



## AS3363 - Three Channel VCA (voltage polarizer)

### Features

- three VCA blocks with a wide range of functions containing three 4-quadrant multipliers and 3 2-quadrant multipliers
- two linear controls for each VCA
- simple signal mixing
- can combine high impedance outputs
- provides high attenuation (-100 dB)
- simplifies multiplexer design
- low current consumption of 3 mA typ at  $\pm 12V$

### Application

For electronic music

### General description

AS3363 contains three VCA blocks, which are intended for use in musical synthesizer applications (VCA blocks, voltage polarizer, multiplexers, morphing, ring modulators etc.). VCA1 and VCA2 implement function of controlling amplification and sign of output signal (voltage polarizing - changing sign and amplitude through "silence"). Additional control input controls attenuation of output current - thus realizing function of double multiplication input signal on two control signals. VCA3 block has additional feature – possibility of control/mixing of two input signals.

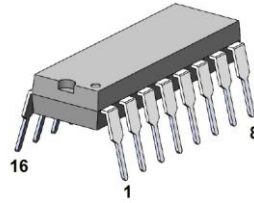
Such solution gives vast opportunities in designing new synth solutions.

Simplified structure of each VCA block:

### Pin information

| PDIP-16, SOIC-16 | Pin Name | Description              |
|------------------|----------|--------------------------|
| 1                | GND      | Ground                   |
| 2                | In1      | Input VCA1               |
| 3                | CVMix1   | Control Input Mixer VCA1 |
| 4                | Vcntrl1  | Control Input VCA1       |
| 5                | Io1      | Current Output VCA1      |
| 6                | Io3      | Current Output VCA3      |
| 7                | Vcntrl3  | Control Input VCA3       |
| 8                | Vee      | Negative Supply          |
| 9                | In3A     | Input VCA3_A             |
| 10               | In3B     | Input VCA3_B             |
| 11               | CVMix3   | Control Input Mixer VCA3 |
| 12               | Io2      | Current Output VCA2      |
| 13               | Vcntrl2  | Control Input VCA2       |
| 14               | CVMix2   | Control Input Mixer VCA2 |
| 15               | In2      | Input VCA2               |
| 16               | Vcc      | Positive supply          |

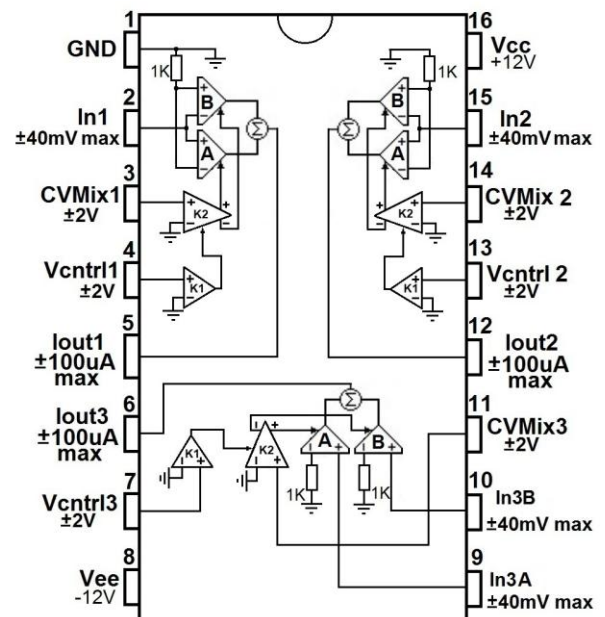
AS3363  
PDIP-16 (300 mil)



AS3363D  
SOIC-16 (150 Mil)



### Circuit Block Diagram





**Absolute Maximum Ratings**

|                                  |             |
|----------------------------------|-------------|
| Voltage between Vcc and Vee pins | 30V         |
| Voltage between Vcc and GND pins | +3V to +16V |
| Voltage between Vee and GND pins | -3V to -16V |
| Control voltage range CVMix      | -3V to +3V  |
| Control voltage range Vcntrli    | -3V to +3V  |
| Vinx                             | -1V to +1V  |

**Electrical Characteristics**

Vcc = + 12V Vee = -12V Tamb = +20 ° C

| Parameter  | Min.  | Typ. | Max.  | Units   |
|--|-------|------|-------|---------|
| Total harmonic distortion(THD) 1)                                      |       |      |       | %       |
| Input voltage ( ±17 mV)  |       | 0,7  |       |         |
| Input voltage ( ±28 mV)  |       | 2    |       |         |
| Input voltage ( ±40 mV)  |       | 4    |       |         |
| Maximum output current ( Vin=±40 mV)                                   |       | ±110 |       | µA      |
| Maximum amplification  |       | 2,5  |       | µA/mV   |
| Input bias current   |       | 1    |       | µA      |
| <b>VCA1, 2</b>   |       |      |       |         |
| Control voltage range CVMix, linear range 2)                           | -1,75 | -    | +1,75 | V       |
| Control voltage CVMix for maximum amplification of non-inverted signal |       | 2    |       | V       |
| Control voltage CVMix for maximum amplification of inverted signal     |       | -2   |       | V       |
| Control voltage CVMix for balance ("silence")                          | -20   | 0    | 20    | mB      |
| Maximum attenuation on output in balance ("silence") 3)                |       | 60*  |       | dB      |
| Control voltage Vcntrl linear range 2)                                 | -1,65 | -    | +1,65 | V       |
| Control voltage Vcntrl for maximum VCA output current                  |       | 2    |       | V       |
| Vcntrl maximum attenuation level (turn "OFF" VCA current)              |       | -2   |       | V       |
| Attenuation ( Vcntrl=-2V)  |       | 100  |       | dB      |
| Feedthrough Vcntrl   |       | 60   |       | dB      |
| <b>VCA3</b>  |       |      |       |         |
| Control voltage CVMix3 for maximum amplification In3A                  |       | 2    |       | V       |
| Control voltage CVMix3 for maximum amplification In3B                  |       | -2   |       | V       |
| Control voltage CVMix for balance amplification In3A and In3B          | -20   | 0    | 20    | mV      |
| Maximum output offset (Vin=0)  | -1    | 0    | +1    | µA      |
| Total harmonic distortion  | -     | 4    | 6     | %       |
| Bandwith   | 8,0   | 10   | -     | MHz     |
| Output current slew rate 3)  | 700   | 1000 | -     | µA/µsec |
| Crosstalk between VCA ( 10 kHz)  | -80   | -90  | -     | dB      |
| Feedthrough CVMix  | -     | ±0,1 | ±0,3  | µA      |
| Maximum input current (for CVMix)                                      | -     | -3   | -     | µA      |
| Maximum input current ( Vcntrlx)                                       | -     | 1    | -     | µA      |
| Output impedance 3)  |       | 10   | -     | MOhm    |
| Maximum voltage range for Outx   | -100  | -    | +100  | mV      |
| Positive supply range Vcc  | +5    | 12   | +16   | V       |
| Negative supply range Vee  | -5    | -12  | -16   | V       |
| Current consumption Icc  | 2,7   | 3,3  | 4,5   | mA      |
| Current consumption Iee  | 2,2   | 2,8  | 3,5   | mA      |

Note 1. THD is independent from CVMix or Vcntrl

Note 2. Out of these range control is exponential

Note 3. Output current is ±100 µA

**Application information**

IC consists of 3 VCA blocks, which are controlled by voltage with maximum output current till  $\pm 100 \mu\text{A}$  each. Outputs of VCA can be connected together, allowing current summing from different VCA's. Maximum output voltage on each VCA can't exceed  $\pm 200 \text{ mV}$ . If higher voltage is needed - IU converter must be used.

VCA1 and VCA2 each has one input signal. VCA3 has two non-inverting input signals IN3A and IN3B. Maximum voltage on these inputs can't exceed  $\pm 40 \text{ mV}$ , thus attenuator must be used with 1k resistor connected to GND.

Each VCA has two control inputs CVMix and Vcntrl, with input voltage ranging from -2V to +2V. Control voltages CVMix1 and CVMix2 allows to change amplification on the VCA output from maximum positive to maximum negative "through silence".

For example:

If CVMix = +2V -> VCA output = maximum non-inverted input signal,

If CVMix = -2V -> VCA output = maximum inverted input signal,

If CVMix = 0V -> VCA output = positive and negative signal are 100% subtracted (silence).

CVMix3 of VCA3 controls mixing of input signals IN3A and IN3B:

If CVMix3 = +2V -> VCA output = maximum amplification from input IN3A,

If CVMix3 = -2V -> VCA output = maximum amplification from input IN3B,

If CVMix3 = 0V -> VCA output = balance from IN3A and IN3B -> 50/50.

Vcntrl1,2,3 – controls output currents of VCA1,2,3 to attenuation -100dB:

if Vcntrlx = +2V -> VCA provides maximum current to output,

if Vcntrlx = 0V -> VCA provides approximately 50% of maximum current,

if Vcntrlx = -2V -> turns "OFF" output current.

For VCA1 and VCA2 mathematical equation is:

$$I_{outx} \sim (I_{nx} * CVMix - I_{nx} (1-CVMix)) * Vcntrlx$$

For VCA3 mathematical equation is:

$$I_{out3} \sim (I_{n3A} * CVMix3 + I_{n3B} *(1- CVMix3)) * Vcntrl3$$

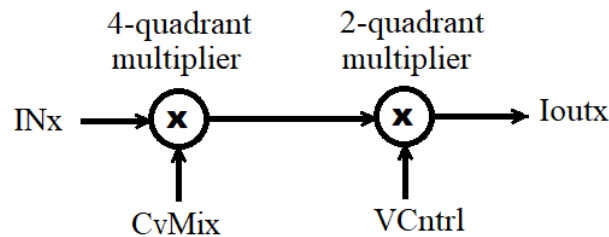
Other possible method of controlling VCA's:

CVMix VCA1 and VCA2 are used only as activation of function "direct" or "inversed" signal transfer and Vcntrl for independent linear control of chosen direct or inversed signals.

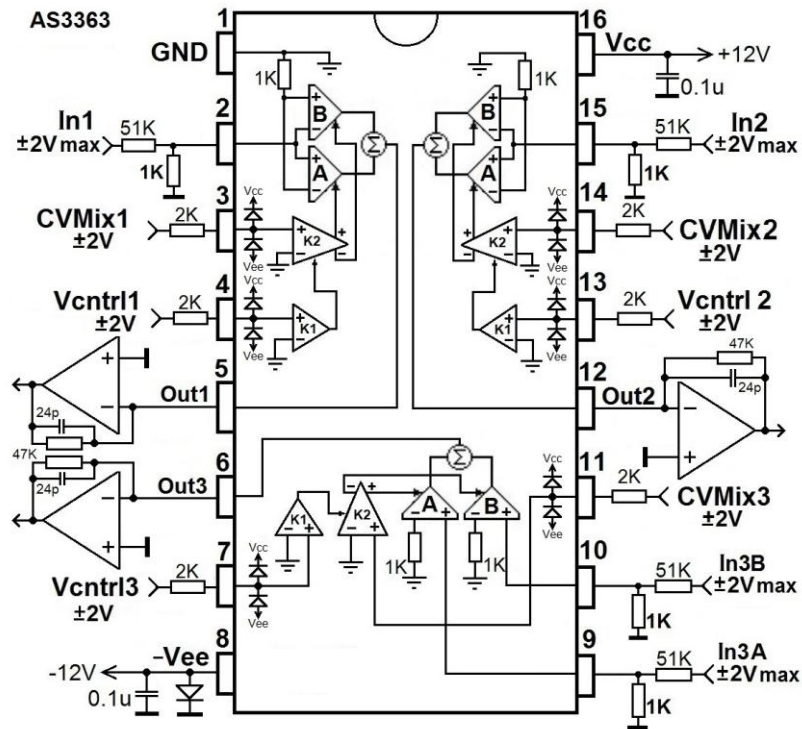
CVMix3 of VCA3 can be used only for chose of transfer from In3A or from In3B, and Vcntrl for independent linear control of amplification of chosen input.

In such application can be controlled independently and inputs CVMix and Vcntrl "change" one another.

Simplified structure of each VCA block can be described as - 4-quadrant multiplier followed by 2- quadrant multiplier.



Simplified VCA structure



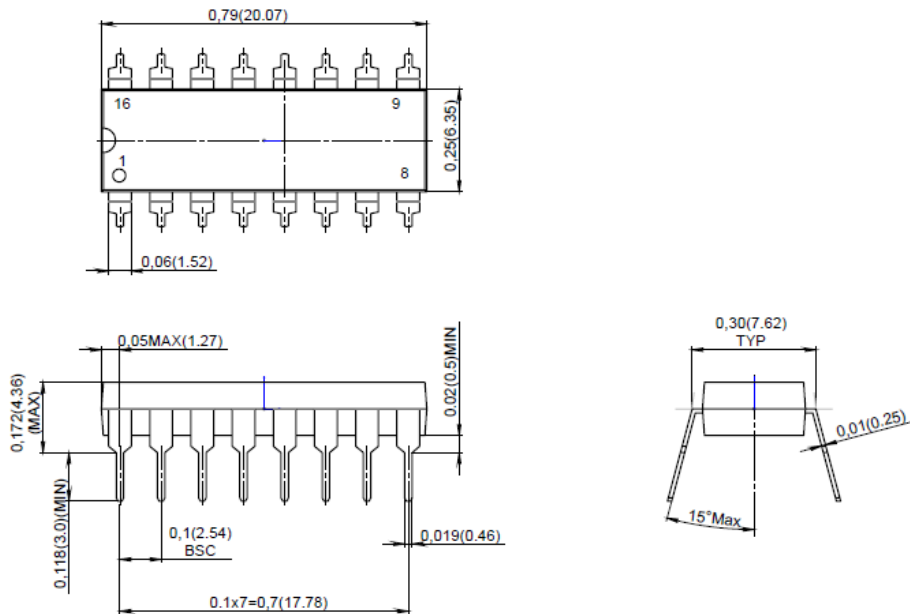
Application diagramm

**Package Information**

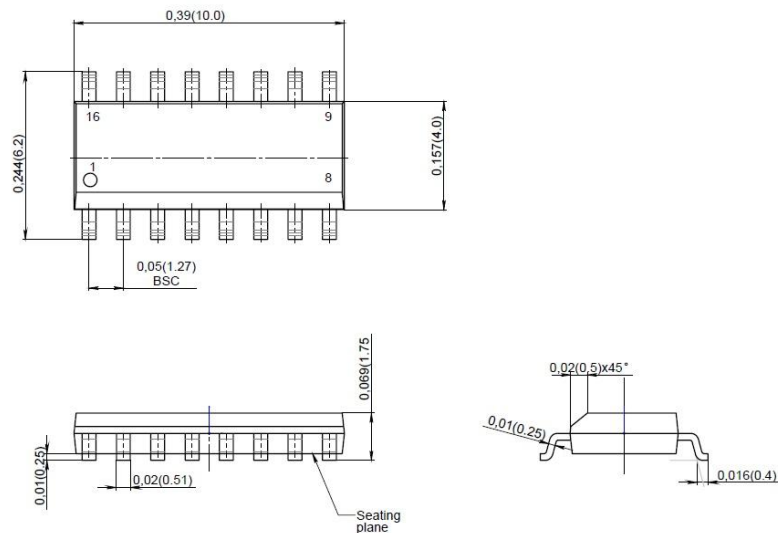
| Device type | Package           |
|-------------|-------------------|
| AS3363      | PDIP-16 (300 Mil) |
| AS3363D     | SOIC-16 (150 Mil) |

Units: inch (mm)

**PDIP-16 (300 mil)**



**SOIC-16 (150 mil)**



**Revision history**

| Date        | Revision | Changes                        |
|-------------|----------|--------------------------------|
| 27-Mar-2019 | 1        | Initial version                |
| 25-Nov-2019 | 2        | Added new package PDIP-16      |
| 13-Dec-2019 | 3        | Application Scheme Changed     |
| 15-Jan-2020 | 4        | THD conditions added           |
| 25-Mar-2020 | 5        | Simplified VCA structure added |