Description

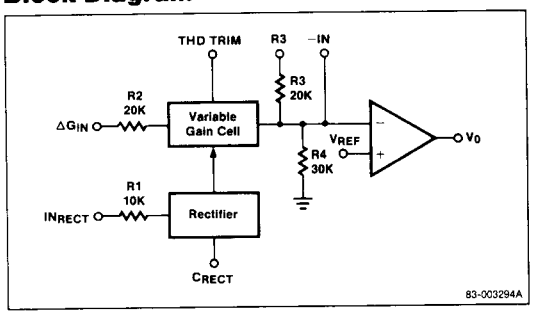
The μPC1571 is a dual gain control circuit in which either channel may be used as a dynamic range compressor or expander. Each channel contains a fullwave rectifier, a temperature compensated variable gain cell, and an operational amplifier.

This circuit is well suited for use in telephone systems, limiters, voltage control amplifiers, and noise reduction circuits.

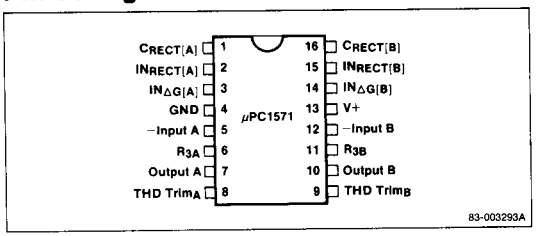
Features

- ☐ Single power supply operation
- ☐ Temperature compensated
- ☐ Complete compressor and expander in a single package
- ☐ Dynamic range greater than 70 dB
- ☐ Outputs fully protected against short circuits

Block Diagram



Pin Configuration



Ordering Information

Part Number	Package	Operating Temperature Range
μPC1571C	16 pin Plastic DIP	0°C to +70°C

Absolute Maximum Ratings

$T_A = +25°C$

Power Supply	16 V
Input Voltage (Note 1)	16 V
Power Dissipation	400 mW
Storage Temperature	−55 to +125°C

Note: 1. Applies to all input terminals.

Comment: Stress above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Limits Min	Typ	Max	Unit
Operating Temperature	T_{op}	0		70	°C
Power Supply	V+	6	8	13.5	V
Rectifier Capacitor	C_{RECT}	2.0	2.2		μF

7

Electrical Characteristics

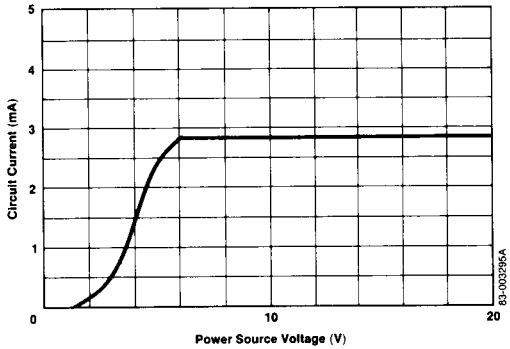
T_A = +25°C, V+ = 8 V, C_{RECT} = 2.2 μF

Parameter	Symbol	Limits Min	Limits Typ	Limits Max	Unit	Test Conditions
Power Supply Current	I_{CC}		2.5	4.0	mA	V_{IN} = 0 V
Internal Reference Voltage	V_{ref}	1.7	1.8	1.9	V	T_A = 0°C to +70°C
V_{ref} Change with Temperature	$\Delta V_{ref}/\Delta T$		15	30	mV/°C	
Output Current	I_O	±10			mA	
Slew Rate	SR		0.2		V/μs	
Internal Resistor Tolerance		−20		+20	%	T_A = 0°C to +70°C
Change with Temperature			1200	1800	ppm/°C	
Unity Gain Level	f_{unity}	−1.5	0	+1.5	dBm	$V_{IN} = V_O$
Total Harmonic Distortion	THD		0.5	2	%	
Expander Output Noise	V_N		−100		dBm	Δf = 3 kHz
Gain Variation A	ΔG_A	−0.2	0	+0.2	dB	V_{IN} = −30 dBm, T_A = 0° to +70°C, f = 1 kHz to 5 kHz
Gain Variation B	ΔG_B	−0.5	0	+0.5	dB	
Compressor Output	V_O	−20.2	−20	−19.5	dB	V_{IN} = −20 dB
		−40.4	−40	−39.3	dB	V_{IN} = −40 dB
		−61.0	−60	−58.3	dB	V_{IN} = −60 dB
			−80		dB	V_{IN} = −80 dB
Expander Output	V_O	−10.5	−10	−9.8	dB	V_{IN} = −10 dB
		−20.7	−20	−19.6	dB	V_{IN} = −20 dB
		−31.5	−30	−29.0	dB	V_{IN} = −30 dB
			−40		dB	V_{IN} = −40 dB
Channel Separation	CS	60			dB	

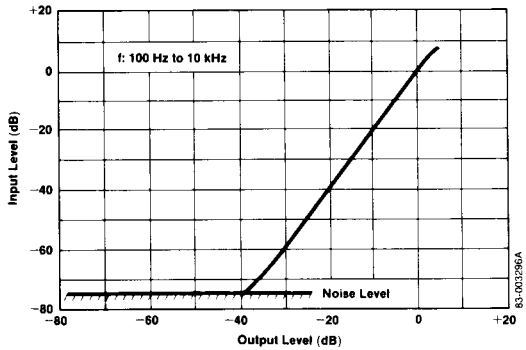
Operating Characteristics

$T_A = 25°C$

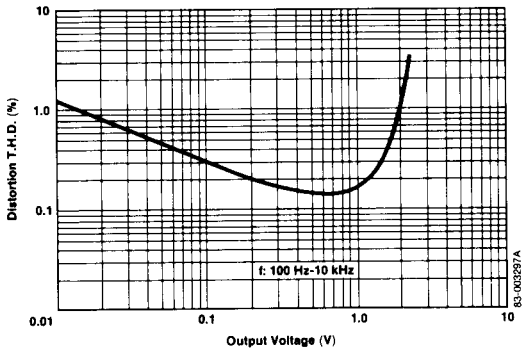
Power Supply Characteristics



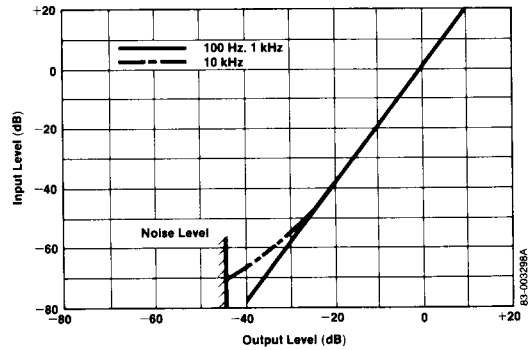
Expander Characteristics



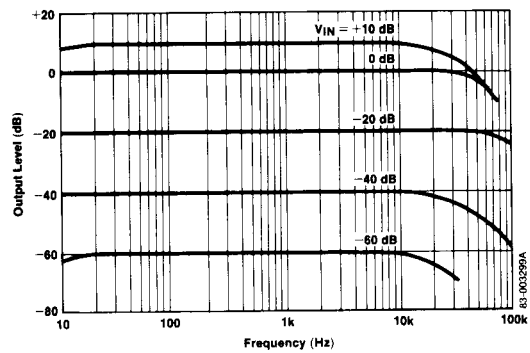
Distortion-Output Voltage Characteristics (Compander)



Compressor Characteristics



Frequency Characteristics (Compander)

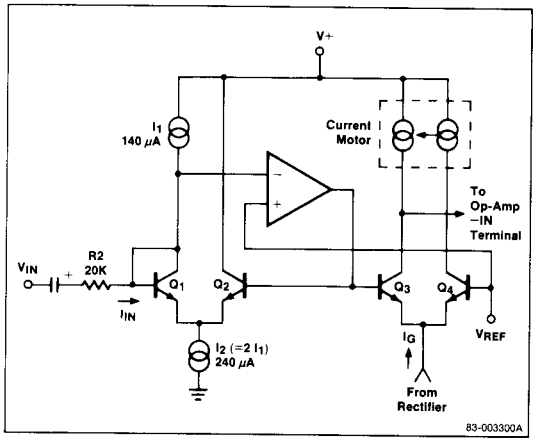


7

Gain Cell Operation

The gain cell is a multiplier comprised of two transistor pairs. I_1 and I_2 are fixed within the IC; I_G is a control current supplied by the rectifier. This current determines the amount of output amplification:

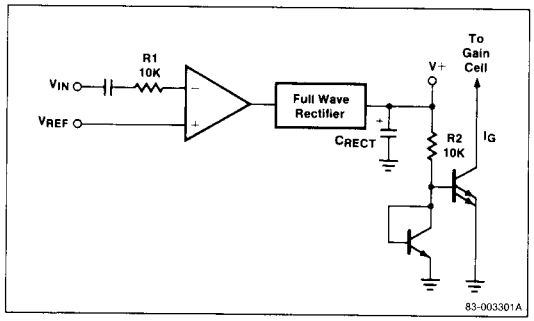
$$I_0 = \frac{I_G \cdot I_{IN}}{140\ \mu A} = \frac{I_G \cdot V_{IN}}{R_1}$$



Rectifier Operation

The output current of the op-amp is averaged by C_{RECT} R_2 then doubled to become I_G:

$$I_G = \frac{V_{IN\ (avg)}}{R_1}$$



Compressor Operation

Using the μPC1571 as a compressor involves placing an expander in the op-amp feedback circuit. For example, if the input increases by 6 dB, the output is limited to 3 dB. The 3 dB increase produces a 3 dB increase in the output of the gain cell, which results in a 6 dB increase in feedback current.

$$\text{Gain} = \frac{.84}{V_{IN\ (avg)}}$$

$$V_0 = (\text{gain})\ (V_{IN})$$

Note that op-amp feedback is AC only. C_{DC} and the two R_{DC} provide DC feedback to set the DC bias at the op-amp output:

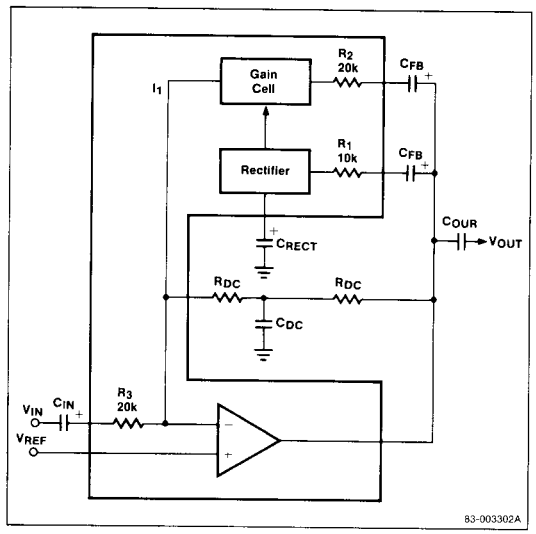
$$V_{OPO\ (DC)} = (1 + \frac{R_{DC\ (total)}}{R_4})\ V_{REF}$$

The output of the compressor will be biased at 3 V DC, assuming the internal resistors are used:

$$V_{O\ (DC)} = (1 + \frac{R_3}{R_4})\ V_{REF}$$

Note that external resistors may be placed in series with R_3 to change the gain, or with R_4 to change the output DC bias.

1/2 μPC1571

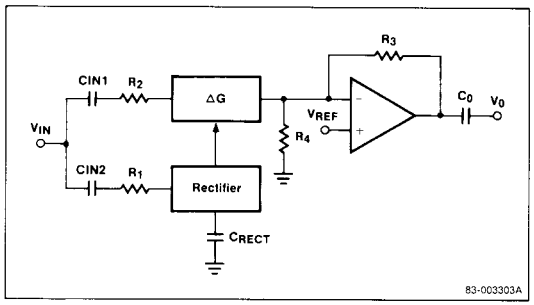


Expander Operation

When connected as an expander, the input signal is applied to both the rectifier and the gain cell. When the signal drops by 6 dB, the gain current drops by a factor of 2 so the overall gain drops by 6 dB. Thus the output level will drop by 12 dB.

Gain = (1.43) ($V_{IN\ (avg)}$)

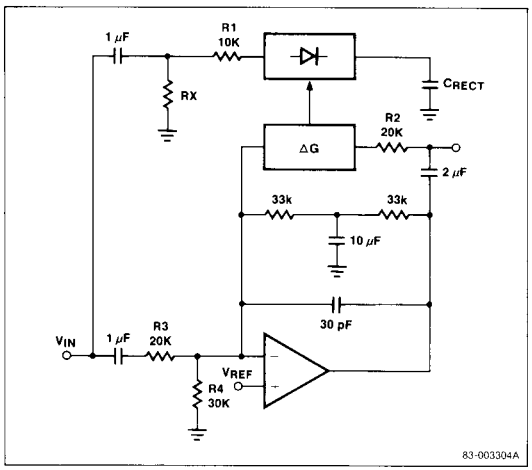
V_O = (gain) (V_{IN})



Applications

A. Automatic Level Control

With the rectifier input tied to V_{IN}, a very high performance ALC can be built. Gain is inversely proportional to input level, so a 20 dB drop in input produces a 20 dB increase in gain. Circuit shown will maintain a fixed output ±1 dB from −43 dBm to +14 dBm at 1 kHz.



7