Gilderfluke & Co.
ROBOTICS & SOUND SYSTEMS

- MACs -
- DIGITAL AUDIO SYSTEM -

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CC-400
CARD CAGE W/
4 REPEATERS

TWO CC-400
CARD CAGES
W/ 8 REPEATERS

CC-1600
CARD CAGE W/
16 REPEATERS

CC-3250
CARD CAGE W/
32 MINI
REPEATERS

MA-100
PA MASTER

MA-200
PA INTERFACE

AMPLIFIERS → SPEAKERS

UP TO 256
PA
STATIONS

REPEATER
POWER
SUPPLIES
AS NEEDED

OPTIONAL PRINTER

OPTIONAL
COMPUTER OR
TERMINAL

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- MACs DIGITAL AUDIO SYSTEM -
- A System Overview -

The MACs DIGITAL AUDIO SYSTEM has been developed to meet all of your needs for Digital Audio Repeaters, Low Level Processing, and Public Address Systems. The following sub systems are available:

· Digital Audio Repeaters (DR-100, DR-300, DR-50, and AB-50)

· Audio Processing Modules (DR-300 and DR-400)

· Intelligent Public Address System

· Digital Audio Sampling System (DAS-100)

Each of these can be used alone or as part of your overall audio system. When used together, all you need to add to make a complete audio system are the power amplifiers and speakers.

Digital Audio Repeaters:

A Digital Audio Repeater is a solid state replacement for loop and cartridge tape decks. It meets the demanding requirements for professional voice message, high quality music, and sound effects systems.
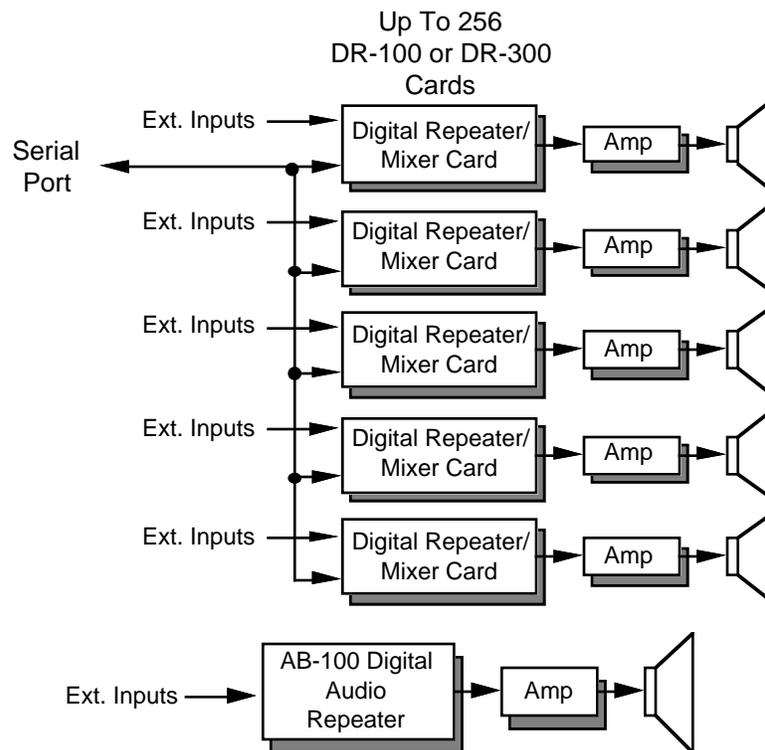
Because it is completely solid state, a Digital Audio Repeater never requires any maintenance. A sound which is recorded on a Digital Audio Repeater will sound just as good twenty or thirty years from now.

Each DR-100 , AB-100 or DR-300 contains a Digital Audio Repeater (the DR-300 adds a complete audio processing system to the basic DR-100 card). Their features include:

· Each card is a single complete audio playback system (except for power amplification and speakers).

· Message length is virtually unlimited. Up to seven memory expansion cards can be added as needed.

· Bandwidths of up to 15 KHz supported (35.1 KHz sample rate). This is roughly equivalent to a new audio tape. Each card will also reproduce at 10, 7.5, 5, 4, 3, and 2 KHz bandwidths as

well.

· Dynamic range of up to 72 dB, again roughly equivalent to a new audio tape.

· Up to 255 different messages can be stored on each repeater. Any of these can instantly be accessed through the RS-485 serial port or switch inputs. This lets you easily build interactive audio systems.

· Dynamic Bandwidth Optimization™ allows the repeater to dynamically follow the highest frequencies of the source material. It will actually stop using any memory at all if an instant of silence occurs!

· Two opto-isolated switch inputs, as well as a parallel auxiliary port and RS-485 serial port on each card.

· OP-100 optoisolator available for auxiliary port. 1/4 J6 input is compatible with all our animation systems.

· All configuration is done through the serial port with easy to use menus (or with onboard dipswitches).

· One optically isolated status output for remote 'running' indicators.

· Global/Mix bus allows signals to be mixed into any card's output or a signal to be sent from one card to any number of other cards. This can be used for sending background tracks or announcements to any number of cards in an installation, or for combining a number of outputs from several cards into one.

· Volume, Mix/Global bus volume, and Bass and Treble controls on every card. These are on a small 'adjuster card', which can be moved between cards without changing any of the settings.

· DR-100 and DR-300 cards plug into CC-1600 (16 slot) or CC-400 (4 slot) card cages. Rack kits are available for CC-400 cages.

· You can use any number of cards in a system to provide any number of simultaneous audio tracks.

An AB-100 is a digital audio Repeater which can be used when all you need is a single audio track. It is a 5 x 12 x 2-1/2 inch box which can be mounted wherever you need to put it. Power for the AB-100 comes from a small wallmount power supply or a 12 VDC power supply for mobile installations.

All configuration and commands for the AB-100 are identical to those for all of the other DR-100 Repeaters. It just won't respond to commands for features for which it doesn't have hardware installed (like the PA system commands).

To record a sound into a Digital Audio Repeater, a master (tape, CD, DAT, video tape) of the sound is played into a IBM compatible computer which has a DAS-100 Digital Audio Sampler installed. The DAS-100 takes the original audio and turns it into digital computer data. This data is then 'burned' into computer memory chips called EPROMs. These are plugged into the Digital Audio Repeaters. From this point on, the repeaters can play back this sound whenever they are told to. Since the sound is stored on the repeater in computer memory chips, it will never change or require any service of any kind. Any tape deck would require regular cleaning and lubrication of the tape heads and moving parts, as well as their regular replacement.

Each Digital Audio Repeater can store up to 255 separate messages in its memory. Each of these can be any length from 1/35th of a second on up. Each of these individual messages is known as a 'spiel'. To access these individual spiels on a card, you can use the serial port interface to the audio system or the AUX PORT available on each card. Any spiel on any card can be played through or looped at any time.

Our Digital Audio Repeaters are intelligent, they know how to 'downshift' their bandwidths to follow the highest frequencies in your audio. If there is a moment of silence in your recording, it will actually stop using any memory at all until the sound starts up again. Because of this, our systems are able use far less memory for an equivalent bandwidth. They are also able to play back both low and high bandwidth sounds from the same Repeater card. The Digital Audio Repeaters each check on how much

memory they need to use and adjust their speeds as often as thirty-five times each second.

Although this 'downshifting' saves the amount of memory you need to use, it can make it darned difficult to estimate the number of EPROMs your recording will need until it has actually been digitized. The following charts show the capacities with a variety of sounds using different sized EPROMs:

Approximate Play Times:

Estimated Playing Times For Various Types Of Sounds

Number Of 27C512 Memory Chips	Voices			High Voices	Music	High Music Sharp Sound Effects	
	Low Rumbles						
	2 Khz	3 Khz	4 Khz	5 Khz	7.5 Khz	10 Khz	15 Khz
Each Chip (1 chip)	14 Sec.	9.3 Sec.	7.5 Sec.	5.6 Sec.	3.7 Sec.	2.8 Sec.	1.7 Sec.
each Repeater (16 chips)	3.7 Min.	2.5 Min.	2 Min.	89.5 Sec.	1 Min.	44.6 Sec	30 Sec.
each Expansion (32 chips)	7.5 Min.	5 Min.	4 Min.	3 Min.	2 Min.	89.5 Sec.	1 Min.

Number Of 27C010 Memory Chips	Voices			High Voices	Music	High Music Sharp Sound Effects	
	Low Rumbles						
	2 Khz	3 Khz	4 Khz	5 Khz	7.5 Khz	10 Khz	15 Khz
Each Chip (1 chip)	28 Sec.	18.6 Sec.	14.9 Sec.	11.2 Sec.	7.5 Sec.	5.6 Sec.	3.7 Sec.
each Repeater (16 chips)	7.4 Min.	4.9 Min.	4 Min.	2.75 Min.	2 Min.	1.5 Min.	1 Min.
each Expansion (32 chips)	14.9 Min.	9.9 Min.	8 Min.	5.5 Min.	4 Min.	3 Min.	2 Min.

Number Of 27C020 Memory Chips	Voices			High Voices	Music	High Music Sharp Sound Effects	
	Low Rumbles						
	2 Khz	3 Khz	4 Khz	5 Khz	7.5 Khz	10 Khz	15 Khz
Each Chip (1 chip)	55.9 Sec.	37.3 Sec.	30 Sec.	22.4 Sec.	14.9 Sec.	11.1 Sec.	7.5 Sec.
each Repeater (16 chips)	14.9 Min.	9.9 Min.	8 Min.	6 Min.	4 Min.	3 Min.	2 Min.
each Expansion (32 chips)	29.8 Min.	19.9 Min.	16 Min.	12 Min.	8 Min.	6 Min.	4 Min.

Number Of 27C040 Memory Chips	Voices			High Voices	Music	High Music Sharp Sound Effects	
	Low Rumbles						
	2 Khz	3 Khz	4 Khz	5 Khz	7.5 Khz	10 Khz	15 Khz
Each Chip (1 chip)	111.8 Sec.	74.6 Sec.	59.7 Sec.	44.7 Sec.	29.8 Sec.	22.3 Sec.	14.9 Sec.
each Repeater (16 chips)	29.8 Min.	19.9 Min.	15.9 Min.	11.9 Min.	8 Min.	6 Min.	4 Min.
each Expansion (32 chips)	59.6 Min.	39.8 Min.	31 Min.	23 Min.	16 Min.	12 Min.	8 Min.

Number Of 27C080 Memory Chips	Voices			High Voices	Music	High Music Sharp Sound Effects	
	Low Rumbles						
	2 Khz	3 Khz	4 Khz	5 Khz	7.5 Khz	10 Khz	15 Khz
Each Chip (1 chip)	223.7 Sec.	149.1 Sec.	119.3 Sec.	89.5 Sec.	59.7 Min.	44.7 Sec.	29.8 Sec.
each Repeater (16 chips)	59.6 Min.	39.8 Min.	32 Min.	24 Min.	16 Min.	12 Min.	8 Min.
each Expansion (32 chips)	119.3 Min.	79.5 Min.	64 Min.	48 Min.	32 Min.	24 Min.	16 Min.

Each DR-50 or AB-50 MiniRepeater holds one EPROM. There is no expansion available on these repeaters.

Each DR-100, DR-300, or AB-100 Digital Audio Repeater Card holds 16 EPROMs. If your recording needs more space than this, you can add memory expansion cards to the Repeater cards. Each expansion card holds another 32 EPROMs. The difference between a MX-100 and a MX-200 is their height. A Digital Audio Repeater / Mixer card with one MX-200 memory expansion board can fit into the same 1 inch wide space as the Digital Audio Repeater / Mixer alone. With two or more memory expansion cards, additional 1 inch wide spaces will be needed and you can use MX-100 expansion cards. Each Digital Audio Repeater / Mixer card can support unlimited amount of data storage. The only limitation is the physical mounting of the memory expansion cards. Seven expansion cards on a Repeater card is the normal physical limit for card cage mounted systems. This forms a package which takes up 4 inches of card cage space.

In audio bricks (AB-100) there is room for up to three memory expansion cards.

The Digital Audio Repeater / Mixer cards can support any type of EPROM memory chips from 27C512

up to 27C080. Each Digital Audio Repeater / Mixer must be told what type of memory chips are being used. This is done in the configuration mode.

Audio Processing:

DR-300 or DR-400 Repeater cards add:

1) Voltage Controlled Amplifier (VCA)

2) Intelligent PA System support

The VCA can be used to remotely control the volume of the audio produced by the card (or fed to it from an outside source) with any 0 to 10 VDC control signal, or from the Intelligent PA System

If these cards are used with the Intelligent PA System, they can be configured to respond to full-mute commands, half-mute commands, or to volume control zone signals from the MA-100 PA System Master. There are eight full and half-mute zones available. Any individual card can be told to respond to any number of these zone commands. There are also eight volume control zones available. Any individual card can be told to respond to any one of the eight volume control zones or to the external VCA input available on each card.

The DR-400 is used when you need to send an audio signal from an external source through Voltage Controlled Amplifiers (VCAs), Intelligent Public Address System, and Shelving Equalizers.

Intelligent Public Address System:

The Intelligent Public Address System is used where a powerful and flexible zoned Public Address System is needed. It can be used with our DR-300 and DR-400 Digital Audio Repeater cards or in stand alone installations.

The PA system consists of one PA Master, one PA Interface Panel for each eight PA stations (the first one is part of the PA Master), and the PA Stations themselves. These are available in four different styles:

1) One Button PA Stations use the microphone's Push To Talk (PTT) button to select any one of the PA zones.

2) The Four Button PA stations can select any of four different PA zones, plus one more with the microphone's PTT button. You can tell the buttons on these stations to latch the zone requested, only momentarily select the zone, or latch it until the next time the PTT button is released.

3) The Smart PA stations can be set up to access all of the features in the entire audio system, including any Digital Audio Repeaters, Animation Control Systems, and volume control zones which happen to be attached to it. They are available with backlit LCD displays on them. Their pushbuttons are normally located on the microphone itself.

4) Phantom PA Stations are used to tie a Digital Audio Repeater to the PA system in order to make automated announcements. When the Repeater is triggered, it will select a PA zone and feed the audio output from the repeater to the selected zone.

Each PA Interface Panel has connections for eight PA stations, eight balanced 'local' PA outputs, and one (optionally eight) balanced Back Ground Music (BGM) inputs. The BGM is normally fed to the eight local PA outputs. When one of these responds to a PA zone request, the PA announcement is fed to it as the BGM is half-muted. Each local PA output can respond to four different prioritized PA zone requests.

The Intelligent Public Address System features include:

· Up to 511 PA zones are available. Sixteen cross-zone announcements can be made at one time, along with any number of local PA zone requests. These latter take place when any PA station requests it's local PA output.

· Supports up to 256 PA stations. These are available in One Button, Four Button or Smart models.

· All setup is done through easy to use menus using any PC or terminal. Configuration includes selecting which zones any PA station button will select, and the normal, half-muted, and PA announcement volumes for the local PA outputs. A key lock and battery protects the configuration data from unauthorized access and power failure.

·   Separate printer and terminal outputs can give a running record of all PA system activity.

·   PA Master controls up to eight volume zones, or any other 0 to 10 VDC controlled device (lights, screens, etc.).

·   Eight PA stations per Interface Panel. Stations are transformer and opto isolated from the rest of the system.

·   Wiring to all PA stations is by 8 conductor telephone line. Power for the stations is provided by the PA interface.

·   Each DR-300 or DR-400 Repeater added to the Intelligent PA system adds another possible PA output to it.

·   The PA system can act as a bridge to run animation systems, Digital Audio Repeaters, etc. from PA stations.

To support the PUBLIC ADDRESS option you will need:

· One MA-100 PA MASTER to control the system and the first eight PA STATIONS.

· One MA-200 for each additional eight PA STATIONS (beyond the first eight) or Local PA Outputs needed.

· Any combination of up to 256 SMART or DUMB PA STATIONS.

· Optionally, any combination of DR-300 or DR-400 Digital Audio Repeater / Mixer cards.
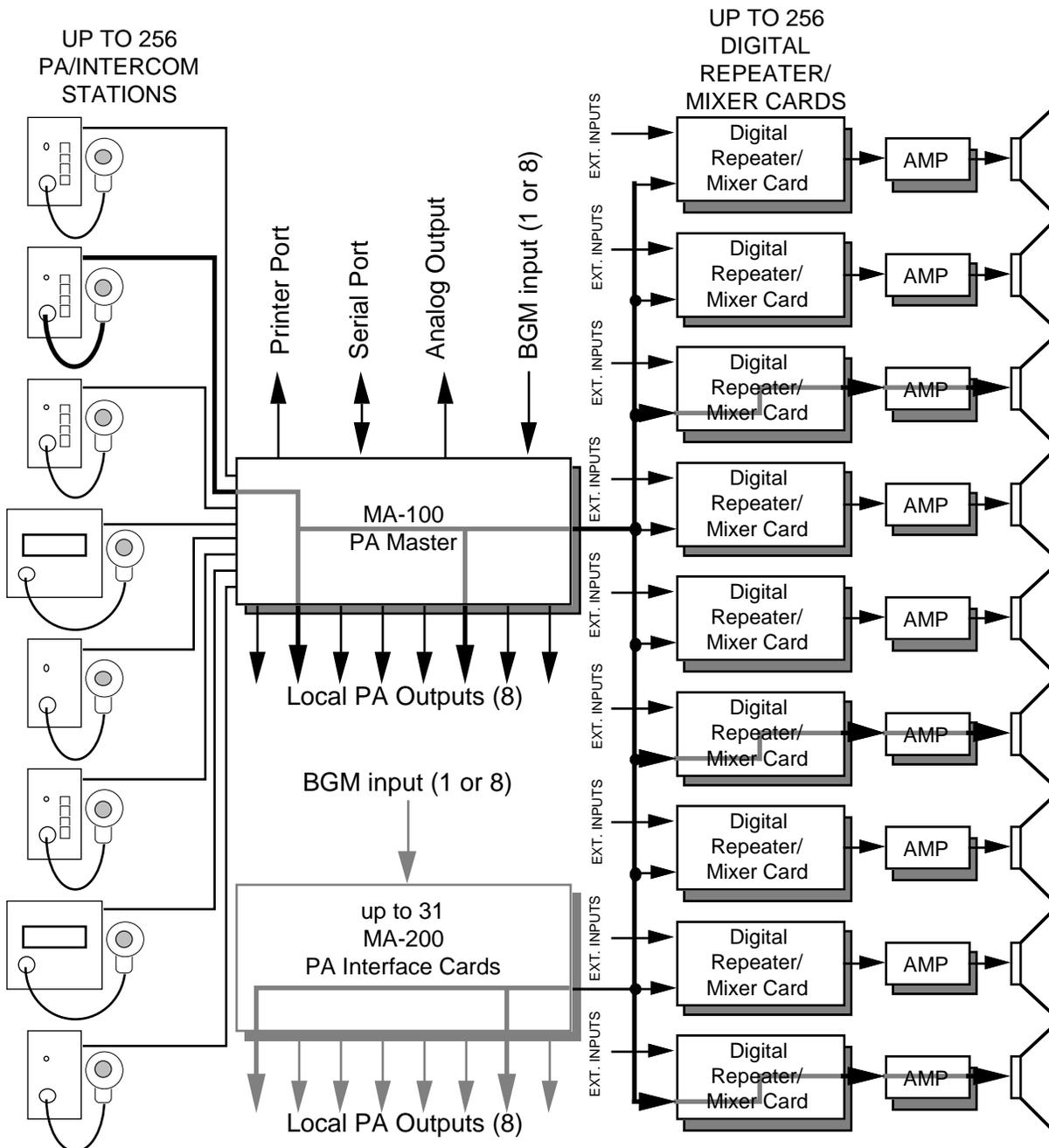
As shown by the darkened audio path in the above illustration, when a user at any PA station requests a PA ZONE, an audio path is opened to any of the Local PA Outputs and DIGITAL REPEATER / MIXER cards in the system which have been configured to respond to requests for that PA ZONE (in this example there are three DR-300 or DR-400 cards and four Local PA Outputs responding). The normal audio on those outputs is dropped to the half muted level (this level is adjustable on each output) while the audio from the PA station is routed to the outputs (the volume of the announcement is also adjustable on each output). The rest of the audio system and the Repeaters on the affected DR-300

cards continue to operate as usual. Up to sixteen such PA announcements can go on at the same time
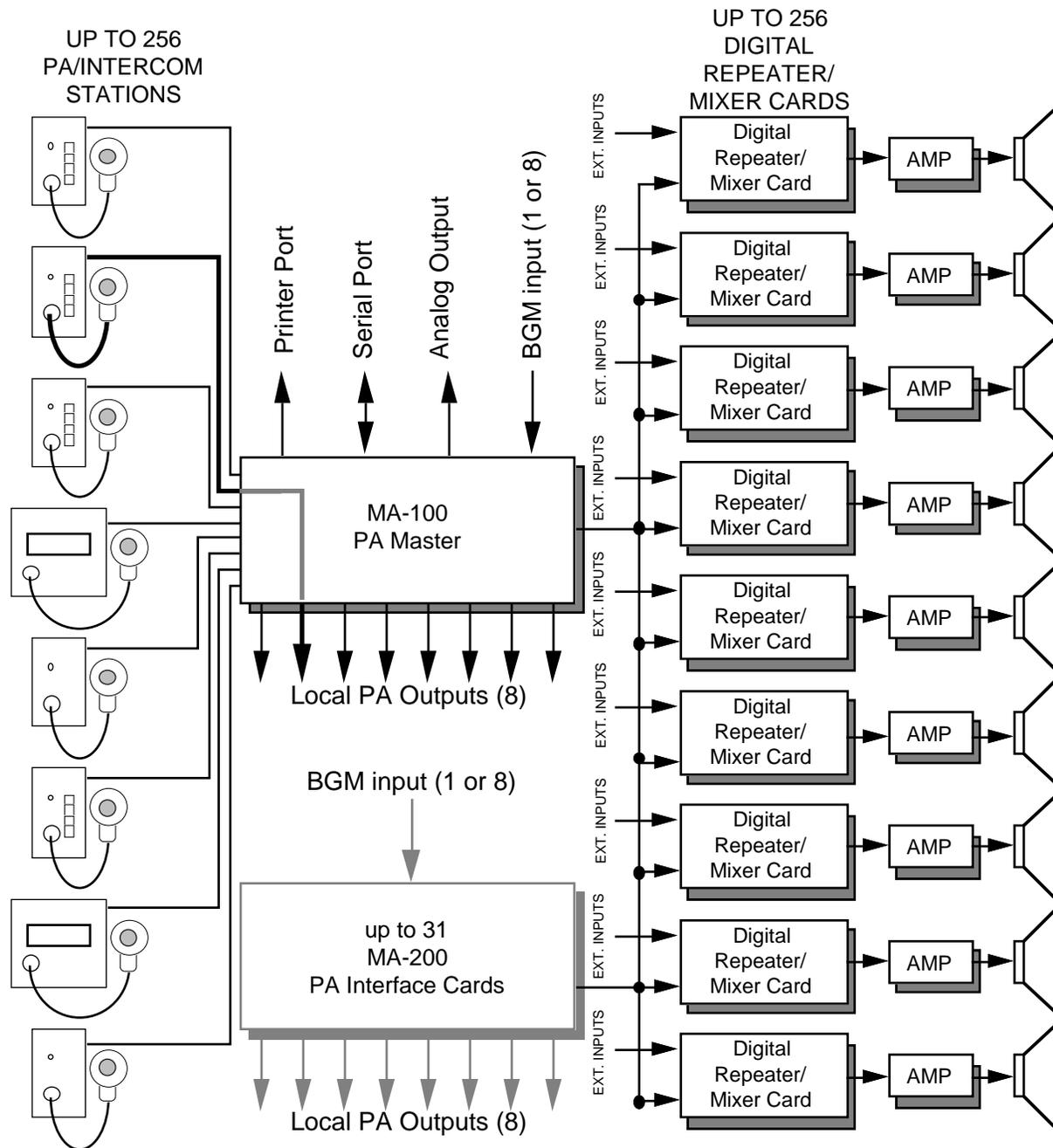
Eight LOCAL PA OUTPUTS are available from each MA-100 or MA-200 card. Each of these outputs normally carries whatever audio is being fed into the 'Back Ground Music (BGM) input' on the back of the unit. When a request for a PA zone comes in from any of the PA STATIONS, the BGM level on any of the LOCAL PA OUTPUTS is dropped to a half-muted level on those LOCAL PA OUTPUTS which are responding and the PA audio is mixed into the output. All audio levels and settings for the LOCAL PA OUTPUTS are adjusted through the software on the MA-100 PA Master. Each LOCAL PA OUTPUT can be told to respond to up to four different PA zone requests. If the PA STATION requesting the LOCAL PA OUTPUT has the same 'number' as the output being requested, a special 'LOCAL PA MODE can be used as shown above. This bypasses the 16 trunk lines which normally carry the PA audio feeds to allow up to 256 such PA announcements to go on at the same time.

There are 256 possible PA ZONES. Any Digital Audio Repeater / Mixer card can be configured to respond to up to eight different PA ZONE requests. Any number of cards can be configured to respond to any individual PA ZONE request. This allows a PA ZONE to be assigned as a global PA ZONE by simply

telling all the Repeater cards in the system to respond to it.

DUMB PA STATIONS are available with either four buttons (plus the microphone button) or one button (just the microphone button). Any of the buttons can be configured to access any PA zone in the system. The buttons on the front of the four button stations can be configured as push-to-talk buttons, to latch the last requested zone, or auto-release the last zone latched when the microphone button is released.

Because the PA system can be used for safety announcements, a number of different priority options are available. The Digital Audio Repeater / Mixer cards each have one PA station each assigned as top and second priority. These are assigned individually for each Digital Audio Repeater / Mixer card. Valid PA requests from the second priority PA station override all other PA requests except those from the top PA station. These priority PA STATIONS will usually be assigned to the station from which safety announcements are normally made, and to the PA station located closest to the emergency exit for the area covered by the speakers attached to that particular Digital Audio Repeater / Mixer card.

If no other PA priority options are used, then all other PA requests will be treated equally. If two valid PA requests come in to the same Repeater card, then both are honored and the audio from both are mixed equally. The STANDARD PRIORITY OPTION allows you to give PA STATIONS with higher number assignments priority over those with lower numbers. The ZONE PRIORITY OPTION allows PA ZONE requests for higher numbered PA ZONES to take priority over those for lower numbered PA ZONES.

The local PA Outputs' priorities are set by the order in which you enter the PA zones an output will respond to. The first entry has the highest priority.

For automated PA announcements, a phantom PA station is used. It is like any other PA STATION except that it has no buttons or microphone on it. The audio and status output from a Digital Audio Repeater is attached to the phantom PA station. When the Repeater is started, the status output triggers the phantom PA station to request a PA ZONE and then feeds its audio into it. The audio will then be routed to the appropriate audio outputs through the PA system just like any other announcement. Different spiels can also be requested and PA Zones accessed through the serial port if needed.

SMART PA STATIONS are available with up to 18 buttons on their microphones. Any button can be configured to request any other intercom station, mute or half-mute zone, send commands to one or more Digital Audio Repeaters, or ramp the volume of any volume control zone up or down. For those PA STATIONS which need access to more features than this number of buttons would allow, a numeric-style entry is used to give them access to any features which you have enabled.

Digital Audio Repeater/Mixer Cards:

These cards are the heart of the MACs Digital Audio System. Each card contains virtually all of the circuitry needed to reproduce and process one audio track. Up to 16 of these cards can fit into one CC-1600 card cage. The Digital Audio Repeater / Mixer cards are available in four versions to best suit your needs:

DR-100:   Digital Audio Repeater and Shelving Equalizer only.

DR-300:   Full card containing Digital Audio Repeater, Mixer, Voltage Controlled Amplifier, Public Address / Muting System, and Shelving Equalizer.

DR-400:   Public Address/Muting System, Mixer, Voltage Controlled Amplifier, and Shelving Equalizer.

AB-100:   Stand-alone version of the DR-100 Repeater card. Comes complete with power supply and case.

A basic DIGITAL AUDIO SYSTEM consists of:

·   One Digital Audio Repeater / Mixer card for each audio track (DR-100)
·   Card Cages to hold the Digital Audio Repeater / Mixer cards
·   Power supplies
·   Power amplifiers
·   Speakers
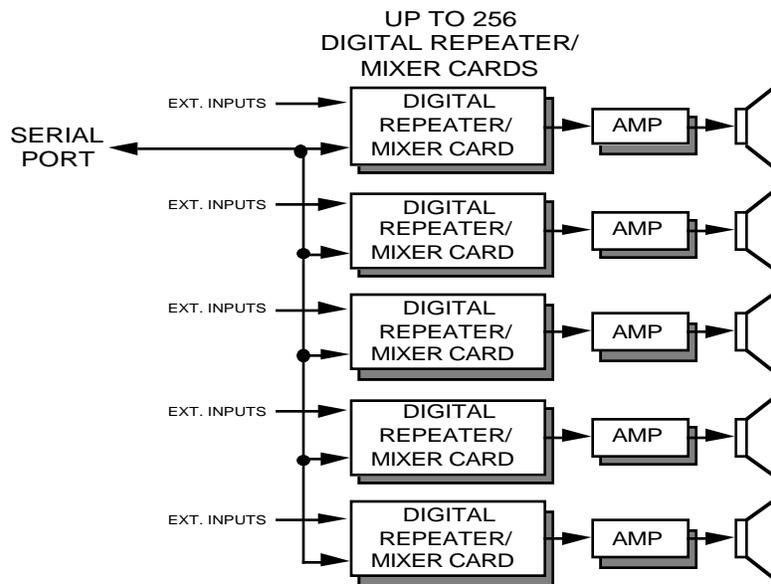
In the basic system DIGITAL REPEATER / MIXER cards act as the source for the audio material and/or to process audio signals before sending them to the power amplifiers and speakers. Up to 256 audio tracks can be supported by using up to 256 Digital Audio Repeater / Mixer cards. The DIGITAL REPEATER is normally the primary source of audio for each track on DR-100 or DR-300 cards. Secondary audio sources can be fed into one of the two external mix inputs available on each DR-300 and DR-400 card. These can come from external sources like audio tape, CD's, video, film, or live microphones.

Additional mixing between individual cards can be done using the MIX / GLOBAL bus available on all DR- Repeaters. The MIX BUS can be used to send a signal which is the combination (sum) of any number of audio signals from other cards into any other one card. This can be used where you need a mixed output, or for bi-amp or sub-woofer applications. The GLOBAL BUS can be used to send the output from any one card to be mixed into the outputs of any number of other cards. This can be used if you need to send a background sound or music to a number of different audio tracks.

The Digital Audio Repeaters can be configured to whatever you want. They can play any spiel just once, or loop any spiel continuously. A delay can be inserted before each spiel, or between each iteration when looping. The control signals for the Repeaters can be sent to them through the serial port, or through the two opto-isolated inputs and auxiliary port available on each card. The external inputs

can run from the audio system's own isolated 'dirty' power supply, or from an external power supply.

Up to 255 different spiels can be stored on each Digital Audio Repeater. These can be any length from 1/35th of a second on up. They can be accessed at random through the serial port or through the AUX PORT. The AUX PORT can be told to use a 'one of eight' style selection, or a parallel 8 bit binary input.

If DR-300 or DR-400 cards are used in a basic audio system, you can use their Voltage Controlled Amplifiers (VCAs) to change the volume of the output from each card. Each card has its own 0 to 10 volt input for the VCA, or you can attach the VCA to one of eight VCA BUS lines if you need to control the volume of more than one card at a time.

The following illustrates the four Digital Audio Repeater / Mixer card options. (The GLOBAL / MIX BUS structure of each card is shown in the GLOBAL LISTEN mode.)

DR-100

DR-300

DR-400

VCA BUS · 10v REF.

PA AUDIO & CONTROL SIGNALS
FROM MA-100 MASTER

VCA IN/OUT

VOLUME

1/2 MUTE

PUBLIC ADDRESS SYSTEM

PA VOLUME

EXTERNAL MIX INPUT 'A'

+
−

EXTERNAL MIX INPUT 'B'

+
−

VOLTAGE CONTROLED AMPLIFIER

35Khz LOWPASS FILTER

BASS   TREB.

GLOBAL/MIX BUS #1
GLOBAL/MIX BUS #2
GLOBAL/MIX BUS #3
GLOBAL/MIX BUS #4
AUXILIARY INPUT

SHELVING EQUALIZER

(or Optional High or Low Pass Filters)

OUTPUT DRIVERS

OUT

AB-100

ISOLATED
POWER SUPPLY

OPTO
ISOLATION

DIGITAL
AUDIO
REPEATER

START & STATUS

35 KHz
LOWPASS

BASS   TREB.

SHELVING
EQUALIZER

(or Optional
High or Low
Pass Filters)

OUTPUT
DRIVERS

OUT

Actual Playing Times:

The following tables show in seconds the capacities of several different types of EPROMs at several different fixed bandwidths. All values shown are in seconds.

- 2 KHz Bandwidth (4,687 Hz UPDATE RATE) -

EPROM: SIZE: Number of bytes per EPROM:			27C512 64K x 8 65,536	27C010 128K x 8 131,072	27C020 256K x 8 262,144	27C040 512K x 8 524,288	27C080 1M x 8 1,048,576
1	EPROM (1 DR-50 MiniRepeater)		13.98	27.96	55.92	111.85	223.70
2	EPROMs		27.96	55.92	111.85	223.70	447.39
3	EPROMs		41.94	83.89	167.77	335.54	671.09
4	EPROMs		55.92	111.85	223.70	447.39	894.78
5	EPROMs		69.91	139.81	279.62	559.24	1,118.48
6	EPROMs		83.89	167.77	335.54	671.09	1,342.18
7	EPROMs		97.87	195.73	391.47	782.94	1,565.87
8	EPROMs		111.85	223.70	447.39	894.78	1,789.57
9	EPROMs		125.83	251.66	503.32	1,006.63	2,013.27
10	EPROMs		139.81	279.62	559.24	1,118.48	2,236.96
11	EPROMs		153.79	307.58	615.16	1,230.33	2,460.66
12	EPROMs		167.77	335.54	671.09	1,342.18	2,684.35
13	EPROMs		181.75	363.51	727.01	1,454.03	2,908.05
14	EPROMs		195.73	391.47	782.94	1,565.87	3,131.75
15	EPROMs		209.72	419.43	838.86	1,677.72	3,355.44
16	EPROMs		223.70	447.39	894.78	1,789.57	3,579.14
Each Expansion:	32	EPROMs	447.39	894.78	1,789.57	3,579.14	7,158.28
Repeater + 1 Expansion:	48	EPROMs	671.09	1,342.18	2,684.35	5,368.71	10,737.42
Repeater + 2 Expansions:	80	EPROMs	1,118.48	2,236.96	4,473.92	8,947.85	17,895.70
Repeater + 3 Expansions:	112	EPROMs	1,565.87	3,131.75	6,263.49	12,526.99	25,053.98
Repeater + 4 Expansions:	144	EPROMs	2,013.27	4,026.53	8,053.06	16,106.13	32,212.25
Repeater + 5 Expansions:	176	EPROMs	2,460.66	4,921.32	9,842.63	19,685.27	39,370.53
Repeater + 6 Expansions:	208	EPROMs	2,908.05	5,816.10	11,632.20	23,264.41	46,528.81
Repeater + 7 Expansions:	240	EPROMs	3,355.44	6,710.89	13,421.77	26,843.55	53,687.09

- 3 KHz Bandwidth (7,031 Hz UPDATE RATE) -

			27C512	27C010	27C020	27C040	27C080
EPROM:			**27C512**	**27C010**	**27C020**	**27C040**	**27C080**
SIZE:			**64K x 8**	**128K x 8**	**256K x 8**	**512K x 8**	**1M x 8**
Number of bytes per EPROM:			**65,536**	**131,072**	**262,144**	**524,288**	**1,048,576**
1	EPROM (1 DR-50 MiniRepeater)		9.32	18.64	37.28	74.57	149.13
2	EPROMs		18.64	37.28	74.57	149.13	298.26
3	EPROMs		27.96	55.92	111.85	223.70	447.39
4	EPROMs		37.28	74.57	149.13	298.26	596.52
5	EPROMs		46.60	93.21	186.41	372.83	745.65
6	EPROMs		55.92	111.85	223.70	447.39	894.78
7	EPROMs		65.24	130.49	260.98	521.96	1,043.92
8	EPROMs		74.57	149.13	298.26	596.52	1,193.05
9	EPROMs		83.89	167.77	335.54	671.09	1,342.18
10	EPROMs		93.21	186.41	372.83	745.65	1,491.31
11	EPROMs		102.53	205.05	410.11	820.22	1,640.44
12	EPROMs		111.85	223.70	447.39	894.78	1,789.57
13	EPROMs		121.17	242.34	484.68	969.35	1,938.70
14	EPROMs		130.49	260.98	521.96	1,043.92	2,087.83
15	EPROMs		139.81	279.62	559.24	1,118.48	2,236.96
16	EPROMs		149.13	298.26	596.52	1,193.05	2,386.09
Each Expansion:	32	EPROMs	298.26	596.52	1,193.05	2,386.09	4,772.1
Repeater + 1 Expansion:	48	EPROMs	447.39	894.78	1,789.57	3,579.14	7,158.28
Repeater + 2 Expansions:	80	EPROMs	745.65	1,491.31	2,982.62	5,965.23	11,930.46
Repeater + 3 Expansions:	112	EPROMs	1,043.92	2,087.83	4,175.66	8,351.33	16,702.65
Repeater + 4 Expansions:	144	EPROMs	1,342.18	2,684.35	5,368.71	10,737.42	21,474.84
Repeater + 5 Expansions:	176	EPROMs	1,640.44	3,280.88	6,561.76	13,123.51	26,247.02
Repeater + 6 Expansions:	208	EPROMs	1,938.70	3,877.40	7,754.80	15,509.60	31,019.21
Repeater + 7 Expansions:	240	EPROMs	2,236.96	4,473.92	8,947.85	17,895.70	35,791.39

- 4 KHz Bandwidth (8,789 Hz UPDATE RATE) -

			27C512	27C010	27C020	27C040	27C080
EPROM:			**27C512**	**27C010**	**27C020**	**27C040**	**27C080**
SIZE:			**64K x 8**	**128K x 8**	**256K x 8**	**512K x 8**	**1M x 8**
Number of bytes per EPROM:			**65,536**	**131,072**	**262,144**	**524,288**	**1,048,576**
1	EPROM (1 DR-50 MiniRepeater)		7.46	14.91	29.83	59.65	119.30
2	EPROMs		14.91	29.83	59.65	119.30	238.61
3	EPROMs		22.37	44.74	89.48	178.96	357.91
4	EPROMs		29.83	59.65	119.30	238.61	477.22
5	EPROMs		37.28	74.57	149.13	298.26	596.52
6	EPROMs		44.74	89.48	178.96	357.91	715.83
7	EPROMs		52.20	104.39	208.78	417.57	835.13
8	EPROMs		59.65	119.30	238.61	477.22	954.44
9	EPROMs		67.11	134.22	268.44	536.87	1,073.74
10	EPROMs		74.57	149.13	298.26	596.52	1,193.05
11	EPROMs		82.02	164.04	328.09	656.18	1,312.35
12	EPROMs		89.48	178.96	357.91	715.83	1,431.66
13	EPROMs		96.94	193.87	387.74	775.48	1,550.96
14	EPROMs		104.39	208.78	417.57	835.13	1,670.27
15	EPROMs		111.85	223.70	447.39	894.78	1,789.57
16	EPROMs		119.30	238.61	477.22	954.44	1,908.87
Each Expansion:	32	EPROMs	238.61	477.22	954.44	1,908.87	3,817.75
Repeater + 1 Expansion:	48	EPROMs	357.91	715.83	1,431.66	2,863.31	5,726.62
Repeater + 2 Expansions:	80	EPROMs	596.52	1,193.05	2,386.09	4,772.19	9,544.37
Repeater + 3 Expansions:	112	EPROMs	835.13	1,670.27	3,340.53	6,681.06	13,362.12
Repeater + 4 Expansions:	144	EPROMs	1,073.74	2,147.48	4,294.97	8,589.93	17,179.87
Repeater + 5 Expansions:	176	EPROMs	1,312.35	2,624.70	5,249.40	10,498.81	20,997.62
Repeater + 6 Expansions:	208	EPROMs	1,550.96	3,101.92	6,203.84	12,407.68	24,815.37
Repeater + 7 Expansions:	240	EPROMs	1,789.57	3,579.14	7,158.28	14,316.56	28,633.12

- 5 KHz Bandwidth (11,718 Hz UPDATE RATE) -

EPROM:			27C512	27C010	27C020	27C040	27C080
SIZE:			64K x 8	128K x 8	256K x 8	512K x 8	1M x 8
Number of bytes per EPROM:			65,536	131,072	262,144	524,28	1,048,576
1	EPROM (1 DR-50 MiniRepeater)		5.59	11.18	22.37	44.74	89.48
2	EPROMs		11.18	22.37	44.74	89.48	178.96
3	EPROMs		16.78	33.55	67.11	134.22	268.44
4	EPROMs		22.37	44.74	89.48	178.96	357.91
5	EPROMs		27.96	55.92	111.85	223.70	447.39
6	EPROMs		33.55	67.11	134.22	268.44	536.87
7	EPROMs		39.15	78.29	156.59	313.17	626.35
8	EPROMs		44.74	89.48	178.96	357.91	715.83
9	EPROMs		50.33	100.66	201.33	402.65	805.31
10	EPROMs		55.92	111.85	223.70	447.39	894.78
11	EPROMs		61.52	123.03	246.07	492.13	984.26
12	EPROMs		67.11	134.22	268.44	536.87	1,073.74
13	EPROMs		72.70	145.40	290.81	581.61	1,163.22
14	EPROMs		78.29	156.59	313.17	626.35	1,252.70
15	EPROMs		83.89	167.77	335.54	671.09	1,342.18
16	EPROMs		89.48	178.96	357.91	715.83	1,431.66
Each Expansion:	32	EPROMs	178.96	357.91	715.83	1,431.66	2,863.31
Repeater + 1 Expansion:	48	EPROMs	268.44	536.87	1,073.74	2,147.48	4,294.97
Repeater + 2 Expansions:	80	EPROMs	447.39	894.78	1,789.57	3,579.14	7,158.28
Repeater + 3 Expansions:	112	EPROMs	626.35	1,252.70	2,505.40	5,010.80	10,021.59
Repeater + 4 Expansions:	144	EPROMs	805.31	1,610.61	3,221.23	6,442.45	12,884.90
Repeater + 5 Expansions:	176	EPROMs	984.26	1,968.53	3,937.05	7,874.11	15,748.21
Repeater + 6 Expansions:	208	EPROMs	1,163.22	2,326.44	4,652.88	9,305.76	18,611.52
Repeater + 7 Expansions:	240	EPROMs	1,342.18	2,684.35	5,368.71	10,737.42	21,474.84

- 7.5 KHz Bandwidth (17,578 Hz UPDATE RATE) -

EPROM:			27C512	27C010	27C020	27C040	27C080
SIZE:			64K x 8	128K x 8	256K x 8	512K x 8	1M x 8
Number of bytes per EPROM:			65,536	131,072	262,144	524,288	1,048,576
1	EPROM (1 DR-50 MiniRepeater)		3.73	7.46	14.91	29.83	59.65
2	EPROMs		7.46	14.91	29.83	59.65	119.30
3	EPROMs		11.18	22.37	44.74	89.48	178.96
4	EPROMs		14.91	29.83	59.65	119.30	238.61
5	EPROMs		18.64	37.28	74.57	149.13	298.26
6	EPROMs		22.37	44.74	89.48	178.96	357.91
7	EPROMs		26.10	52.20	104.39	208.78	417.57
8	EPROMs		29.83	59.65	119.30	238.61	477.22
9	EPROMs		33.55	67.11	134.22	268.44	536.87
10	EPROMs		37.28	74.57	149.13	298.26	596.52
11	EPROMs		41.01	82.02	164.04	328.09	656.18
12	EPROMs		44.74	89.48	178.96	357.91	715.83
13	EPROMs		48.47	96.94	193.87	387.74	775.48
14	EPROMs		52.20	104.39	208.78	417.57	835.13
15	EPROMs		55.92	111.85	223.70	447.39	894.78
16	EPROMs		59.65	119.30	238.61	477.22	954.44
Each Expansion:	32	EPROMs	119.30	238.61	477.22	954.44	1,908.87
Repeater + 1 Expansion:	48	EPROMs	178.96	357.91	715.83	1,431.66	2,863.31
Repeater + 2 Expansions:	80	EPROMs	298.26	596.52	1,193.05	2,386.09	4,772.19
Repeater + 3 Expansions:	112	EPROMs	417.57	835.13	1,670.27	3,340.53	6,681.06
Repeater + 4 Expansions:	144	EPROMs	536.87	1,073.74	2,147.48	4,294.97	8,589.93
Repeater + 5 Expansions:	176	EPROMs	656.18	1,312.35	2,624.70	5,249.40	10,498.81
Repeater + 6 Expansions:	208	EPROMs	775.48	1,550.96	3,101.92	6,203.84	12,407.68
Repeater + 7 Expansions:	240	EPROMs	894.78	1,789.57	3,579.14	7,158.28	14,316.56

- 10 KHz Bandwidth (23,437 Hz UPDATE RATE) -

EPROM:			27C512	27C010	27C020	27C040	27C080
SIZE:			64K x 8	128K x 8	256K x 8	512K x 8	1M x 8
Number of bytes per EPROM:			65,536	131,072	262,144	524,288	1,048,576
1 EPROM (1 DR-50 MiniRepeater)			2.80	5.59	11.18	22.37	44.74
2 EPROMs			5.59	11.18	22.37	44.74	89.48
3 EPROMs			8.39	16.78	33.55	67.11	134.22
4 EPROMs			11.18	22.37	44.74	89.48	178.96
5 EPROMs			13.98	27.96	55.92	111.85	223.70
6 EPROMs			16.78	33.55	67.11	134.22	268.44
7 EPROMs			19.57	39.15	78.29	156.59	313.17
8 EPROMs			22.37	44.74	89.48	178.96	357.91
9 EPROMs			25.17	50.33	100.66	201.33	402.65
10 EPROMs			27.96	55.92	111.85	223.70	447.39
11 EPROMs			30.76	61.52	123.03	246.07	492.13
12 EPROMs			33.55	67.11	134.22	268.44	536.87
13 EPROMs			36.35	72.70	145.40	290.81	581.61
14 EPROMs			39.15	78.29	156.59	313.17	626.35
15 EPROMs			41.94	83.89	167.77	335.54	671.09
16 EPROMs			44.74	89.48	178.96	357.91	715.83
Each Expansion:	32	EPROMs	89.48	178.96	357.91	715.83	1,431.66
Repeater + 1 Expansion:	48	EPROMs	134.22	268.44	536.87	1,073.74	2,147.48
Repeater + 2 Expansions:	80	EPROMs	223.70	447.39	894.78	1,789.57	3,579.14
Repeater + 3 Expansions:	112	EPROMs	313.17	626.35	1,252.70	2,505.40	5,010.80
Repeater + 4 Expansions:	144	EPROMs	402.65	805.31	1,610.61	3,221.23	6,442.45
Repeater + 5 Expansions:	176	EPROMs	492.13	984.26	1,968.53	3,937.05	7,874.11
Repeater + 6 Expansions:	208	EPROMs	581.61	1,163.22	2,326.44	4,652.88	9,305.76
Repeater + 7 Expansions:	240	EPROMs	671.09	1,342.18	2,684.35	5,368.71	10,737.42

- 15 KHz Bandwidth (35,156 Hz UPDATE RATE) -

EPROM:			27C512	27C010	27C020	27C040	27C080
SIZE:			64K x 8	128K x 8	256K x 8	512K x 8	1M x 8
Number of bytes per EPROM:			65,536	131,072	262,144	524,288	1,048,576
1 EPROM (1 DR-50 MiniRepeater)			1.86	3.73	7.46	14.91	29.83
2 EPROMs			3.73	7.46	14.91	29.83	59.65
3 EPROMs			5.59	11.18	22.37	44.74	89.48
4 EPROMs			7.46	14.91	29.83	59.65	119.30
5 EPROMs			9.32	18.64	37.28	74.57	149.13
6 EPROMs			11.18	22.37	44.74	89.48	178.96
7 EPROMs			13.05	26.10	52.20	104.39	208.78
8 EPROMs			14.91	29.83	59.65	119.30	238.61
9 EPROMs			16.78	33.55	67.11	134.22	268.44
10 EPROMs			18.64	37.28	74.57	149.13	298.26
11 EPROMs			20.51	41.01	82.02	164.04	328.09
12 EPROMs			22.37	44.74	89.48	178.96	357.91
13 EPROMs			24.23	48.47	96.94	193.87	387.74
14 EPROMs			26.10	52.20	104.39	208.78	417.57
15 EPROMs			27.96	55.92	111.85	223.70	447.39
16 EPROMs			29.83	59.65	119.30	238.61	477.22
Each Expansion:	32	EPROMs	59.65	119.30	238.61	477.22	954.44
Repeater + 1 Expansion:	48	EPROMs	89.48	178.96	357.91	715.83	1,431.66
Repeater + 2 Expansions:	80	EPROMs	149.13	298.26	596.52	1,193.05	2,386.09
Repeater + 3 Expansions:	112	EPROMs	208.78	417.57	835.13	1,670.27	3,340.53
Repeater + 4 Expansions:	144	EPROMs	268.44	536.87	1,073.74	2,147.48	4,294.97
Repeater + 5 Expansions:	176	EPROMs	328.09	656.18	1,312.35	2,624.70	5,249.40
Repeater + 6 Expansions:	208	EPROMs	387.74	775.48	1,550.96	3,101.92	6,203.84
Repeater + 7 Expansions:	240	EPROMs	447.39	894.78	1,789.57	3,579.14	7,158.28

The Digital Delay feature allows the start time of any digital audio track to be delayed anywhere from approximately 1/35th of a second to about 1/2 an hour from the time it is given a start command. The delay will occur any time a start command is received after a Repeater has received a reset command. In many applications this allows a single start signal to be used for a number of the Digital Audio Repeaters. The actual start of the spiels is then adjusted in the field as needed. The 'DELAY' LED on the front of each Digital Audio Repeater / Mixer shows when it is in delay mode prior to starting its spiel.

When a Repeater is in looping mode, the delay will be inserted between each iteration of the playback loop. In normal looping mode a single spiel is played over and over again. If the LOOP ALL option is on, then all of the spiels on the card will be played sequentially, with the delay inserted between each one.

Both the 'start' inputs and 'running status' output for the Digital Audio Repeater are optically isolated from all other parts of the system. Connections are made to them through four screw terminals for each card on the back of the motherboard. They can be configured to run either from the isolated 'Dirty' power supply or from external power. Eight additional inputs are available through the AUX PORT on each card. These are used to select specific spiels from manual push buttons or switches. The AUX PORT can be configured to select 'one of eight' with individual switch closures to each input or 'one of 255' with a binary spiel select to the inputs.

The Repeater checks both the rising (switch closure) and falling (switch opening) edges of each input. This allows you to configure a Repeater to do one action on one edge of a switch opening or closing, and then take a different action on the opposite edge. An example of this feature would be if you told the Repeater to start on finding a closure on one of the inputs, and then stop when the same input is opened again. The start and AUX PORT inputs can be configured to tell the Repeater to do any of the following things:

1) MUTE AUDIO
2) HALF MUTE AUDIO
3) UN-MUTE AUDIO
4) RESET REPEATER TO START
5) STOP REPEATER IMMEDIATELY
6) START REPEATER
7) START REPEATER LOOPING A SPIEL
8) STOP REPEATER AT END OF CURRENT SPIEL

There are several options which you can select for early start and loop commands. These are start or loop commands which come while the Repeater is still playing the last spiel. You can tell the Repeater to:

1) Ignore early starts.
2) Jump immediately to the beginning of the current spiel.
3) Jump immediately to the beginning of the next spiel.
4) Ignore the early start for now, but save and do it as soon as the current spiel is done.

The 'START' LED on the front of each Digital Audio Repeater / Mixer card is actually a combination of the two opto-isolated start inputs. This shows the actual start inputs' status as it is seen by the Digital Audio Repeater, and not a processed version of them. The 'MANUAL START' button on the front of each Digital Audio Repeater / Mixer card feeds directly into the Digital Audio Repeater's circuitry, and so doesn't light the 'START' LED. Aside from this one detail, it acts just like any input from the 'START' input on the back of the motherboard.

The 'RUNNING' LED on the front of each Digital Audio Repeater / Mixer shows when each is currently running.

- Low Level Mixer -

The mixer section of the circuit is used when there are other sources of audio besides the Digital Audio Repeater. This feature is available on the DR-300 and DR-400 Digital Audio Repeater / Mixer cards. The other audio sources can be live microphones, RF microphones, film, video, or just about anything else. There are two external mixer inputs available to each card in addition to the mix input which comes from the on-board Digital Audio Repeater (DR-300 only). If additional mixer inputs are needed, access is available to what is known as 'the summing point' through a plug on the back of the card cage.

- Global/Mix Buss -

Four GLOBAL / MIX BUSES are available which can be used to interconnect all the cards in your system or to feed an audio signal from an external source into the system. Each card can only use one GLOBAL/MIX BUS function. Typical applications for the Global/Mix Bus are:

· Feeding a background audio track to a number of cards to be mixed with their normal outputs.

· Implementing simple 'non-zoned' Public Address systems.

· Monitoring the audio in an attraction by feeding a number of audio tracks to a single monitor speaker.

· Sub-woofer and multi-amplifier applications where the outputs of a number of cards are fed to a single specially filtered output channel.

When configured for use as a MIX BUS, the audio signals from any number of different cards in the system are fed to one of the MIX BUS lines. This signal, which is made up of the all of the different signals which are fed to it, is picked up by one other card. It then can be processed through the PA, VCA, and EQUALIZER systems just like any other signal. Typical uses for this feature are for sub-woofer applications (where the low end of a number of audio tracks are amplified separately and sent through special low frequency speakers) or monitor systems (where the sum of any number of tracks are fed to a monitor speaker which employees can use to check on the progress of a show).

As a GLOBAL BUS, a signal can be fed into any of the four GLOBAL / MIX BUSES from an external source, or from any one of the other cards in the system. This signal can then be picked up by any number of cards to be incorporated into their audio outputs. A typical application for this feature would be to feed a background musical or rhythm track into many of the audio tracks in the scene. This feature can also be used to send prerecorded 'emergency' or PA announcements to a number of audio tracks without having to go through the PUBLIC ADDRESS SYSTEM.

The GLOBAL / MIX BUS can be linked between different card cages or left separated. If the card cages are linked, then any card in the system can be used to send or receive GLOBAL / MIX BUS signals. If they are kept separate, then each card cage's GLOBAL / MIX BUS can be used locally.

To configure the GLOBAL/MIX BUS, you insert the small configuration cards which were supplied with your DR- cards into JP-1 (these 'rewire' this section of each card as shown on the following illustrations). You then must select which bus you are going to use for this card by switching on one, and only one, of the switches on the dipswitch marked 'MIX BUS' on the card you are configuring. Each card is capable of using only one of the MIX/GLOBAL BUS features at one time.

The following illustrations shows the six possible configurations available with the GLOBAL / MIX BUS. A DR-300 is shown, but these same features are available on all DR-100 and DR-400 cards as well.

- Listening to GLOBAL BUS ('GLO LISTEN' card installed) -
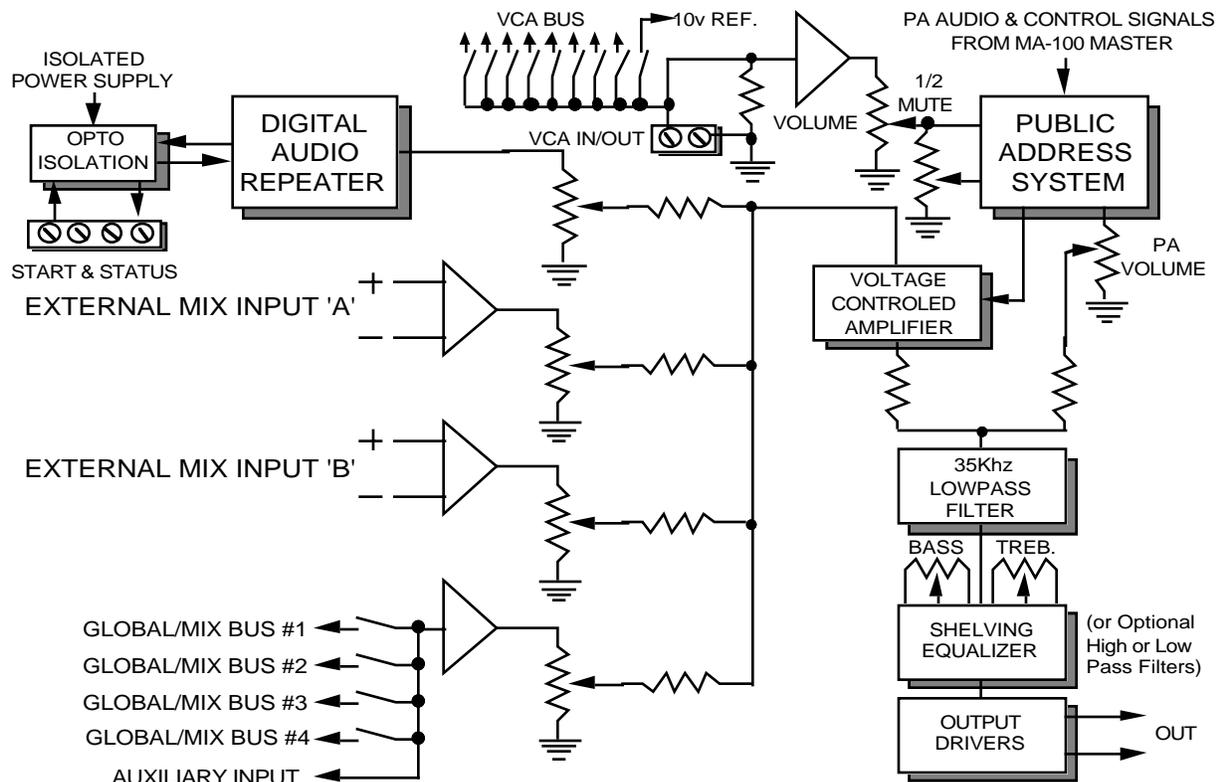
'GLO LISTEN': This is the most commonly used configuration card for the Global/Mix Bus. It is plugged into JP-1 when you want this card to listen to a global signal sent from another card or an external audio signal source. Any number of cards can listen to the same GLOBAL BUS.

The 'BUS FEED' pot on the front panel of the DR- Repeater card you are configuring controls how 'hot' a signal is picked up from the GLOBAL BUS by this card. It can be adjusted to set the level of the GLOBAL BUS input relative to all the other inputs to this card (Digital Audio Repeater and mix inputs, if any).

When used in a simple non-zoned PA application, the preamplifier PA microphone's output is fed to one of the four Global/Mix Bus lines. The cards which will be responding to this PA request are configured to listen to this input. The microphone's push-to-talk button is then wired into one of the start inputs (A or B) on these same repeater cards, which are then configured to half or full-mute when this input goes active. When the push-to-talk button on the microphone is depressed, the normal audio will mute (or half mute), and the microphone's audio will be fed to the cards' outputs.

- Listening to MIX BUS ('MIX LISTEN' card installed) -
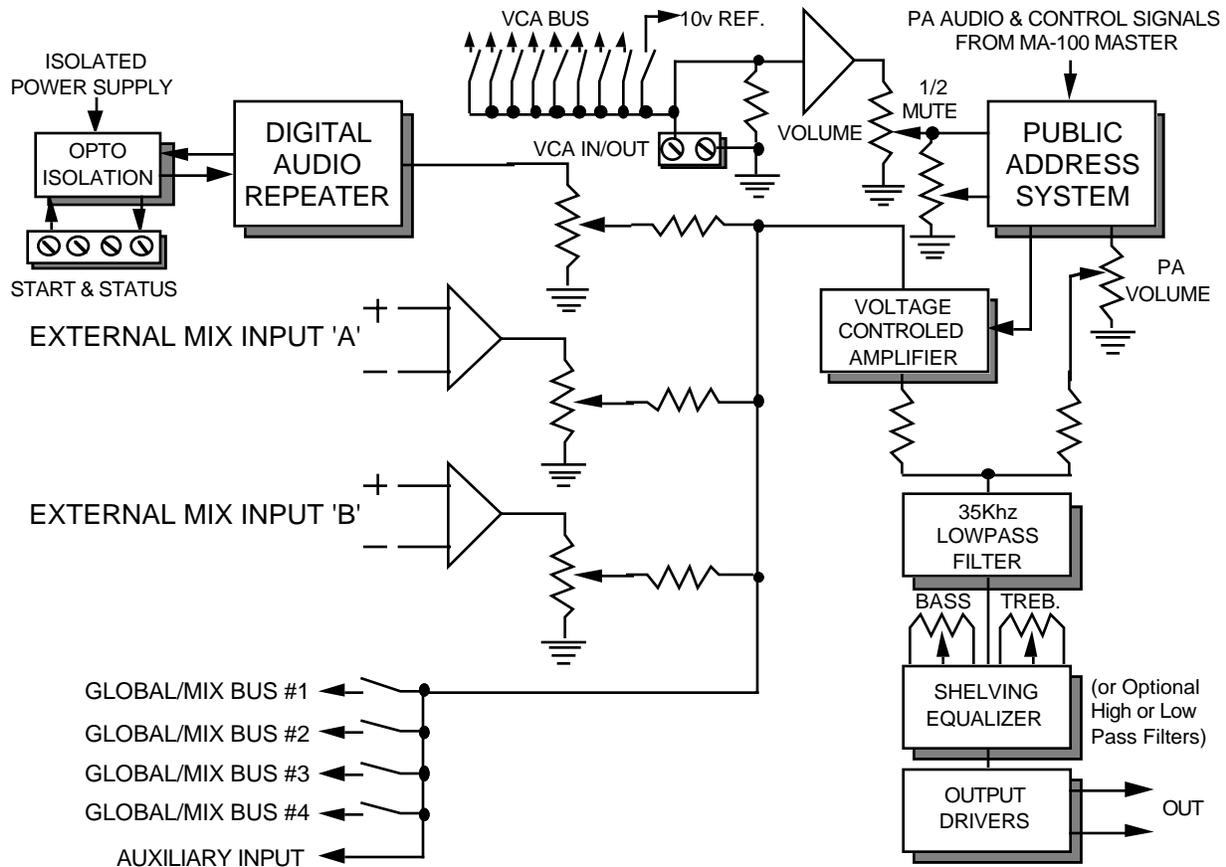
'MIX LISTEN': This configuration card is used when you want this card to listen to the mixed output of a number of different cards which are configured with either 'PRI MIX FEED' or 'GLO MIX FEED' configuration cards and the same 'MIX BUS' switch on as this card. Only one card at a time can be configured to listen to each MIX BUS at a time.

The 'BUS FEED' pot on the front panel of the DR- Repeater card you are configuring has no effect when this configuration card is inserted. To adjust the level of the mixed signals reaching this card, you need to adjust the 'BUS FEED' pots on all of the cards which are feeding this one card.

- MIX BUS Feed from Output ('OUT MIX FEED' card installed) -
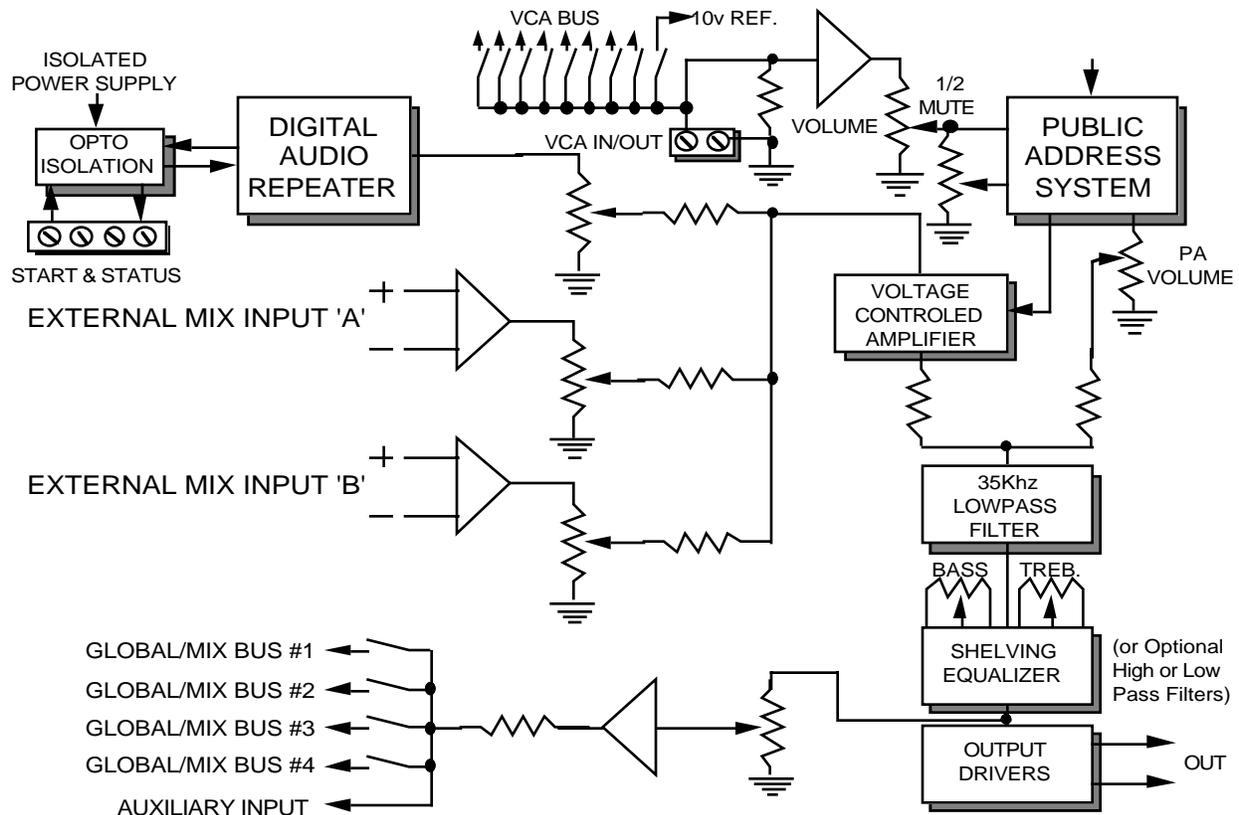
'OUT MIX FEED': When you want to feed the audio signals from this card's output to feed the MIX BUS. The 'output' is 'down stream' of the VCA, PA, and all other audio processing, so it will include these signals and processing in the audio data which is fed to the bus. You must also turn on one, and only one of the 'MIX BUS' switches. This configuration card is used when you want to feed the audio from this card, along with the audio from any number of other cards, to one other card in the system (the card which will listen to the mix bus must be configured with the 'MIX LISTEN' configuration card and the same 'MIX BUS' switch turned on as on this card).

The 'BUS FEED' pot on the front panel of the DR- Repeater card you are configuring controls how 'hot' a signal is sent to the MIX BUS from this card. By adjusting the 'BUS FEED' pot levels of all of the cards feeding this MIX BUS, the relative volumes of all of the signals feeding this MIX BUS can be adjusted.

- MIX BUS Feed from Pri Mix Point ('PRI MIX FEED' card installed) -
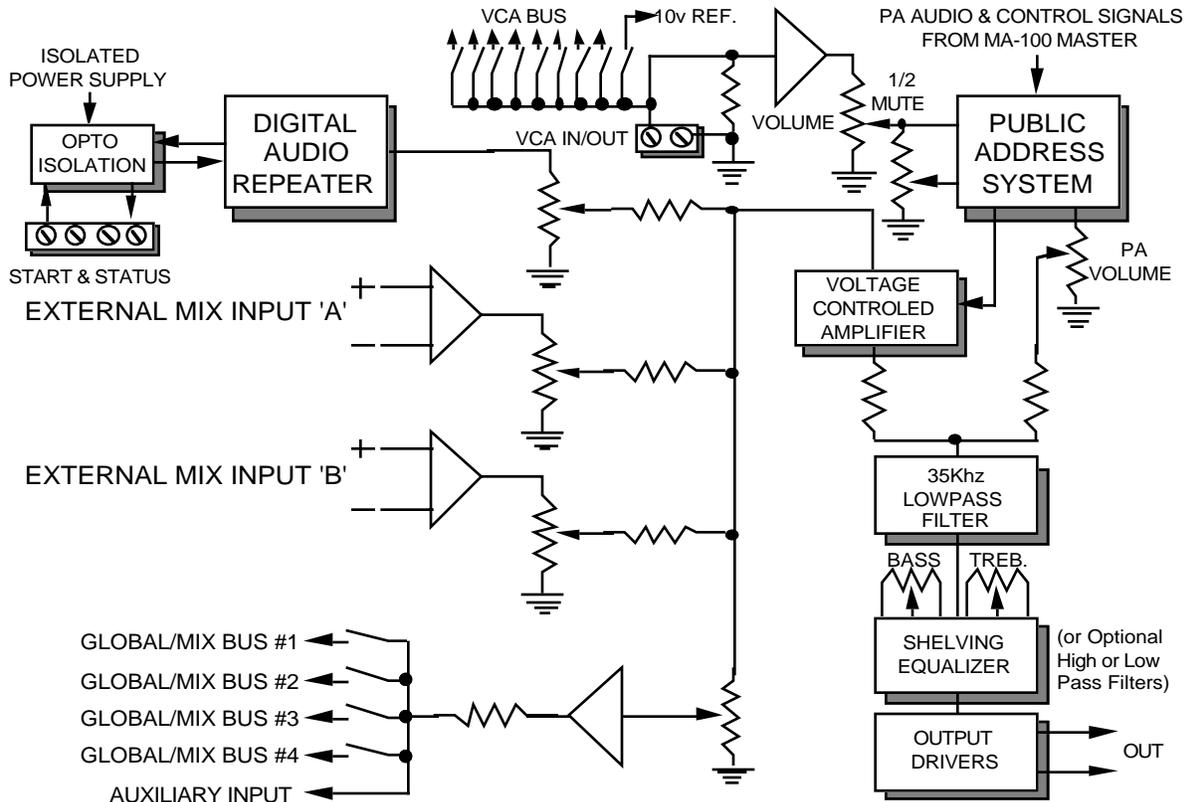
'PRI MIX FEED': When you want to feed the audio signals from this card's primary mix point to feed the MIX BUS. The primary mix point is 'upstream' of the VCA, PA, and all other audio processing, so it will be the 'raw' audio data which will be fed to the bus. You must also turn on one, and only one of the 'MIX BUS' switches. This configuration card is used when you want to feed the audio from this card, along with the audio from any number of other cards, to one other card in the system (the card which will listen to the mix bus must be configured with the 'MIX LISTEN' configuration card and the same 'MIX BUS' switch turned on as on this card).

The 'BUS FEED' pot on the front panel of the DR- Repeater card you are configuring controls how 'hot' a signal is sent to the MIX BUS from this card. By adjusting the 'BUS FEED' pot levels of all of the cards feeding this MIX BUS, the relative volumes of all of the signals feeding this MIX BUS can be adjusted.

- GLOBAL BUS Feed From Out ('OUT GLO FEED' card installed) -
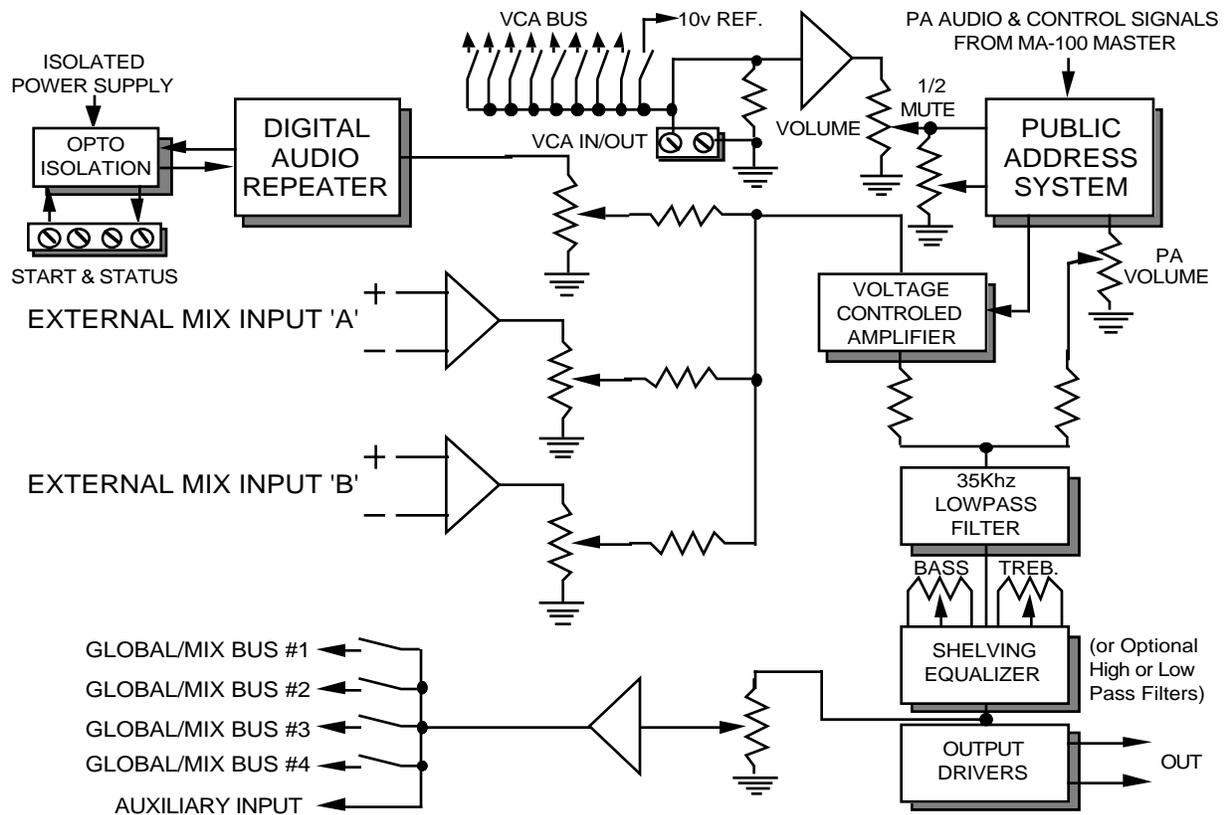
'OUT GLO FEED': When you want to feed the audio signals from this card's output to feed the GLOBAL BUS. The 'output' is 'down stream' of the VCA, PA, and all other audio processing, so it will include these signals and processing in the audio data which is fed to the bus. You must also turn on one, and only one of the 'MIX BUS' switches. This configuration card is used when you want to feed the audio from this card, and only this card, to any number of other cards in the system (the cards which will listen to the global bus must be configured with the 'GLO LISTEN' configuration card and the same 'MIX BUS' switch turned on as on this card).

The 'BUS FEED' pot on the front panel of the DR- Repeater card you are configuring controls how 'hot' a signal is sent to the GLOBAL BUS from this card. The level of the signal picked up by the other cards which are listening to this GLOBAL BUS can be set at those individual cards, and so the BUS FEED pot is usually set fully clockwise on this card and the level adjustments are made elsewhere.

- GLOBAL BUS feed from Pri Mix Point ('PRI GLO FEED' installed) -
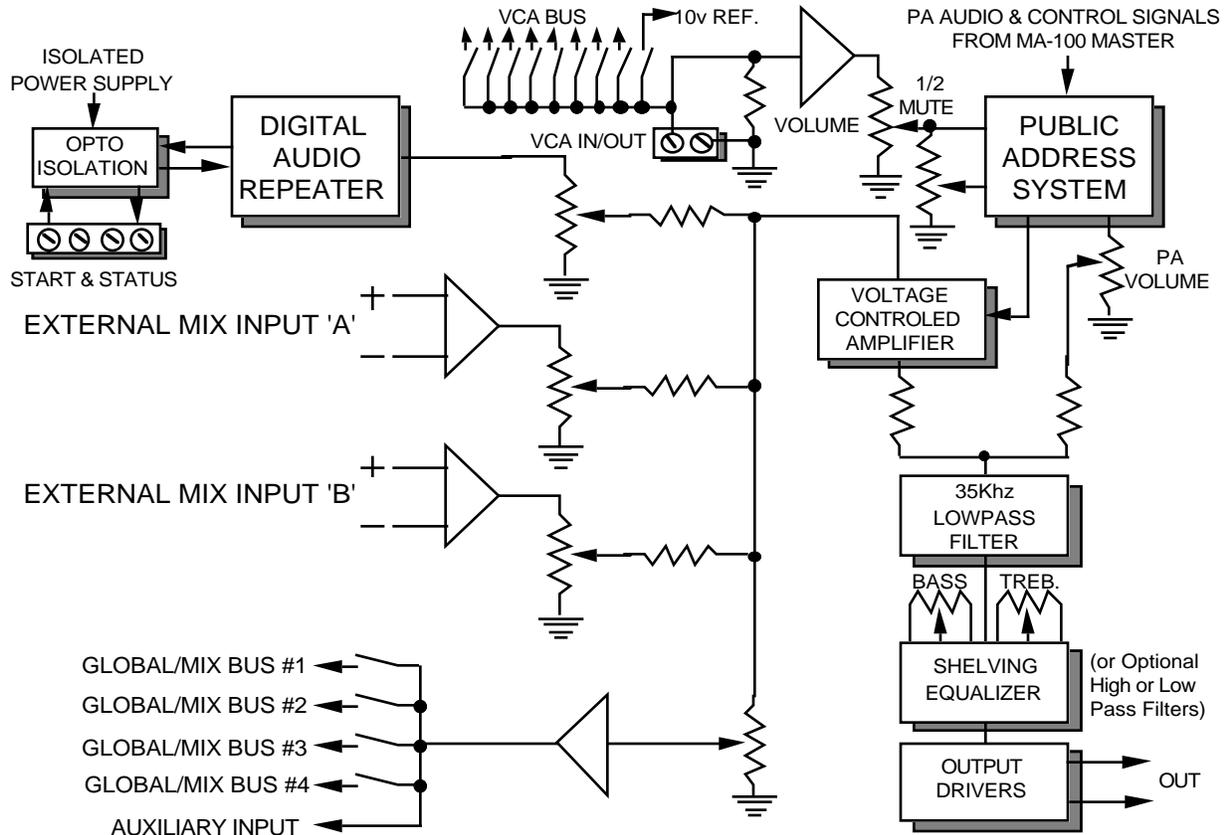
'PRI GLO FEED': When you want to feed the audio signals from this card's primary mix point to feed the GLOBAL BUS. The primary mix point is 'upstream' of the VCA, PA, and all other audio processing, so it will be the 'raw' audio data which will be fed to the bus. You must also turn on one, and only one of the 'MIX BUS' switches. This configuration card is used when you want to feed the audio from this card, and only this card, to any number of other cards in the system (the cards which will listen to the global bus must be configured with the 'GLO LISTEN' configuration card and the same 'MIX BUS' switch turned on as on this card).

The 'BUS FEED' pot on the front panel of the DR- Repeater card you are configuring controls how 'hot' a signal is sent to the GLOBAL BUS from this card. The level of the signal picked up by the other cards which are listening to this GLOBAL BUS can be set at those individual cards, and so the BUS FEED pot is usually set fully clockwise on this card and the level adjustments are made elsewhere.

- Voltage Controlled Amplifier (VCA) -

This feature is available on DR-300 and DR-400 Digital Audio Repeater / Mixer cards. A VCA is used to adjust an audio track's volume by applying a control signal to the Digital Audio Repeater / Mixer card. Typical uses of this feature are for traveling sound effects, remote or automatic volume control, or in live, special event, and semi-live shows which require dynamic volume control.

The control signal is a simple 0 to 10 VDC signal, just like you would feed to a lamp dimmer. This can be fed to each card individually through a two position screw block on the back of the card cage, or can come from any of eight 'VCA BUS' lines which are connected to all of the cards in the system. The latter is used when you want to control the volume of a number of cards from a single control signal source, or from a MA-100 PA MASTER card. This 0-10 VDC control signal is used as a reference which is fed to the VOLUME and then through the HALF MUTE VOLUME control pots on the front panel (see block diagrams). This means that the 0-10 VDC control signal is used to set the maximum volume obtainable from the VCA, with the actual level set a level somewhere below this by adjusting the VOLUME and HALF MUTE VOLUME pots. This is especially useful when a number of cards' VCAs are controlled from the same external signal.

The MA-100 PA MASTER card has eight D/A converters which can generate and deliver 0 to 10 VDC signals to the eight VCA bus lines. Commands from the PA STATIONS can be used to ramp the levels of these outputs up and down to control the volume of a group of cards which have been configured to use the VCA bus as their reference. Commands sent to the MA-100 through the serial port can control the voltage level of these outputs directly.

- Shelving Equalizer -

This is a SHELVING EQUALIZER which can be used to cut or boost the bass or treble in the output signals by up to 20 dB. This is used to peak the audio quality of the audio signal to match the amplifiers and speakers used in your applications. Special versions of these filters can be made in high or low pass versions for sub-woofer and bi-amplifier applications.

- Card Cage and Power Supplies -

Each CC-1600 card cage holds 16 cards. The CC-400 holds up to four cards. All card cage slots on each motherboard are identical. Most of the connections to the system are made to the motherboard on the back of the card cage. For each Digital Audio Repeater / Mixer card there are the following connections (each AB-100 AudioBrick has all these connections except the VCA and MIX INPUTs on the screw terminals on the outside of it's case):

CC-1600 or CC-400:
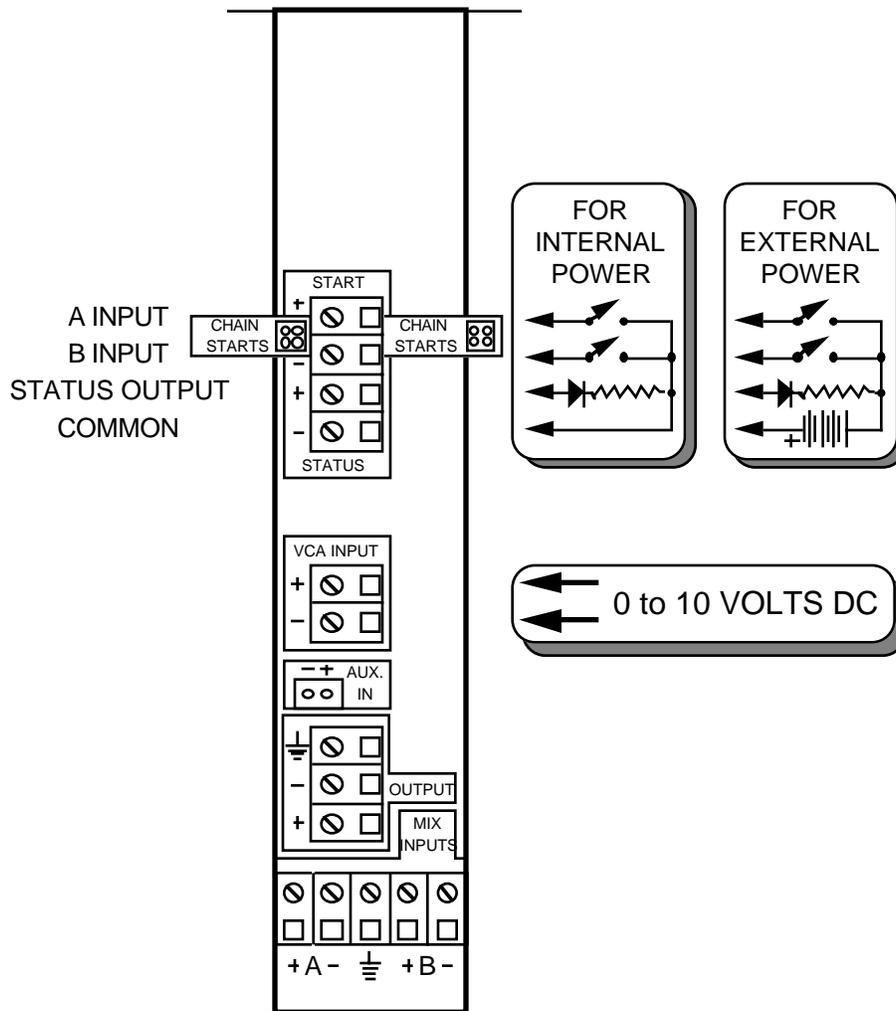
- · **Output:** Line level low impedance output. An optional transformer with an impedance of 150 or 600 ohms can be mounted to these screw terminals if needed.

- · **Mix 'A' Input:** Balanced 10K input impedance.

- · **Mix 'B' Input:** Balanced 10K input impedance.

- · **Aux. Input:** For access to each cards' summing point (see block diagrams).

- · **Repeater Start Input:** Optically isolated from all other parts of the system.

- · **Repeater Status Output:** Optically isolated from all other parts of the system.

- · **Voltage Controlled Amplifier (VCA) Input:** 0-10 VDC input signal.

With the one exception of the 'Aux Input' all connections are by screw terminals on CC-1600 and CC-400 card cages. The 'AUX' input is terminated by a two pin MOLEX connector. As the 'AUX' input is but rarely used, it is shipped unstuffed on the motherboards.

If the start and status inputs are running from the internal power supply, adjacent cards can have

their A and B inputs tied together by inserting a jumper into the 'CHAIN STARTS' jumpers. The jumpers are inserted horizontally. If you are using external power, then you can only use the CHAIN STARTS jumpers if the COMMON connection is also tied together between the cards.

The power supply connections to each CC-1600 is made to 6 screw terminals on the left of each card cage:

Isolated +15 Volts
Isolated Ground

Logic +5 Volts
+ 15 Volts
Ground
-15 Volts
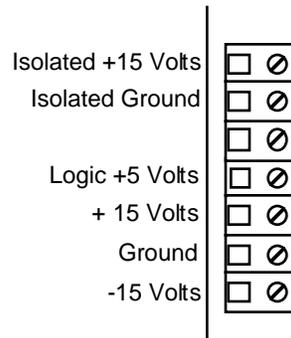
The power connections to the CC-400 are usually made from the 5 pin 180° Din style connector from the PS-100 Power Supply. This power supply provides +/- 12 VDC rather than +/- 15 VDC, and no separate isolated supply for the start and status inputs and outputs. If you need to use another power supply with a CC-400 card cage, cut the traces where shown on the back of the card cage and attach the power supply to the screw terminals as shown for a CC-1600.

There are four additional connectors on the back of each card cage. These are used to link together card cages in installations with more than one card cage. These are:

1) **Digital Data:** Used to link the clock and control signals between card cages. If your installation doesn't use the PA system, the only data which travels through this cable is the master clock for the Repeaters and the serial data lines to and from the Repeater cards. This cable can be omitted as long as one card in each cage is enabled for clocking the other Repeaters and you don't need to use the serial data lines to communicate with the entire system. This cable must be used if you are using the PA system options.

2) **PA:** Used to carry the analog PUBLIC ADDRESS signals between cages. If there is no PA system used, this cable is not needed. As this cable carries audio signals, it should be routed away from any digital or high voltage lines.

3) **Mix Buss:** Used to link the GLOBAL / MIX BUS between card cages. Depending on your application, it will be advantageous to eliminate this cable, or only use it to connect card cages where it is actually needed to link the MIX/GLOBAL BUS. The GLOBAL/MIX BUS connector may also be used for feeding external single-ended signals to the GLOBAL BUS. As this cable carries audio signals, it should be routed away from any digital or high voltage lines.

4) **VCA Buss:** This connection can be used to link the VCA BUS between card cages, or as a convenient place to feed in external VCA control signals to the system. It is compatible with a 1/2 J-6/A analog output cable from Gilderfluke & Company's Animation Control Systems.

- Repeater Hardware Configuration -

Volume and Other Adjustments:

All analog settings for all Digital Audio Repeater / Mixer cards are located on a small sub-card located at the front of the main card. This card is removable, held in place by two 6-32 x 1/4" round head screws. If a Digital Audio Repeater / Mixer card fails for any reason and has to be replaced, this sub-card can be moved to the replacement card. This effectively moves all of the adjustments to the new card so that when it is plugged back into the system little or no additional adjustment will be needed.

The settings of all of the pots (with the exception of those which are used by the SHELVING EQUALIZER) are available on the connector at the edge of the adjustment sub-card. This allows you to set all of your levels as you like them in the field, and then remove this card and document the settings using only a simple meter. These readings can be used for documentation purposes, or to replace the pots with fixed resistors using an FC-200 adjustment sub-card. By using fixed resistors, these settings can never be altered in the field by unauthorized personnel.

You may also replace the adjustment sub-card with an FC-100 or FC-300 (identical, but like the FC-200, with no pots). These cards replace the SHELVING EQUALIZER with a fixed fourth order Butterworth low pass or high pass filter. This card is built to order to your roll off frequency requirements. It is used in sub-woofer and bi-amplifier applications.

The adjustments sub-card has the following controls:

MAIN VCA VOLUME CONTROL

VCA HALF MUTE VOLUME CONTROL

DIGITAL MIX VOLUME

EXTERNAL MIX 'A' VOLUME

EXTERNAL MIX 'B' VOLUME

PUBLIC ADDRESS VOLUME

BUS FEED VOLUME

TREBLE

BASS
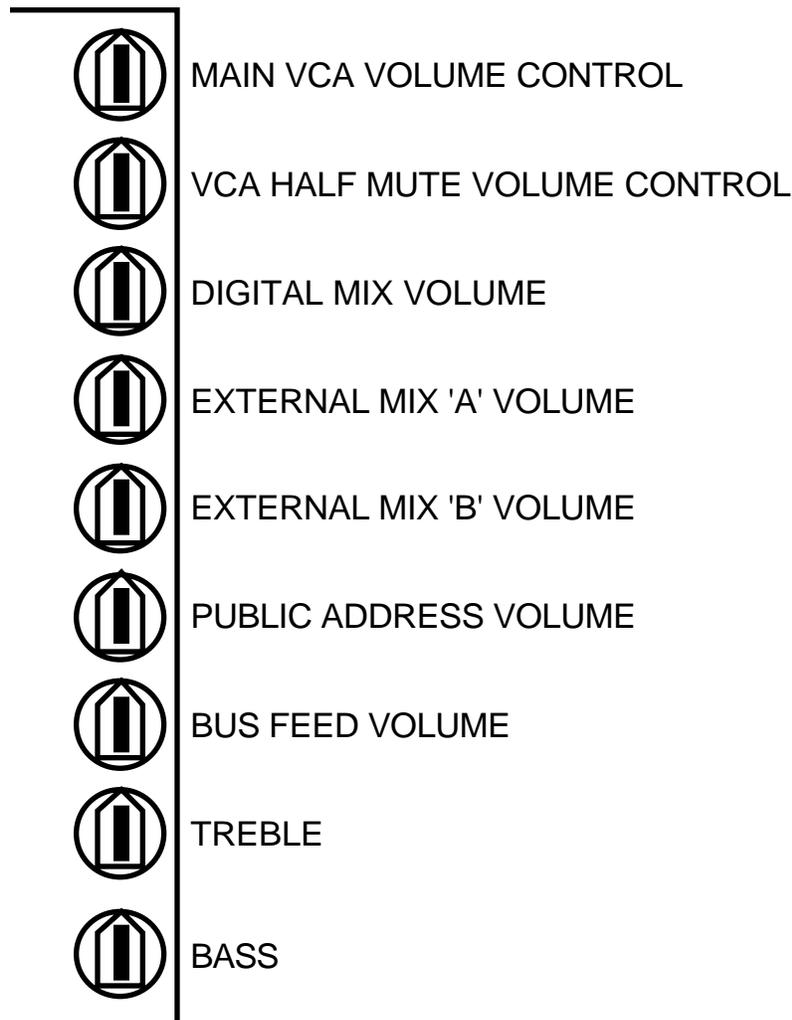
These controls are used as follows:

Main VCA Volume: DR-300, DR-400 : This control is used to control the over all volume of the card. With a 10 VDC input to the VCA circuits (either from the VCA input, VCA Bus, or 10 VDC reference), the range of control is +17 dBm to -80 dBm.

VCA Half Mute Volume: DR-300, DR-400: This control is used to set the volume level of the card when it is in HALF MUTE or PUBLIC ADDRESS mode. The range of adjustment is from -80 dBm up to the level set by the MAIN VCA VOLUME control.

Digital Mix Volume: DR-100, DR-300, AB-100: The DIGITAL MIX VOLUME control, along with the EXTERNAL MIX 'A' VOLUME, EXTERNAL MIX 'B' VOLUME, and occasionally the BUS FEED VOLUME, make up the mixer section of the Digital Audio Repeater / Mixer cards. The relative volume of these three (or four) signal sources is set by adjusting these controls while the over all volume is controlled by the MAIN VCA VOLUME and VCA HALF MUTE VOLUME controls.

External Mix 'A' Volume: DR-300, DR-400: The DIGITAL MIX VOLUME control, along with the EXTERNAL MIX 'A' VOLUME, EXTERNAL MIX 'B' VOLUME, and occasionally the BUS FEED VOLUME, make up the mixer section of the Digital Audio Repeater / Mixer cards. The relative volume of these three (or four) signal sources is set by adjusting these controls while the over all volume is controlled by the MAIN VCA VOLUME and VCA HALF MUTE VOLUME controls.

External MIX 'B' Volume: DR-300, DR-400: The DIGITAL MIX VOLUME control, along with the EXTERNAL MIX 'A' VOLUME, EXTERNAL MIX 'B' VOLUME, and occasionally the BUS FEED VOLUME, make up the mixer section of the Digital Audio Repeater / Mixer cards. The relative volume of these three (or four) signal sources is set by adjusting these controls while the over all volume is controlled by the MAIN VCA VOLUME and VCA HALF MUTE VOLUME controls.

Public Address Volume: DR-300, DR-400: This control sets how loud Public Address announcements will come through on this audio channel.

Buss Feed Volume: DR-100, DR-300, DR-400: Depending on the configuration of the GLOBAL / MIX BUS, this pot is used to set the volume of signals sent to it or received from it. See the section and block diagrams on the GLOBAL / MIX BUS for details.

Treble: DR-100, DR-300, DR-400, AB-100: This control is used to adjust the level of the high end of the SHELVING EQUALIZER.

Bass: DR-100, DR-300, DR-400, AB-100: This control is used to adjust the level of the low end of the SHELVING EQUALIZER.

- VCA Buss Dipswitch Configuration -

A nine position dip switch is used to select what source will be used for the VCA (see the card block diagrams). Switch positions 1 through 8 select any of the eight VCA Bus lines. Switch 9 is used if you don't want or need to use the VCA functions. It feeds the 10 VDC reference level to the VCA circuits. You then use the 'VOLUME' pot on the front panel to set the overall level of the card.

No more than one of these nine switches should be turned 'on' at a time or you will short together the different VCA Bus lines. You can feed in a VCA control signal to an individual card through the dedicated screw terminals on the back of the card cage. Normally you should leave all nine switches 'off' when you do this. However, if you want this signal to feed the VCA's of some additional cards, you can turn on any one of the VCA Bus switches to feed it to a VCA Bus line.
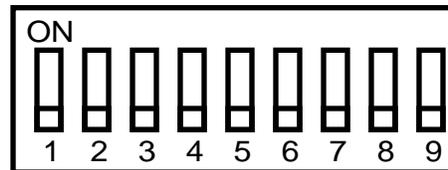
- Global/Mix Buss Dipswitch Configuration -

The GLOBAL / MIX BUS is configured by inserting one of six jumper modules in the socket near the lower left corner of the Digital Audio Repeater / Mixer card. You can then select one, and only one of the GLOBAL / MIX BUS lines by using the GLOBAL / MIX BUS SELECT SWITCH. (Instructions on full use of the GLOBAL/MIX BUS can be found in another section in this manual.)
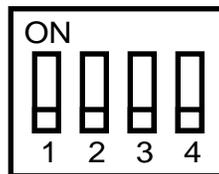
If you are using the AUX INPUT rather than the GLOBAL / MIX BUS as a source or destination, you should leave all four of the switches 'off'.

- Repeater Start and Status Internal/External Power Jumper -

The Digital Audio Repeater START and STATUS signals are optically isolated from all other parts of the system. You have the option of running them from the isolated power supply or from an external power supply. JP-3 header is located in the upper right corner of the Digital Audio Repeater / Mixer card. It is used to select which supply is used for these connections:
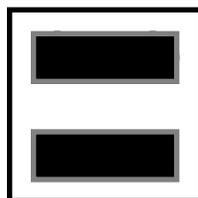
INTERNAL POWER   EXTERNAL POWER

....
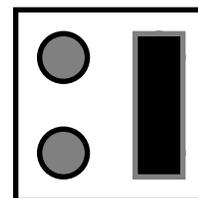
- Output Driver Select Jumpers -

The JP-2 Jumper can be used to plug in an amplifier card for larger output drive capacity, or two jumpers if the load impedance is greater than 1000 ohms. The pin out is as follows:

+ 15 VDC SUPPLY   ⬤ ⬤   GROUND
- 15 VDC SUPPLY   ⬤ ⬤   GROUND
+ AMP IN   ▮ ▮   - AMP INPUT
+ OUTPUT   ▮ ▮   - OUTPUT
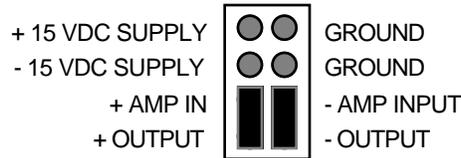
Insert the two jumpers as shown if a higher load impedance is used.

....

- Aux. Port Usage -

The AUX PORT is used to select a specific spiel on a single Digital Audio Repeater. If all you are doing is attaching a short wire with switches on the inputs, you can attach them directly to J6 as shown. Note that a small signal diode (like a 1N914 or 1N4148) is required in series with each switch. These pins on J6 are linked directly to the microprocessor and internal circuitry of the Digital Audio Repeater. Do not attach them in any other way than shown or you may damage the Repeater:
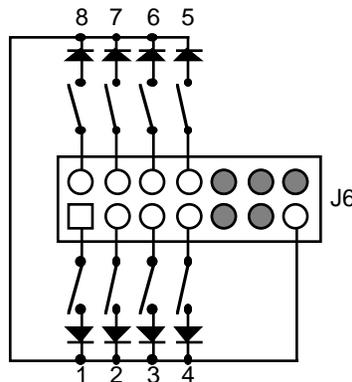
If the wire run is longer than a few inches, you will need to use an OP-100 AUX PORT OPTO-ISOLATOR. This is a small printed circuit board which plugs into the J6 pins on the repeater. The input to the isolator card is a standard 1/4 J-6 connection from any of our animation systems. If you are using a source other than our animation systems, the connections are as follows:

PIN #1	GROUND (not used)
PIN #2	DATA BIT 7
PIN #3	DATA BIT 6
PIN #4	DATA BIT 5
PIN #5	DATA BIT 4
PIN #6	DATA BIT 3
PIN #7	DATA BIT 2
PIN #8	DATA BIT 1
PIN #9	DATA BIT 0
PIN #10	+ 12 to 24 VDC SUPPLY
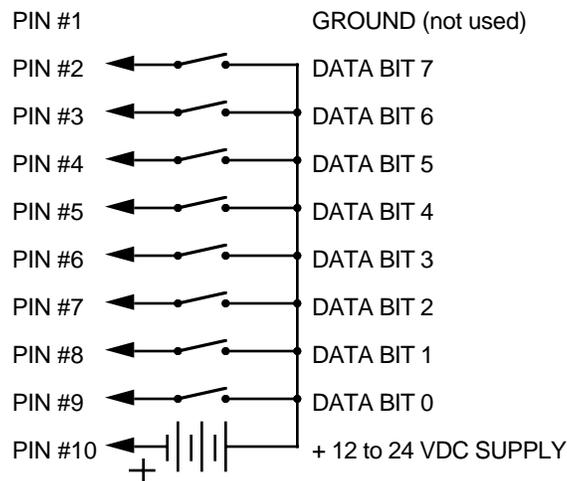
The input to the isolator card is simply eight opto-isolators. Each input is equivalent to turning on a LED with a 2.2 Kohm in series.

34
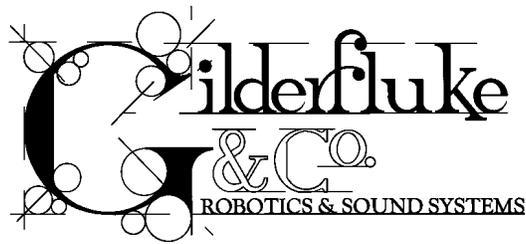
Smart Digital Audio Repeater Configuration:

Configuration from the Serial Port:

There are two ways to configure a Digital Audio Repeater. The first, and easiest, way of configuring a Repeater is through the serial port. The second way is through the two 8 position dip switches located on each card.

To configure the system through the serial port, you need to connect the system just as you do for any serial communications (see the 'serial commands' section of the manual). The configuration mode is entered by the command:

"m" (5AA5) (TRACK#)

This command will bring up the following menu from the Repeater which was addressed.

EXAMPLE: to bring up the configuration screen for a card addressed as 'track 00' (this is the normal default configuration address when a Repeater is shipped): `m5AA500`

This would bring up the following configuration screen (the screen shown is the default configuration):

```
-MACs DIGITAL AUDIO SYSTEM revision 1.12 copyright 1991 GILDERFLUKE & Co. DCM-

  a) Channel number- 00  | g) Select from AUX- yes  | l) #1 PA station- 01
  b) Baud rate- 9600      | h) Direct select- yes    | m) #2 PA station- 02
  c) Odd parity- no       | i) Mute if stopped- no   | o) Std PA priorities- no
  d) EPROM type- 27C010   | j) Start delay- 0010     | p) Zone Priorities- no
  e) Inputs Debounce- 0A  | k) Early starts- Jmp Fwd | q) Loop all mode- no
  f) DR-400 mode- no      | X) exit
                                     1   2   3   4   5   6   7   8
   G) Group assignments:        | 1 | 0 | 0 | 0 | 0 | 0 | 0 | F |
   H) PA Zones Enabled:         | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   I) Half Mute Zones Enabled:  |yes|___|___|___|___|___|___|___|
   J) Full Mute Zones Enabled:  |yes|___|___|___|___|___|___|___|
                                                                        STOP
    INPUT and EDGE      HALF   MUTE    UN     STOP  RESET  START  LOOP  AT END
 K) A input Closing:  |_____|_____|_____|_____|_____|__on__|_____|_____|
 L) A input Opening:  |_____|_____|_____|_____|_____|_____|_____|_____|
 M) B input Closing:  |_____|__on__|_____|__on__|_____|_____|_____|_____|
 O) B input Opening:  |_____|_____|__on__|_____|_____|_____|_____|_____|
 P) PB input Closing: |__on__|_____|_____|_____|__on__|__on__|_____|_____|
 Q) PB input Opening: |_____|_____|__on__|_____|_____|_____|_____|_____|
 R) Aux input Closing:|_____|_____|_____|_____|_____|_____|__on__|_____|
 S) Aux input Opening:|_____|_____|_____|_____|_____|_____|_____|_____|
                          Enter command- _
```

The (5AA5) part of the command is a key to keep this mode from being inadvertently entered. The card addressed by the TRACK# will put a configuration menu on the screen. When this mode is entered by any card, it disables all of the other serial commands on all the cards in the system. As with the normal serial command mode, the upper and lower 'case' of all input is important. An 'a' is a command while an 'A' is a number. All numeric values are entered in HEX (0 - 9, A - F).

If another command is entered while the last command is waiting for additional input, the new

command will be started. If at any point you enter a command in error and it is waiting for additional input, you can leave the command by entering an <ESC>ape key. With the exception of the GROUP ENABLE and PA ZONE ENABLE commands, this will leave the original configuration unaltered. These two commands will only be changed up to the point where you <ESC>aped.

If you want to keep a hard copy printout of the current configuration of any card, you should use the <ESC>ape key to redraw the screen while saving the print in the modem program running on your computer. This file can then be printed out at any time.

Note that only one card in the entire system is allowed to be in configuration mode at one time. For this reason, if you try to put a card which doesn't exist into configuration mode, not only will you not see a configuration screen from that nonexistent card, no other card in the system will want to listen to you until you take the nonexistent card out of configuration mode. To do this, type a: ✗ℕ

The other cards will then start listening to you again.

If you ever need to set the card back to its default settings (the same setting as shown above), you can do so by powering down the card, and then turning on Dipswitch number one, Switch #2. When you power the card back up, the default configuration setting will be reloaded. If you intend to change any of the settings to anything other than the defaults, be sure to turn this switch back off before you power the card back down. Otherwise, it will reload the default configuration right over any changes you have made each and every time you power the card back up.

....

"a"   Enter Track Number:

This command is used to tell the card which addresses it should respond to from the serial commands. No two cards in the system should have the same address assigned to them. When loaded with the default configuration, the address assigned to a card is 00. If more than one card is used in the system, they should be plugged in one at a time and have their addresses changed. Once it has been changed, each card can stay plugged in the card cage.

On software revisions 1.10 and later, the address of the Digital Audio Repeaters can optionally be set using DIPSW #2. If this switch is set to anything other than 'all off' AND the address has NOT been set to anything other than 00 through this command (or the dipswitch programming mode starting on page 47) then the card will assume whatever address is set on DIPSW #2 at the time when the card is reset. Any card addressed in this way will have the address number on this screen surrounded by parentheses '(nn)' to show that the address has been set in this way.

....

"b"   Baud Rate:

The serial port on each Repeater card can support any of the following baud rates:

1) 110
2) 150
3) 300
4) 600
5) 1200
6) 2400
7) 4800
8) 9600   (default value)
9) 19,200
10) 48,000
11) 96,000

The lower baud rates will require that the dead man circuit will need to be disconnected (U-7 pin #6) while in configuration mode. The reason for this is that the dead man needs to be updated about once a second, and at the lowest baud rates it will be spending so much time

printing that it will time out and reset the system. 9600 baud is an average speed to run the system.

All cards in the system must be set to the same baud rate. The default speed is 9600 baud. This command doesn't take effect until you enter the eXit command.

....

"c"   Odd Parity Toggle:

This toggle enables the ODD PARITY data check on the serial port for this Repeater. Parity is a method of confirming that the data sent to the audio system arrives intact. Any data that gets jumbled is ignored. If ODD PARITY is enabled, it must be enabled on all the cards in the system as well as on your computer or terminal. The default value for this command is off. This command doesn't take effect until you enter the eXit command.

....

"d"   EPROM Type:

The following types of EPROMs are currently supported by the digital audio Repeaters Repeaters:

27C512
27C010   (default setting)
27C020
27C040
27C080

All of the EPROMs on a card must be of the same type. Different cards in the same system can each have different types of EPROMs on them. This command doesn't take effect until the eXit command is completed.

....

"e"   Inputs Debounce:

This command allows you to set the number of times the software inside the Digital Audio Repeater will check any inputs before it actually believes a change has happened. A typical value is 0A. If you experience multiple triggers on any input, just raise this number until the problem disappears.

....

"f"   DR-400 Mode:

This toggle should only be turned on only when operating on a DR-400 Audio Processing Cards. It disables all of the commands which DR-400's can't (or shouldn't) use. This saves you the time of turning all of these off individually.

....

"g"   Select From Aux.:

If more than one recording is stored on a single Digital Audio Repeater card, each separate recording is referred to as a spiel. Each spiel can be accessed individually and played back. Up to 255 of these spiels can be stored on a single Digital Audio Repeater card. These requests can be made through the serial port or through the AUX PORT.

This toggle enables the auxiliary port for requesting the spiels on this card. There are two methods of selecting spiels from the AUX PORT. Which one is used is selected by the next command.

....

"h"   Direct Select:

This command is used to switch the AUX PORT between selecting directly (1 of 8) instead of using binary inputs for requesting up to 255 different spiels. The direct select is useful when you have eight or less spiels which need to be called up through the AUX PORT. The AUX PORT can be wired directly to up to eight different pushbuttons. When any of these buttons are pressed it will select the appropriate spiel. The first button pushed will be played at the next start or looping command, unless it is overridden by another spiel request from the serial ports. (The board can also be told to start playing the newly requested spiel immediately if you set the EARLY STARTS option to either 'jump forward' or 'jump back'.)

If this mode is off, then up to 255 different spiels can be selected through the AUX PORT. The AUX PORT can be connected directly to the output of a computer or animation control system. If you need to connect it to pushbuttons, you will need to use diodes or a keyboard encoder to encode a binary number to be sent to the AUX PORT.

As with changes in inputs on the A, B, or PB input, changes on the AUX PORT can be used to start, stop, or whatever a card. If the direct select option is 'on', then a rising edge is on any new arrival of a new closure, and a falling edge is when all input lines are opened. If the direct selection is 'off', then a rising edge is on any change in the AUX PORT except for when all of the inputs go open, which is considered to be a falling edge.

This option defaults to an 'on' condition.

....

"i"   Mute if Stopped:

This toggle allows you to tell a DR-100 or DR-300 to mute all the audio when the Repeater is stopped. This can be used if the mix inputs to the card aren't used for anything else. This defaults to a 'off' condition.

....

"j"   Start Delay:

This command is used to set the START DELAY for this card. If the START DELAY is anything other than 0000, then any start which follows a reset will cause the Repeater to delay for the time set by the START DELAY until it actually starts the Repeater. This is useful in applications where a single start input can be used to start a number of different cards, with the actual starting time of each of the cards set by the delay time. The actual amount of delay time can be adjusted using the START DELAY in the field.

The START DELAY is also used when a Repeater is in looping mode. In between each loop, the Repeater delays by the amount of time set by the START DELAY. This allows you to record a fairly short announcement which needs to repeat all day long. The START DELAY can be used to set how often this spiel repeats. Again, the amount of delay can be adjusted in the field as needed.

Each count of the START DELAY is equal to .029127111 seconds. This allows you to set the delay from about 1/34th of a second on up to about 1/2 hour.

To determine the value you need to use for a particular delay:

1) Divide the number of seconds you want to delay by .029127111.
2) Round the result off to the nearest whole number.
3) Convert result to HEX (a HEX calculator makes this easier).

This feature defaults to a value of 0010. Acceptable input range for the delay is 0000 to FFFF. A 0000 input disables this option.

....

"k"   Early Starts:

The user has the choice of what each card does when it is still playing a spiel and receives a new 'start' or 'loop' command. The options are:

1) DO NOTHING.
2) JUMP FORWARD to the next spiel.
3) JUMP BACKWARDS to the start of the current spiel.
4) BANK START so that it won't be acted upon until the current spiel finishes.

The JUMP FORWARD and JUMP BACKWARDS commands have the lowest priority of all possible spiel requests. Any serial port or AUX PORT spiel request will take priority over these commands.

This feature defaults to a setting of 'JUMP FORWARD'.

....

"I"   #1 Priority PA Station:

In the Public Address System there are a number of different ways to assign priorities to different PA STATIONS and PA zones. This command allows you to assign a single PA STATION as the top priority PA STATION. Any valid PA requests made by the top priority PA STATION will be honored by this card at the exclusion of any other PA requests. The top and second priority PA STATION assignments are usually given to either a PA STATION which is local to the speakers which are controlled by this card, or to a PA STATION from which safety announcements will be made.

The top priority PA STATION defaults to a value of 01. Acceptable input range is from 00 to FF.

....

"m"   #2 Priority PA Station:

In the Public Address System there are a number of different ways to assign priorities to different PA STATIONS and PA zones. This command allows you to assign a single PA STATION as the second priority PA STATION. Any valid PA requests made by the second priority PA STATION will be honored by this card at the exclusion of any other PA requests except those from the top PA STATION. The top and second priority PA STATION assignments are usually given to either a PA STATION which are local to the speakers which are controlled by this card, or to a PA STATION from which safety announcements will be made.

The second priority PA STATION defaults to a value of 02. Acceptable input range is from 00 to FF.

....

"o"   Standard PA Priorities:

In the Public Address System there are a number of different ways to assign priorities to different PA STATIONS and PA zones. If STANDARD and ZONE PRIORITIES are both off, then all valid PA requests (from PA STATIONS other than the top and second priority PA STATIONS for this card) will be treated equally. Any valid request will be honored, and if more than one valid request comes in to the same card, they will simply be mixed.

If the STANDARD PA PRIORITY option is 'on', then PA STATIONS with higher numbers will take priority over those with lower numbers. Only one PA request will be honored at one time.

This feature defaults to an 'off' condition.

....

"p"   PA Zone Priorities:

In the Public Address System there are a number of different ways to assign priorities to different PA STATIONS and PA zones. If STANDARD and ZONE PRIORITIES are both off, then all valid PA requests (from PA STATIONS other than the top and second priority PA STATIONS for this card) will be treated equally. Any valid request will be honored, and if more than one valid request comes in to the same card, they will simply be mixed.

If the PA ZONE PRIORITY option is 'on', then PA zone requests with higher numbers will take priority over those with lower numbers. Only one PA request will be honored at one time.

This feature defaults to an 'off' condition.

....

"q"   Loop All:

Under normal looping mode, a single spiel will repeat over and over again. If this feature is 'on', all the spiels recorded on a single card will be played in a loop. A delay, if enabled, will be inserted between each individual spiel.

This feature defaults to an 'off' condition.

....

"G"   Group Assignments:

When using the serial port to control the audio system, you have the choice of using a number of commands (start, stop, etc.) which select only a single 'group' of cards. This command is used to select which of 12 GROUP ASSIGNMENTS this card will respond to.

Acceptable input range for GROUP ASSIGNMENTS are from 0 to F. If you need less than 12 GROUPS, you should assign the unused spaces to any of the group numbers you have already used.

....

"H"   PA Zone Enables:

You can tell any card in the system to respond to up to 8 different PA zone requests. This command is used to tell the card which zones it should respond to. Any PA requests to a zone other than ones which has been assigned to it will be ignored by this card.

Acceptable input range for ZONE ASSIGNMENTS are from 00 to FF. If you need less than 8 ZONES, you should assign the unused spaces to any of the PA ZONE numbers to FF.

....

"I"   Half-Mute Zone Enables:

There are eight HALF-MUTE zones available in the Digital Audio System. This command is used to select which of the eight, if any, you wish to use. Any HALF-MUTE request for an enabled HALF-MUTE ZONE will half-mute this card.

....

"J"   Full-Mute Zone Enables:

There are eight FULL-MUTE zones available in the Digital Audio System. This command is used to select which of the eight, if any, you wish to use. Any FULL-MUTE request for an enabled FULL-MUTE ZONE will mute this card.

....

Input Triggering:

"K"	**'A' Input Closing Edge:**
"L"	**'A' Input Opening Edge:**
"M"	**'B' Input Closing Edge:**
"O"	**'B' Input Opening Edge:**
"P"	**'PB' Input Closing Edge:**
"Q"	**'PB' Input Opening Edge:**
"R"	**'Aux. Port' Input Closing Edge:**
"S"	**'Aux. Port' Input Opening Edge:**

Each Digital Audio Repeater card has two opto-isolated external inputs, one push button input on the front panel, and one AUX PORT input. These commands are used to select what actions will take place on each edge of each of these inputs. Note that both rising and falling edge actions are available to the user. This allows you to to do things like start a Repeater on a closing edge and then stop it on the opening edge of the same input.

The closing edge on the 'A', 'B', and 'PB' inputs are considered to be when a normally open push button or switch is closed. The opening edge is when that same switch or push button is opened. A closing edge on the AUX PORT is considered to be any of the eight inputs closing if the direct select option is 'on', or any change in the input (except going to all inputs open) if the direct select option is off. An opening edge on the AUX PORT is when all eight of the inputs go to an open condition.

The hardware for the 'A', 'B', and 'AUX PORT' inputs can be configured to run from either an internal power supply and a simple switch closure, or from a external power supply or powered output.

When each Digital Audio Repeater card resets or is first powered up, it checks the conditions on all of the inputs, inverts them, and then compares them with the steady-state conditions of the inputs. What this means is that on power-up, if an input you are using to tell a card to run is in the 'run' condition, the system will start immediately.

If multiple inputs to the system arrive simultaneously, they have the following priorities:

1) 'AUX PORT" INPUTS
2) 'A' input
3) 'B' INPUT
4) 'PB' INPUT

This will probably happen only on power-up.

The 'A' input is the only one which is interrupt driven. It should be used for most start and other inputs which require synchronization between a number of cards.

....

"x" or "X"   **eXit Setup Mode:**

This command is used to exit the setup mode. If you hit this command in error, hitting an <ESC>ape key will get you back to the setup mode. All of the setup commands which don't take effect immediately, take effect when the eXit command is entered. This includes things like the BAUD RATE, so you will have to change the baud rate of the terminal you are using at this time.

The eXit command asks you if you want to save the current setup permanently. If you answer 'Y', the EEPROM will be written with the current configuration. If you answer 'N', the setup mode will be exited without writing to the EEPROM.

All cards in the system have their serial ports disabled while any card in the system is in setup mode. This is the only command to which they will respond. After the initial 'X', all of the other

cards wait for a 'Y' or 'N' before they will start accepting other serial commands again.

- Summary of Setup Commands -

"a"	ENTER TRACK NUMBER:
"b"	BAUD RATE:
"c"	ODD PARITY TOGGLE:
"d"	EPROM TYPE:
"e"	CLOCK ENABLED:
"g"	SELECT FROM AUX:
"h"	DIRECT SELECT:
"i"	MUTE IF STOPPED:
"j"	START DELAY:
"k"	EARLY STARTS:
"l"	#1 Priority PA Station:
"m"	#2 Priority PA Station:
"o"	STANDARD PA PRIORITIES:
"p"	PA ZONE PRIORITIES:
"q"	Loop All:
"G"	GROUP ASSIGNMENTS:
"H"	PA ZONE ENABLES:
"I"	HALF-MUTE ZONE ENABLES:
"J"	FULL-MUTE ZONE ENABLES:
"K"	'A' INPUT CLOSING EDGE:
"L"	'A' INPUT OPENING EDGE:
"M"	'B' INPUT CLOSING EDGE:
"O"	'B' INPUT OPENING EDGE:
"P"	'PB' INPUT CLOSING EDGE:
"Q"	'PB' INPUT OPENING EDGE:
"R"	'AUX PORT' INPUT CLOSING EDGE:
"S"	'AUX PORT' INPUT OPENING EDGE:
"x" or "X"	eXit SETUP MODE:

Configuration via Dip Switches:

If you don't have a terminal or computer handy to do the configuration for a digital audio Repeater, you can use the two dip switches located on each card. If at all possible, we recommend you use the serial port configuration mode if at all possible.

To configure any of the features on the card, set dip switch 1 as shown and then enter in dip switch 2 as desired. To record this condition, turn switch 1 on dip switch one on, and then off. Your selection will have been recorded and you can then change the dip switches to set up the next selection.

In the notation used in the following selection, a 0 = a dip switch position in the 'off' position, while a 1 = a dip switch in an 'on' condition. Bit position 7 is controlled by dip switch position 1. Bit 0 is controlled by dip switch position 8

....

TO SELECT TRACK NUMBER:
DIPSW1= 00000000
DIPSW2= TRACK NUMBER

....

TO SELECT 'A' INPUT ACTION ON CLOSING:
DIPSW1 = 00000001
DIPSW2 =
SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
SWITCH 2 = START REPEATER LOOPING ON THIS EDGE
SWITCH 3 = START REPEATER ON THIS EDGE
SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
SWITCH 5 = STOP REPEATER ON THIS EDGE
SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE
....

TO SELECT 'A' INPUT ACTION ON OPENING:
DIPSW1 = 00000010
DIPSW2 =
SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
SWITCH 2 = START REPEATER LOOPING ON THIS EDGE
SWITCH 3 = START REPEATER ON THIS EDGE
SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
SWITCH 5 = STOP REPEATER ON THIS EDGE
SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE
....

TO SELECT 'B' INPUT ACTION ON CLOSING:
DIPSW1 = 00000011
DIPSW2 =
SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
SWITCH 2 = START REPEATER LOOPING ON THIS EDGE
SWITCH 3 = START REPEATER ON THIS EDGE
SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
SWITCH 5 = STOP REPEATER ON THIS EDGE
SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE

....

TO SELECT 'B' INPUT ACTION ON OPENING:
    DIPSW1 = 00000100
    DIPSW2 =
        SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
        SWITCH 2 = START REPEATER LOOPING ON THIS EDGE
        SWITCH 3 = START REPEATER ON THIS EDGE
        SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
        SWITCH 5 = STOP REPEATER ON THIS EDGE
        SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
        SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
        SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE
        ....

TO SELECT 'PB' INPUT ACTION ON CLOSING:
    DIPSW1 = 00000101
    DIPSW2 =
        SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
        SWITCH 2 = START REPEATER LOOPING ON THIS EDGE
        SWITCH 3 = START REPEATER ON THIS EDGE
        SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
        SWITCH 5 = STOP REPEATER ON THIS EDGE
        SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
        SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
        SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE
        ....

TO SELECT 'PB' INPUT ACTION ON OPENING:
    DIPSW1 = 00000110
    DIPSW2 =
        SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
        SWITCH 2 = START REPEATER LOOPING ON THIS EDGE
        SWITCH 3 = START REPEATER ON THIS EDGE
        SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
        SWITCH 5 = STOP REPEATER ON THIS EDGE
        SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
        SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
        SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE
        ....

TO SELECT 'AUX PORT' INPUT ACTION ON CLOSING:
    DIPSW1 = 00000111
    DIPSW2 =
        SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
        SWITCH 2 = START REPEATER LOOPING ON THIS EDGE
        SWITCH 3 = START REPEATER ON THIS EDGE
        SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
        SWITCH 5 = STOP REPEATER ON THIS EDGE
        SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
        SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
        SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE
        ....

TO SELECT 'AUX PORT' INPUT ACTION ON OPENING:
    DIPSW1 = 00001000
    DIPSW2 =
        SWITCH 1 = STOP REPEATER AT END OF SPIEL ON THIS EDGE
        SWITCH 2 = START REPEATER LOOPING ON THIS EDGE

SWITCH 3 = START REPEATER ON THIS EDGE
SWITCH 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
SWITCH 5 = STOP REPEATER ON THIS EDGE
SWITCH 6 = UN-MUTE AUDIO ON THIS EDGE
SWITCH 7 = FULL MUTE AUDIO ON THIS EDGE
SWITCH 8 = HALF MUTE AUDIO ON THIS EDGE
....

TO SELECT TOP PRIORITY PA STATION:
DIPSW1 = 00001001
DIPSW2 = TOP PRIORITY PA STATION
....

TO SELECT TOP PRIORITY PA STATION:
DIPSW1 = 00001010
DIPSW2 = SECOND PRIORITY PA STATION
....

TO SELECT PA ZONE ENABLE #1:
DIPSW1 = 00001011
DIPSW2 = PA ZONE ENABLED #1
....

TO SELECT PA ZONE ENABLE #2:
DIPSW1 = 00001100
DIPSW2 = PA ZONE ENABLED #2
....

TO SELECT PA ZONE ENABLE #3:
DIPSW1 = 00001101
DIPSW2 = PA ZONE ENABLED #3
....

TO SELECT PA ZONE ENABLE #4
DIPSW1 = 00001110
DIPSW2 = PA ZONE ENABLED #4
....

TO SELECT PA ZONE ENABLE #5:
DIPSW1 = 00001111
DIPSW2 = PA ZONE ENABLED #5
....

TO SELECT PA ZONE ENABLE #6:
DIPSW1 = 00010000
DIPSW2 = PA ZONE ENABLED #6
....

TO SELECT PA ZONE ENABLE #7:
DIPSW1 = 00010001
DIPSW2 = PA ZONE ENABLED #7
....

TO SELECT PA ZONE ENABLE #8:
DIPSW1 = 00010010
DIPSW2 = PA ZONE ENABLED #8
....

TO SELECT GROUP ASSIGNMENTS #1 & #2:
DIPSW1 = 00010011

```
DIPSW2 =
        SWITCHES 4-7 = GROUP ASSIGNMENT #1
        SWITCHES 0-3 = GROUP ASSIGNMENT #2
```
....

TO SELECT GROUP ASSIGNMENTS #3 & #4:
```
DIPSW1 = 00010100
DIPSW2 =
        SWITCHES 4-7 = GROUP ASSIGNMENT #3
        SWITCHES 0-3 = GROUP ASSIGNMENT #4
```
....

TO SELECT GROUP ASSIGNMENTS #5 & #6:
```
DIPSW1 = 00010101
DIPSW2 =
        SWITCHES 4-7 = GROUP ASSIGNMENT #5
        SWITCHES 0-3 = GROUP ASSIGNMENT #6
```
....

TO SELECT GROUP ASSIGNMENTS #7 & #8:
```
DIPSW1 = 00010110
DIPSW2 =
        SWITCHES 4-7 = GROUP ASSIGNMENT #7
        SWITCHES 0-3 = GROUP ASSIGNMENT #8
```
....

TO SELECT GROUP ASSIGNMENTS #9 & #10:
```
DIPSW1 = 00010111
DIPSW2 =
        SWITCHES 4-7 = GROUP ASSIGNMENT #9
        SWITCHES 0-3 = GROUP ASSIGNMENT #10
```
....

TO SELECT GROUP ASSIGNMENTS #11 & #12:
```
DIPSW1 = 00011000
DIPSW2 =
        SWITCHES 4-7 = GROUP ASSIGNMENT #11
        SWITCHES 0-3 = GROUP ASSIGNMENT #12
```
....

TO SELECT FULL-MUTE ENABLES:
```
DIPSW1 = 00011001
DIPSW2 =
        SWITCH 1 = ENABLE ZONE 8
        SWITCH 2 = ENABLE ZONE 7
        SWITCH 3 = ENABLE ZONE 6
        SWITCH 4 = ENABLE ZONE 5
        SWITCH 5 = ENABLE ZONE 4
        SWITCH 6 = ENABLE ZONE 3
        SWITCH 7 = ENABLE ZONE 2
        SWITCH 8 = ENABLE ZONE 1
```
....

TO SELECT HALF-MUTE ENABLES:
```
DIPSW1 = 00011010
DIPSW2 =
        SWITCH 1 = ENABLE ZONE 8
        SWITCH 2 = ENABLE ZONE 7
        SWITCH 3 = ENABLE ZONE 6
```

SWITCH 4 = ENABLE ZONE 5
SWITCH 5 = ENABLE ZONE 4
SWITCH 6 = ENABLE ZONE 3
SWITCH 7 = ENABLE ZONE 2
SWITCH 8 = ENABLE ZONE 1

....

TO SELECT DELAY COUNT MOST SIGNIFICANT BYTE:
DIPSW1 = 00011011
DIPSW2 = DELAY COUNT MS

....

TO SELECT DELAY COUNT LEAST SIGNIFICANT BYTE:
DIPSW1 = 00011100
DIPSW2 = DELAY COUNT LSB

....

TO SELECT E_TYPE FLAG BYTE:
DIPSW1 = 00011101
DIPSW2 =
        SWITCH 1 = not used
        SWITCH 2 = not used
        SWITCH 3 = PA ZONE PRIORITY (ON = 1)
        SWITCH 4 = REGULAR PA STATION PRIORITY (ON =1)
        SWITCH 5 = AUX PORT DIRECT SELECT (ON =1)
        SWITCHES 6 - 8 = EPROM TYPE

                001 = 27C512
                010 = 27C010
                011 = 27C020
                100 = 27C040
                101 = 27C080

....

TO SELECT BAUD RATE FLAG BYTE:
DIPSW1 = 00011110
DIPSW2 =
        SWITCH 1 = not used
        SWITCH 2 = not used
        SWITCH 3 = not used
        SWITCH 4 = not used
        SWITCHES 5 - 8 = BAUD RATE

                0001 = 110 BAUD
                0010 = 150 BAUD
                0011 = 300 BAUD
                0100 = 600 BAUD
                0101 = 1200 BAUD
                0110 = 2400 BAUD
                0111 = 4800 BAUD
                1000 = 9600 BAUD
                1001 = 19200 BAUD
                1010 = 48000 BAUD
                1011 = 96000 BAUD

....

TO SELECT EEFLAG BYTE:
DIPSW1 = 00011111
DIPSW2 = FLAG BYTE

SWITCH 1 = LOOP ALL SPIELS (1 = ON)
SWITCH 2 = CLOCK ENABLED (1 = ON)
SWITCH 3 = SELECT SPIEL FROM AUX PORT (1 = ON)
SWITCH 4 = PARITY ENABLED (1 = ON)
SWITCH 5 = MUTE AUDIO WHILE STOPPED (1 = ON)
SWITCH 6 = JUMP FORWARD ON EARLY STARTS (1 = ON)
SWITCH 7 = BANK EARLY STARTS (1= ON)
SWITCH 8 = GO BACK ON EARLY STARTS (1 = ON)

....

Reset to Default Configuration:

This switch should only be used when an Audio Repeater won't boot for love or money. When Dipswitch one, switch 2 is turned on when the card is powered up, the card will revert to the default configuration. This will allow you to bring up a card when the configuration has been scrambled to such an extent that it won't let the card boot. This default configuration, although loaded into RAM, won't be transferred into the EEPROM until you perform any action which will save the memory. These include eXiting the serial port configuration mode (answering 'yes' when asked if you want to save the configuration), or doing any of the dipswitch configuration commands.

Be sure to turn this switch back off when you are through with it. Otherwise it will load the default configuration every time the card is powered up.
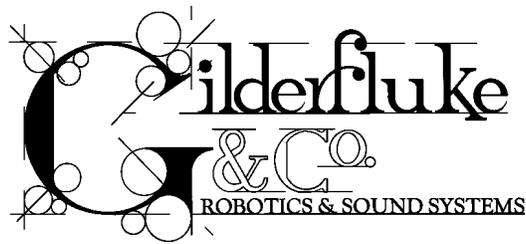
- Serial Port Commands -

The MACs digital audio system can be controlled by simple switch closures to start and stop playback or looping, mute the audio, and perform a variety of functions. In addition to this method of controlling the Repeater cards, you can talk to any or all of the cards at one time through a serial data line from your computer, terminal, or control system.

All commands sent to the MACs digital audio system through its serial interface take the following format. All characters are sent in ASCII. All numeric values are sent in HEXadecimal (HEX for short), and consist of one or more ASCII characters (0-9, A through F). The case (as in upper and lower) of all input is important. A lower case 'a' signifies a command, while an 'A' is a numeric value. If the digital audio system receives another command while it is waiting for additional input needed to complete the previous command, it will abandon the previous command and start working on the new one.

In the following documentation any input you will send to the audio system is shown in outline. The response to a command is shown in *italics*.

If the digital audio system is in a mode where you expect to receive some response from it (generally in one of the echo modes), you must wait to receive all of the characters you are expecting before sending the system a new command. The reason for this is that you are actually talking to up to 256 microprocessors at a time, and if you issue a command which gives a response from one card, and then a command which gives a response from a second card before the first has finished, then the two may try to output data at the same time. This won't cause any damage, but may result in garbled data at the receiver.

It is also possible to overload the digital audio system with too many commands through the serial port. You don't want to take too much time away from the Digital Audio Repeater to serve the serial port.

To communicate with the digital audio system through the serial port, you can use just about any computer or terminal which has a serial port on it. Some newer computer designs, like the Apple Macintosh, come with serial ports which are directly compatible with the RS-422 / RS-485 signal levels the digital audio system wants to see. These signal levels are close enough to be used with the RS-232 signal levels found on most older computers (like most IBM compatibles) with only a simple adapter cable, so long as the wire isn't too long and there aren't too many Repeaters attached to the same serial line. To gain the full advantage of the RS-422 / RS-485 signal levels you will need to use a signal level adapter.

If you are using a computer as a terminal you will need to run a modem or terminal emulation program. These will send everything you type on the keyboard out the serial port on your computer while printing on the screen anything which comes in from the audio system through the serial port. A modem program will usually have the advantage over a terminal emulation program in that it will allow you to save data to your computer's disk drives and then send it back to the audio system at a later date. The digital audio system uses no screen control codes or ESCape sequences, so it should work on any machine with a 80 column by 24 line display. Machines with other display formats will work, but may not look so neat on the screen.

When configuring your modem program, you should set it for 9600 baud, 8 data bits, one stop bit, and no parity. Higher or lower baud rates can be used if you configure the Digital Audio Repeaters' serial port to run at a different speed. You should set your program not to insert an extra LineFeed (LF) character after each Carriage Return (CR) it receives. If you are going to be downloading configuration strings to the system (command 's'), you will also need to tell the modem program to put a slight delay between each character sent in order to not over run the Digital Audio Repeaters' incoming data buffer.

If you have hooked up the Digital Audio Repeaters to your computer and it still doesn't seem to respond to the keyboard, the first thing to check is that you are attached to the right serial port. The easiest way to do this is to disconnect the Digital Audio Repeaters and short between the Tx data out and Rx data in pins on the serial port connector on the back of your computer. On all IBMs and compatibles this means sticking a paper clip or similar tool between pins 2 and 3 on the 'Com.' connector. While still running the modem program, anything you type should be shown on the screen while this paper clip is in place, while nothing will appear when you remove it. If your computer passes this test, then you are using the right serial port and the problem is most likely the baud rate setting or in your wiring to the Digital Audio Repeaters. If you get characters on the screen even with the paper clip removed from the serial port, it means you probably need to set the 'echo' mode to 'none' or 'full duplex' and try this test again.

The serial data signals from the digital audio Repeaters are brought out on the back of the card cage on the connector labeled 'DIGITAL DATA' (CC-400 and CC-1600). The signals can be found on the following pins:

PIN #	SIGNAL NAME:
4	- SERIAL DATA OUT FROM REPEATER (BLACK)
6	+ SERIAL DATA OUT FROM REPEATERS (RED)
7	- SERIAL DATA IN TO REPEATERS (GREEN)
9	+ SERIAL DATA IN TO REPEATERS (YELLOW)
25	SIGNAL GROUND (WHITE or BLUE)

For AB-100 cards, a 6 position RJ-11 (modular telephone style connector) is used for the serial data. Facing the end of the cable with the release latch upwards, its pin out is as follows:

	COLOR	SIGNAL NAME:
LEFT	WHITE	SIGNAL GROUND
	BLACK	- SERIAL DATA OUT FROM REPEATER
	RED	+ SERIAL DATA OUT FROM REPEATERS
	GREEN	- SERIAL DATA IN TO REPEATERS
	YELLOW	+ SERIAL DATA IN TO REPEATERS
RIGHT	BLUE	SIGNAL GROUND

To cross wire the RS-422 / RS-485 signals from the digital audio system to the RS-232 serial port of an IBM compatible, cross connect the signals as follows:

DB-25	DE-9	SIGNAL	SIGNAL FROM/TO AUDIO SYSTEM
2	3	DATA OUT	- SERIAL DATA IN TO REPEATERS (GREEN)
3	2	DATA IN	- SERIAL DATA OUT FROM REPEATER (BLACK)
7	5	GROUND	SIGNAL GROUND (BLUE or WHITE)

Apple Macintosh computers have true RS-422 serial ports built in. To connect to the digital audio system, the pin out is as follows (view is of connector on the outside of a Macintosh):

from + serial data out from repeaters (red) ———— 8 7 6 ———— to + serial data in to repeaters (yellow)

from - serial data out from repeaters (black) ———— 5 4 3 ———— to - serial data in to repeaters (green)

signal ground (white or blue)

2 1
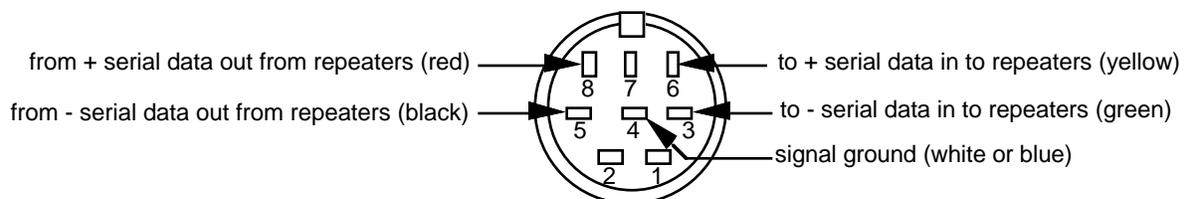
The digital audio system expects to see the serial data in the following format:

ONE START BIT

EIGHT DATA BITS

TWO STOP BITS

If the odd parity is enabled, then the data appears in the following format:

ONE START BIT
SEVEN DATA BITS
ODD PARITY BIT
TWO STOP BITS

When the parity is enabled, any data with a parity error in it is simply ignored.

There are a number of methods which you can use to access a number of cards in the digital audio system at the same time. If you are controlling the audio through the serial input, you can use any or all of them as best suits your application. The Types of Commands Available are:

1) **All -** Any command of this type affects all of the cards in the system.

> **EXAMPLE:** A 'Start All' command will Start All of the Digital Audio Repeaters in the system.

2) **Track Specific -** Only the one card addressed by the command is affected by this type of command. Each card in the system must be configured to respond to a different TRACK NUMBER address in order for the system to operate properly.

> **EXAMPLE**: A 'Start Track#' command will start only the one card addressed by the TRACK# in the command.

3) **Group -** There are 16 possible groups in the digital audio system. They are numbered from 0 through F. You can configure any card in the system to respond to anywhere between 1 and 12 of the different groups (see the configuration sections of this manual for instructions on how to do this). Commands of this type affect all cards that have the matching GROUP NUMBER. This type of command can be used when you wish to access a number of cards at the same time.

> **EXAMPLE:** A 'Start Group#' command will Start All cards which have been configured to respond to the GROUP# in the command.

4) **Cocked -** You can set a flag on any number of different cards in the digital audio system which, when set, will cause those cards to respond to commands of this type. Once cocked, you will have to un-cock a card to stop it from responding to any more COCKED commands.

> **EXAMPLE**: A 'Start Cocked' command will start only those Digital Audio Repeaters which have had their 'COCKED' flags set.

- Digital Audio System Serial Commands -

"a" (TRACK#)   Enter Setup Echo Mode:

This command puts the one card addressed by the TRACK# into this mode while taking all other cards out of this mode. This is a special mode which lets you play with the command structure of the digital audio system and get an echo of all commands accepted in plain English. This form of echo should normally be used only while manually manipulating the system as it can take a relatively long time to echo the 20 to 30 ASCII characters most commands will return when in this mode. During this response time, no additional commands should be given.

When in this mode, address specific commands are echoed by the card to which the command was sent. Non-track-specific commands are echoed by the card which was specified by the TRACK# when this mode was entered. This means that any track specific command sent to a nonexistent card will not be echoed, while any non-track-specific command (like a COCKED command) will be echoed even when no card in the system is actually effected by the command.

EXAMPLE: to put card 00 into SETUP ECHO mode: a00

TRACK 00 Setup Mode Selected

EXAMPLE: a 'Start All' command will echo: 'Start All'

....

"b"   Exit Setup Echo Mode:

This command takes all cards in the system out of SETUP ECHO MODE.

EXAMPLE: to take any and all cards out of SETUP ECHO mode: b

....

"c" (TRACK#)   Enter Global Echo Mode:

This command puts the one card addressed by the TRACK# into this mode while taking all other cards out of this mode. The one card which is in this mode will echo all non-track-specific commands accepted by the system. This type of echo can be used in an automated system to assure that the digital audio system has received any non-track-specific command. Note that since only one card in the system is in this mode at a time, this form of echo only verifies the operation of this one card and no other parts of the system.

EXAMPLE: to put card 00 into GLOBAL ECHO mode: c00

EXAMPLE: a 'Start All' command will echo: *u*

....

"d"   Exit Global Echo Mode:

This command takes all cards in the system out of GLOBAL ECHO MODE.

EXAMPLE: to take any and all cards out of GLOBAL ECHO mode: d

....

"e" (TRACK#)   Enter Echo All Mode:

This command puts the one card addressed by the TRACK# into this mode while taking all other cards out of this mode. The one card which is in ECHO ALL MODE echoes all characters sent to the digital audio system through the serial port. This type of echo can be used to verify that the digital audio system has received all characters sent to it. Note that since only one card in the system is in this mode at a time, this form of echo only verifies the operation of this one card and no other parts of the system.

EXAMPLE: to put card 00 into ECHO ALL mode: e00

EXAMPLE: a 'Start Track# 00' command will echo: *t00*

....

"f"   Exit Echo All Mode:

This command takes all cards in the system out of ECHO ALL MODE.

EXAMPLE: to take any and all cards out of ECHO ALL mode: f

....

"g"   Enter Echo Mode:

This command puts all the cards in the system into ECHO MODE. When in this mode, all track-specific commands are echoed by the card addressed by the command. This is the type of echo mode which best verifies the proper operation of all the cards in the digital audio system.

EXAMPLE: to put card 00 into ECHO mode: g00

EXAMPLE: a 'Start Track# 00' command will echo: *t00*

....

"h"   Exit Echo Mode:

This command takes all cards in the system out of ECHO MODE.

EXAMPLE: to take any and all cards out of ECHO mode: h

....

"i" (TRACK#)   Track Status Report:

This command responds with a stream of ASCII HEX data containing the current status of the card specified by the TRACK#:

BYTE 1 &2 = LED Port Status
        BIT 0 = MUTE STATUS (1 = muted)
        BIT 1 = DELAY STATUS (1 = in delay)
        BIT 2 = HALF-MUTE STATUS (1 = half-muted)
        BIT 3 = not used
        BIT 4 = RUN STATUS (1 = running)
        BIT 5 = STATUS OUTPUT STATUS (1 = on)
        BIT 6 = PA STATUS (1 = on)
        BIT 7 = REPEATER CLOCK ENABLED (1 = on)

BYTE 3 & 4 = INPUT STATUS
        BIT 0 = A INPUT STATUS (1 = closed)
        BIT 1 = B INPUT STATUS (1 = closed)
        BIT 2 = PB INPUT STATUS (1 = closed)
        BIT 3 = not used
        BIT 4 = not used
        BIT 5 = not used
        BIT 6 = not used
        BIT 7 = not used

BYTES 5 through 12 = Memory Address Status BITS 10 THROUGH 42

BYTE 13 & 14 = Dipswitch #1 Status
BYTE 15 & 16 = Dipswitch #2 Status
BYTE 17 & 18 = Aux. Port Status
BYTE 19 & 20 = PA TRUNKS 8 through 15
BYTE 21 & 22 = PA TRUNKS 0 through 7

BYTE 19 = CARRIAGE RETURN
BYTE 21 = LINE FEED

EXAMPLE: to poll the status for card 00: l0 0380000000129000000000

....

"j" (5AA5)   Special Default Setup:

This command should not be used if there is more than one card in the system. It loads the configuration EEPROM with the default setups. As this sets all cards to address 00, it can cause problems if invoked lightly. The '5AA5' which follows the command is a key which keeps garbage from accidentally issuing this command.

The values for the default settings are shown in the setup section of the manual.

EXAMPLE: to do a Special Default Setup to the one and only card in the system: J5AA5

....

"k" (TRACK#)   LED Port Status:

This command responds with the following information for the card specified by the TRACK#:

    BIT 0 = MUTE STATUS (1 = muted)
    BIT 1 = DELAY STATUS (1 = in delay)
    BIT 2 = HALF-MUTE STATUS (1 = half-muted)
    BIT 3 = not used
    BIT 4 = RUN STATUS (1 = running)
    BIT 5 = STATUS OUTPUT STATUS (1 = on)
    BIT 6 = PA STATUS (1 = on)
    BIT 7 = REPEATER CLOCK ENABLED (1 = on)

EXAMPLE: to poll the LED Port Status for card 00: k0038

....

"l" (TRACK#)   Switch Status:

This command responds with the following information for the card specified by the TRACK#:

    BIT 0 = A INPUT STATUS (1 = closed)
    BIT 1 = B INPUT STATUS (1 = closed)
    BIT 2 = PB INPUT STATUS (1 = closed)
    BIT 3 = not used
    BIT 4 = not used
    BIT 5 = not used
    BIT 6 = not used
    BIT 7 = not used

EXAMPLE: to poll the input Switch Status for card 00: l0000

....

"m" (5AA5) (TRACK#)   Enter Configuration Mode:

This command puts the card specified by the TRACK# into the configuration mode. All other cards in the system are locked off from receiving any serial commands when there is even one card in setup mode. They will not accept any serial commands until they hear the commands to exit setup mode being sent to the one card which is in this mode. For details on the setup mode, see the setup section of this manual.

EXAMPLE: to put card 00 into setup mode: m5AA500

Note that only one card in the entire system is allowed to be in configuration mode at one time. For this reason, if you try to put a card which doesn't exist into configuration mode, not

only will you not see a configuration screen from that nonexistent card, no other card in the system will want to listen to you until you take the nonexistent card out of configuration mode. To do this, type a:

xn

The other cards will then start listening to you again.

....

"n" (TRACK#)   Memory Address Status:

This command responds with the address bits 10 through 42 for the card specified by the TRACK#. By polling this value, you can determine at what point in the audio any card is currently at.

EXAMPLE: to poll the Memory Address Status for card 00: n0000000000

....

"o" (TRACK#)   Dipswitch #1 Status:

This command responds with the current status of the dip switch 1 for the card specified by the TRACK#.

EXAMPLE: to poll the dipswitch #1 status for card 00: o0000

....

"p" (TRACK#)   Dipswitch #2 Status:

This command responds with the current status of the dip switch 2 for the card specified by the TRACK#

EXAMPLE: to poll the dip switch #2 status for card 00: p0000

....

"q" (TRACK#)   Aux. Port Status:

This command responds with the current status of the AUX PORT for the card specified by the TRACK#.

EXAMPLE: to poll the Aux. Port Status for card 00: q0000

....

"r" (TRACK#)   Configuration Dump:

This command responds with the current contents of the configuration EEPROM for the Digital Audio Repeater specified by the TRACK#. This string of 1033 ASCII characters is led off by the character string 's5AA5'. As it happens, this is the lead in string for the CONFIGURATION LOAD command. This allows you to save the configuration of one or more Digital Audio Repeaters in your computer for later retrieval or archiving, and then simply and easily reload this data at any time. To save the data to the disk of your computer:

1) Turn off all echo modes.
2) Tell your computer to save all ASCII received from the Digital Audio System.
3) Give this command to any card in the system.
4) Save all stored input to your computer's disk drives.

Step #3 above can be repeated for any number of cards in the system. This stored file can then be played back to the digital audio system where it will be reloaded into the configuration EEPROMs of all the appropriate cards in the system.

The data returned by this command is as follows:

BYTE 1 = 's'

BYTE 2 & 3 = TRACK# (00 to FF)

BYTE 4 & 5 = 'A' INPUT ACTION ON CLOSING
       BIT 0 = HALF MUTE AUDIO ON THIS EDGE
       BIT 1 = FULL MUTE AUDIO ON THIS EDGE
       BIT 2 = UN-MUTE AUDIO ON THIS EDGE
       BIT 3 = STOP REPEATER ON THIS EDGE
       BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
       BIT 5 = START REPEATER ON THIS EDGE
       BIT 6 = START REPEATER LOOPING ON THIS EDGE
       BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 6 & 7 = 'A' INPUT ACTION ON OPENING
       BIT 0 = HALF MUTE AUDIO ON THIS EDGE
       BIT 1 = FULL MUTE AUDIO ON THIS EDGE
       BIT 2 = UN-MUTE AUDIO ON THIS EDGE
       BIT 3 = STOP REPEATER ON THIS EDGE
       BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
       BIT 5 = START REPEATER ON THIS EDGE
       BIT 6 = START REPEATER LOOPING ON THIS EDGE
       BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 8 & 9 = 'B' INPUT ACTION ON CLOSING
       BIT 0 = HALF MUTE AUDIO ON THIS EDGE
       BIT 1 = FULL MUTE AUDIO ON THIS EDGE
       BIT 2 = UN-MUTE AUDIO ON THIS EDGE
       BIT 3 = STOP REPEATER ON THIS EDGE
       BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
       BIT 5 = START REPEATER ON THIS EDGE
       BIT 6 = START REPEATER LOOPING ON THIS EDGE
       BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 10 & 11 = 'B' INPUT ACTION ON OPENING
       BIT 0 = HALF MUTE AUDIO ON THIS EDGE
       BIT 1 = FULL MUTE AUDIO ON THIS EDGE
       BIT 2 = UN-MUTE AUDIO ON THIS EDGE
       BIT 3 = STOP REPEATER ON THIS EDGE
       BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
       BIT 5 = START REPEATER ON THIS EDGE
       BIT 6 = START REPEATER LOOPING ON THIS EDGE
       BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 12 & 13 = 'PB' INPUT ACTION ON CLOSING
       BIT 0 = HALF MUTE AUDIO ON THIS EDGE
       BIT 1 = FULL MUTE AUDIO ON THIS EDGE
       BIT 2 = UN-MUTE AUDIO ON THIS EDGE
       BIT 3 = STOP REPEATER ON THIS EDGE
       BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
       BIT 5 = START REPEATER ON THIS EDGE
       BIT 6 = START REPEATER LOOPING ON THIS EDGE
       BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 14 & 15 = 'PB' INPUT ACTION ON OPENING
       BIT 0 = HALF MUTE AUDIO ON THIS EDGE
       BIT 1 = FULL MUTE AUDIO ON THIS EDGE
       BIT 2 = UN-MUTE AUDIO ON THIS EDGE
       BIT 3 = STOP REPEATER ON THIS EDGE
       BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
       BIT 5 = START REPEATER ON THIS EDGE
       BIT 6 = START REPEATER LOOPING ON THIS EDGE
       BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 16 & 17 = 'AUX PORT' INPUT ACTION ON CLOSING
    BIT 0 = HALF MUTE AUDIO ON THIS EDGE
    BIT 1 = FULL MUTE AUDIO ON THIS EDGE
    BIT 2 = UN-MUTE AUDIO ON THIS EDGE
    BIT 3 = STOP REPEATER ON THIS EDGE
    BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
    BIT 5 = START REPEATER ON THIS EDGE
    BIT 6 = START REPEATER LOOPING ON THIS EDGE
    BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 18 & 19 = 'AUX PORT' INPUT ACTION ON OPENING
    BIT 0 = HALF MUTE AUDIO ON THIS EDGE
    BIT 1 = FULL MUTE AUDIO ON THIS EDGE
    BIT 2 = UN-MUTE AUDIO ON THIS EDGE
    BIT 3 = STOP REPEATER ON THIS EDGE
    BIT 4 = RESET REPEATER TO BEGINNING ON THIS EDGE
    BIT 5 = START REPEATER ON THIS EDGE
    BIT 6 = START REPEATER LOOPING ON THIS EDGE
    BIT 7 = STOP REPEATER AT END OF SPIEL ON THIS EDGE

BYTE 20 & 21 = TOP PRIORITY PA STATION

BYTE 22 & 23 = SECOND PRIORITY PA STATION

BYTE 24 & 25 = PA ZONE ENABLED #1

BYTE 26 & 27 = PA ZONE ENABLED #2

BYTE 28 & 29 = PA ZONE ENABLED #3

BYTE 30 & 31 = PA ZONE ENABLED #4

BYTE 32 & 33 = PA ZONE ENABLED #5

BYTE 34 & 35 = PA ZONE ENABLED #6

BYTE 36 & 37 = PA ZONE ENABLED #7

BYTE 38 & 39 = PA ZONE ENABLED #8

BYTE 40 & 41 = GROUP ASSIGNMENT #1 & #2

BYTE 42 & 43 = GROUP ASSIGNMENT #3 & #4

BYTE 44 & 45 = GROUP ASSIGNMENT #5 & #6

BYTE 46 & 47 = GROUP ASSIGNMENT #7 & #8

BYTE 48 & 49 = GROUP ASSIGNMENT #9 & #10

BYTE 50 & 51 = GROUP ASSIGNMENT #11 & #12

BYTE 52 & 53 = MUTE ZONE ENABLE MASK

BYTE 54 & 55 = HALF MUTE ZONE ENABLE MASK

BYTE 56 & 57 = DELAY COUNT MSB

BYTE 58 & 59 = DELAY COUNT LSB

BYTE 60 & 61 = FLAG BYTE
    BIT 0 - 2 = EPROM TYPE
        001 = 27C512
        010 = 27C010
        011 = 27C020
        100 = 27C040
        101 = 27C080

    BIT 3 = AUX PORT DIRECT SELECT (ON =1)
    BIT 4 = REGULAR PA STATION PRIORITY (ON =1)

BIT 5 = PA ZONE PRIORITY (ON = 1)
BIT 6 = not used
BIT 7 = not used

BYTE 62 & 63 = FLAG BYTE
 BIT 0 - 3 = BAUD RATE SELECT
   0001 = 110 BAUD
   0010 = 150 BAUD
   0011 = 300 BAUD
   0100 = 600 BAUD
   0101 = 1200 BAUD
   0110 = 2400 BAUD
   0111 = 4800 BAUD
   1000 = 9600 BAUD
   1001 = 19200 BAUD
   1010 = 48000 BAUD
   1011 = 96000 BAUD

 BIT 4 = not used
 BIT 5 = not used
 BIT 6 = not used
 BIT 7 = not used

BYTE 64 & 65 = FLAG BYTE
 BIT 0 = GO BACK ON EARLY STARTS (1 = ON)
 BIT 1 = BANK EARLY STARTS (1 = ON)
 BIT 2 = JUMP FORWARD ON EARLY STARTS (1 = ON)
 BIT 3 = MUTE AUDIO WHILE STOPPED (1 = ON)
 BIT 4 = PARITY ENABLED (1 = ON)
 BIT 5 = SELECT SPIEL FROM AUX PORT (1 = ON)
 BIT 6 = CLOCK ENABLED (1 = ON)
 BIT 7 = LOOP ALL SPIELS (1 = ON)

BYTE 66 = CARRIAGE RETURN

BYTE 67 = LINE FEED

EXAMPLE: to poll the configuration for card 00: r00

s0020000A0431044000010200010203040506070100000000F0010100100A0864

....

"s" (TRACK#) (STRING)   Load Configuration:

This command loads the string which follows it into the configuration EEPROM for the Digital Audio Repeater specified by the TRACK#. This command is used to load the configuration from another source into one or more Digital Audio Repeater. Since the Configuration Dump command leads off its string with a 's5AA5', data saved in the Configuration Dump command can be reloaded into the audio system by simply sending back to it.

To do this:

1) Tell your modem program to delay slightly between characters so you don't over run the input buffer of the Digital Audio Repeater (or lower the baud rate 110 or so).

2) Tell your computer to send out the previously saved output string from the Configuration Dump command.

....

Start Commands

"t" (TRACK#)   **Start Track:**
"u"   **Start All:**
"v"   **Start Cocked:**

"w" (GROUP#)   **Start Group:**

These commands start the digital audio Repeater playing on the card(s) addressed by the command. If an addressed card is looping, it will have its looping mode reset. If the card is already playing, it can be configured to do one of the following things:

1) IGNORE IT.
2) SAVE THE START UNTIL IT FINISHES RUNNING.
3) JUMP TO THE START OF THE NEXT SPIEL.
4) JUMP TO THE START OF THE CURRENT SPIEL.

If the card receives a start command after it has received a request for a specific spiel, it will play that spiel. Requests for specific spiels can come from the serial port (highest priority), the AUX PORT (middle priority), and the jump forward, looping, and jump back internal show requests (lowest priority).

....

Stop Commands:

"x" (TRACK#)   **Stop Track:**
"y"   **Stop All:**
"z"   **Stop Cocked:**
"G" (GROUP#)   **Stop Group:**

These commands stop the selected card(s) unconditionally. The stop takes place after the current 1 KByte block of sound data has played.

....

Reset Commands:

"H" (TRACK#)   **Reset Track:**
"I"   **Reset All:**
"J"   **Reset Cocked:**
"K" (GROUP#)   **Reset Group:**

These commands reset the addressed card(s) to the start of their memory. If the cards are running, the reset takes place after the current 1 KByte block of sound data has played. The sound then continues from the start of the memory. A start delay will only take place after a card has received a RESET.

....

Mute Commands:

"L" (TRACK#)   **Mute Track:**
"M"   **Mute All:**
"N"   **Mute Cocked:**
"O" (GROUP#)   **Mute Group:**

These commands unconditionally mute the card(s) selected. If the card(s) selected are already half-muted this command will override that condition and fully mute them.

....

Half-Mute Commands:

"P" (TRACK#)   **Half-Mute Track:**
"Q"   **Half-Mute All:**
"R"   **Half-Mute Cocked:**
"S" (GROUP#)   **Half-Mute Group:**

These commands unconditionally half-mute the card(s) selected. If the card(s) selected are already muted this command will override that condition and half-mute them.

....

Un-Mute Commands:

"T" (TRACK#)	**Un-Mute Track:**
"U"	**Un-Mute All:**
"V"	**Un-Mute Cocked:**
"W" (GROUP#)	**Un-Mute Group:**

These commands unconditionally un-mute the card(s) selected. If the card(s) selected have their PA system active, the PA system will continue to hold the cards in a half-muted condition until it is finished.

....

"X" (TRACK#)   Cock Track:

This command sets the cocked flag on the Digital Audio Repeater Card specified by the TRACK#. Until this flag is reset, this card will respond to all COCKED commands. Any number of cards can be cocked at the same time. This flag will be reset upon the receipt of any 'COCKED' command, or by using one of the two following RESET COCKED commands.

EXAMPLE: to cock card 00: X00

....

"Y" (TRACK#)   Un-Cock Track:

This command resets the cocked flag on the Digital Audio Repeater Card addressed by the TRACK#. After this flag is reset, the addressed card will no longer respond to COCKED commands.

EXAMPLE: to un-cock card 00: Y00

....

"Z"   Un-Cock All:

This command resets the cocked flag on all the Digital Audio Repeater Cards in the system. After the cocked flags are reset, no cards in the system will respond to any COCKED commands.

EXAMPLE: to un-cock all cards in the system: Z

....

Loop Commands:

"!" (TRACK#)	**Loop Track:**
""""	**Loop All:**
"#"	**Loop Cocked:**
"$" (GROUP#)	**Loop Group:**

These commands work exactly like the Start Commands, except that at the end of the current spiel, it will start over again. This will continue until:

1) Another spiel is selected and this new spiel will begin looping.
2) A stop command is received.
3) A start command is received.
4) A stop-at-end command is received.

If the card which is looping has any value other than 0000, then this delay will be inserted between each iteration of the loop. This allows you to record a fairly short announcement and put along enough delay between each time it repeats so that it won't drive everyone crazy. The delay value can be set in the field through hardware and software to adjust how often the spiel repeats. The delay can be set from 0 on up to about 1/2 an hour in 1/34th second

increments.

Looping mode usually plays a single spiel over and over again. If the LOOP ALL option is enabled, then all of the spiels recorded on the card will play in succession. The delay, if enabled, will be inserted between each spiel.

If the spiel which is looped is located in the first 16 memory chips and there is no delay entered, then the card will use a special fast looping mode. This will give you 'seamless' looped spiels. To accomplish the fast looping mode, the start of the loop is considered to be where ever the last start or loop command was given. What this means is that if you play a part of a spiel located in the first 16 memory chips and then stop the card, and then restart (followed by a loop command) or loop it, the card will play to the end of the spiel and then loop back to wherever the card was when the start or loop command was entered. Assuming you normally start the spiel from its beginning, this shouldn't cause any problems. Any spiel which extends beyond the first 16 memory chips or has a delay entered will always play a looped spiel from its start. This means that there is a slightly longer delay between the end of a spiel and the time it starts over.

....

Stop At End Commands:

"%" (TRACK#)	**Stop At End Track:**
"&"	**Stop At End All:**
"'"	**Stop At End Cocked:**
"(" (GROUP#)	**Stop At End Group:**

These commands tell the card(s) selected to stop playing when the end of the current spiel is reached. This allows a spiel which is playing in the looping mode to run to its end before stopping. This compares to the normal STOP commands, which would make the Repeater stop the the instant they are received.

....

Select Spiel Commands:

")" (TRACK#) (SPIEL#)	**Select Spiel Track:**
"*" (SPIEL#)	**Select Spiel All:**
"+" (SPIEL#)	**Select Spiel Cocked:**
"/" (GROUP#) (SPIEL#)	**Select Spiel Group:**

Up to 255 different recordings can be stored on a single card. Each of these individual recordings are called 'spiels'. These commands can be used to select an individual spiel on the selected card(s). Individual spiels can be requested with SPIEL# requests with a range of 01 to FF. Once a spiel is selected, it will be played on the next start. If the card is looping then it will play the requested spiel on the next iteration of the loop. If a spiel selection has been made inadvertently, it can be cleared by sending a request for SPIEL# 00. Spiel requests from the serial port have the highest priority in the system.

....

":" (TRACK#) (DELAY TIME) Set Delay:

This command allows the user to adjust the time set for the delay function on the card selected by TRACK#. The delay can serve two functions:

1) Delay the actual start of playing from 1/34th of a second to about 1/2 hour from the time the start command is received after a reset command.

2) While in looping mode, delay for a period of 1/34th of a second to about 1/2 hour between each iteration of the loop.

   Acceptable values for DELAY are from 0000 to FFFF. Each count is equal to .029127111 seconds. If the value is 0000, the function is disabled.

EXAMPLE: to give card 00 a delay value of 1 minute (080CH is equal to 2060 counts, which is equal to 60.00184866 seconds): :00080C

....

"=" (TRACK#) (ADDRESS) Set Memory Address:

Address bits 10 through 42 for the EPROM array are stored in the microcontroller. These can be read out using the Memory Address Status command, or loaded using this command. Because the addressing for any memory chips mounted on expansion boards is not direct, this method can only be used for accessing the first 16 memory chips. If the system is running when this command is received, then after the current 1 KByte is played, the new address will take effect. If the system is stopped when this command is received, then it will take effect as soon as the card is started.

Setting address values only effects the first 16 memory chips.

EXAMPLE: to set the Digital Repeater on card 00 to address 12345678: =0012345678

....

Clock Commands:

"<" (TRACK#) Stop Clock:
">" (TRACK#) Start Clock:

Only one card in the entire digital audio system will normally be enabled as the master clock for all of the Digital Audio Repeaters in the system. For multi track systems, starting together and then running from the same clock will usually give a good enough synchronization between tracks. If a greater level of synchronization is needed, these commands can be used. They must be used cautiously, however, as they can cause problems if used improperly.

These commands are used to start and stop the clock on the card specified by the TRACK#. To use these commands to tighten the synchronization between cards, you will need to stop the clock before issuing Start Commands, and then restart the clock. If the clock remains stopped for too long, the dead man timer will time out and reset the cards. The dead man time is about 1 second.

EXAMPLE: to start clock on card 00: <00

EXAMPLE: to stop clock on card 00: >00

....

"?" (HALF-MASK) (FULL-MASK) Mute Masks:

This command usually comes from the PA MASTER in a digital audio system which is equipped with a PA system.

This command is followed by an 8 bit half-mute mask and an 8 bit full-mute mask. Any bits on these two masks which match enabled full and half mute zones will cause an appropriate

mute level to be taken.

EXAMPLE: to mute zone 1, 5 and 6, and half mute zone 3, 4, and 8: ?8C31

....

"[" (PA ZONE) (PA STATION) (TRUNK#) PA Command:

This command usually comes from the PA MASTER in a digital audio system which is equipped with a PA system.

This command opens the TRUNK# for each valid request for a PA ZONE. The only PA ZONES which any card will respond to are those which have been enabled through the setup routine.

If the PA STATION number is equal to the TOP PRIORITY PA STATION for a given card, then that PA request will take priority over all other PA requests for that card. The same holds true for the SECOND PRIORITY PA STATION, except that TOP PRIORITY PA requests will take precedence over these too.

If no other priority options are 'on', then all other valid PA requests are treated equally. If more than one valid PA request is active at a time, the audio from both will be mixed.

If the STANDARD PRIORITIES are on, then it uses the PA STATION number to prioritize PA requests. Any request from a higher numbered PA STATION will take precedence over lower numbered PA STATIONS. Only one PA request is allowed on at a time.

If the ZONE PRIORITIES are on, then it uses the PA ZONE number to prioritize PA requests. Any request from a higher numbered PA zone will take precedence over lower numbered PA zones. Only one PA request is allowed on at a time.

If both ZONE and STANDARD PA PRIORITY options are 'on', then the system will use a combination of the two priorities. If the PA system is active and a request from either a higher numbered PA STATION or PA ZONE comes in, the new request will be honored. All other requests will be ignored.

EXAMPLE: if a pa request comes in from PA STATION 55 to access PA zone AA, with the audio feed to be found on trunk line 3: [AA553

....

"]" (TRUNK#)   Clear PA Request:

This command usually comes from the PA MASTER in a digital audio system which is equipped with a PA system.

This command is used to clear PA requests on the digital audio Repeater cards. When a valid PA request comes in to any card, it opens up the appropriate PA TRUNK LINE to feed the audio from the PA STATION to the Repeater card. This command clears the PA request by turning off the TRUNK# of the PA request. If all the trunk lines are off, then it turns off the PA LED on the front of the card and allows the mute level to return to whatever it was before.

EXAMPLE: to clear any PA requests which used trunk line 3:]3

Summary of Serial Port Commands:

"a" (TRACK#)	**Enter Setup Echo Mode:**
"b"	**Exit Setup Echo Mode:**
"c" (TRACK#)	**Enter Global Echo Mode:**
"d"	**Exit Global Echo Mode:**
"e" (TRACK#)	**Enter Echo All Mode:**
"f"	**Exit Echo All Mode:**
"g"	**Enter Echo Mode:**
"h"	**Exit Echo Mode:**
"i" (TRACK#)	**Track Status Report:**
"j" (5AA5)	**Special Default Setup:**
"k" (TRACK#)	**LED Port Status:**
"l" (TRACK#)	**Switch Status:**
"m" (5AA5) (TRACK#)	**Enter Configuration Mode:**
"n" (TRACK#)	**Memory Address Status:**
"o" (TRACK#)	**Dipswitch #1 Status:**
"p" (TRACK#)	**Dipswitch #2 Status:**
"q" (TRACK#)	**Aux. Port Status:**
"r" (TRACK#)	**Configuration Dump:**
"s" (TRACK#) (STRING)	**Load Configuration:**
"t" (TRACK#)	**Start Track:**
"u"	**Start All:**
"v"	**Start Cocked:**
"w" (GROUP#)	**Start Group:**
"x" (TRACK#)	**Stop Track:**
"y"	**Stop All:**
"z"	**Stop Cocked:**
"G" (GROUP#)	**Stop Group:**
"H" (TRACK#)	**Reset Track:**
"I"	**Reset All:**
"J"	**Reset Cocked:**
"K" (GROUP#)	**Reset Group:**
"L" (TRACK#)	**Mute Track:**
"M"	**Mute All:**
"N"	**Mute Cocked:**
"O" (GROUP#)	**Mute Group:**
"P" (TRACK#)	**Half-Mute Track:**
"Q"	**Half-Mute All:**
"R"	**Half-Mute Cocked:**
"S" (GROUP#)	**Half-Mute Group:**

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"T" (TRACK#)	**Un-Mute Track:**
"U"	**Un-Mute All:**
"V"	**Un-Mute Cocked:**
"W" (GROUP#)	**Un-Mute Group:**
"X" (TRACK#)	**Cock Track:**
"Y" (TRACK#)	**Un-Cock Track:**
"Z"	**Un-Cock All:**
"!" (TRACK#)	**Loop Track:**
"""	**Loop All:**
"#"	**Loop Cocked:**
"$" (GROUP#)	**Loop Group:**
"%" (TRACK#)	**Stop At End Track:**
"&"	**Stop At End All:**
"'"	**Stop At End Cocked:**
"(" (GROUP#)	**Stop At End Group:**
")" (TRACK#) (SPIEL#)	**Select Spiel Track:**
"*" (SPIEL#)	**Select Spiel All:**
"+" (SPIEL#)	**Select Spiel Cocked:**
"/" (GROUP#) (SPIEL#)	**Select Spiel Group:**
":" (TRACK#) (DELAY TIME)	**Set Delay:**
"=" (TRACK#) (ADDRESS)	**Set Memory Address:**
"<" (TRACK#)	**Stop Clock:**
">" (TRACK#)	**Start Clock:**
"?" (HALF-MASK) (FULL-MASK)	**Mute Masks:**
"[" (PA ZONE) (PA STATION) (TRUNK#)	**PA Command:**
"]" (TRUNK#)	**Clear PA Request**

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- Digital Audio Repeater/Mixer Connections -

- J-3 -
- 96 PIN DIN CONNECTOR -
- Digital Audio Repeater/Mixer to Motherboard -

	A	B	C
1	- REPEATER CLOCK	N/C	+ REPEATER CLOCK
2	- Tx DATA	N/C	+ Tx DATA
3	- Rx DATA	N/C	+ Rx DATA
4	N/C	N/C	N/C
5	N/C	N/C	N/C
6	N/C	N/C	N/C
7	N/C	N/C	N/C
8	B INPUT	N/C	A INPUT
9	COMMON	N/C	STATUS OUT
10	ISOLATED +15	ISOLATED +15	ISOLATED +15
11	ISOLATED GROUND	ISOLATED GROUND	ISOLATED GROUND
12	LOGIC +15	LOGIC +15	LOGIC +15
13	LOGIC +5	LOGIC +5	LOGIC +5
14	ANALOG +15	ANALOG +15	ANALOG +15
15	GROUND	GROUND	GROUND
16	ANALOG -15	ANALOG -15	ANALOG -15
17	PA AUDIO FEED #1	PA AUDIO FEED #2	PA AUDIO FEED #3
18	PA AUDIO FEED #4	PA AUDIO FEED #5	PA AUDIO FEED #6
19	PA AUDIO FEED #7	PA AUDIO FEED #8	PA AUDIO FEED #9
20	PA AUDIO FEED #10	PA AUDIO FEED #11	PA AUDIO FEED #12
21	PA AUDIO FEED #13	PA AUDIO FEED #14	PA AUDIO FEED #15
22	PA AUDIO FEED #16	VCA IN/OUT	GROUND
23	VCA BUS #1	VCA BUS #2	VCA BUS #3
24	VCA BUS #4	VCA BUS #5	VCA BUS #6
25	VCA BUS #7	VCA BUS #8	GROUND
26	GROUND	AUX. INPUT	GROUND
27	GROUND	GLOBAL / MIX BUS #1	GROUND
28	GROUND	GLOBAL / MIX BUS #2	GROUND
29	GROUND	GLOBAL / MIX BUS #3	GROUND
30	GROUND	GLOBAL / MIX BUS #4	GROUND
31	- OUTPUT	- MIX INPUT 'A'	- MIX INPUT 'B'
32	+ OUTPUT	+ MIX INPUT 'A'	+ MIX INPUT 'B'

- J-2 -
- 1/8" MINIATURE PHONE JACK -
- Single Ended Audio Output -

RING-	GROUND
TIP-	OUTPUT

- J-10 -
- RCA JACK -
- Single Ended Audio Output -
- (AB-100 ONLY) -

RING	GROUND
TIP	+OUTPUT

- J-3 -
- 20 PIN HEADER/SOCKET ASSEMBLY -
- Digital Audio Repeater/Mixer to Adjustment Card -

1	FILTER OP AMP OUTPUT
2	FILTER - OP AMP
3	AUDIO FEED TO ADJUSTMENT CARD
4	AUDIO OUTPUT
5	AUDIO -15 VOLTS
6	AUDIO +15 VOLTS
7	MIX BUS LEVEL POT INPUT
8	MIX BUS LEVEL POT WIPER
9	PA LEVEL POT INPUT
10	PA LEVEL POT WIPER
11	MIX 'B' POT INPUT
12	MIX 'B' POT WIPER
13	MIX 'A' POT INPUT
14	MIX 'A' POT WIPER
15	DIGITAL POT INPUT
16	DIGITAL POT WIPER
17	GROUND
18	VOLUME POT REFERENCE
19	1/2 MUTE WIPER
20	VOLUME WIPER

- J-4 -
- 18 PIN SIP HEADER -
- Digital Audio Repeater/Mixer to Memory Expansion Card -

1	MEMORY CHAIN (NORMALLY REMOVED)
2	MEMORY CHAIN
3	EPROM CHIP SELECT #1
4	EPROM CHIP SELECT #2
5	EPROM CHIP SELECT #3
6	EPROM CHIP SELECT #4
7	EPROM CHIP SELECT #5
8	EPROM CHIP SELECT #6
9	EPROM CHIP SELECT #7
10	EPROM CHIP SELECT #8
11	EPROM CHIP SELECT #9
12	EPROM CHIP SELECT #10
13	EPROM CHIP SELECT #11
14	EPROM CHIP SELECT #12
15	EPROM CHIP SELECT #13
16	EPROM CHIP SELECT #14
17	EPROM CHIP SELECT #15
18	EPROM CHIP SELECT #16
19	LOGIC +5 VOLT SUPPLY
20	LOGIC +5 VOLT SUPPLY
21	LOGIC +5 VOLT SUPPLY
22	GROUND
23	GROUND
24	GROUND

- J-6 -
- 14 PIN HEADER -
- Aux. Port -

1	D0
2	D7
3	D1
4	D6
5	D2
6	D5
7	D3
8	D4
9	+ 5 VDC
10	GROUND
11	6 MHz
12	N/C
13	AUX PORT SELECT
14	ADDRESS PORT SELECT

- J-7 -
- RJ-11 / 6 POSITION TELEPHONE CONNECTOR -
- RS-485 Serial Data -
- (AB-100 ONLY) -

	COLOR	SIGNAL NAME:
LEFT	WHITE	SIGNAL GROUND
	BLACK	- SERIAL DATA OUT FROM REPEATER
	RED	+ SERIAL DATA OUT FROM REPEATERS
	GREEN	- SERIAL DATA IN TO REPEATERS
	YELLOW	+ SERIAL DATA IN TO REPEATERS
RIGHT	BLUE	SIGNAL GROUND

- J-8 -
- 5 position DIN -
- Power Supply -
- (AB-100 Only) -

1	GROUND
2	N/C
3	+ 5 VDC
4	- 12 VDC
5	+ 12 VDC

- J-9 -
- 7 POS. screw terminal -
- Start Inputs, Status Output, and Audio Output -
- (AB-100 Only) -

1	STATUS OUTPUT
2	COMMON
3	B INPUT (RESTART)
4	A INPUT (START)
5	GROUND
6	- OUTPUT
7	+ OUTPUT

- DIGITAL AUDIO SYSTEM MOTHERBOARD CONNECTIONS -

- 'Digital Data' -
- 26 pin IDS connector -
- used to connect digital signals between cages -

PIN #	SIGNAL FUNCTION	CONNECTS TO J1 PIN #
1	- REPEATER CLOCK	1A
2	N/C	1B
3	+ REPEATER CLOCK	1C
4	- REPEATER Tx DATA	2A
5	N/C	2B
6	+ REPEATER Tx DATA	2C
7	- REPEATER Rx DATA	3A
8	N/C	3B
9	+ REPEATER Rx DATA	3C
10	N/C	4A
11	N/C	4B
12	N/C	4C
13	N/C	5A
14	N/C	5B
15	N/C	5C
16	N/C	6A
17	N/C	6B
18	N/C	6C
19	N/C	7A
20	N/C	7B
21	N/C	7C
22	N/C	8B
23	N/C	9B
24	N/C	N/C
25	GROUND	15A, 15B, 15C
26	N/C	N/C

- 'Pwr.' -
- 7 position screw terminal -
- used to attach power to card cages -

PIN #	SIGNAL FUNCTION	CONNECTS TO J1 PIN #
7 (TOP)	ISO +15	10A, 10B, 10C
6	ISO GROUND	11A, 11B, 11C
5	not used	12A, 12B, 12C
4	LOGIC +5	13A, 13B, 13C
3	ANALOG +15	14A, 14B, 14C
2	GROUND	15A, 15B, 15C
1 (BOTTOM)	ANALOG -15	16A, 16B, 16C

- 'PA' -
- 34 pin IDS connector -
- used to connect pa audio signals between cages -

PIN #	SIGNAL FUNCTION	CONNECTS TO J1 PIN #
1	GROUND	
2	PA AUDIO FEED #1	17A
3	GROUND	
4	PA AUDIO FEED #2	17B
5	GROUND	
6	PA AUDIO FEED #3	17C
7	GROUND	
8	PA AUDIO FEED #4	18A
9	GROUND	
10	PA AUDIO FEED #5	18B
11	GROUND	
12	PA AUDIO FEED #6	18C
13	GROUND	
14	PA AUDIO FEED #7	19A
15	GROUND	
16	PA AUDIO FEED #8	19B
17	GROUND	
18	PA AUDIO FEED #9	19C
19	GROUND	
20	PA AUDIO FEED #10	20A
21	GROUND	
22	PA AUDIO FEED #11	20B
23	GROUND	
24	PA AUDIO FEED #12	20C
25	GROUND	
26	PA AUDIO FEED #13	21A
27	GROUND	
28	PA AUDIO FEED #14	21B
29	GROUND	
30	PA AUDIO FEED #15	21C
31	GROUND	
32	PA AUDIO FEED #16	22A
33	GROUND	
34	GROUND	

- 'Mix Buss' -

- 10 pin IDS -

- used to link global / mix bus between card cages -

PIN #	SIGNAL FUNCTION	CONNECTS TO J1 PIN #
1	GROUND	
2	GLOBAL / MIX BUS #1	27B
3	GROUND	
4	GLOBAL / MIX BUS #2	28B
5	GROUND	
6	GLOBAL / MIX BUS #3	29B
7	GROUND	
8	GLOBAL / MIX BUS #4	30B
9	GROUND	
10	N/C	

- 'Start, Status and VCA Inputs' -
- screw terminals -
- used to attach signals to individual cards -

PIN #	SIGNAL FUNCTION	CONNECTS TO J1 PIN #
A INPUT		A INPUT 8C
B INPUT		B INPUT 8A
STATUS OUTPUT	STATUS	9C
COMMON		COMMON 9A
+ VCA INPUT	VCA IN/OUT	22B
- VCA INPUT	GROUND	

- 'VCA Buss' -
- 20 pin IDS (1/2 J-6/A) -
- used to link vca bus between card cages -

PIN #	SIGNAL FUNCTION	CONNECTS TO J1 PIN #
1	N/C	
2	N/C	
3	GROUND	
4	VCA BUS #8	25B
5	GROUND	
6	VCA BUS #7	25A
7	GROUND	
8	VCA BUS #6	24C
9	GROUND	
10	VCA BUS #5	24B
11	N/C	
12	N/C	
13	GROUND	
14	VCA BUS #4	24A
15	GROUND	
16	VCA BUS #3	23C
17	GROUND	
18	VCA BUS #	223B
19	GROUND	
20	VCA BUS #1	23A
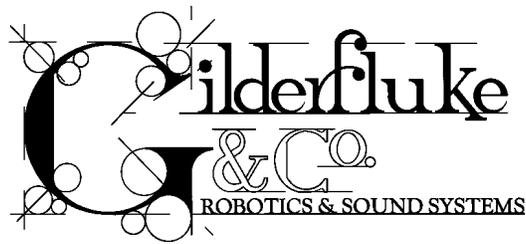
- MX-100 / MX-200 -
- Memory Expansion Boards -
for use with DR-100, DR-300, or AB-100
Digital Audio Repeaters

A MX-100 or MX-200 Memory Expansion Board is used to increase the capacity of a Digital Audio Repeater by 32 additional memory chips. Any number of these memory expansion cards can be used on any Repeater card within the physical space limitations of the Repeater housing. The practical limits are three MX-100's in an AB-100 AudioBrick case, and six MX-100 with one MX-200 on a DR-100 or DR-300. This gives a capacity of up to 112 EPROMs on an AB-100 AudioBrick, or 240 EPROMs on a card cage mounted DR-100 or DR-300.

The MX- expansion cards, like the Repeaters they work with, support EPROMs from 27C512 (64 KBytes x 8) up to 27C080 (1024 KBytes x 8). A red LED on each MX- card shows when the memory chips on that card are active. All EPROM sockets in the Repeater card with which the MX- is used with must be filled. The EPROMs on the MX- card are installed starting with the socket marked as 'ROM 1' and extending through the socket marked 'ROM 32'. There can be no breaks in the EPROM sequence, and the MX- card must be completely filled if additional MX- cards are going to be used.

WHEN INSTALLING EPROMs, BE SURE TO OBSERVE THE 'PIN ONE' MARKINGS ON THE EPROMs, SOCKETS, AND PRINTED CIRCUIT BOARDS. PLUGGING AN EPROM IN BACKWARDS CAN DAMAGE BOTH THE EPROM AND REPEATER!

The only difference between the MX-100 and the MX-200 are the height above the board the EPROMs take. The MX-100 is the standard card. The EPROMs are mounted in standard-style EPROM sockets and the cards can be used in any memory expansion card position. The MX-200 cards use special low profile EPROM sockets. They are used when there isn't room to mount a normal MX-100 card, as when 1, 3, 5, or 7 memory expansion cards are being used in a card cage mounted system and you can't spare the extra slot a normal memory expansion card would extend into. MX-200 cards can only be used as the last or only card in a stack of memory cards, as they don't have connectors on their top to allow additional MX- cards to be stacked on their tops.

When using memory expansion cards in card cage mounted systems, Repeater fronts in special 2", 3" and 4" wide sizes are available. These can be ordered as needed under part numbers RF-200, RF-300, and RF-400, respectively.

Configuration and Installation:

Each MX- Repeater card plugs into J-5 (2 x 17 pin header) and J-4 (1 x 24 pin header) on the card below. They are mounted by four 6-32 standoffs from the card below.

The Repeater card to which the first MX- card is attached must have four 6-32 x 1/2" hex standoffs attached to it. In the case of DR- cards, four standard hex standoffs are mounted to the card using 6-32 x 1/4" round head machine screws. With AB-100 AudioBricks, the standoffs are 6-32 x 1/2" male/female spacers which replace the screws which normally mount the card into the case.

MX- cards beyond the first one all mount using 6-32 x 7/16" male/female spacers (or a 6-32 x 3/8" male/female spacer with a 1/16" thick nylon washer under it) to the MX- card below them. The last card in the series is fastened down with four 6-32 x 1/4" round head machine screws.
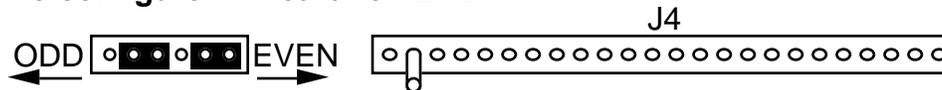
The MX-100 cards are all configured as either 'EVEN' or 'ODD' cards. The first card on top of the Repeater is always an 'EVEN' one. The cards are always configured as follows:

FIRST MX- MEMORY EXPANSION = EVEN
SECOND MX- MEMORY EXPANSION = ODD
THIRD MX- MEMORY EXPANSION = EVEN
FOURTH MX- MEMORY EXPANSION = ODD
FIFTH MX- MEMORY EXPANSION = EVEN
SIXTH MX- MEMORY EXPANSION = ODD
SEVENTH MX- MEMORY EXPANSION = EVEN

All MX-200 cards are factory configured as EVEN card, since they are normally mounted in the first, third, fifth, or seventh MX- positions.
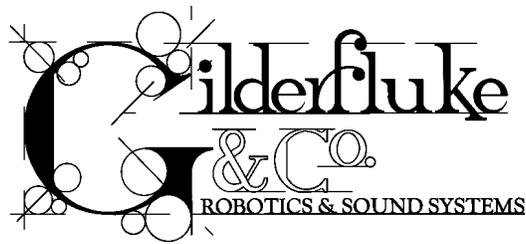
To configure an MX-100 card, two jumpers are moved to the positions shown below, and one of the pins on the J-4 connection is bent downward slightly so that this one pin doesn't plug into any additional MX- card which is mounted on top of it. If the configuration of the MX- cards is to be made permanent, these pins can be cut off instead of merely bent.

To configure MX- card for 'EVEN':

ODD ◄ [o■■o■■] EVEN ►   J4
[o o o o o o o o o o o o o o o o o o o o o o o o]

To configure MX- card for 'ODD':

ODD ◄ [■■o■■o] EVEN ►   J4
[o o o o o o o o o o o o o o o o o o o o o o o o]

- Intelligent Public Address System -

The PUBLIC ADDRESS SYSTEM is used to make announcements from any of up to 256 PA STATIONS to any of up to 511 PA ZONES within your park or attraction. The muting system can be used to mute any of up to eight full-mute zones, or 'half-mute' any of up to eight half-mute zones. Each DR-300 or DR-400 Digital Audio Repeater / Mixer card contains what is in effect a telephone switching network's three dimensional switching array.

When an operator selects a PA zone by pressing an enabled button on any of the PA STATIONS, all the audio tracks in that zone drop to the half muted volume level and the audio from the microphone at the requesting PA STATION is routed to the outputs. Up to sixteen PA STATIONS and PA zones can be used at any time for accessing across PA zones. Any number of stations can access their own LOCAL PA OUTPUTs simultaneously.

The full and half-mute zones are accessed by pressing an enabled button on any of the SMART PA STATIONS. These buttons are normally configured to operate in a 'push on/push off' mode. If you mute a zone at one SMART PA STATION, you can un-mute it at any other that has access to that zone.

Whether a given audio track will respond to a PA or mute command is set in the configuration mode for each card. Any individual card can respond to up to eight different PA ZONE, MUTE ZONE or HALF MUTE ZONE requests. LOCAL PA OUTPUTS can each be configured to respond to up to four different PA zone requests.

Three LEDs on the front of each Digital Audio Repeater / Mixer show any and all PA and Muting system activity. The 'P.A.' LED lights whenever a card receives a valid command for a PA announcement. The '1/2' LED shows any Half Mute request. The 'MUTE' LED lights for any Full Mute request. Since PA requests also Half-Mute the audio, the '1/2' LED will also light during PA requests.

- MA-100 PA Master -

The MA-100 PA MASTER controls all the PA STATIONS and Digital Audio Repeater / Mixer cards. One PA MASTER is required in any system which has any PA STATIONS attached to it. When installed, the PA MASTER becomes the conduit through which all serial communications with the audio system takes place. It will buffer and dispatch any commands sent to the Digital Audio Repeater / Mixer cards so that they won't interfere with PA system commands.

The MA-100 is a 19" rack mounted unit which takes up 1-3/4" of panel space. It includes one MA-200 for attaching the first eight PA STATIONS and LOCAL PA OUTPUTS to the system.

The PA MASTER can support a printer and a terminal through two RS-422 / RS-485 serial lines. You can tell the PA MASTER to report all system activity, or only errors like missing PA STATIONS or microphones. All activity is logged by the real time clock in the MA-100.

The MA-100 has eight 0 to 10 VDC outputs which can be controlled by the serial port or SMART PA STATIONS. These can be used to control the voltages on the VCA bus to control the volume coming out of the DR-300 and DR-400 Repeaters, or these voltages can be used to control lighting or any other system which needs an analog control signal.

- MA-200 PA Interface -

The MA-200 PA INTERFACE is used to attach an additional eight PA STATIONS to the Digital Audio System. It fits into 1-3/4" of 19" rack space. It includes a single (optionally eight) balanced BGM input which is fed to the eight balanced LOCAL PA OUTPUTS, along with any PA feeds they need. Each LOCAL PA ZONE can respond to up to four different PA zone requests. The normal and half-muted levels of the BGM coming out of the LOCAL PA OUTPUTS, as well as the volume of the PA announcements, are all set through the MA-100's configuration screens.

- Public Address Stations -

Up to 256 PA STATIONS can be attached to any MACs Digital Audio System at one time. These can be any mix of SMART PA STATIONS, FOUR BUTTON PA STATIONS, ONE BUTTON PA STATIONS, and PHANTOM PA STATIONS.

SMART PA STATIONS are mounted in deep quad J-boxes. They can be used with microphones with sixteen buttons (plus two volume control and the normal push-to-talk buttons) or just two (plus the push to talk). Options available include an alphanumeric LCD display (with or without backlighting) to show all PA system activity.

Any button on any SMART PA STATION can be configured to access any feature in the DIGITAL AUDIO SYSTEM. These are:

· Select any enabled PA ZONE

· Ramp the volume up or down on any VOLUME ZONE

· HALF-MUTE or FULL-MUTE any enabled MUTE ZONE

· Send any command to the Digital Audio Repeater to start, stop, select a spiel, or whatever for any or all Repeaters in the system.

· Send any command to the Smart Brick System to start, stop, select a show, or whatever for any or all Smart Bricks in the system.

Any button on a SMART PA STATION can be configured to act as a momentary contact, or as a 'push on/push off' style button. You can also tell the buttons to wait for the microphone to be keyed before a 'push on/push off' becomes active, and then release when the microphone keyswitch is released

DUMB PA STATIONS are available with four buttons (PA-400) on their front (plus the microphone button) or with just the microphone button (PA-100) for those stations which only need to access a single PA zone. Dumb PA STATIONS mount in standard duplex outlet boxes. The buttons on the front of the Four Button PA STATIONS can be configured as push-to-talk buttons, or as latches which determine what PA

zone will be accessed the next time the the microphone's push-to-talk button is pressed. When operating in this latter mode, you can tell the station's microphone button to revert to the PA zone it normally accesses when it is released.

The Phantom PA STATIONS are used for automated announcements and automated 'emergency' spiels. In this application, instead of having a microphone attached to it, the Phantom PA STATION uses the output of one of the Digital Audio Repeater / Mixer cards as its input. This card is usually configured in the 'loop while' mode so that it will loop as long as the start input is active. The enabling input for the Phantom PA STATION comes from the 'running status' output of this Digital Audio Repeater / Mixer card. When the Repeater with the automated spiel on it is started by a switch closure on its start input, it automatically selects the required PA ZONE through the PHANTOM PA STATION. The spiel will continue until the enabling signal is released and the spiel has finished. In emergency spiel applications, you may want to assign the phantom PA STATION a fairly low priority so that a live person giving useful information can easily 'step' on the canned spiel. If the audio system is being controlled by a serial data link from another computer or control system, serial commands can be used to select and start canned spiels and route them to the desired PA ZONES.

The wiring needed by any PA STATION is a single eight conductor modular style telephone cable. This will normally provide all the power, communications, and audio signals to the PA STATION. On some longer runs (greater than 1000 feet, it may be necessary to add a local power supply to the PA STATION. If absolute silence is required on the PA audio channel, then a shielded twisted pair is recommended for the microphone line.

All wires between the PA STATIONS and the MA-100 or MA-200 panels are transformer or opto-isolated. MOV varistors can be used between each of the wires and chassis (earth) ground to provide lightning protection if needed.

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- DAS-100 -
- Digital Audio Sampler -

for use with
DR-100, DR-300, or AB-100
DIGITAL AUDIO REPEATERS
and
DR-50 or AB-50
Mini Audio Repeaters

The DAS-100 Digital Audio Sampler is used to record monophonic or stereo audio signals onto the hard disk of an IBM compatible computer's hard disk. From there they can be burnt into EPROMs for installation in DR-100, DR-300, AB-100, AB-50 or DR-50 Digital Audio Repeaters for permanent audio playback installations.

The hardware part of the package consists of a 5" long Interface card which mounts inside an IBM compatible computer. This provides the interface to the computer, I/O buffering, and control for the Sampler. It is linked to the Sampler box by a 50 position ribbon cable. It is in this box that the actual conversion between the Analog audio and Digital computer signals takes place. This part of the system is mounted outside the IBM case to optically isolate the audio signals from the electrically noisy environment inside an IBM case, as well as to make it easier for you to get to its input and output plugs, volume controls, and clipping indicator LEDs.

The software was written in C, with assembly language routines where speed is critical. It allows you to record and play audio samples of up to an hour in length (limited only by your hard disk capacity), remove areas of silence so that the samples will take less EPROM space, view a graphical representation of the audio sample, print labels for the EPROMs, and save the files for burning into EPROMs to the disk.

This manual assumes at least a working knowledge of the care and feeding of IBM compatible computers. We assume when we tell you to install the interface card in the computer or copy the software to the hard disk, you know how to do these things. If you have managed to get an IBM hard disk up and running, you'll have no problems installing the DAS-100, or wrestling alligators, or with any other challenges you might face in the future.

- Hardware Requirements -

To use the DAS-100, you will need an IBM AT class machine or compatible running a 80286 (or better) processor at a speed of at least 12 MHz. The screen needs to support EGA or better. The DAS-100 to IBM interface is a 'short' card which can be mounted in any 8 or 16 bit slot available. For color displays in the DUMP MENU, you will need an EGA or better screen.

The hard disk and its controller needs to be fast enough to support a 1 to 1 interleave and 28 millisecond access times. This normally means that the disk controller must have a 16 bit interface to the IBM bus and the hard disk drive will need to be of the 'RLL', 'EISA' or 'SCSI' varieties. If the disk is too slow, you may not be able to sample at all, or will only be able to sample monophonic signals. Storing audio samples eats up a lot of hard disk space. When taking a stereo sample at 15 KHz bandwidth, it will require 4 MBytes per minute just to store the original sample. The program can then generate several overlays having to do with this file as you perform evaluations and optimization, and then the EPROM image files you will eventually burn can take up as much room as the original sample file (although these can be redirected to another disk or saved just a few at a time).

Since you will eventually need to erase the samples you have already taken to open up hard disk space, a tape backup device is highly recommended to allow you to archive old samples. It is usually much easier to retrieve an archived sample and burn new EPROMs from it than to have to start from scratch if you need to make some minor changes in an installation.

The DAS-100 is a memory mapped device. It requires 8 k bytes of address space. This normally starts at D00000H. It will not work if anything else is located in this memory address area. (Even if your machine has more than 640 KBytes of memory installed, this extra memory is normally mapped to addresses above the area we are concerned with.) If there is a conflict with some other device on the bus, the DAS-100 can be re-addressed anywhere between 000000H and FFFE00H. Check your manuals for all other equipment and memory on the bus to assure that there will be no conflicts with your existing hardware. If the DAS-100 needs to be re-addressed, the jumpers located on the board can be moved as needed. They are marked from A-13 to A-19. Inserting a jumper on a pair of pins sets that address bit 'low'. Removing it sets it 'high'. Contact the factory if this presents a problem for you.

The DAS-100 software doesn't burn EPROMs directly, but instead saves files to disk in the proper format for later burning into EPROMs using virtually any commercially available EPROM burner. This allows you to get a simple and inexpensive single chip burner if you will only occasionally be burning chips, or a fast set burner which can do 8 or 16 chips simultaneously if you will be burning a lot of chips. The requirements for the EPROM burner are that it is compatible with IBM compatible computers, can take a binary format input file, and can handle the larger CMOS EPROMs which are used by the Digital Audio Repeaters. These are 27C512 (64 k x 8), 27C010 (128 k x 8), 27C020 (256 k x 8) 27C040 (512 k x 8), and 27C080 (1024 k x 8) EPROMs. Note that some manufacturers will shuffle the order of the last three digits of the part numbers so that a 27C010 may be called a 27C100, etc.. The speed of the EPROMs is not terribly important for the Digital Audio Repeaters. Any speed at or below 200 nanoseconds will be plenty fast,. It isn't very likely you will find these larger EPROMs at any speeds slower than 200 nanoseconds. EPROMs used in the Digital Audio Repeaters must be manufactured using CMOS memory technologies.

- Installation -

Before you start installation of the DAS-100, it is prudent to make a backup of any important software on your hard disk.

To install the DAS-100 on your computer system, you must first check that it meets all of the requirements above. If it does, power it down and plug the DAS-100 interface card into any slot. Plug the 50 position wire from the interface card to the sampler box. The audio input and output lines on the sampler box are clearly marked. Attach them to your audio system just like any stereo tape deck would be plugged in. Plug the power supply into the sampler box, and then plug the power supply in (as with the AB-100 AudioBricks, don't plug or unplug the 5 pin DIN power connector with the power supply plugged in to the wall.). Turn on your computer and install the supplied software on the hard disk. As always, put the original disk aside as a backup.

Invoke the program 'SAMPLER'. It should come up with the opening screen. If you have an audio signal going into the inputs and the output is feeding an amplifier, you should now start hearing the sound as it is fed through the system (Turn your amplifier down a bit the first time you do this.). You can now stroll through the commands available in the software, but you can do this even if the DAS-100 hardware weren't installed as it comes up in a 'DEMO' mode if it can't find the hardware. To verify full operation of the system:

1) Use the FILE NAME command to create a new file. This first time in the program, you MUST direct the file name to where your hard disk is located ('C:', 'D:', etc.) and to any sub-directory on that disk (if any) where you want the samples to go. The sub-directory, if used, must be created prior to entering the Sampler program. After this first time through the FILE NAME command, the DAS-100 software will continue to use the drive and directory specification you gave it until you change it again.

2) Select a sample length using the SAMPLE LENGTH command.

3) Take an audio sample using the RECORD SAMPLE command.

If the message 'Board Not Installed, Operation Ignored' appears, then the DAS-100 software isn't finding the hardware. Verify that the software is addressed correctly by opening the configuration menu (you MUST do this if you had to re-address the hardware). The address should read D000H. This means the board is addressed at D00000H. The last two zeros aren't used since they are always '0'. If you changed the hardware address, change the software address to reflect the new address now.

This completes the hardware and software installation.

- Software and Operation -

The operation of the DAS-100 has been designed to be as easy as possible. All of the commands are accessed through a combination of single keystrokes on a series of seven or so menus.

Audio data is stored in 'files' on the hard disk. Each of these is a MS-DOS file, along with a number of related overlays with the same file name as the sample (the .extensions are all different to reflect their functions). Within any file, you can have as many different separate samples as you wish. Each of these can be taken at any bandwidth or filter rate and given any names you wish. Their lengths can be anywhere from 1/35th of a second on up to the capacity of your hard disk. It is these separate samples which can be accessed at random once burnt into EPROMs when installed in a Digital Audio Repeater. Since it is possible to pick and choose between all of the different samples, a library of sound effects can be built as needed.

The **SAMPLE DATA DISPLAY** window just about always appears at the left of the screen while you are in the DAS-100 software. It shows all of the important information about the current audio sample you are working with.

The **MAIN MENU** is the one you see when you first enter the program. It contains the most commonly used commands in the system, as well as access to the other menus. When you are in any other menu, the <ESC>ape key, <SPACE> bar, or <RETURN> will almost always get you back to where you were before, or back to the main menu as appropriate.

The **DATA DUMP** menu allows you to see the audio data for the sample you are working on. You can use this to find glitches, pops, or other anomalies in the audio or to fade in or out at the ends of the sample.

The **CONFIGURATION MENU** is used to set some of the values which you won't need to change very often. These include the EPROM SIZES and I/O ADDRESS for the DAS-100. Also secreted away in this menu are the commands you can use to rename or delete an individual sample or erase the entire file set you are working with.

With the **EVALUATE DATA** menu, you can scan through one or more of the samples and eliminate any 'silences' from the audio data. When the data is later burnt into EPROMs, these areas won't take up any valuable EPROM space. You can also automatically trim off any silence at the beginnings and ends of the samples.

The **EPROM IMAGE** menu is where you save the EPROM-sized files which will later be burnt into the EPROMs for installation in the Digital Audio Repeater cards. You can direct where these EPROM image files will be stored, and how many of them will be written out to the disk drives. This allows you to save them a few at a time to lower capacity floppy disks for archiving or to burn the EPROMs on a different machine. When saving EPROM images, you can pick and choose among all of the samples found in the current file, use as few or as many as you want, and place them in any order you desire. It is only after you have made all of these selections that the DAS-100 software can total up the number of EPROMs you will need.

The **PRINT REPORTS** menu lets you print protective labels for the EPROMs on an EPSON MX-80 or compatible dot matrix printer. The information for these labels comes from the checksum files on the disk (filename.CKL and filename.CKR), which are generated when you do an EPROM IMAGE save. For this reason, you must have saved the EPROM images before printing the labels. The DAS-100 expects labels which are 1" wide x 1/2" high, and come in seven column wide pin feed sheets.

- Internal Details -

Because of the rather low I/O speed of an IBM compatible computer, the data is buffered into and out of the DAS-100 through four 2 KByte deep FIFO buffers. This allows the IBM to ignore the hardware for periods as long as it takes 1 KByte worth of audio to come or go on the DAS-100. Even at a 15 KHz bandwidth (35.1 KHz sample rate), this allows the IBM 1/35th of a second between having to service the DAS-100. It is during these periods that the software handles all disk I/O, screen handling, and other functions. The disk drive controller buffers data by a certain number of blocks ahead, and dumps these to/from the disk as these buffers are filled/emptied. When the buffers are changed, you can see the time display update on the screen.

The format of the data which is burned into the EPROMs is in blocks of 1 KByte each. The first byte of the audio data is normally replaced by one flag byte. This sets the operating settings for the following 1023 audio data bytes. Bits 0 to 2 set the sample rate, while bits 3 to 5 set the output filter cutoff point. The last two bits flag the ends of samples.

bits	2	1	0	sample rate	frequency cutoff
	1	1	1	35,156.25 Hz	15.00 KHz
	1	1	0	23,437.50	10.00 KHz
	1	0	1	17,578.125	7.50 KHz
	1	0	0	11,718.75	5.00 KHz
	0	1	1	8,789.00	3.75 KHz
	0	1	0	7,031.00	3.00 KHz
	0	0	1	4,687.00	2.00 KHz
	0	0	0	Delay[1]	OFF[1]

bits	5	4	3	filter frequency	frequency cutoff
	1	1	1	1.5 MHz	15.00 KHz
	1	1	0	1.0 MHz	10.00 KHz
	1	0	1	750.0 Khz	7.50 KHz
	1	0	0	500.0 KHz	5.00 KHz
	0	1	1	375.0 KHz	3.75 KHz
	0	1	0	300.0 KHz	3.00 KHz
	0	0	1	200.0 KHz	2.00 KHz
	0	0	0	OFF[2]	OFF[2]

bit 6:

0	no effect
1	end of all sampled data after this 1 KByte is played.

bit 7:

0	no effect
1	stop after this 1 KByte is played.

---

[1] If the sample frequency is set to delay, then the next two bytes following the flag byte are used to set how long the delay will be (MSB first). Each count is equivalent to one 1 KByte block of data played when played at a 15 KHz bandwidth (this is equal to 1024/35,156.25 of a second). The normal flag byte for the remaining 1021 bytes of data follows the two delay bytes. All four of these flag bytes take the place of the normal flag bytes which would be found in these positions.

[2] This condition doesn't effect the frame rate, but just shuts down the output filter.

- Left Window Display -

This is the display window which almost always appears at the left hand side of the screen. It displays are:

Sample- Required:
This shows the length of the sample you have requested. It is set by the SAMPLE LENGTH command. The 'blocks' are the number of 1 KByte blocks per channel which are needed by the sample. Sample lengths can be entered as the time or the number of blocks required.

Sample- Actual:
Because the times you enter are rounded off to the nearest 1 KByte, often the length of the sample will be slightly different than what you have requested. This display shows what the actual times will be.

Start Point:
After a sample is taken, you can trim off its beginning manually by using the PLAYBACK TIMES command, or automatically by using the TRIM commands. This shows the time after the beginning of the actual sample the new start point is located.

Stop Point:
After a sample is taken, you can trim off its end manually by using the PLAYBACK TIMES command, or automatically by using the TRIM commands. This shows the time after the beginning of the actual sample the new end point is located.

Sample Rate/Filter:
This shows the sample rate and filter cutoff for the current sample.

Stereo/Mono:
This shows if the sample uses one or two audio tracks.

File Name:
This is the name of the MS-DOS filename currently being used (drive and directory selections are not displayed). All of the samples taken will be written into this file. Disk drive selections, directory selections, and file names are changed using the FILE NAME command on the MAIN MENU.

Sample Name:
This is the name of the sample within the file (named above) which we are working on. There can be any number of samples within a single file. Different samples are selected using the SAMPLE NAME command.

Disk Space:
This shows the amount of time (and 1 KByte blocks) available on the current disk drive. The time available will change as the SAMPLE RATES and MONOPHONIC/STEREO are changed. Capacities over one hour and 100,000 blocks are rounded off to '59:59.99' and '99,999'.

EPROM Count:
This tells you how many EPROMs will be required for the current sample if no compression of any kind is done on it. Since this will show a sample requiring a whole EPROM, even if it only uses the first 1 KBytes, do not use this number to judge how many EPROMs you will need. The SAVE EPROM command in in the EPROM IMAGE menu will give you a final count of your EPROM requirements. Different counts for the left and right EPROMs are shown in case different EPROM types are used for the two channels.

EPROM Type:
This shows the type of EPROM to be used for each channel. These can be changed by the EPROM SIZE commands in the CONFIGURATION MENU

- Main Menu Commands -

Sample Length:

This command is used to enter the length of the sample you are going to take. You can enter the sample length in time format (MM:SS.00), or by proceeding a number with 'B' ('b1234'), you can enter the number of 1 KByte blocks you would like the sample to use. Block entry can be used when you want to change the sample length by just a hair.

If you enter the sample length in the time format, then the length in time of the sample won't change as you alter the SAMPLE RATE, but the number of blocks it takes to store it will. If you enter the sample length in blocks, then the number of blocks won't change as you alter the SAMPLE RATE, but the sample length will.

You don't really need to worry about entering sample lengths which are exactly what you will be needing. As long as the sample length is long enough to hold the entire sample, the ends can later be trimmed to an exact fit. If you enter in a new value for an existing sample and then play it back, its original values will be restored.

Playback Times:

This command allows you to alter the start and end times for a sample which has already been taken. They are automatically reset whenever a sample is recorded. They can be set automatically to take silences off both ends of a sample using the TRIM command in the EVALUATION MENU.

Stereo/Mono:

This alternates the mode between recording one or two audio channels at a time. The monitor mode remains in stereo, no matter the setting of this toggle.

Original/Evaluated:

This allows you to choose between hearing the sample as originally taken, or the version of it with all of the silences removed. If a sample hasn't been evaluated this command is locked out. When a new sample name is chosen, it will toggle this line to the highest level of evaluation available for that sample.

Looping Mode:

This toggle allows you to have a playback repeat until you tell it to stop.

Threshold (Record):

For sampling, you can enter a threshold for the DAS-100 to listen for before it starts recording the data to disk. This allows you to enter the RECORD command, and then at your leisure start the tape deck or whatever source you are using for your audio. The DAS-100 won't start sampling until the sound level on the right channel exceeds the threshold you have entered (signals on the left channel are ignored).

Hitting the left or right arrow keys increment/decrement the THRESHOLD level. Selecting this command with the <RETURN> key or its first letter allows you to enter in a number directly. A value of '0' disables the threshold function.

Too high a level on this setting can cause a 'pop' or any quiet parts at the beginning of your sample to be missed. It should be set as low as your source material will allow. A digital source can usually use a threshold level of 15 or so. An analog tape playback may require a threshold of 20 to 40, depending on the amount of 'hiss' coming from the tape. Some low end tape decks can also produce a 'clunk' on the audio output when the tape is started, and this can exceed the threshold if it is set too low. If you are curious about the noise levels coming from your audio source, you can take some trial samples and take a look at them on the DUMP DATA screen.

You can use the THRESHOLD function for recording multi-track samples (more than two audio tracks). To do this, you trigger the DAS-100 from the same 'right' audio track on multiple stereo passes while recording a different 'left' channel each time. As long as the source tape deck runs at a steady speed, you can record as many tracks as you like. You then toss out all but one of the extra right channel EPROM files when you are done.

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Monitor Mode:

This toggle allows you to listen to whatever is coming into the inputs of the DAS-100. The audio data is digitized and then reconstructed a few moments later and sent to the outputs. With the monitor mode turned on, you can set the levels for the incoming audio to just below the clipping level. You want to set the inputs to where the 'CLIP' lights never turn on.

Sample Rate:

This allows you to select the number of samples per second, and therefore the bandwidth available for your audio. The higher the sample rate, the better the sound quality, and the more memory it will consume. As you change the SAMPLE RATE setting, you will see the storage requirements change in the data display window on the left of the screen. In general you should listen to the audio you want to sample with the sample rate set to 15 KHz and adjust the FILTER CUTOFF to see just how low you can set it without adversely affecting the audio quality. Once you have determined this, you can set the SAMPLE rate to any setting equal to or above the FILTER CUTOFF you are going to be using.

Sample rates available with the DAS-100 are:

Sample rate:	samples per second:
15.0 KHz	35,156.25 Hz
10.0 KHz	23,437.5 Hz
7.5 KHz	17578.125 Hz
5.0 KHz	11,718.75 Hz
4.0 KHz	8,789.0 Hz
3.0 KHz	7,031.0 Hz
2.0 KHz	4,687.0 Hz

Filter Cutoff:

This command is used to set the cutoff points of the input and output filters. Darn little sound will get through above the frequency selected. You should normally set the FILTER CUTOFF as low as you can without affecting the quality of the sound. The SAMPLE RATE is then set to an equal or higher rate. There is nothing to stop you from setting the FILTER RATE to a higher setting than the SAMPLE RATE, but this will produce a pretty funky sounding sample.

Filter Cutoffs available with the DAS-100 are:

Sample rate:	Actual cutoff:
15.0 KHz	15.0 KHz
10.0 KHz	10.0 KHz
7.5 KHz	7.5 KHz
5.0 KHz	5.0 KHz
4.0 KHz	3.75 KHz
3.0 KHz	3.0 KHz
2.0 KHz	2.0 KHz

File Name:

Hitting the right and left arrow keys will cycle you through all the sample files the DAS-100 can find on you currently selected disk and directory. To select another disk or directory, see a pick list of all available files to chose from, or make a new file, select this command using the <RETURN> key or first letter of the command. This will display the pick list of all available files. Use the up down arrows or first letters of the files to select one and then hit <RETURN> or <SPACE> to return to the MAIN MENU with the new selection. Hitting the <ESC>ape key will return you to the MAIN MENU without any new selection.

If you want to make a new file or select a different disk drive or directory, select 'New' at the bottom of the list (the 'N' key is usually a quick way to get there). You can now enter in a disk drive, directory, and filename. If you enter a drive selection and/or directory selection, then this will now become the default location for your files (the last character must be a '/' if you don't specify a file name at the same time). If there are no files already on the new drive/directory selected, it will default to a filename of 'DEFAULT'. You can use this name or enter a new one. Hit <RETURN> when finished.

Sample Name:

Hitting the left and right keys will cycle you through all of the samples in the currently selected file. Hitting <RETURN> or the first character of the command will bring up a pick list for all of the samples in the current file. You can select one using the up and down arrow keys, and then hitting <RETURN> or <SPACE> when you are satisfied.

The 'New' selection is used to create a new sample. It prompts you to enter a new name or modify the existing one (The modified name will be the name of a new sample. Use the RENAME SAMPLE command if you just want to change a sample's name.). Hit <RETURN> when you are done. New samples default to the settings of the last sample which had been selected.

Record Sample:

This command is used to sample in the audio data. Recording can be stopped at any time by hitting any key on the keyboard (although this leaves the old sample with as much of the new audio as you let in at its front). The audio you are sampling is fed through as you sample it so you can hear what is going on. Monophonic samples use only the Right channel.

If the THRESHOLD has been set, the DAS-100 waits for the input on the right channel to exceed the threshold before it starts recording data (the left channel is ignored). If you have made the sample length longer for an existing sample, then the DAS-100 will prompt you and then spend a little time making room for this new sample length.

Clipping makes a rather unpleasant noise in digital audio systems. For this reason it is important to adjust the levels for the sample before it is taken. If you can't watch for clips while taking the sample, don't worry, you can see them on the playback too.

Playback:

This command plays back the currently selected sample. Playback can be stopped at any time by hitting any key on the keyboard. MONOPHONIC samples come out only on the RIGHT channel. The clip indicators will repeat any clips which were found when the audio was sampled. If the LOOPING MODE is ON, then the sample will repeat until you tell it to stop (by hitting any key).

Configuration Menu:

This gets you to the CONFIGURATION MENU.

Evaluate Data Menu:

This gets you to the DATA EVALUATION MENU.

Dump Data:

This gets you to the DATA DUMP MENU.

EPROM Image Menu:

This gets you to the EPROM IMAGE MENU.

Print Reports:

This gets you to the LABEL PRINTING MENU.

Quit:

This gets you back to DOS.

- Configuration Menu Commands -

I/O Address:

This allows you to set the location where the DAS-100 software expects to find the DAS-100 hardware. See the installation section of the manual for information on setting this value.

EPROM Size Right:
EPROM Size Left:

These commands let you set the size of the files which will be saved when you save an EPROM image. It doesn't actually have anything to do with the types of EPROMs used, only the size of the files which are saved. Sizes available are:

27C512 = 64 KBytes x 8 (512 Kbits)

27C010 = 128 KBytes x 8 (1 Mbits)

27C020 = 256 KBytes x 8 (2 Mbits)

27C040 = 512 KBytes x 8 (4 Mbits)

27C080 = 1024 KBytes x 8 (8 Mbits)

Rename Sample:

This command lets you enter a new name for the current sample.

Delete Sample:

This command lets you erase the current sample.

Erase This File Set:

This command lets you erase all of the files associated with the currently selected filename. As this is a rather drastic thing to do, this command is hidden over here in the CONFIGURATION MENU where you are less likely to hit it accidentally and it asks you 'Are you Sure' before actually doing it.

Flag Byte Save:

If off, the EPROM image files are saved without the flag bytes which normally precede every 1 KByte block of data. It is normally left 'on'

- Evaluation Menu Commands -

Sample Names:

This works more or less like the same command in the MAIN MENU, with the exception that when you bring up the pick list of existing sample names, you can select any number of them that you want. Only those files which have been selected will be evaluated by the other commands in this menu.

Use the up/down arrows or first letter of any sample name to move the cursor to it. Hit the <RETURN> key to select it. You can then select any other sample by the same procedure, or exit the pick list by hitting either the <ESC>ape key or <SPACE> bar. The line upon which the cursor is sitting when you close the pick list will be the one selected to be displayed on the data display window at the left of the screen and will be played by the PLAYBACK command. These selections can be carried through to the EPROM IMAGE menu if so desired.

Playback Times:
Original/Evaluated:
Looping Mode:
Playback:

Just like on the MAIN MENU.

Silence Threshold:

This is NOT just like on the MAIN MENU. This allows you to set the threshold for what the DAS-100 will consider as silence during the sampled data. When saved to EPROMs for use in a Digital Audio Repeater, any silence period (up to 1/2 hour) will only take three bytes of EPROM space. Since the cost of the EPROMs is one of the major budget factors in any digital audio installation, anything which saves EPROM space can save a lot on the bottom line. The amount of space saved depends on what is being sampled. Music usually doesn't have any silence periods in it and so the savings will be minimal. Voice announcements benefit the most from silence removal. The exact amount of memory saved depends on the speaker and where you set the threshold level. With the ORIGINAL / EVALUATED toggle set to 'SILENCE', you will be able to hear the sample with the silences removed.

Hitting the left or right arrow keys increment/decrement the THRESHOLD level. Selecting this command with the <RETURN> key or its first letter allows you to enter in a number directly. If the threshold level hasn't been changed from what had previously been used on a sample, any new calls to the SILENCE EVALUATION command will be ignored.

When you select a new sample name for display or playback, the threshold level under which it was last evaluated will be moved into this slot.

Trim:

This command automatically sets the start and stop times for the sample(s) which have been selected by removing any leading or trailing silences. The samples you want to trim must have had a SILENCE EVALUATION done before this command can do anything with them. If you don't like what this command has done, you can still change the start and stop times manually (or change the threshold level, re-evaluate, and re-trim).

Silence Evaluation:

This command evaluates the selected sample(s) for any periods where the audio level doesn't exceed the SILENCE THRESHOLD you have set. During any periods which are interpreted as 'silence' the audio will be fully muted. The left and right channels are evaluated independently. You can hear the result of this evaluation by doing a PLAYBACK with the ORIGINAL / EVALUATED toggle set to 'SILENCE'.

Too high of a threshold level will mute the audio when it shouldn't. In the case of recorded speech, this can cause the beginnings and ends of words to be cut off. Note that the Digital Audio Repeaters are somewhat more forgiving than the DAS-100 hardware as far as the way the beginnings and ends of silences sound.

- Data Dump Commands -

<Up> <Down>:

These select the sample for display from the currently open file.

<Left> <Right>:

These move you forward and backwards in time through the sample. If you exit this menu and then return, it will remember where you were.

<PGUP> <PGDN> <W>hole:

Because the resolution of a standard IBM screens precludes the possibility of displaying an entire 1 KByte block of data at a time, these commands allow you to display the first or second 512 Bytes, or the entire 1024 Bytes at half resolution.

<B>itmap:

This command allows you to see a HEX dump of the audio data.

<M>odify:

This command allows you to artificially set the filter cutoff frequency for a 1 KByte block of data.

Fade In:
Fade Out:

These commands allow you to ramp the audio data up or down from/to a zero output level. This can be used to eliminate 'pops' at the beginning or end of a sample. These usually aren't a problem, as the playback hardware is designed to absorb 'pops' to some extent. 'Pops' are usually created if you artificially cut a sample when a signal is at a very high level. Under these circumstances, you may need to use these commands.

The changes are recorded into the disk file when any other page of data is displayed. If you don't want to save any changes you have made, you must use the UNDO command BEFORE any other.

Undo:

Restores a faded in / faded out data to its original form if done before any other command.

Start:

This command allows you to enter the time or block number you want to have displayed. It is faster than hitting the arrow keys to move long distances.

Right/Left:

This toggles the display between the RIGHT and LEFT audio data.

- EPROM Image Menu Commands -

EPROM Directory:

This command allows you to tell the DAS-100 where you want to put the EPROM image files. You can enter a disk drive and directory specification to send the files to any disk you want. Since the EPROM image files are relatively small, they can be sent to floppies for archiving or to be used in another machine to burn the EPROMs.

Start EPROM / End EPROM:

These commands allow you to create the EPROM images for a whole set of EPROMs while actually only writing out a limited selection of them to your disk. This comes in handy if you have limited disk space or are writing to a floppy. These can be incremented/decremented using the arrow keys or entered directly by selecting them with the <RETURN> key or first letters of the commands.

Remove EPROM Files:

This command removes any EPROM files ('.Rnn' and '.Lnn') and checksum files ('.CKR' and '.CKL') that have been generated for the current sample file. Note that if you are working with very large numbers of EPROM files this command will only remove the first ninety-nine left and right EPROM files.

Program EPROMs:

This is the command in which you choose which samples are to be written to the EPROM files, and in which order. If you are doing multiple passes at this command (as when saving only a few EPROM files at a whack), you must use the exact same selection procedure for the files each time. If you don't, there may be discontinuities in the audio and the EPROM labels won't match the EPROMs.

On entry, this command brings up a pick list of all of the samples stored in the current file. As with the Evaluation pick list, you can select as many or as few of these for burning as you desire (by selecting the sample name using the up and down arrow keys and hitting the <RETURN> key, or using <F1> or <F2> to select or deselect all). If there have been any evaluations done on the audio data, you can also select what level of evaluation you would like to be burnt into the EPROMs for individual samples by using the left and right arrow keys (This pick list always comes up showing the highest level of evaluation available for each sample.). When you are satisfied with your selections, hit the <ESC>ape key or <SPACE> bar to put these files into EPROM files. They go into the EPROMs in the order in which they appear on the pick list. When the DAS-100 is finished, it will come back to the pick list so you can select any additional files to be added to the EPROM files. By selecting only a file or two at a time for insertion into the EPROM files, you are able to put the samples into the EPROMs in any order you wish, or even have multiple copies of the same audio data (or evaluated and unevaluated versions of the same file if you are not sure how each one will sound when installed). When you are satisfied with the EPROM files, simply hit a <SPACE> or <ESC>ape when there are no samples selected to return to the MAIN MENU.

Saving EPROM images writes to the disk two different types of files. The first are the EPROM files. The size of each of these files is set with the EPROM SIZE commands in the CONFIGURATION MENU. These are straight binary files with the same filename as the main sample file, but with the extension of .R01, .R02 ,..... .R99 for the right audio channel, and .L01, .L02, ...L99 for the left audio channel. Beyond 99 files, the 'R' and 'L' increment to 'S' and 'M', respectively. They keep incrementing like this until all of the EPROMs have been finished.

The second files generated by the SAVE EPROMs command are .CKL and .CKR. These store the checksum values for the EPROMS which have been saved for use by the PRINT LABEL command. Note that these files reflect the values only for the most recent EPROM SAVE command for the current file being used.

- Report Menu Commands -

Label Name:

Although the labels default to the name of the file you are working from, you can give them any name which will fit into 15 spaces.

Label Column:

If you have already used a few labels from a line, you can tell the DAS-100 to start printing at the next available label space. This can be incremented/decremented using the arrow keys or entered directly by selecting it with the <RETURN> key or first letter of the command.

Start Label:
End Label:
Channel:

If you don't want to print all of the labels, you can select and print just a few of them for the left, right, or both audio channels. These can be incremented/decremented using the arrow keys or entered directly by selecting them with the <RETURN> key or first letters of the commands.

Print Test:

This prints a line of 'X's at the current printer position and then increments the LABEL COLUMN number by one. It is used to align your printer to the labels.

Print Labels:

This command prints all or a selection of the EPROM labels for the current file. You must have done an EPROM IMAGE SAVE for this file before this command will execute so that it can know how many EPROMs there are and what's in each one. Each label gets:

Name (from the filename or the name you entered). Maximum of 15 characters.
EPROM number of total EPROMs
Checksum
Time and Date of when the EPROM files were saved.

The DAS-100 expects labels which are 1" wide x 1/2" high, and come in seven column wide pin feed sheets. Compatible labels are available from:

W. H. Brady
2221 W. Camdon Road
PO Box 2131
Milwaukee, Wisconsin 53201 U.S.A.
Phone (414) 351-6630

Part number:

DAT 49 - 969

- Calibration -

The DAS-100 may require an occasional calibration of its analog circuitry. To check the calibration, take a stereo sample with both volume controls turned fully down (counter clockwise) and no audio cables attached. Then look at the sample with the dump screen. Both channels should look like fairly flat lines dead center in the screen with only a touch of jitter on each side.

To adjust the DAS-100, remove the top of the case. Inside you will see six multi-turn trimmers. The four pots to the left of the case are used to set the offset of the operational amplifiers (TLO71's) located right below them. With both of the volume controls turned fully down (counter clockwise), no audio cables attached (these could be a source of electrical noise), and the DAS-100 software running in monitor mode with a sample and filter rates set to 15 KHz, attach a good quality meter between ground and pin #2 of each IC and adjust the pot directly above it until the meter reaches exactly 0.000 volts. Start with the two IC's and pots closest to the left of the case, and then move to the two middle pots and IC's. Once these four pots are adjusted, it is time to adjust the two pots located above the LM311's. The right channel is controlled by the pot towards the top of the case. The only remaining pot controls the left channel. Take a short audio sample (10 blocks or so) and look at it. Adjust the two pots as needed to bring both traces back into the center line. Repeat the sample and adjust sequence until you are satisfied with the calibration.

- A Sample Sample Session -

The purpose of this section of the manual is to give you a step-by-step example of how to take your first audio samples. By the time you have reached this point the hardware and software should be installed in your computer and your audio system connected to the inputs and outputs of the DAS-100. The exact order of the steps is unimportant, and many of them are optional or can be carried through from an existing sample.

1) Type 'SAMPLER' at the command prompt to call up the DAS-100 software. The main menu screen should appear on the screen.

2) Select the file and sub-directory you want this sample to go into. Note that if the DAS-100 software can't find any sample files in the currently selected drive/directory when it is invoked, it will create a file name called "DEFAULT". This can be a new file (created by selecting the 'NEW' at the bottom of the list of existing sample files), or a previously existing sample file. If you just want to change the drive or directory you are currently looking at, select the 'NEW' and enter in only the drive/directory you want to use. When you hit <RETURN>, this will be the new default location for your sample files. If you select to create a 'NEW' file, the last file you were working with will appear for you to modify its name or change it completely. If you type any character except for the arrow keys, the entire line will be erased for you to enter an new name. If you use the arrow keys, you can move back and forth across the name and change it as needed. Since this creates a DOS filename, all of the usual filename rules apply.

3) Select the name of the new sample to be taken. Note that if this is a new file name set, the DAS-100 software will create a default sample named "SAMPLE 1". You can select a new sample name (created by selecting the 'NEW' at the bottom of the existing sample name list) or an existing sample name. If you select an existing sample name, it will be recorded over. If you select to create a 'NEW' sample name, the sample name you were last working with will appear for you to modify or change completely. If you type any character except for the arrow keys, the entire line will be erased for you to enter an new name. If you use the arrow keys, you can move back and forth across the name and change it as needed. If you are working with a new file set, you can get rid of the default "SAMPLE 1" name by simply selecting by the 'NEW' at the bottom of the list and then typing over it.

4) Select whether you will be doing a MONOPHONIC or STEREO sample. You normally shouldn't mix stereo and monophonic samples in the same file set, since they will take different positions in the final EPROMs when they are created.

5) If it isn't already on, turn on the audio source you will be sampling. Run through the sounds and adjust the two level controls (you can turn the left channel all the way down if you are doing a monophonic sample) until the clipping LEDs no longer light. This is just a preliminary adjustment so you don't need to be too precise.

6) Still listening to the audio coming through the system, toggle the filter rates to find out what sounds best. When sampling low frequencies without any higher overtones, a lower filter rate will simply sound better and use less room in the EPROMs. You can use any filter rate for any sample within a file set.

7) Set the sample rate to a frequency which is equal or to greater than the filter rate set in the step above. The lower the frequency used for the sample, the less memory it will take. You can use any sample rate for any sample within a file set.

8) Now is the time to seriously listen to the sound you will be sampling and adjust the level(s) down to where they don't clip. Note that some sound effects (like gunfire, explosions and the like) are just about impossible to keep from clipping and still record them at a respectable level. Luckily, most of these sorts of sounds don't sound any worse for the wear if you do allow them to clip a bit.

If you will be recording multiple samples onto the same EPROMs, you will need to decide if you want to record them all at a set level, or adjust the levels for each sample individually. Normally it is best to record them all at a similar level. To do this you find the loudest of the samples and use it to set your levels and then don't touch them for the rest of the samples.

If your source has a large change in volume during it, you may want to try 'riding' the level controls to keep the signal at a consistent level. A better solution is to run the audio through an audio expander/limiter before feeding it into the DAS-100. This will automatically adjust the level to keep it within a certain range.

9) Set the sample length. Normally you can time the sound you are going to sample and enter its length plus a little extra. You don't need to be any too precise with this measurement, as any extra space at either end can be trimmed off later. The number of EPROMs that this particular sample will take is now shown on the left side of the menu. This is without any data compression or silence removal which may take place later, and is rounded up to the next EPROM even if the sample extends only a little way into it.

10) Set the threshold level. This is an optional feature which makes it easier to start sampling right when the sound starts. If set to 0, then the sampling starts as soon as you press the SAMPLE command. If this is set to any other value, the audio coming in on the right channel must exceed this level before the sampling actually starts. What this means is that you can enter the SAMPLE command, and then take your time before starting your audio source. At the first peep out of the source, the sampling will actually commence. The level you set for your threshold depends on how clean the audio source is. When using a digital source like a CD or DAT there is very little tape his and so the threshold can be set relatively low (10 or 20). When using a record or audio tape, there will be a lot of hiss and rumble which can cause premature sampling and so the threshold may need to be set as high as 30 or 40. If it is set to high, you will hear it cut off the very start of the sound being sampled when you play it back.

11) Take the sample. Use the SAMPLE command to start collecting data. If the threshold is set to 0, then the sampling will start immediately. Otherwise, the sampling will wait until the level on the right channel exceeds the threshold. You can cancel a sample at any time by hitting any key on the keyboard. You can re-sample as many times as you like.

12) Listen to the result. Use the PLAYBACK command to listen to the sample you have taken. You can watch for any clips on the LEDs you might have missed while you were taking the sample.

13) If you wish, you can manually trim off any extra time at the beginning or end of the sample using the START/END TIME commands. If the sample is to be used in an endless loop, you can turn on the LOOPING toggle, and trim the sample until the ends match.

14) Take additional samples. If you are doing multiple samples in this file set, you can repeat steps 3 through 13 as many times as you wish.

At this point you are ready to evaluate the sampled data:

15) Evaluate the data. You have the option of performing evaluations on any or all of the samples you have taken so far. Switch over to the EVALUATION MENU.

16) Use the EVALUATION MENU's SAMPLE NAME command to select any or all of the sample names you want to evaluate.

17) Set the threshold for the silence evaluation. As with the threshold for taking the samples, too low a level will result in clipping off the starts and ends of sounds. Too low of a level will mean any tape hiss and noise will be taken for real sounds.

18) Do silence evaluation. Use the SILENCE EVALUATION command to find any parts of the sample(s) which fall below the silence threshold.

19) Listen to the result. Switch the ORIGINAL/EVALUATED toggle over to 'SILENCE'. Listen to the re-sults of the evaluation. You can select other sample names and listen to them as well. If the results weren't satisfactory, or if you have some more samples which need evaluation with different parameters set, you can repeat steps 16 through 18 as many times as you like.

20) Automatically trim the sample(s). You now have the option of trimming off any silence at the beginning and/or end of the sample(s) by using the TRIM command. The only samples which will automatically be trimmed are those which have been previously evaluated for silence, and are currently selected by using the EVALUATION MENU's SAMPLE NAME command. After this command has finished you can see that the start/stop times for the appropriate samples have

been modified. You can listen to the results, and manually modify them further if you so desire.

At this point you are ready to make the EPROM images:

21) Select the type (actually just the size) of EPROM you will be using from the configuration menu.

22) Also in the configuration menu, check that the 'SAVE EPROM FLAGS' toggle is on.

23) Select the EPROM IMAGE menu.

24) If you don't want to save all of the EPROMs on this pass, set the start and end EPROMs as needed.

25) Select the EPROM IMAGE command. This will bring up a pick list of all of the sample names in this file set. Also shown will be the highest evaluation level available for each of the samples. You can select all of the samples, or only the ones you want. The left and right arrows can be used to select the evaluation level which will be saved to the EPROMs. When you hit the space bar or <ESC>ape key, the currently selected samples will be written to the EPROM image files in the order they appear on the pick list. When finished, the program will return to the pick list. You can now select additional samples to go into the EPROMs, or if you hit the space bar or <ESC>ape with no samples selected, you will be returned to the main menu.

At this point you are ready to print the EPROM labels:

26) Select the reports menu. If you don't want to print all of the labels, set the start and end label values as needed. If you aren't sure about the position of the labels in the printer, you can print a test label.

27) Print labels. The print command will print all of the labels for the last EPROM set you just saved.

At this point you are ready to burn the EPROMs:

28) You must exit the DAS-100 software to burn the EPROMs. Exit and then call up your EPROM burner's software. The EPROM images are stored with the file name you entered in step 2 above with the extension of .R01, .R02, .R03, etc. (.L01, .L02, .L03, etc. for the left channel if there is one). Load the files (one by one, unless you have an EPROM burner which can program different files into different EPROMs at the same time). You can compare the checksums with those printed on the labels as you load and burn the files.

29) As the EPROMs are burnt you can install and test them in your Repeater cards.

- HEXadecimal to DECIMAL to PERCENTAGE -

The following chart shows decimal, HEXadecimal, and a few percentage equivalents to aid you when you need to convert between numbering bases:

decimal	HEX	ASCII	%	decimal	HEX	ASCII	%	decimal	HEX	ASCII	%	decimal	HEX	ASCII	%
00	00	null	0	64	40	@	25%	128	80	(null)	50%	192	C0	(@)	75%
1	01	soh/^A		65	41	A		129	81	(soh)		193	C1	(A)	
2	02	stx/^B		66	42	B		130	82	(stx)		194	C2	(B)	
3	03	etx/^C		67	43	C		131	83	(etx/)		195	C3	(C)	
4	04	eot/^D		68	44	D		132	84	(eot)		196	C4	(D)	
5	05	eng/^E		69	45	E		133	85	(eng)		197	C5	(E)	
6	06	ack/^F		70	46	F		134	86	(ack)		198	C6	(F)	
7	07	bell/^G		71	47	G		135	87	(bell)		199	C7	(G)	
8	08	bs/^H		72	48	H		136	88	(bs)		200	C8	(H)	
9	09	ht/^I		73	49	I		137	89	(ht)		201	C9	(I)	
10	0A	lf/^J		74	4A	J		138	8A	(lf)		202	CA	(J)	
11	0B	vt/^K		75	4B	K		139	8B	(vt)		203	CB	(K)	
12	0C	ff/^L		76	4C	L		140	8C	(ff)		204	CC	(L)	
13	0D	cr/^M		77	4D	M		141	8D	(cr)		205	CD	(M)	
14	0E	so/^N		78	4E	N		142	8E	(so)		206	CE	(N)	
15	0F	si/^O		79	4F	O		143	8F	(si)		207	CF	(O)	
16	10	dle/^P		80	50	P		144	90	(dls)		208	D0	(P)	
17	11	dc1/^Q		81	51	Q		145	91	(dc1)		209	D1	(Q)	
18	12	dc2/^R		82	52	R		146	92	(dc2)		210	D2	(R)	
19	13	dc3/^S		83	53	S		147	93	(dc3)		211	D3	(S)	
20	14	dc4/^T		84	54	T		148	94	(dc4)		212	D4	(T)	
21	15	nak/^U		85	55	U		149	95	(nak)		213	D5	(U)	
22	16	syn/^V		86	56	V		150	96	(syn)		214	D6	(V)	
23	17	etb/^W		87	57	W		151	97	(etb)		215	D7	(W)	
24	18	can/^X		88	58	X		152	98	(can)		216	D8	(X)	
25	19	em/^Y		89	59	Y		153	99	(em)		217	D9	(Y)	
26	1A	sub/^Z		90	5A	Z		154	9A	(sub)		218	DA	(Z)	
27	1B	ESC		91	5B	[		155	9B	(ESC)		219	DB	([)	
28	1C	FS		92	5C	\		156	9C	(FS)		220	DC	(\)	
29	1D	GS		93	5D	]		157	9D	(GS)		221	DD	(])	
30	1E	RS		94	5E	^		158	9E	(RS)		222	DE	(^)	
31	1F	VS		95	5F			159	9F	(VS)		223	DF	( )	
32	20	SP	12.5%	96	60	`	37.5%	160	A0	(SP)	62.5%	224	E0	(`)	87.5%
33	21	!		97	61	a		161	A1	(!)		225	E1	(a)	
34	22	"		98	62	b		162	A2	(")		226	E2	(b)	
35	23	#		99	63	c		163	A3	(#)		227	E3	(c)	
36	24	$		100	64	d		164	A4	($)		228	E4	(d)	
37	25	%		101	65	e		165	A5	(%)		229	E5	(e)	
38	26	&		102	66	f		166	A6	(&)		230	E6	(f)	
39	27	`		103	67	g		167	A7	(')		231	E7	(g)	
40	28	(		104	68	h		168	A8	(()		232	E8	(h)	
41	29	)		105	69	i		169	A9	())		233	E9	(i)	
42	2A	*		106	6A	j		170	AA	(*)		234	EA	(j)	
43	2B	+		107	6B	k		171	AB	(+)		235	EB	(k)	
44	2C	`		108	6C	l		172	AC	(')		236	EC	(l)	
45	2D	-		109	6D	m		173	AD	(-)		237	ED	(m)	
46	2E	·		110	6E	n		174	AE	(·)		238	EE	(n)	
47	2F	/		111	6F	o		175	AF	(/)		239	EF	(o)	
48	30	0		112	70	p		176	B0	(0)		240	F0	(p)	
49	31	1		113	71	q		177	B1	(1)		241	F1	(q)	
50	32	2		114	72	r		178	B2	(2)		242	F2	(r)	
51	33	3		115	73	s		179	B3	(3)		243	F3	(s)	
52	34	4		116	74	t		180	B4	(4)		244	F4	(t)	
53	35	5		117	75	u		181	B5	(5)		245	F5	(u)	
54	36	6		118	76	v		182	B6	(6)		246	F6	(v)	
55	37	7		119	77	w		183	B7	(7)		247	F7	(w)	
56	38	8		120	78	x		184	B8	(8)		248	F8	(x)	
57	39	9		121	79	y		185	B9	(9)		249	F9	(y)	
58	3A	:		122	7A	z		186	BA	(:)		250	FA	(z)	
59	3B	;		123	7B			187	BB	(;)		251	FB	( )	
60	3C	<		124	7C			188	BC	(<)		252	FC	( )	
61	3D	=		125	7D			189	BD	(=)		253	FD	(|)	
62	3E	>		126	7E	~		190	BE	(>)		254	FE	(~)	
63	3F	?		127	7F	del		191	BF	(/)		255	FF	(del)	100%