Compander IC
Monolithic IC MM1102

This IC was developed for use in cordless telephones. It is a compander IC incorporating compressor/expander circuits for a significant noise reduction effect without complicated external circuitry. On the transmission side, the dynamic range of audio signals is compressed by the compressor circuit; on the receiving side, the expander expands the signals. As a result the dynamic range over the transmission channel is reduced logarithmically by one-half.

Features

1. Can be driven at low voltages (down to 2.4V)
2. Internal mute function
3. Internal limiter (IDC) function
4. Two internal op-amps (for splatter filter)
5. Internal standby function
6. Data input, output pins
7. Independent mute circuit

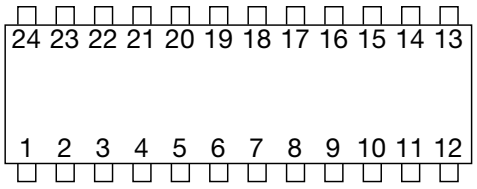
Package

SSOP-24A (MM1102XF)

Applications

1. Cordless telephones
2. Various mobile communication devices

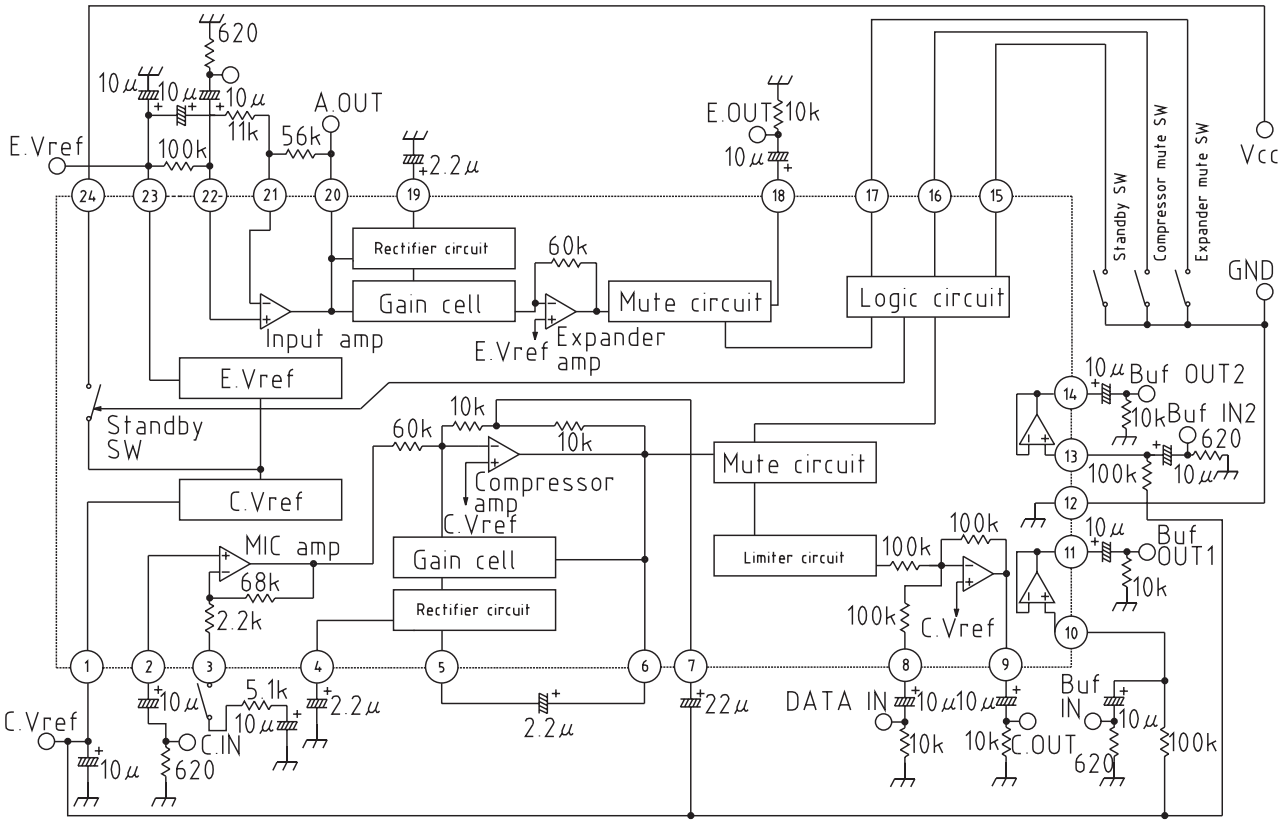
Pin Assignment



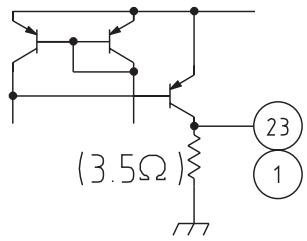
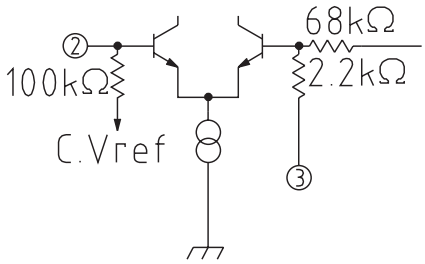
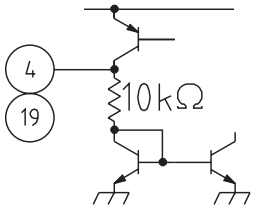
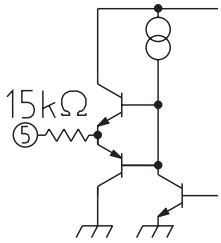
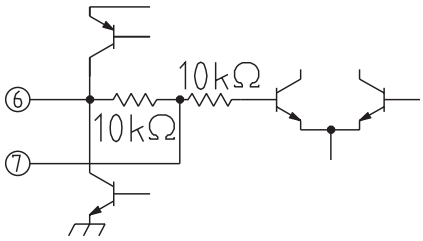
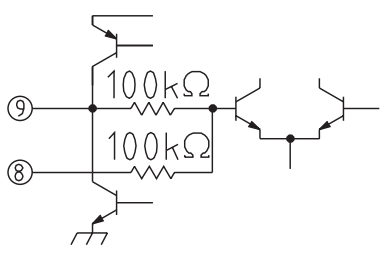
SSOP-24A

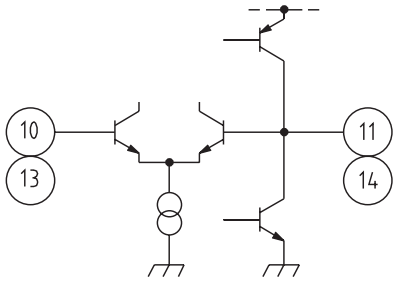
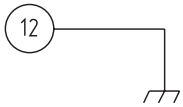
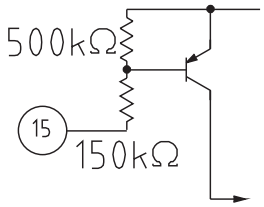
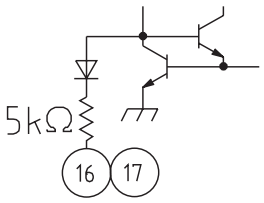
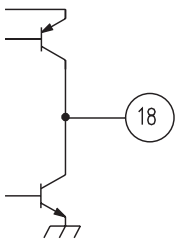
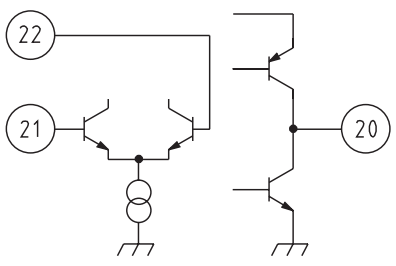
1	C.Vref	9	C.OUT	17	E.MUTE SW
2	C.IN	10	BUFIN 1	18	E.OUT
3	C.IN–	11	BUFOUT 1	19	E.RECT
4	C.RECT	12	GND	20	A.OUT
5	C.RIN	13	BUFIN 2	21	A.IN–
6	C.FB	14	BUFOUT 2	22	A.IN+
7	C.NF	15	STANDBY SW	23	E.Vref
8	DATA IN	16	C.MUTE SW	24	V_{CC}

Block Diagram



Pin Description

Pin no.	DC voltage	I/O resistance	Function	Equivalent circuit
1 23	1.5V 1.3V	— —	Regulator output 1PIN···C.Vref 23PIN···E.Vref	
2 3	1.5V 1.5V	100kΩ 2.2kΩ	Mike amp unit Mike amp input stage	
4 19	— —	10kΩ 10kΩ	Rectifier circuit unit Attack and release times determined	
5	1.5V	15kΩ	Rectifier circuit unit Input pin	
6 7	1.5V 1.5V	— 10kΩ	Compressor amp unit 6PIN···Output pin 7PIN···Feedback resistance	
8 9	1.5V 1.5V	100kΩ —	Inverting amp (0dB) 8PIN···Input pin 9PIN···Output pin	

10 (13) 11 (14)	– –	– –	Buffer amp unit Pin 10 (13): Input pin not biased internally Pin 11 (14): Output pin	
12	0V		GND pin	
15	Vcc (3V)	150kΩ	Standby SW The IC operates at approx. Vcc-1 V and below. At open and high (Vcc) levels, it is in the standby state.	
16 17	0.7V 0.7V	– –	Compressor · expander Mute SW Muted at approx. 0.6V and below; operates normally at open and high levels	
18	1.3V	–	Expander unit Output pin	
20 21 22	– – –	– – –	Pin 20: Output pin Input amp Pin 22: Input pin (+) Pin 21: Input pin (–) None of these are biased internally	

Absolute Maximum Ratings (Ta=25°C)

Item	Symbol	Ratings	Units
Storage temperature	T_{STG}	–40~+125	°C
Operating temperature	T_{OPR}	–10~+70	°C
Power supply current	V_{CC} max.	+2.4~+8	V
Allowable loss	Pd	450	mW

Electrical Characteristics (Except where noted otherwise, Ta=25°C, V_{CC}=3V, f_{IN}=1kHz)

Item		Symbol	Measurement conditions	Min.	Typ.	Max.	Units
	Consumption current	I_{CC}	No signal		4.4	6.5	mA
	Standby current consumption	I_{SCC}			0	10	µA
	Threshold voltage	Vth			0.65		V
Compressor unit	Input reference level	Vinc	V_{OC}=100mVrms, V_{IN}=0dB	8.0	13.5	18.0	mVrms
	Gain error difference *	Gc1	V_{IN}=–20dB	–0.5	0	0.5	dB
		Gc2	V_{IN}=–40dB	–1.0	0	1.0	dB
	Distortion	THD_C	V_{IN}=0dB		0.3	1.0	%
	Output noise voltage	Vnc	No signal (CCITT)		2.5	5.0	mVrms
	Mute attenuation	Attc	V_{IN}=0dB, Mute SW : on		–50	–40	dB
	Limit voltage	Vlimc	THD=10%	1.15	1.3	1.45	V_{P-P}
	DATA pin voltage gain	G_{DATA}	V_{IN}=0dB, Mute SW : on	–0.5	0	0.5	dB
	DATA pin maximum output	VD max.	THD=10%, Mute SW : on		0.70		Vrms
	Crosstalk	CT_C	$EXPV_{IN}$=0dB		–33	–28	dB
	Ripple rejection ratio	RR_C	V_R=100mVrms, f_R=1kHz		–23	–18	dB

Electrical Characteristics (Except where noted otherwise,Ta=25°C, V_{CC}=3V, fin=1kHz)

Item		Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Expander unit	Input reference level	Vine	Voe=100mVrms, V_{IN}=0dB	25	35	50	mVrms
	Gain error difference *	Ge1	V_{IN}=–10dB	–0.5	0	0.5	dB
		Ge2	V_{IN}=–20dB	–1.0	0	1.0	dB
		Ge3	V_{IN}=–25dB	–1.5	0	1.5	dB
	Distortion	THDe	V_{IN}=0dB		0.15	1.0	%
	Maximum output voltage	Ve max.	THD=10%	550	700		mVrms
	Output noise voltage	Vne	No signal (CCITT)		20	40	µVrms
	Mute attenuation	Atte	V_{IN}=0dB, Mute SW : on	60	70		dB
	Input amp voltage gain	GI	V_{IN}=0dB	14.6	15.6	16.6	dB
	Input amp maximum output	Veo max.	THD=10%	0.90	1.10		Vrms
	Crosstalk	CTe	COMPV_{IN}=0dB		–75	–60	dB
	Ripple rejection ratio	RRe	V_R=100mVrms, f_R=1kHz		–60	–50	dB
	Buffer amp gain	Gba	Voba=100mVrms	–1	0	+1	dB
	Buffer maximum output voltage	Voba max.	THD=10%	0.35	0.50		Vrms
	COMP reference voltage	C.Vref			1.5		V
	EXP reference voltage	E.Vref			1.3		V

*Gain error difference = (V_{OUT}+20dB) –V_{IN} × G (dB)
G : COMP=0.5, EXP=2

Function Description

1. Compressor unit

The compressor unit consists of the mike amp, compressor, limiter circuit, data amp, and mute circuit. The mike amp gain can be adjusted through an external resistance, and so the mike amp can be connected directly to a microphone. An internal limiter circuit to prevent overmodulation as well as a data amp (0dB amp) enabling transmission of data signals without compression are also provided. Switching between audio signals and data signals is possible using the compressor mute switch.

2. Expander unit

The expander unit consists of an input amp, expander, and mute circuit.
The input amp makes available all input and output signals at pins, and so can be used freely as an amplifier, filter amp, or data amp. When used as a data amp, the expander mute switch can be set so that the expander output is nearly silent.

About Application Circuits

1. Mike amp

The compressor unit mike amp is exposed to circuits outside the IC via positive and negative input pins. The positive input pin is connected to C.Vref by a bias resistance of 100kΩ, so that no external bias is needed.

he internal configuration appears in Fig. 1. When pin 4 is open the gain is lowest, and an input voltage of approx. 13.5mVrms is the reference level. When the external resistance is 0Ω, the gain is maximum. The internal configuration appears in Fig. 1.

2. Rectifier circuit unit (rectifier)

The product of the external capacitance and the internal resistance (10kΩ) determines the time constants for the attack and release times.

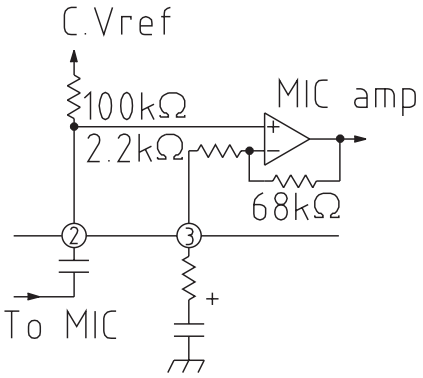


Fig.1

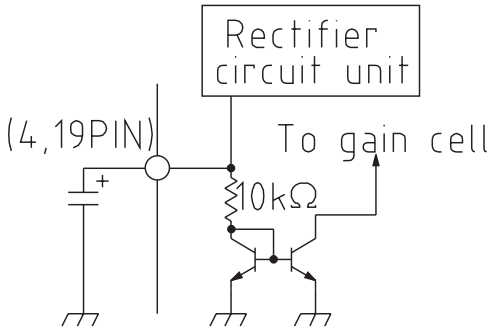


Fig.2

3. Compressor amp

The compressor amp requires that the DC gain be unity and the AC gain be infinite. In order to satisfy this requirement, AC feedback is eliminated and only DC feedback is used. In order that only DC feedback be present, a capacitor to eliminate AC components is connected to pin 8. The cutoff frequency is determined by the product with the internal resistance (10kΩ).

4. Compressor data amp

The data amp uses an inverting amp. The internal input resistance is 100kΩ, and the DC bias voltage is 1.3V. The compressor mute switch at pin 15 is used to switch between data signals and audio signals.

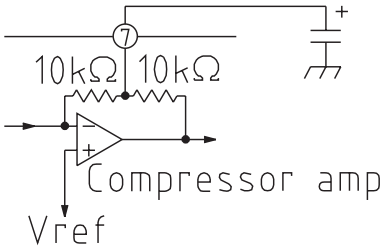


Fig.3

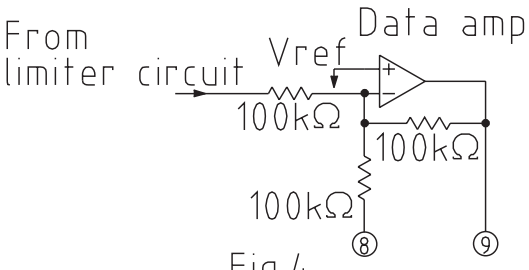


Fig.4

5. Expander input amp

The positive and negative input pins and the output pin are exposed to circuitry outside the IC. The expander input amp can be used as a signal amplifier, a buffer amplifier, and a filter amp. By taking the signal from this amp's output pin, the data signal can be obtained without passing through the expander. If the expander mute switch is turned on, this signal can be prevented from appearing in the expander output.

6. Mike amp input switch and mute switches

The internal equivalent circuit for each of these switches appears in Fig. 6.

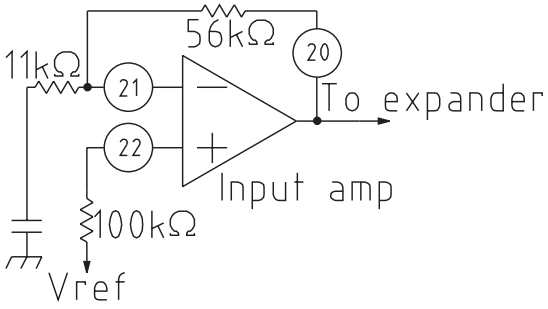


Fig.5

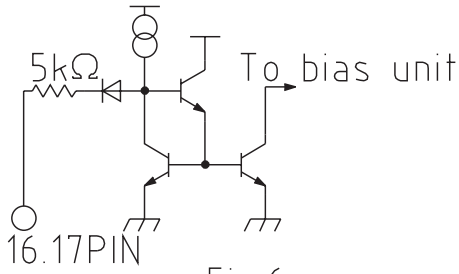


Fig.6

7. Standby switch

The internal equivalent circuit for the standby switch appears in Fig. 7.

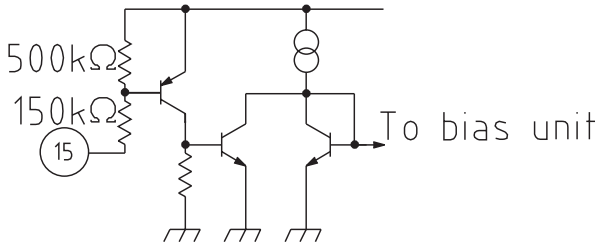
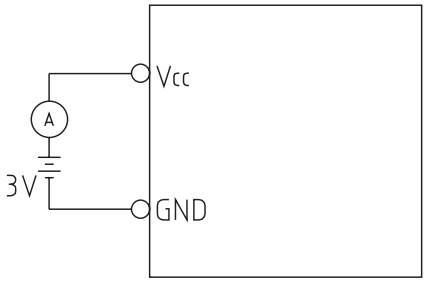


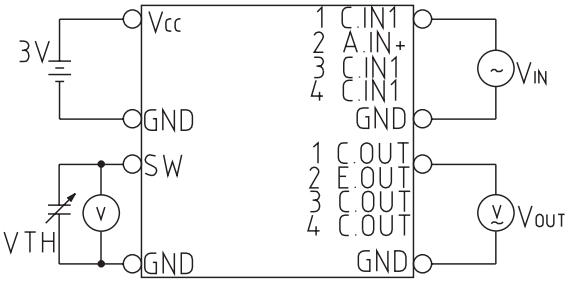
Fig.7

Measuring Circuit (Except where noted otherwise, V_{IN}=1kHz)

1. Consumption current

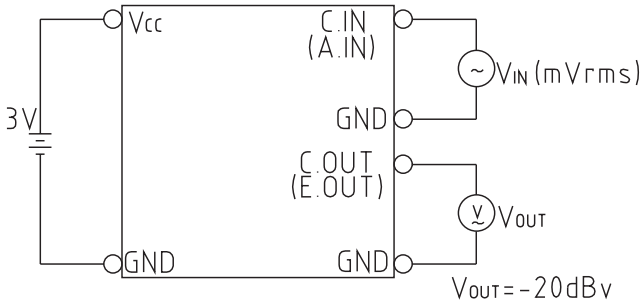


2. Threshold voltage

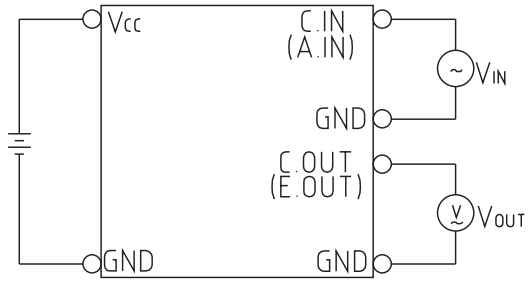


1. Compressor mute
2. Expander mute
3. C.IN SW

3. Input reference level



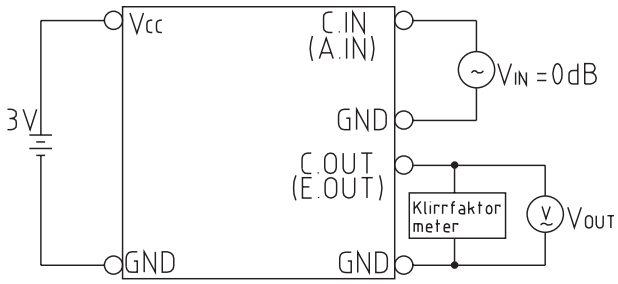
4. Gain error difference



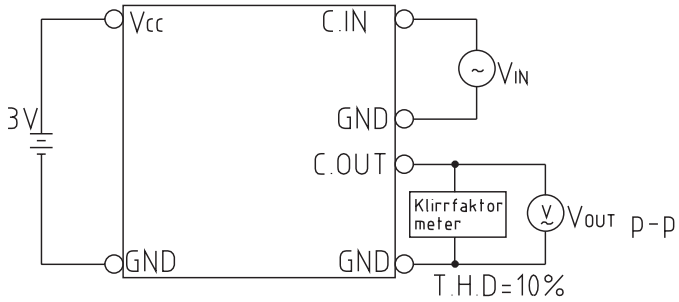
Gain error difference= (V_{OUT} (dBv) −20dB)×←V_{IN} (dB) G
(G=COMP=0.5, EXP=2)

Gain error difference (1) Gc1=−20dB, Ge1=−10dB
Gain error difference (2) Gc2=−40dB, Ge2=−20dB
Gain error difference (3) Ge2=−30dB

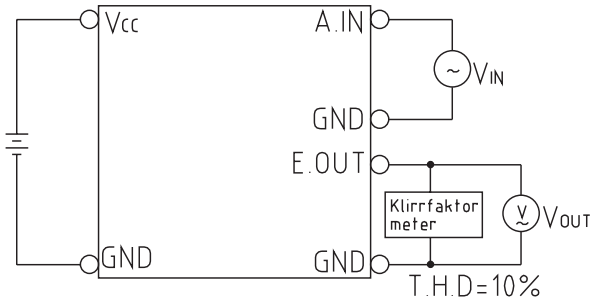
5. Distortion



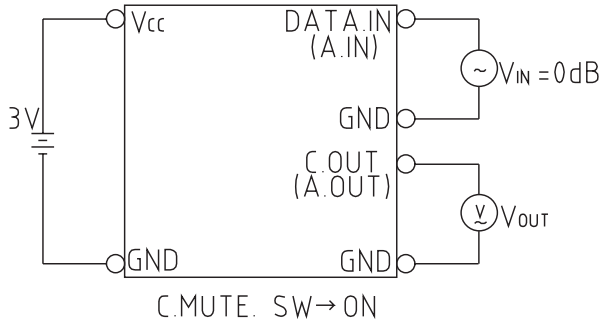
6. Limit voltage



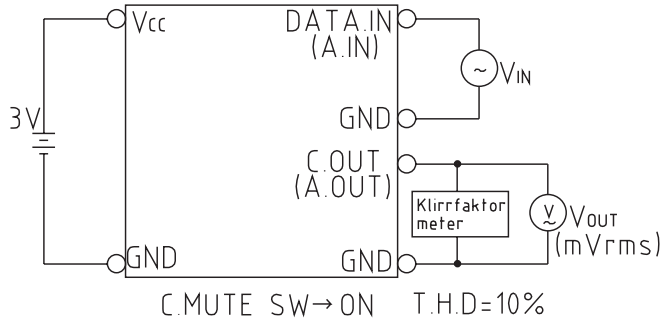
7. Maximum output voltage



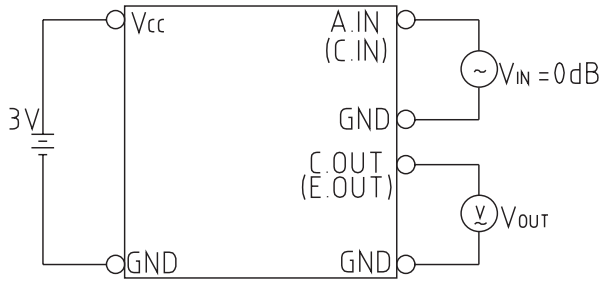
8. DATA pin/Input amp voltage gain



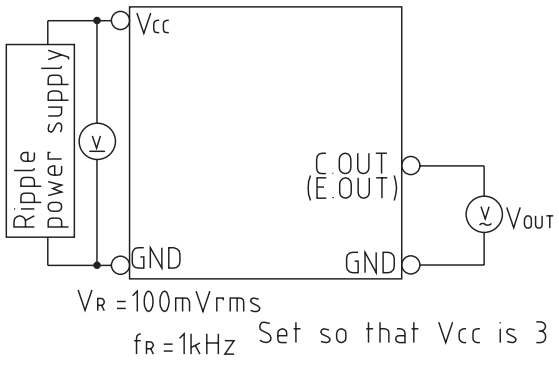
9. DATA pin/Input amp maximum output



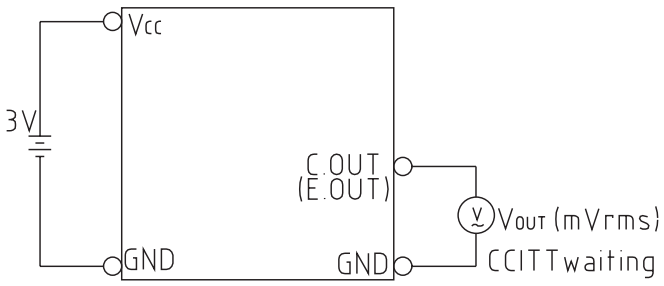
10. Crosstalk



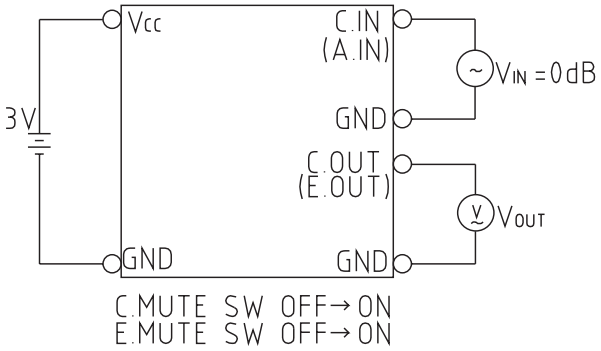
11. Ripple rejection



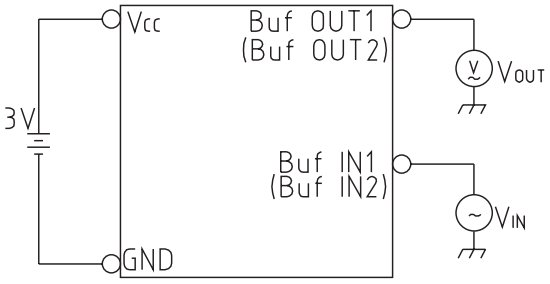
12. Output noise voltage



13. Mute attenuation



14. Buffer amp gain



15. Reference voltage