BBE® Stereo Sound Enhancement Processor

GENERAL DESCRIPTION

The XR-5451 is a matched pair of sound enhancement processors using the patented BBE® Sound Enhancement technique to provide more lifelike audio to reproduced sound regardless of its source. No initial encoding of the source signal is needed to achieve the sound enhancement. The XR-5451 provides this enhancement without additional speakers and is compatible with headphone transducers for use with walkabout or portable stereo systems.

With the use of the definition control the amount of enhancement can be controlled to the listener's liking. This single control affects both channels equally, reducing the complexity of the system adjustment. In addition, a single control disables the sound enhancement with internal analog switches.

The XR-5451 is fabricated using bipolar technology to provide extremely low noise low total harmonic distortion and acceptable current consumption (15 mA typical) for battery operation applications and is available in 32 lead shrink DIP packaging for use over the -30 to +75°C temperature range.

FEATURES

Recreate Concert Sound without Initial Encoding
Single Definition Control for Ease of Adjustment
Extremely low noise: -92 dBV typically using IEC-A Weighting
Matched Circuits for Stereo Applications
Transducer Independent: Functions with head phones or large speakers
No extra speakers needed to achieve the effect

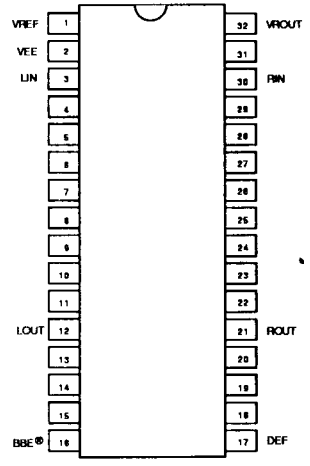
APPLICATIONS

Walkabout stereo systems
Portable Sound Systems
Sound Enhancement for Home Stereo Systems
Television Sound Systems (Stereo Ready)

ABSOLUTE MAXIMUM RATINGS

Power Supply: V_{CC}	26 VDC
32 Pin DIP Package	TBD mW
Derate above 25°C	TBD mW/°C
Storage Temperature	-65°C to +150°C
Voltage Applied to any input	V_{EE}- 0.3 to V_{CC} +0.3

PIN ASSIGNMENT



SYSTEM DESCRIPTION

The XR-5451 is designed for use with stereo sound systems to enhance the music to provide more realism to the sound. The XR-5451 would normally be located in the preamplifier section of a sound system after the tuner or input section and before the amplifier stages to drive the transducers (speakers or headphones). The definition control, which affects both channels of the dual channel device, is adjusted until satisfactory to the listener. An external SPST switch can be used to provide the BBE bypass function for the sound processor.

The XR-5451 has internal biasing for analog reference, eliminating the need for an external bias source in single supply applications. However the XR-5451 can also be used in split supply applications.

Since no initial encoding of the signal source is needed, virtually any audio signal, including both monaural and stereo broadcasts and recordings, can benefit from the use of the XR-5451 BBE® sound enhancement processor.

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ELECTRICAL CHARACTERISTICS: VCC = +5 VDC VEE = -5VDC T_A = +25°C unless otherwise specified.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
ICC	Positive Supply Current		15.0	22	mA	
IEE	Negative Suppy Current		15.0	22	mA	
VREG	Regulator Output	-0.32	-0.22	-0.12	V	no load
	Load Regulation	-10	+5	+20	mV	+ 1 mA load
FILTER SECTIONS						
MBGAIN	Midband Signal Path Gain	0.65	1.15	1.65	dB	
LBGAIN	Loband Signal Path Gain	3.6	4.1	4.6	dB	
HBGAIN	Hiband Signal Path Gain	0.4	1.4	2.4	dB	
GMIN	Minimum Hiband Signal Path Gain	-9.6	-8.6	-7.6	dB	
GMAX	Maximum Hiband Signal Path Gain	8.6	9.6	10.6	dB	
OFFG	Gain of BBE OFF Signal Path	-0.5	0.0	0.5	dB	
RECTIFIER SECTIONS						
MBDOFF	Offset of Midband Detector	-20	0	+20	mV	
HBDOFF	Offset of Hiband Detector	-20	0	+20	mV	
MBDGN	Gain of Midband Detector	-11.2	-9.8	-8.4	VDC/VPP	
HBDGN	Gain of Hiband Detector	-5.9	-5.2	-4.4	VDC/VPP	
OMNSE	Noise in BBE ON Mode		-92		dBV	IEC-A Weighted
OFFNSE	Noise in BBE OFF (BYPASS) Mode		-112		dBV	
PSRR	Power Suuply Ripple Rejection		30		dB	10 Hz
			45		dB	60 Hz
			50		dB	100Hz

PRINCIPLES OF OPERATION

The XR-5451 provides a means to compensate for the delay and amplitude distortion caused by loudspeakers, headphones and other transducers of electrical signals to mechanical motion. With the DEFINITION control adjustments for different types and sizes of transducers and environments, as well as the listener's taste, can be performed

The amplitude compensation is controlled by the energy content of the signal. If a signal has a deficiency of energy in the upper frequency region, the signal energy level of the upper frequencies will be amplified to compensate for the transducers' limitations. The degree of compensation to the incoming signal is controlled by the DEFINITION control.

The phase compensation changes the time sequence of the frequency spectrum so that the transducer may reproduce the sound envelope more faithfully. The time shift introduced by the phase compensation is fixed internally and is not controlled by the user.

APPLICATION INFORMATION

The XR-5451 requires some caution as to the layout in order to obtain the low noise low Total Harmonic Distortion and good channel separation that is possible with the device. Figure 2 provides the typical application circuit. The XR-5451 requires 27 capacitors, 1 resistor and 1 potentiometer to be used to obtain the signal processing functions needed for the sound enhancement of the BBE sound system. These components must have certain characteristics to obtain good performance from the XR-5451.

The potentiometer and capacitor can be of any type since it is controlling a slowly changing DC level. The resistors can be either carbon film, carbon composition or metal film. 10% tolerance is adequate for their value.

The decoupling capacitors on V_{CC}, V_{EE} and V_{REF} can be aluminum electrolytic capacitors. The recommended value is 1.0 µF. In a single supply application, the VCC/2 output would have a 1.0 µF capacitor from pin 32 to the signal ground of the system. V_{EE} would be tied to ground and no capacitor would be needed for this pin.

The filter capacitors are recommended to have a tolerance of ± 20% maximum in order to obtain correct filtering of the audio input. Ceramic dielectric capacitors can be used for the filter capacitors as long as no strong electric fields will be near them. If this cannot be prevented, a foil type capacitor (MYLAR® or Polyester) is recommended so that the outer foil layer can be used as a shield by grounding the outer layer. Non-polarized capacitors are recommended for all locations except where polarity is indicated on the typical application schematic (figure 2). This will allow the same circuit to be used for split supply or single supply operation.

The ground traces should be the widest traces on the printed circuit board. Since the entire circuit contained in the XR-5451 is analog, there is no need to separate any of the grounds associated with the device. However, if any switched-capacitor filter technology shares the power supply with the XR-5451, it is recommended to use separate ground traces to prevent clock coupling.

The XR-5451 is designed to work in both single supply and split supply applications.

The IC has an internal mid supply voltage reference circuit which has been tuned to optimize signal headroom for low supply voltage applications. Internal to the BBE IC, all signals are referenced to this voltage. The reference voltage is available externally on Pin 32.

In order to maintain high power supply ripple rejection, the capacitors from Pin 8 and Pin 25 must be connected to IC Pin 32. It is recommended that other capacitors be connected to chassis ground. Chassis ground is VEE (Pin 2). The decoupling needed for VEE and VCC will depend upon the noise present on the supplies. The XR-5451 will not generate any noise on VDD or VEE.

The control pin for the analog switch has an internal pulldown current so that externally only a single throw switch is required. The external switch resistor (Rs on the application schematic) should be made as large as possible in order to minimize the "popping" sound which can occur when switching from BBE_ON to BBE OFF mode. If Vmin is the lowest possible voltage between Pin 31 and Pin 2 in your application, then the switch resistor should be chosen so that $Rs \leq Vmin / 72\mu A$. If Rs is larger than that value, the switch circuit may not function properly over all device variations.

LICENSING AGREEMENT

The XR-5451 is manufactured by EXAR under license from BBE Sound, Inc. BBE is a registered trademark of BBE Sound Inc. A license from BBE Sound, Inc. (714-897-6766) is required for sales of the XR-5451.

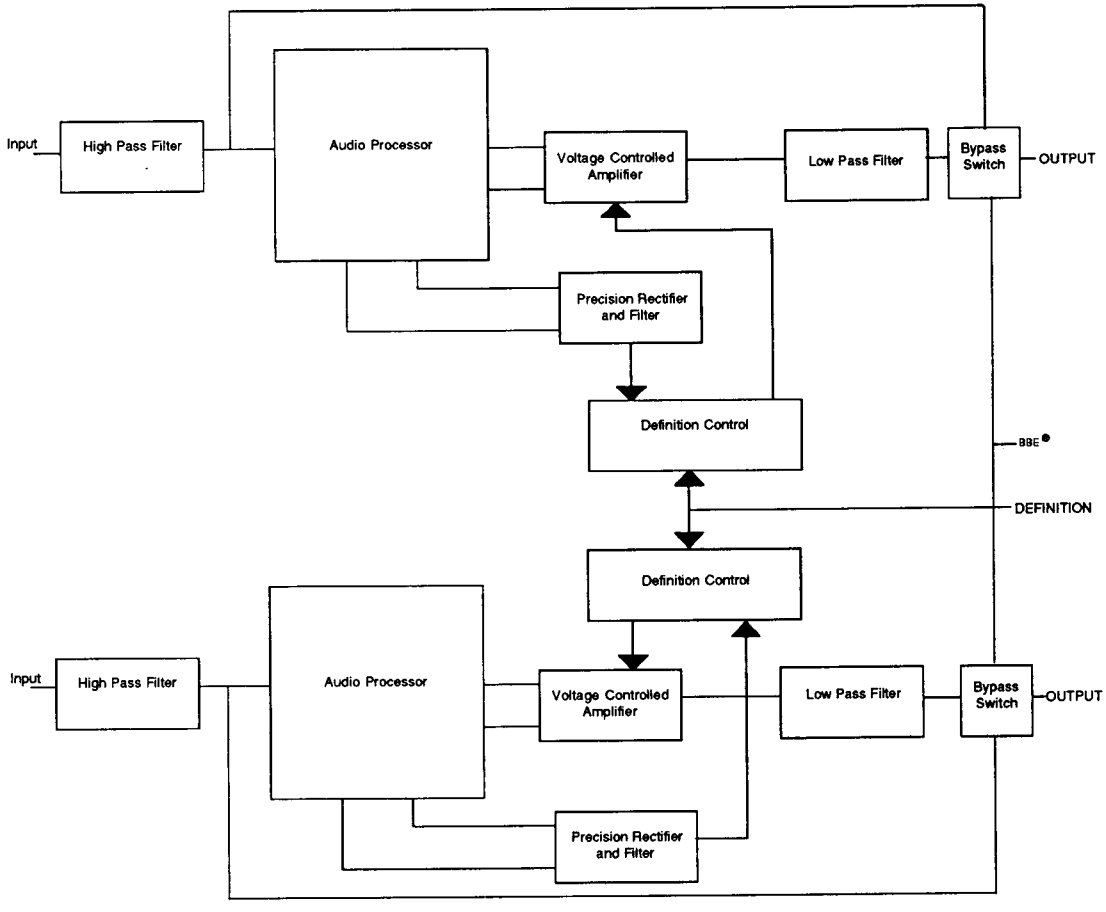

Figure 1. XR-5451 Simplified Block Diagram

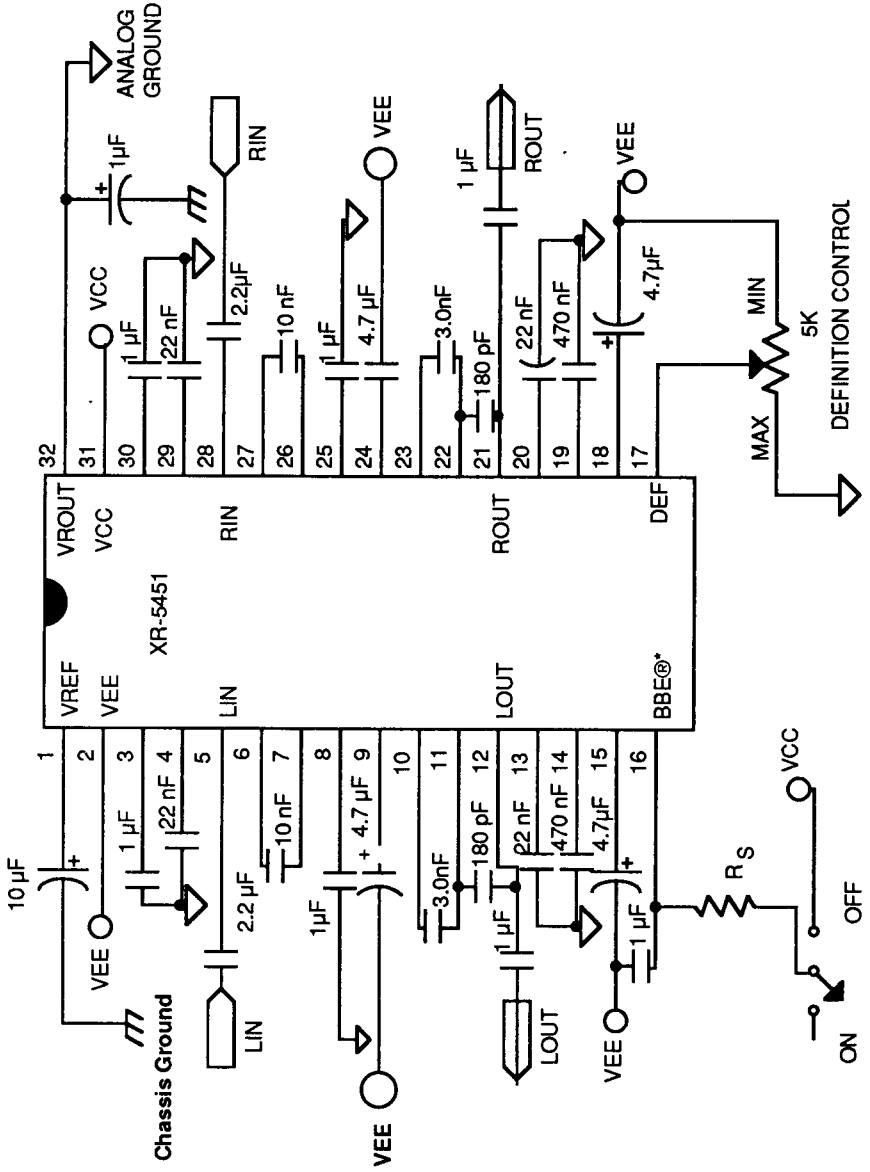

Figure 2. XR-5451 Typical Applications Schematic