THAT Corporation

Low Noise, High Performance Microphone Pre-amplifier

THAT 1510

FEATURES

- Excellent noise performance through the entire gain range
- Exceptionally low THD+N over the full audio bandwidth
- Low power consumption – 6 mA typical
- Wide bandwidth – 3 MHz typ. @ G=1000
- High Slew Rate – 28 V/µs @ G=10 and C_L=50pF
- Wide Output Swing – ±13 V typ. on ±15 V supplies
- Gain adjustable from 1 to >1000 with a single external resistor
- Drop-in compatible with SSM-2017

APPLICATIONS

- Mixing Consoles
- P/A Systems
- Analog and Digital Snakes
- Breakout Boxes for Digital Systems
- Instrumentation

Description

The THAT 1510 is a high-performance audio preamplifier suitable for microphone preamp and bus summing applications. The IC is pin compatible with the Analog Devices SSM2017 in both the 8-pin DIP and 16-pin SOIC packages. An 8-pin SOIC package is also available, providing a compact form factor for new designs.

Designed from the ground up in THAT's complementary bipolar, dielectric isolation process, the THAT 1510 improves on existing integrated microphone preamps by offering lower noise at low gains, better distortion characteristics, lower power consumption, higher slew rate and bandwidth, and increased output voltage swing. The part is fully protected against ESD on all critical pins, and reliability is further enhanced by its reduced power requirements.

In short, the THAT 1510 provides superior performance in a popular format at an affordable price.

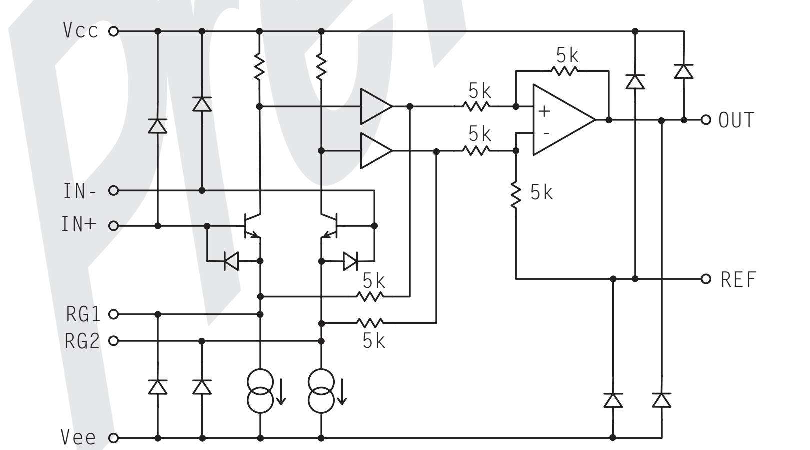

Figure 1. THAT 1510 Equivalent Circuit Diagram

Pin Name	DIP	SO8 Pin	SO16 Pin
RG_1	1	1	2
-In	2	2	4
+In	3	3	5
V-	4	4	7
Ref	5	5	10
Out	6	6	11
V+	7	7	13
RG_2	8	8	15

Table 1. THAT 1510 pin assignments

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SPECIFICATIONS[1]

Absolute Maximum Ratings (T_A = 25°C)

Positive Supply Voltage (V_{CC})	+20 V	Operating Temperature Range (T_{OP})	-40 to +85°C
Negative Supply Voltage (V_{EE})	-20 V	Storage Temperature Range (T_{ST})	-40 to +125°C
Output Short-Circuit Duration (t_{SH})	Continuous	Junction Temperature (T_J)	150°C
Power Dissipation (P_D)	TBD mW	Lead Temp. (T_{LEAD}) (Soldering 60 sec)	TBD °C
Max Input Swing (IN+ and IN-)	V_{CC} +.3V to V_{EE} -.3V		

Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Positive Supply Voltage	V_{CC}		+5		+18	V
Negative Supply Voltage	V_{EE}		-5		-18	V

Electrical Characteristics[2]

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Current	I_{CC}	No signal	—	6.1	8.2	mA
	I_{EE}		—	—	-8.4	mA
Input Bias Current	I_B	No signal; Either input connected to GND	—	8.6	25	µA
Input Offset Current	I_{OS}	No signal	—	—	±2.5	µA
Output Referred Offset Voltage	Vos_{OR}	No Signal, V_{CM}=0	—	—	± 50	mV
Input Referred Offset Voltage	Vos_{IR}		—	—	± 1.2	mV
Input Voltage Range						
Common Mode	V_{IN-CM}	Common mode, all gains	—	± 13	—	V
Normal Mode	$V_{IN-UNBAL}$	Unbalanced One input to GND, 0dB gain	—	± 13	—	V
Differential Gain	G_{diff}		0	—	70	dB
Ref Input Voltage Range			—	± 8	—	V
Ref Input Impedance			—	10	—	kΩ
Ref Input Gain to Output			—	0	—	dB
Input Impedance	$Z_{IN-DIFF}$	Differential				
		0dB gain	—	32||1.9	—	MΩ||pF
		20dB gain	—	32||2.0	—	MΩ||pF
		40dB gain	—	32||2.5	—	MΩ||pF
		60dB gain	—	29||8.0	—	MΩ||pF
	Z_{IN-CM}	Common mode				MΩ||pF
		all gains	—	8||7.7	—	MΩ||pF

1. All specifications are subject to change without notice.
2. Unless otherwise noted, T_A=25°C, V_{CC} = +15V, V_{EE} = -15V

Electrical Characteristics (Cont'd)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Common Mode Rejection	CMR	V_{CM} =± 10V; DC to 60 Hz				
		0 dB gain	20	55	—	dB
		20 dB gain	40	75	—	dB
		40 dB gain	60	95	—	dB
		60 dB gain	80	115	—	dB
Power Supply Rejection	PSR	V_{CC} = -V_{EE} = ±5V to ±20V; DC to 60 Hz				
		0 dB gain	—	85	—	dB
		20 dB gain	—	105	—	dB
		40 dB gain	—	120	—	dB
		60 dB gain	—	124	—	dB
Total Harmonic Distortion	THD	V_{OUT} = 7Vrms; R_L = 5 kΩ				
		f = 1kHz; BW = 20 kHz				
		0 dB gain	—	0.0005	—	%
		20 dB gain	—	0.0005	—	%
		40 dB gain	—	0.0005	—	%
		60 dB gain	—	0.005	—	%
		f = 20kHz; BW = 80 kHz				
		0 dB gain	—	0.002	—	%
		60 dB gain	—	0.005	—	%
Equivalent Input Noise	en_{OUT}	f = 1kHz,				
		0dB gain	—	57	—	nV/√Hz
		20dB gain	—	7	—	nV/√Hz
		40dB gain	—	1.7	—	nV/√Hz
		60dB gain	—	1	—	nV/√Hz
Input Current Noise	i_n	60dB gain	—	2.3	—	pA/√Hz
Noise Figure	NF	60dB gain				
		R_S = 150 Ω	—	1.6	—	dB
		R_S = 200 Ω	—	1.3	—	dB
Slew Rate	SR	R_L = 2 kΩ				
		C_L = 50 pF	16	28	—	V/µs
Bandwidth -3dB	BW-3dB	R_L = 2 kΩ; C_L = 10 pF				
		0dB gain	8	15	—	MHz
		20dB gain	6	8	—	MHz
		40dB gain	5	7	—	MHz
		60dB gain	2	3	—	MHz
Output Gain Error	$G_{ER\ OUT}$	f = 1kHz; R_L = 2 kΩ				
		0dB gain	—	± 0.25	± 1	dB
		20dB gain	—	± 0.20	± 1	dB
		40dB gain	—	± 0.20	± 1	dB
		60dB gain	—	± 0.05	± 0.5	dB
Output Voltage Swing	VO	R_L = 2 kΩ				
		all gains	± 13	± 13.3	—	V
Output Short Circuit Current	I_{SC}	R_L = 0 Ω	—	± 17	—	mA
Minimum Resistive Load	R_{Lmin}		—	2	—	kΩ
Maximum Capacitive Load	C_{Lmax}		—	—	200	pF
Gain Equation		$G = 1 + \frac{10k\Omega}{R_G}$				
Gain Resistor	R_G					
		0dB gain		∞		Ω
		20dB gain		1,100		Ω
		40dB gain		101		Ω
		60dB gain		10		Ω

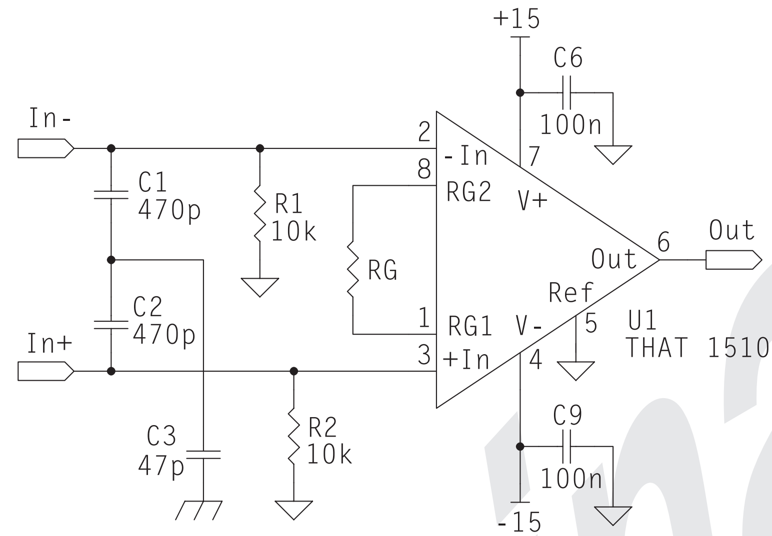


Figure 2. Basic 1510 Circuit

Applications

Gain Setting

A single external resistor between the RG1 and RG2 pins is all that is needed to set the gain of the THAT 1510, according to the formula

$$G = \frac{1+10k\Omega}{RG} \qquad or$$

$$RG = \frac{10k\Omega}{G-1}$$

RG1 and RG2 may be left open for unity gain operation. To avoid excess noise and ensure temperature stability, wirewound or metal-film resistors are recommended for RG.

Total gain accuracy will depend on both the tolerance on RG, and on the gain equation accuracy of the THAT 1510. Total gain drift will result from the mismatch between the tempco of RG and the tempco of the internal resistors (±20 ppm/° C typical).

Noise Performance

The THAT 1510 has significantly lower noise at low gains than similar IC microphone preamps. At

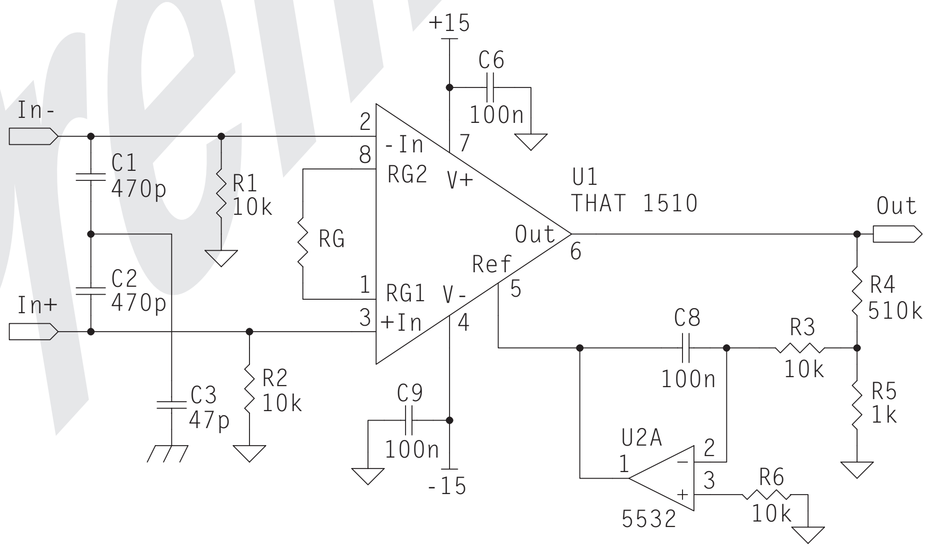


Figure 3. 1510 Circuit with Output Offset Correction

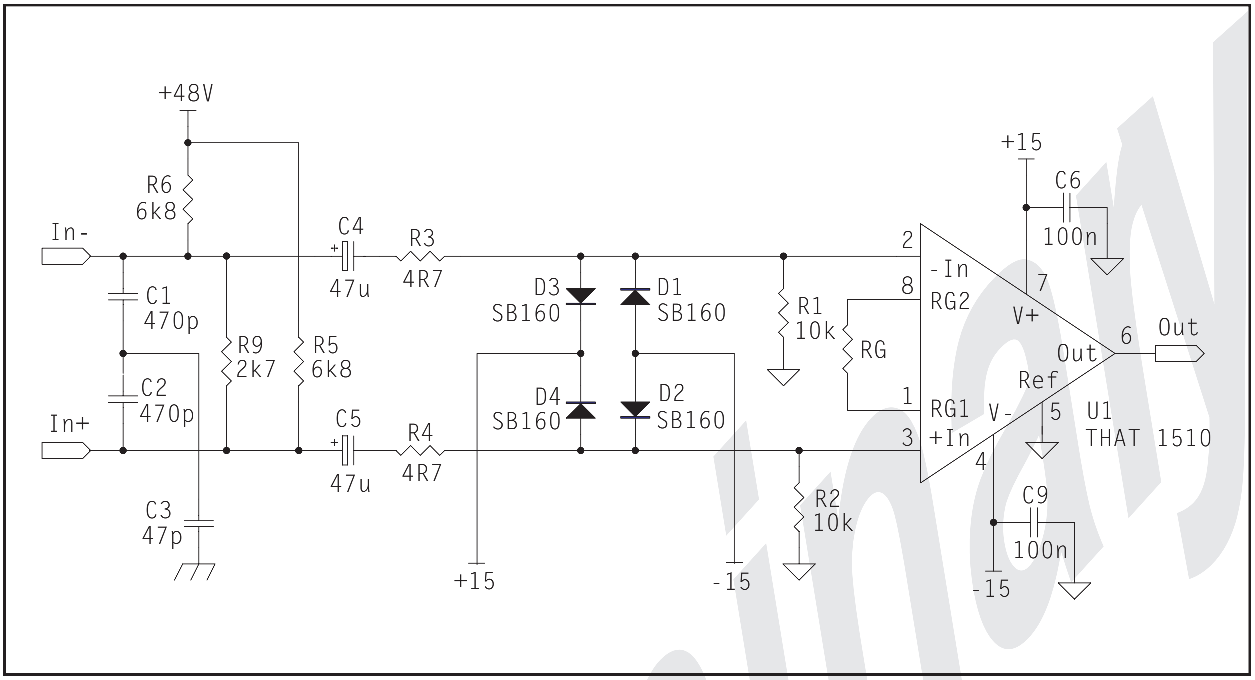


Figure 4. 1510 Circuit with Phantom Power

1 kHz, its equivalent input noise is 1 nV/√Hz at 60 dB gain. At 0 dB gain, equivalent input noise is 55 nV/√Hz, nearly 6dB better than competitive IC designs

Inputs

Protection diodes are employed at all pins except V+ and V- of the THAT 1510. These diodes prevent accidental ESD/EOS damage to the IC. Other diodes across the base-emitter junctions of the input transistors prevent reverse breakdown of these junctions, which could degrade noise performance.

The THAT 1510's inputs are floating, so a dc bias connection is required to maintain the inputs within the IC's input common-mode range. Three different schemes are shown in Figures 2, 3, and 4. Note that the values of R1 and R2 in these figures should be kept small to limit common-mode pickup. A value of 10 kΩ is recommended.

Reference Terminal

The “Ref” pin provides the reference for the output signal, and is normally connected to analog ground. If necessary, the “Ref” pin can be used for offset correction or DC level shifting. If this is done, the “Ref” pin should be driven from a low impedance source such as an op-amp output to avoid degrading CMRR.

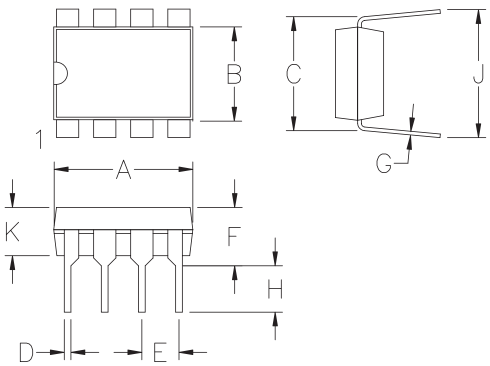
Phantom Power

Phantom power is required for condenser microphones. Figure 4 shows the recommended phantom power circuit for the THAT1510. When there is provision for phantom power, the designer must beware of the possibility of a phantom power fault. These faults usually occur when a mic pre channel is floating with phantom power applied (a common situation in portable consoles with a single phantom power switch for all mic inputs), and is accidentally shorted to a line driver output or ground. A large portion of the energy stored on the coupling capacitors can be shunted through internal junctions in the IC's, resulting in degradation and failure. Note that this energy is often more that 100 mJ, an order of magnitude greater that the energy in the most stringent (optional) ESD tests.

The SB160s, D1 through D4, comprise a bridge that shunts the potentially destructive currents that can result from a phantom power fault directly to the power supplies. If external protection is not provided, these currents will find a path though the IC, often through the on-chip ESD diodes, and sometimes through the input devices themselves. Since these currents can be as high as several amps in a low noise circuit, bond wires or on-chip metal can fail. With Schottky diodes in place, current into the input will be limited to less than 100 mA, which is well within the capability of the process.

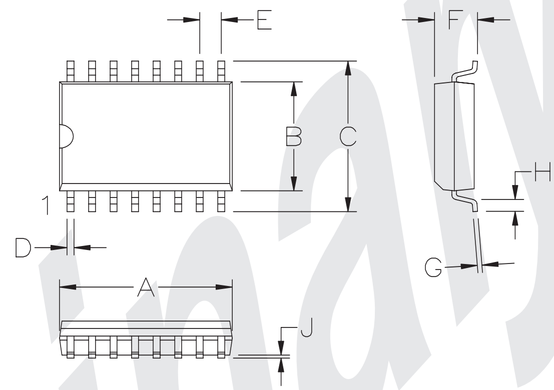
Package Information

The THAT1510 is available in 8-pin mini-DIP, 8-pin SOIC, and 16-pin SOIC packages. The package dimensions are shown in Figures 5, 6, and 7 while pinouts are given in Table 1.



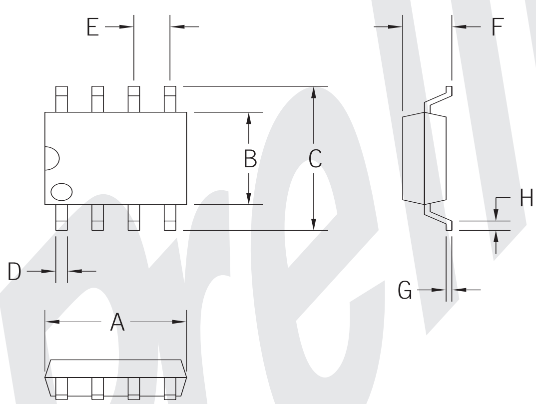
ITEM	MILLIMETERS	INCHES
A	9.53	0.375
B	6.35±0.10	0.250±0.004
C	7.47/8.13	0.294/0.320
D	0.46	0.018
E	2.54	0.100
F	3.66/4.32	0.144/0.170
G	0.25	0.010
H	3.18±0.10	0.125±0.004
J	8.13/9.40	0.320/0.370
K	3.30±0.10	0.130±0.004

Figure 5. -P (8-pin DIP) version package outline



ITEM	MILLIMETERS	INCHES
A	10.10/10.29	0.397/0.405
B	7.39/7.59	0.291/0.299
C	10.11/10.52	0.398/0.414
D	0.30/0.51	0.012/0.020
E	1.27	0.050
F	2.44/2.64	0.096/0.104
G	0.23/0.33	0.009/0.013
H	0.51/1.02	0.020/0.040
J	0.10/0.30	0.004/0.012

Figure 6. -S16 (16-pin SO) version package outline



ITEM	MILLIMETERS	INCHES
A	4.80/4.98	0.189/0.196
B	3.81/3.99	0.150/0.157
C	5.80/6.20	0.228/0.244
D	0.36/0.46	0.014/0.018
E	1.27	0.050
F	1.35/1.73	0.053/0.068
G	0.19/0.25	0.0075/0.0098
H	0.41/1.27	0.016/0.05

Figure 7. -S8 (8-pin SO) version package outline