2nd Edition

accutronics®

Accu-Bell♪
Sound Inc.

When it comes to musical amplification and sound reinforcement applications, Spring Reverberation has continued to offer the greatest value. In order to achieve the best performance possible when incorporating Spring Reverberation into an audio amplification design, it is helpful to understand the characteristics and the principles by which it operates.

The Reverb Story

When Laurens Hammond introduced the first Hammond Organ in 1935, most people were only familiar with the traditional pipe organs they had heard at churches and theaters. So, when they purchased a Hammond for their homes, they expected the same room-filling sound they had come to know and love. Of course, in their thickly carpeted living rooms with low ceilings and drapery covered windows, they didn't get it.

Thus, Laurens Hammond needed to find a way to add reverberation to the living room. He discovered that Bell Labs had devised an electromechanical device to simulate a single delay experienced on long distance calls. The device used two springs to transmit the delaying singnal and four additional springs to dampen and "center" the driver saddle. While the dampening springs were housed in long tubes filled with oil, one of the springs transmitting the delay singnal ended in a short tube which, by varying the amount of oil in the tube, varied the decay time. After modifying the reverb to create many echoes, it was perfect for Hammond's needs.

At the time, the unit stood four feet tall. But size was not a problem because all Hammond Organs came with separate tall Tone Cabinets which contained the speakers and reverb unit.

As time went by, though, Tone Cabinets became shorter or unnecessary with smaller, self-contained organs. Three Hammond Organ Company engineers, Alan Young, Bert Meinema and Herbert Canfield, developed the necklace reverb, so-named because the springs hung in the same fashion as a necklace. Introduced in 1959, the necklace reverb was about 13 inches wide, 1 inch deep and 14 inches tall. The metal framework, or housing, was shaped like a "T" and the springs drooped from one end of the horizontal "T" line to the other, creating a necklace effect. This improvement made the reverb unit smaller, lighter, less expensive and more natural sounding, yet it had one annoying problem: when the unit was jarred or shaken, the springs would bang against each other and/or the metal "T" frame. This created a thundering, crashing sound in the speakers, something that in the 1950s was definitely not part of the act.

Nor was it acceptable in Grandma's living room.

In 1960, Alan Young was again assigned the task of developing yet another reverb unit that would solve the previous units' problems. A fine engineer, Young was also a musician who frequently took projects home to experiment at night and on weekends. Since Young wanted a reverb unit to be no bigger than his brief case, his efforts resulted in what is now called the Accutronics Type 4 reverb unit. (At that time it was the Hammond Type 4.) With the bugs worked out, the new unit caught on with organ makers and anyone else requiring reverberation. One such customer was Leo Fender, maker of Fender guitars, who added the Type 4 to his now-famous Fender Twin Reverb. With that type of endorsement, the Type 4 became the industry standard.

By 1964, the increasingly busy Hammond Organ Company had run out of room to produce the reverb units. So Hammond moved production to another Hammond-owned unit, Gibbs Manufacturing, in Janesville, Wisconsin. In 1971, the reverb

ONE SUCH CUSTOMER WAS LEO FENDER, MAKER OF FENDER GUITARS, WHO ADDED THE TYPE 4 TO HIS NOW-FAMOUS FENDER TWIN REVERB.

business moved again to another Hammond unit, Accutronics® , in Geneva, Illinois. Meanwhile, employees at Gibbs decided to start their own reverb manufacturing company called O.C. Electronics, giving Accutronics major competition in the reverb market. Many service technicians still recall O.C. Electronics because of the popular sticker attached to each of their units stating: "Made by Beautiful Women in Janesville, Wisconsin."

Not long after the move to Geneva, Illinois, Accutronics developed smaller reverb units - the 2 spring Type 1 reverb and the 3 spring Type 8. These two new reverb units were just over nine inches long, down from a length of 17 inches.

As manufacturers have continued to design smaller amps, smaller reverb units have gained favor and market share.

In 1974, Accutronics, still division of Hammond Organ, acquired a printed circuit board maker in Cary, Illinois, which was renamed Accutronics. (Meanwhile, in 1977, Hammond Organ became a member of The Marmon Group of companies, a Chicago-based association of manufacturing and service companies.) In 1982, the two operations were combined in the Cary plant. By this time, the reverb units were beginning to be known as "the Accutronics Reverb" and the founder of O.C. Electronics was getting ready to retire. In late 1985, Accutronics acquired O.C., once again uniting the two companies trainied in the design and manufacture of the original Hammond reverb units.

In 1990, the reverb division had outgrown its home in Cary, so it was moved a new 33,000 square foot plant across town and renamed Sound Enhancements, Inc. (Sound Enhancements also includes the Morley line of special effects peddles, stomp boxes and switches, which was purchased in 1989.)

Today, ***Accu-Bell Sound*** still makes the world-famous Accutronics Reverb for such major amplifier manufacturers as Fender, Peavey, Marshall and others. Despite the introduction of digital reverb several years ago, Accutronics' reverb business continues to grow because of its warm, true sound, its reliability and its tradition of great reverberation since 1939.

In 2009, the friendly acquisition of Accutronics® Brand and Assets from Sound Enhancement Products Inc. by Belton Engineering ,Ltd.. There are no immediate plans to change the manufacturing source, delivery will not change without improvement. The staff at Sound Enhancement Products, Inc. continued to produce reverbs until November of 2009. All of manufacturing was then transferred to Belton reverb and

Spring

the Engineering staff followed to train the new owners on how to continue on the production of Accutronics reverbs with the same degree of quality Accutronics® is famous for ***Accu-Bell Sound Inc.*** is committed to producing the finest Electro Mechanical Spring reverbs in the world and continue on with the long heritage started by Hammond Organ in 1959.


Accu-Bell Sound Inc.

•1935

Hammond Introduces First Organ.

Laurens Hammond introduced his first organ, which did not feature reverb, in 1935.

•1959

First Necklace Reverb Unit Introduced.

The Hammond Organ Company released the much smaller necklace reverb in 1959.

•1962

Leo Fender Introduces Fender Reverb Amp.

In 1962, Leo Fender set the guitar world abuzz with the introduction of his first Fender Reverb.

•1985

Sound Enhancements Purchases O.C. Electronics.

A manufacturer of reverb units with its origins in the original Hammond company was purchased in 1985.

•1991

The name Accutronics Reverb was retained as a trade name when the manufacturing company changed its name to Sound Enhancements.

•2009

The friendly acquisition of Accutronics® Brand and Assets from Sound Enhancement Products Inc. by Belton Engineering ,Ltd..

The Company changed its name to ***Accu-Bell Sound Inc.*** which is committed to producing the finest Electro Mechanical Spring reverbs in the world.

accutronics®

·1964

Reverb Manufacturing moves to Gibbs.

By 1964, an increasingly busy Hammond Organ Co, moved reverb manufacturing to Gibbs in Janesville, Wisconsin.

·1971

Accutronics is Born.

Manufacture of the Hammond Reverb Unit was moved to Geneva, Illinois and the unit was renamed the "Accutronics Reverb."

·1977

Accutronics Becomes a member of the Marmon Group.

In 1977, Accutronics became part of the Chicago-based Marmon Group of Companies.

Sound Inc.

& BELTON

Spring

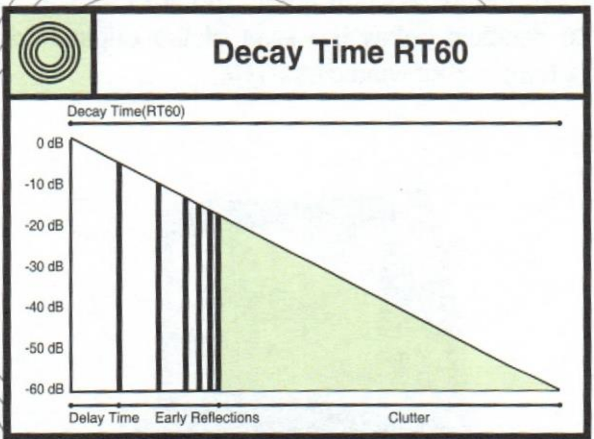
IT'S ALL IN THE BOUNCE **The acoustical effect of Reverberation can be thought of as the complex interaction of delayed sound. It can be heard in nearly any listening environment, taking place when sound waves traveling through the air are reflected by surfaces such as walls, ceilings and floors.**

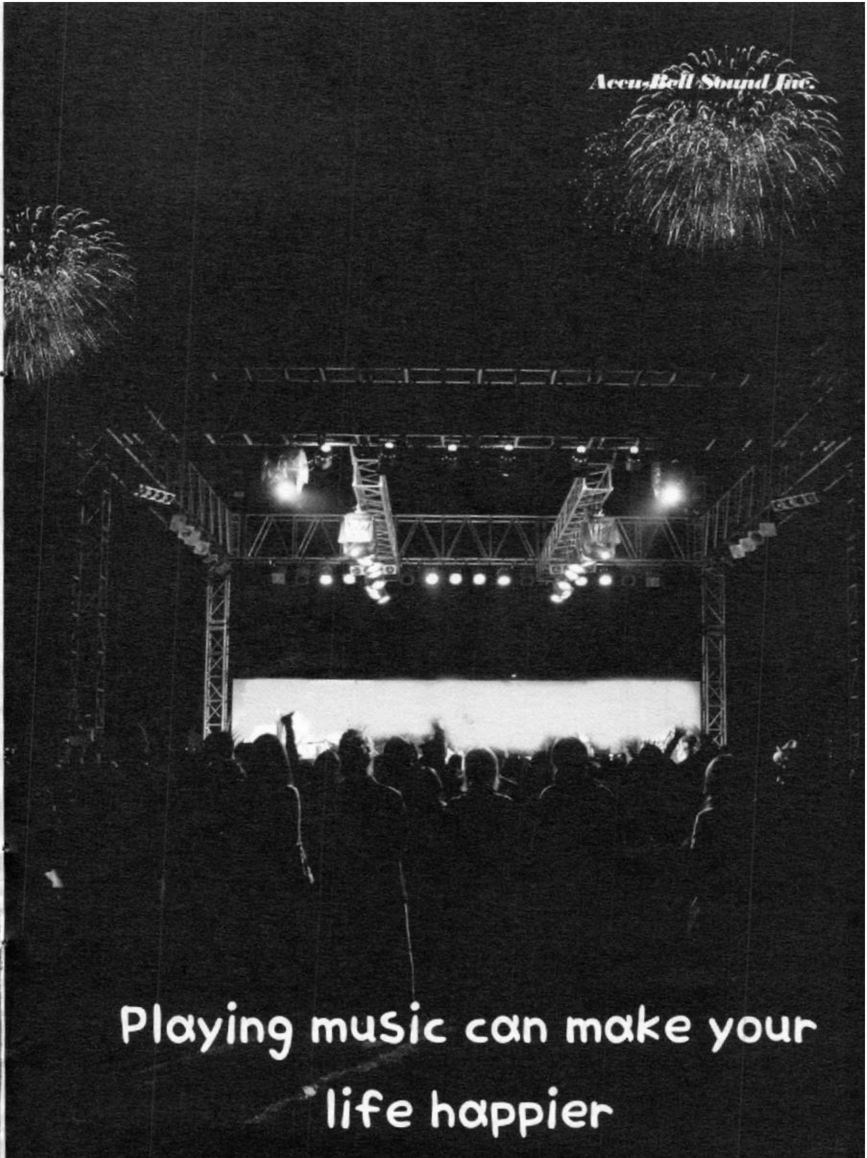
DELAY, CLUTTER AND DECAY **The properties of reverberation are most noticeable when the effect results from a single abrupt sound impulse, such as a hand clap, or a door being slammed in a large room. At first, it is possible for the ear to distinguish the individual echoes, referred to as Early Reflections. This time between hearing the initial sound and the arrival of the first echo is called the Delay Time. The lengths of the first few delays gives the listener a 'sense' of the overall size of the listening space.**

After the delayed impulses have traveled back and forth through the listening space several times, the individual echoes overlap one another increasingly.

This blending of separate echoes into a diffused, breath-like effect takes place during the Clutter Phase, the length of which gives the listener a sense of the acoustical reflective quality, or liveliness of the listening environment.

The combined length of this phase is called the Decay Time, The standard used in architectural acoustics for the measure of Decay Time is the number of seconds required for the overall lavel of the reverberant sound to fall to a measured value of 60 decibels below the level of the original "dry" sound. This term is abbreviated as RT60.

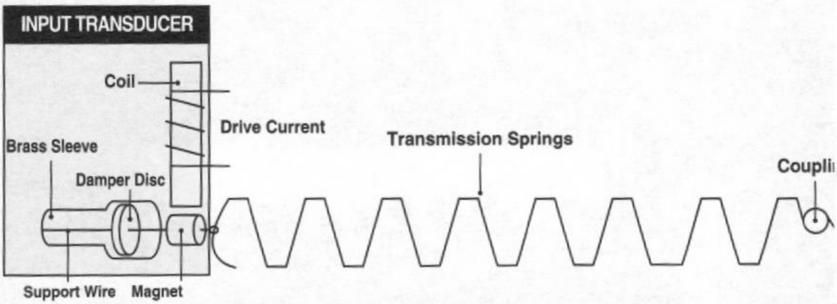

Decay Time RT60
Decay Time(RT60)
0 dB
-10 dB
-20 dB
-30 dB
-40 dB
-50 dB
-60 dB
Delay Time
Early Reflections
Clutter


Accu-Bell Sound Inc.
Playing music can make your
life happier

Spring

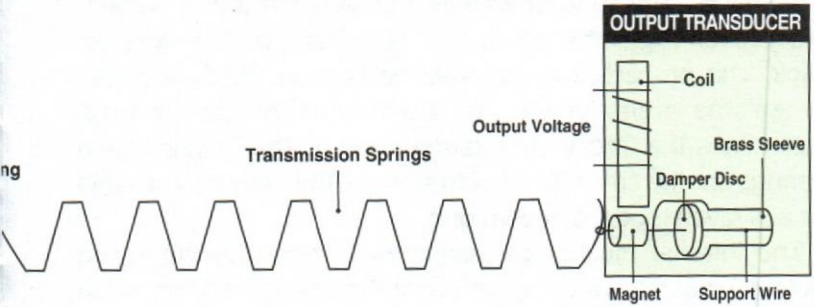
> In the early 1960's, Hammond organ engineer Alan C. Young was awarded a patent for successful development of a smaller reverb.

Throughout the history of audio amplification, numerous techniques have been developed to simulate the natural effect of reverberation. These have included acoustic chambers and pipes (reflective spaces into which a speaker and microphone were placed), large steel plates, and recirculating electromechanical delay equipment based on magnetic tape or rotating electrostatic elements.



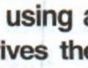
Developments in solid state electronics yielded analog bucket brigade (capacitive charge coupled) delay devices, and most recently, digital delay technology. The use of coiled springs to delay audio signals was originated by early telecommunications engineers to simulate the effects of long distance telephone lines. While the prolonged sequence of echoes was undesirable for their purposes, it seemed very useful to an inventor named Laurens Hammond, who promptly borrowed the concept for use with the keyboard instrument which bears

his name. The coiled spring reverb design underwent a continuing process of refinement. In the early 1960's a Hammond engineer named Alan C. Young was awarded a patent on a design which proved to be practical for use in portable amplification equipment. Since then, Spring Reverberation has found its way into applications ranging from high fidelity audio to car radios. Spring Reverberation employs a combination of electromagnetic and mechanical elements to simulate reflective paths of delayed sound.



The principle on which it operates can be seen by using a single spring delay line model. An audio signal drives the Coil of the Input Transducer, exerting a twisting force of the miniature cylindrical Magnet, which is attached to one end of a precision stainless steel transmission Spring.

Leo Fender liked the new, smaller reverb and placed it in his Fender Twin Reverb amplifiers, to the delight of guitarists everywhere.



Spring

The resulting torsional wave motion travels the length of the spring until it reaches the Output Transducer, where another magnet(identical to the one on the Input side of the spring) twists in response to the mechanical wave, inducing a signal in the Output Coil. The time elapsed while this sequence of events takes place is the Delay Time at which the spring path is rated.

The Support Wire, which anchors the magnet to the Brass Sleeve, is twisted by the wave as well, and reflects that wave motion back into the Transmission Spring towards the Input Transducer. The support wire also passes through a Damper Disc, which regulates the amount of twisting motion 'echoed' back. The properties of the specific Damper Discs installed (when the transducers are assembled at the factory) determines the Decay Time range desired. The Transmission Springs are the same for all of the Decay Time ranges available for any given model of reverb unit.

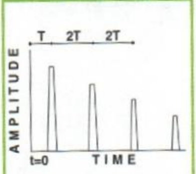
The internal mechanical elements in both the Input and Output Transducers damp and reflect twisting motions in the same way.

Therefore, any given wave will continue to rebound back and forth through the spring until it is damped below the level of audibility. Just as with acoustical reverberation, this is the measured Decay Time of the spring delay line.

Because the wave must travel through the Transmission Springs twice (once in each direction) between each subsequent time it induces a signal at the Output Transducer, reflections from the second one on are spaced apart by twice the rated Delay time.

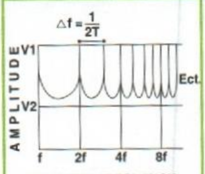
When a continuous signal is applied, the reflected echoes will overlap the ongoing sound. Depending on the frequency and harmonic content of the input signal, this overlap will result in a combination of cancellation and reinforcement. A single spring delay line will exhibit resonances at frequencies dependent on the inverse of its delay time.

Delay Line Output for Single Pulse Input at Time t=0



T = Delay Time for Spring

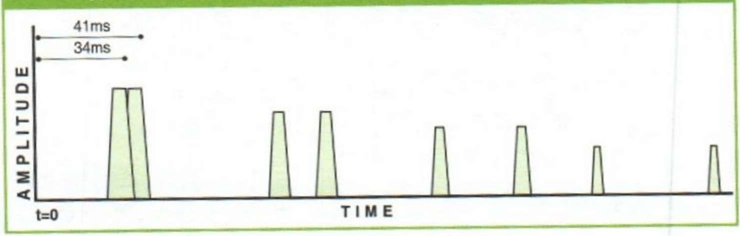
Frequency Response for Same Delay Line



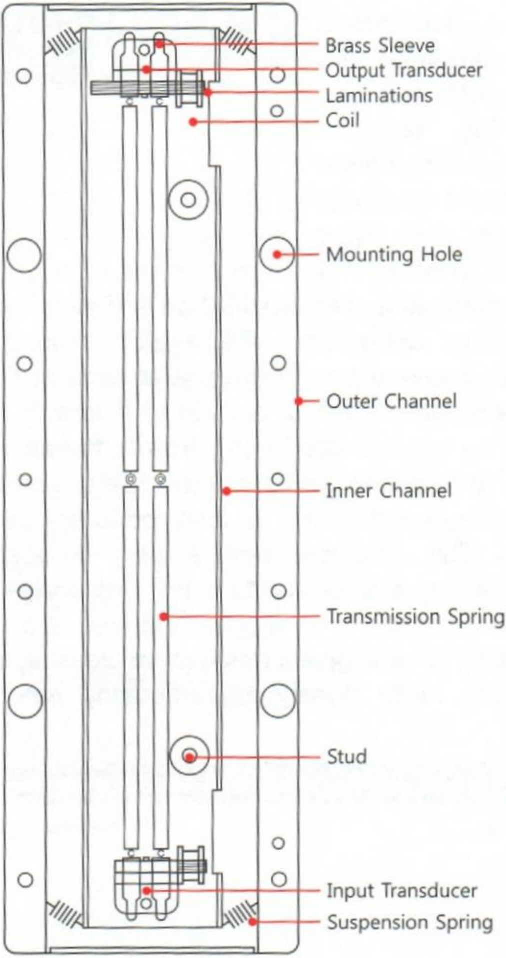
RELATIVE FREQUENCY

Just as reverberation in a natural listening space is enhanced by echoes combining from different reflective distances, incorporating two or more delay line paths of different length will yield a less periodic overlap of reflections. This produces both a more diffused clutter phase, as well as a smoother frequency response over the usable range of the unit. To the listener, the effect of multiple delay lengths give a much more pleasing quality of reverb effect, more closely approximating natural room acoustics.

Type 4 Reverb Unit Output for Single Pulse Input at Time t=0

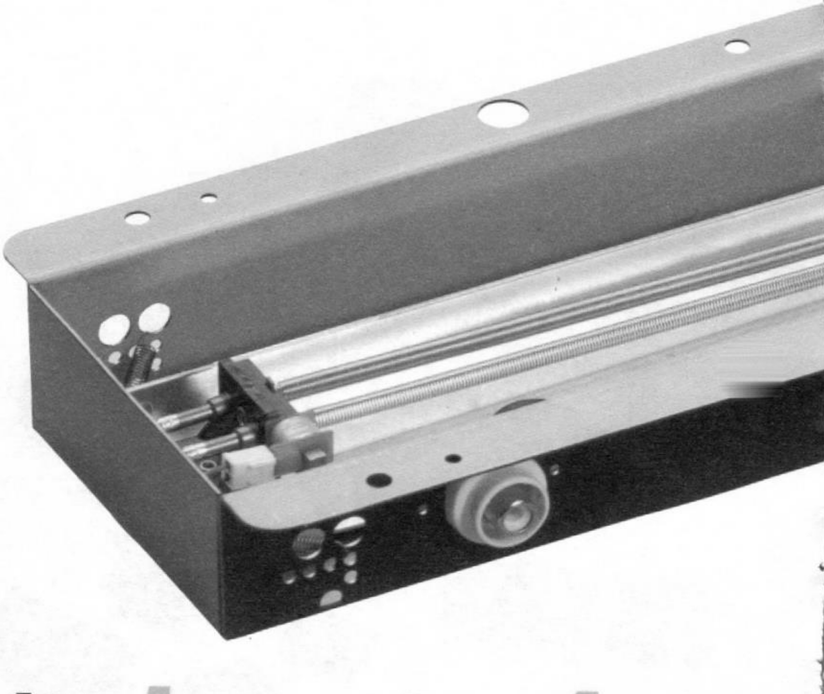


Spring


Brass Sleeve
Output Transducer
Laminations
Coil
Mounting Hole
Outer Channel
Inner Channel
Transmission Spring
Stud
Input Transducer
Suspension Spring

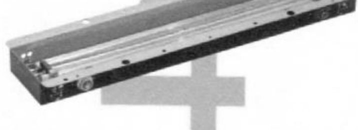

accutronics
DIGITAL SOUND EFFECTOR
BELTON
accutronics
accutronics

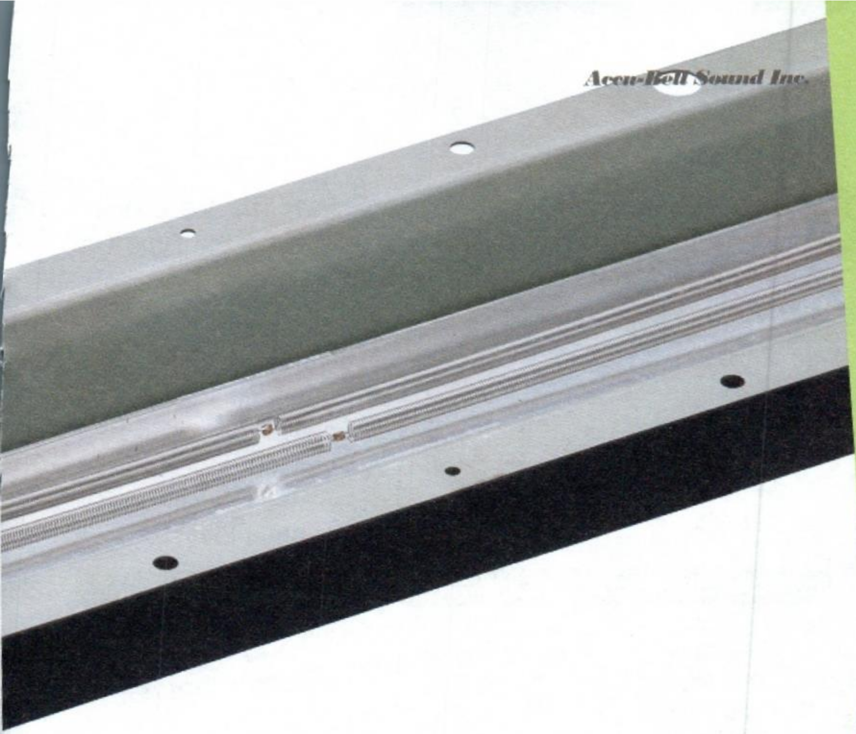
Spring



Type 1

Type 4





Type 8

Type 9

Spring

Select Reverb Type

Design your own *Model Number System.* The Accutronics numbering system enables you to order either the **Type 1** or **Type 4** model with the exact specifications you desire.

Example ·············▸ **1 or 4 , then**

F Input Impedance
B Output Impedance
1 Decay Time
A Connectors
1 Locking Devices
C Mounting Plane

■ Input Impedance	■ Output Impedance	■ Decay Time
A 8 Ohm	A 500 Ohm	1 Short=1.2 to 2.0 Sec
B 150 Ohm	B 2250 Ohm	2 Medium=1.75 to 3.0 Sec
C 200 Ohm	C 10000 Ohm	3 Long=2.75 to 4.0 Sec
D 250 Ohm		
E 600 Ohm		
F 1475 Ohm		

■ Connectors	■ Locking Devices	■ Mounting plane
A Input Grounded Output Grounded	1 No Lock	A Horizontal Open Side up
B Input Grounded Output Insulated		B Horizontal Open Side Down
C Input Insulated Output Grounded		C Vertical Connectors Up
D Input Insulated Output Insulated		D Vertical Connectors Down
E No Outer Channel		E On End Input Up
		F On End Output Up

Accutronics® Spec.

Type 1

BELTON Spec.

BS2

A small low cost, two spring unit designed for application when price is a major factor. Ideally suited for practice amps.

Accutronics® Spec.

Type 4

BELTON Spec.

BL2

The industry standard for years, the Type 4 is still manufactured using Hammond's original design. Four counter-wound and coupled springs deliver superior mechanical performance and the classic sound that helped make the Fender Twin Reverb Amps famous.

Spring

Select Reverb Type

Design your own *Model Number System.* The Accutronics numbering system enables you to order either the **Type 8** or **Type 9** model with the exact specifications you desire.

Example → **8 or 9, then**

- **F** Input Impedance
- **B** Output Impedance
- **1** Decay Time
- **A** Connectors
- **1** Locking Devices
- **C** Mounting Plane

Input Impedance

- A 10 Ohm
- B 190 Ohm
- C 240 Ohm
- D 310 Ohm
- E 800 Ohm
- F 1925 Ohm

Output Impedance

- A 600 Ohm
- B 2575 Ohm
- C 12000 Ohm

Decay Time

- 1 Short=1.2 to 2.0 Sec
- 2 Medium=1.75 to 3.0 Sec
- 3 Long=2.75 to 4.0 Sec

Connectors

- A Input Grounded Output Grounded
- B Input Grounded Output Insulated
- C Input Insulated Output Grounded
- D Input Insulated Output Insulated
- E No Outer Channel

Locking Devices

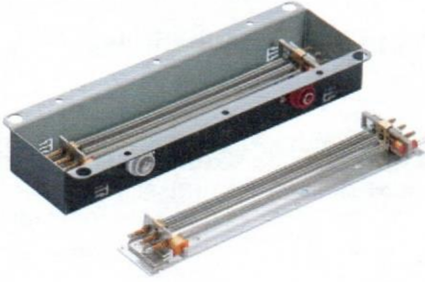
- 1 No Lock

Mounting plane

- A Horizontal Open Side up
- B Horizontal Open Side Down
- C Vertical Connectors Up
- D Vertical Connectors Down
- E On End Input Up
- F On End Output Up

Accutronics® Spec.

Type 8



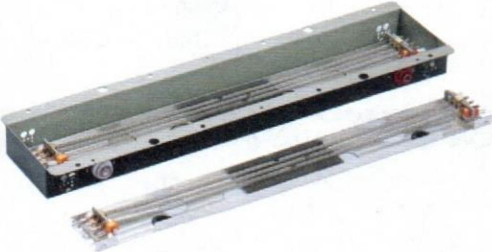
BELTON Spec.

BS3

Designed for applications in which overall sound quality is important and a compact package is required. Small in size, this three spring reverb approaches the rich textural quality of our larger reverb units.

Accutronics® Spec.

Type 9



BELTON Spec.

BL3

Six springs, counter wound, coupled and placed in parallel, combine to create ***Accu-Bell Sound's*** fullest, richest, reverb effect throughout the full range of musical sound. Ideally suited for keyboard, sound reinforcement and pedal steel applications.

Spring

Electrical Specifications

	Impedance @ 1KHz ± 15%		Plastic Bobbin (Color of Coil)	DC Resistance (Ohms±15%)	# of Turns	Nominal Drive Current (AC mA)
Input	**Type 9 or 8**	**Type 4 or 1**				
	(In Ohms)	(In Ohms)				
A	10	8	White	.81	124	28.0
B	190	150	Black	26	538	6.5
C	240	200	Violet	27	600	5.8
D	310	250	Brown	36	688	5.0
E	800	600	Orange	58	1100	3.1
F	1925	1475	Red	200	1700	2.0
Output	**Type 9 or 8**	**Type 4 or 1**				
A	600	500	Green	42		
B	2575	2250	Red	200		
C	12000	10000	Yellow	800		

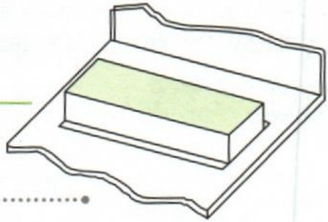
Typical Decay Time

Short=1.2 to 2.0 Sec
Medium=1.75 to 3.0 Sec
Long=2.75 to 4.0 Sec

Mounting Plane

A Horizontal Open side Up

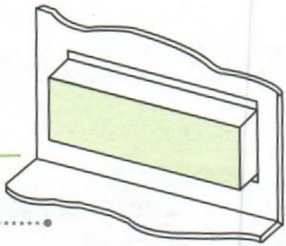
B Horizontal Open side Down



Shown open side down

C Vertical Connectors Up

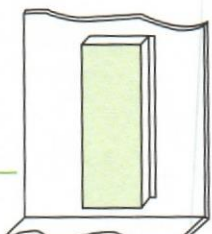
D Vertical Connectors Down



Shown connectors down

E On End Input Up

F On End Output Up



Shown end output up

Spring

Blue Reverb

Select Reverb Type

Design your own *Model Number System.* The Accutronics numbering system enables you to order either the **Blue Reverb** model with the exact specifications you desire.

Example

- **A** Accutronics®
- **M** Mini Size
- **C** Compact Type
- **2** No. of Springs
- **B** Input Impedance
- **F** Output Impedance
- **2** Decay Time

■ Input Impedance

- B 150 Ohm
- E 600 Ohm

■ Output Impedance

- F 1500 Ohm
- G 2250 Ohm

■ Decay Time

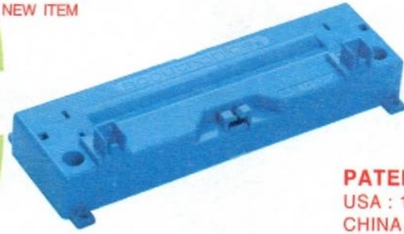
- 2 Medium=1.75 to 2.5 Sec
- 3 Long=2.0 to 3.5 Sec

Impedance @1KHz ± 10%			Inductance In mH ± 15%	DC Resistance In Ohms ± 15%	Recommended AC Drive mA For Approx 3.5A-T
IN PUT	B	150 Ohm	23.0	26	6.5
	E	600 Ohm	85.5	80	3.1
Out PUT	F	1500 Ohm	220.0	218	
	G	2250 Ohm	350.0	320	

Accutronics® Spec.

Type AMC

NEW ITEM



PATENT NO.
USA : 12/072043
CHINA : 200810081033.8
KOREA : 10-0934456-0000

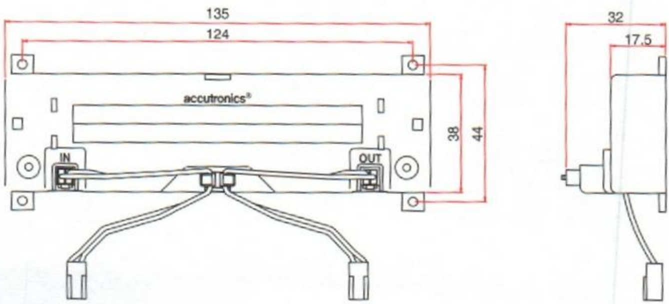
Features

- Compact and low cost type
- 2 natural coil spring type
- Input impedance are changeable
- Length of connect wire are changeable by optional

Applications

- Specially suited for small wattage amplifier
- For electric organs, guitar amplifier
- Ideally suited for practice amps
- 2 Springs Type

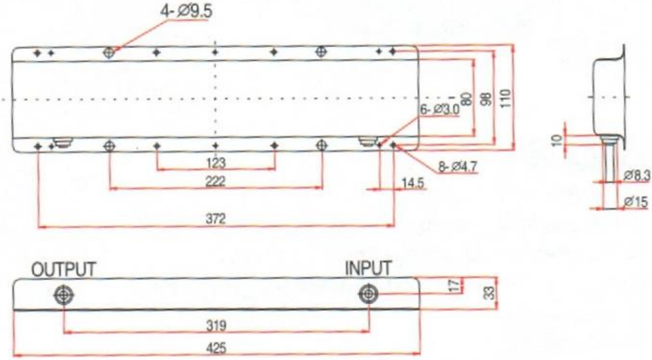
Schematic Drawings



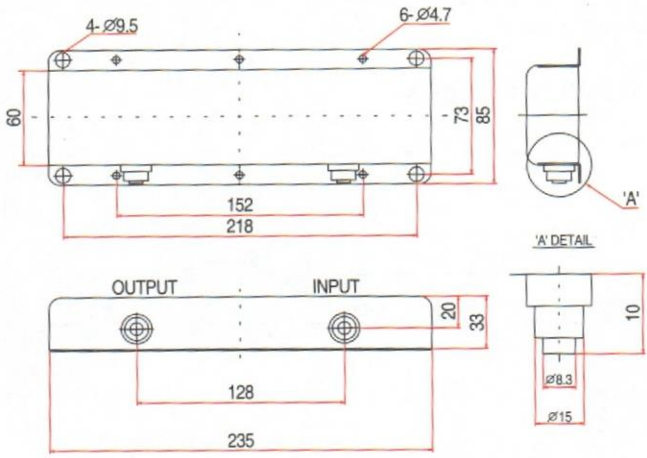
Spring

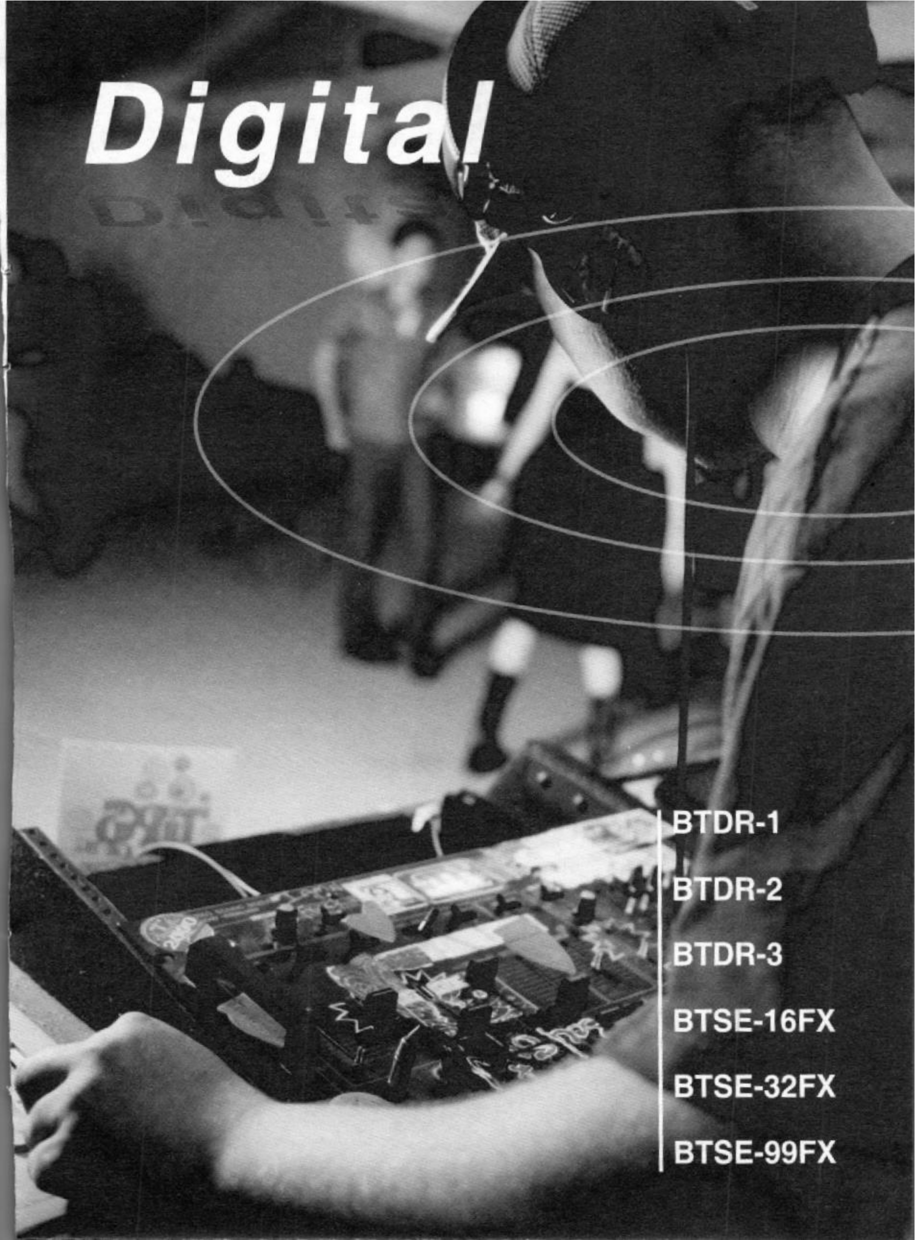
Schematic Drawings

Type 4 and 9 (BL2 and BL3)



Type 1 and 8 (BS2 and BS3)





Digital

BTDR-1

BTDR-2

BTDR-3

BTSE-16FX

BTSE-32FX

BTSE-99FX

Digital

DIGI-LOG™ REVERB MODULE (BTDR-1)

A great digital reverb sound that easily replaces a spring reverberation unit

Features

- Simple interface requires only input, output, +5V, and ground
- Available in horizontal or vertical mounting
- Pin-compatible with BTSE-16FX Digital Effector
- AC-coupled input and output require no external capacitors
- RoHS compliant

Pat. No. : US 8,204,240
CN ZL200880021110.9

Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Supply Current	I_{CC}		60	100	mA
Input Voltage	V_{IN}			1.5	V_{PEAK}
Voltage Gain			0		dB(>10kΩ load)
Residual Noise			-80	-72	dBV
Input Impedance	Z_{IN}		10k		Ω
Output Impedance	Z_{OUT}		220		Ω
Operating Temperature		-40		+85	C

Subject to change without notice

Available Options

	Decay		
	S	M	L
Type	short	medium	long
Time (T_{60})	2.0 s	2.5 s	2.85 s

Ordering code

(Only for BTDR-1 & 2)

B	T	D	R	—	1	—	H	—	M

BT-abbreviation of BELTON

D-Digital

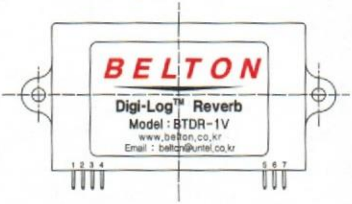
R-Reverb

SERIES NO.
1
2
3

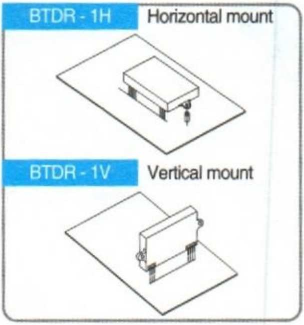
MOUNT
H-Horizontal
V-Vertical

DECAY TIME
S-Short
M-Medium
L-Long

Connection Diagram

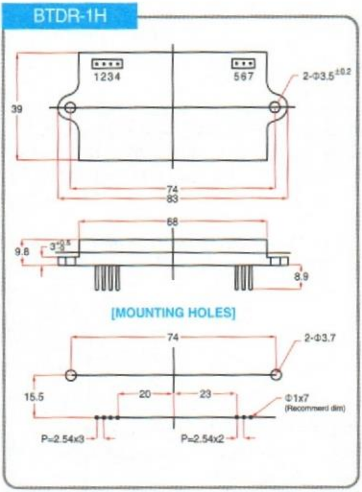


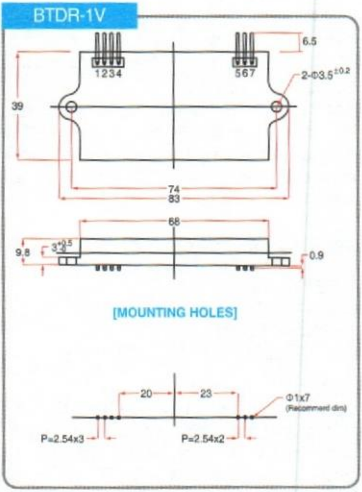
1. VOUT
2. VOUT
3. GND (Signal)
4. VIN
5. GND (Power)
6. N.C.
7. Vcc



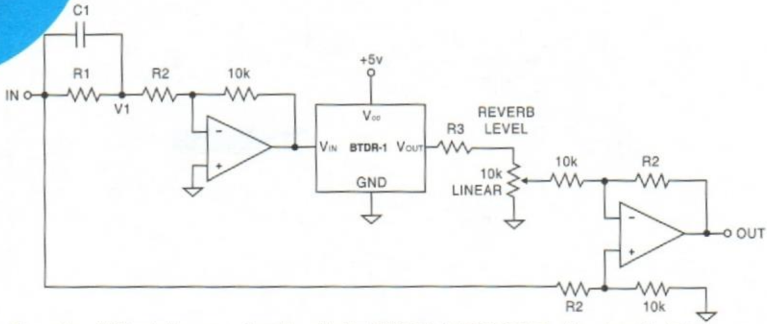
Note : Pins 3 and 5 are internally connected. If using a common ground for signal and power supply, connect only pin 5 and leave pin 3 unconnected.

Dimensions





Application Circuit



- The value of R2 sets the proper input level to the BTDR-1. Set R2=6.7kΩ · V_1, where V_1 is the maximum peak voltage measured at node V_1 shown in the schematic above.
- C1 and R1 are optional and create a high-pass or shelf filter that attenuates the low frequency input to the reverb.
  - ◆ For a low shelf filter :
  - Set $C1 = 1/(2\pi \cdot R2 \cdot f_c)$, where f_c is the shelf frequency.
  - Set $R1 = R2 \cdot (1-G_s) / G_s$, where G_s is the shelf gain.
  - ◆ For a high-pass filter :
  - Set $C1 = 1/(2\pi \cdot R2 \cdot f_c)$, where f_c is the cutoff frequency.
  - Omit R1 (R1 = 0)
- Adjust R3 to limit maximum reverb level. R3 may be omitted for maximum reverb level.
- The use of a regulated 5V supply, such as a 78L05, is highly recommended. A ceramic bypass capacitor may be necessary between Vcc and GND if the regulator is not close to the reverb module.
- Audio noise during power-down can be minimized by quickly discharging supply from 5V to 0V; otherwise, external output muting is recommended.

Example : Configure the circuit above for a shelf filter with fc=200 Hz and 10 dB attenuation when the Maximum voltage at $V_1 = 8V_{PK}$.

- $R2=6.7k\Omega \cdot 8V=53.6k\Omega$
- $C1=1/(2\pi \cdot 53.6k\Omega \cdot 200Hz) \approx 0.015\mu F$
- $G_s = 10^{(-10dB)/20}=0.316$
- $R1 = 53.6k\Omega \cdot (1-0.316)/0.316 \approx 115k\Omega$

Considerations for FCC Compliance

- No high-frequency clocks are conducted outside of BTDR-1's internal ICs, minimizing emissions.
- Use of the BTDR-1V(vertical mounting) should lower conducted emissions, since it eliminates parallel signal paths between the BTDR-1, and main interface PC board
- No guarantees of FCC compliance are made for the BTDR-1, as it has not been tested for radio-frequency emissions, either radiated or conducted.

DIGI-LOG™ REVERB MODULE (BTDR-2)

A great digital reverb sound that easily replaces a spring reverberation unit

Features

- Small package is half the size of the BTDR-1
- Stereo outputs may be summed for mono operation
- Simple interface requires only input, output, +5V, and ground
- AC-coupled input and outputs require no external capacitors

Pat. No. : US 8,204,240
CN ZL200880021110.9

Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Supply Current	I_{CC}		60	100	mA
Input Voltage	V_{IN}			1.5	V_{PEAK}
Voltage Gain			-3		dB(each output)
Residual Noise			-77	TBD	dBV
Input Impedance	Z_{IN}		10k		Ω
Output Impedance	Z_{OUT}		220		Ω
Operating Temperature		-40		+85	C

Preliminary, subject to change without notice

Available Options

Decay			
	S	M	L
Type	short	medium	long
Time (T_{60})	2.0s	2.5s	2.85s

Ordering code

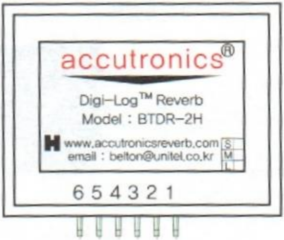
(Only for BTDR-1 & 2)

B T D R — 2 — H — M

- BT-abbreviation of BELTON
- D-Digital
- R-Reverb
- SERIES NO.: 1, 2, 3
- MOUNT: H-Horizontal, V-Vertical
- DECAY TIME: S-Short, M-Medium, L-Long

Digital

Connection Diagram

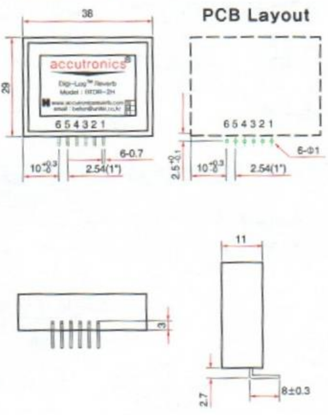


1. +5V
2. Power GND
3. Input
4. Signal GND
5. Output 2
6. Output 1

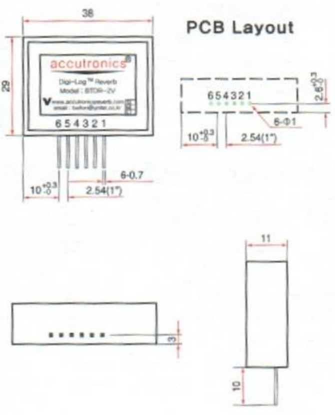
Note: Pin 2 and 4 are internally connected. See the Application Circuit for more information on how to connect the grounds.

Dimensions

BTDR-2H



BTDR-2V



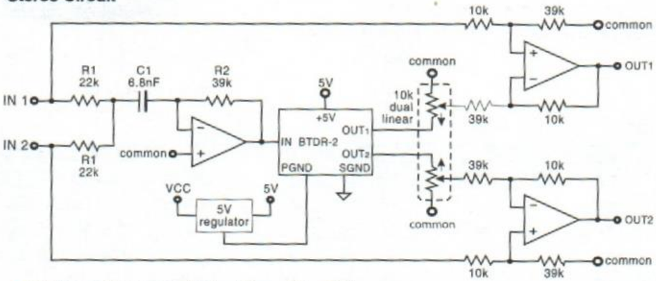
Application

A regulated 5V supply is mandatory. An LDO regulator is recommended for battery-powered devices.

◆ The following example circuits are for instrument-level signals :

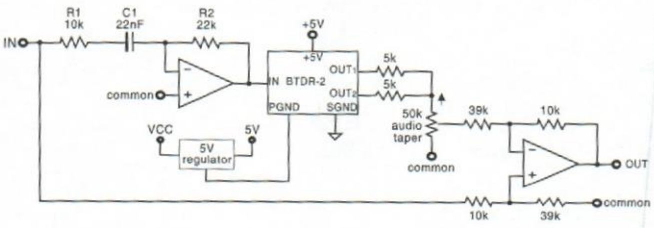
- "Common" is "Signal GND" in a split-supply circuit or Vcc/2 in a single-supply circuit.
- Audio noise during power-down can be minimized by quickly discharging supply from 5V to 0V; otherwise, external output muting may be necessary.
- R1, R2 and C1 create a pre-EQ high-pass filter and may be adjusted to taste.

Stereo Circuit



- High-pass frequency (Hz) = 1/(π · C1 · R1)
- High frequency gain (dB) = 20 · log(2 · R2/R1)

Mono Circuit



- High-pass frequency (Hz) = 1/(2π · C1 · R1)
- High frequency gain (dB) = 20 · log(R2/R1)

Considerations for FCC Compliance

- The maximum internal clock frequency is approximately 14MHz.
- Although Accu-Bell believes that circuits employing solely the BTDR-2 will easily pass FCC Part 15, no guarantees of compliance are made; the circuit must be tested as a whole for radiated and conducted emissions.

Digital

DIGI-LOG™ REVERB MODULE (BTDR-3)

A great digital reverb sound that easily replaces a spring reverberation unit

NEW ITEM

Pat. No. : US 8,204,240
CN ZL200880021110.9

Features

- Reverb depth (decay) adjustable via 2 external resistors or 1 dual pot
- Stereo outputs may be summed for mono operation
- Simple interface: input, output, +5V, and ground
- AC-coupled input and outputs require no external capacitor

Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Supply Current	I_{CC}		60	100	mA
Input Voltage	V_{IN}			1.5	V_{PEAK}
Voltage Gain			-3		dB(each output)
Residual Noise			-77	TBD	dBV
Input Impedance	Z_{IN}		10k		Ω
Output Impedance	Z_{OUT}		220		Ω
Operating Temperature		-40		+85	C

Subject to change without notice.

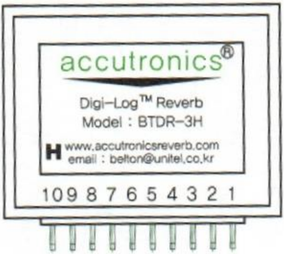
Ordering code

(Only for BTDR-1 & 2)

B	T	D	R	—	3	—	H	—	M

- BT-abbreviation of BELTON
- D-Digital
- R-Reverb
- SERIES NO.: 1, 2, 3
- MOUNT: H-Horizontal, V-Vertical
- DECAY TIME: S-Short, M-Medium, L-Long

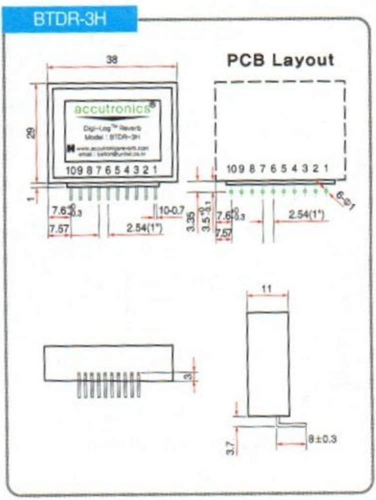
Connection Diagram

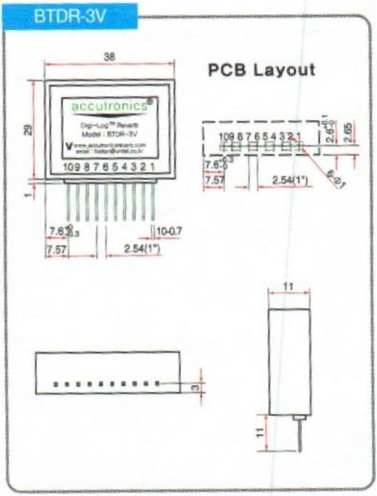


1. +5V
2. Power GND
3. Input
4. Signal GND
5. Output 2
6. Output 1
7. Pot 1A
8. Pot 1B
9. Pot 2A
10. Pot 2B

Note: Pins 2 and 4 are internally connected.
See the Application Circuit for more information on how to connect the grounds.

Dimensions





Applications

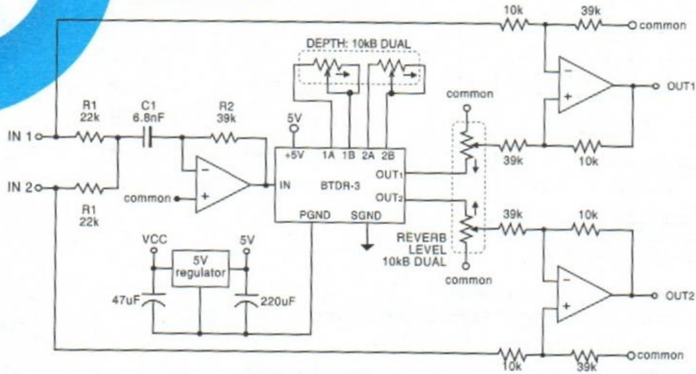
A regulated 5V supply is mandatory. An LDO regulator is recommended for battery-powered devices.

◆ The following example circuits are for instrument-level signals:

- "Common" is "Signal GND" in a split-supply circuit or Vcc/2 in a single-supply circuit.
- Audio noise during power-down can be minimized by quickly discharging supply from 5V to 0V; otherwise, external output muting may be necessary.
- R1, R2 and C1 create a pre-EQ high-pass filter and may be adjusted to taste.

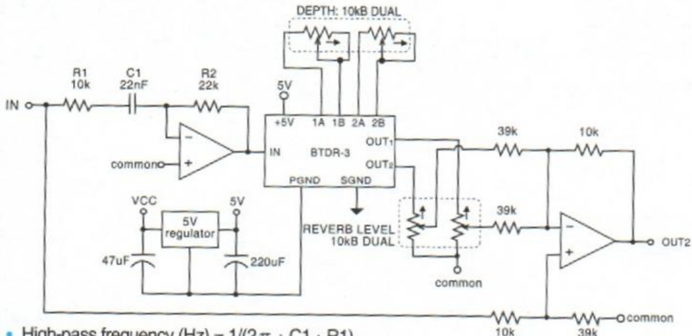
Digital

Stereo Circuit



- High-pass frequency (Hz) = 1/(π · C1 · R1)
- High frequency gain (dB) = 20 · log(2 · R2/R1)

Mono Circuit



- High-pass frequency (Hz) = 1/(2π · C1 · R1)
- High frequency gain (dB) = 20 · log(R2/R1)

Considerations for FCC Compliance

- The maximum internal clock frequency is approximately 14MHz.
- Although Accu-Bell believes that circuits employing solely the BTDR-2 will easily pass FCC Part 15, no guarantees of compliance are made; the circuit must be tested as a whole for radiated and conducted emissions.

DSP MODULE (BTSE-16FX)

General Specification of Sound Effector

Overview

The BTSE-16FX Effect board provides 16 different digital audio effects to be used for mixers or other audio applications that require sound enhancement. Equipped superb quality digital effects processing engine which it adds that extra punch needed to make audio presentations truly stand out.

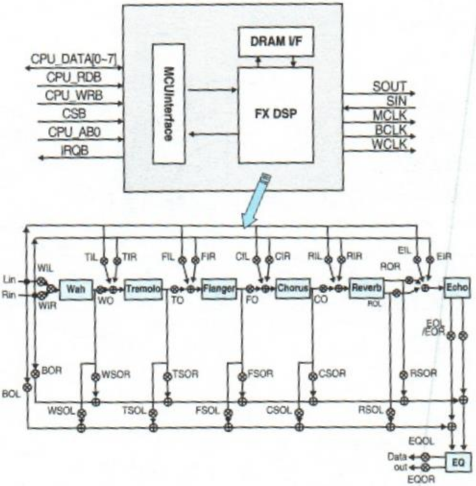
Specifications

FX Presets	16	S/N(A-weighted)	90 dB	Power Supply	DC 5V
Passband Frequency	20hz~20khz	Dynamic Range	90 dB	RoHS(PB free)	O
DSP arithmetic	24 bit	Sampling Rate	48 khz		

Applications

- Guitar and keyboard Amplifiers/ Combos
- Audio mixing consoles / Powered Mixing Console
- Karaoke systems
- Stand - alone stereo Effect units for studio and PA usage

Block Diagram

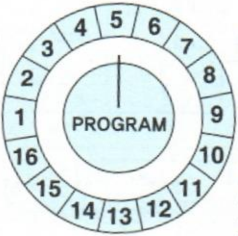


Digital
Effects Program Chart

Program List	Name	Description
1100	Hall 1	Bright hall reverb for drum,guitar and vocals.
1110	Hall 2	Warm hall for acoustic guitars,pianos and vocals.
0110	Room 1	Hardwood studio for acoustic instrument.
0100	Room 2	Ambience for acoustic mixers and synth sounds.
0000	Room 3	Warm room for guitars and rhythm.
0010	Plate 1	Classic plate reverb for lead vocals and drums.
0011	Plate 2	Sizzling bright plate reverb for vc.
0001	Plate 3	Short vintage plate reverb for snares and guitars.
0101	Chorus	Stereo chorus for guitars and pianos.
0111	Flanger	Stereo flanger for jet wash effects.
1111	Delay 1	125ms snapback delay for voclas and guitars.
1101	Delay 2	190ms delay for percussive arpeggios.
1001	Chorus/Room 1	Chorus with reverb for guitars,synths, and pianos.
1011	Chorus/Room 2	Auto wah guitar effect with reverb for lead instuments.
1010	Chorus/Delay	Chorus Delay for guitars,synths, and pianos.
1000	Rotary Speaker	Rotary speaker emulation for organs and guitars.

Program Mode Change for Panel

Prog. List	
1100	1. HALL 1
1110	2. HALL 2
0110	3. ROOM 1
0100	4. ROOM 2
0000	5. ROOM 3
0010	6. PLATE 1
0011	7. PLATE 2
0001	8. PLATE 3



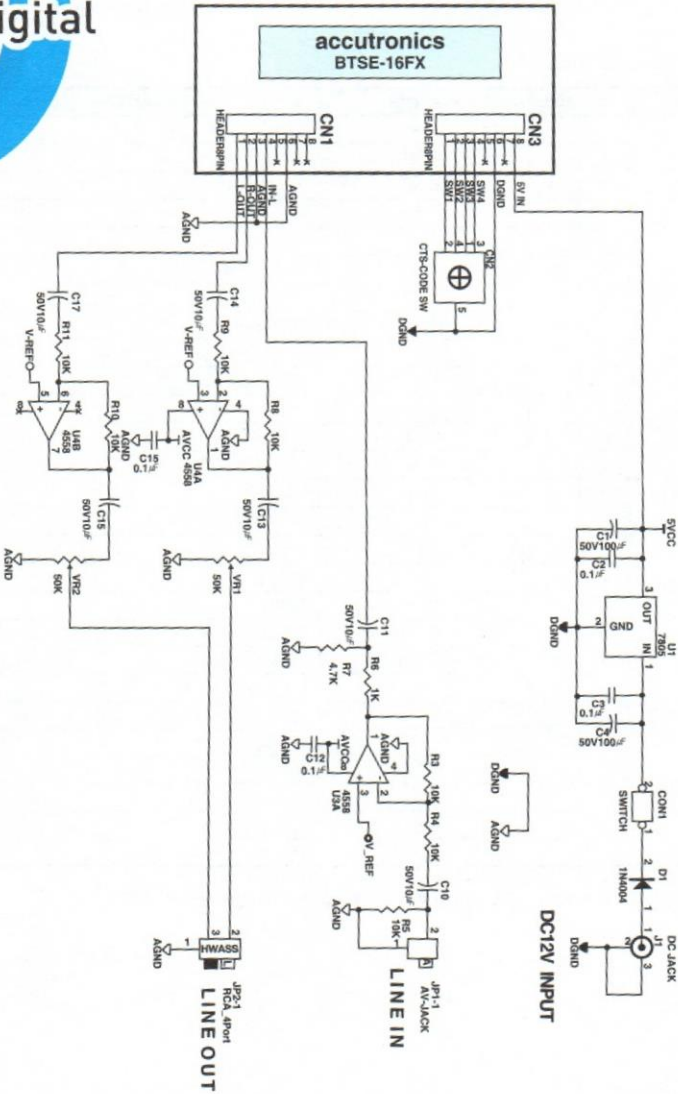
	Prog. List
9. CHORUS	0101
10. FLANGER	0111
11. DELAY 1	1111
12 DELAY 2	1101
13. CHO+REV1	1001
14. CHO+REV2	1011
15. DELAY 3	1010
16. ROTAR SPK	1000

Pin Descriptions

Part	Pin	Case	PIN Name	Function
CN1	1	1	L-Out	Audio Out Left
	2	2	R-Out	Audio Out Right
	3	3	AGND	Analog Ground
	4	4	IN	Auido Input
	5	5	3.6V	+3.6V Out
	6	6	AGND	Analog Ground
	7	7	MUTE	Mute (SW 5 bit)
	8	8	FND-DATA	FND Data out
CN2	1		DB0	Serial data
	2		DB1	Serial clock
	3		RSTC	Rest
	4		GND	Ground
	5		3.6V	+3.6V Out
CN3	1	9	SW1	SW 0 bit
	2	10	SW2	SW 1 bit
	3	11	SW3	SW 2 bit
	4	12	SW4	SW 3 bit
	5	13	BANK	SW 4 bit
	6	14	DGND	Digtial Ground
	7	15	FND-CLK	FND clock out
	8	16	5V	+5V power supply
CN4	1		ISP-CLK	ISP Clock
	2		ISP-SD	Analog Ground
	3		RSTB	Rest
	4		GND	Ground
	5		3.6V	Analog Ground
	6		TEST	Test

※CN2, CN4 Pin is only used download firmware on MCU, EEPROM

- Suggestion for control : CTS code switch (BTDS20V-116 : BELTON S/W SPEC)


accutronics
BTSE-16FX
CN1
HEADER8PIN
CN3
L-OUT
R-OUT
AGND
IN-L
5V IN
DGND
SW1
SW2
SW3
SW4
CN2
CTS-CODE SW
C17
50V10㎌
C14
R11
R9
10K
V-REF
U4B
4558
U4A
AVCC 4558
C15
0.1㎌
R10
R8
C13
VR1
VR2
50K
C11
R6
1K
R7
4.7K
C12
AVCCa
U3A
R3
R4
R5
C10
V_REF
HWASS
JP2-1
RCA_4Port
LINE OUT
JP1-1
AV-JACK
LINE IN
5VCC
C1
50V100㎌
C2
C3
C4
U1
7805
OUT
GND
IN
CON1
SWITCH
D1
1N4004
J1
DC JACK
DC12V INPUT

DSP MODULE (BTSE-32FX)

General Specification of Sound Effector

Overview

The BTSE-32FX Effect board provides 32 different digital audio effects to be used for mixers or other audio applications that require sound enhancement. Equipped superb quality digital effects processing engine which it adds that extra punch needed to make audio presentations truly stand out.

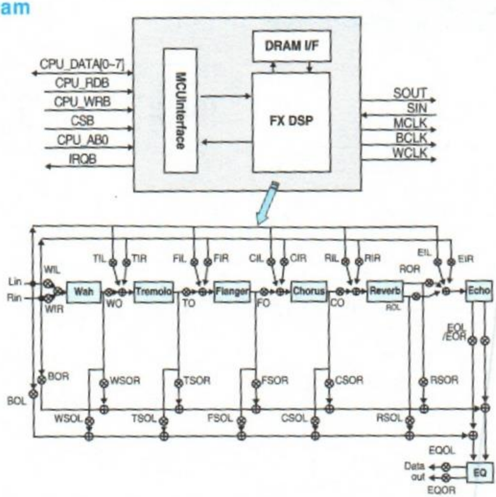
Specifications

FX Presets	32	**S/N(A-weighted)**	90 dB	**Power Supply**	DC 5V
Passband Frequency	20hz~20khz	**Dynamic Range**	90 dB	**RoHS(PB free)**	O
DSP arithmetic	24 bit	**Sampling Rate**	48 khz		

Applications

- Guitar and keyboard Amplifiers/ Combos
- Audio mixing consoles / Powered Mixing Console
- Karaoke systems
- Stand - alone stereo Effect units for studio and PA usage

Block Diagram



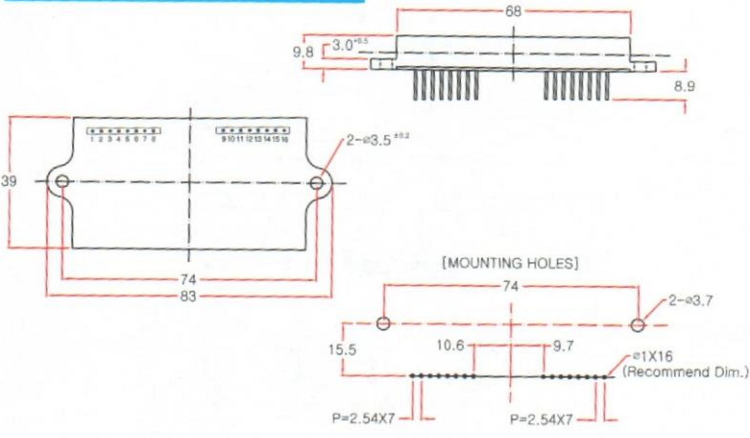
Digital

Effects Program Chart

Reverb			Delay			Chorus		
01	Hall	6.0 sec	14	Delay 50%	400ms	23	Chorus & Hall slow	4.0 sec
02	Hall	4.5 sec	15	Delay 50%	500ms	24	Chorus & Delay medium	0.15 sec
03	Hall	3.0 sec	16	Delay 50%	800ms	25	Chorus & Delay slow	0.3 sec
04	Hall	1.6 sec	17	Voice Doubler	60ms	**Flanger**		
05	Room	1.6 sec	18	Voice Doubler	120ms	26	Flanger slow	
06	Room	1.0 sec	19	Chorus slow		27	Flanger medium	
07	Plate	3.0 sec	20	Chorus medium		28	Flanger fast	
08	Plate	1.6 sec	21	Chorus fast				
09	Ambient	1.6 sec	22	Chorus & Hall		29	Gated Reverb	125 ms
10	Delay&Room	1.6 sec		medium 2.0 sec		30	Gated Reverb	200 ms
11	Delay 50%	100ms				31	Reverse Reverb	150 ms
12	Delay 50%	200ms				32	Reverse Reverb	250 ms
13	Delay 50%	300ms						

Schematic Drawings

BTSE-16FX / BTSE-32FX / BTSE-99FX

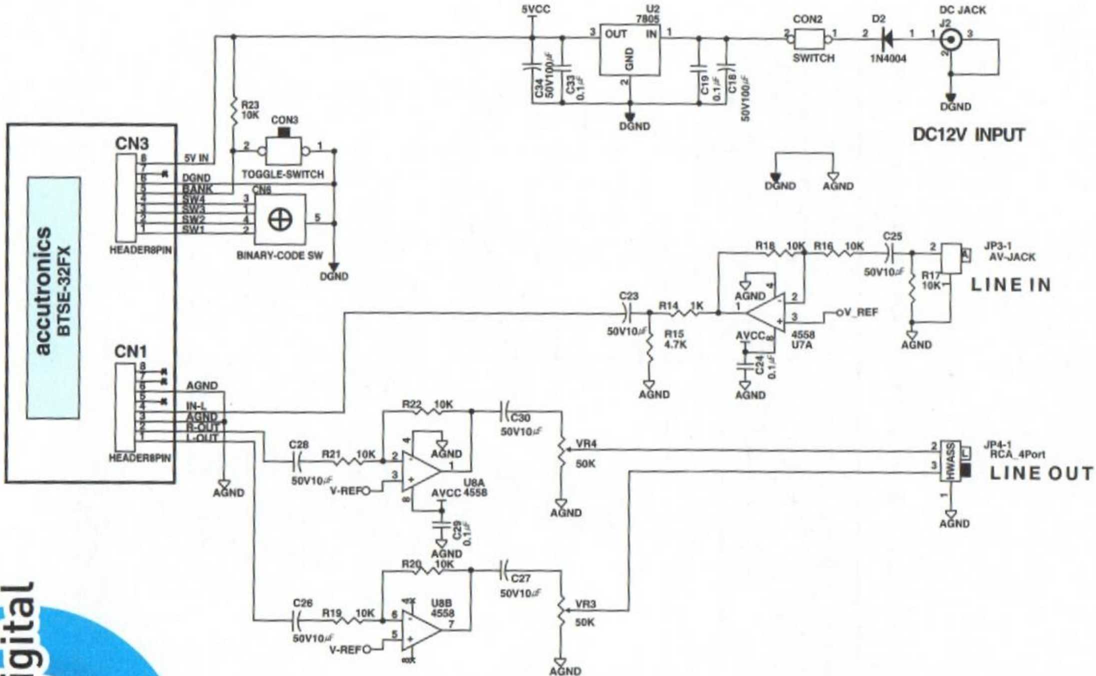


Pin Descriptions

Part	PIN	Case	Name	Function
CN1	1	1	L-Out	Audio Out Left
	2	2	R-Out	Audio Out Right
	3	3	AGND	Analog Ground
	4	4	IN	Auido Input
	5	5	3.6V	+3.6V Out
	6	6	AGND	Analog Ground
	7	7	MUTE	Mute (SW 5 bit)
	8	8	FND-DATA	FND Data out
CN2	1		DB0	Serial data
	2		DB1	Serial clock
	3		RSTC	Rest
	4		GND	Ground
	5		3.6V	+3.6V Out
CN3	1	9	SW1	SW 0 bit
	2	10	SW2	SW 1 bit
	3	11	SW3	SW 2 bit
	4	12	SW4	SW 3 bit
	5	13	BANK	SW 4 bit
	6	14	DGND	Digtial Ground
	7	15	FND-CLK	FND clock out
	8	16	5V	+5V power supply
CN4	1		ISP-CLK	ISP Clock
	2		ISP-SD	Analog Ground
	3		RSTB	Rest
	4		GND	Ground
	5		3.6V	Analog Ground
	6		TEST	Test

※ CN2, CN4 Pin is only used download firmware on MCU, EEPROM

- Suggestion for control: Binary code (Positive) switch (BTDS20V-116 : BELTON S/W SPEC)


accutronics
BTSE-32FX
CN3
HEADER8PIN
5V IN
DGND
BANK
SW4
SW3
SW2
SW1
R23
10K
CON3
TOGGLE-SWITCH
CN6
BINARY-CODE SW
DGND
5VCC
U2
7805
OUT
IN
GND
C34
50V100㎌
C33
0.1㎌
C19
0.1㎌
C18
50V100㎌
DGND
CON2
SWITCH
D2
1N4004
DC JACK
J2
DGND
DC12V INPUT
DGND
AGND
R18 10K
R16 10K
C25
50V10㎌
JP3-1
AV-JACK
R17
10K
LINE IN
AGND
C23
50V10㎌
R14 1K
R15
4.7K
AGND
AVCC
C24
0.1㎌
AGND
4558
U7A
V_REF
CN1
HEADER8PIN
AGND
IN-L
AGND
R-OUT
L-OUT
AGND
R22 10K
C30
50V10㎌
C28
50V10㎌
R21 10K
V-REF
U8A
4558
AVCC
C29
0.1㎌
AGND
VR4
50K
AGND
JP4-1
RCA_4Port
HWASS
LINE OUT
AGND
R20 10K
C27
50V10㎌
C26
50V10㎌
R19 10K
U8B
4558
V-REF
VR3
50K
AGND

General Specification of Sound Effector

Overview

The BTSE-99FX Effect board provides 99 different digital audio effects to be used for mixers or other audio applications that require sound enhancement. Equipped superb quality digital effects processing engine which it adds that extra punch needed to make audio presentations truly stand out.

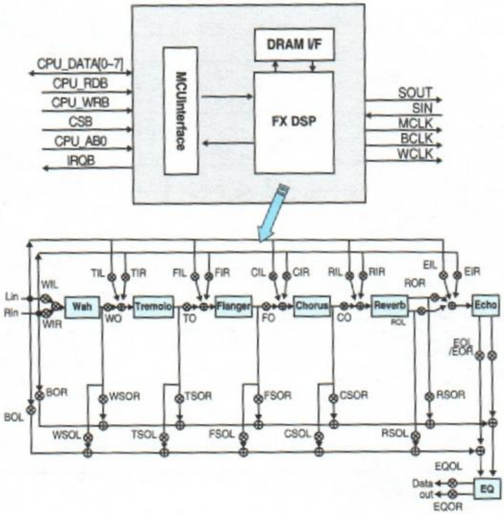
Specifications

FX Presets	99	**S/N(A-weighted)**	90 dB	**Power Supply**	DC 5V
Passband Frequency	20hz~20khz	**Dynamic Range**	90 dB	**RoHS(PB free)**	O
DSP arithmetic	24 bit	**Sampling Rate**	48 khz		

Applications

- Guitar and keyboard Amplifiers/ Combos
- Audio mixing consoles / Powered Mixing Console
- Karaoke systems
- Stand - alone stereo Effect units for studio and PA usage

Block Diagram



Digital

Effects Program Chart

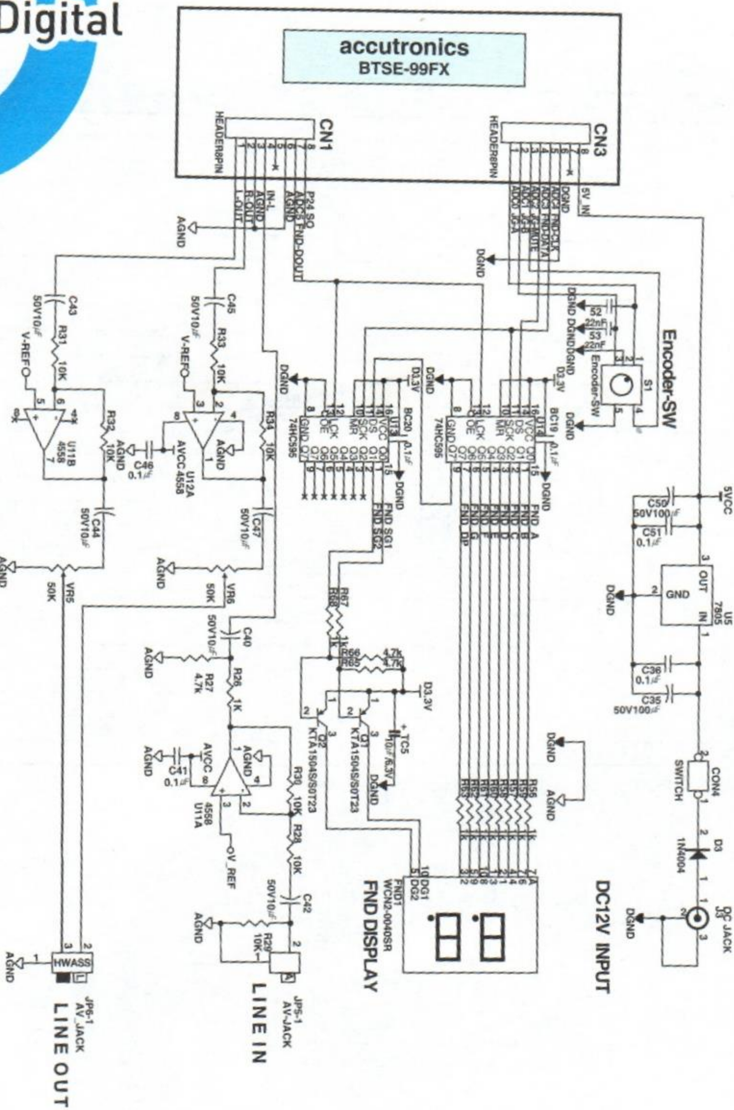
Reverb			Delay					Chorus				
01	Hall	2.0 sec	38	Echo	100 ms	+ Room	1.0 sec	70	Chorus	fast		
02	Hall	2.5 sec	39	Echo	150 ms	+ Room	1.5 sec	71	Chorus	fast	+ Echo	100 ms
03	Hall	3.0 sec	40	Echo	200 ms	+ Hall	2.0 sec	72	Chorus	fast	+ Room	1.0 sec
04	Hall	4.0 sec	41	Echo	250 ms	+ Hall	2.5 sec	73	Chorus	medium		
05	Hall	5.0 sec	42	Echo	300 ms	+ Hall	3.0 sec	74	Chorus	medium	+ Echo	200 ms
06	Hall	6.0 sec	43	Echo	350 ms	+ Hall	3.5 sec	75	Chorus	medium	+ Hall	2.0 sec
07	Hall	8.0 sec	44	Echo	400 ms	+ Hall	4.0 sec	76	Chorus	slow		
08	Hall	10.0 sec	45	Echo	500 ms	+ Hall	5.0 sec	77	Chorus	slow	+ Echo	300ms
09	Room	1.0 sec	46	Voice Doubler	60 ms			78	Chorus	slow	+ Hall	4.0 sec
10	Room	1.5 sec	47	Voice Doubler	80 ms			Flanger				
11	Room	2.0 sec	48	Voice Doubler	100 ms			79	Flanger	fast		
12	Room	2.5 sec	49	Voice Doubler	120 ms			80	Flanger	fast	+ Echo	100 ms
13	Room	3.0 sec	50	Voice Doubler	140 ms			81	Flanger	fast	+ Room	1.0 sec
14	Room	4.0 sec	51	Signal Delay	50 ms			82	Flanger	medium		
15	Plate	1.0 sec	52	Signal Delay	100 ms			83	Flanger	medium	+ Echo	200 ms
16	Plate	1.5 sec	53	Signal Delay	150 ms			84	Flanger	medium	+ Hall	2.0 sec
17	Plate	2.0 sec	54	Signal Delay	200 ms			85	Flanger	slow		
18	Plate	2.5 sec	55	Signal Delay	250 ms			86	Flanger	slow	+ Echo	300 ms
19	Plate	3.0 sec	56	Signal Delay	300 ms			87	Flange	slow	+ Halll	4.0 sec
20	Plate	4.0 sec	57	Signal Delay	400 ms			Tremolo				
21	Ambient	0.5 sec	58	Signal Delay	500 ms			88	Tremolo	fast		
22	Ambient	0.7 sec	59	Echo	50%	+ F.B	100 ms	89	Tremolo	fast	+ Room	1.0 sec
23	Ambient	1.0 sec	60	Echo	50%	+ F.B	125 ms	90	Tremolo	medium		
24	Ambient	1.3 sec	61	Echo	50%	+ F.B	150 ms	91	Tremolo	medium	+ Hall	2.0 sec
25	Ambient	1.6 sec	62	Echo	50%	+ F.B	200 ms	92	Tremolo	slow		
26	Gated	75ms	63	Echo	50%	+ F.B	250 ms	93	Tremolo	slow	+ Hall	4.0 sec
27	Gated	100ms	64	Echo	50%	+ F.B	300 ms	Wah Wah				
28	Gated	125ms	65	Echo	50%	+ F.B	350 ms	94	Wah Wah	fast		
29	Gated	150ms	66	Echo	50%	+ F.B	400 ms	95	Wah Wah	fast	+ Room	1.0 sec
30	Gated	200ms	67	Echo	50%	+ F.B	500 ms	96	Wah Wah	medium		
31	Gated	300ms	68	Echo	50%	+ F.B	350 ms	97	Wah Wah	medium	+ Hall	2.0 sec
32	Reverse	75ms	69	Echo	50%	+ F.B	800 ms	98	Wah Wah	slow		
33	Reverse	100ms						99	Wah Wah	slow	+ Hall	4.0 sec
34	Reverse	125ms										
35	Reverse	150ms										
36	Reverse	200ms										
37	Reverse	300ms										

Pin Descriptions

Part	Pin	Case	PIN Name	Function
CN1	1	1	L-Out	Audio Out Left
	2	2	R-Out	Audio Out Right
	3	3	AGND	Analog Ground
	4	4	IN	Auido Input
	5	5	3.6V	+3.6V Out
	6	6	AGND	Analog Ground
	7	7	FND-STB	FND strobe
	8	8	N.C	(not used)
CN2	1		DB0	Serial data
	2		DB1	Serial clock
	3		RSTC	Rest
	4		GND	Ground
	5		3.6V	+3.6V Out
CN3	1	9	JOG-A	Encoder A
	2	10	JOG-B	Encoder B
	3	11	JOG-MUTE	Encoder Push S/W
	4	12	FND-DATA	FND Data out
	5	13	FND-CLK	FND clock out
	6	14	DGND	Digtial Ground
	7	15	N.C	(not used)
	8	16	5V	+5V power supply
CN4	1		ISP-CLK	ISP Clock
	2		ISP-SD	Analog Ground
	3		RSTB	Rest
	4		GND	Ground
	5		3.6V	Analog Ground
	6		TEST	Test

※CN2, CN4 Pin is only used dowenload firmware on MCU, EEPROM

Digital



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HEADER8PIN
CN3
Encoder-SW
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