

PULSE CODE MODULATION SAMPLED DATA FILTERS

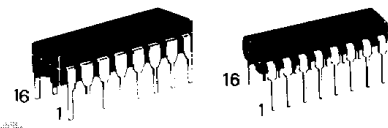
The MC14413-1, -2 and MC14414-1, -2 are sampled data, switched capacitor filter ICs intended to provide the band limiting and signal restoration filtering necessary in PCM Codec voice digitization systems. Both ICs are capable of operating from either a single or split power supply and can be powered-down when not in use. Included on both chips are two totally uncommitted op amps for use elsewhere in the systems as I to V converters, gain adjust buffers, etc.

- Transmit Band-pass and Receive Low-pass (MC14413-1, -2)
- Transmit and Receive Low-pass (MC14414-1, -2)
- D3/D4 Specifications (MC14414-2/13-2)
- CCITT Specification (MC14414-1/13-1)
- Low Operating Power Consumption — 30 mW (Typical)
- Power Down Capability — 1 mW (Maximum)
- Single Supply Capability when Used with MC14404/6/7 Codecs
- ± 5 to ± 8 Volt Power Supply Ranges
- Receive Filter Compatible with 15% to 100% Duty Cycle PAM Inputs with $\text{Sin}x/x$ Correction
- No Precision Components Required (MC14413-1, -2)
- TTL Compatible Inputs Using VLS Pin
- Two Operational Amplifiers Available to Reduce System Component Count

MC14413-1
MC14413-2
MC14414-1
MC14414-2

CMOS LSI

(LOW-POWER COMPLEMENTARY MOS)
PULSE CODE MODULATION
SAMPLED DATA FILTERS

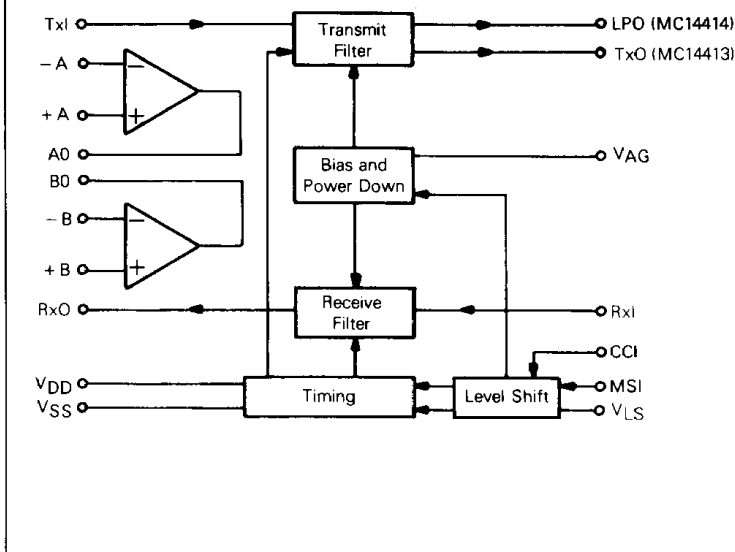


L SUFFIX
 CERAMIC PACKAGE
 CASE 620

P SUFFIX
 PLASTIC PACKAGE
 CASE 648

NOT RECOMMENDED
 FOR NEW DESIGN

BLOCK DIAGRAM



PIN ASSIGNMENT

VAG	1	16	VDD
+ A	2	15	RxI
- A	3	14	RxO
A0	4	13	TxI
B0	5	12	LPO/TxO
- B	6	11	CCI
+ B	7	10	MSI
VSS	8	9	VLS

MAXIMUM RATINGS (Voltages referenced to V_{SS})

Rating	Symbol	Value	Unit
DC Supply Voltage	V _{DD} -V _{SS}	-0.5 to 18	V
Input Voltage, All Pins	V _{in}	-0.5 to V _{DD} + 0.5	V
DC Current Drain per Pin (Excluding V _{DD} , V _{SS})	I	10	mA
Operating Temperature Range	T _A	-40 to 85	°C
Storage Temperature Range	T _{stg}	-65 to 150	°C

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that V_{in} and V_{out} be constrained to the range V_{SS} < (V_{in} or V_{out}) < V_{DD}.
 Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}).



RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
DC Supply Voltage	V _{DD} -V _{SS}	10	12	16	V
Convert Clock Frequency	CCI	50	128	400	kHz
Master Sync Frequency	MSI	-	8	32	kHz

DIGITAL ELECTRICAL CHARACTERISTICS (V_{SS}=0 V)

Characteristic	Symbol	V _{DD} V _{dC}	0°C		25°C			85°C		Unit	
			Min	Max	Min	Typ	Max	Min	Max		
Operating Current	I _{DD}	12	-	5.0	-	2.0	4.3	-	5.0	mA	
Power-Down Current (PDI=V _{SS})	I _{PD}	12	-	50	-	10	40	-	50	µA	
Input Capacitance	C _{in}	12	-	-	-	5.0	7.5	-	-	pF	
MODE CONTROL LOGIC LEVELS											
V _{LS} Power-Down Mode	V _{IH}	12	11.5	-	11	11	-	11.5	-	V	
		15	14.5	-	14	13	-	14.5	-		
V _{LS} TTL Mode	-	12	2	9.0	2.0	-	9	2	9.0	V	
		15	2	11.0	2.0	-	12.0	2	11.0		
V _{LS} CMOS Mode	V _{IL}	12	-	0.8	-	-	0.8	-	0.8	V	
		15	-	0.8	-	-	0.8	-	0.8		
V _{AG} Power-Down Mode	V _{IH}	12	11.5	-	11.5	10.5	-	11.5	-	V	
		15	14.5	-	14.5	13.5	-	14.5	-		
V _{AG} Analog-Ground Mode	V _{IL}	12	-	9.0	-	-	9.0	-	9.0	V	
		15	-	12.0	-	-	12.0	-	12.0		
CMOS LOGIC LEVELS (V_{LS}=V_{SS})											
Input Current CCI	I _{in}	12	-	±1.0	-	±0.00001	±0.3	-	±1.0	µA	
Input Current MSI (Internal Pulldown Resistors)	"1" Level "0" Level	I _{in}	12	-	200	-	50	100	-	200	µA
		I _{in}	12	-	-1.0	-	-0.00001	-0.3	-	-1.0	
Input Voltage CCI, MSI	"0" Level	V _{IL}	12	-	-	-	5.25	3.60	-	-	V
		V _{IL}	15	-	-	-	6.75	4.0	-	-	
	"1" Level	V _{IH}	12	-	-	9.0	6.75	-	-	-	V
		V _{IH}	15	-	-	11.5	8.25	-	-	-	
TTL LOGIC LEVELS (V_{LS}=6 V, V_{SS}=0 V)											
Input Current CCI	I _{in}	12	-	±1.0	-	±0.00001	±0.3	-	±1.0	µA	
Input Current MSI (Internal Pulldown Resistor)	"1" Level "0" Level	I _{in}	12	-	200	-	30	-	-	200	µA
		I _{in}	12	-	-1.0	-	-0.00001	-0.3	-	-1.0	
Input Voltage CCI, MSI	"0" Level "1" Level	V _{IL} V _{IH}	12	-	-	-	-	V _{LS} +0.8	-	-	V
		V _{IL} V _{IH}	12	-	-	V _{LS} +2.0	-	-	-	-	

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ANALOG ELECTRICAL CHARACTERISTICS (V_{DD} = 12 V)

Characteristic	Symbol	0°C		25°C			85°C		Unit	
		Min	Max	Min	Typ	Max	Min	Max		
Input Current V _{AG}	I _{in}	-	±30	-	-	±10	-	±30	μA	
Input Current RxI, TxI	I _{in}	-	-	-	±0.00001	±1.0	-	±1.0	μA	
AC Input Impedance (1 kHz)	RxI, TxI	Z _{in}	1.0	-	1.0	2.0	-	1.0	MΩ	
Input Common Mode Voltage Range	TxI, RxI	V _{ICR}	-	-	1.5	-	10.5	-	V	
Output Voltage Range (R _L = 20 kΩ to V _{AG}) (R _L = 600 Ω to V _{AG}) (R _L = 900 Ω to V _{AG})	TxO, LPO, RxO	V _{OR}	1.5 2.0 1.5	10.5 9.3 10.5	1.5 2.0 1.5	- - -	10.5 9.3 10.5	1.5 2.0 1.5	10.5 9.3 10.5	V
Small Signal Output Impedance (1 kHz)	TxO (MC14413) LPO (MC14414) RxO	Z _o	-	-	-	50 50 50	-	-	-	Ω
Output Current (V _O = 11 V) (V _O = 1 V)	TxO, LPO, RxO TxO, LPO, RxO	I _{OH} I _{OL}	-5 5	-	-5 5	-6.0 7	-	-5 5	-	mA

OP AMP PERFORMANCE (V_{DD} - V_{SS} = 12 V)

Characteristic	0°C		25°C			85°C		Unit
	Min	Max	Min	Typ	Max	Min	Max	
Input Offset Voltage	-	±80	-	-	±70	-	±80	mV
Open Loop Gain Z _L = 600 Ω + 200 pF to V _{AG}	-	-	-	45	-	-	-	dB
Input Bias Current	-	-	-	±0.1	-	-	-	μA
Output Voltage Range (R _L = 20 kΩ to V _{AG}) (R _L = 600 Ω to V _{AG}) (R _L = 900 Ω to V _{AG})	-	-	1.5 2.0 1.5	- - -	10.5 9.3 10.5	-	-	V
Output Current V _{OH} 10.5 V _{OL} 0.5	-	5.1 -5.1	-	7.0 -7.0	-	-	5.1 -5.1	mA
Output Noise	-	0	-	-3	-	-	0	dBrnc0
Slew Rate	-	-	-	2	-	-	-	V/μs

RECEIVE FILTER SPECIFICATIONS

(V_{DD} - V_{SS} = 12 V, CCI = 128 kHz, MSI = 8 kHz, includes sinx/x correction, V_{in} = -10 dBm0, full scale = +3 dBm0, 7 V p-p)

Characteristic	0°C		25°C			85°C		Unit
	Min	Max	Min	Typ	Max	Min	Max	
Gain (1020 Hz)	-0.3	0.30	-	±0.2	-	-0.30	0.30	dB
Pass-band Ripple (50 Hz to 3000 Hz) Relative to 1.02 kHz@0 dBm0	-0.15	+0.15	-	±0.08	-	-0.15	+0.15	dB
Out of Band Rejection Relative to 1.02 kHz@0 dBm0								dB
3400 Hz	-	-0.9	-	-0.5	-0.9	-	-0.9	
4000 Hz-4600 Hz	-	-1.5	-	-0.8	-1.5	-	-1.5	
4600 Hz-64 kHz	-14	-	-14.2	-15.5	-	-14	-	
	-28	-	-30	-33	-	-28	-	
Output Noise (RXI = V _{AG}) ref to 900 Ω	-	-	-	8	12	-	-	dBrnc0
Dynamic Range	-	-	81	83	-	-	-	dB
Absolute Delay Difference								μs
1150 to 2300 kHz Delay	-	22	-	12	22	-	22	
1000 to 2500 kHz Delay	-	35	-	25	35	-	35	
800 to 2700 kHz Delay	-	41	-	31	41	-	41	
Crosstalk 0 dBm@3 kHz	-	-	-	76	-	-	-	dB
Power Supply Rejection Ratio V _{DD} = 12 V + 0.1 Vrms@1 kHz	-	-	-	40	-	-	-	dB

MC14413-1, MC14413-2, MC14414-1, MC14414-2

TRANSMIT FILTER SPECIFICATIONS ($V_{DD} - V_{SS} = 12\text{ V}$, $CC = 128\text{ kHz}$, $MSI = 8\text{ kHz}$, $V_{in} = -10\text{ dBm0}$, full scale = $+3\text{ dBm0}$, 7 Vp-p)

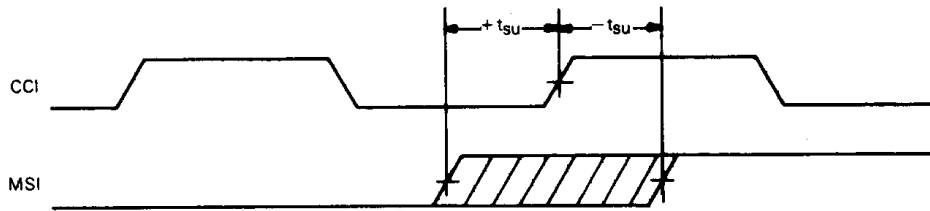
Characteristic		0°C		25°C			85°C		Unit
		Min	Max	Min	Typ	Max	Min	Max	
Gain (1020 Hz)	MC14413-1, -2	-0.3	+0.3	-	± 0.2	-	-0.3	+0.3	dB
	MC14414-1, -2	-0.25	0.25	-	± 0.15	-	-0.25	0.25	
Pass-band Ripple (300 Hz to 3000 Hz)	Relative to 1.02 kHz@0 dBm0	-0.15	0.15	-	± 0.08	-	-0.15	0.15	dB
Rejection									dB
50 Hz (Relative to 1.02 kHz)	MC14413-1, -2 Only	-24	-	-26	-28	-	-24	-	
60 Hz	MC14413-1, -2 Only	-22	-	-22.7	-25	-	-22	-	
180 Hz		-	-0.8	-	-0.3	-	-	-0.8	
3400 Hz	MC14414-1/13-1	-	-0.8	-	-0.5	-0.8	-	-0.8	
	MC14414-2/13-2	-	-1.5	-	-0.6	-1.5	-	-1.5	
4000 Hz-4600 Hz		-14	-	-14	-15.5	-	-14	-	
4600 Hz-64 kHz		-32	-	-32	-33	-	-32	-	
Output Noise (300 Hz-3400 Hz)	MC14413-1, -2	-	15	-	10	15	-	15	dBm0
	MC14414-1, -2	-	12	-	7	10	-	12	
Dynamic Range (7 V p-p Max)	MC14413-1, -2	-	-	78	84	-	-	-	dB
	MC14414-1, -2	-	-	81	87	-	-	-	
Absolute Delay Difference									μs
1150 to 2300 kHz Delay		-	22	-	12	22	-	22	
1000 to 2500 kHz Delay		-	35	-	25	35	-	35	
800 to 2700 kHz Delay		-	41	-	31	41	-	41	
Crosstalk	0 dBm@3 kHz RXO, TXO	-	-	-	76	-	-	-	dB
Power Supply Rejection Ratio	$V_{DD} = 12\text{ V} + 0.1\text{ VRMS}@1\text{ kHz}$	-	-	-	40	-	-	-	dB

2

SWITCHING CHARACTERISTICS ($V_{DD} - V_{SS} = 10\text{ V}$)

Characteristics	Symbol	0 to 70°C			Units
		Min	Typ	Max	
Input Rise Time	CCI, MSI	t_{TLH}	-	-	4 μs
Input Fall Time		t_{THL}	-	-	
Pulse Width	CCI, MXI	t_{WH}	200	-	ns
Clock Pulse Frequency	CCI	f_{CL}	50	-	500 kHz
CCI Duty Cycle			40	-	60 %
Setup Time MSI Rising Edge to CCI Rising Edge (CCI = 128 kHz)*		t_{SU}	-3.0	-	+3.0 μs

*Specifications assume use of 50% duty cycle for clocks.



FUNCTIONAL DESCRIPTION OF PINS

Pin 1 — V_{AG} (Analog Ground)

This pin should be held at approximately $(V_{DD}-V_{EE})/2$. All analog inputs and outputs are referenced to this pin. If this pin is brought to within approximately 1.0 V of V_{DD} , the chip will be powered down.

Pin 2 — +A

Noninverting input of op-amp A.

Pin 3 — -A

Inverting input of op-amp A.

Pin 4 — A0

Output of uncommitted op-amp A.

Pin 5 — B0

Output of uncommitted op-amp B.

Pin 6 — -B

Inverting input of op-amp B.

Pin 7 — +B

Non-inverting input of op-amp B.

Pin 8 — V_{SS}

This is the most negative supply pin and digital ground for the package.

Pin 9 — V_{LS} (Logic Shift Voltage)

The voltage on this pin determines the logic compatibility for the CCI and MSI inputs. If V_{LS} is within 0.8 V of V_{SS} , the thresholds will be for CMOS operating between V_{DD} and V_{SS} . If V_{LS} is within 1.0 V of V_{DD} , the chip will power down. If V_{LS} is between $V_{DD}-2$ V and $V_{SS}+2$ V, the thresholds for logic inputs at CCI and MSI will be between $V_{LS}+0.8$ V and $V_{LS}+2.0$ V for TTL compatibility.

Pin 10 — MSI (Master Sync Input)

This pin should receive a low-to-high transition concurrent with each new PAM sample received at the receive filter input, ADI. A new transmit filter output sample will be presented 8 CCI clocks after this.

Pin 11 — CCI (Convert Clock Input)

Normally, a 128 kHz clock signal should be applied to this pin to operate both filters at $f_o=3100$ Hz. For other break frequencies use the following equation: $f_o=0.02422 f$ clock.

Pin 12 — TxO (Transmit Band-pass Output— MC14413-1, -2)

This is the output of the transmit band-pass filter. It is 100% duty cycle PAM at 8 kHz.

Pin 12 — LPO (Transmit Low-pass Output — MC14414-1, -2)

This is the output of the transmit low-pass filter. It is 100% duty cycle PAM at CCI frequency, normally 128 kHz.

Pin 13 — TxI (Transmit Input)

This is the transmit-filter input.

Pin 14 — RxO (Receive Output)

This pin is the output of the receive filter. It is 100% duty cycle PAM at the same frequency as the CCI pin, normally 128 kHz.

Pin 15 — RxI (Receive Input)

This is the receive filter input. It will accept 15% to 100% duty cycle PAM at 8 kHz.

Pin 16 — V_{DD}

Nominally 12 volts.

NOTE: Both V_{AG} and V_{LS} are high-impedance inputs.

PCM FILTER DESCRIPTION

Transmit Filter Description

The transmit filter in both the MC14413-1, -2 and MC14414-1, -2 consists of a 5-pole elliptic low-pass section operating at a sampling rate of 128 kHz. This filter provides the band limiting necessary to prevent aliasing of the input signal in the codec. Since the transmit filter itself samples at a 128 kHz rate, its input (TxI) signal should be band limited to 124 kHz. If energy above 124 kHz could be present, a single-pole RC pre-filter should precede the transmit filter.

In addition to the low-pass section, the transmit filter of the MC14413-1, -2 incorporates a 3 pole Chebychev high-pass filter to provide 50/60 Hz and 15 Hz rejection. Although the MC14414-1, -2 does not include this filter, it can be externally realized using one of the on-board uncommitted op amps as an active filter. This is shown in Figures 10 and 11.

Both the MC14413-1, -2 and MC14414-1, -2 can be used in cascade to produce a sharper rolloff. This is especially useful in testing the MC14413-1, -2 since the 8 kHz PAM from the Tx filter will be sampled and $\sin x/x$ corrected by applying the Tx output to the RxI input and observing RxO.

Receive Filter Description

The receive filter sections of the MC14413-1, -2 and MC14414-1, -2 are identical and are 5-pole elliptic low-pass filters operating at a sampling rate of 128 kHz. These filters are used to smooth the PAM output of the PCM Codec. They are similar to the transmit low-pass sections with the exception that they include a 1/8 duty cycle 8 kHz pre-sampler on their inputs (RxI).

This circuitry resamples the codec's PAM output and thereby effectively eliminates the $\sin x/x$ distortion normally associated with 15% to 100% 8 kHz PAM pulse trains and eliminates the need to predistort the receive filter's pass-

band characteristic.

In normal use as a codec's receive filter, MSI will be an 8 kHz signal. With the MC14407 codec family, the filter MSI is the same as the codec MSI. With other codecs, the MSI signal is receive sync.

The MC14414 may also be used in analog applications by disabling the $\sin x/x$ correction. If MSI and CCI are tied together, the receive filter has the same frequency response as the transmit filter and a gain of 18 dB.

Timing And Synchronization

Timing and synchronization of the MC14413-1, -2 and MC14414-1, -2 are provided by the CCI and MSI inputs. A 128 kHz signal should be applied to CCI. An 8 kHz signal, whose low-to-high transition coincides with a new output sample from the PCM codec, should be applied to MSI. The rising edges of the CCI and MSI signals should be skewed no more than 3.0 μ s for proper operation.

Logic levels of these signals can be either TTL or CMOS compatible. Choice of logic level can be user determined by applying the appropriate voltage to the level shift control pin, V_{LS} .

Power Down

Both the MC14413-1, -2 and MC14414-1, -2 may be powered down in either of two ways: by bringing V_{AG} to within 0.5 V of V_{DD} or by bringing V_{LS} to within 0.5 V of V_{DD} .

If used on a single supply with the MC14406/7 PCM Codec, the filter IC will power down automatically when the codec does, since the codec raises its V_{AG} pin to V_{DD} in power down. When used in a split supply configuration, the circuit shown in Figure 7 may be utilized.

FIGURE 1 — RECEIVE FILTER TYPICAL AND GUARANTEED PERFORMANCE (MC14413-1, -2/MC14414-1, -2, SINX/X CORRECTION INCLUDED)

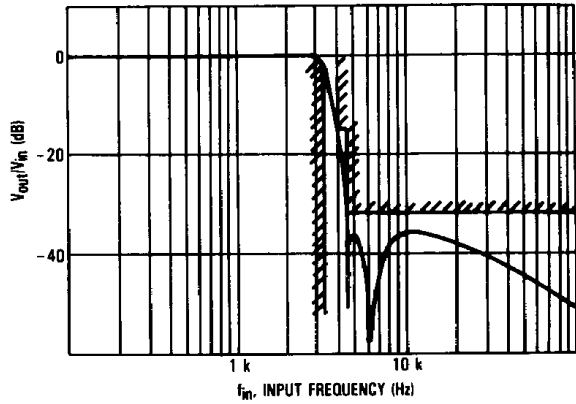


FIGURE 2 — RECEIVE FILTER TYPICAL AND GUARANTEED PASS-BAND PERFORMANCE (MC14413-1, -2/MC14414-1, -2)

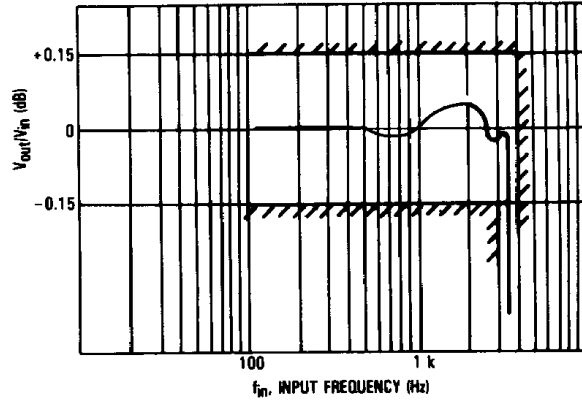


FIGURE 3 — TRANSMIT FILTER TYPICAL AND GUARANTEED PERFORMANCE (MC14413-1, -2 AND MC14414-1, -2 USING FIGURES 10 AND 11)

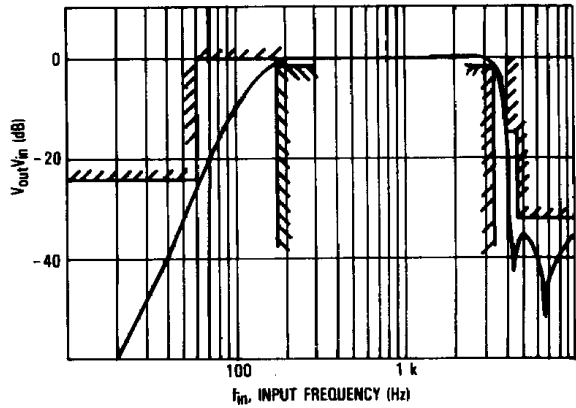


FIGURE 4 — TRANSMIT FILTER TYPICAL AND GUARANTEED PASS-BAND PERFORMANCE (MC14413-1, -2 AND MC14414-1, -2 USING FIGURES 10 AND 11)

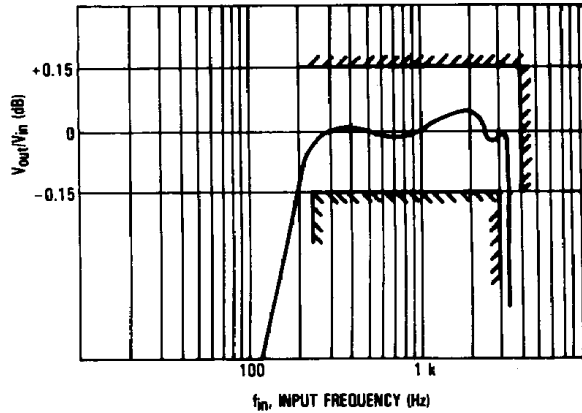


FIGURE 5 — TRANSMIT FILTER TYPICAL AND GUARANTEED PASS-BAND PERFORMANCE (MC14414-1, -2)

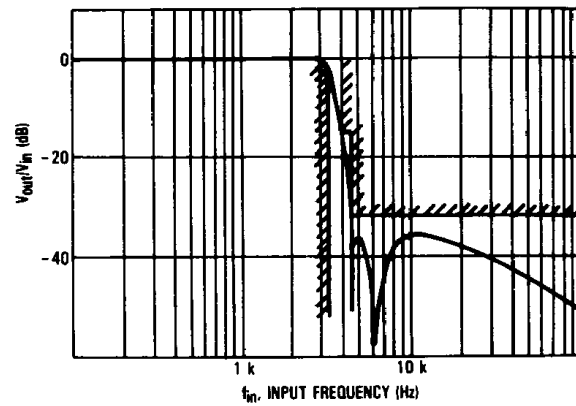
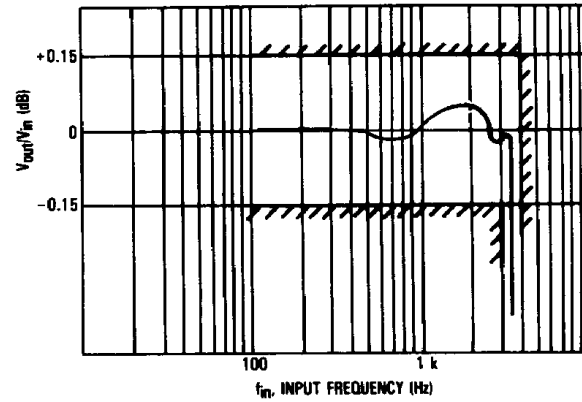


FIGURE 6 — TRANSMIT FILTER TYPICAL AND GUARANTEED PERFORMANCE (MC14414-1, -2)



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MC14413-1, MC14413-2, MC14414-1, MC14414-2

FIGURE 7 — TYPICAL CIRCUIT CONFIGURATION USING THE MC14407 CODEC AND MC14413-1, -2 FILTER (SPLIT SUPPLY)

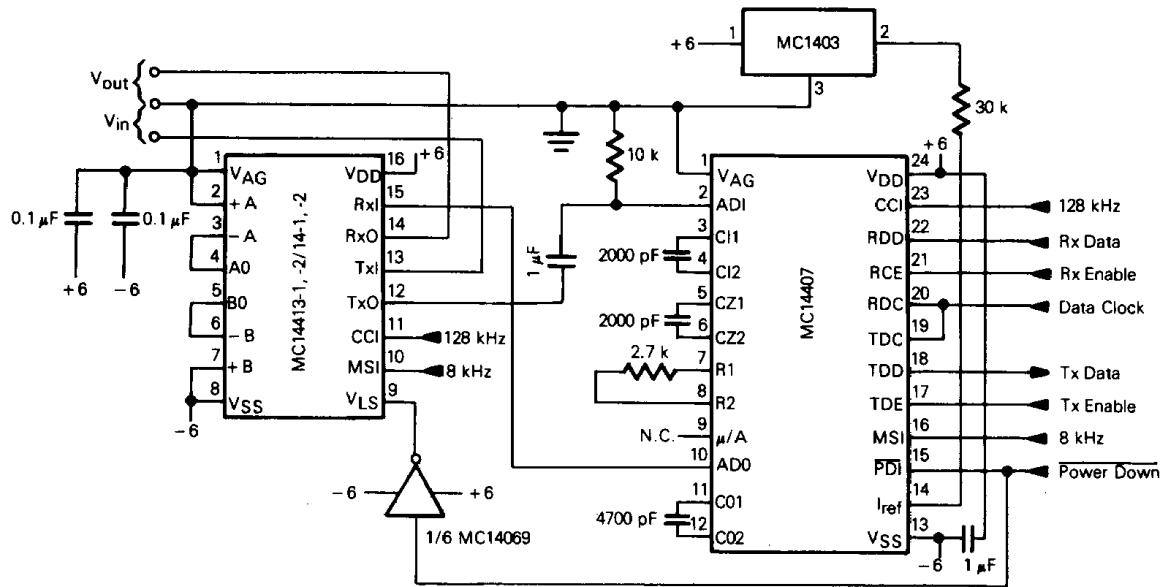
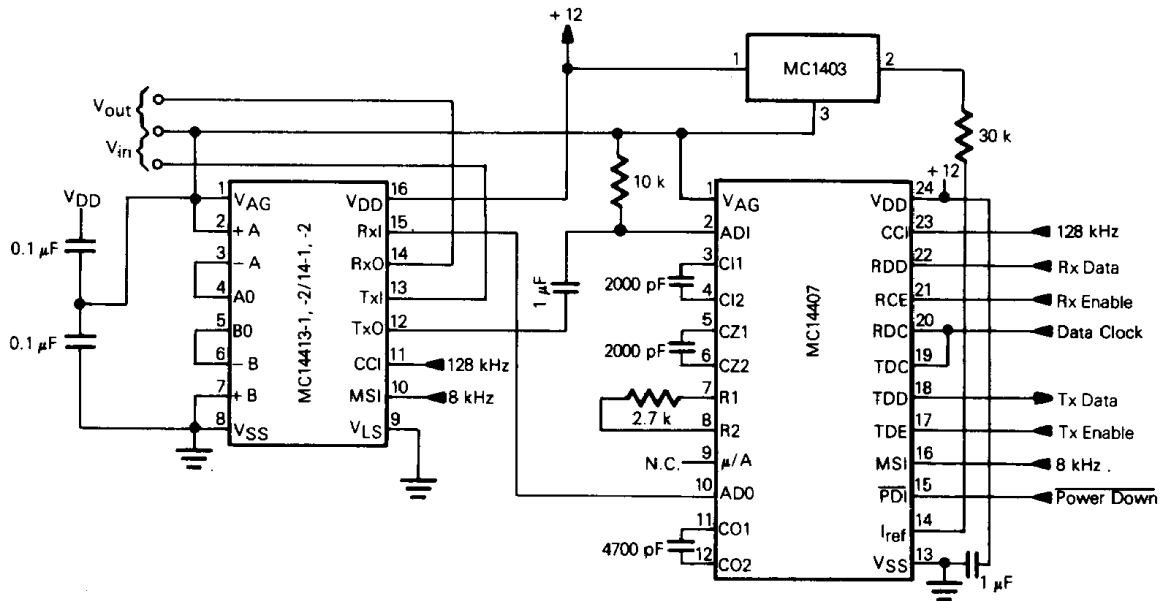
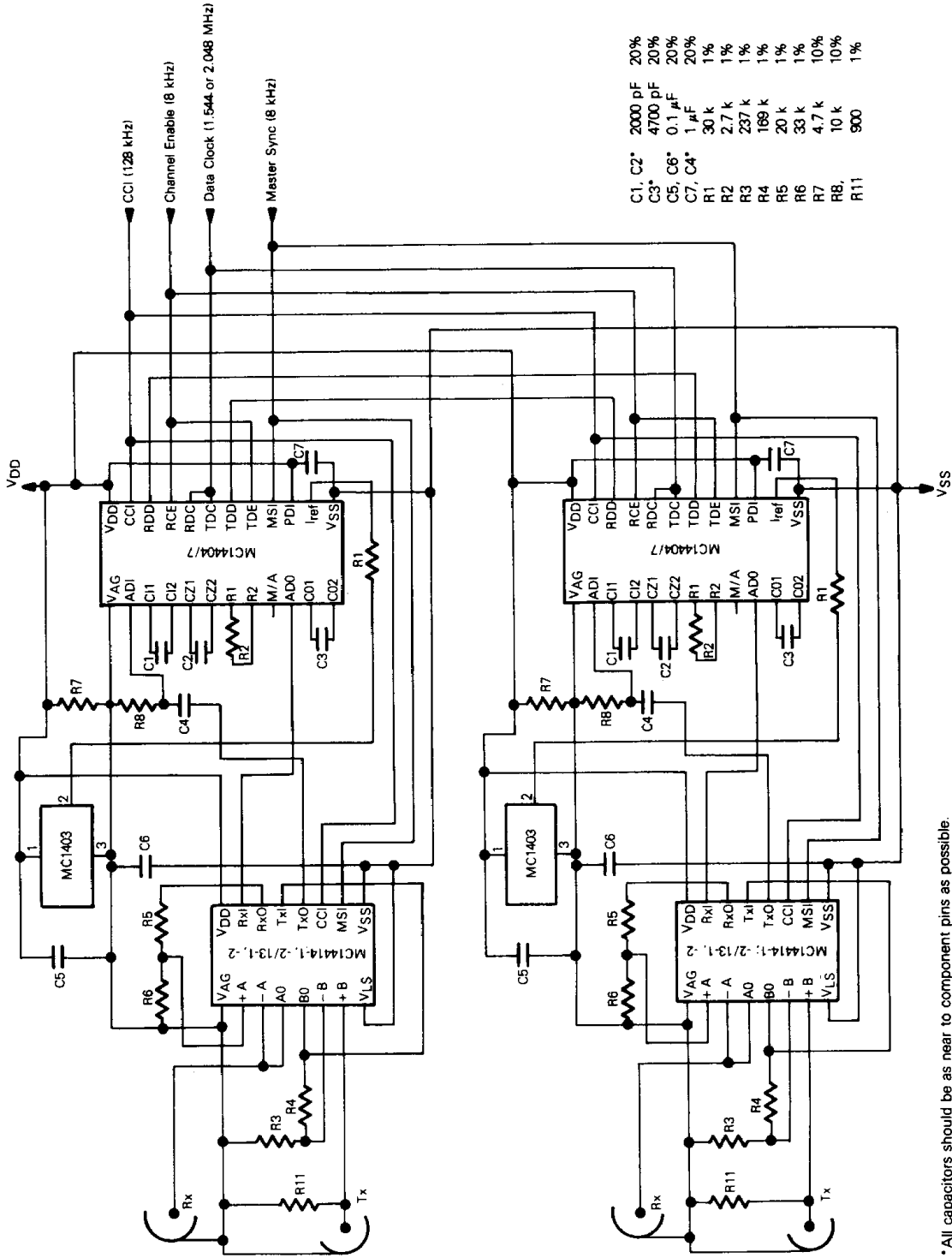


FIGURE 8 — TYPICAL CIRCUIT CONFIGURATION USING THE MC14407 CODEC AND MC14413-1, -2 FILTER (SINGLE SUPPLY)



*Keep all capacitors as near to device pins as possible.

FIGURE 9 - MOTOROLA CODEC FILTER EVALUATION BOARD



C1, C2*	2000 pF	20%
C3*	4700 pF	20%
C5, C6*	0.1 μF	20%
C7, C4*	1 μF	20%
R1	30 k	1%
R2	2.7 k	1%
R3	237 k	1%
R4	169 k	1%
R5	20 k	1%
R6	33 k	1%
R7	4.7 k	10%
R8, R11	10 k	10%
	900	1%

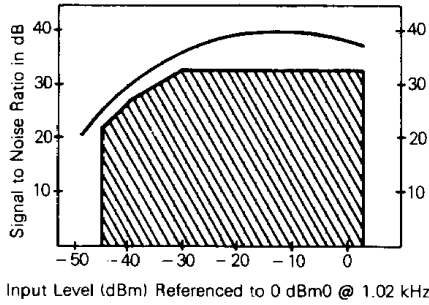
* All capacitors should be as near to component pins as possible.
 * In noisy environments, R3-R6 should be 10 kΩ or less to minimize pickup.

TYPICAL END-TO-END CHANNEL PERFORMANCE FOR MOTOROLA
MC14413-1, -2/14-1, -2-MC14404/7 CODEC AND FILTER

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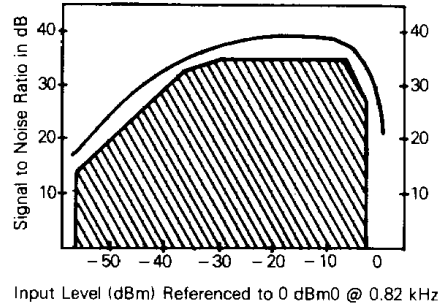
MC14407/13-2
SPECIFICATION BELL PUB 43801

QUANTIZING DISTORTION
SINUSOIDAL INPUT
C MESSAGE WEIGHTED

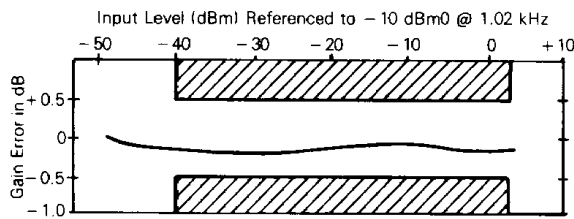


MC14404/13-1
SPECIFICATION CCITT G7.12

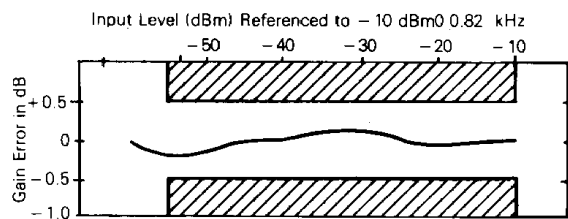
QUANTIZING DISTORTION
PSEUDO RANDOM NOISE
3 kHz FLAT WEIGHTING



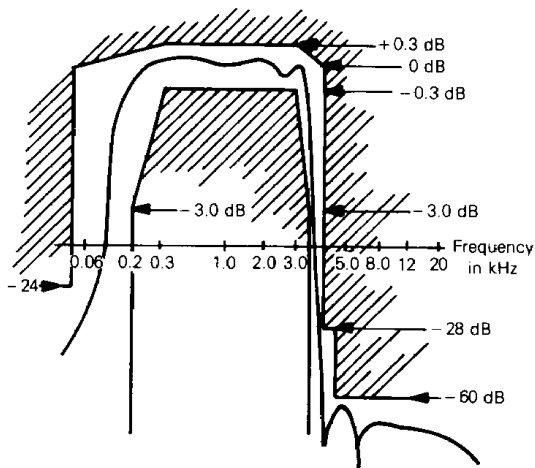
SINUSOIDAL GAIN TRACKING



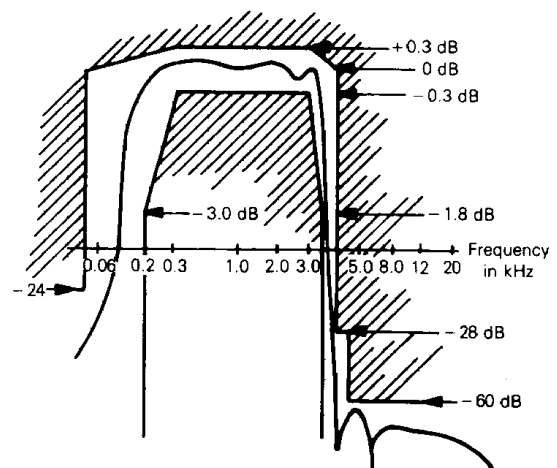
PSEUDO-RANDOM NOISE GAIN TRACKING



GAIN vs FREQUENCY, SINUSOIDAL



GAIN vs FREQUENCY, SINUSOIDAL

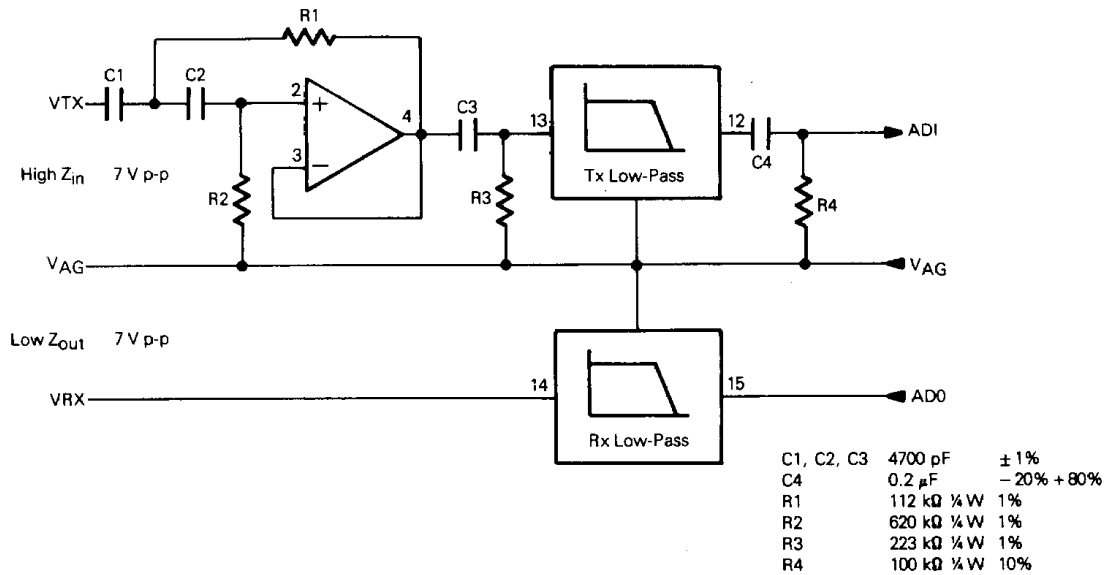


TYPICAL END-TO-END PERFORMANCE OF MOTOROLA CODEC AND FILTER
 (All measurements made using HP3779B PCM Test Set)

Specification	Typical Performance of MC14407/4 Codec and MC14413 Filter	Bell System D4 Voice Frequency Requirements PUB 43801	CCITT G7.12 Voice Frequency Requirements
Channel Saturation	+3 dBm0	+3 dBm0	+3 dBm0
Gain Tracking with 1 kHz Tone			
+3 to -40 dBm0	±0.2 dB	≤ ±0.5 dB	≤ ±0.5 dB
-40 to -50 dBm0	±0.3 dB	≤ ±1.0 dB	≤ ±1.0 dB
-55 dBm0	±0.5 dB	≤ ±3.0 dB	≤ ±3.0 dB
Quantizing Distortion @ 1 kHz			
+3 to -30 dBm0	37 dB	≥ 33 dB	> 33 dB
-35 dBm0	34 dB	≥ 30 dB	≥ 30 dB
-40 dBm0	31 dB	≥ 27 dB	≥ 27 dB
-45 dBm0	25 dB	≥ 22 dB	≥ 22 dB
Idle Channel Noise with VTX = VAG	16 dBmnc0	≤ 23 dBmnc0	≤ -65 dBm0P
Quiet Code Noise (all 1's at decoder (RDD) input)	10 dBmnc0	≤ 15 dBmnc0	≤ -75 dBm0P
Selective Response @ Multiplex of 8 kHz	-60 dBm0	See Frequency Response	≤ -50 dBm0
Frequency Response @ 0 dBm0 Input			
50 Hz Gain	-28 dB	-	≤ -24 dB
60 Hz Gain	-24 dB	≤ -20 dB	-
200 to 300 Hz Ripple	±0.20 dB	≤ ±0.3 dB	≤ ±0.5 dB
3400 Hz Gain	-1.0 dB	≥ -3.0 dB	≥ -1.8 dB
4000 Hz Gain	-32 dB	≤ -28 dB	≤ -28 dB
≥ 4600 Hz Gain	< -62 dB	≤ -60 dB	≤ -60 dB
Single Frequency Spurious Response			
In Band with Input 1 kHz @ 0 dBm	≤ -44 dB	≤ -40 dB	≤ -40 dB
Out of Band with Input 0 to 12 kHz @ 0 dBm	≤ -32.5 dB	≤ -28 dB	≤ -25 dB
Differential Delay Distortion			
1150 to 2300	58 μs	≤ 60 μs	
1000 to 2500	72 μs	≤ 100 μs	
900 to 2700	91 μs	≤ 200 μs	

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FIGURE 10 — FILTER SCHEMATIC FOR MC14414-1, -2 WITH 60 Hz REJECT FILTER



*In noisy environments, R1-R4 should be 10 kΩ or less to minimize pickup.

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FIGURE 11 — FILTER SCHEMATIC FOR MC14414-1, -2 WITH 60 Hz REJECTION AND 900 TERMINATION

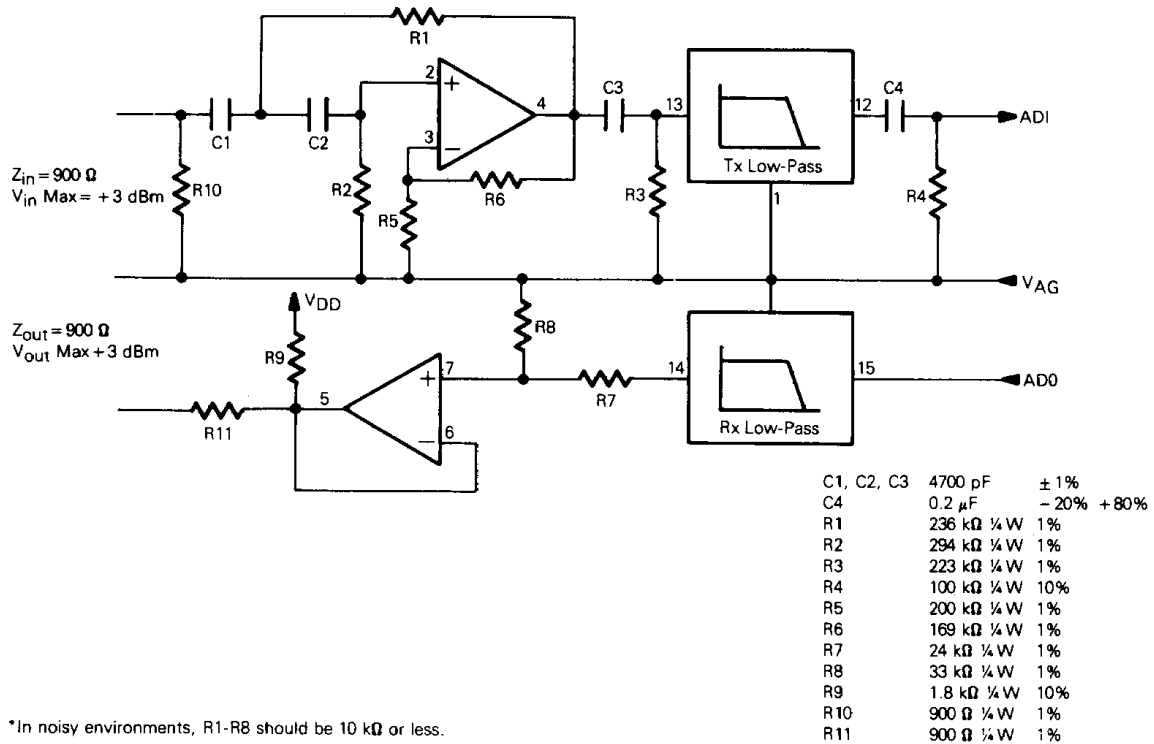


FIGURE 12 — TYPICAL 2-WIRE PORT INTERFACE USING MC14413

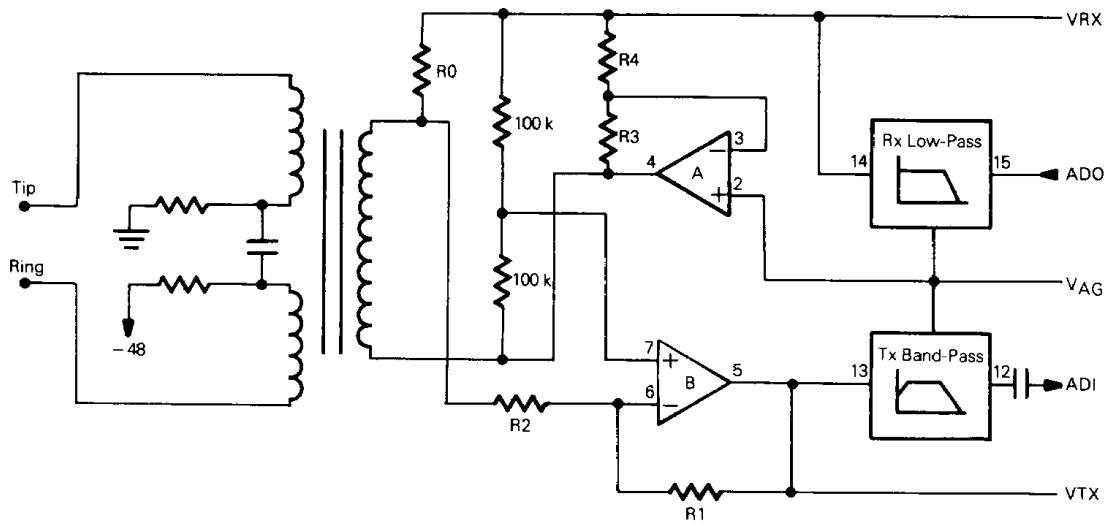
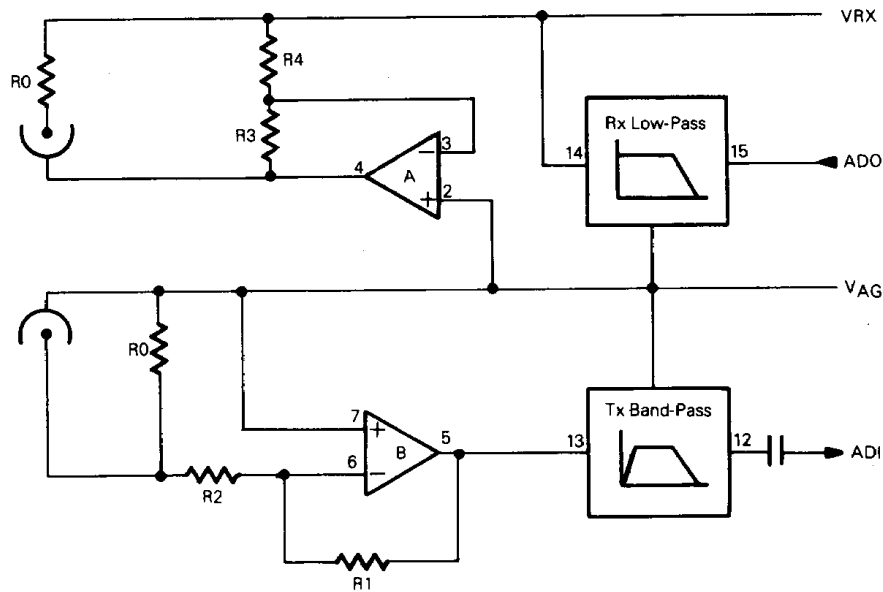


FIGURE 13 — TYPICAL 4-WIRE PORT INTERFACE USING MC14413

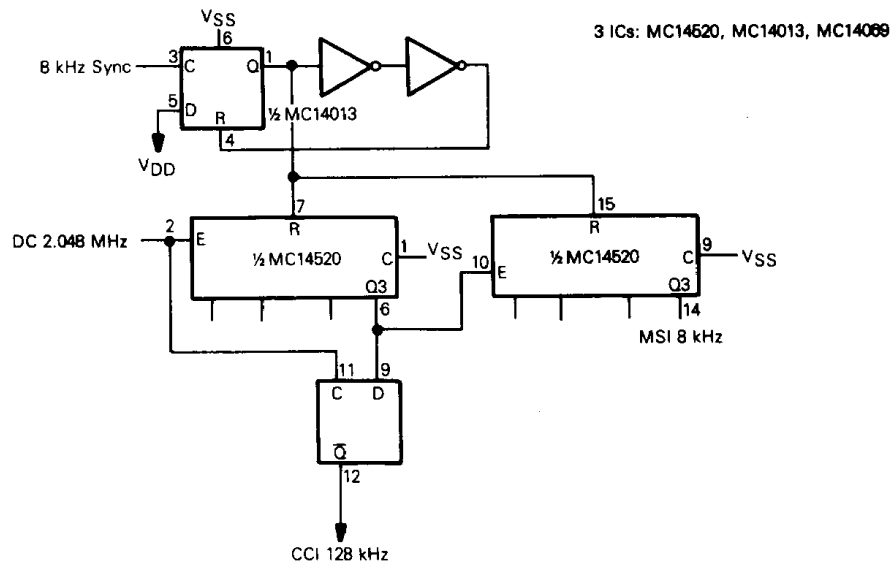


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Full Scale Voltage at TxO (LPO) RxI	Port Impedance (RO)	Relative Level	R1	R2	R3	R4
5 V p-p	800 900	4.16 dB 2.4 dB	161 k 198 k	100 k 150 k	23.9 k 51.8 k	100 k 100 k
6.2 V p-p, +9 dBm	800 900	6.00 dB 4.26 dB	100 k 245 k	100 k 150 k	Short 18.5	Open 100 k
7.6 V p-p, +9 dBm	900	6.00 dB	150 k	150 k	Short	Open

Interface to 2-wire or 4-wire ports using the MC14413-1, -2/14-1, -2 is shown in Figures 12 and 13, respectively. The table above shows some voltages typically used with the filter and the appropriate resistor values for cases in which the codec/filter OTLP is less than or equal to the 0 dBm level. If the codec/filter overload voltage is greater than required for 0 dBm levels in the load, the RxO output can be voltage divided by two resistors and the extra op amp used as a voltage follower.

FIGURE 14 — GENERATOR FOR 128 kHz IN SYSTEM USING 2.048 MHz CLOCK



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FIGURE 15 — 128 kHz FREQUENCY SYNTHESIZER USING 8 kHz INPUT

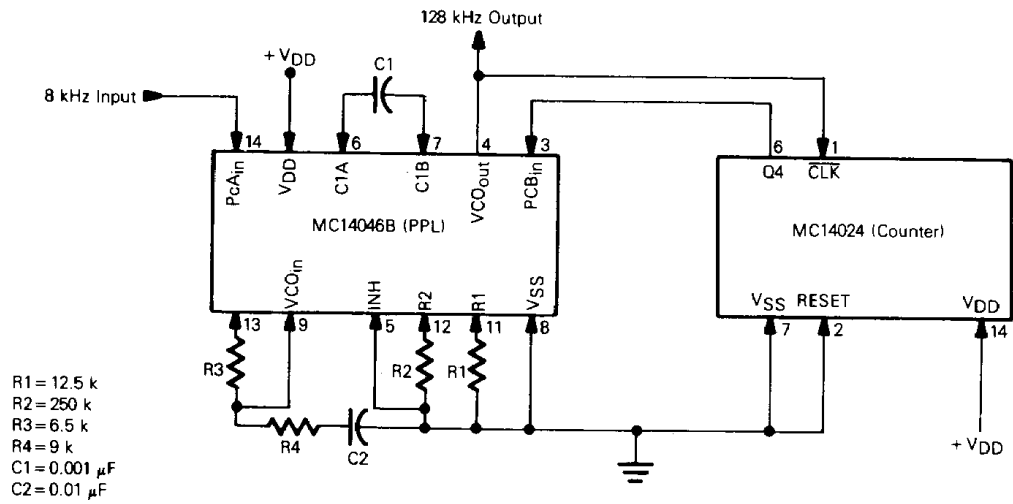


FIGURE 16 — GENERATION OF 128 kHz IN SYSTEM USING 1.544 MHz CLOCK

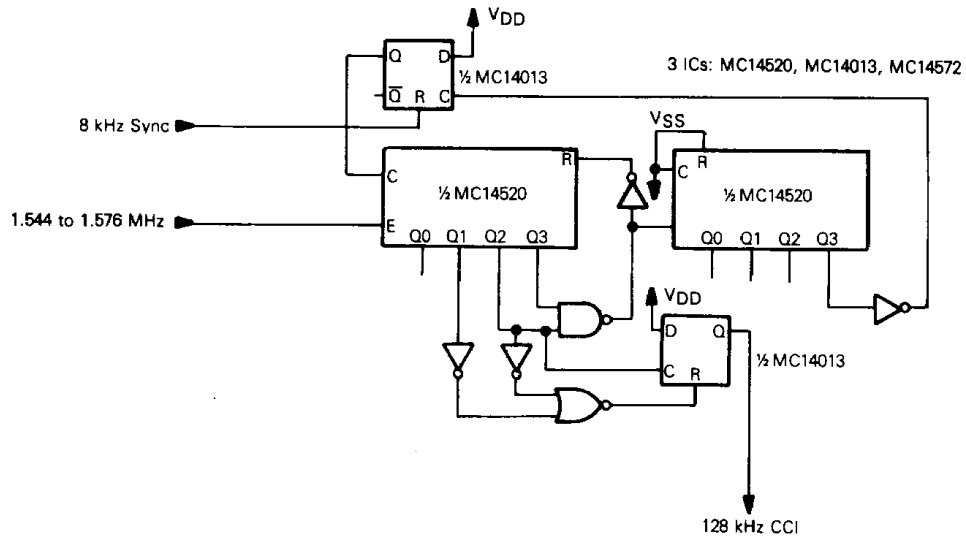
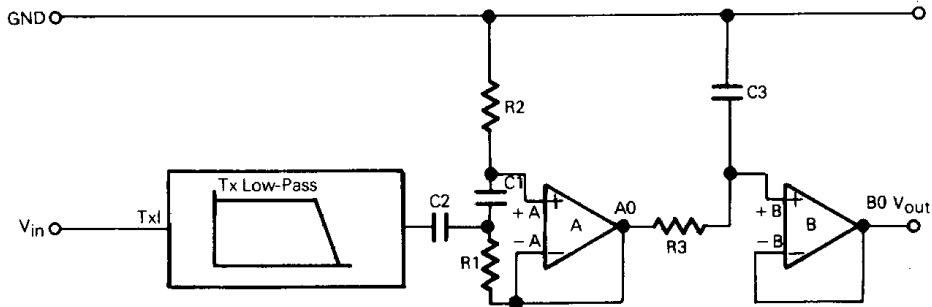


FIGURE 17 — TELEPHONY C-MESSAGE FILTER USING MC14414-1, -2 FILTER



C1, C2, C3	4700 pF	2%
R1	19.6 k	1%
R2	97.6 k	1%
R3	8.25 k	1%

VAG, VLS connected to GND
 MSI, CCI connected to 134 kHz TTL clock
 0.1 μ F, VDD to VAG and VSS to VAG
 Rx Filter can also be used and will provide 18 dB of input gain
 VDD = +5 V, VSS = -5 V

NOTE: Op Amps A and B are the free op amps on the MC14414-1, -2 filter.

