AS3341 - linear in dB temperature compensated voltage controlled current source (VCCS)

- controlled range – till 14 octave
- fully temperature compensated
- summing node inputs for current control
- matched differential NPN pair
- high exponential scale accuracy

AS3341D
SOIC-16 (150 mil)

APPLICATIONS

- stabilized current sources
- MOOG-type filters
- for electronic music

General Description

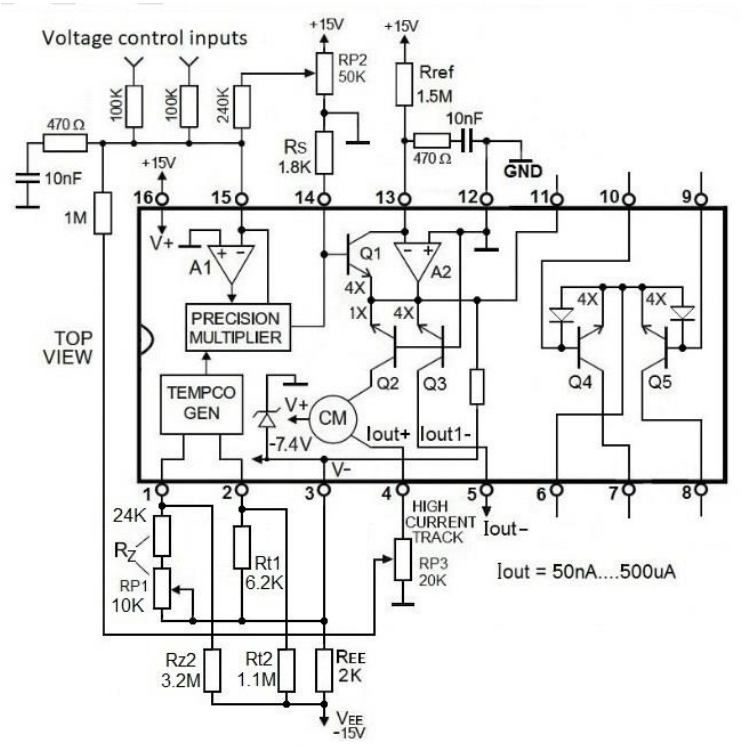
AS3341 is a voltage controlled current source with internal temperature compensation and a matched pair of NPN transistors. Current source uses a temperature-compensated core of the VCO AS3340, with an exponential and linear control scale.

The output current Iout- can be varied within a wide range from 50 nA to 500 µA. AS3341 also has a current output Iout + = 1 / 4Iout- which can be used to compensate for the linearity of the control characteristic for a large output current Iout- .

AS3341 Pin Information

SOIC-16 Pin No	Pin Name	Description
1	I_Ref	Reference current adjust
2	I_Temp	Temperature dependent current adjust
3	V_{EE}	Negative supply
4	Iout+	High current track (source)
5	Iout-	Output current (sink)
6	CE	Common emitter Q4,Q5
7	CQ4	Collector Q4
8	CQ5	Collector Q5
9	BQ5	Base of Q5
10	BQ4	Base of Q4
11	EQ1	Emitter of Q1
12	GND	Ground
13	IRefIn	Current Reference Input
14	V_S	Scale
15	Ic	Current control input
16	V_{CC}	Positive supply

Fig.1 AS3341 Circuit Block and Connection Diagram



Absolute Maximum Ratings

Voltage Between V_{CC} and V_{EE} Pins	+24V, -0,5V
Voltage Between V_{CC} and GND Pins	+18V, -0,5V
Voltage Between V_{EE} and GND Pins	-6V, +0,5V
Current through Any Pin	±40mA
Voltage Between Current Control Pin or Reference Current Pin and GND Pin	±6V
Voltage Between Multiplier Output Pin and GND Pin	+6V, -1V
Storage Temperature Range	- 55°C to 120°C
Operating Temperature Range	- 25°C to 75°C

Electrical Characteristics

V_{CC}=+15V V_{EE} = Internal Zener T_A= 20°

Parameter	Min	Typ	Max	Units
Output current range , Iout-	0.05	-	500	µA
Maximum output current , Iout-	500	600	700	µA
Control voltage range, with trimming 1)	0	-	10	V
Control voltage tracking , with trimming 1)		1		V/octave
Control current for maximum output current		150		µA
Control current for minimal output current		0		µA
Input current, reference current	80	200	400	nA
Input current, output current control	80	200	400	nA
Tempco of input current	-1000	-	+1000	ppm
Uoffset, reference current input	-5	-	+5	mV
Uoffset, output current control	-5	-	+5	mV
Rout (Iout-)		10	-	MΩ
Uout max (on Iout-)	-0.2	-	+10	V
Positive supply, Vcc	10	12	18	V
Negative supply, Vee 3)	-4.7	-6	-18	V
Current consumption, Icc	2.0	2.5	3.5	mA
Current consumption, Iee 2)	2.0	2.5	3.5	mA
Matched NPN pair				
H_{FE} (U_{CB} = 0V till U_{max} , I_C = 100 µA)		200		
Matching of H_{FE} (U_{CB} = 0V till U_{max} , I_C = 100 µA)		0.5	2	%
U_{BE} offset (U_{CB} = 0V, I_c = from 10 µA till 1 mA 5)	-	100	200	µV
U_{CE} saturation (I_C = 1 mA, I_B = 100 µA 6)			0.25	V

Notes:
1. With 100K resistor at the output current control input
2. With a negative supply voltage of -6 V
3. If the negative supply voltage is more than -7 V, a current-limiting resistor is required.
4. UCB = 0V to Umax, Ic = 100 µA
5. UCB = 0V, Ic = 10 µA to 1 mA
6. Ic = 1 mA, IB = 100 uA

Specifications subject to change without notice.

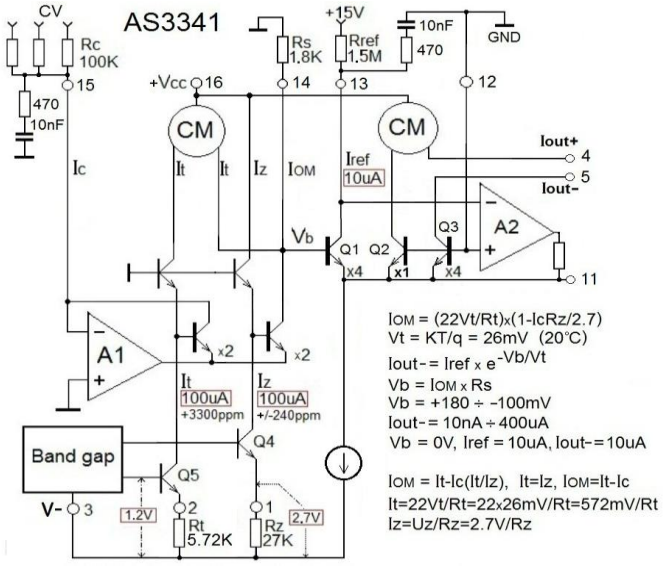


Fig.2 Structure of AS3341 multiplication block and exponentiator

Application information

AS3341 uses a temperature-compensated core of the VCO AS3340, with an exponential and linear control scale. The output current Iout- can be varied within a wide range from 50 nA to 500 µA.

Current output Iout+ = Iout- /4 can be used to compensate non-linearity of the control characteristic for a large output current Iout-, as shown in Fig. 1 by potentiometer RP3.

Control voltages are fed through a 100 kΩ input resistors to the control input pin 15 (summing current node). The 240 kΩ resistor from the control input must be connected to a stable voltage source. This resistor sets the initial value of the output current when there is no control voltage (240 kΩ resistor connected to RP2 potentiometer connected to + Vcc Fig.1).

Control voltage range can be set from 0 to 10 V as shown in Fig. 1, and set the standard output current control voltage step to 1 V / octave. Several control signals can be applied simultaneously to the control input through summing resistors so that the total current through them is not negative and does not exceed +200 µA.

Maximum output current Iout- is 550 µA. The most accurate part of the output current range is from 100 nA to 200 µA.

Voltage at pin 2 of the AS3341 is 0.572 V relative to the negative supply voltage at pin 3. Resistor Rt sets the current at pin 2 to approximately 100 µA. The voltage at pin 1 is 2.7 V relative to pin 3. By adjusting the potentiometer RP1, as shown in Fig. 1, the total resistance of the resistor Rz is set so, that at pin 1 a current of 100 µA is also obtained.

Reference current Iref is supplied to the reference current input pin 13 RefIn through the reference resistor Rref connected to a stable voltage source. The reference current can be selected from 5 to 15 µA. The recommended typical current value Iref = 10 µA, then at zero based on the Q1 transistor (pin 14), the output current of the Iout- microcircuit will be 10 µA. This can be obtained with a control voltage CV = 5 V. The value of the output current Iout can be fine-tuned with the RP2 potentiometer. The current reference input can also be used to linearly control the output current.

An on-chip 7.4 volt Zener diode allows the device to operate off ±15 volt supplies, as well as +12, -5 volt supplies. For voltages greater than -7.4 volts, a series current limiting resistor R_{EE} must be added between pin 3 and the negative supply. Its value is calculated as follows:

$$R_{EE} = (V_{EE} - 7.4) / 0.004.$$

For example, with V_{EE} = -12 V, the resistance of the R_{EE} resistor can be set to 1.2K.

To minimize self-heating and improve thermo-stability it is recommended to keep V_{EE} = -5 V…-6 V (external power supply). External V_{EE} also minimize current through GND and improves stability.

AS3341 Typical connection diagram for use in a ladder filter circuit

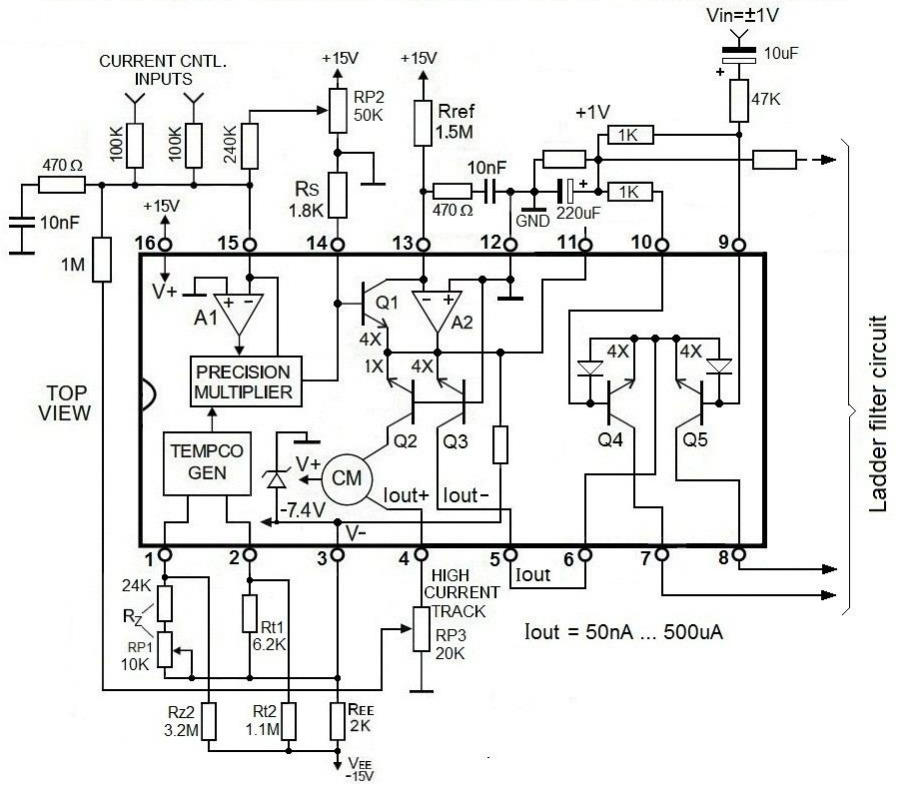


Fig. 3 Vcc =+15V Vee= -15V

To improve and adjust temperature compensation fine trimming of TempCo must be used. I_temp (pin 2) total current ~ 100 µA must be composed from two parts – current through R_T1 (approximately 92 µA) and current through R_T2 (approximately 8 µA) connected between external voltage source and pin2 (I_Temp). R_T1 organizes the main part of thermal compensation, and R_T2 allows it to finely adjust to several tenth of ppm/C°. For improving stability depending on – Vee , resistor RZ2 must be used. In this case, fluctuations of -Vee simultaneously affect both control inputs I_ref (Pin1) and I_temp (Pin 2).

Examples of such applications for different supply voltages are shown on Fig.1, 3 , 4, 5.

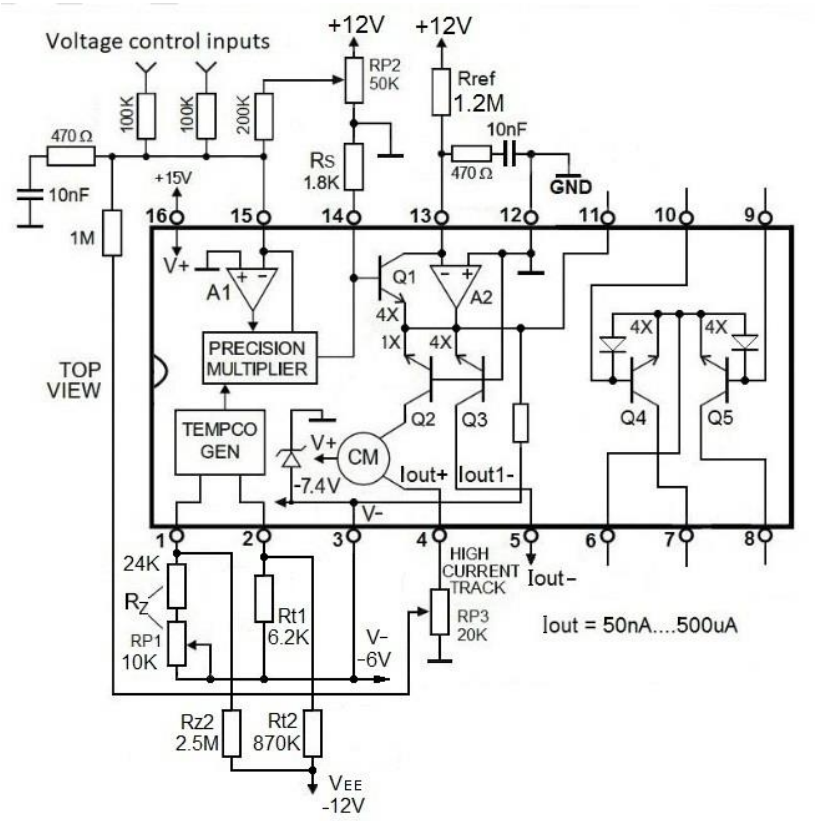


Fig. 4 Vcc =+12V Vee= -6V / -12V

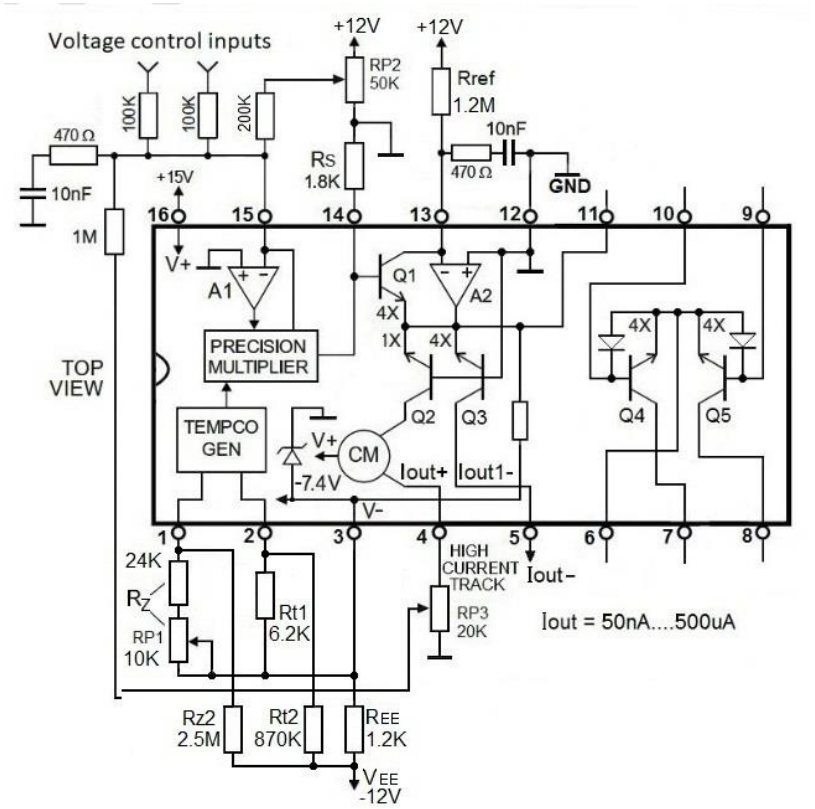


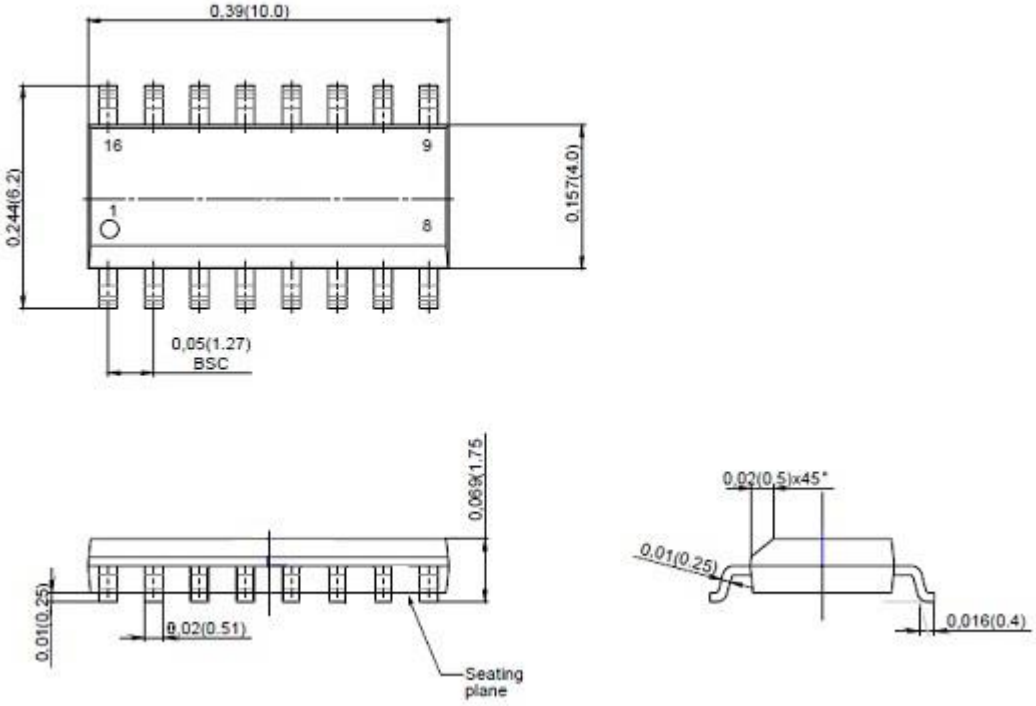
Fig.5 Vcc =+12V Vee= -12V

Package Information.

Device type	Package
AS3341D	SOIC-16 (150 Mil)

Units: inch (mm)

SOIC-16 (150 Mil)



Date	Revision	Changes
04-May-2021	**1**	Preliminary version 1
09-Jun-2021	**2**	Trimming of TempCo added