Speakerphone Control IC

GENERAL DESCRIPTION

The XR-T6421 is a monolithic integrated circuit for use in high performance speakerphone systems. It is designed to provide all control functions for the XR-T6420-2 speakerphone audio circuit.

The XR-T6421 contains the level sensors and logic necessary to change the attenuation in the transmitting or receiving path in order to avoid acoustic feedback.

Circuitry is included to detect background noise level and provide a preset amount of attenuation in each path when no voice is present.

FEATURES

Low Current
Background Noise Detection and Suppression
External Control of Attack and Decay Time Constants
Independent Control of Gain and Frequency Response
Provides Three Level Control of Transmit & Receive Paths

APPLICATIONS

Speakerphones
Intercoms
Voice Operated Switches

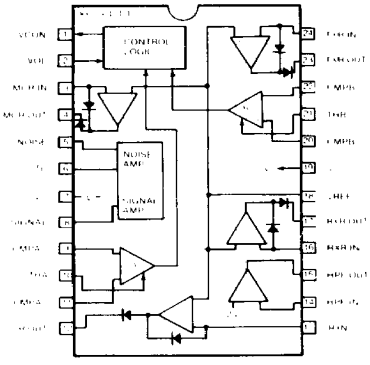
ABSOLUTE MAXIMUM RATINGS

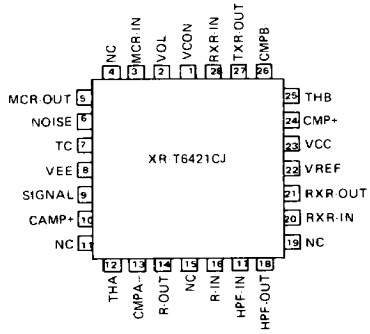
Power Supply	20 V
Power Dissipation	1 W
Derate Above +25°C	7 mW/°C
Any Input Voltage	V_{CC} +0.5 V to V_{EE} -0.5 V
Storage Temperature	**-65°C to 150°C**

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-T6421CP	Plastic	0°C to 70°C
XR-T6421CJ	PLCC	0°C to 70°C

FUNCTIONAL BLOCK DIAGRAM





SYSTEM DESCRIPTION

The speakerphone concept essentially requires that only one direction of sound transmission be permitted at any time. This restraint is brought about by the large gains required to provide loudspeaker volume and high microphone sensitivity. Owing to the inevitable acoustic coupling between loudspeaker and microphone, plus imperfections in the hybrid 2 to 4 wire conversion, it is necessary to lower the gain in either the transmitting or receiving path at any one time to avoid regeneration.

The XR-T6420-2 and XR-T6421 chip set enables the system designer to make a highly adaptive, high perfromance speakerphone. The XR-T6421 provides for all sensing and control functions, while the XR-T6420-2 contains all audio paths needed to switch the gain in either path and provide interfacing between the system and line.

ELECTRICAL CHARACTERISTICS

Test Conditions: $T_A = 25°C$, $V_{CC} = 10V$, unless specified otherwise.

PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
Supply Voltage Range	5		20	V	
Supply Current		1.4	3	mA	V_{CC} = 10 V
V_{REF}	1.85	2.1	2.25	V	
RECTIFIERS					
V_{OUT}	1.9	2.1	2.27	V	VAC = 0
V_{OUT} (High Level)		5.0		V	
V_{OFFSET} 1	-5		5	mV	Vpin 4 - Vpin 12
V_{OFFSET} 2	-5		5	mV	Vpin 17 - Vpin 23
A_{OL}	45			dB	
I_{bias}		0.2		μA	
HPF					
V_{OUT} DC	2.3	2.6	2.9	V	
Maximum Isource (Pin 15)		1.0		mA	
Maximum Isink (Pin 15)		1.0		mA	
A_{OL}	32			dB	
I_{bias}		0.25		μA	
VOICE CIRCUITRY					
Noise Amplifier Offset V6 - V5	-3		12	mV	V_{IN} =
Signal Offset V8 - V18			15	mV	V_{IN} =
Signal Gain	.8	1	1.2		$\frac{Vpin\ 8 - Vpin\ 18}{Vpin\ 5 - Vpin\ 6}$
CONTROL OUTPUT					
V_{CON} High	V_{CC}-.9		V_{CC}-.5	V	
V_{CON} Idle	4.9	5	5.1	V	20 kΩ to 5 V
V_{CON} Low Minimum			.95	V	
V_{CON}-V_{OL} Offset	50		250	mV	
COMPARATORS					
I_{bias}		1		μA	
Offset	5		17	mV	V_{POS} - V_{NEG}

PRINCIPLES OF OPERATION

Rectifiers — All four rectifiers are operational amplifiers with the noninverting input connected to V_{REF}. The circuit contains the diodes internally to provide the function of a negative peak detector. Using the typical application schematic of Figure 1, the "gain" of the rectifier is R2/R1. The output is then filtered using another RC network. The attack time is given by R3.C and the decay time by (R2 + R3).C.

High Pass Filter — This is a simple gain stage with a class AB output stage. Pin 14 is about 2.6 V above V^-. This amplifier is normally used as a high pass filter to reduce line induced hum from the detection circuitry.

Noise Control Circuitry — This function provides a signal on Pin 8 related to the difference between Pins 5 and 6. Pin 5 is usually connected to the filter network of the microphone rectifier. This signal represents the speech plus noise from the microphone. Pin 6 has an external RC network and functions as a detector for the noise level. The output on Pin 8 is the difference between Pins 5 and 6, referenced to V_{REF}.

Comparators — Both comparators have internally generated offset of -10mVolts nominally. With no difference between the inputs, the output will be in the low state. The amount of offset can be increased by connecting a resistor between the threshold adjust pin and V^-.

Control Logic — The purpose of the logic is to derive the three speakerphone states, depending on Comparators A and B. The three states are:

1) Transmit → Pin 1 = V^+ -0.7V
2) Receive → Pin 1 ≅ Pin 2 + 0.1V
3) Idle → Pin 1 is High Impedance.

The truth table for the logic is:

Comparator		State
A	B	
0	0	Idle
0	1	Receive
1	0	Transmit
1	1	Idle

CIRCUIT DESCRIPTION

Pin 1 - V_{CON} — Provides three voltage states depending on input conditions. The first is a low impedance voltage about equal to V^+ -.7 Volt. The second state is a low impedance voltage equal to voltage on Pin 2. The third state is a high impedance state.

Pin 2 - V_{OL} — A high impedance input used to modify the control voltage (Pin 1) when in the low state.

Pin 3, 4 - MCR — Negative peak detector usually connected to microphone amplifier output. Gain, attack, and delay times are externally set.

Pin 5 - NOISE — High impedance input used to buffer speech plus noise input from microphone rectifier.

Pin 6 - TC — External RC network determines response to background noise level. RC network determines rise time, internal circuitry will discharge network if Pin 6 > Pin 5.

Pin 8 - SIGNAL — Provides voltage proportional to Pin 5, Pin 6 output impedance is nominally 36 K ohms.

Pin 9, 11 - CMP A — Used to compare signal level to level of speaker signal.

Pin 10 - TH A — Used to increase offset of comparator A. With TH A open, offset is approximately -10 mV.

Pin 12, 13 - R — Negative peak detector normally connected to speaker amplifier. Gain, attack, and decay times are externally set.

Pin 14, 15 - HPF — Inverting amplifier, normally connected as a high pass filter to reject low frequencies from received signals into the control circuitry.

Pin 16, 17 - R_XR — Negative peak detector normally connected after line receive amplifier. Gain, attack, and decay times are externally set.

Pin 18 - V_{REF} — Internal 2 Volt reference.

Pin 20, 22 - CMP B — Used to compare transmitted and received signal levels.

Pin 21 - TH B — Used to increase offset of comparator B with TH B open, offset is approximately -10 mV.

Pin 23, 24 - T_XR — Negative peak detector normally connected to transmit amplifier. Gain, attack, and decay times are externally set.

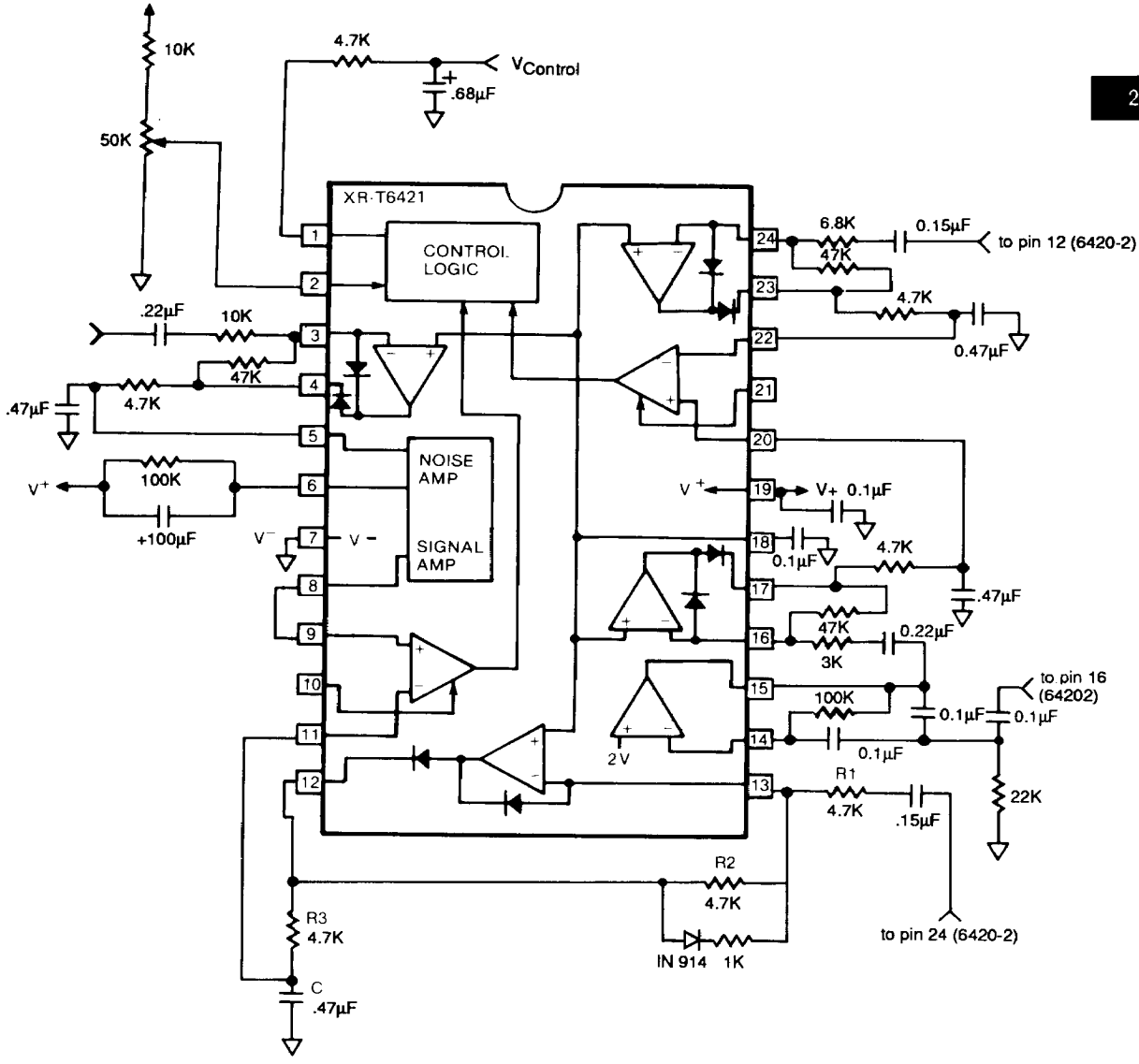


Figure 1. Typical Application Schematic