ART

DR2a

DIGITAL REVERBERATION SYSTEM

Owner's Manual

Applied Research & Technology Inc.

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INTRODUCTION

The ART DR2a Digital Reverberation System is a high quality digital signal processing device providing realistic natural reverberation as well as creative new reverb effects.

In designing the DR2a, ART incorporated the latest findings in digital reverberation research and gave careful consideration to user feedback on desirable features. Microcomputer control of a high speed digital signal processor allows quick and easy adjustment of relevant reverb parameters such as room size, "liveness", color and depth. ART technology makes it affordable.

User oriented front panel controls select one of several different room types, length of pre-delay, amount of high frequency absorption, apparent position within the reverberant space, diffusion and decay time. The reverb signal may be defeated from the front panel or remotely via a rear panel jack. Bright LEDs provide a clear display of the current settings.

Once you achieve a desired sound, you can store the settings for later recall in one of three presets, which may then be locked. In the event of an unexpected loss of power, the presets are preserved for up to several hours.

Designed to replace less flexible spring and plate reverbs in demanding stage and studio applications, the DR2a is quiet and clean, and may be switched to accommodate high or low signal levels. The input is balanced and separate jacks provide stereo and mixed mono outputs capable of driving line levels into 600 ohms. The two stereo outputs provide a full, wide stereo image.

Special consideration was given to features that make the DR2a more convenient to use inline with musical instruments. A front panel reverb level control, in conjunction with the mixed mono output, is useful when no other mixing or level adjustment facilities are readily available. A rear panel dry kill switch removes the dry signal from the mono output when external mixing is desired.

We recommend that you first read these instructions to learn more about the DR2a Digital Reverberation System and its operation. Keep in mind that the settings described here are only a starting point. There is no substitute for hands on experience. Experiment for yourself.

INSTALLATION

In this section we'll discuss some general considerations for setting up and installing the DR2a Digital Reverberation System and cover what connections go where. We'll also discuss the setting of rear panel and internal switches which, normally, are set only once and are thus not part of the normal day to day operation of the unit. Note that, throughout the rest of this manual, whenever we refer to actual labels, we'll indicate them by using all upper case letters (e.g. the ROOM TYPE control).

OPERATING ENVIRONMENT

The DR2a is an outboard device which may be used in a variety of setups including:

* with mixing consoles having reverb send and return facilities.

* directly in line between a musical instrument and an amplifier.

* in the effects loop of an amplifier.

Your intended application will dictate the mounting requirements and which of the switch settings and connections discussed below are most appropriate.

The DR2a is designed for convenient mounting in a standard EIA nineteen inch rack and occupies one vertical rack position (1.75 inches high). As with any rack mount equipment, especially single high units, care should be taken to support the rear of the unit if the rack might be subjected to mechanical shock (in a touring case for example).

Mounting location is not critical, but for greater reliability we recommend that you not place the unit too near power amps, power supplies, tube equipment or other sources of heat. The DR2a runs warm to the touch normally, so if possible allow at least an inch above and below the rear of the unit for convection cooling.

LEVEL SETTINGS

The rear panel IN/OUT LEVEL switch selects between two operating ranges for optimum signal level matching:

1) HIGH position (pushbutton out) selects nominal input/output operating levels of 0 dBV (+6 dBV max. input). Use this position with line level console or amplifier loops.

2) LOW position (pushbutton in) selects nominal input/output operating levels of -12 dBV (-6 dBV max. input). Choose this position for in line use with amplified musical instruments and lower level recording equipment.

Refer to the discussion of the level display in the Controls and Operation section for more information on setting the IN/OUT LEVEL switch.

BASS ROLLOFF SWITCH

The BASS ROLLOFF switch allows you to tailor the low end response of the DR2a to suit your requirements. Low frequency filtering is applied to the incoming signal before it is sent to the digital processing circuitry. The switch selects between two rolloff frequencies, 50 and 150 Hz. Units are shipped from the factory with the switch set in the 50 Hz position. We feel this setting is optimum for most applications as it approximates the spectral balance of natural reverberation. However, if it is not optimum for your application, you can change it.

The switch is located inside the DR2a and requires the removal of the top panel for access. You'll find the switch, labeled S2 on the printed circuit board, near the rear panel DRY KILL switch. Position the slider toward the rear panel to select the 50 Hz rolloff frequency. Position the slider away from the rear panel for 150 Hz operation. (Both positions are labeled on the board.)

CONNECTIONS

All connections to the DR2a are made at the rear of the unit via jacks which accept standard 1/4-inch phone plugs.

Input

The input impedance is 47k ohms, balanced using active circuitry. This is a mono input, so when connecting to consoles with stereo sends, use only one send output or else mix the sends to mono before connecting to the DR2a.

With a balanced input, use a three conductor phone plug with the following connections: Signal (+) = tip, Signal (-) = ring, Ground = sleeve.

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The input may also be used with an unbalanced (single ended) line. The preferred method is to connect separate conductors from the console send ground to the reverb (-) input and input ground. This allows the noise canceling benefits of the balanced input to be more fully realized. Special care should be taken to keep input noise low, since the DR2a has high gain at some frequencies with long decay time settings. Small amounts of input noise, hum, or crosstalk can result in exaggerated output noise. In less critical applications, the (-) input may be tied directly to the input ground or use a two conductor (tip and sleeve) phone plug.

Outputs

All outputs are single ended and mate with two conductor phone plugs. Each output has a source impedance of less than 1K ohms and can drive full output levels into 600 ohm line impedances.

The LEFT and RIGHT stereo outputs provide a realistic stereo image, simulating two microphones in a reverberant space. These outputs provide straight (no dry signal mixed in) reverb signals and are unaffected by the front panel REVERB LEVEL control.

The MIXED output provides a mono signal combining the reverberant information from both stereo outputs with the dry (unprocessed) signal. The front panel REVERB LEVEL control varies the amount of reverb in the mixed output signal. This mixing capability is especially useful for in line use with musical instruments where external mixing facilities are neither available nor otherwise needed. Pushing the rear panel DRY KILL pushbutton in removes the dry signal from the mixed output to allow external mixing of the mono reverb signal.

External Control

The rear panel also includes a 1/4-inch phone jack labeled REVERB KILL, providing an optional means of defeating the reverb signal remotely (e.g. with a footswitch). It is designed to be used with a momentary, normally open or alternate action (push-on / push-off) switch connected between a two conductor phone plug's tip and sleeve terminals.

AC Mains

The DR2a operates from a power source of 105 to 125 volts AC (50-60 Hz). Models manufactured for use outside the United States are modified to comply with electrical standards for the country of destination. The transformer is fuse protected against overload.

CONTROLS AND OPERATION

The ART DR2a Digital Reverberation System combines a high degree of technical sophistication with a versatile combination of controls and features. A major goal in the development of the DR2a was to offer maximum flexibility while keeping it easy and uncomplicated to operate. This section explains the function of each control on the front panel (from left to right), and also the rear panel REVERB KILL jack.

MAIN CONTROLS

Each of the main control groupings on the DR2a front panel consists of labeled LEDs to indicate the current setting and a pushbutton(s) to modify that setting. Pushing a button repeatedly is analogous to turning a rotary selector switch. Except for DECAY TIME, all the controls may be imagined as turning in a clockwise (left to right) direction with continuous rotation (no stops). The DECAY TIME control can be "rotated" in either direction but has end stops at the minimum and maximum time values.

PRESETS

The DR2a has a three preset memory which can be used to store and recall front panel control settings. This feature makes it easy to set up two separate reverb "programs" and quickly switch between them. The preset memory is protected against loss of power for up to several hours. It won't forget your settings in the middle of a live performance or costly studio session after a momentary blackout or when someone trips over the power cord and pulls out the plug.

Pushing the PRESET button steps through each of the four preset states. With both LEDs off, the DR2a's reverb output signal is disabled. In this mode, the other front panel controls may be set up and enabled as a group with the next push of the PRESET button. This selects PRESET 1 (indicated by the LED), enables the DR2a's reverb output and stores the settings in memory. Pushing the button again selects PRESET 2. (The DR2a's reverb output is enabled when either PRESET 1,2 or 3 is selected.) Pushing the button again selects PRESET 3. Pushing the button once more starts the sequence over again with the reverb defeated and the remaining LEDs indicating the PRESET 1 settings just stored.

Selecting any of the presets recalls the previously stored settings to the front panel display. To enter a new preset, just change the control settings of an existing preset. The DR2a automatically stores any changes in the currently active preset, overwriting its previous contents, if the preset is unlocked.

CONTROLS AND OPERATION

When power is first applied to the DR2a (or after being off for an extended period of time), it comes up with the reverb defeated (both PRESET LEDs off), the presets unlocked, and the primary (BANK 1) room types selected. The PRESETS are initialized with the following settings:

	PRESET 1	PRESET 2	PRESET 3
ROOM TYPE	PLATE	ROOM	HALL
PRE DELAY	25 ms	25 ms	25 ms
H.F. DAMPING	LOW	LOW	LOW
POSITION	REAR	MID	MID
DIFFUSION	HIGH	HIGH	HIGH
DECAY TIME	1.6 sec.	6.4 sec.	12.8 sec.

ROOM TYPES

Pushing the ROOM TYPE button selects one of three different types of reverberation, indicated by the lit LED. Each primary "room" (BANK 1), in sequence from left to right, models successively larger structures. Each has a different character. These types are:

1) PLATE - provides a reverberant sound similar to plate reverbs. This setting has a relatively diffuse impulse response. It is especially suited for percussive material.

2) ROOM - simulates the sound of a small chamber with smooth, non parallel walls and little architectural detail. This setting works well with vocals and other complex material.

3) HALL - simulates the sound of a large, hall with parallel, textured walls and a moderate amount of detail. This setting enhances sustained sounds such as flute or strings.

CONTROLS AND OPERATION

Alternate Room BANKS

The room types just discussed comprise a basic group of useful reverb sounds. But the DR2a has two additional groups of room types with different PLATE, ROOM, HALL, GATED and REVERSE reverberation for even greater versatility.

We'll refer to the primary room types above as BANK 1. BANK 2 provides a more diffuse PLATE, a smaller ROOM, and an alternate HALL. BANK 3 provides a tighter PLATE, GATED reverberation, and REVERSE reverberation.

To access the alternate BANKs, push and hold both DECAY TIME buttons at the same time. The flashing LED indicates which BANK is currently selected. In this mode, the PLATE, ROOM, and HALL LEDs correspond to BANK 1, BANK 2, and BANK 3, respectively. Select the BANK you want by pushing the ROOM TYPE button again until the appropriate LED is flashing. Then release the DECAY TIME buttons.

This process is really not as complicated as it seems. Practice changing BANKS and ROOM TYPES within each BANK. Listen to how each room sounds. Soon you'll have no trouble selecting any one of the nine different room types available. The room types in each group are summarized below:

	ROOM TYPE		
BANK	PLATE	ROOM	HALL
1	----------	primary	----------
2	diffuse	small	alternate
3	tight	GATED	REVERSE

Incidentally, the selected BANK is also saved when storing settings with the PRESET control. This allows you to switch between two different BANKS quickly and easily for instant comparison or changing reverb requirements.

The ROOM TYPE control (in conjunction with the different BANKS) may be viewed as a kind of character control for selecting the desired reverb sound. The PRE DELAY, H.F. DAMPING, POSITION, DIFFUSION, and DECAY TIME controls provide further "fine tuning" of the room's character.

CONTROLS AND OPERATION

Room types and recommended control combinations are discussed in greater detail in the section on Applications and Suggested Settings.

The following information describes the GATED and REVERSE ROOM TYPES. (Note: the POSITION control is disabled when either of these rooms is selected.)

With BANK 3 selected, the ROOM position of the ROOM TYPE control provides GATED reverb. With this setting, the initial decay is like that of natural reverberation, but instead of continuing gradually to silence, the reverberation comes to an abrupt halt at the end of the selected decay time. GATED reverb provides the illusion of space without the clutter of long decay tails.

Also in BANK 3, the HALL position of the ROOM TYPE control provides REVERSE reverb. This sounds distinctly unnatural - like reverb in reverse. Here the reverberation level increases with time, but again comes to an abrupt halt at the end of the selected decay time. REVERSE reverb provides particularly interesting special effects.

PRE DELAY

In conventional recording practice, a delay is often inserted between the console and the reverb chamber. This "pre delay" serves two functions:

1) to add an apparent depth to the reverb sound, and

2) to separate, in time, the initial sound from the dense reverberation. This leaves the initial sound uncluttered and more distinct, as it stands alone for the duration of the pre delay.

The DR2a includes pre delay processing. The PRE DELAY control selects one of four delay times in 25 ms increments, from 0 to 75 ms maximum ("ms" is an abbreviation for millisecond which is one thousandth of a second). The LEDs indicate the four settings as follows:

1) Both LEDs off -- 0 ms (no pre delay)

2) "25" LED on, "50" LED off -- 25 ms

3) "25" LED off, "50" LED on -- 50 ms

4) Both LEDs on -- 75 ms (25 + 50 = 75)

CONTROLS AND OPERATION

H.F. DAMPING

As sound travels through air, or reflects off soft surfaces, the higher frequencies are absorbed quicker than the rest of the sound. This high frequency absorption is called "damping". The greater the amount of damping, the "softer" or less "live" the simulated room sounds.

The DR2a's H.F. DAMPING control selects four different amounts of damping. With both LEDs off, there is no damping and the reflective qualities are those of a room with bare, smooth walls. The LOW setting provides a small amount of damping, as if some baffling were used. The MID setting increases damping to that of a room filled with furniture. The HIGH setting applies the maximum amount of damping, as if the walls of the room were hung with thick curtains. Heavy damping used with long decay times may sound unnatural since we tend to associate a longer decay with "live" rooms, but it is a useful effect in the studio.

POSITION

The POSITION control allows you to change your apparent position in the simulated room by varying the mix of early reflections and later reverberation. With both LEDs off, your position is at the front of the room, near the sound source. The MID setting puts you in the middle of the room. The REAR setting puts you near the back of the room. As you move away from the front of the room, you hear less of the early reflections and more reverberation.

DECAY TIME

Natural reverberation results when sound reflects off the boundaries of a confined space. With each reflection, some energy is lost. The "decay time" is defined as the time required for the reverberant sound to decay to one millionth (-60 dB) of its original energy. The decay time of a reverberant space depends on the size and shape of the space, the composition of the boundaries, and the presence (or absence) of objects within the space that absorb or reflect sound energy.

The DR2a's DECAY TIME control provides two buttons to vary the amount of decay time. The left button decreases the decay time towards the MINimum value, while the right button increases the decay time towards the MAXimum value.

Six LEDs indicate decay time between the minimum and maximum limits. The range of available decay times depends on which room type is selected. The ranges are: 0.1 to 3.2 seconds for the PLATE setting, 0.2 to 6.4 seconds for the ROOM setting, 0.4 to 12.8 seconds for the HALL setting, and 0.1 to 0.6 seconds for GATED and REVERSE settings. The front panel displays the decay times for the appropriate rooms.

PAGE TWO

Alternate room BANKS were discussed earlier and are one type of PAGE TWO function with which you are already familiar. As with the alternate room BANKS, to enter the PAGE TWO mode, push and hold both DECAY TIME pushbuttons at the same time. Rapidly flashing LEDs in the PRESET, ROOM TYPE, and H.F. DAMPING control areas indicate current PAGE TWO settings. (PRESET LEDs may be on continuously if a preset is already locked. More on this in a moment.)Changes to the PAGE TWO settings take effect immediately (as with the primary controls). When the DECAY TIME buttons are released, the display reverts to normal but the PAGE TWO settings are retained. The procedure for changing the PAGE TWO settings are described individually below.

Locking Presets

Locking a PRESET prevents it from being changed inadvertently. To lock a PRESET, first select the desired PRESET and set up the other controls as you would normally. Next, enter the PAGE TWO mode by pushing both DECAY TIME pushbuttons. While holding the buttons in, push the PRESET button. The corresponding LED(s) stops flashing, indicating that the PRESET is locked. Release the DECAY TIME buttons to return to the primary mode. Now any changes made in the control settings while that PRESET is selected will not write over the stored settings.

To unlock the PRESET, enter the PAGE TWO mode and push the PRESET button again. The LED(s) will resume flashing. Return to the primary mode. Now the PRESET may be set up and stored as usual. To summarize, while in PAGE TWO mode, a flashing LED indicates that the PRESET is unlocked, a continuously lit LED indicates that the PRESET is locked.

DIFFUSION

Diffusion smooths the reverb sound by increasing the echo density and filling in the spaces between individual echoes. The DIFFUSION control is accessed as a PAGE TWO function of the H.F. DAMPING control. You may vary the reverb sound from rough to smooth in three steps.

To change the amount of DIFFUSION, enter PAGE TWO mode and push the H.F. DAMPING pushbutton. With both LEDs off (LOW), the minimum amount of DIFFUSION is selected. This setting creates the illusion of sound bouncing off many surfaces and produces a choppy effect, especially with percussive material. With the left (MID) LED flashing, an intermediate amount of DIFFUSION is selected. The maximum amount of DIFFUSION is selected when the right (HIGH) LED is flashing.

Lesser amounts of diffusion help to maintain the clarity of the processed sound and may give better results with vocals or strings. Greater amounts of diffusion provide smoother, more natural sounding reverberation, better suited for percussion.

LEVEL DISPLAY

The input signal level is indicated by four LEDs arranged as a vertical bar graph display on the front panel. This level meter is calibrated in 6 dB steps from -18 to 0 dB. For maximum dynamic range, the input level should be adjusted so that the level display reads about 0 dB on average signal peaks. Note that the REVERB LEVEL control does not adjust the input level. The use of this control is discussed below.

The OVerFlow indicator (next to the level display) warns when numerical values in the digital signal processor exceed the processor's calculating range. This may produce audible distortion. Overflow is most likely to occur with material having an abundance of high frequencies (such as cymbals) in combination with long decay times or with the REAR setting of the POSITION control. Under these conditions, you may need to set the input level lower than normal.

If the HIGH setting of the rear panel IN/OUT LEVEL switch is selected, and you're unable to get level readings above -12 dB most of the time, try the LOW setting (button in). On the other hand, if the LOW setting is selected and the OVF LED is turning on frequently, then the HIGH setting may be better for your application. The level display readings should determine your selection of switch settings, the recommendations given in the Installation section are only guidelines. The DR2a allows you to choose the best configuration for optimum signal-to-noise performance in your specific application.

REVERB LEVEL CONTROL

As mentioned in the Installation section, the REVERB LEVEL control varies the amount of mono reverb signal mixed with the dry (unprocessed) signal to form the output signal available at the rear panel MIXED OUT jack. With the slider fully to the left (MIN), there is no reverb signal present at the output. Moving the slider to the right adds a proportionate amount of reverb to the output signal. With the slider fully to the right (MAX), the output signal is a 50/50 blend of dry and reverb signals.

It is appropriate to mention the rear panel DRY KILL switch again here. Pushing the button in removes the dry signal from the signal at the MIXED OUT jack to allow external mixing of the mono reverb signal. The REVERB LEVEL control becomes, in effect, an output level control since only the reverb signal remains at the output.

EXTERNAL REVERB KILL CONTROL

The rear panel REVERB KILL jack provides an optional means for remotely defeating the DR2a's reverb output signal and allowing front panel controls to be set up and enabled as a group. The connection requirements are discussed in the Installation section. We'll assume you're using an external footswitch connected to the DR2a with a phone to phone cable.

You'll recall that the reverb signal can also be defeated by the front panel PRESET control. The kill function provided by the external footswitch is analogous except that the "setup" feature can be used with all three presets. (With the front panel defeat, only PRESET 1 can be set up.)

CONTROLS AND OPERATION

With any preset selected, pushing the footswitch causes the corresponding LED to flash. This indicates that the reverb output signal is disabled and that new settings may be entered if desired. The footswitch has no effect if the DR2a is already defeated from the front panel.

The kill function is useful for temporarily removing reverberation to check on other elements of your sound without disturbing carefully set levels. It also allows quick, smooth cuts of reverb crests when using longer decay times. Or, by using a normally closed momentary switch with longer decay times, you can produce a sustain function.

You can see there's a lot more to the DR2a Digital Reverb than first meets the eye. We recommend that you spend the time to become familiar with the features and controls of the DR2a. Try everything out at least once. We think you'll find the DR2a a truly versatile signal processor.

APPLICATIONS AND SUGGESTED SETTINGS

The ART DR2a Digital Reverberation System is useful in a wide range of applications and capable of producing some unique effects. In this section we'll look at specific applications, with the emphasis on combinations of control settings.

It is difficult to put sounds into words. Therefore, the following labels and descriptions are necessarily somewhat subjective. Some of the sounds provided by the DR2a closely approximate the sound of real rooms. Others are unique to the DR2a. Let's look at each of the room types and some control combinations to try with them.

PLATE

Sizzling Snare -

BANK	1
ROOM TYPE	PLATE
PRE DELAY	NONE
H.F. DAMPING	NONE
POSITION	REAR
DECAY TIME	0.4 seconds
DIFFUSION	HIGH

Gives the illusion of brightness with clarity - adds brilliance to snare and cymbals

Locker Room Vocals -

BANK	3
ROOM TYPE	PLATE
PRE DELAY	25 ms
H.F. DAMPING	HIGH
POSITION	REAR
DECAY TIME	0.8 seconds
DIFFUSION	LOW

A tight, dull, resonant effect - good for harmonies.

APPLICATIONS AND SUGGESTED SETTINGS

ROOM

Drums with Snap! -

BANK	1
ROOM TYPE	ROOM
PRE DELAY	75 ms
H.F. DAMPING	NONE
POSITION	MID
DECAY TIME	3.2 seconds
DIFFUSION	MID

Adds presence to drums, providing a crisp, clean fullness

Rich Vocals -

BANK	1
ROOM TYPE	ROOM
PRE DELAY	25 ms
H.F. DAMPING	LOW
POSITION	MID
DECAY TIME	1.6 seconds
DIFFUSION	MID

Surrounds you with smooth, full sound, adding richness.

HALL

Cathedral -

BANK	2
ROOM TYPE	HALL
PRE DELAY	50 ms
H.F. DAMPING	LOW
POSITION	MID
DECAY TIME	6.4 seconds
DIFFUSION	LOW

Gives the feeling of an unlimited space, with the sound reflecting and combining almost endlessly.

APPLICATIONS AND SUGGESTED SETTINGS

Downtown Club -

BANK	1
ROOM TYPE	HALL
PRE DELAY	NONE
H.F. DAMPING	HIGH
POSITION	REAR
DECAY TIME	1.6 seconds
DIFFUSION	HIGH

Simulates the conditions of closeness with open spaces as found in a small club.

REVERSE

Staccato Snare -

BANK	3
ROOM TYPE	REVERSE
PRE DELAY	75 ms
H.F. DAMPING	NONE
POSITION	disabled
DECAY TIME	0.6 seconds
DIFFUSION	LOW

GATED

Smooth Gate -

BANK	3
ROOM TYPE	GATED
PRE DELAY	25 ms
H.F. DAMPING	LOW
POSITION	disabled
DECAY TIME	0.4 seconds
DIFFUSION	HIGH

These are some of the more useful and interesting applications we've come up with. This information is intended to be a starting point for your own exploration of the many applications of the DR2a Digital Reverberation System. Experiment.

REVERBERATION PRINCIPLES

In this section we'll go over some basic concepts of natural reverberation and see how our perception of reverberant spaces is influenced by various auditory cues. We'll also look at some of the different approaches to simulating reverb artificially.

BACKGROUND

Reverberation: a complex sonic phenomenon characterized by multiple sound reflections from room surfaces, with a gradual decay in overall level and a rolling off of higher frequency components.

That's it in a nutshell, but there's more that can be said. Imagine a single distinct sound - a hand clap, for example - in the middle of a room. Like the ripples spreading from a pebble dropped in a pool, the sound waves spread out in all directions from the clapped hands. Soon the waves encounter boundaries in the room, like walls or large objects, and are reflected off in various directions. Shortly thereafter, the hand clapper hears the first of the reflected sound waves to return, perhaps almost as loud as the original clap. As time goes on, more and more of the reflected waves make their way back to him, their levels decaying with time because each reflection consumes some energy.

Auditory Cues

If you were doing the clapping and were blindfolded, you could still tell a lot about where you were. If there was no reverberation, you'd know you were either in an open area or were surrounded by very "soft" walls. If there was reverberation, you could distinguish between a shower stall, a small room, a large auditorium, or the empty cargo hold of an oil tanker. You could sense something about the character of the space - whether the small room was empty or lavishly furnished, for example. You'd gather this information from several auditory cues.

Early echoes - One cue comes from the time delay between the initial sound and the early well defined echoes of the first reflections off the floor, ceiling, and walls. This time relates directly to the the perceived size of the space.

Sound in air takes about a millisecond (one thousandth of a second) to travel a distance of one foot. That's fast, but its not instantaneous. You can sense the lag in larger spaces. Each additional millisecond between a sound and its early echoes adds to the apparent size of the space.

REVERBERATION PRINCIPLES

Echo density - Other cues come from the echo density. The time it takes for the echo density to build provides additional information about the size of the space. With larger structures, the time required for the sound to travel between boundaries is longer and thus it takes longer for the echo density to build.

In small spaces the echo density builds quickly with shorter times between boundaries. Sometimes this is a desirable effect. But it may come at the expense of annoying dominant resonances, especially with long decay times simulating very hard walls (as in a shower stall or garbage can, for instance). Often the choice of a reverberant structure is a trade off between echo density and naturalness of the sound (lack of coloration).

The echo density also gives an idea of the character of a space. A boundary with an irregular surface or a space with a lot of objects turns a single impulse into multiple echoes. The complexity of the sound increases rapidly to provide a diffuse echo pattern of high density. On the other hand, an empty room may not "fill in the spaces" between echoes, resulting in a hard and repetitive sound. The echo density of an empty room is heavily dependent on its shape and relative dimensions.

High frequency rolloff - Heavy drapes, thickly padded furniture, and even people all tend to absorb sound, with higher frequencies affected the most. A timpani drum may resound from the walls while a cymbal crash is muffled. The more the high frequencies are muffled, the "softer" the space seems.

SIMULATED REVERB

We've talked about how what we hear influences our perception of reverberant spaces. During this discussion, the natural reverberation of real structures was implied. But often it is not possible, or at least not convenient, to use real structures. And sometimes you may want effects that have no parallel in nature. For these reasons, there has been a long history of attempts to produce reverb effects artificially.

Spring reverb is one of the oldest types of reverb simulators. It consists of a long, small diameter spring stretched between two transducers or pickups. One converts the audio signal into a wave which propagates through the spring. The other senses the spring's mechanical energy and translates it back into an electrical signal. In the process of traveling through the spring, sound picks up characteristics a little like natural reverberation.

REVERBERATION PRINCIPLES

The simplest spring reverbs have only two boundaries for waves to reflect off of at either end of the spring. The resulting reverb effect may have pronounced resonances and sound "boingy". Audio delay lines with simple regeneration suffer from similar shortcomings.

The plate reverb substitutes a rectangular metal plate for the spring and has pickups at various points around the periphery. Now there are two dimensions and four boundaries. The reverb effects are fuller and more complex. The response is more balanced. The range of effects is limited, but the sound is more pleasing than that of a spring reverb.

Digital reverbs forsake mechanical contrivances in favor of digital processing of audio signals. A digital reverb can simulate the sound of spring and plate reverbs as well as the reverberation of real structures. With digital techniques, the state of electronics technology, not the underlying approach, is what limits the degree of realism possible.

We still have a long way to go, however. No current digital reverb (including the DR2a) can exactly model the actual mechanisms of natural reverb (or the actual mechanisms of a plate reverb, for that matter). The considerable processing power and speed required is not likely to be economically available in the near future. Instead, the approach taken is to develop a reverb effect of sufficient complexity so that by carefully adjusting various parameters we can produce a sound similar to that of a real structure. In other words, the "sound" of a structure is simulated, not the conditions that produce that sound.

Lest we you with a negative impression, we must point out that digital techniques can produce quite realistic reverberation, with a degree of control over reverb parameters that's not possible with real structures. And the special effects attainable are totally unique.

TECHNICAL OVERVIEW

This section presents a brief overview of the technology underlying the design of the DR2a. First we'll describe the major functional blocks of the DR2a's circuitry and then we'll examine some basic elements of digital signal processing (DSP) used in creating reverb effects.

CIRCUIT DESCRIPTION

Refer to the system block diagram, Figure 1, below as we follow an audio signal through each stage from input to output.

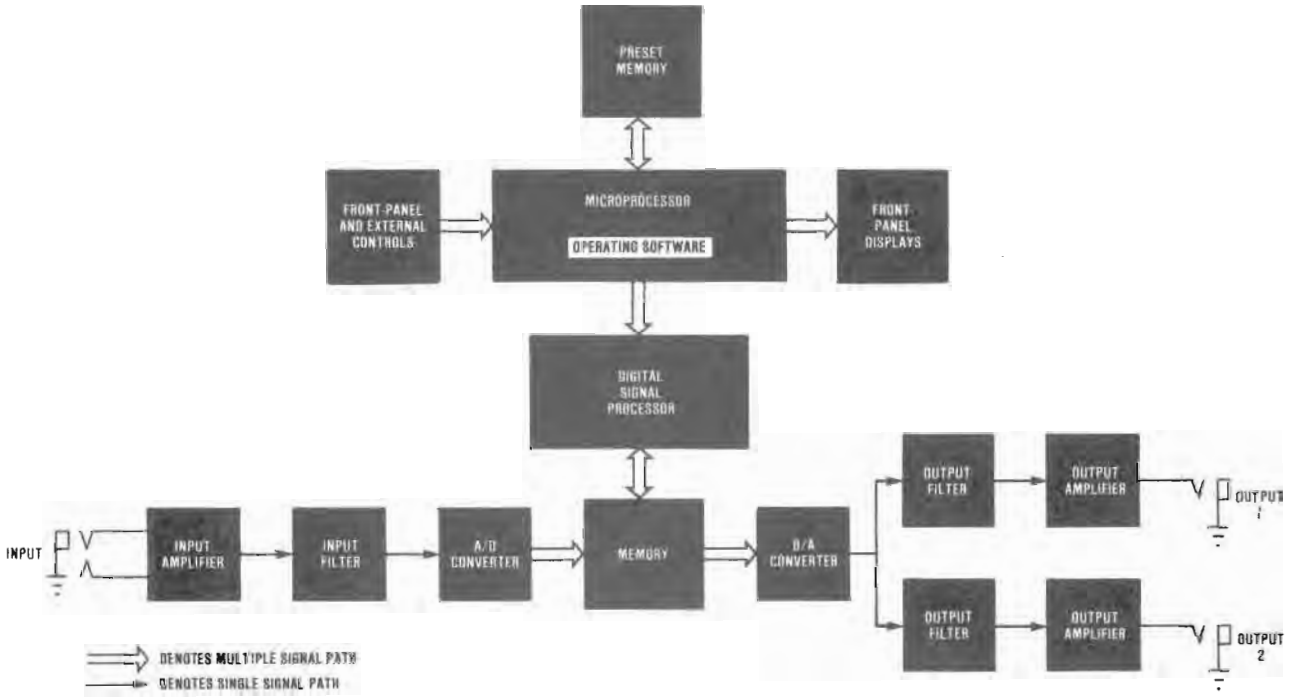

FIGURE 1

Although the DR2a is predominantly digital, it must interface with analog audio signals. The input amplifier bridges a balanced line and provides buffering between the audio source and the DR2a's internal circuitry. This amplifier has unity gain with the rear panel IN/OUT LEVEL button out (HIGH position) or provides 12 dB of gain with the button in (LOW position).

Next, the input filter removes very high frequency material from the signal before it is encoded. This filtering is necessary to prevent "aliasing", a type of distortion which occurs when the incoming signal has frequency components greater than half of the sample rate.

The signal is then sampled at discrete instants of time and converted into a continuous stream of digitally encoded numbers by the analog-to-digital (A/D) converter. After conversion, the numbers are stored in memory.

The heart of the DR2a is a high speed digital signal processor, capable of performing millions of arithmetic calculations per second. The digital signal processor retrieves the encoded numbers (representing the input signal) from memory and processes them according to the currently selected parameters It then stores the calculated results back into memory. These results represent the original signal, altered by reverberation.

At regular intervals, the processed data is recalled from memory and converted back into an audio signal by the digital-to-analog (D/A) converter. Alternate samples go to each of the two output sections and produce the left and right parts of a stereo image. The outputs may be defeated by either the front panel PRESET control (both LEDs off) or via the rear panel REVERB KILL jack. The output filters remove very high frequency noise introduced by the sampling process. The output signal level is shifted by an amount which exactly complements that introduced at the input (both are controlled by the rear panel IN/OUT LEVEL switch). Finally, the output amplifiers buffer the signals and provide line driving capability.

Although not shown in the diagram, the DR2a employs additional circuitry to implement the functions provided by the MIXED OUT jack, in conjunction with the front panel REVERB LEVEL control and the rear panel DRY KILL switch. The left and right output signals are summed together and fed to the REVERB LEVEL control. The variable level mono reverb signal is next summed with the output of the DRY KILL switch and then output at the MIXED OUT jack. With the DRY KILL button out, the dry signal is selected. With the button in, the dry signal is defeated.

The microprocessor, along with its operating software (in EPROM), determines the "personality" of the DR2a. It monitors the front panel controls and the rear panel REVERB KILL jack for user input and also outputs setting information to the user via the front panel displays. Button depressions are translated into commands understood by the digital signal processor.

Thus the user can make quick changes to the reverberant sound using intuitive concepts like "room types" without being concerned about the details of digital signal processing. If you'd still like to know more about the "details" anyway, see "DSP and Reverberation" below. The microprocessor also controls the storage of front panel settings in the preset memory and their retrieval for later use or immediate comparison. The presets (and the current front panel settings) are preserved for several hours after AC power is removed.

DSP AND REVERBERATION

The following presents a simplified description of how reverb is created using digital signal processing. The two basic elements employed are the FIR and IIR filters.

FIR stands for "Finite Impulse Response". When driven by an impulse (a "click"), the output of this filter will settle in a finite amount of time. The FIR filter may be represented as a tapped delay line, or a series of delays, whose outputs are summed together. Refer to Figure 2 below. Each tap may have its own coefficient or "level control". No feedback is applied.

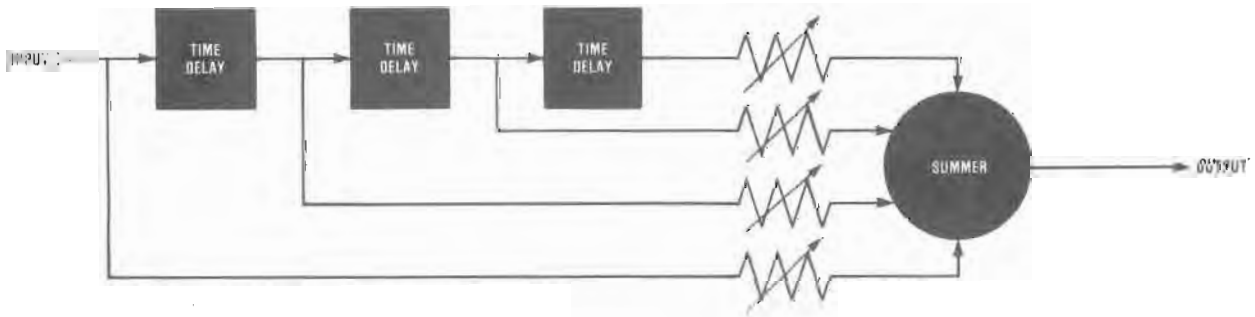

FIGURE 2

TECHNICAL OVERVIEW

IIR stands for "Infinite Impulse Response". If the arithmetic precision were unlimited, the output of this filter would never settle completely when driven by an impulse. Hence, its impulse response would be infinite. There are many possible IIR filter configurations. The main distinguishing characteristic, as opposed to FIR filters, is the presence of feedback wrapped around them. In other words, some of the output signal is fed back to the input or regenerated.

Figure 3 represents a simple IIR filter.

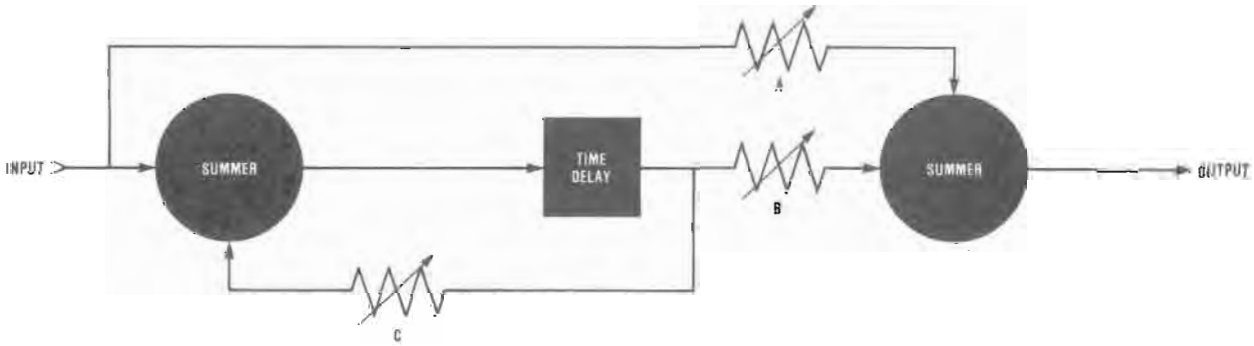

FIGURE 3

This configuration is like that of many digital delays. Controls A and B, acting together, function like a "mix" control. Control C is a "regeneration" control.

Reverb is created by combining many of these FIR and IIR filter elements in various ways, with varying time delays and coefficients (the level controls in the diagrams). The relationship of each of these variables to the resultant sound of the reverberation is very complex. Often, changing only a single user parameter, such as decay time, requires many changes to the digital signal processing variables. As mentioned before, the DR2a's microprocessor takes care of these details, freeing the user to concentrate on the sound.

SPECIFICATIONS

HARDWARE DEPENDENT	
Maximum Input Level	+6 dBV
Maximum Output Level	+6 dBV
Operating Level	0 dBV HIGH setting -12 dBV LOW setting
Input Impedance	47K ohms balanced
Output Impedance	1K ohms single ended
Bandwidth	10 kHz
Dynamic Range	75 dB (typical)
Power Requirements	105 - 125 volts AC, 50 - 60 Hz 25 watts, fused, (export units configured for destination country)
Dimensions	1.75" high, EIA rack width, 9" deep
SOFTWARE DEPENDENT	(Revision level 1.3)
Decay Time	0.1 - 12.8 seconds
Pre Delay	0 - 75 ms in 25 ms steps
User Presets	Three, all lockable
Room Types	Nine different algorithms. 3 PLATES, 2 ROOMS, 2 HALLS, GATED, REVERSE

NOTE: All software specifications are subject to improvement and expansion, as they are defined by the Revision level PROM furnished with the unit.

APPENDIX

SOFTWARE UPDATES

The DR2a's operating software is contained in an EPROM, located to be easily field replaceable. This software controls the user environment as well as the creation of reverb effects. The software you have is a "snapshot" of the state of reverb development at the time it was programmed. The fine-tuning of reverb effects and addition of new useful features is an on-going process at ART. Algorithms are refined based on in-house experimentation and user feedback. New applications are discovered. When warranted, the software is updated and a new revision level is created. This version is shipped with all new units and made available to owners of earlier units at a reasonable cost. Updates are provided in the form of a kit containing a new memory IC, complete installation instructions, and revisions to the manual. Contact an authorized dealer or ART for more information regarding software updates for your unit.

All registered owners of ART DR2a's will be informed of software updates as they become available. To register, call or write to our Customer Service department requesting that you be notified of any DR2a updates, please include your serial number.

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MARCH 1985

THE ENCLOSED MATERIAL IS A PRELIMINARY USER'S GUIDE DEFINING THE BASIC CONTROL PARAMETERS OF THE DR2.

IN THE NEAR FUTURE, A COMPLETE OWNER'S MANUAL WILL BE SENT UNDER SEPARATE COVER.

TO INSURE YOUR RECEIPT OF THE MANUAL, PLEASE NOTIFY US BY MAIL OR PHONE WITH YOUR NAME AND ADDRESS.

APPLIED RESEARCH & TECHNOLOGY, INC.
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ROCHESTER, NEW YORK 14608
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INTRODUCTION

The ART DR2 Digital Reverb is a professional digital signal processor providing realistic natural reverberation. Besides normal room reverberation, creative use of the DR2's extreme settings can create smaller or larger than life effects.

Designed by demand, the DR2 provides microcomputer controlled, digital signal processing, necessary for the creation of natural reverberation sounds. Utilizing these digital techniques provide for quick and easy control of relevant reverb parameters such as "liveness", color, and depth. ART technology makes it affordable.

User oriented front panel controls allow for selection of multiple room types, length of predelay, amount of high-frequency absorption, relative position, and decay time. Two presets and a bypass feature allow you to recall or change your desired reverb sound, at the push of a button.

Designed to replace less flexible spring and plate reverbs in demanding studio or stage applications, the DR2 is quiet and clean, with a balanced input and stereo or mixed mono outputs that operate at high or low signal levels.

Reliability is designed into the DR2 and the unit is ruggedly constructed to withstand the rigors of hard usage.

We recommend that you first read these instructions to learn more about the DR2 Digital Reverb and its operation. Keep in mind that the settings described here are only a starting point. Experimentation and creativity provide for your own unique sound.

FEATURES & CONTROLS

FRONT PANEL

I PRESET SELECT BUTTON

Press this button to select one of three PRESET functions. As the button is pressed the PRESET LED's indicate PRESET 1, 2, or "0". When either the PRESET 1 or 2 LED is lit, the DR2 recalls the last previous setting of the control parameters used. When no LED is lit the device is in a "BYPASS" mode and no reverberant signal is present at the OUTPUT jacks. This setting also allows for set-up of the control functions that may be used when the device is brought back to the active mode.

II PRESET LED's

These LED's will inform you of the present PRESET status.

a. LED's out: BYPASS mode, device generates no reverberant signal, control functions may be set-up for next reverberation application.

b. PRESET 1 or 2 LED on: Indicates device is in ACTIVE mode and recalls the last reverb setting used.

c. PRESET 1 or 2 LED blinking: Externally bypassed using the BYPASS jack and a footswitch from the rear panel. The DR2 may be pre-programmed as described in "a" above.

III ROOM TYPE Select Button

By depressing this button one of three ROOM TYPES will be selected. Each time the control is actuated a ROOM TYPE LED will light in a left to right position.

IV ROOM TYPE LED

In conjunction with the ROOM TYPE select button being depressed, the corresponding LED will light indicating an algorithmic representation of a PLATE, ROOM, or HALL.

a. PLATE: Described as such because of the similiarities between the resulting reverberation of the program and an actual plate. This setting has a relatively diffuse impulse response and a warm sounding bottom end aimed generally towards percussive type material.

b. ROOM: A small chamber designed with smooth non-parallel walls and little architectural detail. The ROOM program works well with vocals and other complex input material.

c. HALL: This program could be defined as a good sized empty, irregular hall with parallel walls and a moderate amount of detail. Quite useful for sustaining sounds and effects of all types of input material.

By themselves the ROOM TYPES mean very little to the actual characteristics of reverberation. They merely set a basis or starting point to the total reverberant sound when combined with the other important parameters that make up a reverberation type effect.

V PRE DELAY

Allows for the selection of four different PRE DELAY settings. Each time the button is depressed the corresponding PRE DELAY LED will light denoting the actual value.

VI PRE DELAY LED's

These LED's display the amount of PRE DELAY used in the DR2 in increments of 25 milliseconds (ms).

a. LED's out: Indicates 0 ms of PRE DELAY.

b. "25" LED on, "50" LED out: Indicates 25ms of PRE DELAY.

c. "25" LED out, "50" LED on: Indicates 50ms of PRE DELAY.

d. Both LED's on: Indicates 75ms of PRE DELAY.

VII H.F. DAMPING SELECT BUTTON

Selects one of three H.F. DAMPING factors available on the DR2 each time the button is depressed.

VIII H.F. DAMPING LED's

There are three H.F. DAMPING possibilities represented by these LED's.

a. Both LED's out: No H.F. DAMPING.

b. "LOW" LED on, "HIGH" LED off: Small amount of H.F. DAMPING (some baffling used).

c. "LOW" LED out, "HIGH" LED on: Substantial amount of H.F. DAMPING (rugs on the walls).

IX POSITION SELECT BUTTON

Each time the POSITION select button is depressed one of three apparent listening position points is selected.

X POSITION LED's

These LED's indicate where an individual situated in a listening position would hear the reverberant related reflections of sound.

a. Both LED's out: At the source or front of the room.

b. Mid LED on, rear LED off: Towards the middle of the room.

c. Mid LED off, rear LED on: Near the rear or back of the room.

XI DECAY TIME SELECT BUTTONS

Two buttons allow you to increase or decrease the amount of DECAY TIME. The left button decreases towards the MINIMUM DECAY TIME while the right button increases towards the MAXIMUM DECAY TIME.

XII DECAY TIME LED's

There are six LED's that indicate the amount of DECAY TIME from MINIMUM to MAXIMUM. In direct conjunction with the ROOM TYPE function the following chart shows the individual DECAY TIMEs in seconds.

LED	Ø	Ø	Ø	Ø	Ø	Ø
PLATE	0.1	0.2	0.4	0.8	1.6	3.2
ROOM	0.2	0.4	0.8	1.6	3.2	6.4
HALL	0.4	0.8	1.6	3.2	6.4	12.8
	MIN ----------					MAX

XIII OVF LED

When this LED is illuminated it indicates that the numerical limit of the digital processor had been exceeded and can handle no more information. Clipping occurs and a lower input level is recommended.

XIV INPUT LEVEL DISPLAY

The input level is indicated on the front panel by a vertical bar-graph display. The level meter is calibrated in 6dB steps from -18dB to 0dB.

XV REVERB LEVEL CONTROL SLIDER

When the MONO MIX output is in use the REVERB LEVEL control allows you to mix a controlled amount of the reverb signal with the dry signal to produce a mixed output. With the control fully to the left (MIN), there is no reverb signal present at the output. As you move the control towards the right, a proportionate amount of reverb signal is added to the output. With the control fully to the right (MAX), there is a 50/50 blend of dry and reverb signal present at the output.

REAR PANEL

I DRY KILL SWITCH

This switch is provided for the MONO MIX output to allow external mixing to be used with that output. When the switch is in the OUT position dry level is present at the output. With the switch engaged (IN) only the reverb signal (as controlled by the REVERB LEVEL control) is passed through to the output.

II INPUT JACK

The input of the DR2 is mono, high impedence, active balanced, ¼" phone jack. Using conventional Ring, Tip, Sleeve configuration the structure is as follows:

Ring; (-), Tip; (+), Sleeve; Ground

III MONO MIX OUTPUT

The mono audio output is a low output impedence, ¼" phone jack. Output is controlled by the REVERB LEVEL control on the front panel. When the DR2 is bypassed the output contains the input signal if the DRY KILL switch is in the out position.

IV LEVEL SWITCH

The LEVEL switch on the rear panel allows selection of HIGH or LOW operating signal levels. When the switch is in the HIGH position (OUT), high level signals such as send levels from a mixing console may be used. With the switch engaged (IN) lower level signals such as keyboards, or tape sends are optimized.

V STEREO OUTPUTS (OUTPUT 1, OUTPUT 2)

Both OUTPUT 1 and OUTPUT 2 are low impedence single ended ¼" phone jacks. These outputs provide true (not simulated) stereo sound when both are used. Only reverb signal is present at these outputs.

VI REVERB KILL JACK

The REVERB KILL jack provides the user with a means of bypassing the reverb signal via a remote control such as a footswitch. When the KILL function is used in PRESET 1 or PRESET 2 mode, the PRESET LED will flash to alert you to the KILL function.

EXTERNAL/INTERNAL CONTROLS

I REVERB KILL JACK

A ¼" mono phone jack is located on the rear panel of the DR2. Using a footswitch (on/off or momentary) the DR2 may be externally bypassed. When the footswitch is engaged one of the PRESET LED's will blink indicating BYPASS mode. The DR2 may be pre-programmed as described in IIa of the FEATURES & CONTROLS section.

II BASS ROLLOFF SWITCH

Internally located on the printed circuit board behind the DRY KILL switch, this switch allows you to select one of two bass frequency rolloff positions in the input circuitry before digital processing occurs. When the switch is positioned toward the rear panel, the rolloff frequency is 50 Hz. The opposite sets the rolloff frequency at 150 Hz. To access this control simply remove the top panel of the DR2 and select the bass frequency rolloff that relates to your needs. All DR2's shipped from the factory are set to the 150 Hz position as this position most closely approximates the spectral balance of natural reverberation.

INSTALLATION

I OPERATING INFORMATION

The DR2 is an outboard device intended to be used with a mixing console equipped with reverb send and receive controls, directly in line between a musical instrument and an amplifier, or in the effects loop of an amplifier. Two operating levels are provided for signal level matching, determined by the IN/OUT LEVEL switch located at the rear panel. With the switch in the HIGH position (out) the input/output levels are 0dB, +6dB max, the LOW position (in) levels are -12dB, -6dB max.

II CONNECTIONS

All connections to the DR2 are made at the rear of the unit. There are input and output connections accepting standard ¼ inch phone plugs.

III INPUT

The input impedence is 47k ohms, balanced using active circuitry. This is a mono input, so when connecting to consoles with stereo sends, use only one send output or else mix the sends to mono before connecting to the reverb.

IV OUTPUTS; LEFT, RIGHT

These two outputs provide true stereo, simulating two microphones in a reverberant space. The outputs are single ended with a source impedence of 100 ohms. They are capable of driving full output levels into 600 ohm line impedences.

V OUTPUT; MIXED

This output provides a mono mixed combination of dry and reverb signal. The mixed output ratio is determined by the REVERB LEVEL control on the front panel. The DRY KILL switch is provided for the MIXED output to allow external mixing in mono using this output. This output is single ended with a source impedence of 100 ohms.

SOFTWARE VERSION 1.2

The software which controls the DR2 allows for simple control of the complex digital signal processing circuitry. A brief description of the software capabilities follows.

Previously, we have discussed the three primary ROOM TYPES. A unique feature of version 1.2 software provides the user three groups of ROOM TYPES which include three different algorithms of PLATE, ROOM, and HALL, hereafter referred to as Group 1, 2, and 3. Access of these different groups is attained by holding in the two DECAY TIME buttons while selecting the group by pressing the ROOM TYPE select button. When the DECAY TIME buttons are in, push the ROOM TYPE button, the PLATE LED will blink indicating Group 1. By pressing the ROOM TYPE buttom again, the ROOM LED will blink indicating Group 2, and pressed again the HALL LED will blink indicating Group 3. Select the Group desired in this manner then release the DECAY TIME buttons. By use of the PRESET function you may store two different Groups for instant recall. Simply select a Group number and store it in either PRESET. Change the PRESET and store a different Group.

The ROOM TYPES in each Group are as follows:

Group 1: NATURAL TYPE PLATE, NATURAL ROOM, NATURAL HALL

Group 2: DIFFUSE PLATE, SMALL ROOM, ALTERNATE HALL

Group 3: TIGHT PLATE, CLUB-type ROOM, SMALL HALL

Group 1 ROOM TYPES represent flat uncolored rooms where Group 2 and 3 may be described as rooms with "character".

When the DR2 is powered up, the unit is in the "BYPASS" mode with the primary (Group 1) ROOM TYPEs selected. PRESET 1 and 2 are initialized to a software pre-programmed setting. The PRESET programs are as follows:

PRESET 1;
ROOM TYPE: PLATE
PRE DELAY: 25ms
H.F. DAMPING: LOW
POSITION: REAR
DECAY TIME: SECOND LED

PRESET 2;
ROOM TYPE: HALL
PRE DELAY: 50ms
H.F. DAMPING: LOW
POSITION: MID
DECAY TIME: SIXTH

APPLICATIONS

Multiple variations of normal room reverberation may be attained using the DR2. The following applications represent sound capabilities that approximate reverberant effects needed in a mixdown situation. Of course, what sounds desirable to one person may not reflect another's concept of the same sound. With the DR2 this is not a problem, all you have to do is vary the parameters until it sounds as you like it. Remember, besides normal room reverberation, creative settings can create smaller or larger than life effects.

Drums with SNAP!;
ROOM TYPE: ROOM
PRE DELAY: 75ms
H.F. DAMPING: none
POSITION: MID
DECAY TIME: Fifth LED

Presence is added to the drums with these settings providing a crisp clean fullness.

Sizzling Snare;
ROOM TYPE: PLATE
PRE DELAY: none
H.F. DAMPING: none
POSITION: REAR
DECAY TIME: Third LED

Brilliance to snare and cymbals is achieved giving the illusion of brightness while maintaining clarity.

Cathedral;
ROOM TYPE: HALL
PREDELAY: 50ms
H.F. DAMPING: LOW
POSITION: MID
DECAY TIME: Sixth LED

The feeling of unlimited space allows the sound to combine and reflect almost to the point of obscurity.

Rich Vocals;
ROOM TYPE: ROOM
PRE DELAY: 25ms
H.F. DAMPING: LOW
POSITION: MID
DECAY TIME: Fifth LED

Surround yourself with smooth full additive sound making your voice sound rich.

Locker Room Vocals;
ROOM TYPE: PLATE
PRE DELAY: 25ms
H.F. DAMPING: HIGH
POSITION: REAR
DECAY TIME: Fourth LED

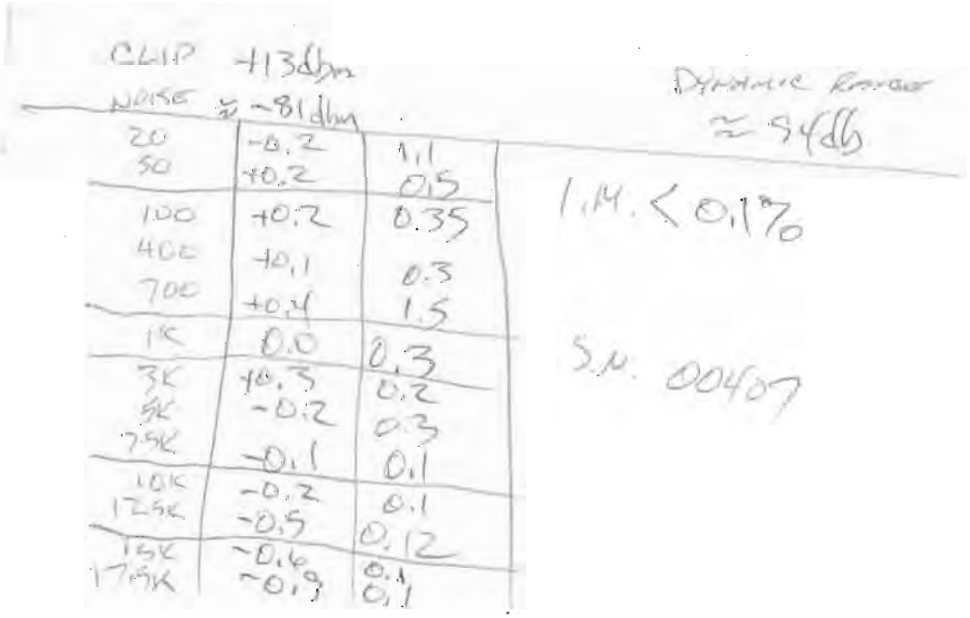
A tight dull, resonant effect is achieved using these settings allowing for unsurpassed harmonic sound.

Downtown Club;
ROOM TYPE: HALL
PRE DELAY: none
H.F. DAMPING: HIGH
POSITION: REAR
DECAY TIME: Third LED

Closeness in a large area is represented in this configuration of settings mimicing conditions of a small club.

SPECIFICATIONS:

Connections: ¼: Ring, Tip, Sleeve phone jacks
Preset Capabilities: 2 user settable presets and bypass
Decay Time: 0.1 second to 12.8 seconds
Frequency Response: 20Hz - 10KHz
Dynamic Range: 75dB (typ)
Input: Mono, 47K balanced, +6dB max
Pre Delay: 0 - 75 milliseconds
Room Types: Three primary, six alternate
User Adjustable Parameters: Six
Output: Mono/Stereo, low impedence unbalanced, +6dB max
Operating Level: High = 0dB, Low = -12dB rear switchable, applies to all inputs and outputs
Power: U.S. 115VAC, other, adjusted for country of destination
Protection: Internally fused (½ Amp Slo-Blo) mains transformer
Dimensions: 1.75" high, EIA rack, 9" deep



20	-0.2	1.1
50	+0.2	0.5
100	+0.2	0.35
400	+0.1	0.3
700	+0.4	1.5
1K	0.0	0.3
3K	+0.3	0.2
5K	-0.2	0.3
7.5K	-0.1	0.1
10K	-0.2	0.1
12.5K	-0.5	0.12
15K	-0.6	0.1
17.5K	-0.9	0.1

ART

DR2 FACT SHEET VERSION 1.3

The DR2 Digital Reverb is a professional microprocessor controlled digital signal processor capable of providing both realistic natural reverberation and special effects-type reverberation sounds. Besides normal room reverberation, creative use of the DR2's extreme settings and special programs allow you to create smaller, larger, or unnatural reverb-related effects. Through the course of this fact sheet, we will explore and define some of the many parameters of the DR2.

Version 1.3 software for the DR2 incorporates all of the features as covered in this fact sheet. In relation to the original software (version 1.2), version 1.3 software has new features, multiple DIFFUSION settings, extended control of H.F. DAMPING, THREE presets with lock-in capability, the addition of two effects-type ROOM TYPES: GATED and REVERSE reverb, and refined ROOM TYPE algorithms.

When the DR2 is powered up, the unit is in the BYPASS mode with the primary (Group 1) ROOM TYPEs selected. Also, the unit is initialized to software pre-programmed settings for the presets. Control of reverb-relevant parameters are accessed via the front panel. Six user-oriented factors may be adjusted to provide a particular reverb sound. As a point of interest, the number of unique settings the DR2 is capable of producing come to a total of 6,624! The individual parameters are as follows:

ROOM TYPE

There are a total of nine different ROOM TYPES accessable in three "groups" of three Rooms. The first and second groups (Group 1, Group 2) contain natural room algorithms that produce the fundamentals of a: PLATE, ROOM, and HALL. In the last group (Group 3) room algorithms provide for a PLATE, GATED REVERB (ROOM position), and REVERSE REVERB (HALL position). Gated reverb is most like natural reverberation where the output signal decreases in amplitude with time, but unlike natural reverberation, comes to a complete stop at the end of the displayed period. It provides the illusion of space without the clutter associated with long decay tails. Reverse reverb is completely unnatural and may be described as backwards reverb. Output signal amplitude increases with time to an abrupt stop.

PRE DELAY

During conventional recording situations, a delay is often inserted between the console and the reverb chamber. PRE DELAY serves two functions, to add an apparent depth to the reverb sound and to separate in time the original sound from the dense reverberation. PRE DELAY on the DR2 is set in 25ms increments from 0 to 75ms.

H.F. DAMPING

As sound travels through air, or reflects off a soft surface, high frequencies are absorbed quicker than the balance of the sound. In essence, this means that these higher frequencies are damped out thus the term damping. The DR2's H.F. DAMPING provides control from bright to dull settings in four steps.

DIFFUSION

The DIFFUSION control is new to the DR2. With previous software (version 1.2), DIFFUSION was set at the HIGH position providing smooth reverb sounds. By use of the SECONDARY FUNCTION control, (discussed later in the fact sheet) you may now set DIFFUSION from "low" to "high" in three settings utilizing the H.F. DAMPING control section. At "low" DIFFUSION, the sound has the illusion of bouncing off many baffles and panels to produce an articulated sound. As the control is increased, the effect is smoothed to a more natural sound. Low DIFFUSION helps maintain clarity of the processed sound and is best suited for vocals or strings, while high DIFFUSION should be used for percussive material.

POSITION

The POSITION control allows you to change the perspective of the reverberant sound relative to the proximity and placement of initial and reflected sound.. The three POSITION settings, FRONT, MID, and REAR relate to listening to sound in a hall starting at the source and moving further away. As you walk away, you hear less of the initial reflections and more of the diffuse reverberation.

DECAY TIME

Natural reverberation results from sound reflecting off the walls of a confined space. The character of the reverberant sound is dependent on the size and shape of that space. DECAY TIME, as it relates to reverberation may be defined as the time required for the reverberant sound to decay to one-millionth (-60dB) of its original energy. The DR2 simulates decay time from a minimum of 0.1 seconds to 12.8 seconds. The DECAY TIME control is directly related to ROOM TYPE. DECAY TIME range is selected by the ROOM TYPE setting.

PRESET

There are three PRESETs plus BYPASS available on the DR2. Each of these PRESETs may be "locked-in" utilizing the SECONDARY FUNCTION feature for instant recall. Presets allow you to set up a particular reverb sound commonly used that you can revert to quickly. With the DR2's PRESET control, you can recall a previously prepared set of parameters, and if need be tailor it slightly to your current requirements.

SECONDARY FUNCTION

There are three parameters accessible from the SECONDARY FUNCTION feature. The three parameters controlled are: PRESET "lock-in", Group select, and DIFFUSION. By depressing and holding in the two DECAY TIME select buttons, the PRESET, ROOM TYPE, and H.F. DAMPING LED's will blink rapidly. To "lock-in" a PRESET, depress the PRESET select button; the LED stops blinking and the PRESET is "locked-in". If the LED is not blinking, the PRESET is already "locked-in". To "unlock", just depress the PRESET button once, the LED will blink and you can reset the parameters and "re-lock" the PRESET.

Selection of Groups is accomplished by depressing the ROOM TYPE select button momentarily. Either the PLATE, ROOM, or HALL LED will blink indicating Group 1, 2, or 3 respectively. DIFFUSION selection is accomplished by depressing the H.F. DAMPING select button momentarily. No LED blinking indicates LOW DIFFUSION, Left LED; MID DIFFUSION, Right LED; HIGH DIFFUSION.

APPLICATIONS

I RICH VOCALS;

Group: ONE
ROOM TYPE: ROOM
PRE DELAY: 25ms
H.F. DAMPING: LOW
DIFFUSION: Left LED
POSITION: MID
DECAY TIME: Fourth LED

II LOCKER ROOM VOCALS;

Group: Three
ROOM TYPE: PLATE
PRE DELAY: 25ms
H.F. DAMPING: HIGH
DIFFUSION: LEDs Off
POSITION: REAR
DECAY TIME: Fourth LED

III CATHEDRAL;

Group: TWO
ROOM TYPE: HALL
PRE DELAY: 50ms
H.F. DAMPING: LOW
DIFFUSION: Left LED
POSITION: MID
DECAY TIME: Fifth LED

IV STACCATO SNARE;

Group: THREE
ROOM TYPE: "HALL" (REVERSE)
PRE DELAY: 75ms
H.F. DAMPING: NONE (No LED's)
DIFFUSION: LED's Off
POSITION: MID
DECAY TIME: Fifth LED