R78
180K ohms	1	R36
200K ohms	6	R48,R54,R55,R56,R79,R92
220K ohms	2	R32,R38
300K ohms	1	R67
680K ohms	1	R14

1/2 WATT RESISTORS

22 ohms	2	R1,R2
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POTENTIOMETERS

5K ohms	2	P1,P2
50K ohms	12	P3 thru P14

RESISTOR NETWORKS

4.7K ohms	4	RN1 thru RN4
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PARTS LIST

<u>VALUE</u>	<u>QTY.</u>	<u>LOCATION</u>
<u>CAPACITORS</u>		
18 pF MLC	2	C86,C87
27 pF MLC	1	C61
0.001 uF FILM	10	C6,C9,C10,C11,C12,C13,C16, C17,C27,C29
0.0022 uF FILM	1	C5
0.0047 uF FILM	4	C7,C36,C37,C43
0.01 uF FILM	2	C28,C42
0.047 uF FILM	2	C8,C18
0.1 uF FILM	6	C25,C35,C38,C45,C49
0.1 uF MLC	37	C14,C15,C23,C24,C30,C31,C40, C44,C50,C51,C55,C56,C57,C58, C60 thru C70, C72 thru C82,C85, C88,C89
0.33 uF FILM	1	C41
0.47 uF FILM	5	C52,C53,C54,C83,C84
0.47u/250V FILM	1	C1
1.0 uF MLC	1	C59
1.0 uF TANT	2	C21,C47
4.7 uF TANT	5	C26,C32,C46,C62,C63
10 uF TANT	7	C3,C4,C20,C22,C33,C48,C71
10uF/50V ELECTRO	1	C2

DIODES

1N914/1N1418	13	D1,D4 thru D12,D18,D19,R29, (cathode toward C18)
1N4002	1	D15
1N5228B	3	D13,D24,D25
1N6236/HSCH1001	3	D14,D16,D17
RED LED	1	LED1

TRANZORBS

1.5KEC160C	1	TZ1
MPTE-15	1	TZ3
SSA40A	3	TZ4,TZ5,TZ6
SSA75A	1	TZ7

PARTS LIST

<u>VALUE</u>	<u>QTY.</u>	<u>LOCATION</u>
<u>TRANSISTORS AND VOLTAGE REGULATORS</u>		
2N3904	8	Q5,Q7,Q8,Q10,Q11,Q16,Q17, Q18
2N4391	1	Q4
LM320LZ-5.0	1	Q1
LM340T-5	1	Q6 (mounted vertically w/heat sink)
LM340T-10/7810	1	Q3 (mounted vertically w/heat sink)
MPS2907A	1	Q9
RFP2N12L	1	Q15 (mounted horizon. w/heat sink)
VN10KM/MPF10LM	3	Q12,Q13,Q14

CONNECTORS

6-pin IC socket	2	for IC1,IC2
8-pin IC socket	3	for IC3,IC4,IC6
14 pin IC socket	8	for IC5,IC7,IC8,IC9,IC10,IC22,IC25, IC28
16-pin IC socket	11	for IC13 thru IC19,IC21,IC24,IC27, IC30
18-pin socket	1	for IC12
20-pin socket	2	for IC11,IC20
28-pin socket	3	for IC23,IC26,ic29
40-pin socket	1	for IC31
2-pin male header	6	for CTCSS DE-EM, TX VOICE TX TONE, RE DE-EM, 600 OHM, BATT
3-pin male header	4	for CTCSS INPUT, FILTER, CTCSS, COR
modular phone	1	PHONE
DB-25 female	1	I/O CONN (right- angle PCB mount)
2.1-mm jack	2	BATT, DC POWER
header jumpers		(as req'd for 0.025 sqare post)

TRANSFORMERS

13645	1	TR1
13649	2	TR2,TR3

CRYSTALS

3.579545 MHz	1	Y1 (flat to board, case grounded)
4.000 MHz	1	Y2 (flat to board, case grounded)

PARTS LIST

<u>VALUE</u>	<u>QTY.</u>	<u>LOCATION</u>
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MISCELLANEOUS

PC board	1	
ferrite beads	29	FB1 thru FB29
pushbutton	1	SW1
lithium battery	1	BATTERY
heat sink	3	for Q3,Q6,Q15
mounting pad	1	for Q4
cabinet	1	
wire jumper	1	REG IN

HARDWARE

#4-40 X 3.8 screw	2	for DB-25-to-PCB
#4-40 X 1/4 screw	6	for cabinet cover
#4 internal lockwasher	12	for cabinet cover, rack panel, DB-25
#4-40 nut	6	for DB-25, rack panel
#6-32 X 3/8 screw	3	for heat sinks
#6-32 X 1/4 screw	6	for PCB-to-cabinet mounting
#6 internal lockwasher	9	for heat sinks, PCB-to-cabinet
#6-32 nut	3	for heat sinks

INTEGRATED CIRCUITS

LCA110	1	IC1
OCI871	1	IC2
TCM1520A	1	IC3
Si7661	1	IC4
MF6CN-50	1	IC5
LM13080	1	IC6
LF444	3	IC7,IC8,IC9
MX-315	1	IC10
74HC374	2	IC11,IC20
MT8870	1	IC12
CD4051	1	IC13,IC15
CD4053	2	IC14,IC16
MT5089	1	IC17
74HC138	2	IC18,IC21
74HC259	2	IC19,IC24
74HC10	1	IC22
HM6264LP-15	1	IC23
74HC00	2	IC25,IC28
27128	1	IC26
74HC251	1	IC27
6340/68SC40	1	IC29
74HC423	1	IC30
6809	1	IC31

PARTS LIST

1/4-WATT RESISTORS

68 ohms	1	R63
270 ohms	1	R51
390 ohms	1	R91
560 ohms	1	R11
1K ohms	8	R12, R52, R57, R59, R60, R64, R65, R97
1.5K ohms	2	R5, R37
2.2K ohms	3	R3, R4, R46
4.7K ohms	13	R6, R20, R21, R30, R81, R82, R84, R85, R87, R88, R94, R95, R96
10K ohms	14	R31, R45, R47, R49, R50, R53, R61, R62, R80, R83, R86, R89, R90, R93
18K ohms	11	R9, R10, R22, R23, R24, R25, R26, R27, R28, R68, R70
36K ohms	2	R15, R16
39K ohms	4	R13, R17, R19, R34
51K ohms	7	R39, R40, R41, R42, R73, R74, R75
56K ohms	1	R43
100K ohms	13	R7, R8, R33, R35, R44, R58, R66, R69, R71, R72, R76, R77, R78
180K ohms	1	R36
200K ohms	6	R48, R54, R55, R56, R79, R92
220K ohms	2	R32, R38
300K ohms	1	R67
680K ohms	1	R14

1/2-WATT RESISTORS

22 ohms	2	R1, R2
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POTENTIOMETERS

5K ohms	2	P1, P2
50K ohms	12	P3 thru P14

RESISTOR NETWORKS

4.7K ohms 10-pin	4	RN1 thru RN4
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CAPACITORS

18 pF MLC	2	C86, C87
27 pF MLC	1	C61
0.001 uF FILM	10	C6, C9, C10, C11, C12, C13, C16, C17, C27, C29
0.0022 uF FILM	1	C5
0.0047 uF FILM	4	C7, C36, C37, C43
0.01 uF FILM	2	C28, C42
0.047 uF FILM	2	C8, C18
0.1 uF FILM	6	C25, C35, C38, C39, C45, C49

0.1	uF MLC	37	C14,C15,C23,C24,C30,C31,C34,C40, C44,C50,C51,C55,C56,C57,C58,C60, C64 thru C70,C72 thru C82,C85, C88,C89
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1N5228B	3	D13,D24,D25
1N6263/HSCH1001	3	D14,D16,D17
RED LED	1	LED1

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#6-32x1/4 screw	6	for PCB-to-cabinet mounting
#6 int lockwasher	9	for heat sinks,PCB-to-cabinet
#6-32 nut	3	for heat sinks

INTEGRATED CIRCUITS

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TCM1520A	1	IC3
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