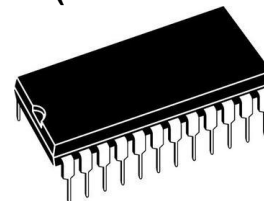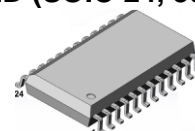# AS3372E µP Controllable Signal Processor

Features

- 2-channel VC input mixer with external input
- 4-pole low pass VCF & Quality Final VCA
- universal mixing/panning VCA-block
- 0 to +5V high Z control Inputs for direct interface to system DAC from CMOS multiplexer
- VCF uses open loop design for enhanced sound richness
- VCF has constant loudness as resonance changed
- TC compensated VCF
- Final VCA has low feed-through without trimming

AS3372E (PDIP-24 300mil, 2.54)

AS3372ED (SOIC-24, 300mil, 1.27)

General Description

The AS 3372E is a general purpose signal processing device for audio tone sources. Included on-chip are a two channel voltage controlled input mixer, a dedicated 4-pole low pass voltage controlled filter with voltage controllable resonance, universal mixing/panning VCA-block and a quality final voltage controlled amplifier. With the exception of the filter cut-off frequency, (the filter frequency control voltage ranges from -150mV to +100mV) all control inputs are very low bias current, high impedance inputs which range from 0 to + 5 volts. This feature allows the common DAC output voltage in a microprocessor system to be multiplexed to these inputs with only a CMOS analog multiplexer and hold capacitors, thus eliminating the usual Sample & Hold buffers.

The two input VCAs of the mixer feature audio taper control scales and high attenuation at zero control voltage. The signal inputs are low level (±40mV for 5% THD), allowing multiple tone sources to be conveniently mixed into each channel. Additional filter input allows design flexibility.

A unique feature of the 24dB/octave filter is that, unlike others of this type, the passband gain remains constant as the amount of resonance is varied, thus eliminating the annoying drop in volume at higher resonance settings. Other features include wide frequency control range, temperature compensated transconductors, low noise, low control feed-through, and a smooth behaviour when swept.

The final output VCA is a current in, current out type, allowing multiple inputs to be easily mixed into its input, and easy interface of its output to the rest of the system. The control scale is very linear, and the point at which the VCA shuts off is very well defined (+100mV ± 50mV). Owing to its exceptionally low noise and exceptionally low control feedthrough without trimming, this VCA is well suited to being controlled by fast transient waveforms.

Universal mixing/panning VCA block provides flexible signal processing solutions.

Functional diagram

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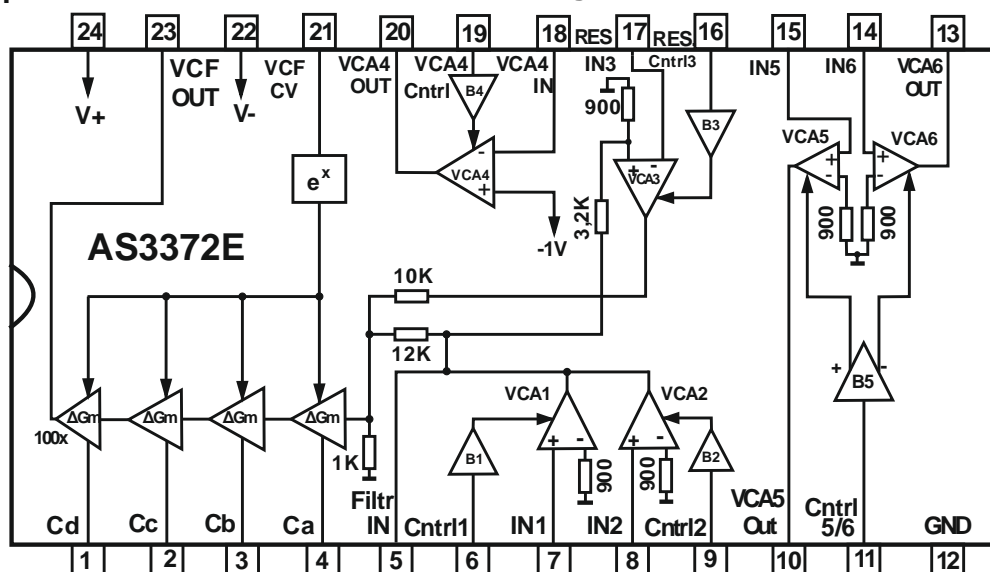
Pin Information

Pin №	Pin Name	Description	Pin №	Pin Name	Description
1	C_D	Filter capacitor 4	13	VCA6 Out	VCA6 Output
2	C_C	Filter capacitor 3	14	In6	VCA6 Input
3	C_B	Filter capacitor 2	15	In5	VCA5 Input
4	C_A	Filter capacitor 1	16	Res Cntrl	Filter Resonance CV
5	Filtr In	Filter Input (VCA1/2 Output)	17	Res In	Resonance Input
6	Cntrl 1	VCA1 Gain CV	18	In4	VCA4 Input
7	In1	VCA1 Input	19	Cntrl 4	VCA4 Gain CV
8	In2	VCA2 Input	20	Out 4	VCA4 Output
9	Cntrl 2	VCA2 Gain CV	21	VCF CV	Filter control voltage
10	Out 5	VCA5 Output	22	-Vee	Negative Supply Voltage
11	Cntrl 5/6	VCA5/6 Gain CV	23	VCF_Out	Filter output
12	GND	Ground	24	+Vcc	Positive Supply Voltage

AS3372E Block & Typical Connecion Diagram
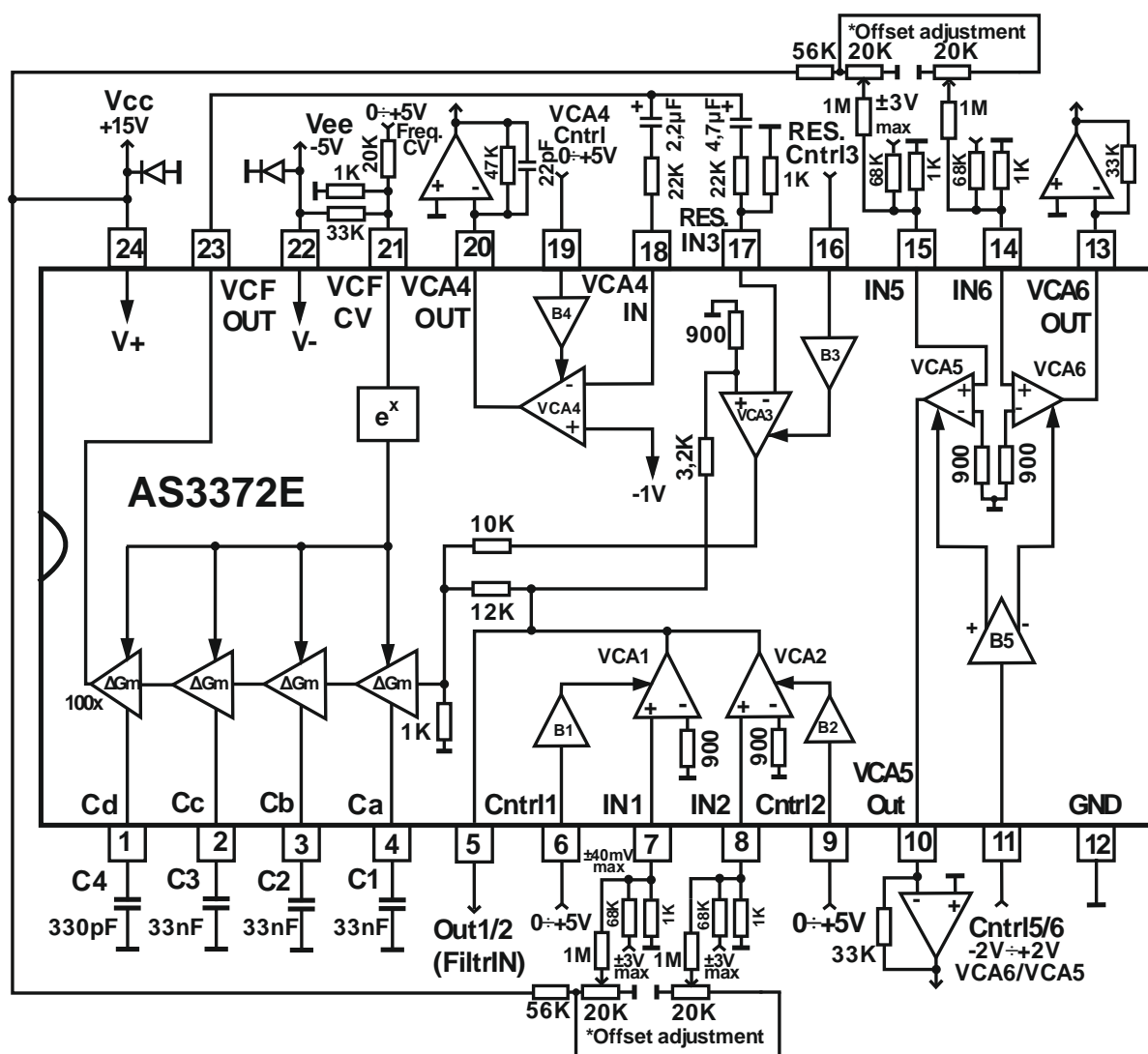
*Offset adjustment if required

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Electrical Characteristics

These specifications apply for Vcc = +15 V, Vee = –5 V T_A = 25°C

PARAMETER	MIN	TYP	MAX	UNIT
INPUT MIXER VCAs (VCA1, VCA2)				
Gain Range for 0 - 5V Control	0-4,5	0-5,2	0-6	
Maximum Input Signal for 5% THD	-	±40	-	mV
Attenuation at Vmix =0	80	100	120	dB
DC Control Feedthrough pin 5 (without adjustment)	-	7	10	mV
DC Control Feedthrough pin 5 (with adjustment)	-	0,1	1	mV
Signal Input Bias Current (Vmix = + 5V)	-0,1	-0,3	-1	µA
Mix Control Input Bias Current	-0,02	-0,1	-0,5	nA/V
Gain Variation (unit to unit)	-	0,7	±2	dB
Input Mixer Output maximum voltage(FiltrIn)	-300		+400	mV
VC FILTER				
Frequency Control Range	14	-	-	octaves
Frequency Control Voltage for 14 Octave Range		-155 to +110		mV
Frequency Control Scale	+17,5	+19	+20,5	mV/octave
Exponential Scale Error, Midrange	-	0,3	1	%
Initial Frequency at V_{FREQ}=0 (C_A=C_B=C_C=30nF;C_D=300pF)	650	1000	1650	Hz
Frequency Control Input Bias	-0,3	-1,2	-3,5	µA
Resonance Control Range	Q=0dB		oscillation	
Resonance Control Voltage Required for Oscillation	+2,2	+2,8	+3,4	V
Resonance Control Input Bias Current	-0,02	-0,1	-0,5	nA/V
Resonance Input Signal Gain for 0 - 5V Control	0-165	0-190	0-220	
Resonance Signal Input Bias (V_{RES} = +5V)	-0,3	-1	-3	µA
Maximum Output Swing:	9	10	11	V.P.P.
Nominal Output Swing for 5% THD (No Resonance)	2,2	2,5	2,8	V.P.P.
Nominal Output Swing with Resonance	4,4	5	5,6	V.P.P.
DC Output Shift Over 10 Octave Range (-130mV < V_{FREQ} < + 60mV)	-	100	250	mV.P.P.
Output Noise, Filter Wide Open	-	-	200	µV.R.M.S.
Quiescent DC Output Voltage	+2,0	+2,5	+3,0	V
Output Sink Current	-0,4	-0,7	-1	mA
Output Source Drive Current	-	-	+3	mA
FINAL VCA (VCA4)				
Gain Control Range	100	120	-	dB
Maximum Signal Current Gain	0,8	0,93	1,1	
Control Voltage for Maximum Gain	4,5	5	5,5	V
Maximum Attenuation	90	120	-	dB
Control Voltage for Maximum Attenuation	+30	+85	+140	mV
Control Input Bias Current	±0,1	±0,5	±3	nA/V
Voltage at Signal Input Summing Node	-1,15	-1	-0,85	V
Maximum Output Voltage Compliance	-0,2	-	V_{CC}-1	V
Maximum Recommended Signal Input Swing	-	-	±200	µA
Maximum Possible Signal Input Swing	±0,5	-	±0,8	mA
Output Noise	-	-	1	nA.R.M.S.
THD at ±200 µA Input	-	1	3	%
DC Output Offset at Maximum Attenuation	-	-	1	nA
DC Output Shift from Maximum Attenuation to Maximum Gain	-	±0,07	±0,5	µA
UNIVERSAL MIXING/PANNING BLOCK (VCA5/VCA6)				
Control Voltage (Cntrl 5/6)	-2		+2	V
Maximum Input Signal for 5% THD (In5/In6)	-	±40	-	mV
Maximum output current	±120	±150	±180	µA
Maximum gain VCA5 (Vcntrl=+2V)		2		µA/mV
Maximum gain VCA6 (Vcntrl=-2V)		2		µA/mV
Maximum allowed output voltage range	-300		+400	mV
DC Control Feedthrough (without adjustment)	-	-4	-6	µA
DC Control Feedthrough (with adjustment)	-	0,1	1	µA
GENERAL				
Positive Supply Range	+ 9.5	-	+18	V
Negative Supply Range (Maximum Supply Across Chip is 25V)	-4,5	-	-15,5	V
Supply Current	6,5	8,5	11	mA

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Input Mixer VCA1 and VCA2

Input VCA1 and VCA2 amplifiers with a combined current output. The inverting inputs of the amplifiers are internally connected to the ground. Thus, external inputs must be controlled by low impedance (<1K), relative to earth. Passing a constant control voltage to the output can be limited, if necessary, by applying trimming potentiometers on the input pins. The control scale is linear in the range of 0.5 and 5 V. The maximum VCA gain from input to output is 5. The maximum output current of one VCA is approximately 60 µA (type). The output of the Filter Input (VCA1/2 Output) pin 5 can be supplied with an external signal from an amplifier with a current output. Since VCA1/2 have limited output voltages (from -300 to +400 mV), if this voltage is exceeded from all signal sources, an external resistor can be connected to this ground, which will also reduce the VCA gain. Thus, the maximum voltage at the input of the filter will be 50 mV P.P.

Mixing/panning VCA5 and VCA6

Universal mixing/panning VCA5 and VCA6 block provides flexible signal processing solutions.

The gains of the two VCAs are controlled by voltage in the range from -2 V to +2 V. If control voltage is -2V then VCA6 reach its maximum gain, and when control voltage level is +2 V, then VCA5 reach its maximum gain. At a control voltage of 0 V, the gain of each will be half the maximum. The attenuation of the signal at the output of the switched off VCA will be -80 dB. If you want to increase the attenuation to -100 dB, you can apply a control voltage to -2.5 V or +2.5 V. At the VCA5 and VCA6 outputs, the voltage is limited from -0.3 to +0.45 V. So these outputs can be fed to the summation node on the virtual ground of external inverter (IU conversion) to create output voltage. Passing a constant control voltage to the output can be reduced, if necessary, by using trimming potentiometers on the input pins.

Filter

A voltage-controlled filter (VCF) is a standard 4-pole music low-pass filter with VCA with internal feedback. To add a resonant frequency or constant oscillation at the cutoff frequency of the filter, a portion of the filter output is fed to the resonant VCA3, through a resistor and a coupling capacitor. The DC bias voltage at the filter output is +2.5 V (type).

Since the steepness of the last 4th stage is 1/100 of the other three stages, the value of the capacitor is 1/100 of the other capacitors. For the desired frequency range of the filter from 5 Hz to 20 kHz, the capacitance CA, CB and CC is selected as 33nF, and CD becomes 330pF. With these capacitance capacitances at a voltage control frequency VCF CV = 0, the cutoff frequency of the filter is about 1 kHz. A lower frequency of 5 Hz is 7.6 octaves below zero control voltage. This requires a -150 mV signal. The upper limit of 20 kHz requires a control voltage of approximately 100 mV. In the normal case, the filter frequency control voltage must be attenuated by a divider on the resistors to these levels. The control scale has a temperature coefficient of -3300ppm. Therefore, to mitigate the effect of CV temperature, a compensation temperature coefficient of +3300 ppm is used.

VCF output (pin 23) is an output from an emitter follower with low impedance, tolerating a minimum load resistance of up to 6.8K. If more output current is required, an additional resistor can be connected between output 23 and negative power. The output is not short-circuit proof, so if this pin is connected to external equipment, a 510 ohm series resistor is required.

Final VCA

The output VCA is a low-noise circuit with a low level of passing control voltage, which does not require zero adjustment. Therefore, it is well suited for controlling rapidly changing signals.

The VCA signal input is a summing current input at a voltage of -1 V, requiring an external series capacitor and resistor between the input signal voltage and the input pin (pin 18), the maximum input current should be limited to ± 500µA. Somewhat smaller distortions can be obtained with a lower maximum input current of ± 100 to ± 200µA due to a slightly lower signal-to-noise ratio and a higher relative control passage. Distortion also increases low input voltage; therefore, the input voltage of the signal should be maintained at about 2 BPr. The control scale is exponential from 0 to about 100 mV, it controls the current gain from -100 dB to -20 dB. After that, the current gain increases in a linear fashion until it reaches 0 dB at +5 V nominal. This small rounded knee at the bottom of the scale allows the envelope to fall to zero with a natural exponential sound, regardless of small changes in the VCA switching threshold. Since this VCA also has a limited negative output voltage (maximum –0.2 V max), it is best to convert the output current to voltage by a summing op amp with virtual earth. The outputs of several VCAs can be summarized by simply connecting the output pins together before converting to voltage.
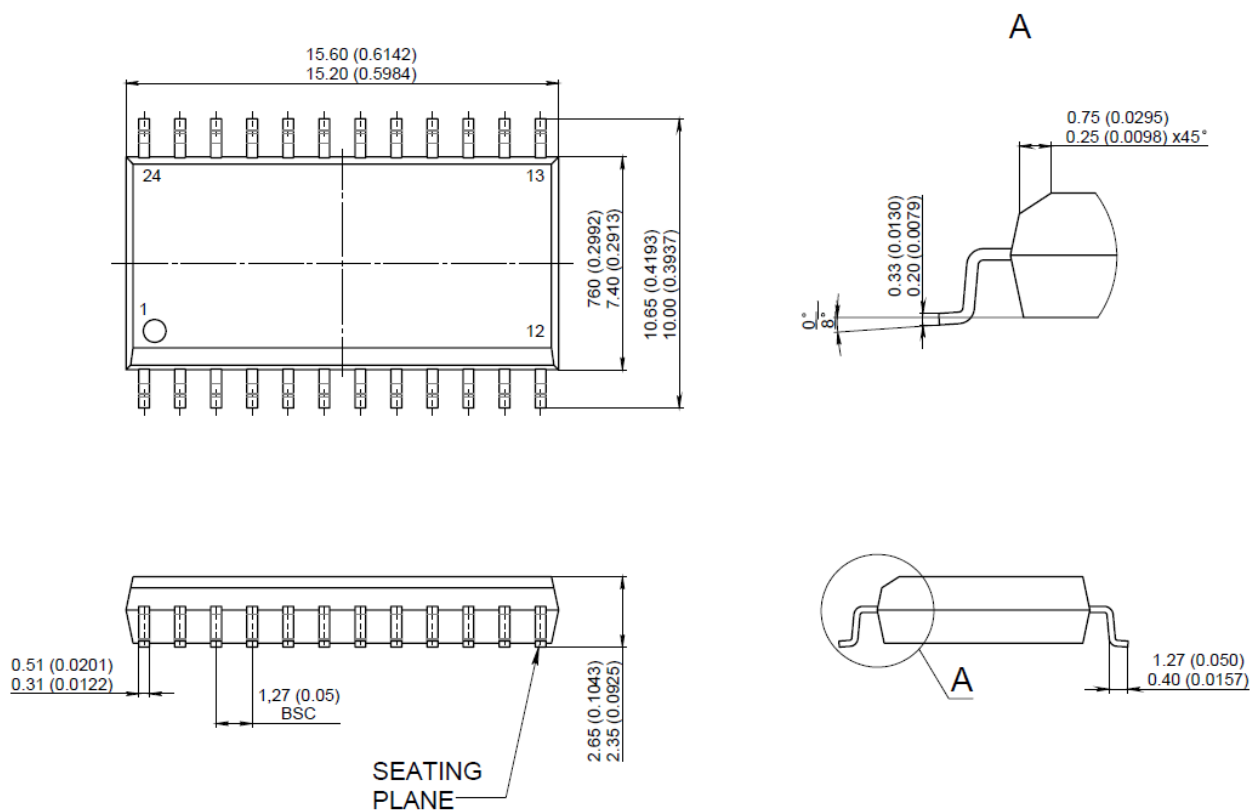
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PART NUMBER	PACKAGE	BODY SIZE (NOM)
AS3372E	PDIP-24	300 mil, 2.54 mm pitch
AS3372E D	SOIC-24	300 mil, 1.27 mm pitch

24-Lead Plastic Dual In-Line Package (PDIP-24) Narrow Body
Dimensions shown in inches and (millimeters)

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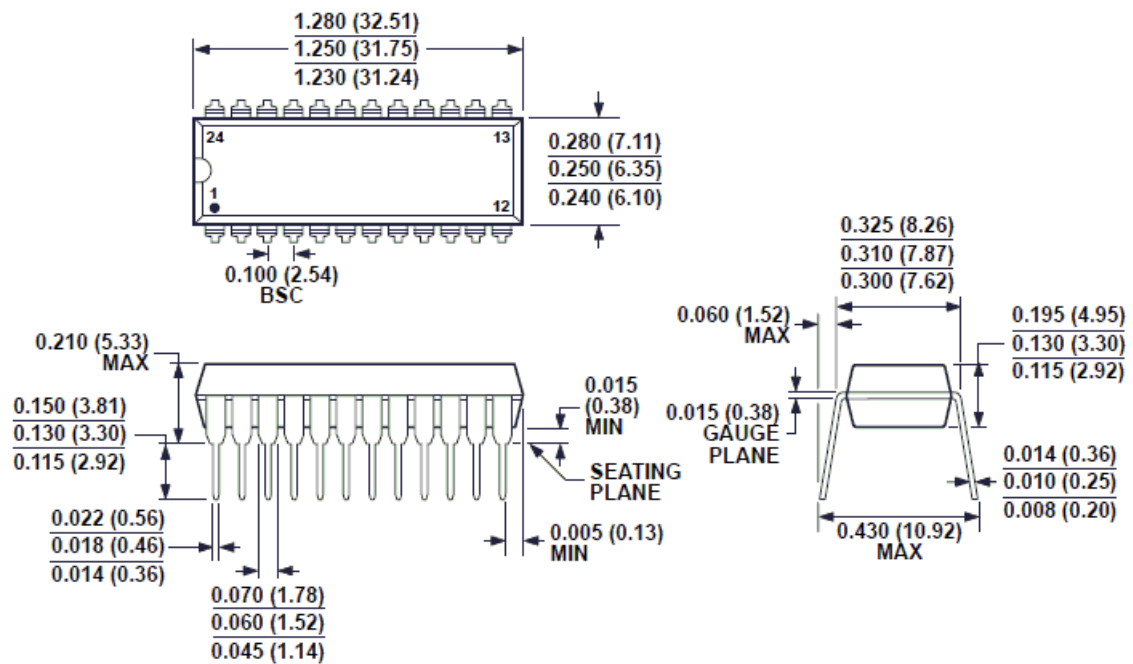
24-Lead Standard Small Outline Package (SOIC_W)
Wide Body
Dimensions shown in millimeters and (inches)

Revision history

Date	Revision	Changes
25-Jan-2019	1	Preliminary version 1
13-Jan-2020	2	Minor change
18-Apr-2020	3	PDIP-24 – New package

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