FF SYSTEMS

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" AFFORDABLE REPEATER CONTROL SOLUTIONS "

FF-8070A Digital Voice Recorder V2.25

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INTRODUCTION

The FF-8070A is a microprocessor controlled audio record and playback interface designed to emulate the Digital Voice Recorder offered by Advanced Comuter Controls (ACC). The 8070A accepts DTMF commands from either of the two audio inputs (A or B) -- in addition, there is a serial input that can be used to initiate play-track commands. The recording of messages is divided into three areas: 1) System tracks, 2) Voice mail, and 3) Audio test. System messages are primarily used by the serial play track command or MSG[3:0] logic inputs to play a DVR track (or tracks) in ID bullitens, function annunciators, tail messages, etc.... The voice mail and audio test features are primarily for use by repeater users via DTMF commands.

The voice mail feature allows users to record and receive messages. The status of the mail box can be interrogated manually (allowing users to interrogate the mailbox to see if they have any messages), or the host controller may automatically poll the mailbox status via the serial play-track command. The audio test records a sample of audio up to 20 seconds long on a test track and immediately re-plays the test track to provide users with a means of monitoring their signal quality -- this feature is also useful for adjusting the DVR levels after installation.

It should be noted that the system tracks and the mail box tracks are separate and there are different command sets to record and play the two types of tracks. NOTE: the audio test and mail box tracks can not be directly accessed by the serial play-track command.

OPERATION OVERVIEW

The FF-8070A DVR uses Continuously Variable Slope-Delta (CVSD) modulation to store audio signals as a stream of single bit values. The system must over-sample to eliminate the carrier frequency -- in this case the sample frequency is 50KHz. The bit stream is stored on 1 mega-bit DRAMS each of which can hold about 20 seconds of sampled audio. The FF-8070A comes standard with 8 one mega-bit DRAMS but there is room for additional memory (up to a maximum total of 32 DRAMS) and is organized as 8 banks of 4 DRAMS each. The memory expansion connector (P1) allows a memory expansion board to be installed which allows an additional 32 DRAMS for a total of 64 mega-bits of storage (over 21 minutes of total audio).

There are 100 system tracks available (7 of which are used as prompts for the voice mail) and these tracks reside in the system section of the DVR memory. The FF-8070A DVR is a random access system, which means that tracks can be recorded and re-recorded as often as desired without any special consideration for any previous record operations. The only stipulation is that the maximum record time of each track can not be exceeded. Each track is allocated a certain maximum record time, this time can range from one second up to 83 seconds for an individual track. Each track is pre-allocated at the factory but the user can modify the record time allocations for the system tracks to meet their special needs. Tracks can be re-allocated after the DVR has been in service, but all re-allocated tracks must be re-recorded -- appendix B discusses the allocation process in more detail.

The FF-8070A also features the ability to play messages based on a 4-bit binary message select port. This port allows the sysop to select and play messages using the logic outputs of their non-ACC controller. The **Set Message Table** command is used to configure the capabilities of this feature.

The mail box section holds the mail box tracks as well as the DVR test track. Thus, if the user turns off the mail box, the DVR test feature is also disabled. If the mail box is turned off, the seven prompt tracks can be used as general system tracks. On power up, the DVR clears all tracks (but not configuration data like prefixes, record time allocations, etc..., these are maintained in non-volitile memory). Thus, the mail box prompt tracks must be recorded after power up in order

for the mail box prompts to function properly. A battery back-up connector is provided to maintain the DVR speech memory in the event of a power failure. The installation section discusses the connection of an appropriate battery.

INSTALLATION

The wiring of the DVR is accomplished through four connectors on the FF-8070A board. The following lists those connectors along with their signal descriptions: ~ = Active low signal

P2: Battery	P3: DVR I/O	P7: Serial Input	P4: MSG inputs
(molex 3 pin)	*(molex 9 pin)*	*(molex 7 pin)*	*(10 pin IDC)*
1) Battery (-)	1) DVR in (A)	1) ~Serial Data In (TTL)	1) DVR out
2) Battery (+)	2) GND	2) ~RESET	2) +5V out (50mA max)
3) Battery (-)	3) CW out	3) GND	3) GND
	4) n/c	4) ~COS in	4) MSG 0
	5) DVR out (B) *	5) ~BUSY out	5) MSG 1
	6) DVR in (B)	6) n/c	6) MSG 2
	7) DVR out	7) n/c	7) MSG 3
	8) +12V in		8) GND
Notes:	9) GND		9) ~PLAY
* Rev G PCB only			10) -5V out (10mA max)

P1 is for DVR expansion and its pin-out is included in appendix D for user reference. The battery input (P2) should be connected to a battery for maintaining DVR operation during power interruptions. The battery must be greater than 8 volts, and less than the voltage at P3-8 for proper operation. A 9V alkaline cell will maintain power to the DVR for up to an hour and a half, while a 3 AHr gell-cell will maintain power for over 30 hours. While 9V cells function, their long term reliability has been questionable in field service. It is generally recomended that a 12V battery be used with at least 1Ahr of capacity.

P3 is a 9 pin Molex connector and contains the DVR I/O signals and main power input:

- {**P3-1**: DVR in (A)} This input is the main audio input to the DVR. The input should be line-level audio (ie., 1 - 4Vpp) from the receiver or host controller. If controller audio is used, DTMF signalling must not be muted at this input or no commands will be decoded by the DVR.
- {**P3-3**: CW out} This output brings out the CW telemetry separately from the DVR audio. The CW telemetry at this pin is not mixed with the DVR audio.
- {**P3-5**: DVR out (B)} This output is used to play to a non-COS source (ie., an autopatch). This output is only available on rev G or higher PCB versions.
- {**P3-6**: DVR in (B)} This input is used to record from a non-COS source (ie., an autopatch). The FF-8070A can not be directly connected to a phone line -- the user must obtain a suitable phone-line interface or obtain the appropriate audio signal from the host controller.
- {**P3-7**: DVR out} This is the DVR audio output. It should be connected to a spare audio input on the host controller (if available).
- {**P3-8**: +12V in} Power input. Should be at least 0.7V greater than the battery voltage for systems with battery backup.

P4 is a 10 pin dual-row IDC (Insulation Displacement Cable) type connector and contains the message select signals:

{**P4-4 to P4-7**: message select in (TTL)} These inputs represent the 4 bit message select value for use in non-ACC systems. These inputs feature on-board pull-up resistors, so they are best driven by open collector or open drain current sink drivers.

P4 pin	Description (color indicates ribbon cable color for the optional cable)
P4-4	MSG0 (yellow)
P4-5	MSG1 (green)
P4-6	MSG2 (blue)
P4-7	MSG3 (violet)
P4-8	GND (gray)
P4-9	~PLAY (white)

{**P4-9**: ~PLAY} This input is grounded and released to request a play of the message presented to the MSG[3:0] inputs as described above. The ~PLAY pulse must be at least 50ms long, and the play operation begins on the rising edge of the pulse. ~PLAY requests are ignored while the ~BUSY signal is at logic 0 (indicating an operation is in progress).

P7 is a 7 pin Molex connector and contains the DVR control I/O signals:

{**P7-1**: ~Serial data in (TTL)} This input receives the serial input data. This input is for TTL data only, a level converter must be used for RS-232 signals.

{**P7-2**: ~RESET} This input is grounded and released to reset the FF-8070A processor. This reset will not erase the DVR recordings -- only power on reset clears the DVR tracks.

{**P7-4**: ~COS in} This input is used to to indicate activity of input A. The COS must be grounded when a signal is received, and open, or >4.0V when no signal is received.

{**P7-5**: ~BUSY out} This output goes low when the 8070A is busy executing a command. (note, on rev G and higher PCBs, this outputs polarity is user configurable. See appendix G).

The DVR card should be placed in an RF tight enclosure and be placed as close as practical to the primary audio source (ie., the receiver or host controller which supplies audio to the 8070A).

DVR FUNCTIONS:

The FF-8070A DTMF commands use a prefix-suffix architecture for commands. The user-defined prefixes may be 1 to 5 digits long and are used to access the 8070A commands listed below. These prefixes must be unique to all other prefixes used by the host controller in order to prevent conflicts when using the 8070A commands.

User Defined Prefixes:		DEFAULT
<rec. prefix>	Record system track	1
<play prefix>	Play system track	2
<mail prefix>	Access mailbox system	4
<prime>	Configuration prefix	8070

The following list describes the 8070A configuration commands -- to be recognized, these commands require the primary prefix -- i.e., to request the version information the string "807008" would be entered (where 8070 is the default primary prefix).

<code>	DESCRIPTION
01*	Interrogate system track size.
02	Set input source. Selects main or aux. DVR input.
03*	System track clear.
040	Search system track -- short play.
041	Search system track -- long play.
050	Start lopoff configure.
051	End lopoff configure.
052	Set number of installed DRAMs.
053	Set number of mailbox tracks.
054	Set user-defined prefix.
055	Set mailbox auto-erase time out.
056	Set mailbox host interrogate delay.
0581	Set DVR ID window time (**see Appendix G**)
0582	Set DVR ID gap time (**see Appendix G**)
0583	Set DVR CW ID message (**see Appendix G**)
059	Blank annunciate mode.
060800	Execute BASIC initialization.
061	ADVANCED initialization code.
067800	Save configuration flag modes.
066	Force mail box message erase
069	Set track interrupt mode.
08	Version request. Responds with the interface model and serial number.
090	Set CW speed.
091	Set CW tone.
092	Set ~PLAY Message Tracks
097	Set Busy output polarity (**see Appendix G**)
098	Set baud rate for serial data input.
099	Set COS active level.

USER COMMANDS

AUDIO TEST Record and play-back test track.
<mail prefix> ***

This function waits for a COS signal (or any DTMF digit if input = B) to begin recording on the test track. After the loss of COS (or another DTMF digit, if input = B), the test track is played back. The maximum record time for the test track is 20 seconds. There is a time-out limit of 5 seconds after the command entry -- if no COS is engaged within this time, the record operation is aborted.

VOICE MAIL Send, Receive, or List voice mail tracks.

<mail prefix>	List active voice mail address headers
<mail prefix> <n>	play-back voice mail track number <n>
<mail prefix> *	record voice mail track
<mail prefix> **	erase last-played voice mail track

There are two parts to a voice mail message, the first is the address header and the second is the voice message. The address header is a brief description of to whom the address is intended (ie., the person's call sign, or "TO ALL HAMS" as an example of a group address). The maximum time for a mail track is 20 seconds which includes the message and address. The DVR uses system tracks 00 through 06 to prompt the entry of voice mail. If any of these tracks are empty, the 8070A will respond "M P" and the track number for the particular prompt in question. The following list describes these system track numbers and their prompt function:

SYS TRACK #	Track function:	Examples:
• Track 00	message address prompt	"Who is your message for"
• Track 01	record prompt	"Record your message"
• Track 02	messages waiting	"There are voice messages"
• Track 03	no messages	"Sorry, there are no messages"
• Track 04	message clear	"Your message has been erased"
• Track 05	message saved	"Your message has been saved"
• Track 06	"oops" track	"oops!"

After entering the record voice mail command (mail prefix + *), the DVR responds with track#00 (who). The user simply keys their transceiver, speaks an appropriate address, and then releases their push to talk. The DVR then responds with track#01 (record) at which time the user keys again and records their message. After the message is recorded (PTT released) the DVR responds with track#05 (message saved). The record cycle is now complete and the message can be retrieved at any time by the addressee.

If all the available voice mail message tracks are in use, the DVR will respond with track#06 ("oops!") instead of track#00. If this occurs, no more messages can be stored until one or more of the active messages is erased. Also, there is a time-out limit of 5 seconds after each prompt -- if no COS is engaged within this time, the mailbox operation is aborted.

To query the mail box, the "list active messages" command (L) is entered. If there are no active messages, the DVR responds with track#03 (no messages). If one or more active messages are present, the DVR reads back the address header for each active message. The order of the message headers is important in that this corresponds to the number entered to retrieve the message track. NOTE: The DVR does not count inactive messages during the list operation. This means that if a message is deleted, any active message numbers that follow it will be decremented by one on subsequent list queries. Thus, a message track may start at position #3, but end up at position number 1 if the previous two messages are deleted (and no other tracks are recorded).

When the play message track function (mail prefix + n) is entered, the DVR looks for the n-th active message -- if present, the header and message are played-back. After the playback is complete, a 60 second timer is activated -- the message erase function (mail prefix + **) must be entered within this time-out period in order to clear the message track. If the erase is successful, the DVR responds with track#04 (message clear).

CONFIGURATION COMMANDS

SOURCE SET Sets source of audio to the DVR (**main** or **aux**)
<prime><02> ; <1 or 2> 1 = main, 2 = aux

The auxiliary DVR input is intended for use by a non-COS audio signal such as a phone line input. The FF-8070A CAN NOT be directly connected to a phone line. The user must provide a suitable interface (such as a simplex patch) for connecting the FF8070A to a phone line. When executing this command, the DVR response will be "In A" if the selected input source is **shared**, or "In B" if **aux**iliary. In the **shared** mode, the DVR will set the "A" input when a COS is active, and switch to the "B" input when there is no COS. This mode will not interrupt a command in progress, thus if a record command is issued from input "B", and the COS then goes active, the DVR will maintain input "B" until the record operation is complete. Of course, this is true of all commands, not just record. In the **aux** mode, a 5 minute timer is started when the input B is selected. This timer is reset every time a valid DTMF command is issued. If the timer expires before any further DTMF input is attempted, the DVR will automatically switch back to **shared** mode. In this way, the DVR will not lock onto the "B" input indefinitely.

As long as the input source = **aux**, the normal COS detection for the DVR is suspended and the DVR only looks for a DTMF and audio signals at the "B" input. When recording from the "B" input, the DVR uses DTMF signals to start and stop the recording process. Any DTMF digit may be used for start or stop -- simply press and release any DTMF digit. When the DVR is looking for a start, it will begin recording after the digit is released -- when looking for a stop, the DVR will stop as soon as a DTMF is detected. This procedure minimizes the amount of DTMF that may find its way into the recording, there is still about 20 - 40 ms that will "bleed" through on stop. This is addressed by setting the LOP stop to 80 or 100 ms (see **LOPEND** for details).

VERSION Interrogate interface version.
<prime><08>
Responds with the interface model and serial numbers. This command is useful to verify that the DTMF signals are being received properly.

SYS RECORD Record system track.
<rec. prefix> <nn> Record track number <nn>
<prime><01*> <nn> Interrogate allocated track length
<prime><07> <nn> Record track number <nn> with no play-back

The <rec. prefix><nn> format is used to record system tracks. The record time of the new track can not exceed the allocated time or an error message will result and the original track will be lost -- refer to appendix B for a listing of the BASIC initialization allocations. The <01*nn> format allows the user to interrogate the amount of time allocated to the indicated track. The response is in seconds and provides the user with a means to interrogate the maximum length allocation for any track. The record protocol is as follows:

- Enter <1><nn> (nn = track# to record) and wait for the "R" (or "R B" if source = auxiliary) response from the FF-8070 -- the DVR waits for a COS signal (or DTMF start if input=B). When the COS is received, the recording operation begins.
- Recording continues until the loss of COR (or DTMF stop if input=B) or until the end of track is reached.
- After the record operation, the track is played back and the record cycle is complete (this step is skipped for the <prime><07> command).

There is a time-out limit of 5 seconds after the "R" response -- if COS (or DTMF start if input=B) is not engaged within this time, the record operation is aborted with no change to the original track.

SYS ERASE <prime><03*> <nn> Erase system track

Removes system track# <nn> from the system. It is not necessary to erase a system message before re-recording. This function simply allows a system track to be eliminated without recording.

Force Mail Erase <prime><066> <nn> Erase Mail box Track(s)

Forces an erase of mail box message track number <nn> without having to interrogate the contents of the mailbox slot. If there are not <nn> active messages, this command is ignored. If <nn> = 0, all of the active messages are erased (leaving the mail box completely empty). This command does not require any play or interrogation of the mail box.

SYS PLAY Play system track.

<play prefix> <nn>	Play track number <nn>
<prime><041> ; <nn>	Search tracks starting at track number <nn>
<prime><040> ; <nn>	Search tracks -- short play version

The first format simply does a playback of the indicated track. The search tracks formats are used to sequentially play a range of system tracks. The DVR starts at track <nn> (or track 00 if <nn> is omitted) and sends the track number followed by a playback of the track for each of the remaining tracks. This format is useful for locating a track if the number has been forgotten. The search continues until a COS is detected or until the last recorded track is encountered (blank tracks are skiped). The search long function plays each track in its entirety, while the search short only plays the first 1 second of each track.

LOPSTART A	<prime><050> ; <nnn>	Start lop-off: input A (in milliseconds)
LOPSTART B	<prime><050*> ; <nnn>	Start lop-off: input B (in milliseconds)
LOPEND A	<prime><051> ; <nnn>	Stop lop-off: input A (in milliseconds)
LOPEND B	<prime><051*> ; <nnn>	Stop lop-off: input B (in milliseconds)

The lop-off value is the amount of time subtracted from the beginning or end of each recorded track. This allows the elimination of switching and squelch noise from the beginning and/or end of tracks which gives a "clean finish" to the DVR tracks. If the system has a long squelch burst, or some other artifact that is heard at the beginning and/or end of a recorded track, then these values may be increased to remove the particular artifact. NOTE: it is not necessary to re-record tracks for new lop-off values to take affect, this value is used in play-back only, so the value may be set any number of times without altering the original track recordings.

LOPSTART A and **LOPEND A** affect all tracks recorded from the "A" input while **LOPSTART B** and **LOPEND B** affect all tracks recorded from the "B" input. The Audio Test track does not use the lop funtion, so squelch noises or DTMF "blips" observed on this track are normal.

 # DRAMS Installed <prime><052> ; <nn> Set number of DRAMs installed

In order to properly store and retrieve tracks, the DVR firmware must know some information about the hardware configuration of the interface. The number of installed DRAMS is preset at the factory for the amount of memory that the DVR shiped with -- however, if additional memory is later added, this value must be changed to reflect the number of DRAMs installed. Refer to appendix C for details on adding DRAM.

 # MAIL Tracks <prime><053> ; <nn> Set number of mailbox tracks available

This function should not be executed until the DRAMS Installed function is updated (only required if there is a change in the DRAM configuration). The user may allocate mailbox tracks within the following limits: 0, 3, 7, 11, 15, 19, 23, 27, or 31. If any other number for <nn> is entered, an error will result. The selection of 0 mailbox tracks turns off the mailbox and audio test functions. The mailbox allocation is restricted by the number of DRAMS installed. The maximum number of mailbox tracks = #DRAMs - 5. Selecting a number greater than that given by this equation will also result in an error. It should also be noted that adding mailbox tracks takes away system tracks. Thus the user must balance the available memory with the requirements for system tracks and mailbox tracks. If this balance is difficult to achieve, then it may be necessary to add more memory.

Set User Defined Prefixes:

Set Primary prefix	<prime><0541> <string>	Set prefix for configuration functions
Set Play prefix	<prime><0542> <string>	Set prefix for PLAY function
Set Record prefix	<prime><0543> <string>	Set prefix for Record function
Set Mailbox prefix	<prime><0544> <string>	Set prefix mailbox functions

response: "PFX" if new prefix is OK
"ERR" if new prefix is a duplicate of an existing prefix.

The user defined prefixes (represented by <string> above) can be between 1 and 5 digits long. These codes may use any DTMF digit except "D" or "#". The 8070A compares the new <string> code with all of the existing user defined prefixes before validating the entry -- if a duplicate is discovered, the new entry is ignored.

Blank Annunciate <prime><059> ; <1/0> Enable/Disable annunciate of blank tracks
response: "B A M" plus "O N" or "O F F"

The blank annunciate flag allows the user to enable or disable the blank track annunciator. The blank track annunciator simply responds with "T N xx" (where xx = track #) any time that a blank track is played. The annunciator will respond to serial play message commands, or to DTMF command inquiries. If the parameter = "1", the annunciator is turned on, or it is turned off if the parameter = "0". The factory default is "On"

Track Interrupt Mode <prime><069> ; <mode> Enable/Disable play track interrupt

There are three interrupt modes available on the FF-8070:

RESPONSE	DESCRIPTION
"I N T O F F"	<mode> = 0, No interrupt allowed -- all tracks will play to completion
"I N T D T M F"	<mode> = 1, Only interrupt if a DTMF digit is detected
"I N T C O S"	<mode> = 2, Interrupt if DTMF or COS detected during play

These modes allow the user to set the play interrupt mode for their DVR. <mode> = 1 is most generally recommended for users who do not want COS interrupt of DVR tracks because it still allows an interrupt mechanism that is available to terminate a track play if desired.

Auto "OOPS!" Mode <prime><069*> ; <1/0> Enable/Disable "oops" on track interrupt

There are three interrupt modes available on the FF-8070:

RESPONSE	DESCRIPTION
"O O P O F F"	<mode> = 0, interrupted tracks stop only
"O O P O N"	<mode> = 1, interrupted tracks stop, followed by a play of track#06

This command allows the DVR to automatically play the "oops" track (#06) when a normal track play is interrupted (by COS or DTMF). When used with an ACC host controller, this mode should be off as the ACC controllers automatically send the "oops" track play command via the serial data signal. The factory default is "O F F".

Save Config. Flags <prime><067800> Set configuration flags to EEPROM

This command "saves" the status of the configuration flags register. On reset, this register is recalled from EEPROM so that the contents can continue to reflect the user's desired setting. The configuration flags save the Blank annunciate flag, the "oops track", and the interrupt mode. Changes made to these settings will not be retained until saved with this command. Also, the auto erase time is saved with this command.

Auto Play delay <prime><056> ; <t> Set or interrogate the auto play delay time

This command is used to set the auto play delay from <t> = 0 to 9 minutes. The auto play delay affects tracks 120 and 121 and prevents them from being played if a user enters the <mail prefix> command within the time set by this command. The factory default is 3 minutes.

Auto Erase delay <prime><055> ; <t> Set or interrogate the auto erase delay time

This command is used to set the auto erase delay from <t> = 0 to 255 hours. The auto erase time is attached to each voice mail message when it is recorded. When the time expires, the message is automatically erased. <t> = 0 hours disables the auto erase feature -- the factory default time is 255 hours. This parameter must be saved using the **Set Config. Flags** command.

CW speed <prime><090> ; <s> Set or interrogate the CW speed
response: "C W S" plus current speed

This command is used to set the CW speed from <s> = 5 to 40 WPM. If a value of "0" is set, all of the CW telemetry is disabled.

CW tone <prime><091> ; <t> Set or interrogate the CW tone
response: "C W F" plus current tone

This command is used to set the CW tone from <t> = 50 to 2000 Hz.

Serial Baud Rate <prime><098> ; <r>
response: "BAUD" plus <r>

This command is used to set the CW tone from <r> = 0 through 4. The baud rate is maintained in non-volitile memory and is retained until changed. The following values are used for <r>:

<r>	Baud rate
0	4800
1	2400
2	1200
3	600
4	300

COS Active Level <prime><099> interrogate
<prime><0990> "C O S Low"
<prime><0991> "C O S Hi"

This command is used to invert the sense of the COS input. If the active high COS is selected, COSin >4.0V indicates open squelch, and COSin <0.8V indicates closed squelch. For active low COS, COSin <0.8V indicates open squelch, and COSin >4.0V indicates closed squelch.

This command is easiest to implement when applying the receiver audio to the AUX input (P7-7). The COS must be in its "inactive" state, or commands will not be accepted at the aux input. The following example shows how to set the level:

enter: 8070022#	SET IN B	force input B (the aux input)
enter: 80700991#	SET COS HI	set active high
enter: 8070067800#	DVR SVC	store setting (required for V2.20 firmware)
enter: 8070021#	SET IN A	return to normal mode

Set Message Table <prime><092> <mm> ; <ttt>

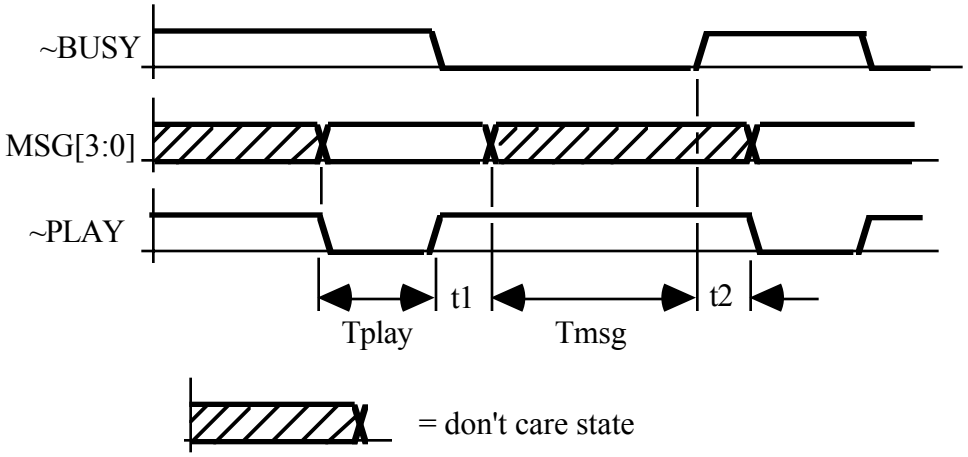
<mm> = the binary value of the MSG[3:0] inputs and is in the range of <00> to <15>. <ttt> is the track number that is to be assigned to the desired MSG[3:0] value and is in the range <00> to <99> but may also include the Run Time tracks <120> and <121> -- other than <120> and <121>, track numbers above 100 are treated as empty tracks by the DVR.

The DVR uses the binary value represented by the MSG0-3 inputs to select a track number from an internal table. This table acts as a cross-reference to convert the MSG0-3 input value to an actual DVR track number. The **Set Message Table** command is used to allow the sysop to define which DVR tracks are to be played by the MSG0-3 inputs. The factory default settings for the play table is for the DVR track# = MSG value for each entry in the table. The following table describes the binary codes for the MSG0-3 inputs:

	MSG inputs				default		MSG inputs				default
value	**3**	**2**	**1**	**0**	track#	value	**3**	**2**	**1**	**0**	track#
0	0	0	0	0	00	8	1	0	0	0	08
1	0	0	0	1	01	9	1	0	0	1	09
2	0	0	1	0	02	10	1	0	1	0	10
3	0	0	1	1	03	11	1	0	1	1	11
4	0	1	0	0	04	12	1	1	0	0	12
5	0	1	0	1	05	13	1	1	0	1	13
6	0	1	1	0	06	14	1	1	1	0	14
7	0	1	1	1	07	15	1	1	1	1	15

To use the MDG[3:0] inputs, the controller must be capable of providing logic outputs that can drive the message select and ~PLAY inputs. It is not necessary to connect all 4 message select inputs -- if fewer messages are desired, you may elect to connect only the desired number of inputs to allow the number of desired tracks (1 input = 2 tracks, 2 inputs = 4 tracks, etc...). In this case, connect to the lowest numbered MSG input (MSG0) and be sure to ground the unused inputs (the higher numbered inputs).

The controller should be configured to set the message select signals and then pulse the ~PLAY signal low and then high. The ~PLAY signal must be held low for at least 50ms -- the selected track will not begin until the ~PLAY signal is brought high. To save steps, the MSG[3:0] signals may be set at the same time as the ~PLAY signal is brought low. However, to insure that the proper message value is read by the DVR, the MSG[3:0] signals must remain stable for at least 50ms after the ~PLAY signal is brought high.



MSG[3:0] logic timing

Tplay	~PLAY pulse width	50ms (min)
t1	MSG hold time	50ms (min)
Tmsg	duration of track play	0s (min) / 84s (max)
t2	next track delay	50ms (min)

NOTE: The ~PLAY input is ignored while ~BUSY = 0.

Serial command input

The serial command input to the FF-8070A allows a secondary command input for the purpose of remotely playing specific tracks from the system area of the 8070A. The serial parameters are: 1200 baud (factory default), no parity, 8 data bits, and 1 stop bit. The command format starts by sending an ASCII "P" (80 decimal) followed by a single ASCII byte (00 to 99, decimal) to indicate the desired track (there are three exceptions to this upper limit which are described later). No delimiters are required and all other characters are ignored. The FF-8070A features a 32 character buffer for the serial data input. This means that several tracks can be queued without having to wait for the current command to clear. There is no handshaking, so there should be at least 10 ms of delay between characters. To queue multiple play commands, simply send multiple "P"+track# combinations (up to 16 max). For example: to play tracks 10 and 11 followed by run time tracks 120 and 121 (see below) the following string would be sent: P [ascii 10] P [ascii 11] P [ascii 120] P [ascii 121]. Track 10 would begin playing immeadiately after the [ascii 10] character is received. However, the buffer still operates and the remaining characters would be buffered during the time that track 10 is being played.

Additonal command Characters:
"~" (ASCII 126, decimal) = reset buffer. This character resets the serial input buffer. While optional, it should be used prior to play commands where possible.

"{" (ASCII 123, decimal) = Execute DTMF string. When this command is received, the serial buffer is reset (terminating any tracks not yet played from the buffer, but not a track in progress) and the DVR waits up to 12 seconds for a string of DTMF characters (ie., 0-9, A-D, *, or #) followed by an EOL (ASCII 13, decimal). If no EOL is received, the buffer is reset and the command is aborted. If the EOL is received, the DVR processes the DTMF string as though it were entered from one of the audio inputs. When the 12 second timer is running, new DTMF entries from either audio input are are ignored.

Run-Time Variable Tracks

These tracks were used by the ACC DVR to play special "pseudo-tracks". The two supported tracks are as follows:

TRACK #120:	This track would play system track #02 ("There's mail for...") if mail was present. If no mailbox slots have activity, nothing is played.
TRACK #121:	List of address headers in the mailbox (if any present) or silence if none are present.

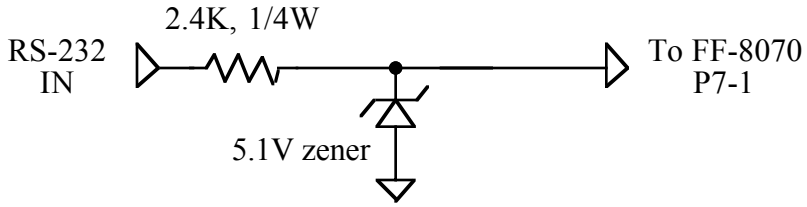
A typical application for these tracks would be for the host controller to call for these tracks as part of an ID or tail message. If no mailbox activity is present, nothing is said. If there were messages, the DVR would respond: "There's mail for..." and list the address headers for each message.

"OOPS!" Track

The "OOPS!" track is used to play a message if a DVR track was interrupted or if the mailbox is full. This track is recorded on track #06, but is also played when track #119 is requested via the serial input. This re-mapping is required to maintain compatibility with the ACC DVR.

Serial Data Voltage Levels

The serial input requires an open collector or open drain driver with a pull-up resistor for proper operation. The pull-up voltage may be from 5 to 15 volts, while the pull-up resistor should range from 2.4K to 10K ohms. If RS-232 signals are directly connected to this input, the FF-8070A may be damaged. The figure below shows a simple buffer circuit that would allow RS-232 signals to be connected to the FF-8070A:



TTL level serial connections (ie., directly from a microprocessor or serial interface chip) require a TTL or transistor inverter to present the correct logic sense to the input of theFF-8070A.

Set Factory Defaults using the SLOAD jumper

The SLOAD jumper is used to initialize the FF-8070A configuration parameters to their factory defaults. This initialization affects the user defined prefixes, blank annunciate mode, CW speed and tone, auto oops! mode, track interrupt mode, and lop values. The SLOAD initialization DOES NOT affect the number of DRAMs, Mail tracks, or the time allocations for each track. If SLOAD is done using the ~Sreset input at P7-2, it will not affect any recorded tracks. To perform the initialization, install a shorting jumper at the position marked "SLOAD" on the DVR (see the parts layout). Next, ground and release the ~Sreset pin (P7-2). After the initialization is complete, the DVR will send the following message in CW (20 WPM, 800 Hz tone): "TEST DE FF8070A V2.19 SNxxx" where "xxx" = the serial number. Finally, remove the jumper at SLOAD -- the initialization is complete.

The following defaults are in effect after SLOAD:

CW speed	20 WPM	CW tone	800 Hz
Blank annunc.	ON	Auto oops!	OFF
Track interrupt	COS	LOPSTART A	0
prime prefix	8070	LOPEND A	0
record prefix	1	LOPSTART B	0
play prefix	2	LOPEND B	0
mail prefix	4	MSG0-3	plays tracks 00 thru 15
COS	active LOW	Busy out	active LOW
CW ID Msg	OFF	ID Timers	0

FF-8070A Command Examples

The FF-8070A is configured at the factory for the amount of memory installed, and the number of mail box tracks is set to 3. The user may wish to modify the mail box assignments or change the user defined command codes. The following examples illustrate how to modify the configuration and demonstrate the operation of the FF-8070A. All examples assume that the FF-800 has its default prefix designations:

• Turn off the mail box and test track:
80700530
response: "Set M T Off"
• Set the number of mail box tracks to 7:
80700537
response: "Set M T Seven"
• Change the primary command prefix to "A":
80700541A
response: "P F X"
• Set lop values

17	record a test track (#07)
response: "R"	after track is recorded, the 8070 will replay to verify
A051200	set lop end to 200ms (0.2 sec)
response: "SET STOP 200"	
A051*60	set aux lop end to 60ms (0.06sec)
response: "SET STOP B 60"	

• Set interrupt mode

A069	check current setting
response: "I N T C O S"	
A0691	set to DTMF interrupt
response: "I N T D T M F"	
27	play a previously recorded track (#07)

The user should note that the played track will not interrupt with COS only, now a DTMF digit must be pressed to interrupt the play operation.

A067800	save interrupt status configuration
response: "D V R S V C"	

ADJUSTMENTS:

The FF-8070A is shipped with all adjustments set at mid-level. After installation, these levels will most likely require adjustment. First, be sure that the equipment (ie., phone patch or receiver) is properly adjusted. If all receiver and transmitter adjustments are correct, use the following procedures to adjust the 8070A:

There are three input level adjustments on the FF-8070A: **VR1** is the main (A) input level, **VR2** is the aux (B) input level, and **VR3** is the CW telemetry level. An Output Level control (located near P4) is used to compensate for any repeater level adjustment. Refer to the parts placement diagram in appendix B for locating these controls. The simplest means for adjusting the DVR is to use the DVR audio test function to record/play test tracks and a dual-trace oscilliscope connected to both the input of the DVR and the output of the repeater -- if a scope is not available, use an amplified speaker, or receiver tuned to the repeater output. While recording, monitor the signal level on the input and compare this to the playback level at the output. Start with the Output Level control at mid-range. Perform a record operation (system track 1 is the best choice to do this) and monitor the playback. If there is insuffucuent level, increase the input level (VR1) and repeat the record process. If there is distortion, first try reducing the Output Level and do a playback of the last track. If there is no improvement, then the distortion is on the input and VR1 should be reduced until the distortion is elliminated. It may be necessary to increase the Output Level during this process if the playback level becomes too weak. Repeat this process while adjusting VR1 and/or Output Level until the record and playback level are as close as possible while minimizing the playback distortion.

The **aux B** input level (VR2) can be somewhat more difficult to adjust since this input usually comes from a phone based source. Here, it is not as important that the input/output levels be balanced -- instead, it is prefered that the recorded level for B correspond to the playback level for A. Thus, to adjust the B input, input "A" must first be adjusted. Then, a system track is recorded from input A (track 0 is a common choice). Next, a track is recorded from input B to another system track (ie., track 1). The two tracks are played in succession and their levels are compared. Adjust VR2 and repeat this record/playback/compare procedure until the two tracks appear to be balanced. Do NOT adjust the Output Level for this step. If you find that you must adjust the Output Level, you may need to repeat the VR1 adjustment (only this time, do not adjust Output Level).

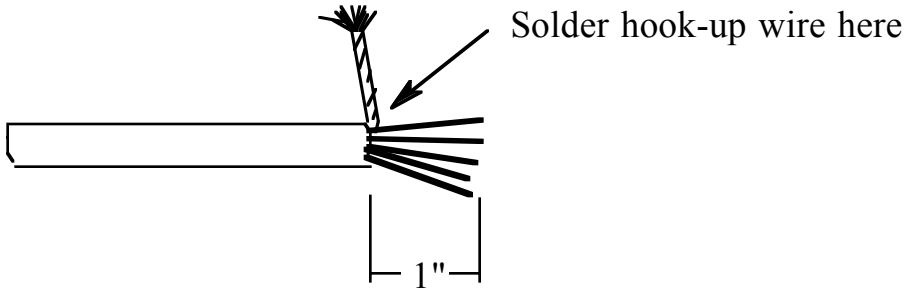
The last step is to adjust the CW level using VR3. The version request command is a good test message with which to adjust the CW level.

Note: an LED is installed on pins 8 and 9 of P5 to allow monitoring of the DTMF receiver's detect signal. If you are having difficulty entering commands, see if this LED is showing stable detect for each DTMF digit. If the DTMF detect is not stable, some adjustment of the receiver level into the DVR may be required. Note that none of the DVR adjustments affect the DTMF receiver level.

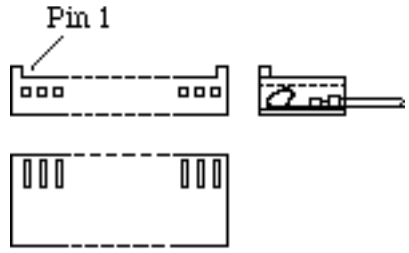
APPENDIX A: FF-8070 WIRING

There are three basic connections that must be made to the DVR to complete the installation: 1) the COS/Busy cable to the host controller (P7). 2) the power and audio cable to the host controller (P3). 3) the back-up battery power cable (P2). In addition, the message select inputs may also require connection (P4) if this feature is desired (a 3' pre-assembled ribbon cable is available).

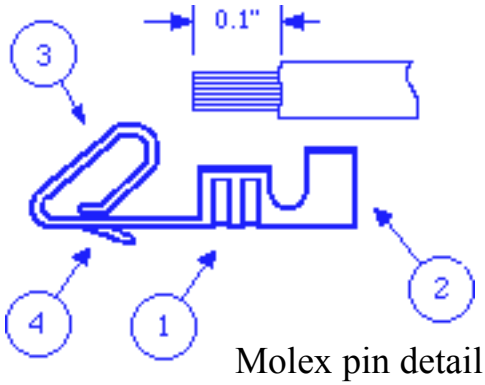
For the various connections, use shielded cable along with the provided housings and crimp pins. Cut the cable to the shortest possible length and strip back the outer sheath 1 inch. Unravel the braid and twist together as shown below and remove the foil inner shield (if present).



Solder a short piece (1 or 2 inches) of hookup wire to the shield as shown above and cut off the remainder of the shield. Cut this wire even with the others and trim 0.1" of insulation from the end of each wire. Using a pair of needle-nose pliers, crimp the exposed conductor into a molex pin as shown at (1) below. Apply a small amount of solder to establish a good connection. If too much solder is applied, it could wick down to the end of the pin at (4) -- this will make the pin difficult to insert and it may not retain properly. If this occurs, the pin should be discarded and another installed in its place. After all pins are secured, crimp at (2) around the insulation for strain relief.



Molex housing



Molex pin detail

The shield wire should connect to the GND connection of the specific housing. When inserting the pin into the housing, be sure that the contact loop at (3) is oriented toward the tabs on the housing as shown above.

APPENDIX B: FF-8070A Track Allocation

The track allocation command <061> is used to more finely define the allocation of DVR memory. The basic allocation command <060800> is executed at the factory and allocates the 100 system tracks as 10 banks of 10 tracks each. In each bank, the first six tracks are 5.9 seconds long, while the remaining four are 11.9 seconds long. With this allocation scheme, the only way to get access to all 100 tracks is to add the FF-8070EXP expansion memory card. However, most applications do not require this much memory, so all that is required is to re-allocate some or all of the system memory.

The first step is to determine how many tracks of different lengths are required. Use the <061*nn> code to de-allocate all tracks starting with and following track number "nn" -- it is usually advisable to start at track "00" and re-allocate all tracks at once, but this is not required. The <061nn*tt> code is used to allocate <nn> tracks at <tt> seconds each. This continues until all desired tracks are allocated, or until the 100th track is allocated (at which point the DVR will no longer accept allocation inputs and an "Abort" response is sent). The "Abort" response simply means that all of the 100 system tracks have been allocated. The re-allocation process should be done before recording tracks because each re-allocated track is erased in the process. The allocation data is stored in non-volitile memory which is specified to maintain data for up to 10 years. Thus, if the DVR looses power, the tracks must be re-recorded, but the time allocations are retained.

APPENDIX C: Adding DRAM

Adding memory to the DVR is relatively simple. However, the process requires that all power be removed from the DVR board -- this will necessitate that all tracks be re-recorded after the memory is added. Memory is added in groups of four 1 Mega-bit DRAMS (411000, 511000, or equivalent) as follows:

first group: U1, U11, U21, & U31
second group: U2, U12, U22, & U32
: :
: :
last group: U8, U18, U28, & U38

Any supplier of computer memory is likely to supply the DRAMS used on the FF-8070. The access time is not critical (anything faster than 120ns is sufficient). FF-Systems can also provide additional memory if another source is not available.

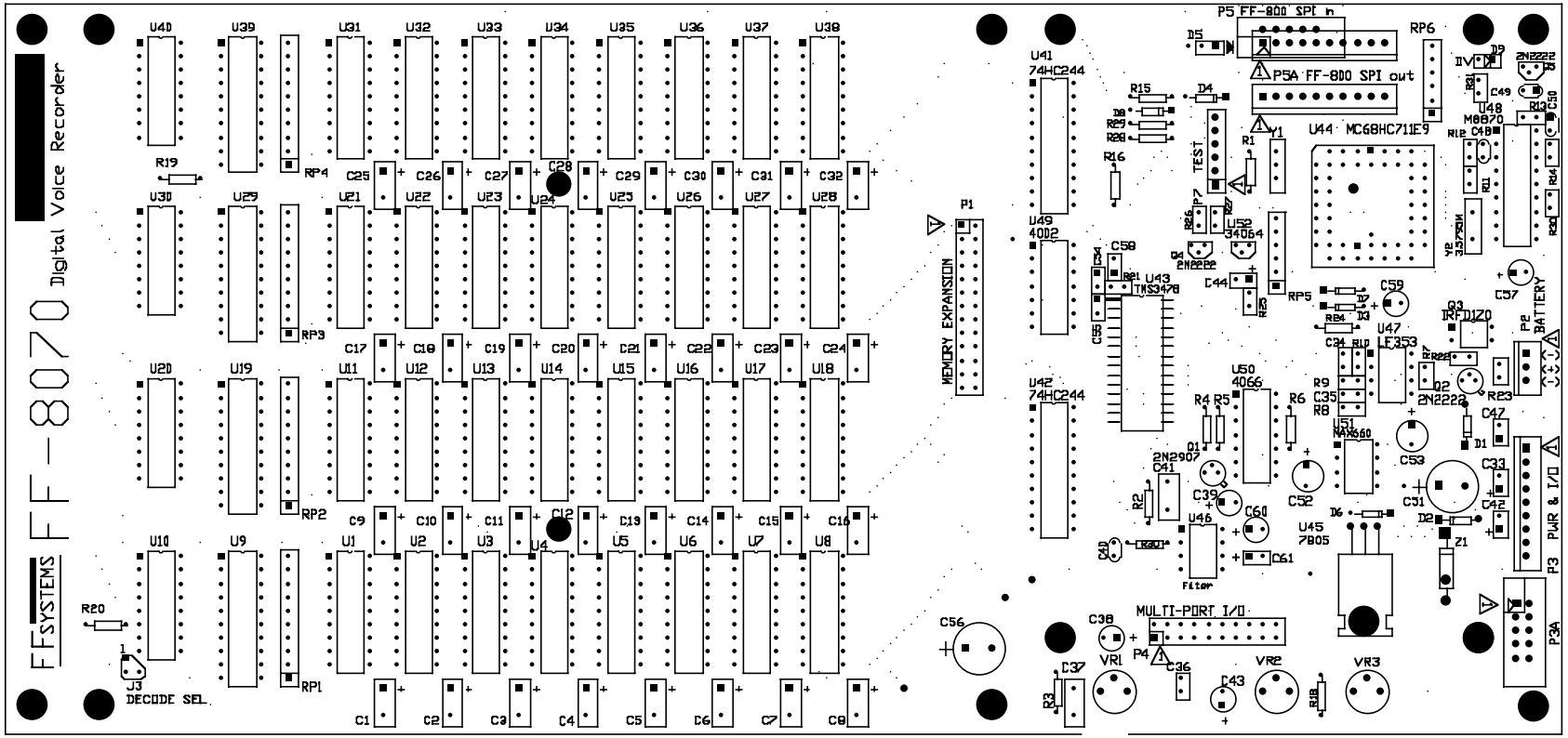
After the installation, the user must execute the **DRAMS Installed** and **MAIL Tracks** commands to tell the DVR how much memory is installed and to reconfigure the mail box system. **MAIL Tracks** must be executed even if there is no change to the number of voice mail tracks.

For systems that require more memory than the 10 minutes available on the FF-8070, a memory expansion card is available that piggy-backs on to the FF-8070 (part# FF-8070EXP). This card provides room for an additional 32 DRAMS or about 10 more minutes of record time. Contact FF-Systems for more information.

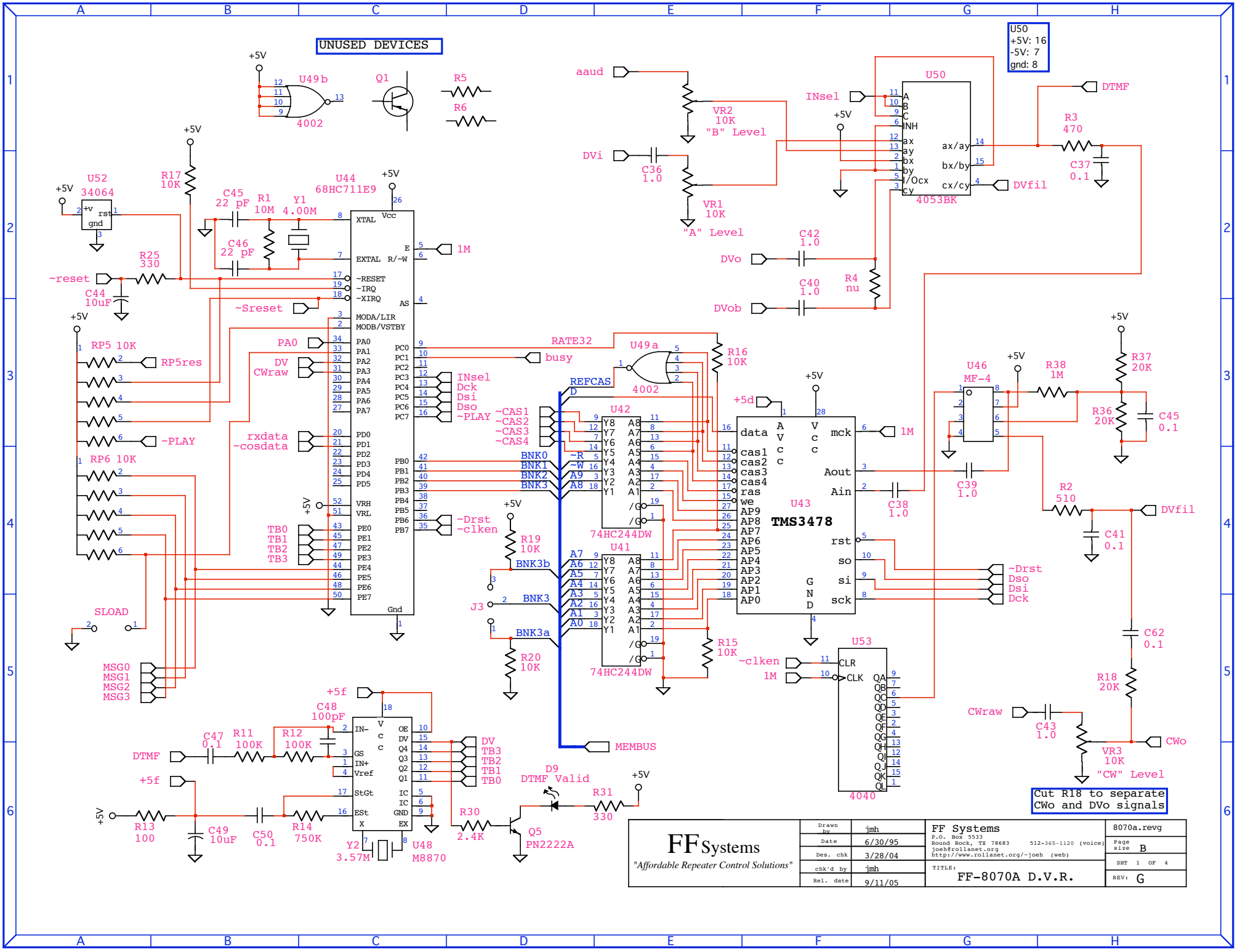
APPENDIX D: Schematic and Parts Layout

FF-8070A Parts List

C1 - 32, 37, 41, 45, 50, 60, 61, 62	0.1 µF ceramic capacitor, 50V
C33, 36, 38, 39, 40, 42, 43, 47	1.0 µF non-polarized electrolytic capacitor, 35V
C34, 35, 48	100 pF ceramic capacitor, 50V
C41	0.01 µF ceramic capacitor, 50V
C44, 49, 57, 58, 59	10 µF electrolytic capacitor, 25V
C51	330 µF elecrolytic capacitor, 35V
C52, 53, 56	100 µF electrolytic capacitor, 25V
R1	10M Ω, 1/4 watt resistor
R2	5.1 KΩ, 1/4 watt resistor
R3	470 Ω, 1/4 watt resistor
R9, 22	1K Ω, 1/4 watt resistor
R18, 23	20K Ω, 1/4 watt resistor
R7	51K Ω, 1/4 watt resistor
R8, 10, 15, 16, 19, 20, 26, 28,	10K Ω, 1/4 watt resistor
R11, 12	100K Ω, 1/4 watt resistor
R13	100 Ω, 1/4 watt resistor
R21	10 Ω, 1/4 watt resistor
R24, 25, 27, 29, 30	330 Ω, 1/4 watt resistor
R17, 36, 37	20K Ω, 1/8 watt SMD resistor, 1206 type package
VR1 - 3	10K Ω potentiometer
RP1 - 4	1.5K x 9 resistor pack, common bus
RP5 - 6	10K x 5 resistor pack, common bus
D1, 2, 6	1N4001 Diode, 50PIV
D7, 8	1N4735, 6.2 V zener diode, 1/2 watt
LED1 (P5-8 and P5-9)	red LED, (DTMF detect)
Q2, 4	PN2222A NPN transistor
Q3	IRFD1Z0 N channel HEXFET transistor
Z1	15V tranzorb circuit protector
Y1	4.00MHz ceramic resonator
Y2	3.5795MHz crystal
U1 - 8, 11 - 18, 21 - 28, 31 - 38	411000 1 M x 1 bit DRAM I.C.
U9, 19, 29, 39	74HC244 Octal bus driver I.C.
U10, 20, 30, 40	74HC138 1 of 8 decoder I.C.
U43	TMS3478NL CVSD record/playback I.C.
U44	MC68HC711E9-CFN2 microprocessor I.C.
U45	LM7805 +5V regulator I.C.
U46	MF-4 low pass filter I.C.
U47	LF353 op-amp I.C.
U48	M8870 DTMF receiver I.C.
U49	4002 Dual 4 input NOR gate I.C.
U50	4053 3PDT analog switch I.C.
U51	ICL7660 dc-dc converter I.C.
U52	MC34064P-5 voltage monitor I.C.
U53	4040 ripple counter I.C.
P2	3 pin Molex header
P3	9 pin Molex header
P7	6 pin header



FF-8070 Component Layout


UNUSED DEVICES
U49b
4002
Q1
R5
R6
U50
+5V: 16
-5V: 7
gnd: 8
aaud
VR2
10K
"B" Level
DVi
C36
1.0
VR1
10K
"A" Level
INsel
4053BK
ax/ay
bx/by
cx/cy
DTMF
R3
470
C37
0.1
DVfil
C42
1.0
DVo
C40
1.0
DVob
R4
nu
U52
34064
R17
10K
C45
22 pF
R1
10M
Y1
4.00M
C46
22 pF
U44
68HC711E9
R25
330
~reset
C44
10uF
~Sreset
1M
RP5 10K
RP5res
~PLAY
RP6 10K
SLOAD
MSG0
MSG1
MSG2
MSG3
PA0
DV
CWraw
rxdata
~cosdata
TB0
TB1
TB2
TB3
INsel
Dck
Dsi
Dso
~PLAY
~Drst
~clken
RATE32
busy
U49a
4002
R16
10K
REFCAS
~CAS1
~CAS2
~CAS3
~CAS4
U42
BNK0
BNK1
BNK2
BNK3
74HC244DW
U41
BNK3b
BNK3
BNK3a
J3
R19
10K
R20
10K
R15
10K
MEMBUS
+5d
U43
TMS3478
mck
Aout
Ain
rst
so
si
sck
U46
MF-4
R38
1M
R37
20K
R36
20K
C45
0.1
C39
1.0
C38
1.0
R2
510
C41
0.1
C62
0.1
R18
20K
C43
1.0
VR3
10K
"CW" Level
CWo
U53
CLR
CLK
4040
Cut R18 to separate
CWo and DVo signals
+5f
C48
100pF
C47
0.1
R11
100K
R12
100K
U48
M8870
Y2
3.57M
C49
10uF
C50
0.1
R13
100
R14
750K
R30
2.4K
D9
DTMF Valid
R31
330
Q5
PN2222A
FF Systems
"Affordable Repeater Control Solutions"
Drawn by jmh
Date 6/30/95
Des. chk 3/28/04
chk'd by jmh
Rel. date 9/11/05
FF Systems
P.O. Box 5533
Round Rock, TX 78683 512-365-1120 (voice)
joeh@rollanet.org
http://www.rollanet.org/~joeh (web)
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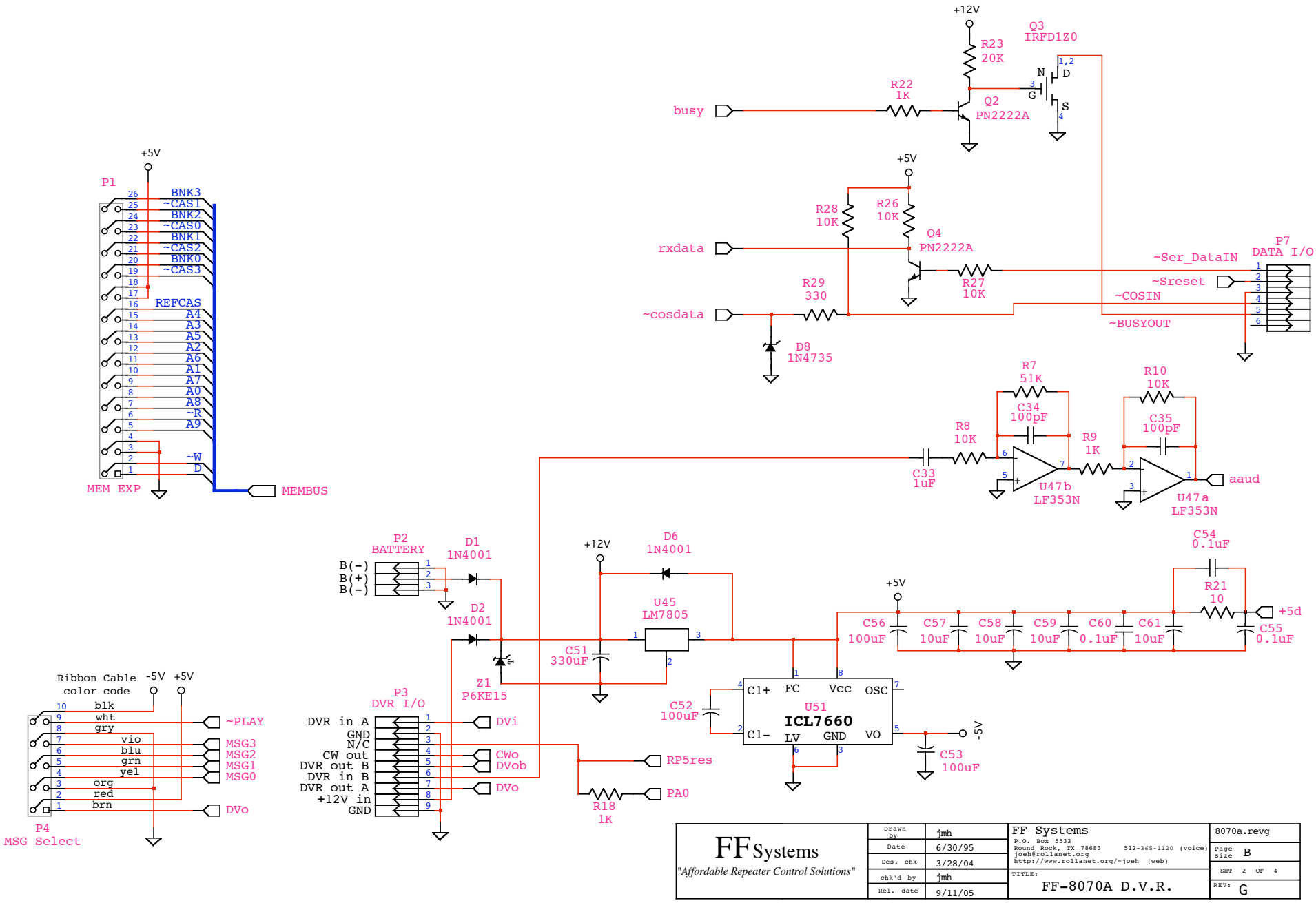
FF-8070A D.V.R.
REV: G



FF Systems "Affordable Repeater Control Solutions"	Drawn by	jmh	FF Systems P.O. Box 5533 Round Rock, TX 78683 512-365-1120 (voice) joeh@rollanet.org http://www.rollanet.org/~joeh (web)
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	chk'd by	jmh	TITLE: FF-8070A D.V.R.
	Rel. date	9/11/05	

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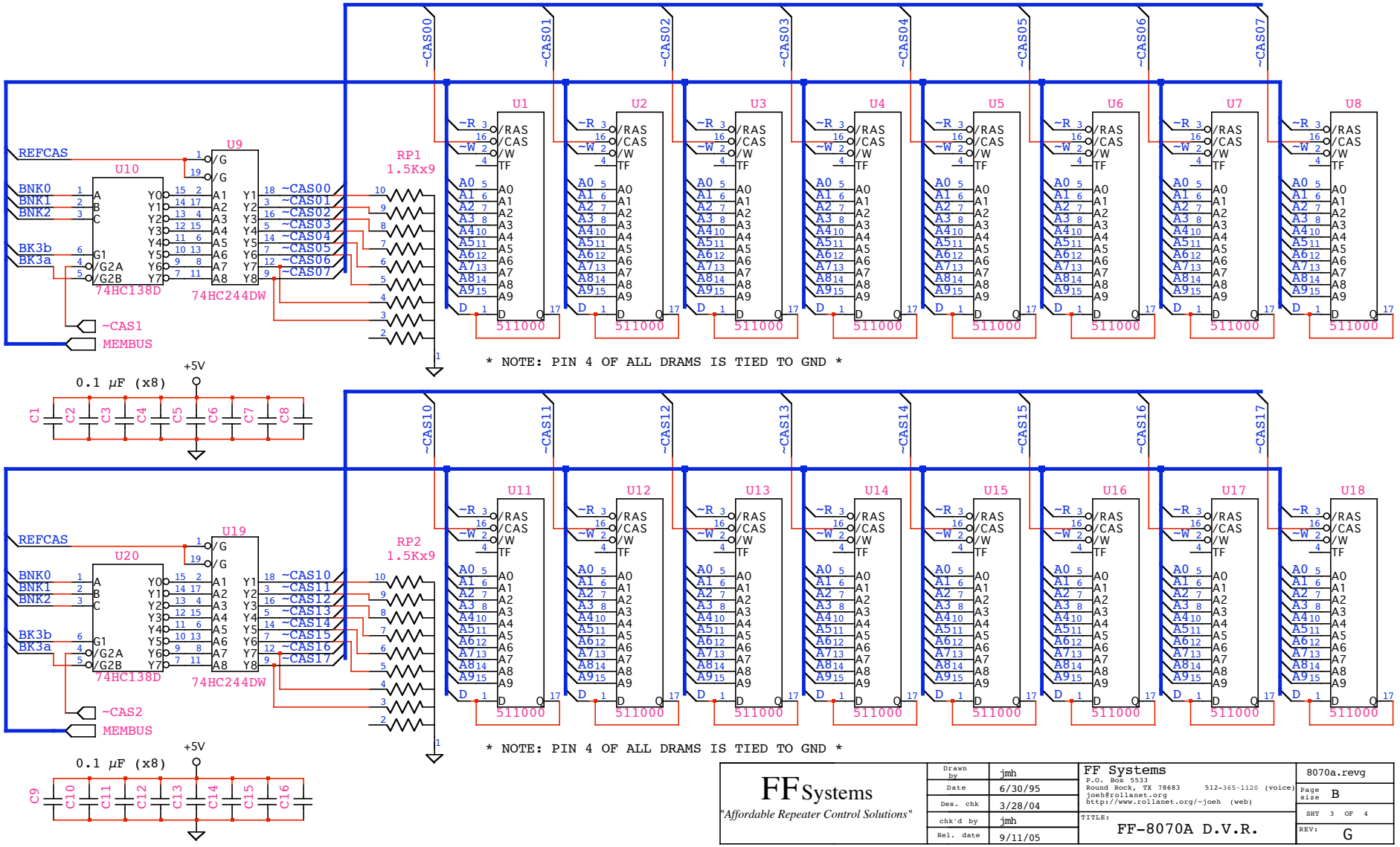

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Date	6/30/95
Des. chk	3/28/04
chk'd by	jmh
Rel. date	9/11/05

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joeh@rollanet.org
http://www.rollanet.org/~joeh (web)

TITLE: FF-8070A D.V.R.

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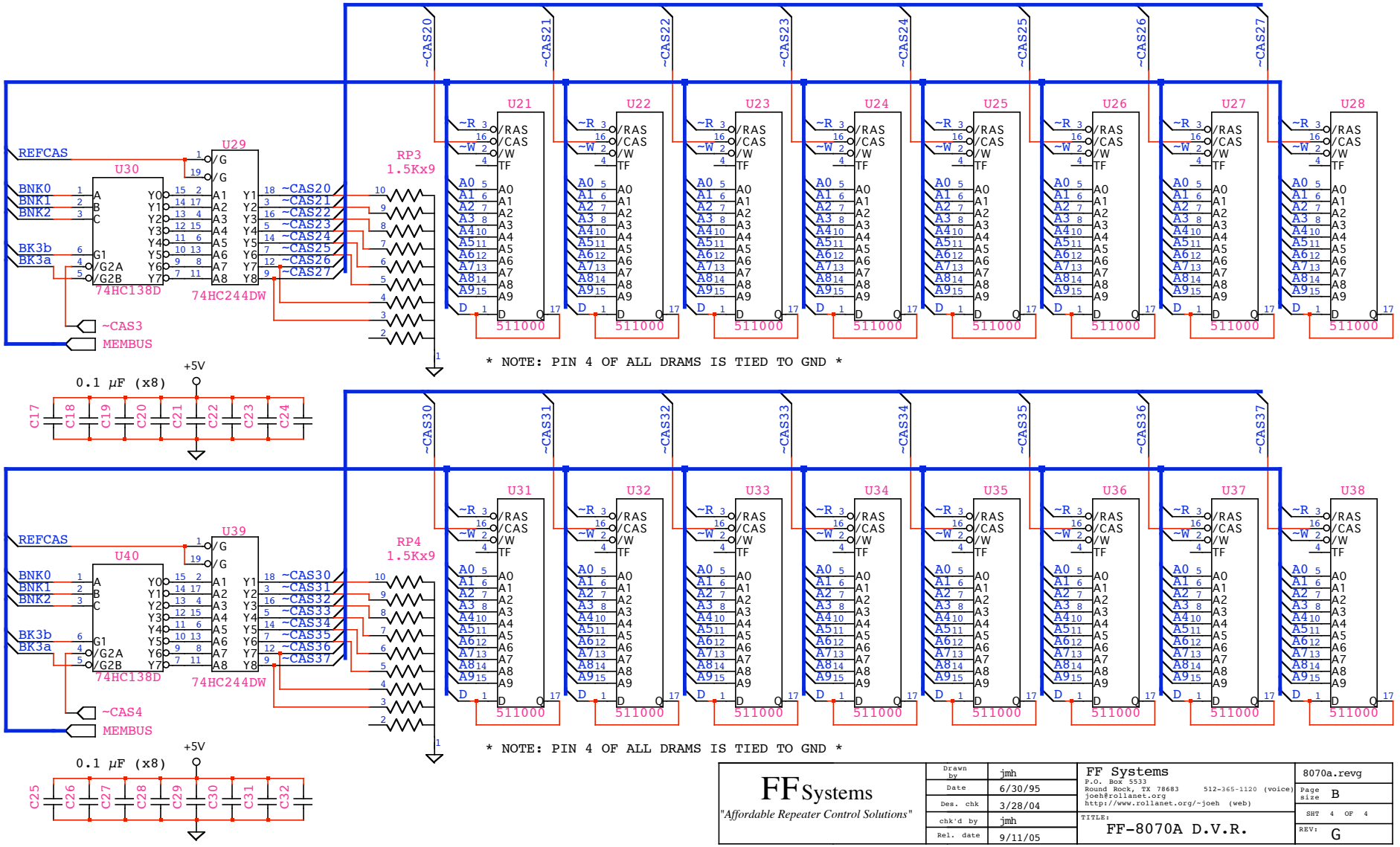

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"Affordable Repeater Control Solutions"

Drawn by	jmh
Date	6/30/95
Des. chk	3/28/04
chk'd by	jmh
Rel. date	9/11/05

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http://www.rollanet.org/~joeh (web)

TITLE: FF-8070A D.V.R.

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REV:	G

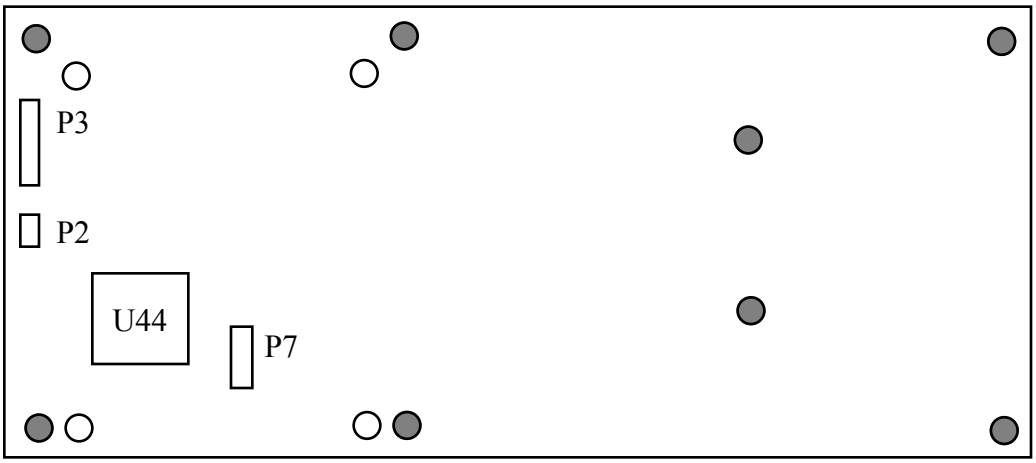
Appendix E: FF8070 Mechanical Installation

Notes about mounting your new DVR

The FF-8070A includes 8 standoffs and associated hardware to be used in the installation of the DVR board. However, the DVR features 14 mounting holes -- which you use is not important to the operation of the system as long as all 8 standoffs are used (and they are distributed evenly accross the board). If you are considering the addition of the FF-8070EXP memory expansion module, you will need to be sure to install the standoffs as shown in the figure below. Failure to do so may result in difficulty when you try to install the FF-8070EXP.

● = Use these holes to mount the board.

○ = Don't use these holes.



FF-8070 Mounting hole diagram. Not to scale -- mounting holes exaggerated for clarity.

APPENDIX F: ACC RC-85/96/850 Repeater controllers

The factory supplied FF-8070 has all of the features needed to operate in unison with ACC repeater controllers. However, there are some modifications that are required to connect these controllers. This application note details the connections to the ACC repeater controllers, as well as the required modifications for the FF8070A.

Connections:

Table 1 shows the connections required for the ACC repeater controllers. You will need an appropriate length of wire or multi-conductor cable to connect the FF-8070A. We recommend 9 conductor sheilded cable which uses 26AWG insulated conductors. Use the connector housings and pins supplied with the FF-8070A to make the connections. Refer to the FF-8070A manual for details on attaching and installing the pins.

DVR signal	FF8070A	ACC signal	RC-85	RC-96	RC-850
audio IN	P3-1	RCV audio	J4-7	J4-3	%
COS in	P7-4	RCV COS	J3-1	J4-8	Dig I/O, 17
audio OUT	P3-7	TX Mix	J4-2	J4-1	%
Busy OUT*	P7-5	BUSY	J3-6	J4-7	Analog, 19
aux IN	P3-6	Phone OUT	U16, pin1	J4-5	U5, pin7
Data	P7-1	Serial Data (CX-1)	J3-12	J4-4	Dig I/O, 11
AGND	P3-2	Analog Gnd		J4-2	
DGND	P7-3	Digital Gnd		J4-SH	

% RX audio and COS...refer to the RC-850 manual for further information.
* FF-8070A modification required for rev F and lower PCB versions, see below.

When connecting to the RC-85 or RC-850, you should note that several of the ACC signals listed above (ie., Serial Data, RCV audio, or RCV COS) may already have connections. The FF-8070A should "parallel" these connections.

The FF-8070A requires LOW COS input. If your receiver provides active high COS (ie., there is >4V the the COS when squelch is open), you may be required to remove R28 and install a pull-down resistor from COS to ground. The resistor value should be in the 10K to 51K range. Be sure to set the FF-8070A for active high COS. This can be done by connecting the receiver audio to the AUX audio input (P3-7) (leave the COS input to the FF-8070A disconnected) and entering: 80700991#. The 8070A will respond with "SET COS HI" in CW. Next, ground the COS input to the 8070A (still with the reciever COS disconnected) and enter: 8070067800#. The response to this command is "D V R S V C" in CW, this command saves the COS level setting. The receiver may now be connected to the DVR input (P3-1) and the COS input (P7-4).

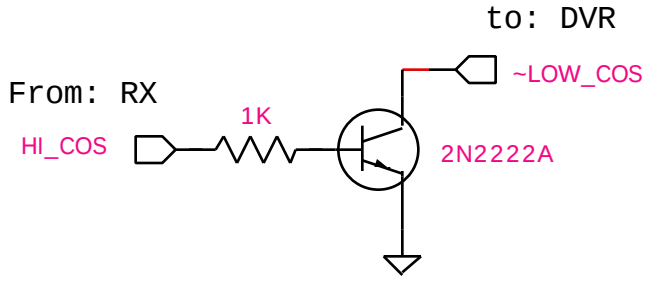
As an alternative to the pull-down resistor (i.e., in cases where there isn't enough voltage to drive the COS input) an inverter must be installed between the reciever COS and the FF-8070A. See Figure 1 for and example circuit using a 2N2222A NPN transistor. When using this method, the COS configuration steps shown above are not required due to the fact that the FF-8070A is factory configured for active low COS.

Busy Out Signal
The Busy out signal may be modified by user command on rev G and higher PCBs (see appendix G) to be either active low or active high. Note that the ACC Controllers require an active high busy signal.

For rev F and lower PCBs, the Busy OUT signal from the FF-8070A only goes low when the DVR is processing a command. This is reversed from the requirements of the ACC controllers. To correct this, remove Q3 from its socket (see the parts placement diagram in the FF-8070A manual) and install a jumper from pins 2 to 3 of Q3 (see figure 2). A trimmed lead from a 1/4 watt resistor makes a good jumper for this purpose. This effectively inverts the BUSY signal and provides the proper logic level for the ACC controllers.

A note about phone line operation for rev F and lower PCBs:
The FF-8070A can be operated via the phone line interface of the ACC controller. Command and record operations may be performed as described in the FF-8070A manual. However, the ACC controller will direct the DVR responses to the repeater output. This is due to the fact that the FF-8070A only has one audio output port. Thus, you will have to be aware that your actions may be heard on the output of the repeater when the phone line is used to control the FF-8070A.

A note about phone line operation for rev G and higher PCBs:
The DVR has a "DVR out B" signal (P3-5) which is only active during "B" channel operations. Thus, the above limitation is not an issue for the more recent DVR versions. For controllers that lack a "B" channel input, the DVR out B signal at P3-5 may be tied to P3-7 (DVR out A) to allow the "B" channel output to play to the main channel.



COS Level conversion Circuit

Figure 1. Transistor inverter example

The FF-8070A DATA input requires an external pull-up resistor for proper operation. If the CX-1 data from the ACC controller does not already have resistor, one must be installed -- 10K to +12V is acceptable.

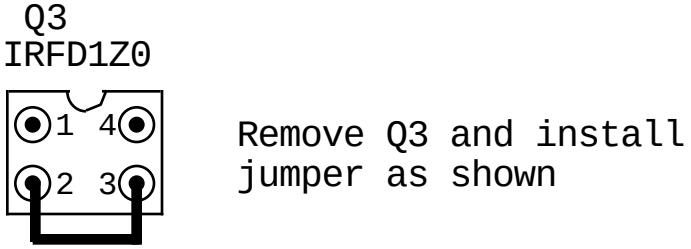


Figure 2. BUSY output modification
(Rev F and lower PCBs only)

RC-85 Set-up

The RC-85 dip switches must be set according to the table below for proper operation. No change of these switches is required if the RC-85 is currently connected to a BCD-type radio interface. Consult the RC-85 manual for more information regarding the dip switches.

	SW4	SW5	SW6
BCD interface	on	on	off
BCD interface (glitch free)	on	on	on

Table of RC-85 switch settings.

Adding DVR tracks to RC-85 messages

The RC-85 must have firmware version 2 or higher to interface to the FF-8070A. DVR tracks CAN NOT be mixed with CW or speech. However, a single message may play several DVR tracks. The following procedure illustrates the programming process:

1) Unlock the RC-85 security access.

2) Enter *13xy, where "xy" specifies the desired message.

3) Enter "P(track number)" for as many tracks as are desired. For example: To play tracks 29 and 30 in a message, enter: "71 02 09 71 03 00" (71 is the ascii value for "P").

4) When finished, enter a "*0" to store the message.

5) refer to the FF-8070A manual for information in recording DVR tracks.

RC-850 & RC-96 Set-up

Refer to your controller's manual for details on DVR setup and programming. The set-up and controller programming are the same as for the ACC DVR.

FF-8070A Chassis Connections:

The FF-8070A Chassis option features an enclosure to house the FF-8070A DVR. The Chassis features two connectors, two power LEDs, and two fuses. The LED/fuse combinations are for the main power and battery power inputs. The DB-9 male connector is for power (both main and battery) while the DB-9 female connector is for the repeater connection. The following table lists the connector pinouts:

P201: Power	P202: RC-96
(DB-9, male)	*(DB-9, female)*
1) Main +12V in	1) TX Audio (J4-1)
2) Main +12V in	2) AGND (J4-2)
3) Battery +12V in	3) RX Audio (J4-3)
4) n/c	4) Serial Data (J4-4)
5) n/c	5) Phone Out (J4-5)
6) GND	6) Phone Spare In (same as TX Audio) (J4-6)
7) GND	7) Busy Out (J4-7)
8) GND	8) COS in (J4-8)
9) GND	9) DGND (J4-SH)

NOTE: the P202 pinout reflects the ACC RC-96 controller, but may be adapted for any controller as needed.

APPENDIX G: New Commands (V2.23 thru 2.25)

Set Busy Polarity Set the Busy output active level (hi or low)

<prime><097> Read busy setting

response: "BZY" plus "HI or "LOW"

<prime><0970> Set busy = active low (GND)

response: "SET BZY LOW"

<prime><0971> Set busy = active high (open circuit)

response: "SET BZY HI"

The busy polarity may be adjusted to match that required by the host controller. ACC repeater controllers require an active high busy signal to function with the DVR.

Set ID Timer Set ID time period

<prime><057> Read ID timer setting

response: "ID" plus the ID time or "OFF"

<prime><057nn> Set ID timer to "nn" min (nn = 0 to 99)

response: "SET ID" plus the ID time or "OFF"

The ID Timer is the amount of time between IDs. The valid range is 0 to 99 minutes. A setting of "0" turns off the ID function. None of the other ID parameters are affected by turning off the ID function.

Set ID Window Set ID timer window to allow "smart ID"

<prime><0581> Read ID window setting

response: "ID WIN" plus the value

<prime><0581nn> Set ID window to "nn" sec (nn = 0 to 99)

response: "SET ID WIN" plus the value

The ID window is the time remaining within the ID time out period in which the DVR will attempt to send an ID after a loss of active COS. In this way, the DVR will attempt to send an ID just before the ID timer expires, but not while someone is transmitting (unless the ID timer reaches zero). A typical value for the ID window time is 30 to 60 seconds. The valid range is 0 to 99 seconds.

Set ID Gap Time Set ID Gap window

<prime><0582> Read ID gap setting

response: "ID GAP" plus the value

<prime><0582nn> Set ID gap to <nn> sec (nn = 0 to 99)

response: "SET ID GAP" plus the value

The ID Gap Time is similar to the repeater hang time and specifies how long after a loss of valid COS before an ID will be attempted if the ID timer is within the ID window. While the valid range is 0 to 99 seconds, this setting should be from 0 to 10 seconds for best performance.

Set CW ID Message Set CW ID message

<prime><0583>	Play the current CW ID message
<prime><0583> <codes>	Set CW ID message
<prime><058304>	Delete the last character of the message
<prime><058327>	Clear the entire CW ID message

The CW ID is the message sent when the ID timer expires while someone is presenting an active COS to the DVR. This COS would have been active for a time that is longer than the ID window setting, so no "smart ID" could be sent and the ID timer reached zero.

The <codes> are 2 or 3 digit character codes that are each separated by a "*" digit. Each code is the ASCII representation of the desired alpha-numeric character desired. The following table depicts the supported codes. Codes that are unsupported are ignored and are not included in the table listing:

Code	Character	Code	Character	Code	Character
32	space	61	--	77	M
44	,	63	?	78	N
45	-	64	@	79	O
46	.	65	A	80	P
47	/	66	B	81	Q
48	0	67	C	82	R
49	1	68	D	83	S
50	2	69	E	84	T
51	3	70	F	85	U
52	4	71	G	86	V
53	5	72	H	87	W
54	6	73	I	88	X
55	7	74	J	89	Y
56	8	75	K	90	Z
57	9	76	L		

Example:

To set the CW ID to "DE KE0FF/R", enter the following codes (default <prime> code illustrated):

8070058327
The DVR responds with "SET NO ID" in CW.
8070058368*69*32*75*69*49
The DVR responds with "SET DE KE1" in CW.
807005804
The DVR responds with "SET DE KE" in CW.
8070058348*70*70*47*82
The DVR responds with "SET DE KE0FF/R" in CW.
80700583
The DVR responds with "DE KE0FF/R" in CW.

Note that the "SET" message is not part of the CW ID message and is only sent when new codes are entered. The CW ID is automatically stored into nonvolotile memory as each sequence of characters is entered.

DVR ID System

The DVR ID system uses the message play table to define which messages are sent as DVR IDs (see **Set Message Table**, pg. 12). Message Table entries 8 thru 11 hold the "main" voice ID track numbers while message Table entries 12 thru 15 hold the COS ID track numbers. If no track number is entered for the COS ID tracks, then the DVR will send the CW ID message if an ID is required while the COS is active.

The DVR will automatically rotate through the programmed message table entries allowing a variety of different DVR tracks to ID the repeater on successive ID cycles. If only one type of ID is desired, then the user should enter only that DVR track# into all 4 slots in the message table for either the main slots (8 - 11) or COS ID slots (12-15) (the main & COS IDs may be different tracks).