

# FF-800 Repeater Controller

## Installation and Operation Manual

Firmware Revision 3.11  
Updated October, 2024

Hardware revisions E through G

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## DTMF Command Hyperlinks:

[#\\*](#) Command Delimiter

### User Level Commands ({#xx} = [Prefix Assign](#) function#)

<a href="#">00</a>	{#01}	Control Prefix	<a href="#">132</a>	{#38}	TR Control Port A
<a href="#">01</a>	{#02}	Configuration Prefix	<a href="#">133</a>	{#39}	TR Control Port B
<a href="#">100</a>	{#03}	Control Unlock	<a href="#">134</a>	{#40}	TR Control Port C
<a href="#">101</a>	{#04}	Repeater Off	<a href="#">135</a>	{#41}	TR Control Port D
<a href="#">102</a>	{#05}	Repeater On	<a href="#">136</a>	{#43}	DTMF Repeat
<a href="#">103</a>	{#06}	DTMF UP/DN	<a href="#">137</a>	{#44}	S Meter Peak
<a href="#">104</a>	{#07}	Reset Controller	<a href="#">138</a>	{#45}	S Meter Average
<a href="#">105</a>	{#08}	Aux. Repeater Off/On	<a href="#">139</a>	{#46}	Configuration Unlock
<a href="#">106</a>	{#09}	RBI-1/BCD Frequency	<a href="#">140</a>	{#47}	Autopatch Secondary 1
<a href="#">107</a>	{#10}	Control Patch Logon Sysop	<a href="#">141</a>	{#48}	Autopatch Secondary 2
<a href="#">108</a>	{#11}	User Message Play	<a href="#">142</a>	{#49}	Autopatch Secondary 3
<a href="#">109</a>	{#12}	Autopatch Cancel	<a href="#">143</a>	{#50}	Date Talk
<a href="#">110</a>	{#13}	Tone Test	<a href="#">144</a>	{#51}	RBI-1 CTCSS Frequency
<a href="#">111</a>	{#14}	Autopatch Main	<a href="#">145</a>	{#52}	RBI-1 CTCSS Mode
<a href="#">112</a>	{#15}	Read Temperature F	<a href="#">146</a>	{#53}	Auxiliary Re-dial
<a href="#">113</a>	{#16}	Read Temperature C	<a href="#">147</a>	{#54}	Macro Execute Bank 5
<a href="#">115</a>	{#18}	Output Control	<a href="#">148</a>	{#55}	Macro Execute Bank 6
<a href="#">116</a>	{#19}	Emergency Speed Call	<a href="#">149</a>	{#56}	Macro Execute Bank 7
<a href="#">117</a>	{#20}	Speed Call Bank 1	<a href="#">150</a>	{#57}	Macro Execute Bank 8
<a href="#">217</a>	{#21}	Speed Call Bank 2	<a href="#">151</a>	{#58}	Reverse Autopatch
<a href="#">317</a>	{#22}	Speed Call Bank 3	<a href="#">152</a>	{#59}	RBI-1 Power
<a href="#">417</a>	{#23}	Speed Call Bank 4	<a href="#">153</a>	{#60}	Page Two Tone
<a href="#">118</a>	{#24}	Time Talk	<a href="#">154</a>	{#61}	Macro Execute 81
<a href="#">119</a>	{#25}	Autopatch Cancel, Uncond.	<a href="#">155</a>	{#62}	Macro Execute 82
<a href="#">120</a>	{#26}	Autopatch Extend	<a href="#">156</a>	{#63}	Macro Execute 83
<a href="#">121</a>	{#27}	CT Test	<a href="#">157</a>	{#64}	Macro Execute 84
<a href="#">122</a>	{#28}	Macro Execute Bank 1	<a href="#">158</a>	{#65}	Macro Execute 85
<a href="#">123</a>	{#29}	Macro Execute Bank 2	<a href="#">159</a>	{#66}	Macro Execute 86
<a href="#">124</a>	{#30}	Macro Execute Bank 3	<a href="#">160</a>	{#67}	Macro Execute 87
<a href="#">125</a>	{#31}	Macro Execute Bank 4	<a href="#">161</a>	{#68}	Macro Execute 88
<a href="#">126</a>	{#32}	SPI Command	<a href="#">162</a>	{#69}	Control Patch Logon User
<a href="#">127</a>	{#33}	Output Pulse	<a href="#">163</a>	{#70}	Pager Mem. Exec.
<a href="#">128</a>	{#34}	SPI 4 Command	<a href="#">164</a>	{#71}	Pager Mem. Alias
<a href="#">129</a>	{#35}	SPI 5 Command	<a href="#">165</a>	{#72}	Output CTCSS to Binary
<a href="#">130</a>	{#36}	SPI 6 Command	<a href="#">166</a>	{#73}	Output Decimal to Binary
<a href="#">131</a>	{#37}	SPI 7 Command			

## **Control Level DTMF Command Hyperlinks:**

<a href="#">1</a>	Speech Suppress Toggle	<a href="#">450</a>	Tail Message Enable
<a href="#">2</a>	Force Timer Reset	<a href="#">452</a>	ID Bulletin Enable
<a href="#">3</a>	Force COS Resynch.	<a href="#">453</a>	ID Interrupt Mode
<a href="#">400</a>	Speed Call Program/Erase	<a href="#">455</a>	Machine Alert
<a href="#">401</a>	Reverse Patch Sysop	<a href="#">459</a>	ID Force
<a href="#">405</a>	Control Patch Logoff	<a href="#">460</a>	Level Set External
<a href="#">406</a>	Control Patch Monitor	<a href="#">471</a>	Scheduler Event Time
<a href="#">407</a>	Autopatch Enable	<a href="#">473</a>	Scheduler Event Enable
<a href="#">408</a>	Don't Answer Next	<a href="#">474</a>	Scheduler Event Macro
<a href="#">409</a>	Read Last Number	<a href="#">475</a>	Command Trigger Assign
<a href="#">410</a>	Clock Set	<a href="#">476</a>	LiTZ Trigger Assign
<a href="#">411</a>	Clock 12/24 Hour Mode	<a href="#">477</a>	LiTZ Detect Time
<a href="#">420</a>	TX Lock	<a href="#">480</a>	State Recall
<a href="#">439</a>	Lock Security	<a href="#">490</a>	Display Control
<a href="#">442</a>	DTMF Access Control		

**Configuration Level DTMF Command Hyperlinks**

<a href="#">480</a>	State Store	<a href="#">570</a>	Voter Port Assign
<a href="#">485</a>	State Store	<a href="#">572</a>	Voter CT MODE
<a href="#">500</a>	Level Set RX Audio	<a href="#">574</a>	Voter CW String Enable
<a href="#">501</a>	Level Set TX Audio	<a href="#">575</a>	Voter Active Level
<a href="#">505</a>	RBI-1/BCD Mode	<a href="#">580</a>	Message Edit
<a href="#">506</a>	Output Decimal Width	<a href="#">590</a>	Macro Enter
<a href="#">510</a>	Timer Set	<a href="#">591</a>	Macro Enter Abort
<a href="#">512</a>	Output Pulse Timing	<a href="#">592</a>	Macro Enter Save
<a href="#">513</a>	Output Port Lock	<a href="#">595</a>	Time Delay Macro Execute
<a href="#">515</a>	Clock Disable	<a href="#">596</a>	Macro Abort if True
<a href="#">517</a>	Clock Smoothing	<a href="#">597</a>	Macro Abort if False
<a href="#">520</a>	Prefix Assign	<a href="#">598</a>	Macro User Flags
<a href="#">521</a>	PIN Prefix Select	<a href="#">599</a>	Macro Parameter Designate
<a href="#">522</a>	Delimiter mode	<a href="#">605</a>	S Meter Calibrate
<a href="#">525</a>	User Function Control	<a href="#">610</a>	Output Active Level
<a href="#">526</a>	PIN Enter	<a href="#">630</a>	Dial Prefix Enter
<a href="#">527</a>	PIN Mode select	<a href="#">632</a>	Dial Prefix Enable
<a href="#">530</a>	Control Patch Enable	<a href="#">633</a>	Autopatch Hang-up Set
<a href="#">531</a>	Autopatch Courtesy Tone	<a href="#">634</a>	Autopatch Valid Length
<a href="#">532</a>	Number of Rings	<a href="#">635</a>	Autopatch Hang-up Read
<a href="#">533</a>	Remote Patch Enable	<a href="#">636</a>	Patch Options Enable
<a href="#">534</a>	Reverse Patch Mode	<a href="#">637</a>	Reverse Patch Wait
<a href="#">535</a>	Modem Up/Down	<a href="#">639</a>	Autopatch Busy Override
<a href="#">536</a>	Modem On Line	<a href="#">650</a>	Pager Mem. Program
<a href="#">538</a>	Baud Rate	<a href="#">651</a>	Pager Alias Program
<a href="#">539</a>	DTMF Log Echo	<a href="#">655</a>	Exchange List Control
<a href="#">540</a>	Remote Base Action	<a href="#">656</a>	Exchange Delete
<a href="#">541</a>	TR Priority Set	<a href="#">657</a>	Exchange Add
<a href="#">542</a>	TR Mode	<a href="#">670</a>	Scheduler Control
<a href="#">543</a>	Link Response Control	<a href="#">699</a>	Macro Prefix Designate
<a href="#">544</a>	PTT Slave to CTCSS Decode	<a href="#">800</a>	Version Interrogate
<a href="#">545</a>	COS Active Level	<a href="#">854</a>	COS Over Patch, keydown
<a href="#">546</a>	CTCSS Mode Set	<a href="#">855</a>	COS Over Patch Configure
<a href="#">547</a>	CTCSS Active Level	<a href="#">855*</a>	CAP Monitor Level
<a href="#">548</a>	CTCSS Selective Encode Output Select	<a href="#">864</a>	COS Over Patch, keyup
<a href="#">549</a>	CTCSS Selective Encode		
<a href="#">550</a>	CT Allocate		
<a href="#">551</a>	CT Edit Mode		
<a href="#">552</a>	DTMF Cover Tone		
<a href="#">553</a>	CT Allocate Voter		
<a href="#">554</a>	DTMF Un-Mute Digit		
<a href="#">555</a>	Message Assign		
<a href="#">556</a>	Message Play		
<a href="#">560</a>	Set CW Speed		
<a href="#">564</a>	DTMF Anti-Un-Mute Digit		
<a href="#">565</a>	Set CW Frequency		

## Serial Command Hyperlinks

<a href="#">?</a>	Display serial command list	<a href="#">LEV V</a>	Voter COS logic level
<a href="#">ADDIN</a>	Autopatch lock-in add	<a href="#">LF</a>	Line-feed mode
<a href="#">ADDOUT</a>	Autopatch lock-out add	<a href="#">LLOG</a>	DTMF log display
<a href="#">APREF</a>	Autopatch dial prefix mode	<a href="#">LOAD</a>	Configuration memory restore
<a href="#">ASSIGN</a>	Message assign display	<a href="#">LOCKIN</a>	Autopatch lock-in display
<a href="#">BBSSET</a>	ID bulletin control	<a href="#">LOCKOUT</a>	Autopatch lock-out display
<a href="#">CALL</a>	Repeater callsign string	<a href="#">LOGOFF</a>	Serial command secure
<a href="#">COVER</a>	DTMF cover tone mode	<a href="#">LOGON</a>	Serial command access
<a href="#">CRX</a>	Control RX simulate	<a href="#">MACRO</a>	Macro display
<a href="#">CTENT</a>	Courtesy tone edit	<a href="#">MESSAGE</a>	System message edit
<a href="#">CTGET</a>	Courtesy tone recall to edit	<a href="#">MODEM</a>	Modem initialize string
<a href="#">CTSEL</a>	Courtesy tone assign	<a href="#">PASSET</a>	Serial password enter
<a href="#">CTSTOR</a>	Courtesy tone save from edit	<a href="#">POT</a>	RX Audio level
<a href="#">CWFR</a>	CW tone (global)	<a href="#">RESET</a>	Warm reset
<a href="#">CWSP</a>	CW speed (global)	<a href="#">SAVE</a>	Configuration memory save
<a href="#">DATE</a>	Date edit	<a href="#">SCHEDULE</a>	Schedule event list display
<a href="#">DCECON</a>	Modem connect string	<a href="#">SCIC</a>	Serial port connect mode
<a href="#">DCEDN</a>	Modem off-line string	<a href="#">SDLIST</a>	Speed dial list
<a href="#">DCEUP</a>	Modem on-line string	<a href="#">SDMESSAGE</a>	Speed dial message edit
<a href="#">DELETE</a>	Courtesy tone delete	<a href="#">SDSET</a>	Speed dial program/erase
<a href="#">DELIN</a>	Autopatch lock-in delete	<a href="#">SITNAM</a>	Edit site name string
<a href="#">DELOUT</a>	Autopatch lock-out delete	<a href="#">STATE</a>	State save/recall
<a href="#">DIALPFX</a>	Autopatch dial prefix edit	<a href="#">TALSET</a>	Tail message control
<a href="#">DIS1</a>	Display COS/PTT status	<a href="#">TIME</a>	Time of day edit
<a href="#">DIS2</a>	Display I/O status	<a href="#">TIMER</a>	System timers
<a href="#">DUPLEX</a>	Serial duplex mode	<a href="#">TONBUF</a>	DTMF digit buffer display
<a href="#">ESCAP</a>	Modem Escape Character	<a href="#">TPOT</a>	TX Audio level
<a href="#">HANDS</a>	Serial handshake mode	<a href="#">TTAXS</a>	DTMF access mode
<a href="#">HANG</a>	Hang-up autopatch	<a href="#">VCTSEL</a>	Voter courtesy tone assign
<a href="#">IDCLR</a>	ID force	<a href="#">VERIFY</a>	Configuration file verify
<a href="#">LEVC</a>	COS logic level	<a href="#">VERSION</a>	Firmware version display
<a href="#">LEVO</a>	Output logic level	<a href="#">WORDS</a>	Display speech word list
<a href="#">LEVP</a>	CTCSS logic level		



## Introduction

Thank you for purchasing the FF-800 Repeater Controller. This product will give you years of reliable service. The FF-800 Repeater Controller represents the state of the art in microprocessor control systems. It has the flexibility to control everything from the simplest to the most complex repeater systems. This manual describes the installation and operation of your new controller. Each option offered by FF Systems comes with its own manual -- thus, depending on which option(s) have been purchased, there may be other manuals that you must consult.

## Warranty

FF Systems warrants its products to be free from defects for one year from the date of shipment. FF Systems may opt to repair or replace (at our option) any defective product. FF Systems does not warrant any defect due to lightning or other natural disaster. Any user modifications or repairs to any product sold by FF Systems will void this warranty. All returns must be accompanied by a Return Material Authorization (RMA) number provided by FF Systems prior to shipment. Shipments that do not have the proper return authorization prominently noted on the outside of the package will not be accepted. The purchaser is responsible for all shipping charges for any service procedure(s) performed by FF Systems (including warranty service).

## Contact Address:

FF Systems

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[joeh@ke0ff.org](mailto:joeh@ke0ff.org)

# 1. Specifications and Features

## 1.1. Specifications

Power requirement	12Vdc (+/-15%) @ 350mA
Digital Signals:	
COS, Voter logic, CTCSS and trigger inputs	-0.7 to +40V
Phone busy input	+/- 12Vdc
Peripheral bus input	-0.7 to +5Vdc
Peripheral bus output	0 to +5Vdc, 3mA source/sink max
KEY and OUTPUT lines	0 to +40Vdc, 500mA sink (max)
Serial interface	RS-232 voltage levels cable length: 3 meters (max)
Analog Signals:	
A/D converter inputs 0 to +5Vdc conversion range	protected from -0.7 to +12V max
Audio inputs	4Vpp (max) 2Vpp (recommended)
DTMF valid input (S/N better than 20 db SINAD)	0.8 to 4Vpp
Maximum DTMF receive twist	+/- 10 db
DTMF frequency tolerance	+/- 2%
DTMF detect time	50 ms (min)
Audio output (normalized)	4Vpp
Audio inputs (RXA, B, C, D, CNTL, AUXDTMF)	
Gain(adjustable)	-23 db to +23 db in 100 steps
Input impedance	50K ohms, AC coupled
Audio output impedance	175 ohms, DC coupled

## 1.2. Description of Features

- 4 receiver inputs and outputs. Digital COS and CTCSS inputs for each receiver that can be configured for active high or active low operation. Digital potentiometers allow remote control of receiver, transmitter, and courtesy tone levels.
- 5th port can operate as a local microphone input or as an additional radio port.
- Control receiver input -- allows separate path for passing control commands
- 4 analog inputs for remote voltage sensing. Scaling and configuration commands allow custom metering range and units.

- 4 edge detecting digital command trigger inputs that can be configured to execute user defined function macros at rising and falling edges. Useful for power fail detection, security alarm, etc...
- Voter logic inputs for multiple receiver applications. Up to 8 receivers supported -- allows different courtesy tone for each receiver on a given receiver input port. User can configure for last active receiver or most active receiver for courtesy tone determination.
- CTCSS logic input for each receiver. Various CTCSS/COS combinations can be user programmed to meet desired CTCSS requirements.
- RS-232 serial port that can be connected to a terminal, TNC, or modem. Supports the following baud rates: 75, 150, 300, 600, 1200, 2400, 4800, and 9600. Various commands allow the user to control access via the modem or TNC to enhance security.

The RS-232 port supports command line programming that is fundamentally different from that of the DTMF inputs. Includes a "remote front panel" feature that allows the user to monitor the status of the FF-800 from a remote location.

- Synchronous serial expansion bus for adding advanced features such as the following:
  - FF-8070 Digital Voice Recorder (DVR)
  - FF-899 HF rig interface (currently supports the following: IC-735, IC-706, TS-440, TS-870, FT-890, and FT-767)
  - FF-8090 ICOM IC-901 Interface
  - FF-8900 ACC FC-900 ICOM UX module interface
  - Shift-register capture of BCD frequency data for controlling "thumb-wheel" type
  - Doug Hall RBI-1 Kenwood interface.
- 8 on-board digital outputs which can turn on, off, or pulse.
- 8 external digital outputs which are captured off of the synchronous serial expansion bus utilizing shift-register IC's (user supplied).
- Autopatch with busy line detect logic input and an off-hook logic output for shared phone line environments.
- DTMF test function allows the controller to read back up to 30 DTMF digits for verification of tone pad acceptance.
- Advanced message management system which allows custom function announcement messages, IDs, tail messages, etc....
- Full featured autopatch with number read-back or read-back suppress, custom hang-up code, re-dial, phone line control of controller, reverse autopatch, DTMF regeneration, dial out prefix capability (for PBX systems), 250 speed dials including 10 emergency speed dials -- each speed-dial features an individual annunciator message.

- 64 command macros which allow a series of DTMF commands to be executed using one function code.
- Time of day clock with voice read back of time and date.
- 52 event scheduler which supports time triggered functions. The user can define month, date, and time. Wildcard operators allow events to trigger at the same time each day, week, or month as desired. Up to four simultaneous events can be processed.
- 8 user programmable courtesy tones (max of 6 elements each), sine wave tone synthesis with 0.1 Hz resolution from DC to 3500 Hz. Courtesy tones can be either single or dual tone each with 10dB gain adjustment, attack/decay, and frequency sweep effects.
- 8 pre-defined courtesy tones.
- Owner programmable system messages:
  - 6 rotating ID bulletins
  - 2 rotating ID welcome messages
  - 8 tail messages
  - Autopatch announce, Speed call announce, autopatch disconnect,
  - Emergency Speed dial announce, Link / Remote base mode announce
  - for each of the 4 rx/tx pairs, repeater time out, etc....
- Selectable cover tone modes for DTMF digits. The user may mute with a cover beep for each digit, mute with a cover beep once each second, mute with no beeps, or no mute.
- 18 user programmable system timers, including: Tail rate, Repeater time-out, ID, Courtesy tone delay, Hang time, Autopatch duration, plus more...
- 6 repeater states that store system configuration parameters that can be recalled on demand.
- DTMF code log stores all valid DTMF digits into a logging buffer that can be viewed via the RS-232 serial port. The buffer stores the most recent 200 DTMF digits entered. A user selectable option allows the code log to be dumped in real-time to a serial printer or PC for continuous logging. Date/time stamp for each entry to indicate exactly when the sequence was detected. This feature is useful for assisting users who are having difficulty with commands, or to help spot potential problems with "hackers".
- In-system FLASH programming capability allows quick and easy firmware updates with no special programming equipment and no disassembly required.

### 1.3. Firmware Revision History

## v3.10

Mon, Aug 12, 2001, 18:00

- Added display “gas-gauge” status indicator for LOAD/SAVE/VERIFY functions.
- Updated ASSIGN command to list all 99 functions.

- Added xmodem (128 byte, checksum only) load, save, and verify (XLOAD, XSAVE, and XVERIFY).
- Fixed bug in date set that prevented updates of the day of week.
- Added "PL Always" to the CTCSS Selective Encode feature. Also added a 200ms delay from deactivation of PL to TX drop to eliminate squelch burst on tone encoded radios.
- Added "Remote Base Warning" message to Remote Base Adjust feature. Will send warning message at 30, 20, and 10 seconds before adjust action occurs.
- Added serial port command to list the current DTMF prefix settings (CODELIST).

## **v3.08/3.09**

Tue, Jul 10, 2001, 23:25

- Changed serial "INGET" command to "LOGON".
- Fixed a bug with SDMESSAGE that prevented access of speed dial messages 240-249.
- LEVP/LEVC now list port names for user reference.
- Serial LOAD command was modified to support an error buffer that holds up to 40 of the last errors encountered during a configuration load. If there are errors, a user prompt is displayed that queries the desired action: A)bort, R)etry, or F)actory default. Automatically performs factory initialization if there is no response to the query after 120 seconds.
- Modified LOAD so that it will not overwrite the time clock or serial password.
- Configuration files may now have comments to hold user notes. Any line that begins with a semi-colon is ignored by the LOAD command.
- VERIFY is a new serial command that verifies the integrity of a SAVE file. This is used to verify a newly saved file has been captured properly (it doesn't compare any data stored in the controller). Verify works just like LOAD except that it doesn't alter the controller configuration.
- DIS1 and DIS2 are new serial commands that allow snapshot interrogation of the controller I/O status.
- Modified the factory initialization routines to key all TXs and announce "Base Start Complete" at the conclusion of the initialization procedure. Allows users with no local speaker to know when the initialization is finished.
- Fixed a bug in the R B Adjust message that would mute the message if a COS was active.
- Forced pulse width to a minimum value of 1 to prevent random timing problems that resulted from a setting of 0.
- Modified the code that uses the day of the week (scheduler, time interrogate, etc...) to filter unused bits that can be inadvertently set causing problems with weekly scheduler events.
- Fixed a bug in the DTMF output level configuration command.
- Modified the BCD Output command (user166) to use the output level settings when accessing the internal outputs.
- Added the BCD Width command to restrict the bits affected by the BCD Output command. The syntax is cnfg 506 ; n where n = 1 to 8 bits. The width is always aligned with the lowest bit.
- Added a Message pre-assign command to assign each "ff" message function to its corresponding message number. cnfg555AAAA
- Added TIME and DATE serial commands. Time clock now supports century and year and automatically calculates the day of the week.
- Modified DTMF set time command to accept either 2 or 4 digit year entries. 2 digits leaves

current century unmodified. Also automatically calculates the day of the week.

- Added a 24 hour mode to the time interrogate commands, cntl41112 sets 12 hour mode, cntl41124 sets 24 hour mode. Set time is still always in 24 hour format.
- Added a new feature called COS over patch. This feature allows a control operator on a control autopatch session to use the repeater as though they were on a transceiver. Once configured, the control operator uses a DTMF digit to "key" (keydn) the repeater at which point they are transmitting on all enabled ports. Another, different, DTMF digit is used to "unkey" (keyup) the repeater at which point they are monitoring the repeater output. Note that this feature uses command trigger #1. If this input is used, it must be moved to another trigger input before the CAPCOS feature can be utilized.
- CAP Monitor mode must be on (cntl4061) to use "key down" and "key up".
- New configuration command to enable CAP COS mode: cnfg855 ; 1/0. 1 = on, 0 = off.
- New configuration command to set the monitor level: cnfg855\* ; 0/1/2. 0 = max level, 2 = min level.
- New configuration commands to set the DTMF "key" (cnfg854 ; d) and "unkey" (cnfg864 ; u) digits. d = key down DIGIT, u = key up DIGIT. NOTE: d & u digits MUST be different for the feature to work correctly.
- New control command that allows a control patch to be initiated from a DTMF command port. cntl404 is used after an autopatch command (and also after the control unlock command). once executed, the controller will enter control patch mode at which point the answering party will have 13 seconds to enter the control patch logon command.
- The APO Cancel modification is recommended when using the CAP COS mode. The APO Cancel modification is a retrofit module that plugs into the sockets for U17 and U18 that reduces the DTMF interference that can occur while in CAP Monitor mode. Contact Joe Haas at [joeh@rollanet.org](mailto:joeh@rollanet.org), or call 512-238-7580 for details.

## **v3.07**

Fri, Dec 29, 2000, 16:29

- Fixed a latent bug that could cause lock-up problems with the controller. While rare, it was possible to lock-up the controller while entering DTMF digits at a high rate. While the exact cause isn't clear, the problem was actually with the tone generation software and was caused by the DTMF cover tones overlapping (individual mode). Modified the tone software to be fault tolerant thereby removing the lock-up mechanism.

## **v3.06**

Wed, Feb 16, 2000, 8:07 PM

- Re-fixed RBI-1 memory support. This was fixed in V2.19P, but was lost in the V3.00 translation.
- Fixed the SDM command to take all 250 speed dial slot numbers.
- Changed Set Baud command to allow immediate baud rate update (previously, a reset was required to update the new rate). To make update immediate, use (pfx) \* (r), where (r) = rate digit.

## **v3.05**

Sun, Jan 2, 2000, 4:11 PM

- Added new macro flags (40:lclrx, 41:lcltx, 42-45:MacTimer1-4, 46:Autopatch timer,

47:Reverse Patch wait timer). The timer flags test true if timer = 0.

- Modified scheduler system to improve operation. Added ability to queue coincident events. The scheduler will execute up to 4 coincident events (duplicate macros are excluded).
- Added Macro Timer Set command (cnfg595) to allow timer driven macros. This allows a macro to be executed after an elapsed time (not tied to clock). Syntax: cnfg595mmt.t mm = macro#, t..t = time in seconds to macro execute. The time is measured from the BEGINING of the Interrogate message.

## **v3.04**

Thu, Nov 25, 1999, 14:06

- Added OUTlock (cfg513) to allow the logic outputs to be security locked. This allows the sysop to require config security before a logic output can be changed. Applies to all commands that control outputs. The internal and external ports are controlled separately.
- Added fauxRAP (cfg640).
- Added ability to page speed dial message on reverse patch (151). by adding a speed dial slot# as a parameter to the 151 command, the controller announces the speed dial message for that slot. MSG speaks even if no speed dial is programmed.

## **v3.03**

Sat, Nov 20, 1999, 20:28

- Fixed teen speak, was inserting an random word in the output speech for teen numbers.
- Modified TR Mode (TRCONF) to support LCL port. Syntax: cnfg5421x, x = 0 to interrogate, 1 for RX, 2 for TX, 3 for OFF.
- Added DTMF LEVC command cnfg545, allows COS active level to be modified from DTMF ports.
- Added DTMF LEVP command cnfg547, allows CTCSS active level to be modified from DTMF ports.
- Added hex->out command to store decimal value as hex code to the logic outputs, user166. This command uses msg#94 for telemetry msg. Syntax: 166 interrogates, 166xxx sets code for 'xxx', 166\* interrogates external outputs, 166\*xxx sets code for 'xxx' on external port
- Added CTCSS->out command to store mx165 tone code settings to outputs[5:0], user165. Uses same PL codes as for the RBI-1 CTCSS command. 165 interrogates, 165xx sets PL# 'xx', 165\* interrogates external port, 165xx sets PL# 'xx' on external port. The external port supports the FF-Tone CTCSS encode/decode module.
- Added several ctcss features and config commands:
  - 1) cnfg544: slave PTTs to any CTCSS (per port).
  - 2) cnfg548: designate output# for encode enable output register. This allows a CTCSS encoder to be selectively enabled during COS, ID, etc... Output #9 = FF-Tone.
  - 3) cnfg549: encode output options 1) follow cos, 2) follow cos w/hangtime, 3) follow command telem, 4) follow IDs, 5) follow autopatch

## **v3.01**

Fri, Apr 30, 1999, 23:27

- Fixed error in SIMTEK store/recall functions.

## **v3.00**

Mon, Mar 29, 1999, 19:12

- Reformatted object code to use extended memory.

- Added word-number to serial WORD command. Lists word number (used in DTMF message edits) with each word.
- Added SDMESSAGE command to allow serial command edits of speed dial messages. Each speed dial message now has an individual 8byte speech message that may be programmed (requires expanded U5 RAM).
- Speed dial memories support double length storage (expanded U5 required). Banks 1 & 2 are now 14 digits, bank 3 is 20 digits, and bank 4 is 60 digits. This was implemented in v2.19n, but may be new to those of you who haven't upgraded in a while.
- Modified LOAD and SAVE commands to support expanded U5 RAM. These commands now save/restore all available non-volatile storage. LOAD is still compatible with pre-v3.xx configuration data.

## **Revisions previous to v3.00**

Previous revision history can be obtained from the internet at:

<http://www.rollanet.org/~joeh/FFtp/REVnotes.html>



## 2. Quick-Start Guide

This section comprises a short checklist that is designed to get your controller connected and on the air quickly. No attempt is made to describe the demonstrated functions and the commands provided below assume that the FF-800 is in its factory default condition.



**Figure 2-1. TX/RX connector pin layout (4 pin mini-DIN male, wire side view)**

### **Receiver Connection – Active LOW COS**

The FF-800 uses mini-DIN connectors for the primary receiver and transmitter connections. Referring to Figure 2-1, connect the receiver using 4 conductor, shielded cable and a 4 pin mini-DIN connector (supplied). Refer to Figure 4 -5 and Figure 4 -6 for mini-DIN connector assembly details.

#### Receiver pinout (P11 through P14)

Pin 1: receiver COS  
Pin 2: receiver audio  
Pin 3: GND  
Pin 4: CTCSS (logic)

### **Receiver Connection – Active HIGH COS**

While the FF-800 can accommodate active high COS, it is generally recommended that an NPN inverter be used to convert the active high COS to active low. Use the circuit of Figure 4 -9 and connect the receiver using the pin table shown above.

### **Transmitter Connection**

Referring to Figure 2 -1, connect the transmitter using 4 conductor, shielded cable and a 4 pin mini-DIN connector (supplied).

#### Transmitter pinout (P15 through P18)

Pin 1: PTT  
Pin 2: TX audio (NOTE: place a 0.1uF or 1.0uF (non-polar) capacitor in series with audio signal)  
Pin 3: GND  
Pin 4: Logic output (port A = out 1, port B = out 2, etc...)

## Callsign Programming

Once the TX/RX connection is complete, apply system power and observe the FF-800 startup message at the TX output, “F F Eight Hundred V x Point y z Echo” (“xyz” are the software revision numbers). Do not be concerned if the audio levels are excessive, these will be adjusted shortly. The repeater should ID using the default callsign of “FF800”.

Next, using a transceiver tuned to the repeater frequency and offset, enter the DTMF security code “100” and observe the speech response “O K”. If no response is heard, but the courtesy tone is heard, then the RX level into the FF-800 should be adjusted (at the receiver) until the controller responds to DTMF digits.

Once the controller is responding to DTMF digits, use the following table to build up the repeater callsign code sequence. Use the scratchpad below for assistance.

Letters:

CHR	Code	CHR	Code	CHR	Code	CHR	Code
A	65	H	72	N	79	U	86
B	66	I	73	O	80	V	87
C	67	J	74	P	81	W	88
D	68	K	75	Q	82	X	89
E	69	L	76	R	83	Y	90
F	70	M	77	S	85	Z	91
G	71	N	78	T	85		

Numbers:

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

EXAMPLE: Repeater call = “KE0FF”

K		E		0		F		F	
75	*	69	*	#0	*	70	*	70	

Callsign scratchpad:

	*		*		*		*		*
--	---	--	---	--	---	--	---	--	---

NOTE: Omit any “\*” digits after the last character.

Once the callsign codes are complete, enter the following code sequence:

DTMF code	Response
'100'	"O K"
'139'	"O K"
'01551'	"T X T Enter"

Enter the callsign sequence from the scratchpad above (including the "\*" between codes, stop entering and release PTT after the last code)...the response should be the repeater callsign using synthesized speech. From the example above:

'75\*69\*#0\*70\*70'    "K E Zero F F"

If the response is correct, enter '\*3100' (response: "T X T Complete") which saves the callsign into non-volatile memory.

Enter '00491'        "This Is (callsign) Repeater"

This will verify that the callsign was entered correctly. The callsign programming is complete. Note that the repeater callsign is now programmed as a speech phrase (11), which can be used in any message to speak (or send in CW) the repeater callsign. Simply use the speech code '11' in any message (or use [ID] when editing a message via the serial port). By using the ID phrase (11) in messages, the repeater callsign can be easily changed by simply entering the new callsign as described above.

## Callsign Programming via the Serial Port

If a serial connection is applied to the FF-800, the callsign programming can be easily accomplished. The serial terminal parameters should be set to full duplex, 9600 baud, 8 data bits, one stop bit, and no parity. To access the FF-800, first enter the serial port security login command (note that there is no character echo until after the login command is successfully executed):

```
LOGON FF800<cr>           {logon command, note: these characters will not be echoed}
I FF800<cr>               {pre-V3.08 firmware logon format}

FF-800 LOGON
FF-800 Firmware V 3.09 tacan revF+
June 2001 test release
16:09:12, Tuesday, July 10, 2001

Site Name: ANY TOWN, USA
>CALL 'KE0FF'             {Next, enter the message edit command for the ID:}
K E 0 F F
>
```

The repeater callsign is now programmed.

## TX Level Adjust

The FF-800 features digital level controls for the TX and RX audio chains. These levels are adjusted via command codes on either the DTMF inputs or the serial port. The best way to adjust the TX level is to use a deviation meter and the DTMF test command, '1101234567'. This allows you to check the deviation of the repeater using the speech synthesizer to set the optimal deviation.

If a deviation meter is not available, the best alternative is to have a monitor receiver that is tuned to the repeater output. Have an assistant using a separate transceiver (transmitting on the repeater output frequency) perform test counts followed by the DTMF code: '1101234567' on one of the repeater command inputs. The two levels are compared by ear and adjustments made until the levels are reasonably close. The idea is to adjust the TX level until the repeater synthesized speech is approximately the same level as an operator's speech. Don't worry if you want to change the speech level, this can be done separately at a later time, for now, you just want to get the TX drive level set.

Regardless of the method, the Port A TX level command is as follows:

<u>DTMF code</u>	<u>Response</u>
'100'	"O K" (only need to enter once per session)
'139'	"O K" (only need to enter once per session)
'015011xx'	"Set T X A x x", 'xx' = level in percent, 00 thru 99 (leading zeros required).
'1101234567'	"One Two Three Four Five Six Seven"

Or via the serial port:

LOGON FF800  
TPOT 1 xx  
CRX 1101234567

*{this is the serial port login command, only needed once per session}*  
*{'xx' = level in percent, 0 – 99}*  
*{DTMF test digits command}*

## RX Level Adjust

A deviation meter and an RF signal generator are highly recommended for adjusting the RX level. By injecting a standard level, 1KHz tone into the receiver front end, the RX level can be adjusted for the desired deviation at the repeater output. It is best if the test signal can be turned on and off so that DTMF commands can be entered. If a control RX, Local Microphone, or serial terminal are available, these alternate command inputs may be used to adjust the RX level allowing the test tone to be constantly on.

If a test set is not available, have an assistant transmit DTMF digits on the repeater input. Use a separate receiver and switch between repeater input and output to compare the levels. To do this properly, the DTMF digits must be unmuted first. This is done by pressing "#" briefly followed by the desired DTMF digit or sequence. Repeat this sequence until the input and output levels seem to agree.

The Port A RX level command is as follows:

<u>DTMF code</u>	<u>Response</u>
'100'	"O K" (only need to enter once per session)
'139'	"O K" (only need to enter once per session)
'015002xx'	"Set R X A x x", 'xx' = level in percent, 00 thru 99 (leading zeros required).

Or via the serial port:

I FF800	<i>{this is the serial port login command, only needed once per session}</i>
POT 2 xx	<i>{'xx' = level in percent, 0 – 99}</i>

Once the level adjustments are complete, issue the STATE SAVE command to store the configuration. Failure to do so will result in the loss of the configuration data. It is also a good idea to make a note of the level settings for future reference.

<u>DTMF code</u>	<u>Response</u>
'100'	"O K" (only need to enter once per session)
'139'	"O K" (only need to enter once per session)
'014801'	"Set Machine Set One"

Or via the serial port:

STATE 1 S

The last command you should need is the **Set Time** command:

'00410hhmmssDDMMYYYY'	"Time"
-----------------------	--------

hh = hour  
mm = minute  
ss = second  
DD = Date  
MM = month  
YYYY = the full year

Enter all digits (14 total), including leading zeros or the data will be rejected. *NOTE: pre-V3.09 versions only allow 2 digits for the year.*

When finished, enter the LOCK command to secure the repeater:

'00439'	"O K"
---------	-------

The repeater is now ready to go on the air. It is factory pre-set with a 10 minute ID timer and ID messages that use the CALL phrase (word #11) to issue the repeater ID. If the controller loses power or is reset, it will retain these settings and reset automatically. If it becomes necessary to deactivate the repeater due to abuse or to initiate repairs, use the following codes:

‘102’                      Repeater Off  
‘101’                      Repeater ON

*NOTE: When the controller is in the “OFF” state due to the ‘102’ command, it will only respond to the ‘101’ command. Serial port commands are not affected.*

## 3. Operational Overview

There are many different aspects to the operation of the FF-800 repeater controller. The FF-800 carries a variety of configuration options as well as several interface options including: temperature sensing, input/output logic control, voter logic and CTCSS inputs, multiple DTMF command paths, and more. This section discusses the various operational characteristics of the FF-800 system and provides an overview of the commands and options available.

### 3.1. Transceiver Assignments

The FF-800 has five tx/rx ports including a local microphone port to interface to your repeater's RF system. The transceiver assignment options represent a unique combination of features. Each tx/rx port can be configured to operate in one of three modes: Main, Link, or Remote Base. Each configuration behaves somewhat differently, and these differences are described below:

- **MAIN:** This is a traditional repeater port. It features timeout and hang timers with courtesy tones and repeater ID messages. It also accepts DTMF commands and provides responses regardless of which port accepted the DTMF command (except for control autopatch responses). Control level security unlock (‘100’) is required to control a MAIN port.
- **LINK:** A link port is similar to a main port except for the behavior of the TX portion. While a link has a timeout timer and can accept DTMF commands, there is no hang time and command responses are only echoed if the command was entered on that particular link RX (and only if this feature is enabled). A courtesy tone is generated, but it is only heard on MAIN ports. Control level security unlock (‘100’) is required to control a LINK port.
- **REMOTE BASE:** A remote base is fundamentally different from a MAIN or LINK port. There are no timeout or hang timers, and no DTMF commands are accepted. No security is required to control a REMOTE BASE port.

In addition to defining the "personality" of each port, there is a user defined priority system that defines the priority level of each receive port in the system. In this system, the highest priority receive port that has activity is passed to the transmit side of the controller -- all lower priority receive ports are muted. There are no restrictions concerning how the priority progression is defined

-- if desired, a remote base port can have a higher priority than a main port (though this would be unusual). The priority system continuously updates the audio switch status to reflect current receiver activity -- thus, if a port is active into the controller, and a higher priority port comes active, the higher priority port will be immediately passed to the transmit ports and the original port is muted.

A third feature that helps define the unique port structure of the FF-800 is the digital level controls that are present for each port. This allows the user to independently control the audio level of each receive input or transmit output in the system. This is especially helpful in linked systems where the controller may be remotely located from one or more link sites. If a change is made at one of the link sites that results in an audio level shift, the user has the ability to remotely compensate the audio level for that particular receive port. Also, the digital levels can be more precisely controlled than mechanical level controls and the digital controls are not subject to wear or corrosion as there are no moving parts.

#### 3.1.1. COS and CTCSS inputs

Each port has a COS and CTCSS logic input to convey channel activity information to the FF-800 operating system. The active voltage level can be user defined separately for each port -- this active level can be high, or low. High active levels are any input voltage above 3.0 volts (40 volts maximum) or floating (a disconnected COS input will go high due to a 22K pull-up resistor on each input). Low active levels are any voltage below 0.8 volts (see section 4.3 COS and Logic Inputs for more detailed information on interfacing the FF-800). In addition to setting the active voltage level, there are several combinations of COS and CTCSS inputs that can be selected to signify channel activity. The following list describes each mode:

<u>Mode</u>	<u>Conditions required for active status</u>
COS only	Only COS active (CTCSS ignored)
CTCSS only	Only CTCSS active (COS ignored)
not CTCSS	COS active AND CTCSS inactive
COS & CTCSS	COS active AND CTCSS active
COS or CTCSS	COS active or CTCSS active

The user may select any of these options depending on the type of CTCSS solution that is desired for their RF system. Furthermore, each port is programmed separately and these parameters (as with all configuration parameters on the FF-800) can also be changed as desired to reflect changing system requirements, or to allow for different operating modes for different situations.

#### 3.1.2. PTT outputs

Each of the PTT and Logic outputs on the FF-800 are of an open drain, high current MOSFET transistor. Each output can sink as much as 500 milliamps of current with a maximum  $r_{ds(on)}$  resistance of 0.2 ohms. The active (on) state of the logic outputs is user programmable. For PTT systems that require high active PTT signals that can source current (i.e., a transmitter strip that keys by applying 13.8 volts to the power input) the user should refer to Figure 4 -16 for an example of driving an active high PTT transmitter.

### 3.1.3. Voter logic inputs

There are 8 logic inputs that are dedicated to receiving current voted receiver information from a multi-site voter. This information is used by the FF-800 to select the courtesy tone for the port assigned as a voted port. This selection can either be by last active COS, or most active COS. The voter logic signals expected by the FF-800 are one-of-N type ( $N = 1$  to 8) where  $N$  = number of receivers in the voter. This means that the voter must provide a signal for each receiver and only activate the signal corresponding to the current voted receiver. The active level of each voter logic input can be individually set by the user for active high, or active low.

## 3.2. DTMF Command System

Standard DTMF signaling is used by the FF-800 to input function codes and data. The electrical specifications are given in section 4.2 Receiver Audio. However, there are some timing considerations and configuration options that the user must know. The minimum valid duration of a DTMF digit is about 60 milliseconds, digits that are shorter than this will not be reliably accepted (if at all). In addition, the inter-digit delay (the time BETWEEN digits) must not exceed 4 seconds or the entry in progress will be aborted. There is also a function execute limit of 9 seconds from the last DTMF code -- if this time is exceeded, the command will not execute. Function execution begins when the input channel becomes inactive (i.e., it loses COS). However, function execution can be forced to occur before the channel goes inactive by entering what is called the "delimiter sequence". The delimiter sequence consists of the two DTMF digits "#\*". Whenever this sequence is encountered, the FF-800 will immediately try to execute any DTMF codes that are pending in the buffer. The delimiter sequence is valid from any input source that accepts DTMF codes and can be used at any time.

DTMF codes are accepted from enabled Main or Link ports, or from the auxiliary DTMF input. If more than one port is active at a time, the DTMF decoder monitors the highest priority port. If function access is desired from a Remote Base port, the receive audio from that port can be connected to the auxiliary DTMF input to allow limited function access (RESET, PORT CONTROL, or any bank 4 MACRO). If a link must have reverse access, it may also connect to the auxiliary DTMF input to allow port activation from the link side when the link is turned off. If multiple inputs are to be connected to auxiliary DTMF, an external priority switch should be used to prevent collisions. The AUX DTMF input behaves somewhat differently from the normal input. The normal input requires COS to allow recognition of DTMF digits -- however, the AUX DTMF input does not require COS and does not require the delimiter sequence. This is because the recognition of tones is based on their entry timing. The same minimum validate time and inter-digit delay that is in effect for the normal input also applies to the AUX DTMF input. However, when the inter-digit delay expires for the AUX DTMF input, the FF-800 attempts to execute the contents of the auxiliary buffer. Thus, any commands entered via the AUX DTMF input will execute four seconds after the last digit is entered.



The FF-800 is designed to mute DTMF codes from the output of the repeater as soon as they are detected. The muted tone is replaced by a "cover tone" generated by the FF-800. However, the user can control the cover tone and muting with the following four modes:

<u>Mode</u>	<u>Description</u>
Individual	DTMF muting on, one cover beep for each DTMF detected
Steady	DTMF muting on, one cover beep every second
None	DTMF muting on, no cover beeps
No mute	DTMF muting off, no cover beeps

#### 3.2.1. Control Receiver input

The control receiver input is a dedicated input for accepting DTMF digits. When control COS input goes active, any DTMF entry in progress on any other input (including control autopatch) is aborted and the DTMF decoder is switched to the control receiver. This input is isolated from the normal audio chain, such that audio on this input can not be passed to the repeater output. Also, there are no cover tones for a DTMF entry from the control receiver. When executing commands from the control receiver, the response will appear at any enabled main TX port (if the repeater is idle, the main port(s) will go to transmit to issue the function response and then go inactive after the response is complete).

#### 3.2.2. Control Auto Patch input

The user may enable or disable the control autopatch for the FF-800 controller. The control autopatch allows the user to enter control functions from any DTMF equipped phone. When a control autopatch is in progress, DTMF entry from all receiver inputs (except the control receiver) is disabled, and the FF-800 will not mute any DTMF digits from these inputs. Command responses are routed away from the normal mixer input which means that the user on the phone will hear the FF-800's responses, but these responses will not appear at the repeater output. There is an activity timer that governs the access to the control autopatch, if no valid control or configuration commands are entered for 15 minutes (the default time -- the user may change this timer if desired), the FF-800 will hang-up the control autopatch and return the repeater to normal operation. If a control autopatch is inadvertently terminated without logging off, the only way to regain control (other than waiting for the time-out) is via the control receiver input, or the auxiliary DTMF input.

#### 3.2.3. Auxiliary DTMF input

The auxiliary DTMF decoder is provided to allow a second and independent control path for the FF-800. It is primarily intended for reverse access from links or remote bases, but can serve as a secondary control input if desired. The important difference between the control receiver and the auxiliary DTMF input is that there is no COS input for the auxiliary DTMF input. All digit entries are timed and execution occurs automatically four seconds after the last digit is entered. In restricted

mode, only port control commands, reset, and bank 4 macros are recognized from the auxiliary input. In the secondary control mode, any valid command is recognized.

Auxiliary DTMF input also responds to the current setting of the Anti Un-Mute command. If an anti-unmute digit is received as the first digit of a command string, it is ignored. This allows the controller to ignore the remote repeater's un-mute digit if it "blips" through to the FF-800.

#### 3.2.4. Main and Link Channel input

The FF-800 only responds to DTMF input from ports designated as "main" or "link". DTMF inputs are only recognized for the highest priority active COS that is applied to the FF-800. Lower priority inputs, or inputs which do not qualify for active status (i.e., the port is off or the CTCSS inputs are not active as programmed) will not be recognized for DTMF input. "Link" or "main" ports that require DTMF access under any active status conditions should make use of the auxiliary DTMF input (see above).

### 3.3. Serial Command Interface

The serial port interface firmware allows the user to connect a PC or terminal to the FF-800 to ease the programming and maintenance of the FF-800 system. The connection may be direct, via modem, or via packet TNC. There are several commands and functions that allow the FF-800 to control a modem or TNC that provide a variety of secure access methods. The baud rate is user selectable over a wide range to accommodate most standard modem or TNC protocols.

### 3.4. Speech Synthesizer

The speech synthesizer is a commercial quality device that uses Linear Predictive Coding (LPC) to produce speech. LPC is a method of compacting speech data that is very faithful at retaining the natural tone of the original speech. As such, the speech produced is of very good quality and is easily understood.

### 3.5. Telephone Interface

The FF-800 telephone interface is designed to connect directly to commercial phone lines and provides two additional signal connections that are optically isolated for protection. The "off hook" output is used to alert other systems on the same phone line that the phone is busy. The converse to this signal is the "busy input". This input can be driven by other systems to tell the FF-800 that the phone line is busy. If the busy signal is activated, the FF-800 will not allow autopatch traffic to occur.

### 3.6. Serial Peripheral Expansion Bus

The FF-800 provides a synchronous serial expansion bus that can be used for many enhancements to the user's system. Provisions for BCD frequency output allow the user to implement "frequency agile" remote bases -- plus, the expansion bus also communicates with FF Systems enhancement interfaces which allow the addition of Digital Voice Recorder, ICOM IC-901/900 radio interface, HF radio interface, as well as future interface designs.

### 3.7. Logic Outputs

There are eight user outputs that may be used as control signals for external systems. The serial peripheral expansion bus allows the user to expand the outputs by adding eight external outputs. This requires that the user provide a shift register I.C. to capture the serial data stream that contains the external output information (see appendix A for more information).

### 3.8. Logic Inputs

There are four logic inputs that can be used to trigger a user selected macro. For each input, a trigger can occur at the rising edge of the input, and another can occur at the falling edge. Such inputs are useful for setting up such features as a site intrusion alert or for signaling commercial power failures.

### 3.9. Analog Inputs

The FF-800 has four analog inputs which allow the user to sample various parameters (temperature, humidity, voltage, power, etc...) and report the telemetry on command. A standard LM335 temperature sensor IC can directly connected to the FF-800 to form the heart of a simple temperature sensor input. The analog inputs expect a voltage between 0 and 5 volts -- all inputs must be converted to this range before connecting to the FF-800. The user can then set up the input for a given conversion factor and units or use the standard telemetry commands for temperature or S meter readings.

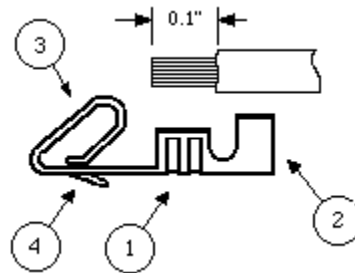
### 3.10. Automatic Command Execution

There are several methods that the system operator may employ to engage automatic command. The macro system forms the basis of this ability by allowing a series of commands to be grouped into one. These commands may then be available for direct application by users, or they may be assigned to scheduler events, command trigger inputs, or the LiTZ detect feature (LiTZ is the long interrupt tone zero standard for accessing emergency services). The scheduler is very flexible and allows the operator to specify event times with "wild cards" -- these "wild cards" can indicate that events are to occur every year, month, day, day of week, hour, or minute.

## 4. Installation

This section describes the procedures required to perform the physical installation of the FF-800 Repeater Controller. The focus is on the connection of power, audio, COS, transmitter PTT, and some preliminary transmitter audio adjustments. The installation of other features such as analog inputs, voter logic inputs, etc... will be covered in Section 5 along with the commands that deal with these external operations. Appendix B shows the parts placement diagram and schematic of the FF-800 and the user should refer to this appendix to locate the various connectors that will be discussed. For those purchasing the FF-180 chassis, refer to the Chassis Supplement for additional wiring and installation information.

Most connections to the FF-800 are made via Molex connectors (supplied) -- although the transmitter and receiver connections are also provided via 4 pin "mini-DIN" style connectors. The Molex connectors are easily installed once the method of attaching the pin inserts is mastered. Figure 4 -2 illustrates a typical Molex pin insert. Notice that there are two flanges near one end of each pin insert. Prepare each wire to be attached by stripping 0.1" of insulation -- do not pre-tin conductors. It is highly recommended that the proper tooling be utilized when crimping the Molex pins. When using proper tooling, soldering is not required, and the termination process is much faster.

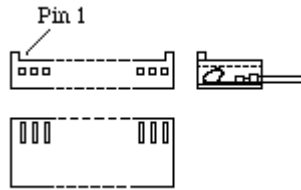


**Figure 4-2. Molex pin insert detail**

For those situations where the proper tooling is not available, use the following procedure to assure reliable wire termination: The wires are attached by folding the inner flange (1) on the exposed conductor, using pair of needle-nose pliers, and then applying a small amount of solder to secure the connection. Once the connection has cooled, the outer flange (2) is folded around the insulation to provide strain relief.

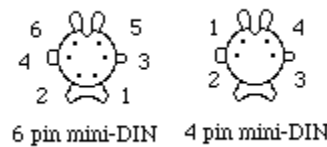
If too much solder is applied to the connection, excess solder may wick up to the contact loop (3) and/or the locking clip (4). If this happens, the pin insert is ruined and must be replaced. Only use the minimum amount of solder and heat to establish a good electrical connection.

Figure 4 -3 illustrates a typical Molex housing. Pin one is located by orienting the housing as shown. Alternately, the last pin (opposite of pin 1) on the housing can be located by looking at the bottom face of the housing. For a 9-pin housing, the number "9" is imprinted in the housing next to the appropriate hole, a 7 pin housing has a "7", and so on. Thus pin 1 is the hole at the opposite end of the housing.



**Figure 4-3. Molex housing detail**

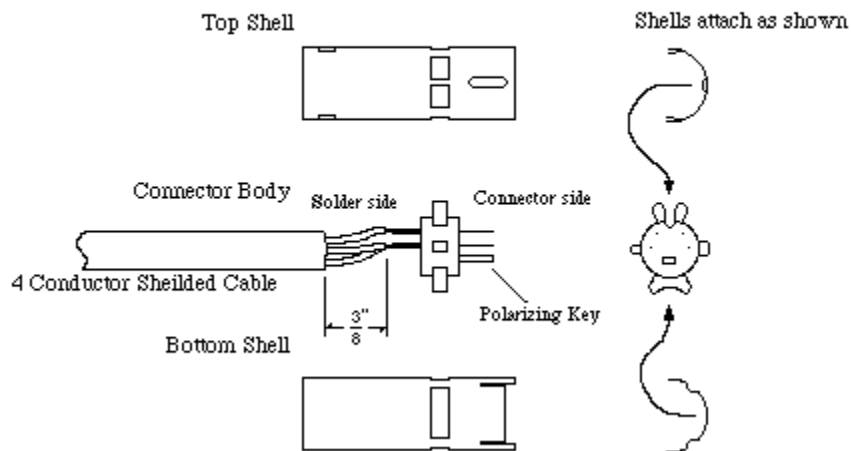
The mini-DIN connectors are comprised of a contact array, two metal inner shells, two plastic outer shells, and a plastic connector housing. Figure 4-4 illustrates the pin assignment diagrams for both the 4 pin and 6 pin connectors.



**Figure 4-4. mini-DIN pin assignments (wire side view)**

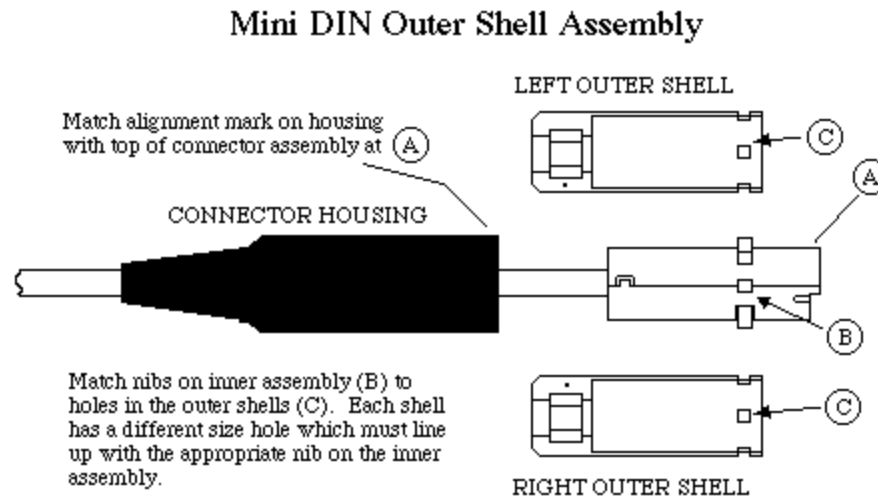
There are two steps to assembling the mini-DIN connectors: the inner assembly and the outer assembly. The inner assembly involves cable preparation and connection and Figure 4-5 illustrates the steps involved. First, prepare the cable (preferably shielded) by exposing 3/8" of the conductors as shown. Next, place the outer hood over the cable (see Figure 4-6) and attach the wires to the contact assembly. Be sure to note the color code of each connection for later reference. Next, place a small piece of electrical tape around the soldered connections -- one wrap is sufficient, too much tape will prevent the top and bottom shells from mating properly.

#### Mini DIN Inner Shell Assembly



**Figure 4-5. mini-DIN connector inner assembly**

Place the top and bottom shells around the contact assembly and then do the same with the left and right shells (as shown in Figure 4 -6). Be sure to properly orient the left and right shells as shown or they will not mate properly. Finally, push the connector housing over the outer shells until it is flush with the inner shells at location (A) in Figure 4 -6. Be sure to hold the outer shells in place until the connector housing is pressed into place. Once the assembly is complete, the connector is ready to install -- the alignment mark on the connector housing should point "up" when inserting into the female mini-DIN connectors.



**Figure 4-6. mini-DIN outer housing assembly**

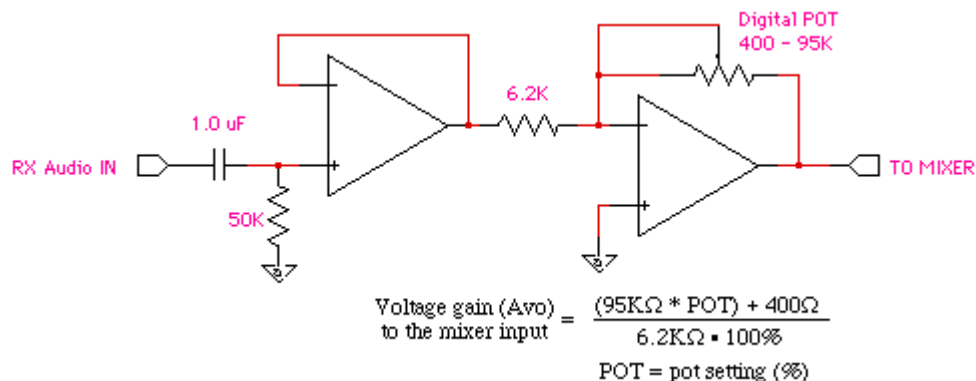
#### 4.1. Power

The FF-800 Repeater Controller requires an input voltage source of +12Vdc(+/- 15%) @ 350mA. This connection is made via P1 which is located along the edge of the FF-800 near U22. Pins 1, 2, 3, and 4 are connected to ground -- while pin 5 is the +12V input. Pins 6 and 7 provide positive (pin 6) and negative (pin 7) 5 volts for use in external circuits as necessary. Each output can source up to 50mA maximum.

#### 4.2. Receiver Audio

The audio inputs are routed through P2 and P3 and also through P11 - 14. P2 handles RXA, RXB, RXC, and RXD -- P3 handles the Local MIC and Control RX. P11 through P14 each handle a single receiver (A through D, respectively). Figure 4 -7 illustrates a simplified model of the receiver audio input circuit. Not shown is the audio multiplexer that mutes audio from all but the selected receiver -- this allows either squelched or discriminator audio to be utilized. The min/max limitation of 0.8/4.0 Vpp is due to the op-amp output constraints. The non-inverting op-amp stage is used to provide a high input impedance to prevent loading of the receiver audio. The input impedance of 50Kohm is the result of the parallel combination of the DTMF decoder input and the 100Kohm bias resistor used at the non-inverting input buffer. This may be of significance because there are times that the DTMF decoder will not be connected (i.e., if the control receiver COS is active, or there is a

control autopatch in progress) which will cause the input impedance to be that of the bias resistor alone (100Kohm). This should only be of concern where the output impedance of the receiver(s) is greater than 10Kohm. The high pass filter formed by the decoupling capacitor and the bias resistor has a cut-off of less than 3 Hz so the response of the audio section is reasonably flat across a 10 to 3000 Hz bandwidth.

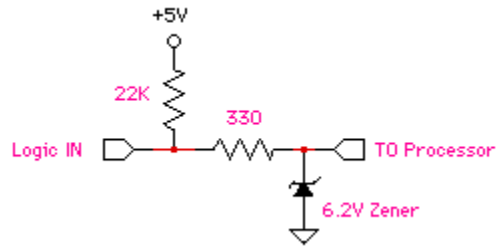


**Figure 4-7. FF-800 RX audio input model.**

The next stage is an inverting amplifier that utilizes a digital pot in the feedback path to provide gain or attenuation of the receiver channel. The equation shown in Figure 4 -7 can be used to calculate the output voltage based on the POT setting for a particular receiver input (the mixer and output gain = 1) assuming that the corresponding output level settings are at maximum. This stage also has a 100pF capacitor in parallel with the feedback resistor to prevent the op-amp from oscillating due to parasitic high frequency poles in the feedback circuit. This results in a low-pass filter with a minimum 3db cut-off of 16 kHz (at POT = 99%) and a maximum 3db cut-off of greater than 1MHz (POT = 1%).

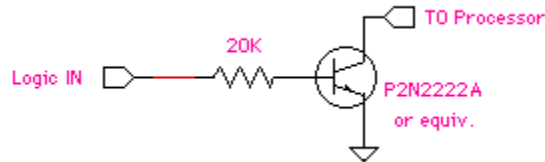
### 4.3. COS and Logic Inputs

COS inputs parallel their corresponding audio inputs on P2 and P3 and P11 - 14. The FF-800 uses a zener diode and series resistor to protect the digital inputs from the outside world as illustrated in Figure 4 -8. This input circuit is also used by the voter logic, CTCSS, and command trigger inputs. A logic low or "0" is any voltage below 0.8 V -- A logic high or "1" is any voltage above 4.2 V (or open circuit). Circuits driving these inputs must be capable of sinking or sourcing 0.02 mA (minimum) for proper operation. The upper limit for input voltage on these pins is determined by the power limits of the 50K pull-up resistor. The absolute maximum voltage is 80 volts -- however, some latitude should be given to this limit and the user is recommended to limit the input voltage to no more than 40V.



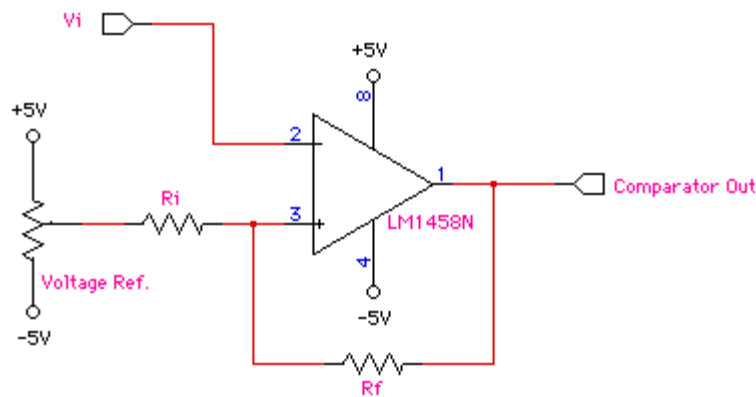
**Figure 4-8. FF-800 logic input circuit model**

For inputs that do not sink current to ground, a load resistor to ground must be added to the logic input. This resistor should be in the range of 470 to 1000 ohms. The load resistor pulls the logic input to a logic zero (0.1 V for  $R = 1000$  ohms) and requires that the input device be able to source at least 5 ma to create a logic 1. If the input device has a high impedance drive circuit, it may be necessary to add a transistor buffer to the appropriate logic input(s). Figure 4 -9 illustrates a simple NPN transistor switch that is suitable for buffering high impedance circuits. The base resistor can be varied in accordance with the drive characteristics of the sourcing circuit.



**Figure 4-9. NPN inverter circuit**

Another situation that may require some external buffering occurs when an input signal does not vary below 0.8 V or above 4.2 V. The NPN switch can not be used with signals that don't vary well below 0.8V because the transistor will never turn off, thus a different circuit is required to provide the logic levels required by the FF-800. Figure 4 -10 illustrates an op-amp comparator circuit with hysteresis that is used to indicate weather the input voltage is above or below the reference voltage. If the op-amp of Figure 4 -10 is powered from +5V only, the output of the op-amp will directly drive the input to the FF-800. If the input is above the reference, the op-amp will drive its output to +V and if the input is below the reference, the op-amp will drive its output to ground.

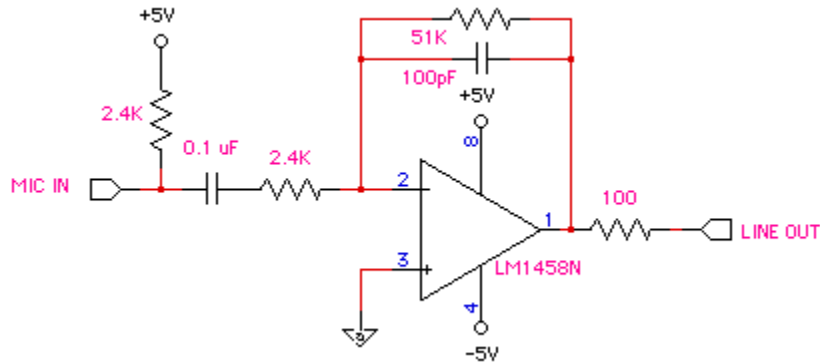


**Figure 4-10. Op-amp comparator circuit**



#### 4.4. Local microphone

The local microphone channel is designed to provide the user with a local input source -- however, this input can also serve as a receiver/transmitter port if a local microphone is not desired. In order to use an electret or DTMF microphone, a user provided external pre-amplifier is required to provide the FF-800 with the proper input level (the FF-8010 display has a built-in pre-amplifier as part of its microphone interface). Figure 4 -11 illustrates an example of an op-amp pre-amplifier circuit. The op-amp is not critical, the LM1458 is quite popular and can be readily obtained through many electronic parts outlets.



**Figure 4-11. Electret microphone pre-amp**

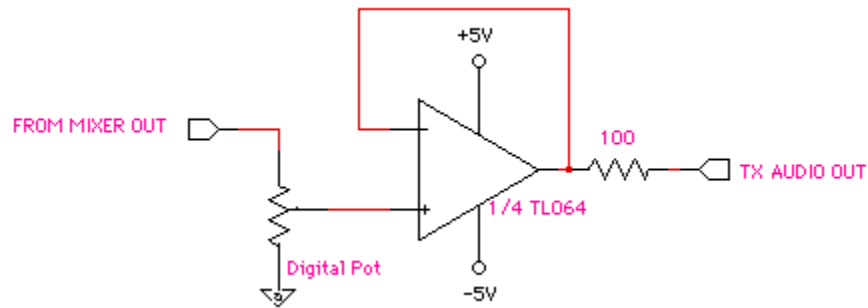
#### 4.5. Control receiver

The control receiver audio (squelched or unsquelched) and COS are connected at P3. Control receiver audio is passed only to the DTMF decoder, not to the main mixer -- thus, control port audio can not be passed to the repeater output. The input impedance is 100K, and is AC coupled through a 1.0  $\mu$ F capacitor. It should be noted that only one input can be connected to the DTMF receiver at a time. Thus, the highest priority active receiver input will have sole access to the DTMF receiver.

#### 4.6. Transmitter audio

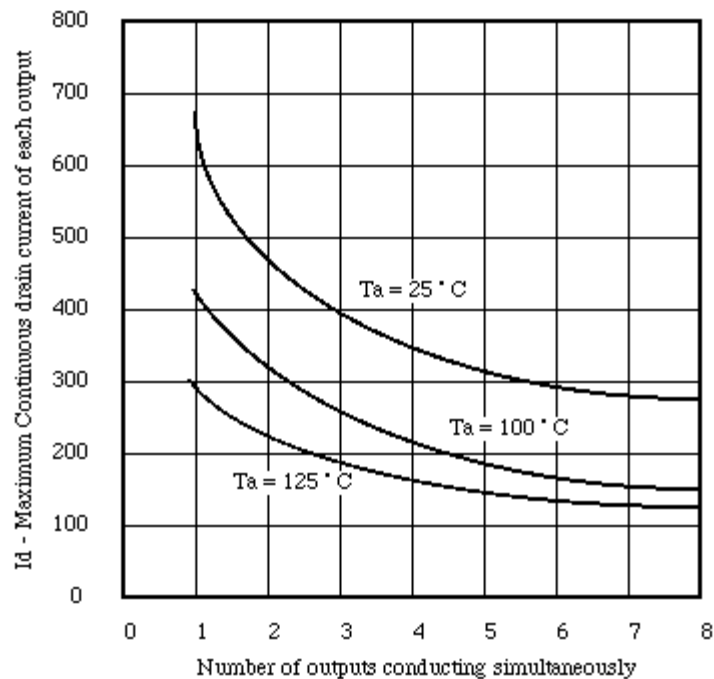
The four transmitter audio outputs are located at P4 (and P15 through P18) and the local output is located at P25. Digital pots control the output levels for ports A through D. The digital pots can be adjusted from either the DTMF or the serial terminal port (the serial terminal port allows real-time adjustment). For best results, each output level should be set at maximum, and the level should be reduced (padded) at the transmitter (either by a potentiometer or the transmitter deviation control). This helps to increase the noise margin on the audio signal. Of course, if this is not possible or practical, the level can be adjusted at the FF-800. Figure 4 -12 illustrates a model of one of the TX audio outputs. The output impedance of the op-amp is about 75 $\Omega$  -- thus, with the series resistor the output impedance is roughly 175 $\Omega$ . The op-amps are all biased at zero volts which means that there is no bias on the output signal. In addition, the audio outputs are all DC coupled and the user must install a capacitor in series with the audio signal. Note that the size of the capacitor will affect

the low frequency roll-off of the FF-800 output. If CTCSS signals are to be passed through the system, the coupling capacitor should be in the 50 - 100  $\mu\text{F}$  range. For applications where CTCSS signals are not an issue, the capacitor may be in the 1 - 10  $\mu\text{F}$  range.



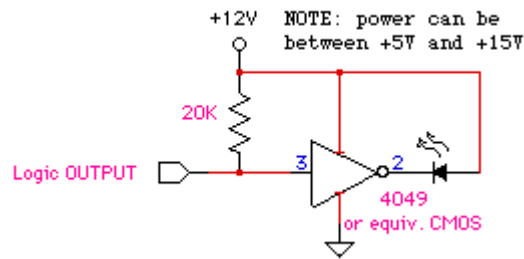
**Figure 4-12. FF-800 TX audio output model**

#### 4.7. PTT and Logic outputs



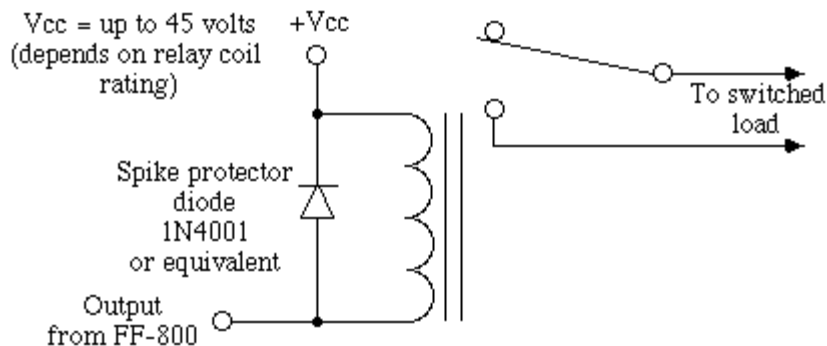
**Figure 4-13. Logic output derating curves**

All of the on board logic outputs (including the PTT outputs) are of an open-drain MOSFET type. Each output can sink up to 500 mA of current, but at 25°C, the device can only sink about 275mA per output when all outputs are on. No pull-up devices are present, so the user must provide them based on the type of load the output is connected to (i.e., a relay load would not need a pull-up resistor, but a CMOS logic device would). Device limitations force the user to de-rate the output current rating if multiple outputs are used to draw high current levels. The curve of Figure 4 -13 illustrates the maximum output current vs. number of "on" devices. As the curve shows, a room temperature device with all eight outputs on is rated at about 250 mA per output. The user will also note that the output current rating must be de-rated with temperature. If the FF-800 is to be operated in an environment where the ambient temperature can exceed normal room temperature (25°C or 70°F) the total allowed current per output is reduced. Any outputs that drive an inductive load (such as a motor or relay) must have a spike suppression component (such as a diode) installed at the load device as shown in Figure 4 -15.



**Figure 4-14. TTL/CMOS level translator circuit**

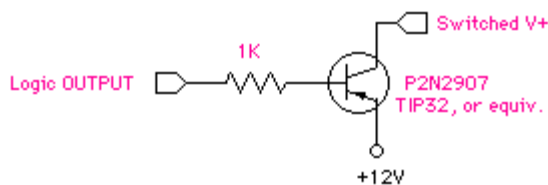
Each output has an associated "active level" which is much like the active level settings for the COS and Voter Logic inputs. The active level settings for the outputs determine whether the output is "on" with a path to ground, or "on" with an open circuit. For the relay of Figure 4 -15, "on" should be active low, while the LED circuit of Figure 4 -14 would require an active high output so that the LED would be on when the output is "On". The factory default level settings are active low so that any "On" output represents a low impedance path to ground. The **Active Level** command is be used to modify the active level status of the outputs (PTT signals are always active low). Note that the FF-8010 display does not change with respect to the output level setting. The LEDs are "ON" to indicate that the respective output is conducting to ground, and off to indicate that the driver is open circuit.



**Figure 4-15. FF-800 direct drive relay circuit**

One possible difficulty with the FF-800 outputs relates to the fact that while they can sink a significant amount of current, they can not SOURCE any current. This causes difficulty when a voltage output that can source current is desired (to key an exciter strip, for example) without using a relay. In this situation, the user must supply an external PNP bi-polar transistor or P-channel FET to act as an inverter/buffer combination. Figure 4 -16 illustrates a circuit that can be used to convert the open-drain, current sink outputs of the FF-800 to an open-collector current source. There are several transistors that can be used for this circuit, the choice of which largely depends upon the amount of current that is to be sourced. Any load that requires less than 200 mA can be driven from a 2N2907 PNP switching transistor. The TIP32 PNP switch is capable of collector currents of up to 3 A, and the TIP34 can handle currents up to 10 A. Since the circuit of Figure 4 -16 drives the transistor into saturation, the typical Vce voltage drop will only be about 0.1 V. This means that the power dissipation in the transistor will typically be very small and only a modest heat sink may be

required for currents greater than 1 A. Any FF-800 output that is to drive a circuit like the one in Figure 4-16 should be configured for active low output because the transistor is turned on by grounding the base resistor.



**Figure 4-16. PNP output buffer circuit**

## 4.8. Telephone Line

Telephone Line connections are made through the standard phone line connector at P21. This connection is all that is necessary for basic phone patch operation (including autopatch, control auto patch, and reverse auto patch). However, if this phone line is shared with other services, there are additional connections that must be made to prevent interference to and from the other services sharing the line.

If the other service(s) using the same phone line have a busy detect input, the busy\_out+ and busy\_out- signals at P8 are used by the FF-800 to provide the line busy signal. These two signals are actually the output of a single opto-isolator (busy\_out - is the emitter and busy\_out + is the collector). busy\_out - is connected to the target service(s) signal ground while busy\_out + is connected to the active low busy input -- if this input does not have an internal pull-up, then one must be provided according to the specifications for the shared equipment requirements. If the service(s) in question require active high busy input, an inverter (such as a 7404 or an NPN switch) will be necessary.

The FF-800 BUSY+ and BUSY- inputs are used to detect when other services have control of the phone line. These two signals are opto-isolator inputs which are current limited and reverse polarity protected. This input can accept voltages of 5V to 20V and can be DC or AC (up to 1 kHz) -- the minimum current drive required is 10 mA. Whenever this input is active, auto patch operations are inhibited by the FF-800.

## 4.9. Adjustments

Adjusting the audio levels on the FF-800 is not difficult, but there is a procedure that should be followed that allows one-pass adjustment for all levels. There are three phases to the adjustment procedure: 1) receiver DTMF adjustment, 2) transmitter level adjustment, and 3) receiver balance adjustment. A service monitor or oscilloscope/receiver combination is suggested, but a good ear and a good receiver can also work well.

Each receiver level must be adjusted at the receiver to provide the optimum level for the DTMF decoder. Each receiver must be capable of providing at least 0.8 Vpp audio for reliable DTMF

detection. If a receiver can not provide this level (or if it's maximum level is near this minimum specification) then the signal must pass through an external amplifier before reaching the FF-800.

The easiest way to determine if valid DTMF detection has occurred is to view the data valid (DV) LED on the FF-8010 Display Interface. For those users who do not have a display, the DV signal can be found at pin 15 of U21 (refer to appendix B for a parts placement diagram). The signal at U21 will go high (+4.0 to +5.0 volts referenced to ground) any time a valid DTMF is detected. While monitoring the DV signal, transmit a DTMF "3" while adjusting the level at the appropriate receiver. Start at minimum level and increase -- note where the DTMF valid first occurs and continue increasing until the DV signal goes low and note where this happens. The final adjustment should be half way between the lower and upper detect limits. Once this adjustment is complete for all receivers DO NOT perform any further adjustments on the receivers. These levels should not need further adjustment unless problems occur with DTMF detection. NOTE: The "3" was suggested earlier because it is typically the most difficult tone pair to detect. However, all codes should be tried (and with several radios) to verify that the adjustment is correct.

Next, choose which audio source is to run at the highest level (i.e., receiver audio, speech audio, or tone audio). The selected source should be run at mid level (50%) and the transmit levels are then adjusted for each connected transmitter to provide the desired deviation. For transmit levels that are adjusted using the transmitter deviation control, the user should initially set the appropriate TX pot(s) to 99% -- only reduce this setting if the FF-800 is providing too much level to allow proper adjustment at the transmitter. After the transmitter level is set, the remaining levels are adjusted to the deviation desired for each.

The last phase of the adjustment procedure involves balancing the receiver inputs. This is where a service monitor is extremely valuable. However, if a monitor is not available, a pair of transceivers can be used. The following description will assume that you are using the two-transceiver (2TR) method. In the 2TR method, one transmitter transmits a test tone into the receiver under test and the listener uses another receiver to compare the original signal to the FF-800 transmitter output. This is done by flipping between the input frequency and output frequency and comparing the levels. A DTMF tone pair makes a good test signal that is easily generated by almost any radio. Be sure to use the un-mute feature, or the tone will be muted by the FF-800 before it reaches the transmitter.

Perform this procedure for each receiver in your system.

## 5. DTMF Commands

This section covers the commands that can be entered via any standard DTMF input to the FF-800 and discusses the security structure for the control and configuration commands. The FF-800 utilizes a two level security system that segregates "control" and "configuration" commands. Control commands can generally turn features on or off, re-assign an existing parameter, or perform basic "house keeping" functions. Configuration commands are those which modify some basic aspect of the FF-800's operation. As an example, the command to force the FF-800 to send an ID is a control command, but the command to program the repeater call sign is a configuration command.

The presentation format is designed to localize specific information about each command. Command names are shown in bold print. The required security access level is also listed, along with the function code and the syntax for any parameters that might be associated with the command. Parameters that follow a semi-colon (;) can be omitted to allow the user to interrogate the current status of the function. General level commands will have their function id# listed in braces {} – the function id# is used with the **Prefix Assign** function to change the prefix for that function. Any command response that results is also listed. Following this "introduction" is a discussion of what the function does and some examples of how to enter the function with various parameters.

### 5.1. Security and Function Management

#### **Control Prefix**

Access: CONTROL

{#01} (00) (command)

#### **Configuration Prefix**

Access: CONFIGURATION

{#02} (01) (command)

The two secured command groups (control and configuration) each have their own prefix that is user defined. The prefixes are attached to the beginning of the appropriate command to tell the FF-800 which type of command is being entered. Even if an operator knows how to operate an FF-800, they can not enter control or configuration commands unless they know the respective prefix. This provides an additional level of security to the FF-800 system. The prefixes must be between 1 and 4 digits in length and can be comprised of any of the 16 DTMF digits (see [Prefix Assign](#), below, for restrictions on these or any other user defined codes).

#### **Control Unlock**

Access: GENERAL

{#03} (100)

Response: "O K"

This command activates a 15 minute timer which allows acceptance of control commands by the FF-800. Most Control commands are identified by the control prefix -- However, there are some general level commands that require **Control Unlock**: Any [TR Control](#) command for a MAIN port, any logic output command if the output lock feature is enabled, and the [Configuration Unlock](#) command. Each successful control command entry resets the timer to 15 minutes. Thus, if at least one control command is entered every 15 minutes, the security access will remain in effect

indefinitely. Security unlock commands do not need to be entered into macros because the Macro-processor automatically unlocks configuration and control prefixes during macro execution.

### **Configuration Unlock**

Access: GENERAL

{#46} (139)

Response: "O K"

The **Configuration Unlock** command behaves in similar fashion as the **Control Unlock** command except that it applies to configuration level commands and any logic output command (if locked). A separate timer is set to 15 minutes -- valid configuration commands reset both the configuration security timer and the control security timer.

### **Lock Security**

Access: CONTROL

(cntl)(439)

Response: "O K"

Once a control or configuration session is complete, the user will want to re-lock the security system of the FF-800. This command locks both the control and configuration security levels thus securing the FF-800 for normal operation. In addition, the **Autopatch Hangup** command will also generally lock the security access (except when the control autopatch monitor mode is on).

### **DTMF Un-Mute Digit**

Access: CONFIGURATION

(cnfg) (554) ; (digit)

enter/interrogate un-mute

(cnfg) (554) (00)

disable un-mute feature

response: "U M D"

This command allows the sysop to configure the DTMF un-mute digit to be any of the 16 DTMF digits. The un-mute feature allows the user to pass DTMF codes to the output of the repeater or remote link. This gives the sysop some flexibility with their system concerning which digit will un-mute DTMF signals. Care should be exercised when choosing an un-mute digit other than the original "#" digit that was used in previous firmware revisions. If the new un-mute digit is the first digit of any prefix, that prefix will be effectively disabled because the FF-800 will not recognize any digits after the un-mute. The exception to this is if the prefix has only one digit -- in this case the prefix will be recognized and will not cause a problem. The sysop should be aware that changing the un-mute digit may require changes to the general level prefixes.

The un-mute feature can be disabled completely by using the "00" format as shown above. NOTE: Those users who are upgrading from v2.12 or earlier should set the un-mute digit as desired immediately following the installation of the new firmware to ensure that the feature is properly initialized.



**DTMF Anti-Un-Mute Digit**

Access: CONFIGURATION

(cnfg) (564) ; (digit)  
(cnfg) (564) (00)enter/interrogate anti un-mute  
disable anti-un-mute feature

response: "O M D"

Anti-un-mute allows the sysop to configure a DTMF anti-un-mute digit to be any of the 16 DTMF digits. The anti-un-mute digit is stripped off of incoming DTMF sequences if it is the first digit of a multi digit entry. This feature is primarily of use when another repeater is accessing the FF-800 (via a link or remote base) using a DTMF un-mute digit. If the remote repeater does not have an audio delay board, some of the un-mute digit may bleed through and be detected by the FF-800. The command formed by the successive digits can not be recognized by the FF-800 because of the un-mute digit from the remote repeater. This feature allows the sysop to correct the situation without forcing the remote repeater to be modified. NOTE: the FF-800 assigns priority to the UN-MUTE digit -- thus, if the anti-un-mute and un-mute digits are the same, then the anti-un-mute is effectively disabled. This means that the FF-800 must have a different un-mute digit than that of the remote repeater system(s).

As with the un-mute digit, care should be exercised when choosing an anti-un-mute digit. If the anti-un-mute digit is the first digit of any user prefix, that prefix will be effectively disabled because the FF-800 will strip the digit before the command can be recognized. The sysop should be aware that changing the un-mute digit may require changes to the general level prefixes. The anti-un-mute feature can be disabled completely by using the "00" format as shown above.

**Prefix Assign**

Access: CONFIGURATION

(cnfg)(520) (function#) (new prefix code)

Response: "P S" if prefix accepted, or "Abort" if prefix rejected

Each of the functions in the general command level have prefixes that can be set by the user. The user must know the function number of the desired command before this command can be executed (indicated in this document in braces {} under the function name).

The FF-800 allows a great deal of flexibility in assigning prefixes -- however, there are a few restrictions that apply to the assignment process. The first restriction involves the un-mute digit (default un-mute is "#"). Since this digit is used by the FF-800 to signal the DTMF un-mute feature (this causes the FF-800 to pass all following DTMF digits) it is not generally suitable as the first digit of a prefix. If this digit is the first digit in a command, then the remaining digits will be ignored and the command will never be recognized. However, the un-mute digit may be used as a single digit prefix for any command that does not require parameters (like the autopatch hang-up code).

Also, prefixes may not be replicated -- the FF-800 performs a search for the new prefix before it will accept the change of assignment. If the prefix already exists in whole or in part, the FF-800 will reject the assignment and respond with "Abort" plus the function number that caused the conflict.

The default prefixes are provided to allow the user with a starting point in getting their controller on the air. In the interest of security, the user should endeavor to modify any of the general prefixes that they consider critical to repeater operation (i.e., **Repeater On/Off**, **Autopatch**, etc...).

## User Function Control

Access: CONFIGURATION

(cnfg)(525) (on/off)

Response: "U F N On" or "U F N Off"

The **User Function Control** command is used to disable the General level commands. **Control Unlock, Configuration Unlock, Repeater On, Repeater Off, Autopatch Cancel, and Emergency Speed Dial** are exempt from this feature. This provides a quick means for disabling user access to commands while still leaving the repeater system on the air. When general level commands are OFF, the FF-800 will still respond to control and configuration level commands.

## Personal ID Number System (PINs)

### PIN Mode select

Access: CONFIGURATION

(cnfg) (527) ; (mode)

Response: see below

This command allows the user to select which of the PIN modes are desired. The (mode) parameter is used as follows:

<u>Command</u>	<u>Description</u>	<u>Response</u>
(cnfg) 5270	PINs Off	response: P I N Off
(cnfg) 5271	PIN required on all cmds	response: P I N All
(cnfg) 5272	PIN individual cmds	response: P I N Indicated
(cnfg) 5273	PIN use access timer	response: PIN Timer
(cnfg) 5274	PIN used every access	response: PIN One Hundred Percent
(cnfg) 527	Interrogate PIN mode	response: current mode

These modes are divided into two groups. The first three modes define WHERE PINs are required, while the last two modes define WHEN the PINs are required. In the "Timer" mode, PINs are required once, then the user may execute commands without using their PIN as long as they execute at least one command within the PIN timeout (timer#17, see [Set Timer](#) command). After the timeout, they must use their PIN again to unlock the system. In this mode, the PIN operates much like an additional security unlock command and may be entered with or without a command to unlock the PIN timer.

The "One Hundred Percent" mode requires that the PIN be always entered for all commands that require PINs. In this mode, the PIN becomes a command prefix for those commands requiring PIN access.

The PINs mode status is maintained as a state variable and the appropriate State Store command should be used after setting the mode as desired. Only the PINs mode is kept in the state array, all other PINs information (Prefix Select, and PIN entries) is global and affects all states.

## PIN Prefix Select

Access: CONFIGURATION

(cnfg) (521) (prefix#) ; (on/off)

Response: "P Q R" + "On" if PIN required, or "Off" if not required

This command allows the user to select which of the user prefixes require a PIN to operate. The (prefix#) indicates which prefix is desired just as with **Prefix Assign** (page 19). (on/off) is "1" for "On" or "0" for "Off".

If the control and/or configuration prefixes (prefix# 01 and 02, respectively) are set to require a PIN, then ALL control and/or configuration commands will require the PIN. It is not possible to PIN specific control or configuration commands.

The user should be sure that at least one known PIN is programmed before setting specific commands for PIN. The factory default PIN is "DDDD".

## PIN Enter

Access: CONFIGURATION

(cnfg) (526) (slot#) ; (4 digit PIN)

Response: "P I N O K"

This command enters or clears any of the 200 PIN slots. If no PIN is entered, the slot is turned off and the PIN that was located in that slot is disabled.

(cnfg) 526sssPPPP

Enter PIN: sss = slot# (3 digits), PPPP = PIN # (4 digits)

(cnfg) 526sss

Clear PIN: sss = slot# (3 digits)

Current firmware does not have a provision for interrogating the PIN numbers, thus the user must keep track of the contents of each slot in use (this will be added in a future revision).

The user must use some care when assigning PIN numbers, as the FF-800 does not check for prefix conflicts. This is only important in the "Indicated" and/or "Timer" mode(s) where some prefixes require PINs, while other prefixes do not. For example, if the **Set Output** prefix is 112 (assume that **Set Output** does NOT require a PIN), and a PIN of 1124 is assigned, a conflict will occur when output#4 is accessed (1124??). The FF-800 will think that a PIN has been entered and will strip the "1124" digits before passing what's left to the normal command processor. Basically, this means that the affected prefix(es) are disabled.

## Machine Alert

Access: CONTROL

(cntl) (455) ; (0)

Response: "Machine Alert ,"

"Power Failure"

indicates system reset

"C O P"

firmware watchdog failure

"R A M"

memory corruption

"C T"

courtesy tone corruption

"V R S"

Version Re-sync

"Cancel"

alert has been cleared

The **Machine Alert** function is used to signal the user that a possible system malfunction has occurred or that there has been a memory configuration error. There are several "watch dog" systems in place to insure that the FF-800 firmware is operating properly. If one of these "watch dog" systems detects an error, the FF-800 will be reset, and the type of error will be logged for later retrieval. The error type is of primary importance to FF-Systems and special attention should be paid to this function should it ever come to activate on your FF-800 system.

The alert is indicated by the phrase "MACHINE ALERT" as the tail message for the controller. If this message is discovered, then the Machine Alert command must be used to interrogate the source(s) of the alert. The user should note the response(s) that the FF-800 gives as well as the conditions that may have precipitated the alert (providing that these conditions were witnessed). The command can be repeated as often as necessary until the entire response can be noted. The user may then clear the alert to remove the annunciator from the system.

Unfortunately, the Machine Alert system is prone to spurious activation on power cycles or resets. In this case, the "Power Failure" and "C O P" alerts will be present. The remaining alerts are not prone to this phenomena and should be regarded as real if they are encountered. Note that a new firmware upgrade is the most likely situation where these alerts would occur.

The following list of examples illustrates the use of the preceding commands (NOTE: all examples in this manual assume that the default prefixes are in place):

#### PREFIX ENTRY:

<b>100</b>	control security unlock
"O K"	FF-800 response
<b>139</b>	configuration unlock
"O K"	
<b>015200287</b>	set new configuration prefix = 87
"P S"	
<b>875200287#</b>	attempt to set new control prefix
"Abort"	new prefix not accepted
<b>875200201</b>	set configuration prefix back to "01"
"P S"	

#### TURN OFF USER FUNCTIONS:

<b>100</b>	control unlock
"O K"	
<b>139</b>	configuration unlock
"O K"	
<b>005250</b>	turn off commands
"Set U F N Off"	
<b>00525</b>	interrogate status
"U F N Off"	

**005251** turn them back on  
"Set U F N On"

ALERT Command:  
**100** control unlock  
"O K"  
**00455** interrogate status  
"Machine Alert, COP, Power Failure, RAM, CT"  
**004550** clear alert  
"Machine Alert, Cancel"

NOTE: The unlock commands at the start of each example are only required at the beginning of a session, they are not required before each command unless the security timers have timed-out or been locked. Note that all remaining examples in this manual will assume that the user has previously unlocked the appropriate security level.

**Version Interrogate** Access: CONFIGURATION  
(cnfg) (800)

response: returns the firmware revision and serial numbers for the FF-800 and any connected interfaces

This command allows the sysop to interrogate the revision and serial number information for their FF-800 system. This information is sometimes needed by FF Systems when responding to technical or service questions. Any connected interface (such as the FF-8070 DVR, or FF-899 HF interface) will also be queried and their response reported. This can be a useful debug tool when trying to determine why an interface is not working properly. If the interface replies to the version command, its communications link is operational, which implies that the difficulty lies elsewhere. If there is no response, a cabling or power problem at the remote interface may be the problem.

## 5.2. RF control commands

"RF control commands" describes the syntax for commands that directly or indirectly affect the RF interface of the FF-800 repeater system and illustrates the operation of each with examples. These commands are used to define or control the RX inputs and TX outputs to which the FF-800 is connected.

**COS Active Level** Access: CONFIGURATION  
(cnfg)(545) (rx#) ; (hi/lo)

Response: "C O R" + "High" or "Low"  
(rx#) 1 = control RX, 2 = local, 3 = A, 4 = B, 5 = C, 6 = D  
(hi/lo) = "1" for active high, "0" for active low

The FF-800 allows the sysop to program the active level of the COS inputs to accommodate the wide variety of receiver systems that are used for repeater operation. The factory default is for active low on all receivers. This means that the FF-800 will activate on COS inputs that are 0.8V or less (a logic low voltage level). For receivers that use high level (3.8V or higher) COS, the COS

Active level command is used to invert the signal in software. However, it should be noted that the active level is not just a software question, there are signal compatibility issues that may affect the COS interface. Refer to Section 3.1.1 for more details.

## TR Mode Access: CONFIGURATION

(cnfg)(542) (port#) ; (type) (telemetry) (duplex)  
 Response: "T R" + port# + type + telemetry + duplex  
 (port#) = "L" for local, "A", "B", "C", or "D"  
 (type) = "M" for main, "L" for link, or "R" for remote base  
 (telemetry) = "A" if telemetry on, nothing if telemetry off  
 (duplex) = "F" for full, "H" for half duplex

The entry of each parameter is as follows:

port: 1 = local, 2 = A, 3 = B, 4 = C, 5 = D  
 type: 0 = off, 1 = main, 2 = link, 3 = remote base  
 telemetry: 0 = off, 1 = on  
 duplex: 0 = half, 1 = full

## TR Control (alternate) Access: CONFIGURATION

(cnfg)(542) (port#) (control)  
 Response: port control message  
 (control) = 0 to interrogate, 1 for RX, 2 for TX/TR, and 3 for OFF. See **TR Control** for details

This command gives the user the flexibility to configure the FF-800 for a variety of RF interface protocols. Changing system configurations can be quickly updated with little or no down-time.

Type definitions	Type characteristics
0) Off	Port input/output is disabled. Port will not respond to TR Control command
1) Main	Constrained by the QSO timer. TR Control requires control unlock.
2) Link	Constrained by the QSO timer. TR Control does not require security. There is no hang time or courtesy tone on link outputs.
3) Remote Base	No timer constraints. TR Control does not require security. Remote base inputs can not enter DTMF commands directly, these ports also do not output a hang time or courtesy tone.

The four TR ports on the FF-800 may be configured in any combination of Main, Link, or Remote Base as desired by the user. In addition, there are two other port options that must be included in the TR mode parameter:

**Telemetry** This controls the status of the function responses for each port. This option enables function responses to be echoed to the port that originated the code entry (the FF-800 always echoes responses to main ports that have this feature enabled, regardless of origin). This must be enabled for MAIN ports, but may be set or clear for LINK and REMOTE BASE ports. Also, it can be set for one port and clear for another, as desired.

**Duplex** Sets port duplex status. Full duplex ports transmit and receive simultaneously while half duplex ports will drop the PTT line if a valid COS is detected on the same port. Remote bases are typically half duplex because they use standard transceivers that do not have in-band full duplex capability. A link can usually be half or full duplex depending upon the hardware used. Main ports

should be full duplex (otherwise, it would probably be more appropriate to configure the port as a link) but there is no restriction on duplex settings for any port.

Of course, before the ports can be configured, the user must make a determination of what types of TR systems will be used. This may involve detailed knowledge of other repeater installations in a multi-site link system. For example, given a full duplex 70cm link from a remote repeater, a user may be tempted to configure the port as a full duplex TR. However, if the remote system loops back audio, a feed-back loop may be created. In this case, the full duplex RF link would be configured as half duplex on the FF-800 to prevent a feedback path, even though the RF hardware can support full duplex.

#### EXAMPLES:

**015422111** set port 1 for main, full duplex and aux interrogate  
"Set T R A M A F" "TR" is the function response, "M" = main, "A" = aux interrogate on,  
"F" = full duplex.

**015422** interrogate port A

"T R A M A F"

**015423310** port B = remote base, aux = on, half duplex

"Set T R B R A H"

**015424300** port C = remote base, aux = off, half duplex  
"Set T R C R H" the omitted "A" means that the aux. interrogate is off for

this port

**015424211** port C = link, aux on, full duplex

"Set T R C L A F"

**015425000** port D = off.

"Set T R D Off"

#### TR Priority Set Access: CONFIGURATION

(cnfg)(541) ; (port#HI)...(port#LO)

The (port#) is as follows:

1 = Local Mic input

2 = Channel A

3 = Channel B

4 = Channel C

5 = Channel D

Response: "T R P" + a list of the ports from high to low priority

Each port in the FF-800 system is assigned a priority level for resolving multiple access contention situations (voting). This priority system is separate from the mode configuration and allows any priority hierarchy regardless of the port mode definitions. The most popular method for assigning priorities is to place main ports first, followed by link ports (if any) and finally with remote base ports (if any). If there are multiple ports of the same type, the user chooses one port to have priority over another of the same type (this choice is usually arbitrary between ports of the same type).

#### EXAMPLES:

**0154112345** ; Local mic = Highest priority, Channel A = next highest,  
etc...

"Set T R P L A B C D" ; Responds with priority list

**0154151342** ; Channel D = highest priority, Local mic = next highest,  
etc...

"Set T R P D L B C A"

**01541** ; Interrogate priority

"T R P D L B C A"

#### TR Control

Access: GENERAL

{#38} (132) ; (c) Port A

{#39} (133) ; (c) Port B

{#40} (134) ; (c) Port C

{#41} (135) ; (c) Port D

(c) = 1 places port in Receive mode

(c) = 2 places port in Transmit mode (transceive mode for Remote Base)

(c) = 3 = turns port off

Response: See below

#### TR Control (alternate)

Access: CONFIGURATION

(cnfg)(542) (port#) (control)

Response: port control message

(control) = 0 to interrogate, 1 for RX, 2 for TX/TR, and 3 for OFF

**TR control** is a collection of several command prefixes that control the receive and transmit status of any of the five T/R ports. Main and Link ports have four operating states: Off, Receive, Transmit, and Transceive. The Remote Base ports only have three operating states: Off, Receive, and Transceive. The difference is the presence of the Transmit only state for Link/Main ports. This allows a transmitter in a multiple receiver system to remain in operation even if its receiver is disabled (Main) or a remote system can monitor via a Link port without formally linking into the system. It should be noted that it takes two command sequences to place a Main or Link port into transceive mode while remote base ports can be placed in transceive with only one sequence. Also, Main port operations require that control security be unlocked (but they do not require a control prefix).

#### EXAMPLES:

**1351** ; port D = receive (assume port D = Remote base)

"D R X"

**1352** ; port D = transmit

"D T X"

**135** ; interrogate port D

"D T X"



**1321** ; port A = receive (assume port A = Main)  
 "A R X"  
**1322** ; port A = transmit  
 "A T X"  
**132** ; interrogate port A  
 "A T R"

Note: The interrogate response is different for remote base channels because they do not have a transmit only option.

The response messages for **TR Control** can be user defined. This allows the user to customize the responses to reflect their system setup. A port with an ICOM IC-901 radio interface might be programmed as "901 T X", and "901 R X", etc... . Also, If a Digital Voice Recorder is installed in the system, these messages can include DVR tracks to add a higher degree of customization. Refer to **Message Assign** and **Message Edit** functions for details on changing these responses.

### Link Response Control Access: CONFIGURATION

(cnfg) (543) (on/off)  
 Response: "R E T X" + "On" or "Off"

When "On", this command allows the FF-800 to echo command responses to a link port IF that port was used to enter the command. If the command is entered via a main port (or the control RX input) the command response would not be transmitted to any of the links. Also, the response is only sent to the link that entered the command (if it is in TX mode) and not to any other link or remote base ports.

"Off" disables this feature and the links do not echo command responses.

### CTCSS Mode Set Access: CONFIGURATION

(cnfg) (546) (port#) ; (mode)  
 Response: (mode)

"C O S"	0	CTCSS input ignored
"P L"	1	COS input ignored
"C O S And P L"	2	COS and CTCSS required
"C O S Plus P L"	3	COS or CTCSS required

The (port#) is as follows:

- 1 = Control Receiver
- 2 = Local Mic input
- 3 = Channel A
- 4 = Channel B
- 5 = Channel C
- 6 = Channel D

This command allows the CTCSS inputs to be included in the test for port activity. The various modes available allow several combinations of CTCSS and COS to represent port activity. Though

not directly indicated, an "anti-PL" mode can also be implemented by setting the "AND" mode with this command, and setting the active level for the corresponding CTCSS input OPPOSITE of its normal active level. This will have the effect of "fooling" the FF-800 into thinking that there is always a CTCSS signal until a CTCSS input is applied.

### **CTCSS Active Level**

Access: CONFIGURATION

(cnfg)(547) (rx#) ; (hi/lo)

Response: "C T C S S" + "High" or "Low"

(rx#) 1 = control RX, 2 = local, 3 = A, 4 = B, 5 = C, 6 = D

(hi/lo) = "1" for active high, "0" for active low

The active level of the CTCSS inputs is adjustable for the same reason that the COS inputs may be adjusted. The factory default is for active low on all receivers.

### **CTCSS Selective Encode**

Access: CONFIGURATION

(cnfg)(549) ; (option#) ... (option#)

Response: "P L Action" + current status

<u>option#</u>	<u>Description</u>	<u>Status Response</u>
0	Disable selective encode	Off
1	COS Follow	C O S
2	Courtesy Tone follow	Timer
3	ID follow	I D
4	Autopatch follow	Patch
5	Command Response follow	Acknowledge

The FF-800 features the ability to use one of the built-in logic outputs to selectively enable a tone encoder based on the current status of the repeater. For example, this feature allows a tone to be activated while a COS is active, but the tone is off during the courtesy tone or hang time periods. This is especially useful for systems where a simplex remote base is used in CTCSS mode. It can also be used for remote monitoring whereby the monitoring receiver is only activated while there is traffic on the system, or during autopatch activity.

The options listed above can be used in any combination and are selected by entering the option# digits desired (in any order). The selected options are added to the existing options which implies that the only way to delete an option is to completely disable the selective encode (option# 0) and re-enter the desired options.

### **CTCSS Selective Encode Output Select**

Access: CONFIGURATION

(cnfg)(548) ; (output#)

Response: "P L Out Action Select" + current output#

The FF-800 allows the user to select which of the built-in outputs are to be used for the selective encode option. In addition, the FF Tone can also be selected, which allows the selective encode option without the need for a logic output. Selecting an (output#) of 1-8 will select the corresponding logic output while an output# of 9 selects the FF Tone module (if installed).

**PTT Slave to CTCSS Decode**

Access: CONFIGURATION

(cnfg)(544) (tx#) ; (rx#) ... (rx#)

set tx slave inputs

Response: "P L Link" + current ports

(cnfg)(544) (tx#) 0

disable tx slave inputs

Response: "P L Link Clear"

(cnfg)(544) 00

disable ALL tx slave inputs

Response: "P L Link Clear All"

<u>tx#/rx#</u>	<u>Description</u>
2	Local mic (L)
3	Port A
4	Port B
5	Port C
6	Port D

The PTT signal of any TX port may be slaved to any CTCSS input. When slaved, the PTT will not activate unless at least one of its corresponding CTCSS inputs is active. Each PTT port is selected independently and may be slaved to any combination of CTCSS inputs. Note that the PTT enable is an OR operation, if any selected CTCSS is active, the PTT will be enabled. Also, note that the CTCSS inputs do not directly drive the PTT logic, thus a CTCSS signal is not necessarily sufficient to activate the respective PTT(s).

**Remote Base Action**

Access: CONFIGURATION

(cnfg) (540) ; (mode)

(mode):

0 = no action taken

1 = set receive action

2 = set off action

Response: "R B A" + "N A" if no action, "R X" if receive, or "Off" if off

The **Remote Base Action** command is used to control the remote base activity option -- this option allows the FF-800 to automatically modify the operating status of any remote base port that is in transceive mode. The automatic action occurs if there is no COS activity for a certain period of time (set by the ACTIVITY timer, see **Timer Set**). The user selects one of two actions to take on timeout: place the remote base(s) in "receive" or "off". The feature is not port selective, but it will only affect a remote base that is in transmit mode when the timeout occurs. Any valid COS into the FF-800 will reset the activity timer (which keeps the remote base(s) in transmit mode).

**EXAMPLES:****015401** ; set Receive action

"R B A R X"

**015402** ; set Off action

"R B A Off"

**015400** ; set No action

"R B A N A"

When either the RX or OFF action is selected, and any remote base port(s) are in transmit, and the ACTIVITY timer times out (no COS detected), then the FF-800 will key the main port(s) and

announce "R B Adjust" to signify that the remote base activity action has occurred. At this point, the affected remote base(s) will be placed in the selected mode. Any remote base(s) that were not in transmit will be unaffected.

### **TX Lock**

Access: CONTROL

(cntl) (420) (m)

(m) = # of minutes to lock (m = 1 to 9)

Response: "T X L"

The FF-800 has the ability to lock on any enabled transmitter for test purposes. This command is useful where the user needs to have one or more transmitters activated for an extended period to perform adjustments or tests that involve the repeater transmit equipment. The lock may be deactivated by the entry of any valid DTMF digit. If the lock is not deactivated manually, the transmitters will automatically deactivate after the specified time has elapsed. The user should be aware that this command will activate the PTT on any main, link, or remote base port that has transmit enabled.

### **Level Set RX Audio**

Access: CONFIGURATION

(cnfg) (500) (pot#) ; (level%)

(pot#):

0 = speech generator level (response = "S" + level)

1 = local mic (response = "L" + level)

2 = rx port A (response = "A" + level)

3 = rx port B (response = "B" + level)

4 = rx port C (response = "C" + level)

5 = rx port D (response = "D" + level)

6 = autopatch audio in (from phone) (response = "A P" + level)

7 = autopatch audio out (to phone) (response = "" + level)

8 = user pot (10K, located at P22) (response = "R X" + level)

The digital level controls present on the FF-800 allow independent level control for each receiver as well as the computer speech and courtesy tones. This level control only affects the input to the main mixer -- the input to the DTMF decoder is not affected by these settings. The DTMF levels must be set at the receiver for proper DTMF detection (see Section 4.9, Adjustments). This gives the user some latitude in balancing the various audio signals and allows adjustments to be made without gaining access to the controller. Since most repeater controllers are mounted in a rack chassis and surrounded by other rack chassis in a typical installation, it can be very difficult to gain physical access to rack equipment without disconnecting the equipment from the rack. Additionally, this feature allows the user to effect changes in any of the levels without being present at the repeater site.

### **EXAMPLES:**

**01500099** set speech level to full amplitude.

"Set R X S Nine Nine" responds with new speech setting

**01500850** set user pot to 50%

"Set R X Five Zero"

**015003** interrogate current setting for port B

"R X B Three One"

## Level Set TX Audio

Access: CONFIGURATION

(cnfg) (501) (pot#) ; (level%)

(pot#):

1 = tx port A (response = "T X A" + level)

2 = tx port B (response = "T X B" + level)

3 = tx port C (response = "T X C" + level)

4 = tx port D (response = "T X D" + level)

5 = CW and courtesy tone master level (response = "T X T" + level)

The digital level controls present on the FF-800 allow independent level control for each transmitter port. The all-digital nature of the FF-800 level controls allows adjustments to be made without gaining access to the controller. Since most repeater controllers are mounted in a rack chassis and surrounded by other rack chassis' in a typical installation, it can be very difficult to gain physical access to rack equipment without disconnecting the equipment from the rack. Additionally, this feature allows the user to effect changes in any of the levels without being present at the repeater site. The transmit levels are maintained as part of the Machine State and are updated by processor reset, Recall State, and this command.

### EXAMPLES:

**01501199** set port A to full amplitude.

"Set T X A Nine Nine" responds with new setting

**01501270** set port B to 70%

"Set T X B Seven Zero"

**015013** interrogate current setting

"T X B Five Zero"

**015015** interrogate current setting

"T X T Five Zero"

## Timer Set

Access: CONFIGURATION

(cnfg) (510) (timer#) ; (timer value)

(timer#) indicates the timer of interest, (timer value) is from 1 - 9999

Response: "Timer" + value

There are several user programmable timers on the FF-800 for controlling various repeater operations like hang time, courtesy delay, etc... . There are two timer units that are utilized by the various timers: "sec" timers are programmed in units of 1 second and have a resolution of 1 second -- "ms" timers program in milliseconds and have a resolution of 10 ms. The following list describes each:

<u>Units</u>	<u>Timer #</u>	<u>Description</u>
sec	0	<b>Tail delay</b> -- this is the delay between tail messages. When a tail message is sent, this value is set into the tail timer. No tail messages will be sent until the tail timer has expired.
sec	1	<b>QSO delay</b> -- this is the time out timer for the repeater. The QSO time defines the maximum length of transmissions from Main or Link ports.

<u>Units</u>	<u>Timer #</u>	<u>Description</u>
sec	2	<b>QSO window</b> -- this sets the point at which the FF-800 will begin to send warning beeps of an impending timeout. This is set to the number of seconds remaining in the QSO time during which time the warning beeps are sent. Thus, if this timer = 15, then the warning beeps will sound 15 seconds before QSO time out.
sec	3	<b>DTMF access activity timer.</b> This timer is reset anytime that a valid COS signal is received by the FF-800. If this timer reaches zero (no activity), the FF-800 will automatically enter the down state of the DTMF access mode. If DTMF access is disabled, this timer has no affect (see DTMF Access Control and DTMF UP/DN).
sec	4	<b>ID TIME.</b> This is the maximum time between IDs.
sec	5	<b>ACTIVITY.</b> This timer determines how long the FF-800 will wait after the last valid COS before automatically modifying the status of a remote base that is in transmit (see Remote Base Action). ACTIVITY is also used by the FF-800 to determine when to send welcome IDs. If the repeater has not had any activity for the duration of ACTIVITY and a COS is detected, the FF-800 will send a welcome ID bulletin IF an ID is required at the time the COS was detected.
ms	6	<b>Courtesy tone delay</b> -- this is the amount of time (in milliseconds) that will pass after loss of a Main or Link COS before the courtesy tone is sent.
ms	7	<b>Hang time.</b> this is the amount of time that the FF-800 will keep any Main TX active after the courtesy tone has finished. If a tail message is
ms	8	<b>"Kerchunk" filter time.</b> This value is the minimum duration active COS that will activate the FF-800. When a valid COS is detected, the FF-800 will activate all enabled TX PTTs (usually within 40 ms of the COS activation). However, if the duration of the COS is less than the "kerchunk" filter time, the FF-800 will deactivate the transmitters after the COS signal is removed. Thus, no audio is lost, but the repeater will not respond to "kerchunks". Once the FF-800 has been activated, the kerchunk filter has no affect.
sec	9	<b>Autopatch Duration.</b> This is the maximum duration for the normal autopatch.
sec	10	<b>Autopatch Extend Time.</b> This is the time that is set when the Autopatch Extend command is issued during an autopatch.
sec	11	<b>Autopatch Activity.</b> This is the maximum allowed delay between valid COS input during an autopatch.
sec	12	<b>Emergency Autopatch Duration.</b> This is the maximum duration for the emergency speed dial functions.
sec	13	<b>Control Patch Duration.</b> This is the duration of a control autopatch (see section 5.5).
sec	14	<b>Reverse Patch Duration.</b> Specifies length of a Reverse Autopatch function.
sec	15	<b>ID Window Anxious.</b> This setting indicates how soon before the ID Time expires that the FF-800 will try to send anxious IDs.
sec	16	<b>ID Window Pending.</b> This setting indicates how soon before the ID Time expires that the FF-800 will try to send pending IDs.
sec	17	<b>PIN Timer.</b> This is the duration of PIN security access.
ms	18	<b>DTMF mute duration.</b> This is the length of time after loss of DTMF that the FF-800 will continue to mute audio from the currently active receiver port.
ms	19	<b>TX key-up delay.</b> This is the length of time after an initial COS before the FF-800 will activate the PTT lines. Max value = 9000. If this timer is set to > 9000, the value is ignored and 0ms of delay is used.

#### EXAMPLES:

<b>0151001100</b>	set time out timer to 100 seconds
"Set Timer One Zero Zero"	response
<b>01510061000</b>	set courtesy tone delay to 1 second
"Set Timer One Zero Zero Zero"	
<b>0151004</b>	read current ID period
"Timer Five Seven Zero"	

#### **DTMF Access Control**

Access: CONTROL

(cntl) (442) ; (on/off)  
Response: "T T A On" or "T T A Off"

The **DTMF Access Control** command is used to enable or disable the DTMF access mode. The DTMF access mode allows controlled access by users via a DTMF command entry. With DTMF access off, any valid COS/CTCSS combination will activate the FF-800 normally. The DTMF access mode allows general users to activate and de-activate the repeater on demand and is useful for intermittent interference problems that are sporadic and short lived. This mode can also be useful in situations where a system operator allows non-members access to their system, but only when an approved member has activated the repeater.

When DTMF access is on, the FF-800 can be activated and de-activated via the DTMF UP/DN command. While de-activated, the FF-800 will still perform mandatory IDs, so this feature is not suitable for de-activating the FF-800 for system service (use Repeater Off for this function). Also, the FF-800 will not respond to any other DTMF commands from main or link ports while deactivated (the FF-800 will always respond via the control receiver or the control autopatch). In addition, an activity timer will automatically de-activate the FF-800 if there is no repeater activity for a period defined by ACTIVITY (see the **Timer Set** command).

#### **DTMF UP/DN**

Access: GENERAL

{#06} (103) ; (on/off)  
Response: "T T Up" or "T T Down"

This command is used to activate or de-activate the FF-800 while the DTMF access is enabled. If DTMF access is off, this command has no effect. If the (on/off) is omitted, the status of the repeater will toggle (if the repeater is up, it will go down, and vis-a-vis). While the FF-800 is de-activated it will not accept any command other than **DTMF UP/DN** (except for the control receiver port and the control autopatch -- these inputs will respond normally to command inputs). Thus, the FF-800 must be activated before it will accept commands from the TX/RX ports.

#### EXAMPLES:

<b>004421</b>	enable DTMF access mode
"Set T T A On"	
"T T Down"	
<b>1031</b>	force UP
"T T Up"	

<b>103</b>	toggle DTMF UP/DN to enter "down" mode
"T T Down"	
<b>103</b>	toggle again for "up" mode
"T T Up"	
<b>004420</b>	disable DTMF access mode
"Set T T A Off"	

<b>Aux. Repeater Off/On</b>	Access: GENERAL
{#08} (105) (on/off)	
Response: none	

This command was designed to be a stealth repeater disable command. It provides no annunciator and takes effect immediately. The FF-800 will still perform mandatory IDs. Its effect is similar to the **DTMF UP/DN** command, but without any announcement.

<b>Repeater On</b>	Access: GENERAL
{#05} (102)	
Response: "R P T Up"	

This command is used to re-activate the FF-800 after the **Repeater Off** command has been executed.

<b>Repeater Off</b>	Access: GENERAL
{#04} (101)	
Response: "R P T Down"	

This command de-activates the FF-800. The controller performs an ID and drops the PTT on all ports. If a COS attempts to interrupt the ID, it will be ignored and the PTTs still drop after the ID is complete. No commands (except **Repeater On**) or COS signals are recognized until the repeater is re-activated via the **Repeater On** command.

#### EXAMPLES:

<b>101</b>	turn off repeater
ID message	
(all PTT lines de-activate)	
<b>102</b>	turn on repeater
"R P T Up"	
<b>1050</b>	turn off inputs, no acknowledge
(all PTT lines de-activate)	
<b>102</b>	turn on normally
"R P T Up"	
<b>1050</b>	turn off
(all PTT lines de-activate)	
<b>1051</b>	turn on
(no response, but FF-800 will respond to valid COS)	



**Reset Controller**

Access: GENERAL

{#07} (104)

Response: "FF Eight Hundred V x.xx Echo" + repeater ID

This command performs a processor warm reset to the FF-800 and any FF Systems SPI peripherals (like the DVR, FF-899, etc...).

**Tone Test**

Access: GENERAL

{#13} (110) (test digits)

Response: lists digits entered

This command will read-back valid DTMF signaling and is useful to identify defective digits on marginally functional keypads.

### 5.3. State Management

Most of the configuration data for the FF-800 is stored in structures called "States". There are 6 States and each holds a different copy of the same parameters. The States can be thought of as data files that store "snapshots" of different repeater configurations. Much of the configuration of the FF-800 can be completely changed by simply recalling a different State. Even if the different State configurations are not going to be used, the user must still save the repeater configuration in State 1. State 1 is recalled on reset, so any configuration that is to survive a power failure or reset must be saved in State 1.

For example, if the FF-800 is used on a repeater that does storm watch operations, the user may want to modify the assignment of certain ports, change the courtesy tones, change any of the various timers, modify the CTCSS access modes, etc.... A macro could be used to implement the changes, but another macro would be required to change back to normal, and depending on the extent of the changes, these macros might be exceedingly large. However, if the user enters the commands manually to obtain the desired configuration, it can be saved in one of the states to be recalled later and the normal configuration can be recalled just as easily.

**State Recall**

Access: CONTROL

(cntl) (480) ; (state#)

Response: "Machine Set" + (state#)

or: custom annunciator message (see **Message Edit**)

The recall of the new state takes effect immediately. If the (state#) parameter is omitted, the FF-800 will return the annunciator message for the current state.

**State Store**

Access: CONFIGURATION

(cnfg) (480) (state#)

Response: "Set Machine Set" + (state#)

or: "Set" + custom annunciator message

The current configuration will be stored into the indicated state. **State Store** also performs a SIMTEK non-volatile store operation.

The following list describes the Functions and parameters that are stored in the FF-800 States:

Voter CT Assign	ID Mode	ID Bulletin Enable
TR Mode	TR Priority	COS Active Level
DTMF Cover tone mode	Dial Prefix Enable	Control Autopatch Enable
Terminal mode	Tail Message Enable	CW Speed
CW Frequency	Remote Base Action	Courtesy Tone Assign
Voter CT Mode	Voted RX Assign	General Function Enable
High accuracy temperature	Voter logic level	Level Set
Pulse Output Timing	Output Set	Output active level
BCD Frequency Set	Timer Set	PL active level
PL Mode	Secondary Autopatch enable	

#### **SIMTEK Store**

Access: CONFIGURATION

(cnfg) (4851)

Response: "Push Sierra"

Most FF-800 controllers feature a non-volatile memory produced by SIMTEK, Inc. This memory device features a primary RAM memory, with a non-volatile storage mirror which holds the desired data while the power is removed from the memory device. Because of the way that this device operates, the mirror memory does not automatically update when the primary RAM is modified. The SIMTEK Store causes the RAM data to be copied to the non-volatile memory which preserves the controller configuration data.

This command is generally not needed since the store operation is performed by the **State Save** command. However, there may be some cases where this command is preferred over the **State Save** command. Since the controller messages and speed dial data is not part of the state management system, changes to these parameters don't require **State Save**. However, they are stored in the SIMTEK device, so any changes do need to be stored to non-volatile memory. Using the **State Save** command will work, but there may have been other system changes (ports turned on or off, IDs changed, etc...) that would be changed in the state configuration by using the **State Save** command. Thus, the **SIMTEK Save** command allows non-state configuration changes to be saved without worrying about the status of the current state configuration.

#### 5.4. Autopatch

The FF-800 autopatch allows the controller audio chain to be tied to a standard POTS (plain-old-telephone-set) telephone line to allow voice traffic or DTMF command control. The "Autopatch" commands relate primarily to voice traffic operations, while the "Control Autopatch" commands relate to remote DTMF control operations. There are several features and options available which allow a great deal of flexibility in configuring and operating the FF-800 autopatch. The following list illustrates the various options for Autopatch operations:

- The patch interface can support up to three phone lines (with external relays) and provides four separate autopatch commands which may be independently enabled or disabled.
- A custom hang-up code allows the repeater user to enter a unique disconnect code along with the phone number. This is useful where hackers use the public hang-up code to interfere with autopatch traffic.
- Phone number read-back suppress allows the repeater user to keep the number dialed private (enabled on a call by call basis).
- 250 speed call slots -- including 10 emergency speed call slots.
- Each speed call slot has a separate message that can be programmed by the sysop.
- Dial out prefix for connecting to PBX type systems or caller-ID block codes.
- Each patch annunciator message can be customized by the user to contain CW, FF-800 speech, DVR tracks, or any combination of these (see **Message Edit** for information on programming messages).

Several of the autopatch commands have custom annunciators. These annunciators are messages that the FF-800 sends to announce the particular command that has been executed. All annunciators come with a factory default message which can be replaced by a custom message if desired.

**Message Edit** details how to create messages, and **Message Assign** details how to assign messages to a particular annunciator (or annunciators). The following autopatch functions/operations have programmable annunciators:

<u>Func#</u>	<u>Command</u>	<u>Default Message</u>
50	<b>Autopatch</b>	Telephone Call
51	<b>Autopatch Cancel</b>	Call Complete
86	Repeat Call	Repeat Call
53	Autopatch busy	Telephone Off Line
52	<b>Speed Call</b>	Speed Call
87	<b>Secondary patch #1</b>	X Telephone Call
88	<b>Secondary Patch #2</b>	Y Telephone Call
89	<b>Secondary Patch #3</b>	Z Telephone Call
90	Secondary patch not available	Telephone Call Abort
0-9	Emergency Speed Dial slots	Emergency n (n = slot#)

The **Message Assign** function description also lists the defaults for each message.

There are several timers that affect the operation of the autopatch functions (see **Timer Set** for details on setting timers). These timers are listed below:

Timer #9	Autopatch duration. This is the maximum duration of a normal <b>Autopatch</b> or <b>Speed Call</b> command. An alert beep will begin 15 seconds before the autopatch duration timer times out to signal that the autopatch is about to deactivate.
Timer #10	Autopatch extend duration -- the amount of extend time provided by <b>Autopatch Extend</b> command.

- Timer #11      Autopatch activity period -- If no valid COS is detected for this amount of time, the autopatch will be automatically de-activated. A warning beep will begin 15 seconds before this time out (this beep is distinctively different from the beep that precedes an autopatch duration timeout).
- Timer #12      Emergency autopatch duration -- the maximum duration of an **Emergency Speed Call** autopatch.

If the FF-800 is to be serviced by a local PBX system, it will be necessary to program the "dial out" prefix. This is the digit or digits that the local PBX requires for access to an outside line (i.e., dial "9" to get an outside line). Once the prefix is entered with the **Dial Prefix Enter** command, the dial prefix must then be turned on using **Dial Prefix Enable**. The dial prefix can also be used to dial for caller-ID block or call-waiting block. Contact your repeater's telephone service provider to obtain the caller-ID block or call-waiting block pre-dial codes for your area.

#### 5.4.1.      Autopatch Configuration Functions

##### **Dial Prefix Enter**

Access: CONFIGURATION

(cnfg) (630) ; (prefix)

Response: "P B X," + prefix

If the dial prefix feature is required, this function will allow the user to customize the prefix to the requirements of the phone system that will be connected to the FF-800. The prefix can contain up to 6 digits which includes any pause digits that are desired. The DTMF "C" digit is the pause digit for the FF-800 system. The DTMF dial firmware will cause a 1 second pause to occur each time it encounters a "C" digit.

##### **Dial Prefix Enable**

Access: CONFIGURATION

(cnfg) (632) ; (on/off)

Response: "P B X On" or "P B X Off"

Turning on the dial prefix enable mode causes the autopatch dial prefix to be sent by the FF-800 prior to all out-going autopatch operations (including speed call autopatches).

##### **Autopatch Valid Length**

Access: CONFIGURATION

(cnfg) (634) ; (#digits)

Response: "V P L" plus #digits

The valid patch length sets the minimum number of digits that are required for an autopatch command -- speed dial slots are exempt from the valid patch length setting. If the number of digits for (number) is less than that set by this command, the autopatch will not be executed. Instead, the controller will treat the autopatch (number) as a speed dial slot and attempt to perform a **Speed Call** command. If the (number) is not a valid speed dial slot, or the speed dial slot is empty, the controller will abort the command with no telemetry response.

**Autopatch Options Enable**

Access: CONFIGURATION

(cnfg) (636) (patch#) ; (on/off)  
Response: "P O E" plus "On" or "Off"

This command allows the sysop to deactivate the patch options. If deactivated, the FF-800 will ignore any non-numeric characters that follow the phone number in an autopatch command. The following describes the (patch#) parameter:

(patch#)	Description
0	Main autopatch
1	Secondary autopatch #1
2	Secondary autopatch #2
3	Secondary autopatch #3
4	Speed dial autopatch (all banks)

**Autopatch Enable**

Access: CONTROL

(cntl) (407) (patch#) ; (on/off)  
Response: "A P" plus "On" or "Off"

(patch#)	Description
1	Secondary #1
2	Secondary #2
3	Secondary #3
4	Speed dial banks 1 - 4
5	Emergency speed dial
6	Main autopatch

The user may selectively enable or disable any of the autopatch commands as described in the above table.

**Reverse Patch Mode**

Access: CONFIGURATION

(cnfg) (534) ; (mode)  
(mode):  
0 = reverse autopatch disabled  
1 = passive reverse autopatch  
2 = active reverse autopatch  
response: "R A P Off"  
"R A P Automatic Wait" (passive mode)  
"R A P Manual Wait" (active mode)

The reverse autopatch has two modes of operation. In the passive mode, the FF-800 will answer an incoming call, establish an alert signal on the repeater output, and wait for a repeater user to issue the Autopatch command (without any phone number -- the custom hang-up patch option may be used with the reverse autopatch if desired). In Active mode, the caller on the phone must enter the Reverse Autopatch command before the FF-800 will signal that a caller is waiting. In both cases the controller will send the ring signal and wait a duration specified by Reverse Patch Wait before hanging up the phone line. If the control autopatch is enabled and the reverse autopatch is in passive mode, the alert signal will not be issued until the control autopatch wait time has expired (this is the

amount of time that the FF-800 waits for the Control Patch Logon command). The alert signal issued by the FF-800 is a dual tone signal that is similar to the ring signal heard on the commercial telephone system. This signal will begin after loss of COS if a signal is being received when the reverse autopatch is requested. If the repeater is not transmitting when the request for reverse autopatch is processed, the FF-800 will activate the main transmitter(s) and issue the "ring" signal until a COS is received, or the reverse patch wait time has expired. The "ring" signal may be interrupted and normal repeater operation may proceed while the "ring" signal is present -- thus, repeater operators may ignore the signal and continue without interruption to the basic operation of the controller.

After the Autopatch command has been entered, the FF-800 enters the autopatch mode whereby the caller can converse with the operator on the repeater. The repeater operator has full control of the FF-800 both during the waiting period and the autopatch mode. The Autopatch command responds with "Reverse Telephone Call" when used to answer a reverse autopatch request.

### **Reverse Patch Wait**

Access: CONFIGURATION

(cnfg) (637) ; (time)  
response: "R P W Time" + time in seconds

The (time) value is entered in seconds and is valid from 0 to 9999. This value specifies how long the FF-800 will keep a caller on the line during a request for reverse autopatch before they are disconnected.

### **Read Last Number**

Access: CONTROL

(cntl) (409)  
response: returns the last dialed phone number

This command can be used to interrogate the last dialed phone number -- the number is read back regardless of the original suppression options and the redial timer does not affect the response.

### **Exchange List Control**

Access: CONFIGURATION

(cnfg) (655) ; (on/off)  
Response: "X Change List" + "On" or "Off"

The exchange list allows the sysop to program up to 200, 3 or 6 digit telephone exchanges that are allowed during autopatch operations. The FF-800 uses a leading "1" or "0" in the phone number to determine if a search of the exchange list is required. If the search is indicated, the FF-800 will begin comparing the exchange of the input number to each entry in the exchange list. If a match is found, the call is allowed. If a match is not found, the call is aborted ("Call Cancel").

3 digit entries: Entries into the exchange list that have 3 digits will only compare to 8 digit phone numbers. This would be for a long distance call to the same area code as that of the controller.

6 digit entries: These entries would be compared to phone numbers having more than 8 digits. The search would include the area code and exchange.

**Exchange Delete**

Access: CONFIGURATION

(cnfg) (656) (exchange)

Response: "X Change Not In List" (exchange) not found

Response: "X Change O K" (exchange) deleted

An exchange may be deleted from the list using this command. (exchange) must be entered exactly as with Exchange Add or the delete command will not be executed.

**Exchange Delete All**

Access: CONFIGURATION

(cnfg) (656) (\*\*)

Response: "X Change List Start"

This command deletes all currently entered exchanges.

**Exchange Add**

Access: CONFIGURATION

(cnfg) (657) (exchange)

Response: "X Change O K" (exchange) added to list

Response: "X Change List Full" list full, not added to list

This command adds the (exchange) to the list. (exchange) can either be 3 or 6 digits. No other formats are allowed. 3 digit exchanges are used to allow long distance calls to the same area code as the FF-800 (when an 8 digit phone number is entered). 6 digit exchanges would include the area code followed by the exchange.

Some areas now require that the area code be included with all long distance calls, even if it is that same as that of the caller. In these cases, all exchange entries would be 6 digits. Note: if the same exchange is desired in two (or more) area codes, two (or more) separate entries are required.

**LockOut List:** When using the Exchange List feature, any "1?" or "0?" entries in the Lock Out List should be removed. Since the Lock Out List has priority, these entries would effectively disable the Exchange List feature by locking out all long distance calls.

## 5.4.2. Basic Autopatch Functions

**Autopatch Cancel**

Access: GENERAL

{#12} (109) ; (hang-up suffix)

Response: "Call Complete" or custom message

After the completion of an autopatch, the **Autopatch Cancel** command is used to disconnect the FF-800 from the phone line. If a custom hang-up suffix was programmed, it will need to be included with the hang-up code in order to enable the hang-up sequence. This command restores the status of all ports configured as Remote Base (these ports are de-activated by any autopatch or speed dial command).

**Autopatch Cancel, Unconditional**                      Access: GENERAL  
{#25}        (119)  
Response: "Call Complete" or custom message

This command is identical to the **Autopatch Cancel** command except that the custom hang-up feature is bypassed. This command is intended to provide control operators with a means of deactivating the autopatch even if the custom hang-up has been utilized.

**Auxiliary Re-dial**    Access: GENERAL  
{#53}        (146)  
Response: "Repeat Call" or custom message

This command is provided to allow users to initiate the re-dial function when patch options are disabled. This allows a re-dial command prefix that is different than and separate from the Autopatch prefix.

**Autopatch Extend**    Access: GENERAL  
{#26}        (120)  
Response: "Plus Time"

This command sets the autopatch time-out to the value stored in timer #10. There is no limit to the number of patch extends that can be executed.

**Autopatch Main**    Access: GENERAL  
{#14}        (111) (phone number) ; (options)  
**Autopatch Secondary #1**                                      Access: GENERAL  
{#47}        (140) (phone number) ; (options)  
**Autopatch Secondary #2**                                      Access: GENERAL  
{#48}        (141) (phone number) ; (options)  
**Autopatch Secondary #3**                                      Access: GENERAL  
{#49}        (142) (phone number) ; (options)  
Response: "Telephone Call" + phone number  
or:            user defined message + phone number

Since the FF-800 autopatch system generates the DTMF tones to dial the desired number, this number must be included with the **Autopatch** command. Numbers must be at least "patch minimum" in length (see **Valid Patch Length**), and the number is checked against the LOCKIN/LOCKOUT tables before it is allowed as a valid number. The busy conditions must be clear or the command will respond with the "Off Line" message and abort. The (options) parameters are used to specify the re-dial function, number read-back suppress, and custom hang-up suffix. If the command passes all tests, the FF-800 saves the status of all ports configured as half-duplex (see **TR Mode**), and turns off all half-duplex ports. The phone line relay is then activated and the FF-800 waits 1 second before dialing the number. The actual DTMF signal is muted from the repeater audio and is replaced by a single tone beep for each DTMF digit dialed. During the dialing sequence, any DTMF digit will interrupt the dialing operation and abort the autopatch (if the custom hang-up feature is specified, this interrupt is disabled). At this point the FF-800 is in autopatch mode and the user will note that the phone audio is passed as repeater audio as long as there are no valid COS



signals into the system. If a valid COS is received, this port is passed to the phone where it is heard at the calling end. Also, the courtesy tones are de-activated while the autopatch mode is in effect.

The Secondary Patch commands basically duplicate the **Autopatch Main** command with three exceptions: 1) the secondary commands can be disabled by the **Secondary Patch Enable** command, 2) the **Autopatch Secondary #2** and **#3** commands each activate a user output when executed, and 3) each Secondary command has its own annunciator message that can be individually customized. These outputs can be used to drive a user supplied relay that can switch the phone line to the FF-800 for multi-line access (or the output(s) can activate a tape recorder, or do any other operation that the user desires). Secondary #2 activates output #4 while Secondary #3 activates output #5. The **Autopatch Cancel** command de-activates these outputs. It should be noted that the outputs are not affected by any patch command if their corresponding secondary patch command is disabled (by **Secondary Patch Enable**). The secondary patch commands obey the same (options) and syntax as the **Autopatch Main** command.

As noted earlier, there are two timers that govern the autopatch -- the duration timer, and the activity timer. If either times-out, the autopatch is automatically terminated. The activity timer is reset by any valid COS, while the **Autopatch Extend** function must be used to reset the duration timer.

The **Autopatch Cancel** command is used to terminate the autopatch mode and return the system to normal operation (i.e., restore half-duplex ports that were disabled by the autopatch command).

The (options) parameter has many facets that allow access to several autopatch options. By including the options in the Autopatch command, the user is freed from remembering and entering several other commands to specify the different options desired for the autopatch. Also, each user can determine which options they desire when they initiate the autopatch (which could differ from call to call). This multi-faceted operation has been designed to minimize complexity while maximizing the available features to the Autopatch command.

There are three distinct options available -- the structure of the options syntax allows each to be specified uniquely such that any or all of the three are available at any time. The "\*" digit is used as both a command character, and a separator character. The following describes each component of the (options):

<\*> ; <\*> <custom hang-up> <\*> ; <\*>

The first <\*> is included for a re-dial command. Re-dial occurs when there is no telephone number included with the autopatch and the <\*> is entered to specify a re-dial command.

The second and third <\*> are separators for the custom hang-up suffix. up to 3 non-STAR digits can be entered to specify the custom hang-up sequence.

The fourth <\*> specifies the number read-back suppress feature. If this character is present, the FF-800 will not read back the entered phone number. This status is saved and the number will not read back on a subsequent re-dial operation even if the read back suppress option is omitted on the re-dial command. In other words, once suppressed, the number will always be suppressed on subsequent re-dial commands (the read back suppress is reset at the beginning of each new patch command).

These three options can be included or omitted as desired, as long as the order is preserved: re-dial first, custom hang-up second, and read back suppress third. The following examples illustrate the autopatch commands introduced thus far:

Each patch command has a configuration option (see **Patch Option Enable**) that allows the patch options to be selectively disabled. Thus, the **Autopatch Main** command may have the patch options enabled, but any or all of the Secondary Patch commands may have the options disabled.

#### Speed dial access via the Autopatch command

The **Autopatch Main** and **Autopatch Secondary #1** command have a subtle option that allows these commands to access the speed dial data base. If a patch command is issued with a "phone#" that has FEWER digits than that specified by **Valid Patch Length**, the "phone#" is interpreted as a speed dial slot and the speed dial command is executed. When used in this fashion, the speed dial slot# can be anything from "10" to "249" -- 10-99 is speed dial bank 1, 100-199 is bank 2, 200-239 is bank 3, and 240-249 is bank 4. To use this feature, set **Valid Patch Length** to 4 or higher.

#### **Control Patch Logon, User**

Access: GENERAL

{#69} (162)

response: "O K"

This command allows users access to the FF-800 via the telephone control input. If this command is used to log on to the FF-800, there is no access to control or configuration commands. Only GENERAL level access commands are recognized after this log-on command is issued. The users must be familiar with the command delimiters to user the control patch (see section 5.5 for a discussion of the command delimiters).

#### EXAMPLES:

**1113683716**

Standard autopatch

"Telephone Call 3 6 8 3 7 1 6" the FF-800 then brings the phone line off hook and dials the number **109**

"Call Complete"

**1113683716\*123\*** Autopatch with custom hang-up

"Telephone Call 3 6 8 3 7 1 6"

**109123**

Disconnect with custom hang-up

"Call Complete"

**1113683716\***

Autopatch with read-back suppress

"Telephone Call"

**1113683716\*123\*\***

Autopatch with read-back suppress and custom hang-up

**109456**

no response, Autopatch Cancel not accepted

**109123**

"Call Complete"

Demonstration of Re-dial:

**1113683716\*147\*** Autopatch with custom hang-up

"Telephone Call 3 6 8 3 7 1 6"

**120**

Extend autopatch

"Plus Ten"

**109147**

"Call Complete"

**111\*\***

Re-dial with read back suppress

"Repeat Call"

**109**

"Call Complete"

NOTE: even though original call had custom hang-up, it was not specified with the re-dial command and was thus not needed.

**111\*456\***

Re-dial again

"Repeat Call"

since the number was suppressed on the last re-dial, it is automatically suppressed again, even though the suppress was not specified here.

**119**

Auxiliary disconnect doesn't need hang-up suffix.

"Call Complete"

#### 5.4.3. Remote Autopatch Options

##### **Autopatch Courtesy Tone**

Access: CONFIGURATION

(cnfg) (531) ; (on/off)  
response: "A P C T" + "On" or "Off"

This feature allows the user to enable courtesy tones during an autopatch. The FF-800 normally suppresses courtesy tones during an autopatch.

##### **Remote Patch Enable**

Access: CONFIGURATION

(cnfg) (533) ; (on/off)  
response: "P Twenty Six Telephone" + "On" or "Off"

The P26 auxiliary autopatch interface connector can be used for a remote autopatch link. This allows a link radio to connect to a remote patch interface while presenting the autopatch and speed dial commands as though the phone line connection was present at the FF-800. In the remote patch mode, the off hook signal (P26-6) only activates (conducts to ground) when the FF-800 is dialing the phone number. The schematic of figure F1.1 shows an example of a remote patch connection. The off hook signal drives a user-supplied relay that re-routes the link TX audio during the dialing sequence. P26-5 supplies the audio from the FF-800 and can be padded by a user supplied potentiometer (10K ohms, nominal) to provide a modulation adjustment for the DTMF dial signaling, this allows the DTMF dial level to be independently set for the link.

The connection from P26 only supplies modulation audio and PTT signals during the dialing sequence. In order to pass repeater audio to and from the remote system, the user must dedicate one of the FF-800 ports to the link radio. This port should link or remote base (depending on the specific nature of the link). If the port is to be deactivated, the autopatch code should be placed in a macro that turns the port on, then executes the autopatch -- the hang-up would also be placed in a macro that would deactivate the patch, and then turn off the link port. Of course, the specific operational details are flexible and can be programmed by the system operator to meet the needs of their installation.

If the remote patch system requires a prefix code, then this is programmed into the PBX dial prefix (DTMF: Dial Prefix Enable, and Dial Prefix Enter or Serial Terminal: APREF and DIALPFX). The remote hang-up code is programmed into the hang-up suffix (DTMF: Patch Hang-up Set). The hang-up code is sent before the autopatch is disconnected and is valid even if the remote patch is disabled. In remote mode, the FF-800 activates P26-6, dials the hang-up code (if any is programmed) and then de-activates P26-6.

<b>Autopatch Hang-up Set</b>	Access: CONFIGURATION
(cnfg) (633) (hang-up DTMF sequence)	
<b>Autopatch Hang-up Read</b>	Access: CONFIGURATION
(cnfg) (635)	
response: "S F X" + digit sequence	

Unlike most of the FF-800 features, the patch hang-up has separate command codes for "set" and "interrogate". If the patch hang-up sequence is not desired, then it should be set to "empty" (i.e., no digits after the set code). This sequence is sent for all autopatches in all modes.

#### EXAMPLES:

<b>01635</b>	interrogate current hang-up codes
"S F X"	(empty)
<b>01633#</b>	set hang-up to "#"
"Set S F X P"	
<b>01633</b>	set empty hang-up
"Set S F X"	

#### 5.4.4. Speed Dial Functions

There are several speed call functions on the FF-800 that allow the FF-800 to automatically dial a number from stored memory. There are 4 types of speed call commands:

- 1: Emergency autopatch (10 slots, maximum of 7 digits per slot)
- 2: Speed call bank 1 (90 slots, maximum of 7 digits per slot)
- Speed call bank 2 (100 slots, maximum of 7 digits per slot)
- 3: Speed call bank 3 (40 slots, maximum of 10 digits per slot)
- 4: Speed call bank 4 (10 slots, maximum of 30 digits per slot)

Starting with Firmware version 2.19o, the FF-800 supports double length speed dials when the U5 NVRAM is replaced with a 32Kx8 device. With this enhancement, the slot lengths are as shown below:

- 1: Emergency autopatch (10 slots, maximum of 14 digits per slot)
- 2: Speed call bank 1 (90 slots, maximum of 14 digits per slot)  
Speed call bank 2 (100 slots, maximum of 14 digits per slot)
- 3: Speed call bank 3 (40 slots, maximum of 20 digits per slot)
- 4: Speed call bank 4 (10 slots, maximum of 60 digits per slot)

Any numeric digit may be stored as a speed dial number. In addition, "\*", "#", and "A", "B" may be stored as well. "C" is the delay digit and results in a 1 second pause in the dial process. "D" can not be used as it indicates the end of number.

The speed call functions are not subject to the **LOCKIN/LOCKOUT** limits imposed on the main and secondary autopatch commands. Thus, the user is free to program any number into any slot (provided that the slot size is not exceeded).

#### **Speed Call Program** Access: CONTROL

(cntl) (4001) (slot#) ; (phone number)	bank# 1
(cntl) (4002) (slot#) ; (phone number)	bank# 2
(cntl) (4003) (slot#) ; (phone number)	bank# 3
(cntl) (4004) (slot#) ; (phone number)	bank# 4

Response: "Speed Call Enter" + phone number  
"Speed Call Clear" slot is empty

All speed call slots are set from this command. If the phone number is omitted, then the contents of the indicated slot are returned. A slot can contain any number of digits up to the maximums indicated above. NOTE: the emergency speed call slots are located in bank 1, slots 0 - 9.

#### **Speed Call Erase** Access: CONTROL

(cntl) (4001) (slot#) (0)	bank# 1
(cntl) (4002) (slot#) (0)	bank# 2
(cntl) (4003) (slot#) (0)	bank# 3
(cntl) (4004) (slot#) (0)	bank# 4

Response: "Set Speed Call Clear"

There is no interrogate option for this function. The indicated slot is erased.

#### **Emergency Speed Call** Access: GENERAL

{#19} (116) (slot#) ; (options)

Response: "E M G" + slot#

or: custom annunciator message

This command performs a speed call function using the emergency speed call slots. Each slot can have a unique annunciator programmed by the user to help identify the nature of the service that is being accessed. The (options) are the same as for the normal or secondary autopatch commands --

however, only the custom hang-up option has any real meaning for speed call commands. The slot numbers reference the first 10 slots in bank 1 (numbers 0 through 9).

In addition to the individual annunciator messages, the emergency autopatch function sets the autopatch duration timer from timer #12 instead of timer #9. This allows the user to set a longer duration for emergency calls if desired.

<b>Speed Call Bank 1</b>	Access: GENERAL
{#20} (117) (slot#)	
<b>Speed Call Bank 2</b>	Access: GENERAL
{#21} (217) (slot#)	
<b>Speed Call Bank 3</b>	Access: GENERAL
{#22} (317) (slot#)	
<b>Speed Call Bank 4</b>	Access: GENERAL
{#23} (417) (slot#)	
Response: "Speed Call" + slot number	
or: custom annunciator + number	

Each bank in the speed call data base has a separate prefix. However, each behaves the same, provides the same annunciator and timer settings. Since the bank number is implied by the particular prefix, only the slot number is required when these commands are executed.

#### EXAMPLES:

**004002003683716** set slot 00, bank 2 = 368-3716

"Speed Call Enter 3 6 8 3 7 1 6"

**00400100911** set slot 00, bank 1 = 911 (emergency speed call #0)

"Speed Call Enter 9 1 1"

**004002015551212** set slot 01, bank 2 = 555-1212

"Speed Call Enter 5 5 5 1 2 1 2"

**00403201** erase slot 01, bank 2

"Set Speed Call Clear"

<b>1160</b>	emergency speed call
"Emergency One"	default message

<b>21700</b>	normal speed call
"Speed Call"	default message

<b>109</b>	hang-up
"Call Complete"	

<b>Autopatch Busy Override</b>	Access: CONFIGURATION
(cnfg) (639) ; (number)	
Response: "Over Call"	

The Patch Busy Over-ride will bring the phone off-hook and dial any included number -- no lock-in or lock-out checks are performed on the number, and no length limits are imposed. This command

is intended for use in extreme cases where it is desired by the control or system operator(s) to check a busy line for trouble or in the case of an emergency, when there may be no other means for access to the phone line. The override command causes the FF-800 to enter the autopatch mode and it is de-activated by the **Autopatch Cancel** command.

### **Reverse Autopatch**

Access: GENERAL

{#58} (151) ; (speed#)

{#14} (111)

when entered from a control patch session

Response: "Call From Telephone" or user programmed annunciator

The reverse autopatch command provides access to the controller via the telephone without using the control autopatch access. After receiving the announce message from the FF-800, the user enters this command followed by a delimiter (i.e., "#\*") and the controller will respond with the function annunciator and begin to issue a ring tone on the repeater output (if there is no active COS). Either the **Autopatch Main** or **Secondary Patch#1** commands without parameters will answer the reverse patch and cause the FF-800 to go into autopatch mode. If the patch is not answered within the Reverse Wait timer (timer#17) the caller will be disconnected without warning. Once this command is issued, the party on the telephone no longer has access to the FF-800 to enter command codes.

(speed#) is a 2 or 3 digit value from 10 to 249 and specifies the optional speed dial message that is announced on the repeater output. If the speed message is blank, it is ignored. The message will announce even if no number is programmed into the respective slot. NOTE: The (speed#) only specifies a message, the phone number programmed into that slot is NOT dialed or spoken.

## **5.5. Control Autopatch**

The control autopatch (and its associated support functions) provides the system operator with the ability to control the FF-800 from any DTMF compatible telephone. This section describes the configuration, security interlocks, and procedure for executing the control autopatch feature of the FF-800.

There are many advantages to a telephone based control path. This allows users to gain access to the system if they do not have a radio available, or if they are in a location that won't allow them access to the system via an RF input. It is also useful if the user is to do a significant amount of system configuration because entry of commands via the telephone can be done while the repeater is in use without disrupting its operation. There is also a degree of privacy that is conveyed by using the telephone as a control path. With the advent of easily obtained DTMF decoders it is becoming less difficult for unscrupulous persons to decode control codes -- especially if there is a control or system operator parked on the repeater for several minutes performing configuration functions.

The prime disadvantage to the control autopatch lies in the fact that the DTMF decoder can only service one source at a time. Thus, when a control autopatch is in progress, DTMF entries from any port on the FF-800 will not be muted or recognized. This is usually not a significant problem since most users monitor repeater activity to detect urgent or emergency traffic that might need access to the autopatch, or other repeater services.

The system operator can enable or disable the control autopatch as well as determine the number of rings that are required before the FF-800 will answer. Other support routines allow the operator to monitor repeater traffic from the phone, initiate a reverse control autopatch, or logoff from the telephone control path. The following paragraphs detail these commands and illustrate them with examples.

### **Delimiter mode**

Access: CONFIGURATION

(cnfg) (522) ; (on/off)  
response: "P S Is Enter Complete" normal "#\*" delimiter  
"Delta Is Enter Complete" for auxiliary delimiter set

This feature allows the user to switch to a delimiter set which is compatible with the ACC line of repeater controllers. In the auxiliary mode, the delimiter is a single "D" (or a single "#" via the control autopatch). There are a couple of limitations in the auxiliary mode when accessing the FF-800 from the control autopatch. The following commands use a "#" and can not be properly used from the control autopatch while in the aux. delimiter mode: **Message Edit**, **Message assign**, and **CT Edit**. These commands are not affected when accessed through the repeater inputs, control receiver input, or the **CRX** command (Serial Terminal command). The default is for the normal (#\*) delimiter.

### **Command Delimiter**

Access: N/A

(#\*) normal delimiter mode  
(#) or (D) auxiliary delimiter mode  
Response: N/A

The Command Delimiter is not a command, but must be used during all control patch command entries. Due to the lack of a convenient source of COS for phone traffic, the Command Delimiter is a unique, DTMF sequence that allows the operator to tell the FF-800 that the command entry is complete. The controller will not respond to DTMF digits entered from the control patch until it detects this two digit sequence. While in the normal delimiter mode, (#\*) may be used from any DTMF input. However, in the auxiliary delimiter mode, the delimiters behave differently: the (#) delimiter is only used from the control autopatch while the (D) digit is used on all other DTMF inputs.

### **Control Patch Enable**

Access: CONFIGURATION

(cnfg) (530) ; (on/off)  
Response: "R A P" + "On" or "Off"

If the control autopatch is disabled, the FF-800 will not answer the telephone line and will therefore not accept control commands via the phone.

### **Number of Rings**

Access: CONFIGURATION



(cnfg) (532) ; (#rings)  
Response: "R I N G" + #rings

This command allows the user to set the number of rings required by the FF-800 before it will answer a potential control autopatch. NOTE: if #rings = 0, the FF-800 will not answer for 256 rings (which effectively de-activates the control autopatch).

**Don't Answer Next** Access: CONTROL  
(cntl) (408)  
Response: "Control Telephone Call Cancel"

This command causes the FF-800 to ignore the next ring cycle from the phone line. If no ring condition is detected within 5 minutes after this command, the FF-800 will resume normal ring detect status.

**Control Patch Logon Sysop** Access: GENERAL  
{#10} (107)  
Response: "O K"

When the FF-800 answers the telephone for a potential control autopatch, it responds "C A P Up" (or user defined message) and then sets an entry timer of 13 seconds which allows the operator time to enter the logon command. If the command is not successfully entered during this period, the controller will hang-up and abort the logon process until it answers the phone again. When this command is entered, it responds with "O K" to indicate to the operator that the logon was successful. The logon duration is 15 minutes and is automatically reset to 15 minutes after every valid DTMF command.

**Control Patch Logoff** Access: CONTROL  
(cntl) (405)  
Response: "O K"

The operator must be sure to use this command to logoff from the FF-800 system prior to hanging up from the control autopatch session. Failure to properly logoff may result in loss of repeater control for up to the amount of time programmed into timer#13. The control receiver input or the Auxiliary DTMF input are the only command channels that are active during a control patch. Thus, if a control patch is not properly disconnected, these two paths are the only way to remotely regain the normal control paths. Of course, the normal operation of the controller is not disrupted, the FF-800 simply won't respond to any DTMF inputs from main or link ports. NOTE: The **Autopatch Disconnect** command can also be used to logoff from the control patch.

**Reverse Patch, Sysop** Access: GENERAL  
(cntl) (401)  
Response: "Control Telephone Call" or user defined message

Another feature unique to the control patch is that of the **Reverse Patch Sysop**. This command connects the operator on the control patch to the repeater output. This command places the FF-800 in the autopatch mode, and the operation of the repeater is just as though an autopatch was made

except that the control path remains to the phone line (i.e., the control patch operator is still in control). The normal autopatch, and activity timers are both in effect during the Sysop Reverse Patch, so if no activity is present on the repeater, the activity timer will eventually deactivate the **Reverse Patch Sysop**. The normal **Autopatch Disconnect** command is used by the control patch operator to deactivate the **Reverse Patch Sysop**. It should be noted that no matter how the **Reverse Patch Sysop** feature is disconnected, the operator will always be returned to the control patch mode. This is indicated by the controller issuing the control patch logon message (function# 54, default = "O K") whenever a disconnect command is issued in **Reverse Patch Sysop** mode. Thus, the operator can not directly logoff from the **Reverse Patch Sysop** mode, first, the reverse patch must be deactivated, then the logoff command can be entered.

### **Control Patch Monitor**

Access: CONTROL

(cntl) (406) (on/off)

Response: "M O N" + "On" or "Off"

While in the control patch session, the operator may find it useful to monitor repeater traffic. The patch monitor command allows the user to monitor the traffic on the repeater without passing phone line audio to the repeater output, and without indicating the presence of the operator on the control patch. NOTE: The **Autopatch Disconnect** command can also be used to turn off the control patch monitor function. When using the **Autopatch Disconnect** command in this fashion, the control patch will not be disconnected (unless **Autopatch Disconnect** is issued twice).

### **COS Over Patch Configure**

Access: CONFIGURATION

(cnfg) (855) ; (1/0)

Response: "C A P C O S" + "On" or "Off"

The "COS Over Patch" feature allows a control autopatch sysop to communicate over the repeater as though they were on a 6th receiver. This feature has three configuration commands that are described below. Once configured, COS Over Patch is only active when the **Control Patch Monitor** is on. By entering a single DTMF digit (keydn), the FF-800 enables the control patch audio to be passed to the repeater output. If a receiver is currently active, the control patch will take priority. If there are no active receivers, the FF-800 will activate all enabled transmitters just as though an enabled COS had gone active.

The COS Over Patch obeys all system timers, so that a "stuck COS" will time out the repeater just as for any other main or link receiver input. To deactivate the control patch audio, the sysop enters a different DTMF digit (keyup) at which time the FF-800 deactivates the audio link and removes the control patch COS. If no other COS inputs are active, a courtesy tone will be sent after the courtesy delay has expired.

The "keyup" and "keydn" digits also reset the control patch activity timer, so there is no need to reset the control patch security timer as long as these codes are in frequent use.

### **CAP Monitor Level**

Access: CONFIGURATION

(cnfg) (855\*) ; (0, 1, or 2)  
Response: "C M Level" + "0", "1", or "2"

This command allows the sysop to modify the repeater audio level that is monitored by the sysop during CAP Monitor mode. "0" = no attenuation, full level; "1" = half amplitude; "2" = 1/4 amplitude. This command may be used in conjunction with the APO Cancel hardware modification to allow the FF-800 to detect DTMF codes while the CAP Monitor is on. See the APO Monitor documentation for details.

#### **COS Over Patch, keyup**

Access: CONFIGURATION

(cnfg) (864) ; (any DTMF digit)  
Response: "C A P Up" + digit

This command sets or interrogates the keyup, or loss of signal (LOS), digit that is used by the COS Over Patch feature.

#### **COS Over Patch, keydown**

Access: CONFIGURATION

(cnfg) (854) ; (any DTMF digit)  
Response: "C A P Down" + digit

This command sets or interrogates the keydown, or acquisition of signal (AOS), digit that is used by the COS Over Patch feature.

### **5.6. Courtesy Tones**

The FF-800 allows the system operator to define and allocate courtesy tones. The entry of a courtesy tone is a two step process. First, the user "defines" the tone by entering the information that will determine what the tone will sound like. Second, the user must "allocate" the tone by telling the FF-800 what port and mode the tone is assigned to. There are 8 user defined tones, and 8 fixed tones, all of which may be allocated in the same manner. Each receiver port has two associated courtesy tones, one for all remote bases = off, and one for any remote base = RX or TX -- both tones can be allocated by the system operator. In addition, there is a remote base transmit annunciator courtesy tone that can be allocated as desired. This tone is sent immediately after a loss of COS when any remote base = transmit. The dependence on remote base status is intended to provide a simple and direct means of identifying when there are remote bases active on the system. This would alert operators that there could be traffic coming from, or going to other systems via one or more of the remote base ports. Of course, these features can be easily configured to mask the state of the remote bases if the system operator does not desire such indications.

The tone generator system that is incorporated into the FF-800 features sine-wave synthesis, attack/decay and frequency sweep effects. The system can generate CW characters, constant tones, "bell" tones, swept tones, two tone "notes", as well as any combination of these effects. Most courtesy tones are actually several tone elements that are strung together in sequence. By varying the parameters of each element, the system operator can create a virtually endless variety of courtesy tones. These "elements" are the basic building blocks with which the system operator will create courtesy tones.

Each element has the following parameters that determine the characteristics of that element:

- Main Tone Frequency
- Beat Tone Frequency (second tone, if desired)
- Amplitude
- Attack, Decay, or Constant amplitude
- Sweep up, Sweep down, or Constant frequency
- Effects Period, this sets the rate of attack/decay/sweep

How these parameters are combined depends upon the particular effect that is desired. Once a courtesy tone is complete, it is stored to one of the 8 available slots for user courtesy tones where it is then available for allocation.

### **CT Edit Mode**

Access: CONFIGURATION

(cnfg) (551)

Response: "C T Enter"

This command places the controller into courtesy tone edit mode. In this mode, all DTMF entries are interpreted as edit commands. These edit commands allow the system operator to enter the elements of a courtesy tone. The user can test all or part of the courtesy tone at any point of the edit process. Elements are entered one at a time per the following syntax:

(duration) (\*) (F1) (\*) ; (F2) (\*) ; (level) (\*) (fx) (\*) (fx rate)

(duration)	length of element in (msec)
(F1)	frequency of tone 1 (0 - 2540 Hz)
(F2)	frequency of tone 2 (0 - 2540 Hz)
(level)	amplitude of element in % (0 - 99)
(fx)	tone effects command (see table below)
(fx rate)	specifies the rate of the effects (if any)

If an element entry begins with a (\*), it is an editor command. The following commands are supported (if an entry ends with a "#" it is ignored):

(*0n)	delete the last "n" elements
(*1)	test last element
(*2)	test all current elements
(*3n)	save to ct# "n" and exit
(*4)	abort edit (no save)

The entry of effects options (attack/decay and sweep) is accomplished with a single digit according to the table below. This format is intended to simplify the entry of elements by limiting the number of digits that must be entered. The user might note that the effects are arranged on the DTMF key pad with attack/decay from right to left and sweep from top to bottom. The center of the numeric pad, "5", represents no effects. To do attack, the command would be "6"; to do sweep+, the command would be "2"; to do attack and sweep-, the command would be "9" and so on... .

DECAY 1 SWEEP(+)	2 SWEEP(+)	ATTACK 3 SWEEP(+)	A
DECAY 4	<b>none</b> 5 <b>none</b>	ATTACK 6	B
DECAY 7 SWEEP(-)	8 SWEEP(-)	ATTACK 9 SWEEP(-)	C
*	0	#	D

**Figure 5-17. Special Effects keypad map**

Figure 4.6.1. Courtesy Tone Edit special effects keypad map.

Another feature of the **CT Edit** function is the element "memory". The FF-800 remembers the last element that was entered and uses it as a template to fill in the optional parameters of the next element. Thus, for many courtesy tones it may only be necessary to enter the (duration) and (F1) parameters for each element. In addition, a default "memory" is initialized when the CT Edit mode is invoked: (F2) = 0, (level) = 99, (fx) = none, (fx rate) = 30. If no changes are made to these parameters during the entry process, they will remain in effect throughout the edit mode (these defaults are typical for most courtesy tones).

The following examples help illustrate the element entry process:

CT example #1: a sequence of three tones with a short space between each. A space (F1 = F2 = 0hz) is an element, so three tones plus two spaces = 5 elements total.

unlock configuration security.

enter "**01551**"

response: "C T Enter"

enter "**300\*400**"

response: a 400 Hz tone

enter "**100\*0**"

response: no tone

enter "**300\*800**"

response: an 800 Hz tone

enter "**100\*0**"

response: no tone

enter "**300\*400**"

response: a 400 Hz tone

enter "**\*2**"

response: all three tones in sequence

enter "**\*30**"

response: "C T Complete"

CT example #2: A bell tone.

unlock configuration security.

enter "01551"

response: "C T Enter"

enter "1500\*800\*0\*99\*4\*15"

response: an 800 Hz tone with a medium rate decay

enter "\*01"

response: "Minus One"

enter "1500\*800\*880"

response: a dual tone with medium rate decay (note memory feature filled in the remaining parameters from the previous element)

enter "\*01"

response: "Minus One"

enter "1500\*400\*0"

response: a 400 Hz tone with a medium rate decay

enter "\*4"

response: "C. T. Abort"

### CT Test

Access: GENERAL

{#27} (121) ; (n)

Response: sends indicated courtesy tone

"n" indicates the courtesy tone number that is to be interrogated. This allows the user to easily check any of the current courtesy tones. If "n" is omitted, the FF-800 will respond with the tone that is currently in the serial port courtesy tone edit buffer (see section 6 for information on how to use the serial port interface). This command is not applicable to the DTMF command **CT Edit** (there is already an interrogate command available to this mode).

### CT Allocate

Access: CONFIGURATION

(cnfg) (550) (rx#) ; (ct#)

(rx#): No Remote Base Active:

01 = Local

04 = rxC

02 = rxA

05 = rxD

03 = rxB

06 = RBTx on

Any Remote Base = On:

07 = Local

10 = rxC

08 = rxA

11 = rxD

09 = rxB

Response: "C T" plus the tone assigned to (ct#)

Once courtesy tones are entered, they must be allocated so that they can be linked to a particular receiver or action. As noted earlier, each receiver has two associated tones, one for indicating that no remote base ports are on, and one for indicating that any remote base port(s) are on. There is also a tone for indicating that there is a remote base port in transmit. The following table describes the different values for (rx#):

(ct#) is from 00 to 07 for the user defined courtesy tones, and 08 to 15 for the factory defined courtesy tones.

Examples:

<b>0155001</b>	interrogate the local receiver courtesy tone
"C T" + assigned tone	
<b>015500313</b>	set port B to a factory defined tone
"Set C T" + new tone	
<b>015500405</b>	set port C to a user defined tone
"Set C T" + new tone	
<b>015500615</b>	set remote base transmit indicator to factory
tone (#15 = no tone)	
"Set C T"	

### **Voter Port Assign**

Access: CONFIGURATION

(cnfg) (570) ; (rx#)	
(rx#): 0 = none	1 = local
2 = rxA	3 = rxB
4 = rxC	5 = rxD

Response: "V R X" + (rx#)

For systems that incorporate a voter, the FF-800 has the ability to assign a different courtesy tone to each receiver in the voter system (up to 8 receivers). **Voter Port Assign** is used to tell the FF-800 which port is connected to the voter so that courtesy tones can be determined according to the voter logic inputs. Connector P-10 is used to connect the voted receiver inputs. The voter logic inputs are derived from the voter system and should indicate only the current voted receiver. The default active level for these inputs is LOW (ground = voted, open = not voted) but the active level can be changed with the **Voter Active Level** command.

Examples:

<b>01570</b>	interrogate current assignment
"V R X Off"	
<b>015702</b>	set port A as voted port
"Set V R X A"	

### **CT Allocate Voter**

Access: CONFIGURATION

(cnfg) (553) (rx#) ; (ct#)  
Response: "V C T" plus the tone assigned to (ct#)

Courtesy tones may be allocated for the voted receivers in the same fashion as for the TX/RX ports. Voter courtesy tones assigned in this fashion will not have any provision for remote base indication. (rx#) = 1 through 8 for the respective voter input. (ct#) is from 00 to 07 for the user defined courtesy tones, and 08 to 15 for the factory defined courtesy tones.

Examples:

<b>015531</b>	interrogate voter#1 courtesy tone
"V C T" + assigned tone	
<b>01553113</b>	set voter#1 to factory defined tone
"Set V C T" + new tone	

## **Voter CT MODE**

Access: CONFIGURATION

(cnfg) (572) ; (mode)

Response: "V M Current" or "V M Time"

The voted courtesy tone can be chosen by one of two methods. (mode) = 1 selects the "Current" mode. In this mode the voted courtesy tone is based on the last active receiver on the voted channel. (mode) = 2 selects the "Time" mode in which the selected courtesy tone is chosen based on the receiver that is voted for the longest amount of time during a particular transmission. The receiver timers are reset after each loss of COS so the indication is updated each time the voted channel is activated.

Examples:

**01572**

interrogate current mode

"V M Current"

**015722**

set time mode

"Set V M Time"

## **Voter CW String Enable**

Access: CONFIGURATION

(cnfg) (574) ; (on/off)

Response: "V C W" + "On" or "Off"

If the user desires to assign a CW character to each receiver in their voted system, they may use this feature to simplify the assignment of receiver courtesy tones. Since this feature doesn't use any user defined courtesy tones, it also helps free up space for other courtesy tones. When this feature is enabled, the courtesy tones for the voted receivers are taken from a message string in message number 0. This message must have a particular format as follows:

[CW] (frequency) (speed) A B s t u v w x y z

The [CW] phrase command provides the speed and frequency parameters that the user desires for the voter courtesy tones. The "A B" characters are required to allow the firmware to verify the message format. The characters that follow the "A B" sequence are the CW characters to be sent -- s = receiver #1, t = receiver #2, etc... . Unused receivers must still be assigned some CW character in order for the format checking to be satisfied. If this message is not entered according to the above format, the FF-800 will revert to the normal voter courtesy tone assignments.

The following examples depict the entry of the CW string via DTMF commands and serial commands (see **Message Edit** for DTMF message entry and section 6 for message entry via the serial terminal interface):

The example system has four receivers at East, South, West, and North.

Message entry via DTMF command:

enter Message Edit mode

**180\*900\*30\*65\*66\***

(enter first part)

responds with CW "A B"



<b>69*83*87*78*</b>	(enter receiver characters)
responds in voice "E S W N"	
<b>88*88*88*88*</b>	(fill in unused receivers)
responds in voice "X X X X"	
<b>*2</b>	(read back entire message)
responds in CW "A B E S W N X X X X"	
<b>*300</b>	(save to message # 0)
"T X T Complete"	
<b>015741</b>	(activate voter cw string mode)
"V C W On"	

Message entry via serial terminal interface:

```
>MESSAGE 0 [CW] 900 30 A B E S W N X X X X
[CW] 900 30 A B E S W N X X X X
>
```

<b>Voter Active Level</b>	Access: CONFIGURATION
(cnfg) (575) (rx#) ; (on/off)	
Response: "V A L" + "On" or "Off"	

The active level of each voter logic input can be set individually. By setting the active level to "on", a high voltage ( $V_{in} > 2.8$  volts) or open circuit will activate the respective input. Selecting "off" as the active level, a low voltage ( $V_{in} < 0.8$  volts) will activate the respective input. The factory default levels are all active off.

Examples:

<b>015751</b>	interrogate receiver #1
"V A L High"	
<b>0157510</b>	set receiver # 1 active low
"Set V A L Low"	

<b>DTMF Cover Tone</b>	Access: CONFIGURATION
(cnfg) (552) ; (mode)	
(mode) "01" = no muting	"02" = muting, no beeps
"11" = muting, steady beeps	"12" = muting, individual beeps
Response: "C T M S"	steady
"C T M I"	individual
"C T M Off"	none
"M U T Off"	no muting

The FF-800 is designed to mute incoming DTMF signals and send a "cover tone" to the repeater output in place of the DTMF signal. This helps to enhance security (because the DTMF signals are not broadcast over as large an area as the repeater covers) and also eliminates DTMF signals from the repeater output (many users find DTMF signaling to be annoying). However, the user has the option to set the muting and cover tone to suit their needs. The four options are indicated above. With "no muting" the DTMF signals pass through the FF-800 just as other audio signals, and there

are no acknowledge beeps. "muting, no beeps" will mute the DTMF signals, but there are no acknowledge beeps. "muting, steady beeps" also mutes DTMF signals, an acknowledge beep is sent once each second as long as DTMF digits are entered. "muting, individual beeps" is similar to the "steady" mode, except that the acknowledge beep is sent after each DTMF digit.

If muting is selected, the tone un-mute digit (default un-mute is "#") can be used to temporarily defeat the muting feature. This is most often done to send DTMF signals to a remote system. To engage the un-mute, simply enter the un-mute digit followed by the digits that are desired. NOTE: any pause of more than 4 seconds between digits after the un-mute digit (#) will cause the un-mute to cancel and DTMF muting will automatically resume.

Examples:

<b>01552</b>	interrogate current mode
"C T M I"	individual beeps
<b>0155201</b>	disable DTMF muting
"Set M U T Off"	
{dtmf digits will now pass to the repeater output}	
<b>0155211</b>	steady beeps
"Set C T M S"	
{muting on with steady rate beeps}	

## 5.7. Message Management

The FF-800 has several user-definable messages that can be used to customize the operation of your repeater system. The message system is organized around a data base of 100 messages, each with a capacity of 15 words (messages can be "doubled-up" to increase the length to 31 words). To customize a function, the user assigns the desired message to the function (i.e., repeater ID, ID bulletin, autopatch announcement, etc...). Of course, there are default messages for all functions, so customization is not required. The default messages are designed to be "generic" so that they might apply to most applications.

One aspect of the message data base is that the user can change the message assignments relatively quickly. Thus, a variety of messages can be entered into the "data base" and the user can choose from a series of "pre-canned" messages and change their function assignment as the need requires. This may be done periodically to change the ID bulletins (or any other function), or it can be done automatically with the scheduler.

### 5.7.1. Message Creation

To create a custom message, you must first choose which of the 100 message slots you will use. While you may use any message for any function, most users find it easiest to use the message slot number that corresponds to the **Message Assign** function#. Once a message number is chosen, you may set about editing the message using the DTMF **Message Edit** or serial port **Message** commands. After editing and storing the message (storing is automatic with the serial port command), you must use **Message Assign** to program the FF-800 to use the new message for the

appropriate function. In the case of ID Bulletins or Tail Messages, it may be necessary to turn on the particular message before it will become active.

Examples:

You desire to program a custom autopatch message. The autopatch message function# is 50, so you choose to put the new patch message in slot 50. Using the serial port (the DTMF **Message Edit** command could also be used), you enter the new message:

```
>MESSAGE 50 TELEPHONE CALL , PLEASE IDENTIFY
TELEPH CALL , PLEAS IDENT
>
```

Next, you use message assign to activate the new message:

```
100                               Security access
O K
139
O K
0155550*50                       set new assignment
Set Five Zero A S N Five Zero
```

The new Autopatch message is now configured. You should note that once a message has been assigned, you only need to re-edit the message to change it (edit functions do not affect the message assignment).

### 5.7.2. Repeater Identification

The center of the FF-800 identification scheme is the [ID] phrase command. When this command is encountered in a message, the contents of the call message are spoken. The call message holds only the call sign of the repeater and can be programmed using the DTMF **Message Edit** command (store to message# 100) or the serial port **CALL** command.

However, an identification typically consists of more than just the call sign of the repeater. At the very least, it is a call sign followed by the word "Repeater" or ("/R" in CW). The FF-800 has several different IDs that can be programmed to have different messages. The differences are largely driven by when the ID is sent. During certain times, when the repeater is active, it may be desirable to send a very brief ID, when activity is lower a longer ID may be desired. There are four types of ID "slots" in the FF-800 firmware. These "slots" define when the ID will be sent, and what message will be used for the ID. The slots are defined as follows:

COS ID	Sent when a COS is active. This is when repeater activity is considered <b>highest</b> .
Anxious ID	Sent just after loss of COS, before the courtesy tone. Activity is somewhat lower than during a COS, but still considered <b>high</b> .
Pending ID	Sent at the end of the hang time. Activity here is considered to be <b>low</b> .

Mandatory ID      Sent if the repeater is idle (no COS and no PTTs active) AND there has been a COS since the last ID. This is considered the **lowest** activity slot.

The timing for these slots is user adjustable (see Timer Set) and is as follows:

<u>ID type</u>	<u>function#</u>	<u>Description</u>
COS ID	10	Sent when ID time has expired.
Anxious ID	12	Sent if loss of COS occurs within anxious timer window (timer #15)
Pending ID	13	Sent if the end of hang time occurs within the pending timer window (timer #16)
Mandatory ID	13	Sent when the ID timer reaches zero and no current repeater activity.

"function#" refers to the **Message Assign** "ff" parameter described on the following pages. The FF-800 has three ID functions (#10: CW short, #12: Voice short, and #13: Voice long). It should be noted that the descriptions above are not binding. For example, the CW short id can be voice or CW, and can be as long as any message on the FF-800. Generally, you will want to use the descriptions as a guide to creating your IDs, but be aware that you are not restricted to those descriptions.

### 5.7.3. ID Bulletins and Tail Messages

In addition to the IDs described above, the Anxious, Pending, and Mandatory IDs have ID bulletin functions that may be programmed to provide periodic supplemental repeater information, or so-called "rotating IDs". Of the eight ID bulletins, two are "welcome" bulletins (bulletins 7 and 8) and are sent just prior to the ANXIOUS ID if there has been no COS activity for the duration of ACTIVITY (timer#5). The remaining ID bulletins (bulletins 1 through 6) are messages that precede the ID function for the PENDING and MANDATORY IDs. Each bulletin may be individually enabled or disabled and the FF-800 "rotates" through the active bulletins in each group (the "welcome" bulletin rotation is separate from the normal bulletin rotation). This rotation feature allows the FF-800 to present a variety of bulletins as it proceeds through various ID cycles.

Rotating IDs make use of the [SPI] S phrase command to suppress the normal ID that is scheduled to follow a particular bulletin. To set up a rotating ID, you need to program at least two bulletin messages, all of which are different in some fashion. Each bulletin message must have two things: 1) the repeater ID (typically, this is in the form of the [ID] phrase) and the [SPI] S phrase. The location of [SPI] S in the message is not critical, though most often it is placed at the end of the message. After the messages have been programmed and assigned, you must use the **ID Bulletin Enable** or **BBSET** commands to turn on the desired bulletins.

There is also a tail message feature available on the FF-800 that allows the user to program up to 8 tail messages (these messages are sent at the end of the hang time). The tail messages can be individually enabled or disabled just as with the ID bulletins. The FF-800 will also rotate through the active tail messages. The rate of tail messages is controlled with the TAIL TIMER (timer #0). This allows the user to limit how often the messages are sent. If a tail message is interrupted with an active COS, it is stopped -- However, the tail timer is still reset and when a tail message comes due

again, it will be taken from the next message in the rotation. The programming sequence for tail messages is similar to that described above: 1) Choose a message slot and edit the message. 2) Use Message Assign to assign the new message slot to the appropriate Tail message function. 3) Turn on the desired messages using the **Tail Message Enable** or **TALSET** commands.

#### 5.7.4. Special Words

There are several words in the FF-800 vocabulary that are used for special functions. These are called "phrase commands" or "phrases" and they can be used in the same manner as speech words.

*Note: For those familiar with ACC controllers, it may be helpful to note that most of the FF-800 phrase words are similar to the ACC run-time variables.*

Phrases allow the user to include various pieces of information into their messages (such as time, temperature, date, etc...). Some phrase commands require additional information to function, this information is entered following the phrase command when editing a message. The following list describes each phrase command, and its associated parameters (if any):

<u>word#</u>	<u>Word Text</u>	<u>Description</u>
11	[ID]	Sends the repeater call sign (DTMF message#100, or serial command "CALL"). By using this phrase command in place of the repeater call sign in messages, updates to the call sign are instantly updated in all messages.
183	[CT] (ct#)	Send courtesy tone. (ct#) = 0 - 15.
180	[CW] (freq) (speed)	causes message interpreter to enter CW mode. All following words are sent as CW characters until end of current message or [SP] word is encountered.
45	-	Dash, this phrase command is the same as [CW] except that the (freq) and (speed) values are taken from the system defaults.
181	[SP]	Speech revert. Returns message interpreter to speech mode.
176	[T]	Speak time of day.
177	[DAY]	Speak month/day/year (only 2 digit year reported).
175	[S]	Salutation in female voice. Returns "Good Morning" (00:00 to 11:59), "Good Afternoon" (12:00 to 18:59), or "Good Evening" (19:00 to 23:59) based on current time of day.
178	[TC] (input#)	Reads temperature in degrees C from (input#). (input#) = 1 to 4.
179	[TF] (input#)	Reads temperature in degrees F from (input#). (input#) = 1 to 4.
182	[SPI] (addr) (track)	Digital Voice Recorder playback command. (addr) = DVR unit address (typically 6), (track) = track number (00 to 99) to play. See FF-8070 manual for DVR programming and usage.
182	[SPI] S	Suppress ID. When used in an ID Bulletin, this phrase command causes the following voice long ID to be suppressed. This removes

<u>word#</u>	<u>Word Text</u>	<u>Description</u>
		the redundant ID when the ID Bulletin contains the repeater call sign.
184	[PAG] (reed1) (reed2)	send two-tone page using the designated reed codes. See section 5.11, Pager Functions, for details concerning reed codes.
185	[OUT] (out#) (on/off)	Set/Clear logic output. This allows a logic output to be controlled to start or stop an external tape recorder, etc...
197	[POZ]	Indefinite pause. This phrase word waits for a logic "0" on input#4 before continuing. This allows the controller to "wait" for some external device to finish its operation before continuing.
186	[LEV] (level%)	Local speech/tone level adjust. This allows the speech/tone level to be increased or decreased for all or part of a particular message. The original setting is not affected and is restored at the end of the message.
44	,	Comma, this is the speech pause command. Each comma provides 0.5 seconds of delay.

In addition, the following CW characters are supported when in CW mode:

<u>Character</u>	<u>CW</u>
,	Comma
_	Underscore, word pause
-	Dash
.	Period
/	Slash
=	Double Dash
?	Question mark

#### 5.7.5. Master Word List

The following list illustrates the current FF-800 vocabulary. Periodically, new words may be added. A new word list may be generated using the WORD command on the FF-800 serial port. This will provide a current listing of the words and their word numbers. Note that the serial port editing commands use the plain English representations rather than the word numbers (word numbers are used for DTMF edit commands).

### Speech Phrase Commands

<u>Phrase</u>	<u>word#</u>	<u>Description</u>	<u>Syntax</u>
[CT]	183	Courtesy tone	[CT] (ct#)
[CW]	180	Enter CW mode	[CW] (tone) (wpm)
-	45	Enter CW mode, global tone/speed. Only valid in speech mode (in CW mode, this character generates the CW for dash)	-
[DAY]	177	Speak month/date	[DAY]
[ID]	11	Speak "Call"	[ID]

[OUT]	185	Set/clear output	[OUT] (out#) (on/off)
[PAG]	184	Send Moto page	[PAG] (reed1) (reed2)
[POZ]	197	Pause for input	[POZ]
[SPI]	182	Play DVR track	[SPI] (addr) (track)
		Suppress ID	[SPI] S
[SP]	181	Speech revert (use after [CW]) exits CW mode	[SP]
[S]	175	Salutation	[S]
[TC]	178	Temp. in C	[TC] (input#)
[TF]	179	Temp. in F	[TF] (input#)
[T]	176	Read time of day	[T]
[LEV]	186	Speech/Tone local level	[LEV] (level%)
XTRA	254	Allow long message (overwrites next message)	XTRA

### Master Word List (word name and word number)

, (comma = speech pause)		ANSWER	112	CHARLIE	284
	44	APPROACH	392	CHECK	97
		AREA	298	CIRCUIT	299
<b>CW characters:</b>		ARRIVAL	389	CLEAR	347
, (comma)	44	AS	395	CLIMB	410
- (dash)	45	AT	118	CLOCK	256
. (period)	46	AUTOMATIC	232	CLOSED	377
/ (slash)	47			COMPLETE	6
= (double dash)	61	<b>B</b>	<b>66</b>	CONNECT	300
? (question mark)	63	BANK	411	CONTACT	373
space (word pause)	32	BASE	110	CONTROL	117
		BELOW	352	COURSE	368
<b>A</b>	<b>65</b>	BETWEEN	258	CRANE	310
ABORT	23	BLOWING	348	CRYSTALS	398
ABOUT	168	BOOST	425	CURRENT	220
ABOVE	396	BRAVO	259	CYCLE	115
ACCELERATED	412	BREAK	101		
ACKNOW	390	BROKEN	337	<b>D</b>	<b>68</b>
ACTION	360	BUTTON	202	DANGER	203
ADJUST	92	BY	318	DAYS	289
ADVISE	363			DECREASE	362
AERIAL	384	<b>C</b>	<b>67</b>	DEGREES	125
AFFIRMATIVE	316	CABIN	388	DELTA	10
AIR	351	CALIBRATE	309	DEVICE	303
ALERT	91	CALL	25	DIRECTION	260
ALL	119	CALM	397	DISPLAY	261
ALOFT	356	CANCEL	120	DIVIDED	317
ALPHA	201	CAUTION	306	DOOR	314
ALTERNATE	346	CEILING	338	DOWN	99
ALTITUDE	418	CELSIUS	321	DUST	323
AMPS	37	CENTER	380		
AND	96	CHANGE	14	<b>E</b>	<b>69</b>

EAST	204	HAIL	324	LEVEL	375
ECHO	114	HALF	315	LIGHT	307
ELECTRICIAN	262	HAVE	364	LIMA	273
EMERGENCY	111	HAZE	353	LINE	18
ENGINE	385	HEADING	406	LIST	426
ENTER	102	HEAVY	332	LONG	376
EQUAL	27	HENRY	269	LOW	30
ERROR	169	HERTZ	241		
ESTIMATED	345	HIGH	94	<b>M</b>	<b>77</b>
EVACUATE	378	HOLD	105	MACHINE	5
EXIT	58	HOTEL	227	MAINTAIN	402
EXPECT	382	HOURS	205	MANUAL	291
<b>F</b>	<b>70</b>	<b>I</b>	<b>73</b>	MARKER	244
FAILURE	226	ICE	335	MAYDAY	243
FARENHEIT	221	ICING	242	MEAN	343
FAST	28	IDENTIFY	379	MEASURE	239
FEET	238	IDLE	393	MEGA	38
FIELD	358	IGNITE	387	METER	4
FINAL	367	IMMEADIATELY	366	MICRO	297
FIRE	167	IN	170	MIDDLE	421
FLIGHT	417	INBOUND	386	MIKE	274
FLOW	263	INCH	270	MILE	240
FOG	331	INCREASE	394	MILLI	207
FOXTROT	264	INDIA	292	MINUS	15
FREEDOM	416	INDICATED	340	MINUTES	275
FREEZING	350	INFORMATION	233	MIST	344
FREQUENCY	93	ING	200	MODERATE	341
FROM	103	INNER	422	MOTOR	276
FUEL	374	INSTRUMENT	423	MOVE	257
FULL	399	INTRUDER	271	MOVING	199
		IS	8	MUCH	372
<b>G</b>	<b>71</b>			<b>N</b>	<b>78</b>
GALLONS	265	<b>J</b>	<b>74</b>	NEAR	228
GATE	266	JULIET	272	NEW	400
GEAR	424			NINER	415
GET	104	<b>K</b>	<b>75</b>	NO	365
GLIDE	357	KEY	173	NORTH	210
GO	29	KILO	206	NOT	16
GOLF	268	KNOTS	359	NOVEMBER	208
GRAIN	381			NUMBER	234
GREEN	290	<b>L</b>	<b>76</b>	<b>O</b>	<b>79</b>
GREENWICH	342	LAND	333	OCLOCK	320
GROUND	229	LAUNCH	407	OF	106
GUAGE	267	LEAN	403	OFF	2
		LEFT	214	OHMS	209
<b>H</b>	<b>72</b>	LEG	401		



OIL	371	<b>S</b>	<b>83</b>	UNDER	286
ON	3	SAFE	312	UNIFORM	287
OPEN	31	SAND	329	UNIT	302
OPERATOR	36	SCATTERED	354	UNLIMITED	355
OSCAR	95	SECONDS	301	UP	122
OTHER	370	SERVICE	235	<b>V</b>	<b>86</b>
OUT	126	SET	33	VALVE	308
OUTER	420	SEVERE	165	VARIABLE	336
OVER	171	SHORT	404	VICTOR	295
<b>P</b>	<b>80</b>	SHOWERS	326	VISABILITY	225
PAPA	277	SHUT	60	VOLTS	293
PARTIALLY	339	SIERRA	42	<b>W</b>	<b>87</b>
PASS	278	SLEET	327	WAIT	21
PASSED	311	SLOPE	414	WAKE	405
PATH	361	SLOW	304	WATTS	12
PER	322	SMOKE	22	WEATHER	162
PERCENT	172	SNOW	328	WEST	219
PLAN	383	SOUTH	215	WHISKEY	217
PLEASE	174	SPEED	34	WHITE	319
PLUS	59	SQUAWK	236	WIND	325
POINT	100	STALL	408	<b>X</b>	<b>88</b>
POSITION	279	START	17	X-RAY	218
POWER	39	STOP	216	<b>Y</b>	<b>89</b>
PRESS	107	STORM	223	YANKEE	288
PRESSURE	211	SWITCH	98	YELLOW	313
PROBE	280	<b>T</b>	<b>84</b>	<b>Z</b>	<b>90</b>
PULL	281	TANGO	285	ZULU	296
PUSH	282	TELEPHONE	230		
<b>Q</b>	<b>81</b>	TEMPERATURE	163		
QUEBEC	283	TEST	121		
<b>R</b>	<b>82</b>	THE	9		
RADAR	369	THEE	224		
RAIN	330	THIN	334		
RAISE	391	THIS	7		
RANGE	108	THUNDERSTORM	164		
READY	113	TIME	20		
RED	222	TIMER	62		
REMARK	419	TOOL	305		
REPAIR	212	TORNADO	166		
REPEATER	1	TOUCHDOWN	409		
REPEAT	237	TOWER	231		
RIGHT	213	TRIM	413		
ROMEO	294	TURBULENCE	349		
		TURN	109		
		<b>U</b>	<b>85</b>		

<b>Numbers (male voice):</b>		<b>Female Voice:</b>			
0	#0	Fafternoon	160	F20	154
1	#1	FA_M	141	F30	155
2	#2	FEVENING	161	F40	156
3	#3	FGOOD	158	F50	157
4	#4	FIS	140		
5	#5	FMORN	159		
6	#6	FOCLOCK	143		
7	#7	FP_M	142		
8	#8	FTHE	138		
9	#9	FTIME	139		
10	#10	F0	128		
11	#11	F1	129		
12	#12	F2	130		
13	#13	F3	131		
14	#14	F4	132		
15	#15	F5	133		
16	#16	F6	134		
17	#17	F7	135		
18	#18	F8	136		
19	#19	F9	137		
20	#20	F10	144		
30	#30	F11	145		
40	#40	F12	146		
50	#50	F13	147		
60	#60	F14	148		
70	#70	F15	149		
80	#80	F16	150		
90	#90	F17	151		
100	#100	F18	152		
1000	#1000	F19	153		

### 5.7.6. Message Command Functions

#### Message Edit

Access: CONFIGURATION

(cnfg) (580)

Response: "T X T Enter"

This command places the controller into message edit mode. In this mode, all DTMF entries are interpreted as edit commands. These edit commands allow the system operator to enter the words of a message. The user can test all or part of the message at any point of the edit process. Each word is entered as a 1 to three digit number followed by a star (\*) -- appendix E contains an alphabetic word list including the code numbers required by this command. The user may enter any number of words during a single transmission as long as the 31 digit tone buffer is not exceeded.

If an entry begins with a (\*), it is an editor command. The following commands are supported:

(*0n)	delete the last "n" words
(*1)	test last entry
(*2)	test current message
(*3nn)	save to message# "nn" and exit nn = 100 stores to CALL message
(*4)	abort edit (no save)

if an entry ends with a "#" it is ignored.

There is an activity timer that aborts the edit mode if no DTMF entries are made within 30 seconds. Thus, it is advisable that the user plan their messages in advance to speed the entry process.

EXAMPLES: {unlock control and configuration security}

**01580**

"T X T Enter"

**34\*230\*25\***

"Speed Telephone Call"

**118\*176\***

"At" {time}

**\*2**

"Speed Telephone Call At" {time}

**\*04**

"Speed"

**25\***

"Call"

**\*2**

"Speed Call"

**\*310**

"T X T Complete"

The message is stored in message slot # 10.

**01580**

Example 2, call sign entry

"T X T Enter"

75\*69\*#0\*70\*71\* enter call sign characters

"K E 0 F G"

\*01 last character wrong, delete

"K E 0 F"

70\* correct last character

"F"

\*2 test entire entry

"K E 0 F F"

\*3100 save to call sign

"T X T Complete"

The message is stored in slot # 100 (call sign). Note that multi-digit numbers must be entered "phonetically" as shown above because the text interpreter does not recognize sequential numbers.

### Message Assign

Access: CONFIGURATION

(cnfg) (555) (ff)	interrogate status of (ff)
(cnfg) (555) (ff) (mm)	assign slot (mm) to function (ff)
(cnfg) (555) (ff) (mm*)	assign DVR track number (mm) to function (ff)
(cnfg) (555) (ff) (#)	clear function assignment & return to default
(cnfg) (555AAAA)	preset all (ff) = slot#ff

Used to set or interrogate the message assignment for the indicated function number. DVR assignments default to a DVR at address 6 and (mm) = the system track number (see the FF-8070 manual for more information about DVR message organization). The function codes for (ff) are defined as follows:

<b><u>Name</u></b>	<b><u>(ff)</u></b>	<b><u>Default message</u></b>
Emergency speed-dial 0	0	Emergency One
Emergency speed-dial 1	1	Emergency Two
Emergency speed-dial 2	2	Emergency Three
Emergency speed-dial 3	3	Emergency Four
Emergency speed-dial 4	4	Emergency Five
Emergency speed-dial 5	5	Emergency Six
Emergency speed-dial 6	6	Emergency Seven
Emergency speed-dial 7	7	Emergency Eight
Emergency speed-dial 8	8	Emergency Nine
Emergency speed-dial 9	9	Fire Emergency
CW Short ID	10	[ID] (in CW)
<not used>	11	n/u
Voice Short ID	12	[ID]
Voice Long ID	13	This Is [ID] Repeater
ID Bulletin 1	14	B B 1
ID Bulletin 2	15	B B 2
ID Bulletin 3	16	B B 3
ID Bulletin 4	17	B B 4
ID Bulletin 5	18	B B 5
ID Bulletin 6	19	B B 6

<b>Name</b>	<b>(ff)</b>	<b>Default message</b>
ID Bulletin 7	20	B B 7
ID Bulletin 8	21	B B 8
TAIL 1	22	Severe Weather Alert
TAIL 2	23	H I (in CW)
TAIL 3	24	The Temperature is (degrees F #1)
TAIL 4	25	Power Amps Temperature (degrees F #3)
TAIL 5	26	T Five
TAIL 6	27	T Six
TAIL 7	28	T Seven
TAIL 8	29	T Eight
OUT 1	30	Out One
OUT 2	31	Out Two
OUT 3	32	Out Three
OUT 4	33	Out Four
OUT 5	34	Out Five
OUT 6	35	Out Six
OUT 7	36	Out Seven
OUT 8	37	Out Eight
OUT 11	38	Out Eleven
OUT 12	39	Out Twelve
OUT 13	40	Out Thirteen
OUT 14	41	Out Fourteen
OUT 15	42	Out Fifteen
OUT 16	43	Out Sixteen
OUT 17	44	Out Seventeen
OUT 18	45	Out Eighteen
IN 1	46	In One
IN 2	47	In Two
IN 3	48	In Three
IN 4	49	In Four
Auto-patch	50	Telephone Call
A/P disconnect	51	Call Complete At (time)
Speed-dial	52	Speed Call
A/P off line	53	Telephone Off Line
Control A/P logon	54	Control Up
Time Out	55	Machine Time Out
State 1	56	Machine Set One
State 2	57	Machine Set Two
State 3	58	Machine Set Three
State 4	59	Machine Set Four
State 5	60	Machine Set Five
State 6	61	Machine Set Six
USER 1	62	U M One
USER 2	63	U M Two
USER 3	64	U M Three

<b><u>Name</u></b>	<b><u>(ff)</u></b>	<b><u>Default message</u></b>
USER 4	65	U M Four
USER 5	66	U M Five
USER 6	67	U M Six
USER 7	68	U M Seven
USER 8	69	U M Eight
A TX on	70	A T X
B TX on	71	B T X
C TX on	72	C T X
D TX on	73	D T X
A RX on	74	A R X
B RX on	75	B R X
C RX on	76	C R X
D RX on	77	D R X
A off	78	A Off
B off	79	B Off
C off	80	C Off
D off	81	D Off
A T/R	82	A T R
BT/R	83	B T R
C T/R	84	C T R
D T/R	85	D T R
Re-dial A/P	86	Repeat Call
Secondary Patch 1	87	X Telephone Call
Secondary Patch 2	88	Y Telephone Call
Secondary Patch 3	89	Z Telephone Call
Secondary Patch Off	90	Telephone Call Abort
Reverse Patch announce	91	Inbound Telephone Call
Phone# Lockout announce	92	Call Cancel
Security Unlock announce	93	O K
Control Patch log-off	94	O K
Local TX On	95	L T X
Local RX On	96	L R X
Local T/R Off	97	L Off
Local T/R	98	L T R

Message Assign examples:

**0155517**

"One Seven A S N Off"

**0155517\*10**

"Set One Seven A S N One Zero"

**0155518\*20\***

"Set One Eight D V R Two Zero"

**0155516#**                      revert to default assignment

"Set One Six A S N Off"

interrogate status of ID bulletin #4

default is assigned

assign to message #10

assign a DVR track

**Message Play**

Access: CONFIGURATION

(cnfg) (556) (mm)

(mm) = message slot number

Response: speaks the contents of the specified message slot or no response if the message is empty.

**Message Play** allows the user to interrogate the contents of any of the message slots.**User Message Play**

Access: General

{#11} (108) (message#)

(message#) = 1 through 8

Response: speaks the contents of the specified User message

**User Message Play** can be used to set up a series of user bulletins for various user defined information areas. Users could then get repeater status, information on group activities, weather information, etc... . Also, these messages can be used as annunciators for complicated macro commands (simply store **User Message Play** into the macro first, then enter the speech suppress command). **Message Assign** functions 61 through 68 identify the user messages.

**CW Frequency**

Access: CONFIGURATION

(cnfg) (565) ; (f)

Response: "C W Frequency" + (f) and sends the call sign in CW.

Sets the global frequency of the CW generator. (f) = 0 - 2550 Hz, if (f) = 0 the CW generator is disabled. This value is not affected by the [CW] phrase command which sets the local CW frequency. The CW generator always defaults to the global frequency until a [CW] phrase command is encountered.

**CW Speed**

Access: CONFIGURATION

(cnfg) (560) ; (s)

Response: "C W Speed" + (s) and sends the call sign in CW.

Sets the global speed of the CW generator. (s) = 0 - 40 WPM. This value is not affected by the [CW] phrase command which sets the local CW speed. The CW generator always defaults to the global speed until a [CW] phrase command is encountered.

CW Examples:

**01565**

interrogate frequency

"C W Frequency Six Zero Zero" plus CALL in CW

**015651000**

set new frequency

"Set CW Frequency One Zero Zero Zero" plus CALL in CW

**01560**

interrogate speed

"C W Speed Two Zero" plus CALL in CW

**0156030**

set new global speed

"Set C W Speed Three Zero" plus CALL in CW

**Tail Message Enable**

Access: CONTROL

(cntl) (450) (n) ; (on/off)

Response: "T A L Off" if tail message is disabled

if the message is enabled, the FF-800 responds with the contents of the message.

The tail messages are enabled and disabled with this command. The FF-800 will rotate through all of the enabled tail messages at an interval specified by the tail timer (timer#0). See **Message Assign** and **Message Edit** for details on configuring tail message contents.

### **ID Bulletin Enable**

Access: CONTROL

(cntl) (452) (n) ; (on/off)

Response: "B B On" or "B B Off"

The ID bulletins are sent just prior to the repeater ID for the pending and mandatory IDs. The controller will rotate to the next enabled ID bulletin each time the bulletin is sent. Bulletins 1 through 6 are assigned to the pending and mandatory IDs, while bulletins 7 and 8 are the welcome bulletins, these are sent just prior to the Anxious ID if there has been no repeater activity for the duration of the activity timer (timer #5). The welcome bulletins are rotated separately from the normal ID bulletins.

Examples:

**004501** interrogate tail message #1

"T A L Off"

**0045011** set tail #1 = on

"Severe Weather Alert" default message for tail #1

**004521** interrogate ID bulletin #1

"B B Off"

**0045211** turn on ID bulletin #1

"Set B B On"

### **ID Force**

Access: CONTROL

(cntl) (459) ; (t)

Response: none

If this command is issued without the parameter (t), it will force an ID time out which will cause the FF-800 to identify. The (t) parameter is included if the user wants to force the ID timeout after (t) seconds ( (t) = 0 to 9999). Note that this does not change the value in the ID timer register (timer #4). Also, note that the ID time out can be forced to a very long time period -- the user should exercise care when setting the ID time out. After the time out, the timer is reset from timer register #4.

Examples:

**01459** force immediate ID

responds with the repeater ID

**01459100** set ID timeout in 100 seconds

ID occurs after 100 seconds



If the user sets a time out using this command, and there is repeater activity before the time out, the FF-800 may ID before the time set by the user (depending on the settings of the ID window timer registers).

### **ID Interrupt Mode**

Access: CONTROL

(cntl) (453) ; (on/off)  
response: "I D I" + "On" or "Off"

The **ID interrupt Mode** allows a voice ID bulletin or ID to be interrupted by a COS -- this causes the voice message to stop and the CW Short ID is sent (ff #10, Message Assign, section 5.7.3). When "On", the ID interrupt is allowed thus causing interrupted IDs to revert to CW Short. However, when "Off", IDs can not be interrupted and they will play to completion regardless of the status of the COS inputs.

## **5.8. Macros and the Scheduler**

The FF-800 macros allow the user to program a series of commands that can be executed by a single command. Parameters can be passed to any command inside a macro when the macro is executed -- this gives the user unparalleled flexibility in configuring their system. Another feature unique to the FF-800 macro system is the ability to program "conditional macro statements". This allows the macro to terminate early if a particular status flag is not in the proper state (the status flags and conditional macro programming will be described in greater detail later). This conditional execution capability lets the user define dynamic macros that can execute different sequences of commands based on the current status of the repeater system. Nested macros are also allowed which enables the user to place macros within macros to form execution trees or thread long command sequences that won't fit within a single macro.

In addition to providing the user with custom command capabilities, the macros are used by the FF-800 to specify the actions taken by the scheduler events and the command trigger inputs. The LiTZ (Long interrupt Tone Zero) support also uses a macro definition to determine what (if anything) the FF-800 will do if a LiTZ is detected. The macro assignments are similar to those for the messages in that there is a data base of up to 64 macros that the user defines for their particular system. These macros are then assigned as desired to the scheduler, trigger inputs, or LiTZ function. All macros are available as immediate execution commands regardless of their assignment status.

### **5.8.1. Macro Management and Execution**

#### **Macro Enter**

Access: CONFIGURATION

(cnfg) (590)  
Response: "M R O Enter"

The **Macro Enter** command places the FF-800 into the macro entry mode -- this mode is similar to the **Message Edit** and **CT Edit** modes in that all subsequent DTMF entries are interpreted as macro entries and normal command entry is suspended until the "macro enter" mode is complete. The user then enters the commands that are desired. Commands are entered by keying the digits for the prefix and parameters just as though the command would normally be entered -- each command entry must be separated by a loss of COS or a delimiter sequence (#\*). Either of these operations causes the command to be analyzed and stored into the macro -- the controller responds "M E" to all valid entries. If the DTMF entry does not correspond to a valid DTMF command, the entry is ignored and the FF-800 responds with "Error" to indicate that the command was not valid. There are several support commands that are valid only from within a macro, and these are described in the following paragraphs.

#### **Macro Enter Abort**

Access: CONFIGURATION

(cnfg) (591)  
Response: "Abort"

This command allows the user to abort the macro entry in progress and discard any entries that have been made. It is only valid from the macro entry mode. After execution, the FF-800 is in normal DTMF command mode.

#### **Macro Enter Save**

Access: CONFIGURATION

(cnfg) (592) (Mm)      M = bank (1-8); m = slot (1-8)  
Response: "Complete"

This command terminates the macro entry mode and saves all entries to macro number (mm). Any macro that previously existed at (Mm) is replaced with the new macro commands. After execution, the FF-800 is in normal DTMF command mode.

#### **Speech Suppress Toggle**

Access: MACRO

(cntl) (1)  
Response: none

This command is only valid when entered into a macro. It toggles the FF-800 speech and tone response suppress status. Thus the first occurrence of this command in a macro will cause the FF-800 to suppress all speech and tone responses until the Speech Suppress Toggle command is encountered again (or the end of the macro). It may be entered as many times as desired (within the size limits of the macro) and is used to suppress function responses for some or all of the commands contained in the macro. Note that the speech suppress status is enabled when entering a macro even if it was disabled from a macro that calls a new macro. Thus, the speech mute feature is applied to each macro as though they were entered alone even if they are called from other macros.

#### **Force Timer Reset**

Access: MACRO

(cntl) (2)  
Response: none

This command is only valid when entered into a macro. This command resets the Tail Timer,

ID timer, DTMF Access activity timer, and Autopatch activity timer. The reset process does not affect the timer SETTINGS, but rather copies those settings to the actual timer registers.

**Force COS Resynch.**

Access: CONTROL

(cntl) (3)

Response: none

This command is only valid when entered into a macro. The FF-800 operating system looks for changes in the COS/PTT signals before updating the status of the COS/PTT registers. When modifying the status or configuration of a controller port inside a macro, there is no COS or PTT transition that can be processed, so this command forces an update of the status registers to allow the FF-800 to recognize the port change.

**Macro Parameter Designate**

Access: CONFIGURATION

(cnfg) (599)

Response: none

This command is placed in a macro just prior to the command that is to receive the macro execute parameter. It may be used several times in a particular macro sequence -- each occurrence in a macro causes the same parameter to be passed. Any parameter that is included with Macro Execute at the time of execution will be passed to the command that immediately follows Parameter Designate.

**Macro Prefix Designate**

Access: CONFIGURATION

(cnfg) (699) ; (prefix/params)

Response: n/a

This command is only valid when used in a macro. It is similar to the Macro Parameter Designate, but it does not operate on the following command, any execution parameters are handled within **Macro Prefix Designate**.

This command works by combining the (prefix/params) entered as part of the macro with the (params) that are entered when executing the macro and then submitting the combined string to the FF-800 DTMF command parser for execution. If the combination results in a valid command prefix, the function is executed. After the function is complete, the macro resumes execution with the next entry. Note that the (prefix/params) embedded in the macro may consist of part of a command prefix, a command prefix and no params, a command prefix and partial params, or it may be completely blank.

The most important aspect of this command is that it allows partial prefixes to be placed in the macro body. The remainder of the prefix (and any parameters that are to go with that prefix) can be supplied by the user at the time the macro is executed. This allows the sysop to construct a macro that basically acts a user defined "group" prefix (much like the control and configuration prefixes) that groups several commands into a group that begins with the same 1-4 digits. The commands in the group would all have the same 1st and 2nd digit which would be placed in the macro with the Macro Prefix Designate command. The 3rd and 4th digits would be different for each command in the group and would be included by the user when the macro is executed. This also provides a way to have a command prefix with up to 7 digits.

This command represents a high degree of sophistication and its utility may not be clear to most sysops -- an application note is scheduled for release soon to deal with this feature in more detail.

### **Macro Abort if True**

Access: CONFIGURATION

(cnfg) (596) (flag#)

Response: none

(cnfg) (596) (\*) (flag#)

Response: "Abort" if true, no response if false

If the specified flag is true, the macro execution in progress will be terminated. This command is only valid from within a macro.

### **Macro Abort if False**

Access: CONFIGURATION

(cnfg) (597) (flag#)

Response: none

(cnfg) (597) (\*) (flag#)

Response: "Abort" if false, no response if true

If the specified flag is false, the macro execution in progress will be terminated. This command is only valid from within a macro.

The termination applies only to the macro that contains the Abort Macro command. If the aborted macro was called from another macro, execution shall return to the calling macro. The abort macro commands can be used to disable macros or the user can nest macros with different abort macro commands to construct dynamic macros -- these macros could execute any of several completely different sets of commands based on the status of a particular flag or flags.

### **Macro User Flags**

Access: CONTROL

(cnfg) (598) (flag#) ; (on/off)

Response: "F L G On" or "F L G Off" on = true, off = false

The user flags provide a means to directly enable or disable a macro or macro path based on the selected user defined flag(s). Any of the system flags can be interrogated with this command, but only the user flags (28 - 35) can be modified. The following list defines the available flags:

<u>Flag#</u>	<u>Description</u>	<u>Flag#</u>	<u>Description</u>
01	any remote base = RX	25	Port B = TX
02	any remote base = TX	26	Port C = TX
03	all remote bases = off	27	Port D = TX
04	Port A = RX	28	user flag #1
05	Port B = RX	29	user flag #2
06	Port C = RX	30	user flag #3

Flag#   Description

07	Port D = RX
08	output #1
09	output #2
10	output #3
11	output #4
12	output #5
13	output #6
14	output #7
15	output #8
16	command trigger #1
17	command trigger #2
18	command trigger #3
19	command trigger #4
20	ID Pending
21	phone off hook
22	busy input
23	DTMF detect
24	Port A = TX

Flag#   Description

31	user flag #4
32	user flag #5
33	user flag #6
34	user flag #7
35	user flag #8
36	COS A
37	COS B
38	COS C
39	COS D
40	Local port RX on
41	Local port TX on
42	Macro timer#1 = 0
43	Macro timer#2 = 0
44	Macro timer#3 = 0
45	Macro timer#4 = 0
46	Autopatch timer = 0
47	Reverse Patch Wait timer = 0

**Macro Execute**

{#28}	(122) (macro#) ; (parameters)
{#29}	(123) (macro#) ; (parameters)
{#30}	(124) (macro#) ; (parameters)
{#31}	(125) (macro#) ; (parameters)
{#54}	(147) (macro#) ; (parameters)
{#55}	(148) (macro#) ; (parameters)
{#56}	(149) (macro#) ; (parameters)
{#57}	(150) (macro#) ; (parameters)
{#61}	(154) ; (parameters)
{#62}	(155) ; (parameters)
{#63}	(156) ; (parameters)
{#64}	(157) ; (parameters)
{#65}	(158) ; (parameters)
{#66}	(159) ; (parameters)
{#67}	(160) ; (parameters)
{#68}	(161) ; (parameters)

**Access: General**

macro bank 1
macro bank 2
macro bank 3
macro bank 4
macro bank 5
macro bank 6
macro bank 7
macro bank 8
macro #81
macro #82
macro #83
macro #84
macro #85
macro #86
macro #87
macro #88

Response: depends on macro actions

The 64 available macros are divided into 8 banks of 8 macros each ( (macro#) = 1 to 8). Since each prefix provides access to up to 8 macros, the user should segregate the macros into groups that are available to different types of users. For example, a macro to change the status of the repeater should not be placed in the same bank as one that contains an open autopatch macro. The optional (parameters) field is used to pass (parameters) to a command within the macro. If the parameters are omitted, the internal command will try to execute with no parameters (the results of this depend on the command). If the (parameters) option is included with a macro that does not use Macro Designate, the parameters are ignored.

**Time Delay Macro Execute**

Access: CONFIGURATION

(cnfg) (595) (timer#) ; (mm) (t..t)

Response: "M R O Number" + macro# + "Timer" + timer setting

This command allows the sysop to set a macro to execute after the specified time delay. (timer#) = 1 to 4, (mm) = macro number, and (t..t) = time setting in seconds (0 to 9999). The timer begins as soon as the response is finished. Since this is considered an automatic invocation (like a scheduler event), no macro parameters are allowed with this command.

**Command Trigger Assign**

Access: CONTROL

(cntl) (475) (input#) (active hi/lo) ; (macro#)

Response: "C M D T" plus (macro#) or "Off"

If a command trigger input is to be implemented, the user must specify the action of the particular input. Each input has two states, high and low, each of which may invoke a macro. Whether a macro is assigned to the active hi or active low state of a particular input depends on how the user wants the input to be interpreted. For example: if an input is usually high, and then goes low to signal some "event", the user would assign the macro that deals with this "event" to the active low state of that input. On reset the FF-800 will examine each input and execute any triggered macros based on the status of the inputs at the time of reset.

**LiTZ Trigger Assign**

Access: CONTROL

(cntl) (476) ; (macro #)

Response: "L T I Z" plus macro number or "Off"

If the user desires to implement the LiTZ standard, they may do so with this command. First, the action or actions that are to result from an LiTZ detection are determined and programmed into a macro (this could be an autopatch to a system operator, a message directing the user what to do, or some other action as desired by the system operator). Once the macro is complete, it is assigned with LiTZ Assign and the feature will be available immediately. The LiTZ standard specifies that a single DTMF "0" held on for a specific amount of time shall trigger the desired function

**LiTZ Detect Time**

Access: CONTROL

(cntl) (477) ; (time)

Response: "L T I Z Time" plus time value

The minimum LiTZ detect duration is set with this command. (time) is in seconds from 1 to 255. This parameter is not a state variable (but is maintained in non-volatile storage).

The following examples describe the macro entry process:

Construct a simple macro to read the time and pulse output #7:

(unlock control and configuration security)

**01590**

macro enter mode

"M R O Enter"

<b>118</b>	read time command
"M E"	entry OK
<b>DDDD12345</b>	invalid command
"Abort"	command ignored
<b>001</b>	toggle suppress speech off
"M E"	
<b>1277</b>	pulse output command
"M E"	
<b>0159211</b>	save macro to bank 1, number 1
"Complete"	
<b>1221</b>	execute macro
"The Time Is One Oh One A M"	the pulse command response is suppressed.

The following macro utilizes the parametric option:

<b>01590</b>	Macro enter mode
"M R O Enter"	
<b>001</b>	speech toggle off
"M E"	
<b>1277</b>	pulse output #7 (i.e., start tape recorder)
"M E"	
<b>001</b>	speech toggle on
"M E"	
<b>01599</b>	designate next command to get parameter
"M E"	
<b>111</b>	autopatch command (leave off phone #, user will supply when the macro is executed).
"M E"	
<b>0159212</b>	save the macro, bank 1, number 2
"Complete"	
<b>12223683716</b>	execute the macro with the phone number.
"Telephone Call 3 6 8 3 7 1 6"	
<b>109</b>	complete phone call
"Call Complete"	
<b>1222**</b>	re-dial with read back suppress
"Telephone Call"	
<b>109</b>	complete phone call
"Call Complete"	
(see Autopatch for explanation of patch parameters)	

Enter a macro to restrict access of port C if Port B = RX or TX:  
 (port C is an HF remote base while port B is a VHF/UHF remote base and it is decided by the repeater committee that the HF remote shall not be activated if the VHF/UHF remote is in use)

<b>01590</b>	macro entry mode
"M R O Enter"	
<b>0159605</b>	abort if port B = RX
"M E"	
<b>1341</b>	put port C in RX
"M E"	
<b>0159213</b>	save macro
<b>1223</b>	execute macro (if B = off)
"C R X"	
<b>1223</b>	execute macro (if B = RX)
"Abort"	

A more complicated macro may be used to support special telephone considerations. The following macro is designed for a site that has two available phone lines -- each line has commercial services which provide a busy signal to the FF-800 when their respective line is in use. These two busy signals are connected to command trigger inputs 1 and 2 (no macro is assigned to these inputs for this example). The repeater owner wants the controller to automatically choose the non-busy phone line each time an autopatch is executed. A relay is connected to output 7 to switch between the two lines -- the inputs are true when the phone line is busy. Two macros will be needed to construct this feature:

<b>01590</b>	macro entry mode
"M R O Enter"	
<b>001</b>	speech off
"M E"	
<b>1232</b>	try to do line 2 macro
"M E"	
<b>0159621</b>	abort if phone off hook (line 2 worked)
<b>11570</b>	turn off line relay (pick line 1)
"M E"	
<b>0159616</b>	abort if line 1 is busy
"M E"	
<b>001</b>	speech on
"M E"	
<b>01599</b>	designate autopatch parameter
"M E"	
<b>111</b>	autopatch command
"M E"	
<b>0159221</b>	save to bank 2, number 1
"Complete"	

The second macro will try to do the autopatch on line 2:

<b>01590</b>	macro entry mode
"M R O Enter"	
<b>0159617</b>	abort if line 2 = busy



"M E"	
<b>11571</b>	activate phone line for line 2
"M E"	
<b>001</b>	speech on (was turned off before)
"M E"	
<b>01599</b>	designate parameter
"M E"	
<b>111</b>	do the autopatch
"M E"	
<b>001</b>	speech off
"M E"	
<b>0159222</b>	save to bank 2, number 2
"Complete"	

The autopatch command would now be <1230> plus the phone number and options (as specified in the Autopatch command). In this example the phone busy input would be left disconnected. If both lines were busy, the FF-800 would respond "Abort" and the user would have to try again later -- otherwise, the controller would connect to the first available phone line and initiate the autopatch. This example demonstrates the power and flexibility of the FF-800 macro system. For custom commands or operations, the user will find few limits to the capabilities that can be incorporated into their system.

#### COMMAND TRIGGER INPUT EXAMPLE:

One possible use for the command trigger inputs would be that of a loss of commercial power alert feature. In this example, a signal is provided to input #3 that goes high when the repeater commercial supply is lost (of course, this assumes that a battery back-up system is in place for the repeater). Two macros must be programmed: one to activate the power fail mode, and one to deactivate the power fail mode. What these macros do is up to the user. They could simply activate/de-activate a tail message or the user could change timer settings and ID message settings to limit transmitter key up duration during the power fail condition (this example sets a tail message).

<b>01590</b>	macro enter mode
"M R O Enter"	
<b>001</b>	speech suppress
"M E"	
<b>0045011</b>	turn tail #1 on
"M E"	
<b>0159221</b>	save to bank 2, number 1
"Complete"	
{set trigger command syntax: (cntl) (475) (input#) (active hi/lo) ; (macro#)}	
<b>004753120</b>	set trigger for macro #20, on high input
"C M D T Two Zero"	

Enter power fail message and assign to tail #1:

<b>01580</b>	text enter mode
"T X T Enter"	

**39\*226**

"Power Failure"

**\*325**

save to message #25

**0155522\*25**

assign message to tail #1

"Two Two A S N Two Five"

The configuration is complete. Bringing input #3 high will activate the "Power Failure" tail message. This example requires the user to manually clear the message, but the user could also program a macro to automatically deactivate the tail message when input #3 goes low (this is left as an exercise for the user to try).

### 5.8.2. Clock Functions

The FF-800 features a battery-backed real time clock that can be used to provide the time of day and date to users (either through command entry or ID bulletins and tail messages). The clock can also be used to schedule "events" that are to occur at a specific time. These "events" trigger the execution of a macro that performs a particular function. The scheduler allows the user to program the FF-800 to automatically re-configure itself to respond to regular, or semi-regular events.

The scheduler allows events to be specified by month, date or day of week, hour, and minute. Any of these parameters can be replaced by a "wildcard" which allows daily, weekly, or monthly events. Since the user defines which time parameters are to be wildcards, the event patterns that can be defined are very flexible.

#### **Clock Set**

Access: CONTROL

(cntl) (410) (hhmmss) ; (MMDDYY) set time (24hr) and date (date is optional)

(cntl) (410) (hhmmss) ; (MMDDYYYY) set time (24hr) and date (date is optional)

Response: "Time" in female voice

(cntl) (410) ; (day of week) set day of week

Response: "D O W" plus numeric day of week

The time and date parameters MUST include leading zeros, which means that One:Ten a.m. would be represented as "011000". Also, the time is always entered in 24 hour format. If the (MMDDYY) is excluded, the current date settings are left unchanged. If the clock is disabled by the Disable Clock command, the Set Clock command will automatically re-start the clock.

The day of the week is automatically calculated from the entered date (when using the "YY" format, the previous century must be current). The (day of week) parameter is a single digit from 1 to 7 (1 = Sunday, 2 = Monday, etc...). The day of week is used by the scheduler to match weekly events (events that occur on the same day of each week).

#### **Clock 12/24 Hour Mode**

Access: CONTROL

(cntl) (411) ; "12" or "24"

Response: "12 Hours Clock" or "24 Hours Clock"

The Clock Hour Mode affects the time interrogate functions (both DTMF and serial port). This setting is a state variable and affects only the interrogation of the clock. Note: the clock set feature always uses the 24 hour time format.

Example:

<b>00410165900</b>	set clock to 4:59 pm
"Time"	
<b>00410165900082493</b>	set clock to 4:59 pm, August 24, 1993
"Time"	
<b>004101</b>	set day to Monday
"Set D O W One"	
<b>00410</b>	interrogate day of week
"D O W One"	

### **Clock Disable**

Access: CONFIGURATION

(cnfg) (515) ; (on/off)

Response: "C L K" plus "On" or "Off"

This command is used to de-activate the internal clock. This operation preserves the clock battery and should be executed if the FF-800 is to be without power for an extended period of time. The clock battery is specified by its manufacturer to last 10 years without power applied. This command can also be used to temporarily disable the scheduler and time functions if desired.

Example: A large metropolitan repeater club maintains spare repeater components as part of their maintenance procedure. The FF-800 that is used as a spare is to be stored until needed:

<b>01515</b>	interrogate clock status
"C L K On"	
<b>015150</b>	turn off clock
"Set C L K Off"	

When the controller is powered up for use, the user would only need to set the time to re-activate the clock.

### **Time Talk**

Access: GENERAL

{#24} (118)

Response: "The Time Is" plus 12 hr format time, all in female voice

This is a user available command that allows the time of day to be interrogated.

Example:

**118**  
"The Time Is Twelve Oh One A M"

### **Date Talk**

Access: GENERAL

{#50} (143)

Response: numeric form of current month and date

This is a user available command that allows the current date to be interrogated.

Example:

**143**

"One Twenty Seven"

January 27

### **Clock Smoothing**

Access: CONFIGURATION

(cnfg) (517) ; (correction)      correct slow clock

(cnfg) (517) ; (\*) ; (correction)      correct fast clock

Response: "S M U Plus" plus (correction)

or "S M U Minus" plus (correction)

While the clock manufacturer specifies the accuracy of their devices, it has been found that some combinations of electrical noise and temperature variations can adversely affect the long term accuracy of the clock module. This command gives the user the ability to set a correction factor of up to plus or minus 30 seconds per day to counteract any errors that might appear in their clock. This procedure can allow the clock to be "trimmed" to within +/- 15 seconds per month of the actual time.

If the user suspects that their clock accuracy is not within acceptable limits, they should begin keeping accurate records of the set time and deviated time. Ideally, the user would set the time and note the date and time for this operation against a known standard (such as WWV). With this information noted, the user can later quantify the extent of the inaccuracy (which is an important pre-requisite to the **Clock Smoothing** command). The clock should run for at least a couple of weeks before trying to determine any error in the current time. After the clock has been running for two weeks or more, determine the total error (in seconds) and divide by the number of days since the clock was set (this gives the error in seconds per day). This value is entered as the (correction) parameter.

Example: The user sets the clock by WWV to 16:34 on August 8. On August 26, at 16:01, the user notes that the clock is 1 minute 10 seconds fast (with reference to WWV). by dividing 70 seconds by 18 days, the user notes that the clock is fast by 3.88 seconds per day (round this up to 4). Thus, we want to correct the fast clock as follows:

**01517**

check current value

"S M U Zero"

**01517\*4**

set to subtract 4 seconds per day

"Set S M U Minus Four"

Note: Always add or subtract the calculated value with the current value. For example, use the same correction as above:

**01517**

check current value

"S M U One"

**01517\*3**

subtract 4 from current setting (1 - 4 = -3)

"Set S M U Minus Three"

If the initial calibrate operation is based on fairly accurate data, subsequent calibrations should not be required.

### 5.8.3. Scheduler Functions

There are some aspects of the scheduler which should be noted by the user. The FF-800 scheduler can execute up to four (4) co-incident events. If more than four events come due at a particular time, the scheduler will keep the first four, and ignore the rest. Thus, low numbered events have priority and the assignments of events should take this in to account.

Another characteristic of the scheduler that the user should note relates to the fact that events execute at 30 seconds past the minute (rather than at :00). This is part of the normal sequence of the scheduler firmware and should not be of consequence to the user (unless the user is expecting the event at :00).

#### **Scheduler Control**

Access: CONFIGURATION

(cnfg) (670) ; (on/off)  
response: "S C D Unit" + "On" or "Off"

This allows the scheduler to be disabled or enabled on command. The status of the scheduler is saved in the State memory, so the user must update all applicable states to reflect the desired operation of the scheduler. This command does not affect any of the event settings.

EXAMPLE:

**016701**

"Set S C D Unit On"

set scheduler on  
responds with new setting

#### **Scheduler Event Time**

Access: CONTROL

(cntl) (471) (event #) ; (hhmmMMDD)  
(cntl) (471) (event #) ; (hhmmd)

hh = hours in 24 hour format

mm = minutes

MM = month

DD = date

d = day of week (1 = sun, 2 = mon, etc...)

Response: "S C D Time" plus the time string

Wild cards are indicated in the response string as "W C".

The weekly event mode responds:

"S C D Time" plus time string, "D O W" plus day of week number.

The time and date parameters must include leading zeros for each parameter. The weekly event setting is specified by the (hhmmd) format. This format will set the event to occur at the same time on the same day of each week. With the exception of (d), any of the other parameters can be

replaced by (\*\*). Doing so specifies the wild card for that parameter -- only (\*\*) is valid as a wild card. This wild card system allows the user to specify any frequency of events from once a minute to once a year.

### **Scheduler Event Macro**

Access: CONTROL

(cntl) (474) (event #) ; (macro#)

Response: "S C D Operator" plus the (macro#)

If there is no macro assigned to an event, the scheduler will not perform any operation when the event time is reached.

### **Scheduler Event Enable**

Access: CONTROL

(cntl) (473) (event#) ; (on/off)

Response: "S C D On" or "S C D Off"

Event Enable allows the user to enable or disable a particular event without resetting any of the scheduler parameters. This command can be used inside a scheduler event macro to create "leap-frog" events. These events would turn on or off other events to meet special scheduling requirements. An example of this would be a scheduler event to reset the clock for day light savings time. If a scheduler event is programmed to set the clock to 1:00 am and that event occurs at 2:00 am, the scheduler system would get stuck in an infinite loop unless that same event macro was to execute Event Enable and deactivate itself. The event could be re-enabled in the spring by the event macro that sets the clock forward (this event does not need to deactivate itself, because it won't loop on itself).

Scheduler Example: For this example the user desires to set a "drive time" mode where the QSO time-out is 90 seconds, and the courtesy tone is changed. This mode would take effect between 6:30 to 9:00 and 16:00 to 18:00. The first step is to define a pair of macros, one to initiate the "drive time" mode, and one to return the repeater to the "normal" mode.

**01590**

macro enter mode

"M R O Enter"

**001**

speech off (no announce desired)

"M E"

**015100190**

set QSO time to 90 seconds

"M E"

**015500207**

port A courtesy tone = #7

"M E"

**0159231**

save to bank 3, number 1

"Complete"

**01590**

macro enter mode

"M R O Enter"

**001**

speech off (no announce desired)

"M E"  
**0151001180** set QSO time to 180 seconds  
 "M E"  
**015500202** port A courtesy tone = #2  
 "M E"  
**0159232** save to bank 3, number 2  
 "Complete"

Configure scheduler:

**00471010630\*\*\*\*** set event 1 for 6:30 am, every day  
 "Set S C D Time Six Thirty W C W C"  
**004740131** macro #31 initiates "drive time"  
 "Set S C D Operator Three One"  
**00473011** turn on event #1  
 "Set S C D On"  
**00471020900\*\*\*\*** set event 2 for 9:00 am, every day  
 "Set S C D Time Nine Oclock W C W C"  
**004740232** macro #32 terminates "drive time"  
 "Set S C D Operator Three Two"  
**00473021** turn on event #2  
 "Set S C D On"  
**00471031600\*\*\*\*** set event 3 for 4:00 pm, every day  
 "Set S C D Time Sixteen Oclock W C W C"  
**004740331** macro #31 initiates "drive time"  
 "Set S C D Operator Three One"  
**00473031** turn on event #3  
 "Set S C D On"  
**00471041800\*\*\*\*** set event 4 for 6:00 pm, every day  
 "Set S C D Time Eighteen Oclock W C W C"  
**004740432** macro #32 terminates "drive time"  
 "Set S C D Operator Three Two"  
**00473041** turn on event #4  
 "Set S C D On"

The user also decides that the "drive time" feature is not appropriate for Saturday and Sunday, so a pair of weekly events are used to turn the previous events off Friday at 18:01 and turn them back on Sunday at 18:01.

**01590** macro enter mode  
 "M R O Enter"  
**001** speech off (optional)  
 "M E"  
**00473010** turn off event #1  
 "M E"  
**00473020** turn off event #2  
 "M E"  
**00473030** turn off event #3

"M E"		
<b>00473040</b>	turn off event #4	
"M E"		
<b>0159233</b>		save to bank 3, number 3
"Complete"		
<b>01590</b>		macro enter mode
"M R O Enter"		
<b>001</b>		speech off (optional)
"M E"		
<b>00473011</b>	turn on event #1	
"M E"		
<b>00473021</b>	turn on event #2	
"M E"		
<b>00473031</b>	turn on event #3	
"M E"		
<b>00473041</b>	turn on event #4	
"M E"		
<b>0159234</b>		save to bank 3, number 4
"Complete"		
<b>004710518016</b>		set weekly event, Friday, 6:01 pm
"Set S C D Time Eighteen Oh One D O W Six"		
<b>004740533</b>		set event macro (events off)
"Set S C D Operator Three Three"		
<b>00474051</b>	turn on event	
"Set S C D On"		
<b>004710618011</b>		set weekly event, Sunday, 6:01pm
"Set S C D Time Eighteen Oh One D O W One"		
<b>004740634</b>		set event macro (events on)
"Set S C D Operator Three Four"		
<b>00474061</b>	turn on event	
"Set S C D On"		

## 5.9. I/O Interface Management

There are several I/O options that are supported by the FF-800 that allow the user to monitor and control "real-world" operations. Some of the interface options require an add-on board (like the FF-8070 Digital Voice Recorder, the FF-899 advanced radio interface, or the Doug Hall RBI-1) while others only require some simple installation steps. The interface connections were described in section 4 -- this section will describe the commands that deal with the various interface features.

There are four basic groups of I/O functions on the FF-800 that are directly available for user access: 1) the logic outputs, 2) the analog inputs, 3) the Serial Peripheral Interface bus (or SPI bus for short),



and 4) the command trigger inputs. The command trigger configuration commands are described in section 5.8.1 -- the remaining interface commands are described in the following sections.

### 5.9.1. Output Control

#### **Output Port Lock**

Access: CONFIGURATION

(cnfg) (513) (port#) ; (on/off)

Response: "M A I N" plus "Open" (unlocked) or "Closed" (locked)

"A U X" plus "Open" (unlocked) or "Closed" (locked)

The logic outputs on the FF-800 are controlled by user level commands. However, there may be situations where the control of an output port may be deemed a configuration command (such as a power control system). For these situations, the Output Port Lock command allows the sysop to require control level access before any of the output commands will function. The internal and external logic ports may be separately locked. If locked, the FF-800 must be in control un-lock before the port may be interrogated or modified.

#### **Output Control Local**

Access: GENERAL

{#18} (115) (output#) ; (on/off)

Response: "Out" (output#) "On" or "Off"

or user defined message + "On" or "Off"

The eight local outputs are those that are located at P5 on the FF-800 controller. These are distinguished from the eight external outputs which are obtained from user supplied shift registers attached to the SPI bus. The valid range for (output#) is from "1" to "8" -- (on/off) is "1" for on and "0" for off. Omitting the (on/off) parameter will interrogate the status of the output.

If the active level for an output is "Low", the response of "On" indicates that the output is conducting to ground. An active level setting of "High" means that the response of "On" indicates that output is in the high impedance state. See Set Output Level for details concerning the output levels.

#### **Output Control External**

Access: GENERAL

{#18} (115) (\*) (output#) ; (on/off)

Response: "Out" (output#) "On" or "Off"

or user defined message + "On" or "Off"

The eight external outputs are obtained from user supplied shift registers attached to the SPI bus. The valid range for (output#) is from "1" to "8" -- (on/off) is "1" for on and "0" for off. The active level for the external outputs is fixed as active high -- thus, a response of "On" indicates that the shift register output is a logic "1". Appendix A has schematics and specifications for the serial shift register outputs.

#### **Output Decimal to Binary**

Access: GENERAL

{#73} (166) ; (decimal#) internal, outputs 1 - 8  
 {#73} (166) \* ; (decimal#) external, outputs 11 - 18

Response: current port setting in decimal

This command allows a decimal value to be translated to an 8-bit binary value at the internal or external logic output ports. The (decimal#) parameter is a one to three digit number (0 to 255) that is directed to the selected output port as a binary value. All eight outputs on the selected port are affected.

### Output Decimal Width

Access: CONFIGURATION

(cnfg) (506) ; (n)

Response: "H E X W" + current setting

This command allows the sysop to set the width (in bits) of the Output Decimal command. The output is always right justified, which means that the lower numbered bits are enabled first. A setting of one bit enables output #1, a setting of 2 bits enables outputs 1 & 2, etc.... The value is stored in non-volatile memory, but is not a state variable.

### Output CTCSS to Binary

Access: GENERAL

{#72} (165) ; (tone#) internal, outputs 1 - 6  
 {#72} (165) \* ; (tone#) external, outputs 11 - 16

Response: selected tone frequency in Hz

This command allows the FF-800 to drive a CTCSS encode/decode IC or module (such as the FF-Tone). The (tone#) parameter is a two digit number taken from the table below that selects corresponding tone frequency. This command affects the lower six outputs of the selected port.

Tone (Hz)	tone#	Tone (Hz)	tone#	Tone (Hz)	tone#
no tone	00	118.8	17	218.1	34
67.0	01	123.0	18	225.7	35
71.9	02	127.3	19	233.6	36
74.4	03	131.8	20	241.8	37
77.0	04	136.5	21	250.3	38
79.7	05	141.3	22	69.3	39
82.5	06	146.2	23	159.8	40
85.4	07	151.4	24	183.5	41
88.5	08	156.7	25	189.9	42
91.5	09	162.2	26	196.6	43
94.8	10	167.9	27	199.5	44
97.4	11	173.8	28	206.5	45
100.0	12	179.9	29	229.1	46
103.5	13	186.2	30	254.1	47
107.2	14	192.8	31	no tone	48
110.9	15	203.5	32		
114.8	16	210.7	33		

**Output Pulse Local**

Access: GENERAL

{#33} (127) (output#) ; (count)

Response: "Out" (output#)  
or user defined message

The pulse command toggles the indicated output. This is useful for controlling devices that require pulse rather than "On" or "Off" control (for example, the up/down buttons on a remote base radio). The (count) specifies the number of pulses and can be from "1" to "99" -- omitting (count) will give one pulse. Usually, pulsed outputs require a certain "static level" ("On" or "Off") in which the output "rests" until it is pulsed. This "static level" is set by the user with the Set Local Output command. Once this level is set, the user should update the appropriate State so that this "static level" is remembered by the FF-800.

**Output Pulse External**

Access: GENERAL

{#33} (127) (\*) (output#) ; (count)

Response: "Out" (output#)  
or user defined message

The external outputs can be pulsed just as the local outputs. As with the local outputs, the user sets the static level for the appropriate output(s) using the Set External Output command.

**Output Pulse Timing**

Access: CONFIGURATION

(cnfg) (512) ; (pulse time)

Response: "P L T" plus (pulse time)

The user can set the pulse width of the pulse output commands using Set Pulse Timing. The pulse time is between "1" and "99" milliseconds and applies to all outputs. The user should be aware that large (pulse time) values may result in long execution delays for the Pulse Output commands. For example, 99 pulses at a pulse time of 99 milliseconds will result in a 9.8 second execution duration. This poses no problems to the operation of the FF-800 so long as the user is aware of the possible delay that may occur.

**Output Active Level**

Access: CONFIGURATION

(cnfg) (610) (output#) ; (on/off)

Response: "O L S" plus "High" or "Low"

The active level for any of the local outputs can be set by the user with this command. As before, the "on" parameter = 1 which indicates active "High" while the "off" parameter = "0" which indicates active "Low".

Examples:

<b>016105</b>	interrogate active level of #5
"O L S Low"	
<b>0161051</b>	set for active high
"Set O L S High"	
<b>1155</b>	interrogate output #5
"Out Five On"	
<b>11550</b>	turn off
"Set Out Five Off"	
<b>1275</b>	pulse once
"Out Five"	
<b>127550</b>	pulse 50 times
"Out Five"	
<b>115*5</b>	interrogate #15
"Out One Five Off"	
<b>115*51</b>	turn on
"Set Out One Five On"	

#### 5.9.2. BCD Frequency Control and the Doug Hall RBI-1

The FF-800 provides the user with the ability to control the frequency and offset settings of up to two "thumb wheel" type radios using user supplied shift register integrated circuits. Appendix A illustrates the circuit diagram for the BCD interface for none, one, and two radios. If the user desires to use the Doug Hall RBI-1 Kenwood radio interface, they must disable the external shift register support in order to configure the FF-800 to communicate with the RBI-1. This is done using the Set BCD Mode command. Thus, the user can not connect both a "thumb wheel" type interface AND an RBI-1 at the same time. It should be noted that the RBI-1 requires external logic to interface to the FF-800. This logic is supplied with the FF-800 chassis option in the form of an external adapter card. This adapter card is available separately for users who construct their own chassis, or the user can refer to appendix A for a circuit diagram of the RBI-1 interface logic.

In the "thumb wheel" mode, the only BCD command that is valid is the Set BCD Frequency command. This command sets the frequency and offset for either of the BCD channels. If the RBI-1 is enabled, the user has access to other commands that allow selection of CTCSS encode or decode, power setting, and support for future RBI-1 enhancements. The Set BCD Frequency is also used in RBI-1 mode to set the frequency of the Kenwood radio(s).

#### **RBI-1/BCD Mode**

Access: CONFIGURATION

(cnfg) (505) ; (mode)

Response: "B C D" plus (mode) number

There are four mode settings for the BCD interface:

(mode)	Description
0	BCD Off, only external outputs supported
1	1 BCD channel supported

2	2 BCD channels supported
3	RBI-1 interface supported

The user should note that the 8 external outputs are available in all modes (the RBI-1 supplies a connector for access to these outputs, refer to the RBI-1 manual for electrical specifications concerning these outputs). If only the user outputs are desired, the selection of (mode) = "0" means that the user need only supply one external shift register to obtain the desired outputs. See Appendix A for details on wiring any of the above BCD interface modes to external equipment.

### **RBI-1/BCD Frequency**

Access: GENERAL

{#09}	(106) ; (MKKKO)	set frequency, 1 BCD channel
	(106) (port number) ; (MKKKO)	set frequency, 2 BCD channels
	(106) ; (M..MKKKO)	Set frequency, RBI-1
	(106) (on/off)	radio power on/off control
	(106) (port number) ; (on/off)	radio power on/off control (2chan)

Response: responds with the frequency setting

#### **1 BCD channel:**

In the 1 channel mode, the (MKKKO) format specifies the (M)egahertz, (KKK)ilohertz, and (O)ffset selection. (O)ffset is specified as "1" = minus, "2" = simplex, and "3" = plus. All digits specified are required.

#### **2 BCD channels:**

This format is similar to the 1 channel mode except that the (port number) must be included to specify which channel is to be accessed. (port number) = "1" for port 1, and "2" for port 2.

#### **RBI-1:**

The RBI-1 format specifies the megahertz digits in a slightly different format from that of the 1 or 2 channel BCD modes. If only the 1 megahertz digit is entered (MKKKO as for the 1 or 2 channel modes) the current band is preserved and the frequency is updated accordingly. If the user desires to change bands, the entire frequency is entered (thus the M..MKKKO designation). The FF-800 automatically determines which band is desired and sends the appropriate information to the RBI-1. The "M..M" means that 2, 3, or 4 megahertz digits are entered depending on the band selected.

#### **All Modes:**

If the (MKKKO) or (M..MKKKO) are replaced with a single "1" or "0", the FF-800 will manipulate the power on settings for the appropriate radio. This allows the radio(s) to be powered off when not in use.

### **Set CTCSS Frequency (RBI-1)**

Access: GENERAL

{#51} (144) ; (frequency number) ; (\*)

Response: responds with the CTCSS frequency in hertz

This command is valid only when the FF-800 is configured for the RBI-1. The CTCSS frequency is entered as a frequency number from 1 to 38 to specify which of the standard CTCSS frequencies are desired. The (\*) at the end of the (frequency number) specifies read-back suppression. This allows the user to set a CTCSS tone without announcing it over the repeater. Suppressed tones will respond with "C T C S S" to indicate that a valid tone is programmed.

The table below illustrates the various (frequency number) values and their respective frequencies.

<u>Tone#</u>	<u>Freq.</u>	<u>Tone#</u>	<u>Freq.</u>	<u>Tone#</u>	<u>Freq.</u>
01	67.0	14	107.2	27	167.9
02	71.9	15	110.9	28	173.8
03	74.4	16	114.8	29	179.9
04	77.0	17	118.8	30	186.2
05	79.7	18	123.0	31	192.8
06	82.5	19	127.3	32	203.5
07	85.4	20	131.8	33	210.7
08	88.5	21	136.5	34	218.1
09	91.5	22	141.3	35	225.7
10	94.8	23	146.2	36	233.6
11	97.4	24	151.4	37	241.8
12	100.0	25	156.7	38	250.3
13	103.5	26	162.2		

#### **RBI-1 Power**

Access: GENERAL

{#59} (152) ; (pwr)

(pwr) = 0 for low, 1 for med, and 2 for high

Response: "High" or "M" or "Low" plus "Power"

This command is valid only when the FF-800 is configured for the RBI-1 and sets the current band to the selected transmit power setting.

#### **RBI-1 CTCSS Mode**

Access: GENERAL

{#52} (145) ; (mode)

Response: "C S E"

encode

"C S D"

encode and decode

"C S Off"

disabled

Once the CTCSS frequency has been selected, the user may then select which of three modes that is desired:

(mode)

Description

"0"

CTCSS encode and decode off

"1"

only enable encode option

"2"

enable both encode and decode

Examples:

**01505**

interrogate status of BCD output

"B C D Zero"

**015051**

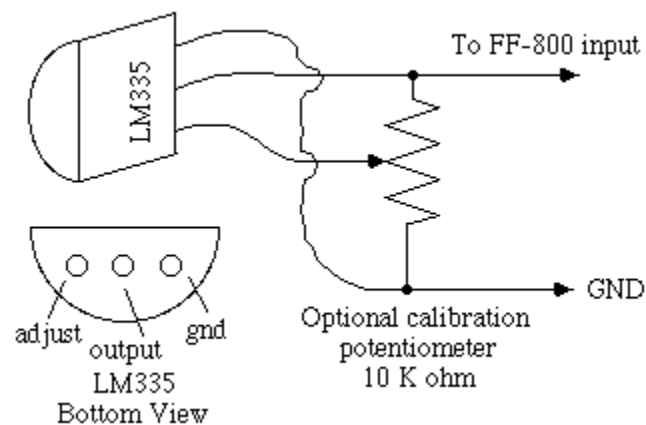
set for one BCD channel

"Set B C D One"

**10654501** set 145.450 (-)  
 "Five Point Four Five Minus"  
**015053** set for RBI-1  
 "Set B C D Three"  
**1061** turn on RBI-1  
 "R B I One On"  
**10612846001** set 1284.600 (-) on the RBI-1  
 "Twelve Eighty Four Point Six Zero Minus"  
**1064438253** set 443.825 (+)  
 "Four Forty Three Point Eight Two Five Plus"  
**10660002** set 446.000 (S)  
 "Four Forty Six Point Zero Zero S"  
**14425** set CTCSS frequency  
 "Set One Fifty Six Point Seven"  
**1451** set encode  
 "Set C S E"

### 5.9.3. Analog inputs

The FF-800 provides four analog inputs which can be used to measure any analog voltage in the range of 0 to 5 volts. There are several commands provided which allow specific functions (such as temperature and S-meter readings)



**Figure 5-18. LM335 temperature sensor circuit**

While section 4 describes the electrical requirements for the FF-800 analog inputs, the details of such connections have been delayed until this section. Before connecting any signal to the analog inputs, the user must first determine what they desire to measure with each input. If temperature is to be measured, the user simply needs to connect an LM335 temperature sensor as shown in Figure 5-18. The Read Temperature F and Read Temperature C commands can then be used to interrogate the temperature at the desired input (no configuration is required).

The standard accuracy for the LM335 is about +/- 2 degrees C due to the step size of the A/D converter.

### **Read Temperature F**

Access: GENERAL

{#15} (112) (input#)

Response: "The Temperature Is" plus temperature in degrees F  
or custom annunciator plus temperature in degrees F

### **Read Temperature C**

Access: GENERAL

{#16} (113) (input#)

Response: "The Temperature Is" plus temperature in degrees C  
or custom annunciator plus temperature in degrees C

Both commands behave in the same fashion and can be used at any time. They are designed to interpret the signal provided by an LM335 temperature sensor I.C. . If these commands specify an input that does not connect to an LM335 temperature sensor, they will return values based on the voltage that is present. The user must insure that the appropriate jumper(s) at JA through JD should be installed when using the LM335 sensors. When constructing sensor probes that will be used outdoors, the LM335 should be attached to a heat sink using a suitable thermal epoxy. This will help reduce self-heating effects that are present in the sensor as well as improve the thermal resistance from ambient to junction. Silicone RTV type sealant or other suitable moisture proofing compound should also be used at the electrical connections. Care should be exercised when applying the sealant -- too much sealant can insulate the LM335 and its heat sink (if used) and introduce potential errors into the sensor mechanism.

If the optional adjustment potentiometer is installed, the user should obtain a thermometer of known accuracy and adjust the pot until the reading from the FF-800 is in good agreement with that of the reference thermometer.

Probe placement is very important. Many probes are installed where they receive a great deal of direct sunlight during all or part of the day which can obviously distort readings. Also, many repeater sites consist of a building in the middle of a gravel or paved area -- the pavement or gravel will absorb and re-radiate a great deal of energy. These factors can cause your sensor to read too high in the afternoon and evening, or too low in the morning. Depending on the surrounding material and its proximity, this error can extend many hours after direct sunlight has ceased because of the stored heat in the immediate vicinity of the sensor. Any material that is good at storing heat (such as stone, brick, the earth, etc...) can cause any temperature sensor to read too high or low if it is in close proximity to the sensor probe.

To alleviate problems from "heat pollution", the probe should be installed as far away from other obstructions as possible (just as for a radio antenna). If possible, mount the probe ten or twenty feet up the tower with a reflective shield a few inches above to eliminate direct sunlight. Of course, the



longer the probe lead, the more susceptible the sensor may become to RFI. Be sure to use shielded cable and install bypass capacitors of 680 pF or 1500 pF across the temperature sensor output. The probe should be placed on the north side of the building or tower.

#### **S Meter Peak**

Access: GENERAL

{#44} (137) (input#)

Response: "S" plus reading

#### **S Meter Average**

Access: GENERAL

{#45} (138) (input#)

Response: "S" plus reading

These functions interpret the voltage present on the specified input in an S-meter format.

#### **S Meter Calibrate**

Access: CONFIGURATION

(cnfg) (605) (input#)

Response: "S Meter Adjust"

The S meter is calibrated by providing a full scale signal to the receiver in question, and entering this command (using the "#" delimiter if necessary). The FF-800 takes a sample of the signal and sets the calibration register accordingly.

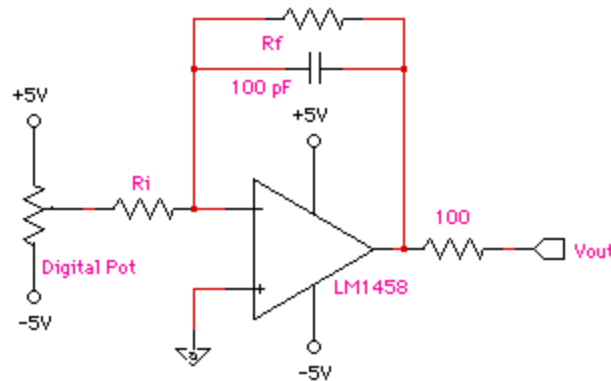
### 5.9.4. Digital Potentiometer Interface

The FF-800 provides two ways to allow the user to interface digital potentiometers into their repeater system. One way is on-board user pot via the connections that are provided at P22. This pot can be used just as a standard pot except that the voltage applied to any pin of the device can not exceed +/-5V. The second way that the user can interface digital pots is to add their own external devices using the DPOT communications bus that is also provided at P22. The following describes the various devices available:

Device types:	Resistance value:
DS1267-10	10K x 2 pots
DS1267-50	50K x 2 pots
DS1267-100	100K x 2 pots
Manufactured by:	
Dallas Semiconductor	(214) 450-0448
4401 South Beltwood Parkway	(800) 336-6933
Dallas, TX 75244-3292	

The user may order direct from Dallas, or contact FF Systems to obtain the desired devices. Up to five devices may be daisy chained to provide up to ten external digital pots for user control of any +/- 5V signal. Figure 4.9.4 illustrates a schematic diagram of the POT-EXP interface. The user should exercise care when installing the interface to avoid RFI problems. The DS1267 uses a synchronous data transfer format to set the digital pots -- it requires three control signals: Clock, Data, and Reset. These three signals should always be routed in a good quality shielded cable (even for short runs). In addition to these signals, the interface requires +12V and ground (the +5V and

-5V are derived on the POT-EXP card). If the user constructs their own card, they can obtain +/-5V from the power connector P1 (be sure to observe the current limitations). The POT-EXP expansion card is available from FF Systems to facilitate the installation of these external devices -- contact FF Systems for details.



**Figure 5-19. Resistance to voltage conversion circuit**

For those signals that exceed the +/- 5V limits for the digital pots, the user may be able to connect the pot to an op-amp circuit to convert the resistance to a voltage of up to +/- 15V. Of course, the resulting signal would only be useful if the control in question responds to voltage rather than resistance. The Spectrum repeater receiver is an example of this solution. The Spectrum receiver squelch control is a potentiometer that provides 0 to 9 volts to the squelch circuit to set the squelch threshold. Of course, the digital pots can only handle signals in the range +/-5V so the op-amp circuit of Figure 5-19 is used to convert a 0 to 5 volt pot output to a 0 to 10 volt op-amp output. The op-amp can then be connected to the spectrum squelch input (after disconnecting the existing pot) to allow the user to remotely control the receiver squelch setting. The values for Ri and Rf are selected by the following formula:

$$V_{out} = V_{pot} (R_f/R_i)$$

Where Vpot is the voltage at the arm of the digital pot for a given pot setting. For the Spectrum example, Rf = 20K and Ri = 10K to obtain a gain of 2. Also, the low pot terminal can connect to -5V or ground depending on the desired output voltage swing. The 100pF capacitor and the 100 ohm resistor are included to enhance the stability of the op-amp. These component values may be varied, or the components eliminated if desired.

#### **Level Set External**

Access: CONTROL

(cntl) (460) (pot#) ; (%setting)

Response:

The external pot settings are maintained in non-volatile memory, but they are not kept in the state variable area. Thus the settings are maintained during loss of power, but the current state has no affect on the settings.

#### 5.9.5. Local Autopatch Connector -- P24

The local autopatch connector provides direct audio connections to the FF-800 phone line interface. This path is intended for use with a future FF Systems back-bone linking controller. However, The signals provided at P24 are generic in nature and can be used to provide a telephone audio path for any application that the user desires. The 6 pin mini-DIN connector contains the following signals:



P24-1	GND
P24-2	Busy I/O
P24-3	Audio TO patch
P24-4	Ring detect (active low)
P24-5	Audio FROM patch
P24-6	Off Hook I/O (active low, 100 mA)

**Figure 5-20. Link patch I/O connector pin assignments**

Figure 5 -20 illustrates the pin layout for the 6 pin mini-DIN connector. The signals at P24-2 and P24-6 (Busy I/O and Off Hook I/O) are bi-directional signals. The user's interface should utilize open collector or open drain logic for these signals so that their interface can monitor the signal outputs when they are not active. The user's interface should not attempt to connect to the phone line when either of these signals are low -- also, both signals should be brought low when the interface is to connect to the phone line. If the FF-800 is connected to a shared phone line, the user's interface will have to provide a busy output to any other service(s) on the shared line.

#### 5.9.6. The FF-SPI Bus and Enhancement Interfaces

The FF SPI Bus is a five wire, synchronous communications bus that is designed to communicate with multiple, addressed slaves. In addition to sending status information to external interfaces, the FF SPI bus allows the user to send DTMF commands to any of the connected interfaces using the FF-800 DTMF decoder. This improves system reliability since the user does not have to make sure that multiple DTMF decoders are all functioning at the same audio input level. These commands are interface specific and the FF-800 does not interpret anything that is sent to the FF SPI bus -- the intended device receives, interprets, and responds to all input that it acquires.

Current interface support includes the FF-8070 Digital Voice Recorder (DVR), the FF-8090 ICOM IC-901 remote base interface, the FF-8900 FC-900/ICOM remote base interface, and the FF-899

generic remote base interface. A future release of the "SPI Application note #01" along with the FF-80x0 design kit will allow users with assembly language and microprocessor design experience to design and implement their own interface. The application note describes the bus protocols and bus architecture for the FF SPI bus and will be available free of charge to all FF Systems customers upon publication (contact FF Systems for price and availability of the FF-80x0 design kit).

Each interface comes with a manual which describes the installation and operation of the particular interface. The FF-800 has several commands that are used to send data to the interfaces. These commands are described below, the user should refer to the interface manual for details on configuring and operating any of the FF-800 interfaces.

**SPI Command** Access: GENERAL  
 {#32} (126) (addr) ; (command digits)  
 Response: see interface manual(s)

The FF-800 protocol supports up to 9 interface slots ( (addr) = 1 to 9) -- address "0" is reserved for FF-800 telemetry and is not accessible from this command. The (addr) parameter is required, but the (command digits) format is determined by the type of interface and the desired command.

The following list maps the allocation of device addresses:

Address	Device
1	FF Systems reserved address
2	not allocated
3	not allocated
4	FF-899 Generic remote base interface
5	FF-8090 IC-901 remote base interface (also FF-8900)
6	FF-8070 Digital Voice Recorder (main)
7	FF-8070 Digital Voice Recorder (auxiliary)
8	not allocated
9	not allocated

**SPI #4 Command** Access: GENERAL  
 {#34} (128) ; (command digits)  
**SPI #5 Command** Access: GENERAL  
 {#35} (129) ; (command digits)  
**SPI #6 Command** Access: GENERAL  
 {#36} (130) ; (command digits)  
**SPI #7 Command** Access: GENERAL  
 {#37} (131) ; (command digits)  
 Response: see respective interface manual(s)

These commands are similar to the SPI Command except that the (addr) parameter is fixed for each. This allows the user to have control over who can have access to individual interfaces. For example, it may be desirable to allow all repeater users to have access to the DVR, but the system operator(s) may wish to provide the FF-8090 commands on a "need to know" basis. by reserving the SPI

Command for system operators, the interface commands can be kept separate by using SPI #4 through SPI #7.

The **SPI #6 Command** also resets the control patch logon timer when issued over the control patch or user control patch. The timer is reset to two (2) minutes.

#### 5.9.7. The FF-8010 Display Interface

The chassis option for the FF-800 repeater controller includes an FF-8010 Display Interface card to display the input and output status of the FF-800 in real time. The front panel legend describes each LED. The enable LEDs indicate when a particular TX or RX port is active. COS signals are active ON, and all incoming COS signals are displayed (even if the respective RX port is disabled). In addition, the active COS (i.e., the highest priority COS) is indicated by a blinking enable LED. Outputs LEDs are ON when the respective output is conducting to ground. Thus, the COS LEDs indicate active level (based on COSLEV settings) whereas the output LEDs indicate when the FET drivers are conducting to ground (regardless of OUTLEV settings).

The display interface receives its display information via the display connector, P23, of the FF-800 and can be controlled by a DTMF command which allows the brightness to be varied, or the display can be extinguished. The user should refer to the Chassis Supplement or FF-8010 documentation for installation and maintenance information.

##### **Display Control**

Access: CONTROL

(cntl) (490) ; (mode)  
Response: "L E D High"  
          "L E D Low"  
          "L E D Off"

bright, (mode) = 2  
dim, (mode) = 1  
display off, (mode) = 0

The default status of the display is bright. Also, a lamp test is performed at reset which causes all LEDs on the display to flash on for about 250 milliseconds. The display status is stored in non-volatile memory, but it is not a state variable -- thus, the display mode will be remembered after a reset, but state changes will not effect the display mode.

Since the display communications are one way only (to the display), the FF-800 doesn't know if a display board is connected. Thus, this command will execute in a system that has no display, but it will have no effect.

#### 5.10. Serial Terminal Management

The serial terminal interface has some security and configuration commands that the user must access if a serial terminal is to be used. The following describes the configuration and control commands relating to the serial terminal interface.

##### **Baud Rate**

(cnfg) (538) ; (rate#)

Access: CONFIGURATION  
change occurs after reset

(cnfg) (538\*) ; (rate#) change is immediate  
Response: "S B R" plus baud rate

The FF-800 supports eight baud rates from 75 to 9600 baud. the following list correlates (rate#) with the appropriate baud rate:

(rate#)	Baud rate
1	9600
2	4800
3	2400
4	1200
5	600
6	300
7	150
8	75

**Modem On Line** Access: CONFIGURATION  
(cnfg) (536)  
Response: none

This command issues the "ATA" modem command via the serial port. This Hayes command causes a modem connected to the FF-800 serial port to go off hook in the answer mode. The user may program this modem control string via the DCECON command (Serial Terminal, see section 6). This command allows the user to call up on the control autopatch and still have "on-demand" access to the modem if desired. In order to take full advantage of this connect method, the user must route the telephone line first through the modem and then to the FF-800 phone line jack (see figure 4.10.1). The user's modem would be connected in a similar manner except that the device that follows the modem is the telephone from which the control autopatch would originate. This connection protocol allows each modem to go off hook and automatically disconnect the user's telephone and the FF-800 autopatch, respectively.

In addition to the phone line connection, the user must issue a couple of Hayes commands to allow their modem to go off hook in the originate mode without any call progress detection. The "ATX0" command disables the call progress detection (dial tone detect, ring detect, etc...) and must be entered before attempting to connect to the FF-800 modem. Once the call progress detection is disabled, the user issues the Modem On Line command via their telephone. When the FF-800 modem carrier is heard, the user types "ATD <enter>" at their terminal to initiate the connect sequence. At this point, the modem should respond "CONNECT". The FF-800 is ready to accept serial commands (see section 6 for details on using the serial terminal interface).

The user should note that the FF-800 is still in the control autopatch mode and this must be disabled before the modem connection is terminated. HANG (section 6) allows the user to de-activate the control autopatch from their serial terminal. However, the user may leave their phone off hook if they desire to return to the control autopatch after they have finished with the serial terminal (this only works if the modem automatically de-activates the connection to the "phone out" connector). After the user enters the "+++ ATH" sequence, the two modems will go on hook and the FF-800

will be reconnected to the phone line (as will the user's phone) -- control autopatch commands may then be entered at will.

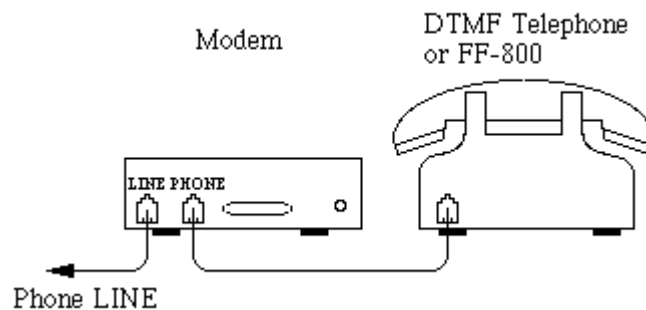
### Modem Up/Down

Access: CONFIGURATION

(cnfg) (535) ; (on/off)

Response: "O K"

There are two message assignments in the message data base that can be used to control the auto-answer status of a modem connected to the serial port of the FF-800. The default messages issue the Hayes standard commands "ATS0=0" for modem (off) and "ATS0=1" for modem = (on). If the user has a non-standard modem, or is using a TNC as a modem, the appropriate control strings can be entered and assigned by the user as desired. The DCEDN and DCEUP commands (Serial Terminal, see section 6) are used to view and/or program the modem (off) and (on) strings (respectively).



**Figure 5-21. Single line phone patch/modem connection**

Examples:

<b>01538</b>	interrogate baud rate
"S B R Ninety Six Hundred"	
<b>015383</b>	set 2400 baud
"Set S B R Twenty Four Hundred"	
<b>104</b>	execute warm reset
"F F Eight Hundred V x.xx ...."	
<b>015351</b>	set modem for auto answer
"O K"	

### DTMF Log Echo

Access: CONFIGURATION

(cnfg) (539) ; (on/off)

Response: "D T M F Echo" plus "On" or "Off"

If the DTMF log echo mode is activated, the FF-800 will echo all DTMF characters received to the serial port. The format is the same as the listing provided by LLOG (Section 6.7) and includes a date/time stamp with each entry. In order to eliminate interference from the serial terminal feature,

the log will only echo if the serial terminal interface is logged off. During logon, the echo is prohibited. This feature allows the DTMF log to be continuously saved to disk, or to an on-site printer for later reference.

### 5.11. Pager Functions

The FF-800 supports several pager functions that allow paging tones to either be initiated by a DTMF command, or embedded within a speech message (allowing a paging sequence to be sent along with the repeater ID, tail message, etc...). In addition to the following functions, the user should reference **[PAG]** in **Message Edit** (5.7.3) or **[PAG]** in **Message Enter** (6.5).

#### **DTMF Repeat**

Access: GENERAL

{43} (136) (Ton) (Toff) (digits)

Response: sends (digits) as DTMF signals on the repeater audio chain.

This command can be used as a simple DTMF paging command, or it can be embedded into a macro to allow macro based paging or remote control. (Ton) and (Toff) are single digits and specify the tone timing as follows:

digit	Ton or Toff time
0	40 ms
1	80 ms
2	160 ms
3	320 ms
4	640 ms
5	1.28 sec
6	2.56 sec
7	5.12 sec
8	7.68 sec

This geometric timing sequence provides a wide range of timing values that may be easily entered. A parametric macro may also be programmed which would allow the end user to key in digits with the timings pre-set:

{unlock to configuration level}

**01590**

"M R O Enter"

**01599**

designate parameter

"M E"

**13600**

dtmf w/ 80ms on/off timing

"M E"

**0159200**

"Complete"

The end user would simply enter "**1220123**" to send the digits "123" at the 40 ms timing.



**Page Two Tone**

Access: GENERAL

{60} (153) (reed#1) (reed#2) standard 2-tone page

{60} (153) (reed#1) group page mode

Response: sends the paging sequence which corresponds to (reed#1) and (reed#2)

(reed#) are obtained from the chart of Table 5-1 and represent the two low digits of the Motorola standard reed codes. Gaps in the reed code pattern have been filled in with other standard paging frequencies -- selection of these reed codes will result in the specified frequency (which is not Motorola standard).

The paging commands will activate any enabled TX PTT output during the page sequence That has auxiliary interrogate enabled (see **TR Mode**). This allows the page to be transmitted to link or remote base ports where aux. interrogate allows.

Group 1		Group 2		Group 3		Group 4		Group 5		Group 6	
<u>reed#</u>	<u>Freq</u>	<u>reed#</u>	<u>Freq</u>	<u>reed#</u>	<u>Freq</u>	<u>reed#</u>	<u>Freq</u>	<u>reed#</u>	<u>Freq</u>	<u>reed#</u>	<u>Freq</u>
110	330.5	120	569.1	138	288.5	140	321.7	150	553.9	190	1122.5
111	349	121	600.9	108	296.5	141	339.6	151	584.8	191	1153.4
112	368.5	122	634.5	139	304.7	142	358.6	152	617.4	192	1185.2
113	389	123	668.9	109	313	143	378.6	153	651.9	193	1217.3
114	410.8	124	707.3	160	953.7	144	399.8	154	688.3	194	1251.4
115	433.7	125	746.8	130	979.9	145	422.1	155	726.8	195	1285.8
116	457.9	126	788.5	161	1006.9	146	445.7	156	767.4	196	1321.2
117	483.5	127	832.5	131	1034.7	147	470.5	157	810.2	197	1357.6
118	510.5	128	879	162	1063.2	148	496.8	158	855.5	198	1395
119	539	129	928.1	189	1092.4	149	524.6	159	903.2	199	1433.4

**Table 5-1. Motorola reed# vs frequency****Pager Mem. Exec.**

Access: GENERAL

{#70} (163) (slot#) normal memory page

response: sends page sequence in selected slot

(163) (msg#) (slot#) post-page message mode

response: sends page sequence in selected slot followed by the system message at (msg#)

This command allows a user to select for transmission any of the 64 paging sequences that can be stored in the pager memory array. (slot#) = 00 through 63 and must have two digits. If the selected memory is empty, there is no response. The memory concept allows users to be referenced by a slot number rather than reed codes. If the post-page message format is used, a pre-programmed message may be sent after the page sequence. This is useful for automatic or control-patch generated pages to announce the purpose of the page. (msg#) can range from 00 to 99.

**Pager Mem. Alias**

Access: GENERAL

{#71} (164) (alias#)

normal alias page

response: sends page sequence in selected slot

(164) (msg#) (alias#)

post-page message mode

response: sends page sequence in selected slot followed by the system message at (msg#)

This command is similar to Pager Mem. Exec. except that it allows the slot number to be replaced by a 2 or three digit "alias" number. The (alias#) is programmed by the sysop and has no pre-defined relationship to the actual slot number that contains the page sequence. One use for this command is to make the (alias#) the same as a persons speed call number to make the number easier to remember. If the post-page message format is used, a pre-programmed message may be sent after the page sequence. This is useful for automatic or control-patch generated pages to annunciate the purpose of the page. (msg#) can range from 00 to 99.

**Pager Mem. Program**

Access: CONFIGURATION

(cnfg) (650) (slot#) (page data)

response: "Automatic Alert"

Pager memories are entered using this command. All parameters are required and only two paging formats are supported by revision 2.13: Motorola 1+1 and Motorola 1+1 group. (slot#) is the two digit slot number (00 - 63) and the (page data) represents the reed codes to be entered into the slot. If two digits are used for (page data), then a group page is indicated. Otherwise, (page data) should be four digits representing the "A" and "B" reed codes.

**Pager Alias Program**

Access: CONFIGURATION

(cnfg) (651) (slot#) (alias#)

response: "Alternate Automatic Alert"

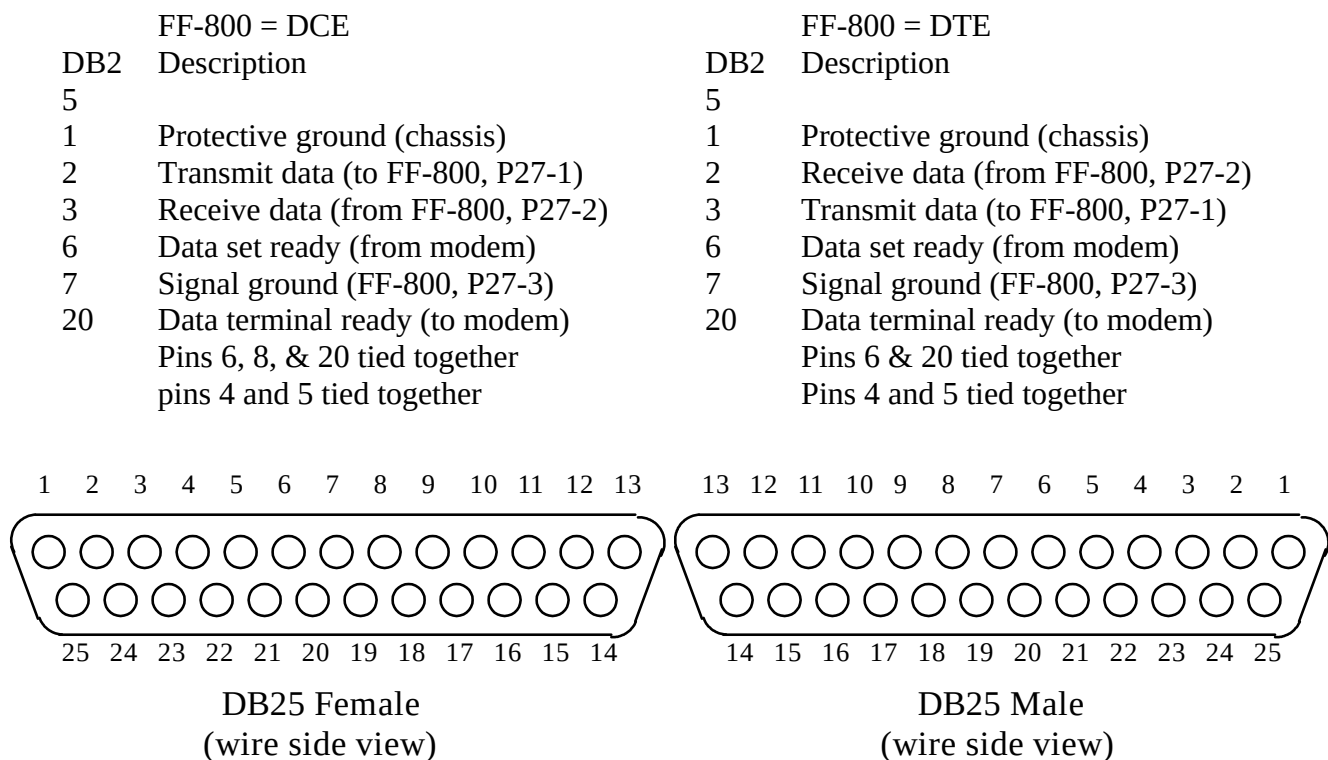
After a pager memory slot has been programmed it may be "named" with an alias number for use with the **Pager Mem Alias** command. The (alias#) must be two or three digits (the FF-800 translates 2 digit alias numbers into three digits by adding a "0" to the beginning of the two digit number. Thus, "23" and "023" are the same alias number). If multiple slots have the same (alias#), the lowest numbered slot will have priority.

## 6. Serial Port Commands

The FF-800 serial terminal interface (located at P27) allows the user to connect to the FF-800 via an RS-232 communications link to issue commands and check the status of the controller. This connection can be on site, or remote via a modem or TNC. Several configuration options are available to allow the user to control the baud rate and access privileges to the serial interface. This section describes the connection and operation of the serial terminal interface.

### Hardware rev G and earlier

For PC board revisions G and earlier, the RS-232 connection to the FF-800 is via a 3 pin Molex connector. This required a user supplied interface cable to connect to a DB-25 to allow the connection of a PC or modem via an industry standard cable. Figure 6 -22 illustrates the two wiring options available. If the user is to direct connect a terminal or computer to the FF-800, a female DB-25 is used and is wired as a DCE (Data Communications Equipment) as shown in Figure 6 -22a. If a modem or TNC is to be used to allow remote access, a male DB-25 is used and the FF-800 is wired as a DTE (Data Terminal Equipment) as shown in Figure 6 -22b.



**Figure 6-22. (a) Factory Wiring for PC connection. (b) wiring for direct modem connection**

### Hardware rev H and later

PCB revision H and later controllers may be ordered with the option of using dual row ribbon cables for most of the system connectors. This allows standard DB-9 and DB-25 crimp connectors to be

used for completely solderless chassis wiring. For those controllers which have the ribbon connector option, the RS-232 connector at P27 is a 16 pin dual row connector which can be attached to a DB-25 female crimp connector (pins 9-13 and 17-14 are not terminated). This connector in combination with the on-board jumpers for pins 4-5, and 6-8-20 provides the wiring configuration shown in Figure 6 -22a. To connect to a modem, use a null modem adapter and a standard serial cable.

The factory default communications parameters are as follows:

Baud rate:	9600
*Word length:	8 bits
*Parity:	none
*Stop bits:	1
Duplex:	full

\* = can not be user modified

In addition, the user can select XON/XOFF flow control if needed and the FF-800 can be configured to send a <CR> only or <CR>/<LF> to meet the requirements of the particular terminal/program used for the serial interface.

There are several configuration options that the user must take into account if they are going to use a modem or TNC to communicate with the FF-800. The Serial Port Connect Type command is used to tell the FF-800 that the modem shares the same phone line as the autopatch. This command allows the FF-800 to determine if the phone line is busy with modem traffic without having to wire into the phone line busy input (P8-6 and P8-7). The connect mode should be set to direct for TNC, direct terminal, or modem connections that use a separate telephone line.

TNC users should be very concerned about security. Because the TNC transmits over an open medium, all remote control via the serial port must be considered open information. This includes passwords, speed dial numbers, DTMF log inquiries, etc... . However, the TNC approach is attractive to those users who can not use a phone modem.

The commands that are available on the serial port are fundamentally different from those available to the DTMF ports. Even so, the command structure is similar to that of the DTMF ports, each command has a command prefix followed by any data parameters associated with the desired operation. However, the commands and data are usually expressed in terms of text names for commands and data rather than a series of DTMF codes and each parameter or keyword must be separated by a space character to allow the FF-800 to differentiate between each parameter "word". This makes the serial port commands somewhat easier to use and remember. Also, the serial port can support help commands and commands which provide detailed parameter read-outs that can be logged to disk for later examination or archive storage.

The format for this listing is similar to that of the DTMF codes. However, here the keyword is also the actual command that is entered by the user. Also, the entire keyword is not required; for most commands, only the first 1 to 3 characters of the keyword are required (the minimum required keyword is indicated below the full keyword), the remaining characters are optional. Parameters are listed in parenthesis with semicolons separating optional data -- the semicolons are not part of the

command input and are included in this manual only to identify optional parameters. (on/off) data is more versatile on the serial port, the following lists all valid (on/off) representations:

"ON":	1	"OFF":	0
	YES		NO
	TRUE		FALSE
	ON		OFF

Any of these "words" will be accepted where (on/off) data is requested. Parameters are separated by spaces and numeric values do not need leading zeros. <cntl-x> will cancel the current line and <backspace> may be used to delete erroneous characters from the current command line. Once the command has been entered with the appropriate parameters, the <enter> or <return> key (ASCII 13 decimal) is used to allow the FF-800 to process the entry. The <cntl-X> or <backspace> keys are both valid until the <enter> key is pressed.

## 6.1. Terminal Configuration and Support

### Security Logon

#### **LOGON** (password)

Enables serial command access. This allows the FF-800 to accept commands via the port and is a security device to limit access to authorized individuals only. The default access code is "FF800" and can be changed using the **PASSET** command.

The FF-800 logon command requires a user defined password which allows access via the serial port to be restricted to authorized users only. The FF-800 will send a power on message to the serial port at the current default baud rate which provides the user with a means of immediately identifying that the serial port is viable on reset. However, the FF-800 will not respond to any input until the **LOGON** command has been entered with the proper password. Once the logon code and password are entered, the FF-800 responds with the startup message and the command prompt (>) is displayed. The serial port is now ready to accept commands.

The logon activates a timer that allows user access for up to 5 minutes. Just as for the control and configuration security timers, the serial port logon timer will reset after each valid command. If no commands are entered, the logon timer will eventually reach zero and the serial port will be automatically logged off. There is no indication for the logoff except that the FF-800 will no longer respond to input from the serial port (until the LOGON command is re-entered).

### Logoff Serial Port Access

#### **LOGOFF**

##### **L**

This command clears the serial port security timer and prevents any further command access until the LOGON command is issued. Logoff is also executed if the following are entered as commands: **NO** or **+++NO**.

## Password Set

### **PASSET** (password)

This command sets the password required to login to the serial port. An interlock mechanism requires that the password be entered twice to be accepted. The (password) must be identical for both entries and those entries must be within 30 seconds of each other. If the second entry is delayed by longer than 30 seconds, the first entry is discarded and the process begins again. On the first pass, the response to this command is "Password Armed -- repeat to verify". If the command is repeated in the specified 30 seconds, and the second (password) matches the first, the response is: "New Password Accepted" and the new password is programmed into the system.

#### Examples:

```
>PASSET  CAPITAN
Password Armed -- repeat to verify
>PASSET CAPITAN
New Password Accepted
>

>PASSET FORMAT
Password Armed -- repeat to verify
>PASSET CAPITAN
New Password REJECTED
>
```

## Site Name Enter

### **SITNAM** (site name)

This is part of the logon message, it is useful for users who maintain several FF-800s at the same or different sites -- it helps identify the unit via the serial port at logon. The (site name) entry may be up to 19 characters (single line only).

## Serial Port Duplex Mode (echo)

### **DUPLEX** ; (on/off)

#### **DU**

With DUPLEX on, the FF-800 will echo back all printable characters when the logon timer is non-zero (when the logon timer expires, no input is echoed). Turning DUPLEX off prevents the FF-800 from echoing characters during logon. The Serial Terminal output is not affected and the command responses display normally. This command is especially useful when a TNC is used to perform remote operations using the Serial Terminal port.

## Serial Port Handshake Mode

### **HANDS** ; (on/off)

#### **H**

Sets the status of XON/XOFF flow control. Flow control is useful when using a PC terminal program to log data. Some terminal programs can loose serial data when writing to disk -- using XON/XOFF flow control allows the PC program to temporarily halt data from the FF-800 and then re-start the data flow when the program can again accept incoming data.

## Line Feed Mode

**LF** ; (on/off)

When this function is "on", each <CR> sent by the FF-800 will be followed by a <LF> character. If terminal or terminal program fails to advance any displayed lines, this must be turned on. If lines are double spaced, this command should be turned off.

## 6.2. Modem/TNC Support Commands

### Serial Port Connect Type

**SCIC** ; (type)

**SC** Establishes serial connection type.

(type): 0=direct connect, 1=modem (shared), 2=TNC or modem (separate)

If the modem (shared) type is selected, and the serial port is logged on, the FF-800 will restrict autopatch access. This mode is used if the autopatch phone line is shared with the modem. Modem (separate) is used with a modem that has a separate phone line or when connecting to a TNC

### Modem Escape Character

**ESCAP** ; character

**ES**

This command sets the character that is to be sent as an escape sequence to be directed at an attached modem. The escape sequence is indicated by the <esc> character (ASCII 27 decimal) in any modem control string (see below). When the FF-800 encounters an <esc> character in an output string, it replaces the escape with three occurrences of the **ESCAP** character. Most modems require a delay after the escape sequence before recognizing the escape -- on the FF-800, delays are introduced with the <cntl>-<D> character (ASCII 04 decimal) -- this character is replaced with a 3 second delay when encountered in an output string. It should be noted that the <esc> and <cntl>-<D> characters do not echo when entered from the terminal, however, they are displayed by the modem string edit commands: **MODEM**, **DCEUP**, **DCEDN**, and **DCECON**.

### Modem Initialize String

**MODEM** ; modem control string

**MO**

This command allows the entry/interrogation of the modem initialize string. This string is sent by the FF-800 at reset if SCIC = 1 or 2 (modem or TNC). It is useful for placing the modem in a known state when the FF-800 is activated or reset for any reason. If SCIC = 0 (direct) this string has no effect. The <esc> and <cntl>-<D> characters are used to place escape sequences and delays in the initialize string. This string is limited to 30 characters and can not have embedded carriage returns (ASCII 13 decimal). The default string is: "<esc> <delay> ATS0=0 H" and will set a Hayes style modem to never answer and hang-up if connected.

### Modem ON-LINE String

**DCEUP** ; modem control string

**DCEU**

This string is sent to the modem anytime the Modem Up/Down command (DTMF, Configuration) is used to turn the modem on (up). This string is limited to 18 characters and can not have embedded carriage returns (ASCII 13 decimal). The default string is: "ATS0=1".

Modem OFF-LINE String

**DCEDN** ; modem control string

**DCED**

This string is sent to the modem anytime the Modem Up/Down command (DTMF, Configuration) is used to turn the modem off (down). This string is limited to 18 characters and can not have embedded carriage returns (ASCII 13 decimal). The default string is: "ATS0=0".

Modem Connect String

**DCECON** ; modem control string

**DCEC**

This string is sent to the modem anytime the Modem On Line command (DTMF, Configuration) is used. This string is limited to 18 characters and can not have embedded carriage returns (ASCII 13 decimal). The default string is: "ATA".

### 6.3. Help Commands

Help Listing

**?**

Lists all command names available to the serial port.

Word List Help

**WORDS**

**W**

Lists all speech words available to the FF-800. <cntl> <W> will abort the listing. Each word is listed with its corresponding word number.

### 6.4. Autopatch and Speed dial Support

Control Autopatch Disconnect

**HANG**

Causes the auto patch to hang up. Used after Modem On Line (section 5.10) to disconnect control autopatch. If this command is not issued, the FF-800 will keep the phone off hook until the control autopatch times out.

Speed Dial List

**SDLIST** (bank) ; (start) ; (stop)

**SDL**

Lists all non-empty speed dial slots in the indicated bank (including the emergency slots in bank 1). (start) and (stop) can be used to limit the list to a specified range. both (start) and (stop) are valid from 0 to 99. This command provides a quick way to view the speed dial data base and obtain the status of each slot.



Speed Dial Program/Clear

**SDSET** (bank) (slot) ; (number)

**SD**

Stores (number) into the speed dial (slot) (slot = 0 - 99). If (number) is omitted, this command will interrogate the current status of the speed dial slot.

Clear Speed Dial Slot

**SDSET** (bank) (slot) (0)

**SDC**

Erases the speed dial (slot).

Autopatch Dial Prefix Mode

**APREF** ; (on/off)

**A**

Controls status of autopatch dial prefix. If no dial prefix is needed, this should be off. See

**DIALPFX** to set the prefix to the desired series of digits that the PBX requires to grant an outside line (this is usually a single "9", but some systems may require a different sequence).

Autopatch Lock-In list add

**ADDIN** (number)

**ADDI**

Autopatch Lock-In list delete

**DELIN** (number)

**DELI**

Autopatch Lock-In list interrogate

**LOCKIN**

**LOCKI**

Autopatch Lock-Out list add

**ADDOUT** (number)

**ADDO**

Autopatch Lock-Out list delete

**DELOUT** (number)

**DELO**

Autopatch Lock-Out list interrogate

**LOCKOUT**

**LOCKO**

This suite of commands is used to access the autopatch phone number control system for the FF-800. This system allows the repeater owner to set up autopatch phone number restrictions to meet their individual application. The system has two lists: Lock-In and Lock-Out -- each list can contain up to 84 digits. The Lock-Out list contains phone numbers (or prefixes) that are prohibited. The Lock-In list is actually an "exceptions" list of numbers (or prefixes) that are allowed even though the

number failed the Lock-Out test. Prefixes are entered by using the "?" as a terminating wild-card character. Thus to limit "900" prefixes, the Lock-Out entry would be "1900?".

The Lock-In list would be useful in the following example: The repeater owner wishes to restrict toll calls but allow "800" calls:

```
>ADDOUT 0?
Phone Lock OUT table
1: 0?
>ADDO 1?
Phone Lock OUT table
1: 0?
2: 1?
>ADDIN 1800?
Phone Lock IN table
1: 1800?
>
```

Thus, any number that begins with "1" or "0" will be prohibited unless it is a "1800" number.

## 6.5. Message Support

There are two activities that affect messages. Messages can be assigned or turned on and off, and messages can be edited or created. It is important to note that many of the factory default messages are stored in system ROM and can not be edited. In order to input your custom message you must re-assign the default message to one of the user editable messages. Then the new message may be entered as desired.

### 6.5.1. Text Message Entry and Special Phrase Words

There are several serial commands for entering/interrogating text messages. The user editable system messages are in a "data base" of 100 messages, each of which can be up to 15 words long. The messages are numbered from 00 to 99 and can be assigned any meaning desired by the user. While messages can be intermixed in any order, the user is encouraged to organize the messages into functional groups -- i.e., a group for ID bulletins, another for tail messages, and so on. Once the messages are defined and entered, the DTMF Message Assign command (Section 5.7) is used to assign a message number to a particular function. Refer to the DTMF function section for details on this part of the message entry process.

Words, as well as individual letters, must be separated by spaces. The FF-800 responds with the parsed string. Invalid words result in the "\_" character being displayed for the word that is in error. The "\_" character is a NULL word (i.e., it says nothing).

Example:

```
>MESS 0 THE EXCITING 1
THE _ 1
>
```

{\_ = invalid word}

### SPECIAL CHARACTERS:

The following list special characters or sequences of characters that are used for special functions.

- A "-" character as the first character of a message will force the message to be sent as cw not voice.
- The "," is used to enter a pause into the speech. Each "," causes the speech to pause for 0.5 sec.
- A quote can be used to force a word to process as individual letters. The processing continues until the first non-alpha numeric character is encountered (this includes spaces). Valid quotes are single front ('), single back (`), and double ("). example:

```
>CALL 'KEOFF
K E O F F
>
>BB1 THIS IS THE MEGA 'ARC ,
THIS IS THE MEGA A R C ,
>
```

There are several special phrase words that can be used inside text messages. These are listed below:

<u>Phrase syntax</u>	<u>Description</u>
<b>[CW]</b> (tone) (speed)	Causes remainder of message to be sent as CW at the indicated tone and speed. (tone) is in Hz, (speed) is in W.P.M.
-	Dash, this phrase command is the same as [CW] except that the (freq) and (speed) values are taken from the system defaults.
<b>[SP]</b>	Return from CW interpreter. Only valid if [CW] previously encountered in same message.
<b>[ID]</b>	Send contents of <b>CALL</b> string.
<b>[S]</b>	Salutation (i.e., "GOOD MORNING", or "GOOD AFTERNOON") in female voice based on the current time of day. Morning = 00:00:00 to 11:59:59; Afternoon = 12:00:00 to 17:59:59; and Evening = 18:00:00 to 23:59:59.
<b>[T]</b>	Time of day in 12 hour format (female voice).
<b>[D]</b>	Month and Date in female voice (numeric format only).
<b>[Y]</b>	Year in tens and ones (male voice).
<b>[TC]</b> (n)	Temperature of input (n) in degrees Celsius.
<b>[TF]</b> (n)	Temperature of input (n) in degrees Fahrenheit.
<b>[SPI]</b> (addr)(nn)	Sends play track# (nn) command to digital voice recorder at peripheral address (addr).
<b>[SPI] S</b>	When entered into an ID bulletin, this sequence causes the following ID to be suppressed. This is used if an ID bulletin contains the legal ID (esp. useful for DVR IDs placed in ID bulletins).
<b>[PAG]</b> (#1) (#2)	Sends Motorola Two Tone page signal using the reed codes for tone (#1) and tone #2).
<b>[OUT]</b> (out) (c)	Causes logic output number (out) to be set ((c) = 1) or clear ((c) = 0).
<b>[POZ]</b>	Causes speech synthesizer to halt until a logic "0" is detected at input #4 (P7-9). Used as a device busy input for external playback unit. The [OUT] [POZ] combination can be used to trigger an external playback unit to send a message as part of an FF-800 message.
<b>[CT]</b> (ct#)	Sends (ct#). (ct#) = 0 - 15.
<b>[LEV]</b> (level%)	Local speech/tone level adjust. This allows the speech/tone level to be

### Phrase syntax

### Description

increased or decreased for all or part of a particular message. The original setting is not affected and is restored at the end of the message. Comma, this is the speech pause command. Each comma provides 0.5 seconds of delay.

## 6.5.2. Message Edit Commands

### Repeater Callsign

**CALL** ; callsign

**CA**

Sets or interrogates the repeater callsign. The callsign is referenced by the [ID] word phrase (word code number 11). Omitting the callsign interrogates the current setting

### System Message Edit

**MESSAGE** slot# ; message-text

**ME**

Sets or interrogates the message at the indicated slot#. slot# is in the range of 0 thru 99. Omitting the message-text interrogates the current setting.

### Speed-Dial Message Edit

**SDMESSAGE** slot# ; message-text

**SD**

Sets or interrogates the speed-dial message at the indicated slot#. slot# is in the range of 10 thru 249. Omitting the message-text interrogates the current setting. The slot# maps to the speed dial number by the following table:

<u>Slot#</u>	<u>Speed-Dial bank</u>
"10-99"	bank1
"100-199"	bank2
"200-239"	bank3
"240-249"	bank4

### Autopatch Dial Prefix Edit

**DIALPFX** ; prefix digits

**DI**

Sets or interrogates the current Autopatch dial prefix (if enabled by APREF). Up to 6 digits can be entered, or the current setting is interrogated by omitting the prefix digits.

## 6.5.3. Message Control

### Bulletin Enable/Disable

**BBSSET** ; (bb#) (on/off) ; ...

**BBS** (bb#) = 1 - 8.

Several bb's can be listed as parameters and the FF-800 process them in the order listed.

### Examples:

```
user entry --> >BBS 1 ON 2 YES 3 FALSE 4 NO <cr>
response -> BB Status:
```

```

1: ON
2: ON
3: OFF
4: OFF
5: OFF
6: OFF
7: OFF
8: OFF
>BBS 1 OFF
BB Status:
1: OFF
these are --> 2: x
left at their 3: x
previous 4: x
value         5: x
              6: x
              7: x
              8: x
              >

```

#### Tail Message Enable/Disable

**TALSET** ; (tail#) (on/off)

#### TALS

Enables the indicated tail messages. The interrogate response includes all tail messages.

#### Example:

```

user entry --> >TALS 1 ON 2 YES 3 FALSE 4 NO <cr>
response ->    TAIL Message Status:
              1: ON
              2: ON
              3: OFF
              4: OFF
              5: OFF
              6: OFF
              7: OFF
              8: OFF

```

#### Message Assignment List Interrogate

**ASSIGN** ; range

#### AS

The status of the Message Assign (DTMF, Configuration) data base can be listed using this command. If the range parameter is omitted, only the first item will be listed. the range parameter consists of the assignment that is to be listed first, followed by a dash (-) followed by the last assignment number to be listed (the last valid function number is 90). Omitting the dash (-) will list only the first assignment number entered. The listing also displays the contents of the assigned message. The following example illustrates the ASSIGN command:

```

>ASSIGN
List Message Assignments:

```

```

func#  msg#  message
00:    OFF   EMERG 1
>AS 1-2
List Message Assignments:
func#  msg#  message
01:    OFF   EMERG 2
02:    11    FIRE EMERG [PAG]   10   19
>

```

## 6.6. Courtesy Tone Edit and Support

Courtesy Tone Enter

**CTENT** ; (duration) (freq1) (freq2) (%gain) (envelope) (FXrate) (sweep)

**CT**

<u>Parameter</u>	<u>Description</u>
(duration)	length of the sub-tone in milliseconds (0 - 2540)
(freq)	frequency of subtones 1 and 2 in Hz (0 - 2550)
(%gain)	relative amplitude of sub-tone in % (0 - 99)
(envelope)	Amplitude envelope, (+) for attack, (-) for decay, or blank for steady amplitude
(FXrate)	is a relative number that relates the rate of change in the envelope or sweep effect. Small numbers (5 - 10) give slow changing effects, while larger numbers (80 - 90) give faster effects.
(sweep)	(+) for frequency sweep up, (-) for frequency sweep down, or blank for no sweep. Subsequent sub-tones are entered on the same line. The response to this command is to list the CT elements.

This command is used to add elements to the courtesy tone edit buffer. Each element adds a new part to the tone in the buffer. The CT Test command (section 5.6) is used to test the tone in the edit buffer. Refer to section 5.6 for more information on the various tone parameters.

Courtesy Tone Delete

**DELETE** (element #)

**DEL**

Deletes the indicated element from the edit buffer.

Courtesy Tone Transfer to the Edit Buffer

**CTGET** (ct#) (ct# = 0 - 7)

**CTG**

Transfers the indicated courtesy tone from internal storage to the edit buffer. The original tone is not affected. This command is useful for retrieving a courtesy tone that is to be modified, or used as the basis for a different tone.

Courtesy Tone Store From Edit Buffer

**CTSTOR** (ct#) (ct# = 0 - 7)

**CTS**

Stores the tone currently in the edit buffer to the desired (ct#). The edit buffer is unchanged and the tone remains available for editing.

#### Courtesy Tone Assign

**CTSEL** ; (r) (ct#)

**CTSE**

Courtesy tone assign. Assigns (ct#) to rx input (r).

(r = 01 - 11) are as follows:

<u>All remote base off</u>	<u>Any remote base RX or TX</u>
1: RXL	7: RXL
2: RXA	8: RXA
3: RXB	9: RXB
4: RXC	10: RXC
5: RXD	11: RXD
6: rb=tx indicate	

The tone for (r) = 6 is used to indicate when any remote base is in transmit -- this tone is sent immediately after loss of COS when. (ct# = 0 - 15) can be assigned independently to any of the above receiver inputs (see section 5.6, CT Allocate for more information on courtesy tone assignments).

#### Voter Courtesy Tone Assign

**VCTSEL** ; (voter rx#) (ct#)

**VCTSE**

Voter courtesy tone assign. Assigns (ct#) to voter rx input (r). These assignments are valid for the port assigned to the voter. When this port (see Voter Port Assign, DTMF, Configuration) experiences a loss of COS, these assignments are used to identify the active receiver for the last transmission.

(voter rx#) = 1 - 8

- 1: voter #1
- 2: voter #2
- 3: voter #3
- 4: voter #4
- 5: voter #5
- 6: voter #6
- 7: voter #7
- 8: voter #8

#### DTMF Cover Tone Mode

**COVER** ; (on/off) ; (mode)

**CO**

Sets cover tone mode. (mode): "1" = steady beeps (1 beep/sec); "2" = individual beeps, "3" = no beeps (mute on), and "4" = no beeps, no mute.

#### CW Frequency (global)

**CWFR** ; (f)

**CWF**

Sets the default frequency of CW characters. (f) = 0 - 2550 Hz.

CW Speed (global)

**CWSP** ; (wpm)

**CWSP**

Sets the default speed of CW characters. (wpm) = 1 - 40.

## 6.7. Miscellaneous Support Functions

Reset Controller

**RESET** 800

**R**

Performs a soft reset. The "800" parameter is a required interlock to prevent inadvertent access of this command -- if the "800" parameter is omitted, the command is ignored.

Version Interrogate

**VERSION**

**VER**

The firmware revision and product serial numbers are listed as a result of this command.

Control RX Simulate

**CRX** (DTMF codes)

**CR**

The DTMF codes entered as (DTMF codes) are passed internally to the control receiver firmware where they are processed as though they were entered into the control receiver port (regardless of whether there is a control receiver present). The FF-800 will respond by engaging the repeater PTT signals and announcing the response for the indicated command. If there is no response, or the command specified by (DTMF codes) is invalid, there is no response given. Spaces inside the DTMF sequence are ignored.

Display COS/PTT Status

**DIS1**

This command displays the current status of the COS, and PTT signals. It is not a continuous update readout, and shows a snapshot status only.

	<cLABCDii>		<LrbpDCBA>
COS	00000011	PTT	00000000
CTCSS	00000011	ENABLE	10000001
ENABLE	_11000__		

cLABCD = control RX, LCL, Port A, Port B, Port C, and Port D receivers, respectively  
ii = command trigger inputs. COS displays triggers 1 & 2, while CTCSS displays 3 & 4. While COS Over Patch is active, the header is "cLABCDiP" with the command trigger 1 input being replaced by the patch COS status. "0" = no COS or CTCSS, while "1" = active (regardless of the LEV settings). The ENABLE rows have the same function as on the FF-8010 display and indicate enabled ports. Note that a COS or CTCSS can be indicated as "1" even if it is not enabled.



The PTT header is "LrbpDCBA" where the upper case letters indicate the corresponding TX port and the lower case letters indicate: r = phone ring input, b = phone busy input, and p = phone off hook.

#### Display I/O Status

##### **DIS2**

This command displays the current status of the OUTPUTs, Voter inputs, and analog inputs. It is not a continuous update readout, and shows a snapshot status only. The analog readings are the raw A/D registers and display values from 0 to 255.

```

                <87654321>
OUT             00000000
Vote IN        00000000
DVL/DV         00
Analog 1:      158
Analog 2:      254
Analog 3:      255
Analog 4:      254
```

#### ID Force

##### **IDCLR**

##### **ID**

Forces the FF-800 to send a repeater ID.

#### Output Logic Level Define

**LEVO** ; (out#) (on/off) on = active high, off = active low

Set active output level for selected internal output. For active high signals, the FF-800 will indicate "ON" when these outputs are open circuited, and "OFF" when they are at ground potential. For active low signals the FF-800 will indicate "OFF" when these outputs are open circuited, and "ON" when they are at ground potential.

#### DTMF Digit Log View

##### **LLOG**

##### **LL**

Lists contents of the DTMF log. Up to the last 250 tone entries are maintained in a log buffer by the FF-800 which allows the user to monitor function entries. The date and time are also logged. The actual DTMF codes for all entries are listed, including invalid codes.

#### State Control (save/recall)

**STATE** ; (state #) ; ("S")

##### **S**

Recalls the selected state from memory. If the ("S") option is used, the current state is stored into memory as (state#). **STATE** also performs a SIMTEK non-volatile store operation.

#### Timer Program

**TIMER** (timer#) ; (timer value)

**TI** (timer#) indicates the timer of interest, (timer value) is from 1 - 9999

There are several user programmable timers on the FF-800 for controlling various repeater operations like hang time, courtesy delay, etc... . There are two timer units that are utilized by the various timers: "sec" timers are programmed in units of 1 second and have a resolution of 1 second -- "ms" timers program in milliseconds and have a resolution of 10 ms. The following list describes each:

<u>Units</u>	<u>Timer #</u>	<u>Description</u>
sec	0	Tail delay -- this is the delay between tail messages. When a tail message is sent, this value is set into the tail timer. No tail messages will be sent until the tail timer has expired.
sec	1	QSO delay -- this is the time out timer for the repeater. The QSO time defines the maximum length of transmissions from Main or Link ports.
sec	2	QSO window -- this sets the point at which the FF-800 will begin to send warning beeps of an impending timeout. This is set to the number of seconds remaining in the QSO time during which time the warning beeps are sent. Thus, if this timer = 15, then the warning beeps will sound 15 seconds before QSO time out.
sec	3	DTMF access activity timer. This timer is reset anytime that a valid COS signal is received by the FF-800. If this timer reaches zero (no activity), the FF-800 will automatically enter the down state of the DTMF access mode. If DTMF access is disabled, this timer has no affect (see DTMF Access Control and DTMF UP/DN).
sec	4	ID TIME. This is the maximum time between IDs.
sec	5	ACTIVITY. This timer determines how long the FF-800 will wait after the last valid COS before automatically modifying the status of a remote base that is in transmit (see Remote Base Action). ZACTIVITY is also used by the FF-800 to determine when to send welcome IDs. If the repeater has not had any activity for the duration of ACTIVITY and a COS is detected, the FF-800 will send a welcome ID bulletin IF an ID is required at the time the COS was detected.
ms	6	Courtesy tone delay -- this is the amount of time (in milliseconds) that will pass after loss of a Main or Link COS before the courtesy tone is sent.
ms	7	Hang time. this is the amount of time that the FF-800 will keep any Main TX active after the courtesy tone has finished.
ms	8	"Kerchunk" filter time. This value is the minimum duration active COS that will activate the FF-800. When a valid COS is detected, the FF-800 will activate all enabled TX PTTs (usually within 40 ms of the COS activation). However, if the duration of the COS is less than the "kerchunk" filter time, the FF-800 will deactivate the transmitters after the COS signal is removed. Thus, no audio is lost, but the repeater will not respond to "kerchunkers". Once the FF-800 has been activated, the kerchunk filter has no affect.
sec	9	Autopatch Duration. This is the maximum duration for the normal autopatch.
sec	10	Autopatch Extend Time. This is the time that is set when the Autopatch Extend command is issued during an autopatch.
sec	11	Autopatch Activity. This is the maximum allowed delay between valid COS input during an autopatch.
sec	12	Emergency Autopatch Duration. This is the maximum duration for the

<u>Units</u>	<u>Timer #</u>	<u>Description</u>
		emergency speed dial functions.
sec	13	Control Patch Duration. This is the duration of a control autopatch (see section 5.5).
sec	14	Reverse Patch Duration. Specifies length of a Reverse Autopatch function.
sec	15	ID Window Anxious. This setting indicates how soon before the ID Time expires that the FF-800 will try to send anxious IDs.
sec	16	ID Window Pending. This setting indicates how soon before the ID Time expires that the FF-800 will try to send pending IDs.
sec	17	Control autopatch security duration. This is the duration of the security access for the control autopatch.
ms	18	DTMF mute duration. This is the length of time after loss of DTMF that the FF-800 will continue to mute audio from the currently active receiver port.
ms	19	TX key-up delay. This is the length of time after an initial COS before the FF-800 will activate the PTT lines. Max value = 9000. If this timer is set to > 9000, the value is ignored and 0ms of delay is used.

DTMF Digit buffer display

**TONBUF**

**TO**

Reads the contents of the DTMF buffer. This buffer contains the last sequence of digits entered. It also displays the buffer for entries in progress.

DTMF Access Mode Control

**TTAXS** ; (on/off)

**T**

Controls the status of the DTMF access mode.

## 6.8. Configuration Save/Restore Commands

Configuration Memory Save

**SAVE**

**SA**

This command initiates a memory dump of the FF-800 configuration memory. This data should be saved as an ASCII file on the computer receiving the information. The command will cause all PTT outputs to be de-activated and the repeater will not respond until the data transfer is complete at which time the FF-800 will self-reset. The **SAVE** command results in about 30K bytes of data (88.5K for U5 expansion memory users) which can be saved using the data-logging feature that most terminal programs employ. XON/XOFF handshaking is used to control the data flow to the computer (the **HANDS** setting is ignored). The user should activate the logging feature after typing **SAVE** but before pressing the <enter> key. Stop the logging feature after the FF-800 stops sending data -- this is indicated by the FF-800 sending the reset message. If any extraneous characters are captured by the log file, they should be removed with a text editor before attempting to re-send the data using the **LOAD** command. The data is sent in Motorola Hex record format -- refer to appendix G for a description of the format.

Configuration Memory Restore

**LOAD**

## LO

This command readies the FF-800 for transfer of the Memory Save data. The repeater operation will be suspended just as for the Memory Save function until the data transfer is complete. The <esc> key will abort the transfer -- if no data is transferred, the FF-800 will simply reset itself. However, if the transfer is aborted before completion, or a data error is encountered, the FF-800 will abort and prompt the sysop to A)abort, R)etry, or F)actory initialize. An error log of the last 40 errors is also displayed. Note that the current time and serial password information is not changed by the load process. Thus, the password or time will not change on the controller after the LOAD is complete (this is not true of the DTMF security codes). The **LOAD** command uses XON/XOFF protocol (the **HANDS** setting is ignored). The terminal program should be configured for at least 10ms of line delay (the delay after a <cr> is encountered) for the load operation to function properly. See Appendix G for more information on load/save operations.

Verify

## VERIFY

### V

The verify operation is used to verify the validity of a SAVED configuration file. This command does not compare the contents of the configuration file, it simply verifies that the checksum integrity is valid.

## 6.9. Radio Port Configuration Functions

Input Logic Level Define, COS & CTCSS

**LEVC** ; (rx#) (on/off) on = active high, off = active low

**LEVP** ; (rx#) (on/off) on = active high, off = active low

Set active logic level for the COS (LEVC) or CTCSS (LEVP) inputs for the selected rx#. (rx#) is defined as follows:

<u>(rx#)</u>	<u>Receiver</u>
1	Control RX
2	Local MIC
3	Port A
4	port B
5	Port C
6	Port D

Input Logic Level Define Voter

**LEVV** ; (vote rx#) (on/off) on = active high, off = active low

Set active level for each voter COS input.

Level Set RX Audio

**POT** ; (pot#) (%setting)

### P

(pot#) = 0 - 8.

Sets internal digital level controls. New settings take effect immediately. This terminal function is especially useful during level adjustments where the repeater is receiving a signal and can not accept DTMF entries. It is also faster which allows quick changes between settings for better comparison.

#### Examples:

```
user entry --> >POT <cr>
FF-800 response -> RX Level settings (%):
                   0: SPCH    31          Speech level
                   1: RXL     31          Local mic level
                   2: RXA     31          Port A level
                   3: RXB     31          Port B level
                   4: RXC     31          Port C level
                   5: RXD     31          Port D level
                   6: API     31          Patch input level
                   7: APO     31          Patch output level
                   8: USER   99          User pot (P22)

user entry --> >POT 2 55 <cr>
FF-800 response -> RX Level settings (%):
                   0: SPCH    31
                   1: RXL     31
                   2: RXA     55
                   3: RXB     31
                   4: RXC     31
                   5: RXD     31
                   6: API     31
                   7: APO     31
                   8: USER   99
```

#### Level Set TX Audio

**TPOT** ; (pot#) (%setting)

**TP**

(pot#) = 1 - 4.

Sets internal digital level controls for the TX port audio outputs. New settings take effect immediately.

#### Examples:

```
user entry --> >TPOT <cr>
FF-800 response -> TX Level settings (%):
                   1: TXA     31          Port A TX level
                   2: TXB     31          Port B TX level
                   3: TXC     31          Port C TX level
                   4: TXD     31          Port D TX level
                   5: Tone    31          Tone/CT level

user entry --> >TPOT 2 55 <cr>
FF-800 response -> TX Level settings (%):
                   1: TXA     31
                   2: TXB     55
                   3: TXC     31
                   4: TXD     31
                   5: Tone    31
```

## 6.10. Scheduler and Time Functions

### Set Time and Date

<b>TIME</b>	; hh:mm:ss	leading zeros required
<b>DATE</b>	; DD/MM/YY	uses current century
<b>DATE</b>	; DD/MM/YYYY	input new century

These commands allow the sysop to set or interrogate the clock settings from the serial terminal port. The DATE command also supports four digit year data which is used to automatically calculate the day of week. Note, the day of week is calculated regardless of the year format used. The current date or time is interrogated by entering the command words with no data.

The numeric day of week is still used in the scheduler functions and follows the format of Sunday = 1, Monday = 2, etc.... Previous versions allowed the sysop to determine the day of week number that corresponds to the "first" day of the week. This might impact scheduler configurations for those who used a day of week format which differs from the new, automatic system.

#### Scheduler Event List Display

**SCHEDULE** ; (start event) ; - (stop event)

**SCH**

This command lists all of the events in the scheduler and includes time, on/off, and macro number. The optional (start event) and (stop event) parameters are limit the listing range to those events indicated. The range separator character (-) must be used when displaying a range of events -- if omitted, only the (start event) will be listed.

```
>SCHED 0 -
Scheduler Event List
The scheduler is ON
ev# time    date    dow    macro    status
00: 00:00   01/01   D:1    OP:**    OFF
01: 00:01   01/01   D:1    OP:**    OFF
02: 00:02   01/01   D:1    OP:**    OFF
      :      :
      :      :
51: 00:52   01/01   D:1    OP:**    OFF
```

Wild card entries are indicated by \*\* (\*\* in the OP position indicates that no macro has been assigned).

#### Scheduler Control

**CONTROL** ; (on/off)

**CON**

The scheduler system can be enabled and disabled with this command. This allows the user to disable the scheduler completely without having to modify each event individually.

#### Macro Command Display

**MACRO** (macro#)

**MA**

This command allows the user to interrogate the contents of any macro. The contents are listed as the DTMF sequence of each function in the macro. For example, if a macro contained the Force ID , Parameter Designate, and Autopatch commands, it would list as follows:

```
>MACRO 00
List macro commands:
01: 00459
02: 01599
03: 111
>
```

The listing contains the prefix commands as they are programmed at the time the MACRO command is issued. If a prefix is changed, that change will reflect in subsequent MACRO lists.

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## Appendix B. Serial terminal Load/Save reference

The data transfer format of the LOAD/SAVE commands uses the Motorola S-record format to transfer ASCII data with error detection. The following describes the structure of the S-record file:

Each line of an S-record file is divided into fields -- these fields are as follows:

[type] [length] [address] [data] [checksum]

Field	# of characters	Contents
type	2	S-record type: "S1" is a data record, "S9" is a terminating record.
length	2	The count of character pairs in the record (excluding type and length).
address	4	The physical memory address of the 1st byte in the record.
data	0-2n	from 0 to n bytes of data in Hex format (0-9, A-F).
checksum	2	The least significant byte of the one's complement of the sum of the values represented by the pairs of characters making up the length, address, and data fields.

All S-record files must end with an "S9" record to properly terminate the transfer process. The standard form of the termination record follows:

```
S9030000FC
```

### LOAD/SAVE Procedure

To insure data integrity and proper operation of the LOAD and SAVE commands, the XON/XOFF handshake protocol is used. This protocol is forced active even if it is turned off with the HANDS command. Most terminal programs support the protocol -- refer to the program documentation or help feature for information on how to set the XON/XOFF protocol (XON = ASCII 17 decimal; XOFF = ASCII 19 decimal). In addition, some line delay is required -- about 10ms is usually sufficient. This delay is required to allow the terminal program to receive the XOFF character from the FF-800 to hold the next line. Without this delay, the program might send one or two characters from the next line while the FF-800 is still busy processing the current line -- if this occurs, an error will result.

It should be noted that the SAVE command transfers all configuration data. If these commands are used to "clone" the configuration of one FF-800 to another, the destination controller may require some configuration after the transfer to reset the call sign or any other configuration settings that might be unique to the destination controller.

The time of transfer can be considerable so the user must take this into account when initiating a transfer. At 9600 baud, a SAVE transfer takes about 90 seconds, at 1200 baud it takes a little over 5 minutes. The LOAD times are slightly longer (by about 10 seconds).

Appendix A. Parts list Connector Pinouts and schematic:

See the *FF-800 Technical Manual* for details.

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