PLESSEY
Semiconductors

ZN470AE/ZN472E

MICROPHONE AMPLIFIER FOR TELEPHONE CIRCUITS

FEATURES

- Conforms to BT Specification S1377
- On Chip Bridge Allows Dual Supply Polarity Operation
- Direct Matching to Electret Transducers
- 4 Gain Settings by Adjustable Links
- Operates from 1mA to 100mA Line Current
- 220mA 20 Second Overload Capacity
- Low Noise
- Low Distortion
- Operates on Telephone Supply Lines
- Meets BT Lightning Surge Requirements
- Minimum External Components in Telephone Circuits

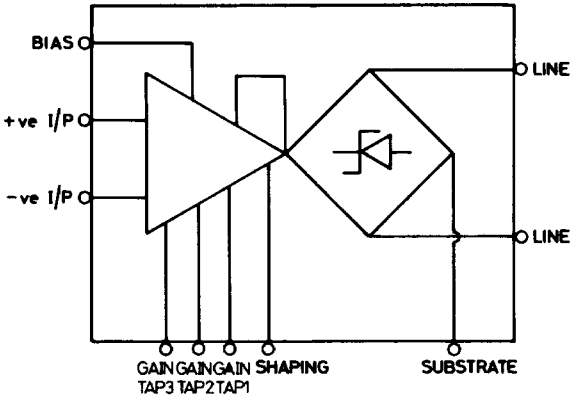
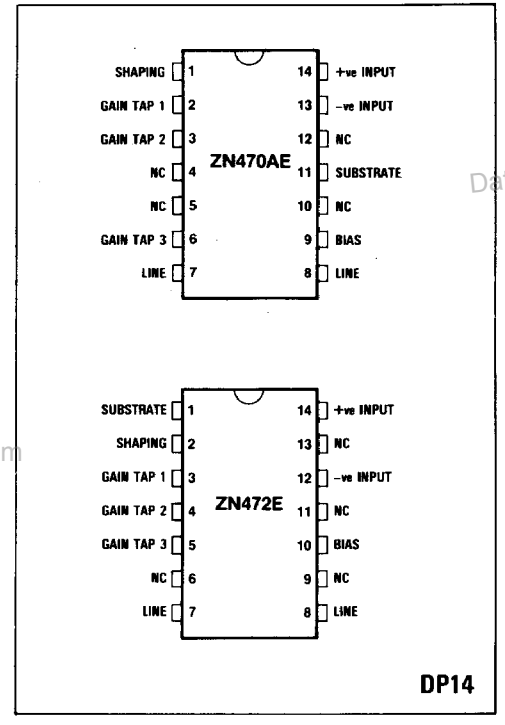


Fig. 1 System Diagram



Pin connections - top view

DESCRIPTION

This microphone amplifier was developed in conjunction with British Telecom for use with an electret transducer to replace the carbon transmitter. Dual polarity operation is accommodated by an on-chip bridge. Full lightning surge protection is given by on-chip components thus eliminating the need for an external surge suppression diode. The high input impedance makes it suitable for use with high or low impedance microphones that provide a high output voltage.

ABSOLUTE MAXIMUM RATINGS

Supply Current .. .. 120mA continuous (220mA for 20 seconds)
Operating Temp. Range .. .. .. −20°C to +80°C
Storage Temp. Range .. .. −55°C to +125°C

A.C. CHARACTERISTICS

$T_{amb} = 25°C$ $R_L = 100\Omega$ $R_O = 15\Omega$ $C = 1000pF$ $I_S = 50mA$
Pins 2, 3, 6 Open-circuit $f = 1kHz$ $V_O = 300mV$ unless otherwise stated.
Circuit as Fig. 2.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Voltage gain Note 1	A_V	–	20	–	dB	
		–	21.5	–	dB	Pins 3 & 6 shorted
		–	23.4	–	dB	Pins 2 & 3 shorted
		–	25.7	–	dB	Pins 2, 3 & 6 shorted
Change in voltage gain from typical at $I_S = 50mA$ when I_S is changed	$\Delta A_V(I_S)$	−1	−0.1	+1	dB	$I_S = 100mA$
		−1	−0.5	+1	dB	$I_S = 20mA$
		–	−0.9	0	dB	$I_S = 10mA$
Change in voltage gain with V_O relative to V_O of 300mV	$\Delta A_V(V_O)$	−1	+0.2	+1	dB	$V_O = 95mV$
		−1	−0.6	+1	dB	$V_O = 950mV$
Change in voltage gain with line polarity	$\Delta A_V(P)$	–	0.2	0.5	dB	
Output impedance	R_{out}	–	50	–	Ω	
Total harmonic distortion	DH(300)	–	1	3	%	$V_O = 300mV$
	DH(900)	–	4.5	6	%	$V_O = 900mV$
Lower cut off frequency	f_{Lco}	–	500	–	Hz	$R_b = 6M8\Omega$ $C_s = 39pF$
Upper cut off frequency	f_{Uco}	–	10	–	kHz	$C = 5600pF$
		–	200	–	kHz	$C = 0$
Output noise Note 2	V_{on}	–	170	316	μV	$V_{in} = 0$
Temperature co-efficient of A_V	$T_c(A_V)$	–	0.1	–	%/°C	$T_{amb} = -20°C$ to $+80°C$

Note 1 Gains are for circuit in Fig. 2. The actual device gain is higher by about 6dB but a 20pF input capacitance attenuates the electret signal to give 20dB to 25.7dB typical gain.

Note 2 Output noise is measured through a psophometer (CCITT recommendation P53).

D.C. CHARACTERISTICS

$T_{amb} = 25°C$, $V_{in} = 0$ with pins 2, 3 and 6 not connected and for either supply polarity unless otherwise stated.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Voltage	V_S	–	5.5	6.0	volts	$I_S = 21mA$
		6.4	6.8	–	volts	$I_S = 50mA$
		–	9.2	9.7	volts	$I_S = 100mA$
Input Current		–	2	–	nA	$I_S = 50mA$
Input Offset Current		–	0.2	–	nA	$I_S = 50mA$
Input Offset Voltage		–	2.5	–	mV	$I_S = 50mA$

MICROPHONE AMPLIFIER APPLICATION

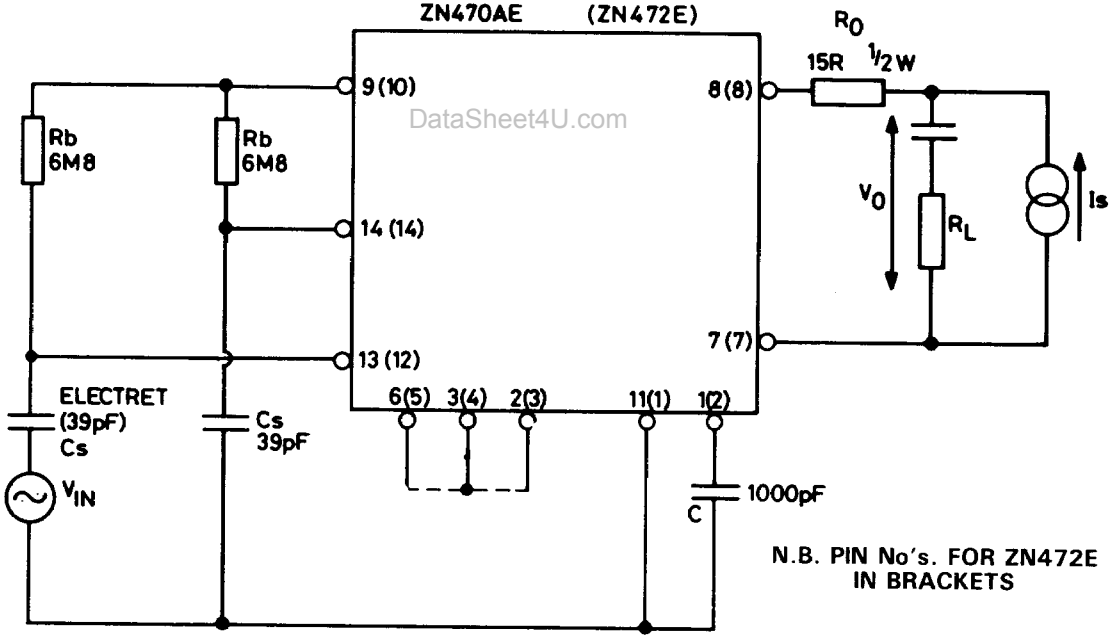


Fig. 2 Typical Electret Microphone Amplifier

The circuit shows ZN470AE/ZN472E with an electret transducer in a typical telephone handset application but with load test included. The gain setting taps may be used to select the appropriate voltage gain to compensate for production spreads in electret sensitivity.

The low frequency cut off is determined by the time constant $C_S R_b$ and a similar matching time constant is required on the other input. C_S is the capacitance of the electret microphone including stray capacitance and its value is therefore determined by the size and characteristics of the types used. The upper frequency cut off is determined by the shaping capacitor C. In addition the overall high frequency response is often controlled by acoustic means.

The leads to the high impedance inputs should be kept as short as possible to avoid the risk of pickup from stray fields.

In locations where high levels of humidity are likely to be encountered it is recommended that precautions are taken to prevent formation of leakage paths between +ve I/P and −ve I/P and between each of these inputs and substrate.

These precautions may take the form of:

a) Guard ring techniques
b) Varnishing or lacquering of the appropriate areas of the PCB.
c) Encapsulation of the complete amplifier module.

The guard ring technique involves completely enclosing the high impedance +ve I/P and −ve I/P nodes by a separate ring of copper. This ring should then be connected to the bias pin as this has a voltage much nearer to the operating voltage of the input pins compared with the substrate, hence current flowing in any leakage path will be minimised.

Note that the guard ring technique is easier to implement using the ZN472E pinning as indicated in Fig. 3.

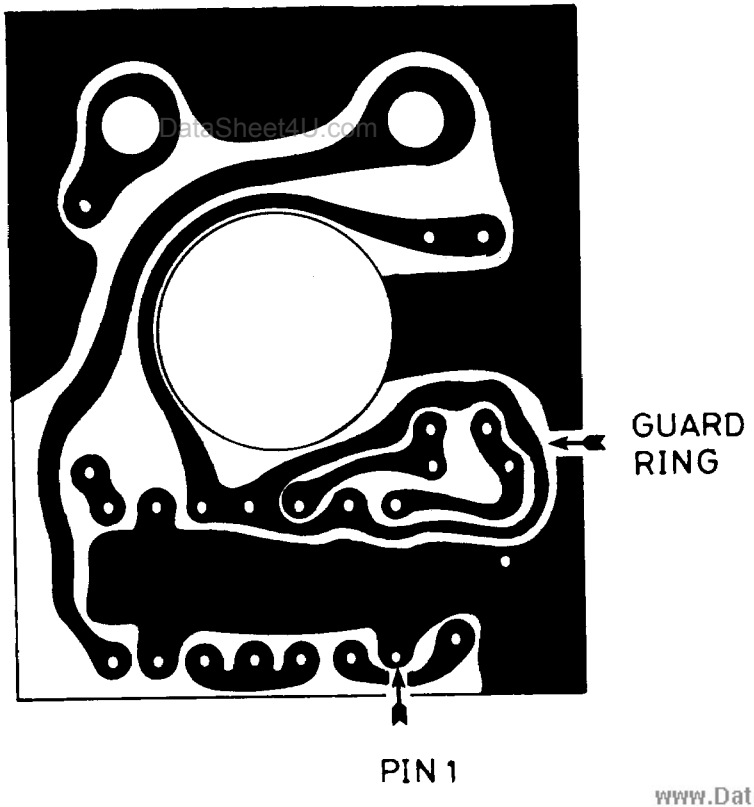
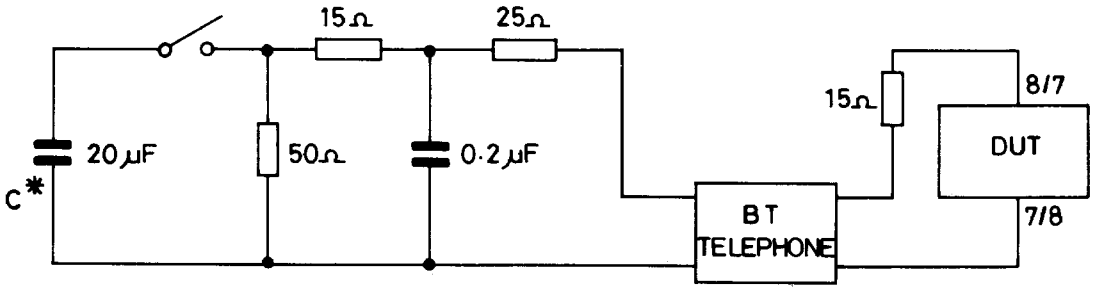


Fig. 3 Reverse Side of a PCB Indicating Guard Ring Screening on the ZN472E.

BT LIGHTNING SURGE TEST CIRCUIT



*C CHARGED TO 1500 VOLTS

When the capacitance is fully charged the switch is closed thus discharging the capacitance into the test network. The device under test, DUT, is connected via a 15ohm resistor to the standard microphone wires. The DUT must survive the discharge on either line polarity.

RELIABILITY

The ZN470AE is fully approved by British Telecom to their specification D3006 for 10 year life applications.

From extensive very long life tests, a predicted failure rate (at 95% confidence level) of less than 0.005% per annum has been calculated for service applications at 45°C and 50mA line current.