CML Semiconductor Products

PRODUCT INFORMATION

FX304 C-Net Audio Processor

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Provisional Issue

Features/Applications

- Full Duplex Audio Processing
- Designed to meet Net-C Cellular Specification
- On-Chip Audio Bandpass Filters (300-3000Hz)
- Fixed Frequency Inversion
- Clear/Invert Facility
- Output Enable/Disable
- High Baseband and Carrier Rejection
- Independent I/P Gain Adjustment
- On-Chip Clock Oscillator Circuits
- Crystal Oscillator Stability
- Single 5V CMOS Process
- Surface Mount and DIL Package Styles

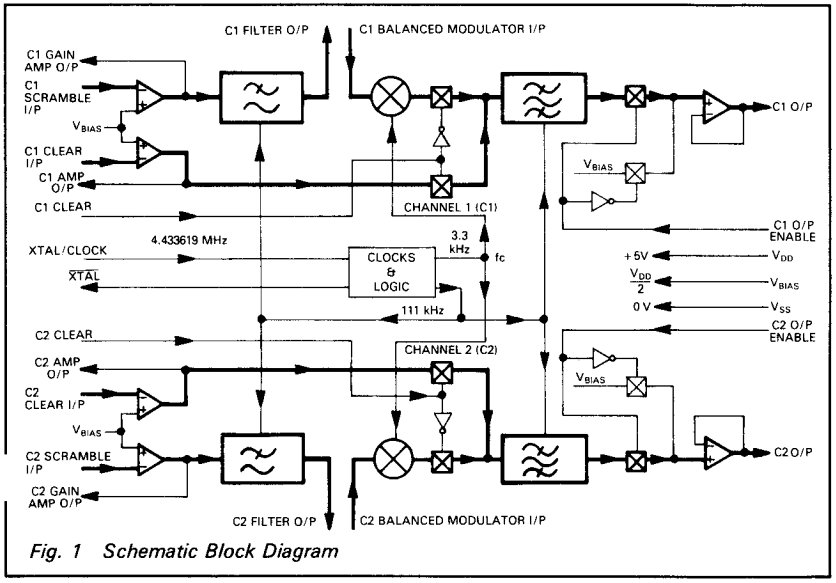


Fig. 1 Schematic Block Diagram

FX304

Brief Description

The FX304 is a duplex filter array and frequency inversion scrambler compatible with the Net-C specification. The two channels, C1 and C2 are identical and independent, each consisting of:

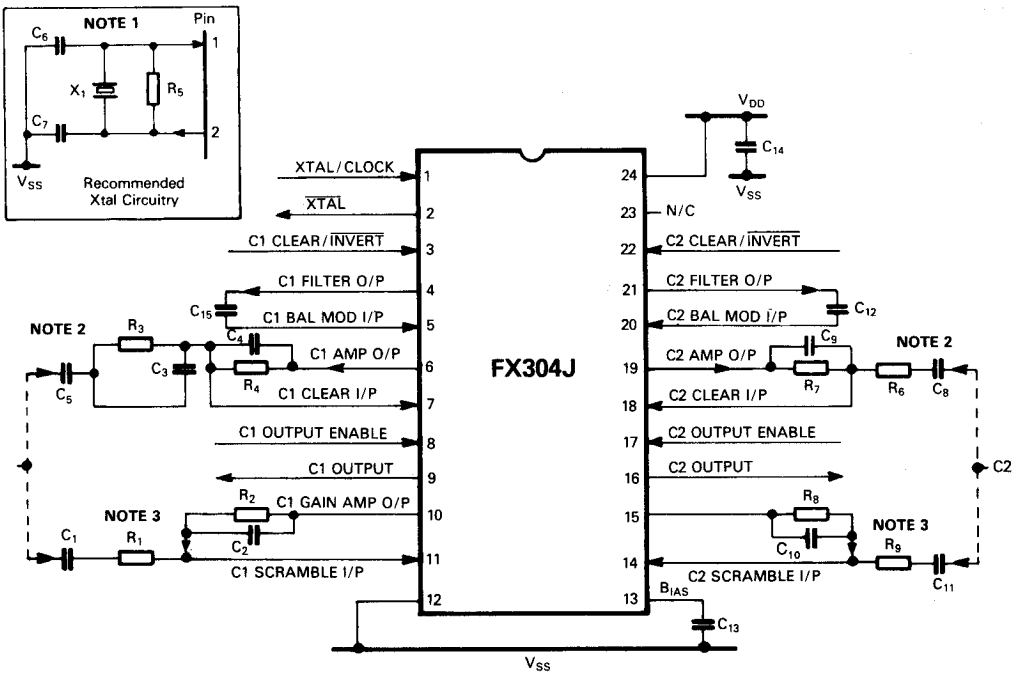
1. A 10th order 3.1kHz input lowpass filter in the 'Invert' path.
2. A balanced modulator providing fixed frequency inversion (3.3kHz) and having high baseband and carrier rejection.
3. A 14th order channel output bandpass filter (300Hz to 3kHz).
4. Input Op-Amps in both 'Clear' and 'Invert' paths allowing external components to set input gains, and pre-emphasis or de-emphasis in the 'Clear' path.
5. Clear/$\overline{\text{Invert}}$ switching causing automatic changover of signal routes and input circuitry.
6. A buffered low noise output with switching clock filter.
7. An output enable switching facility.

Both filter sets meet the Net-C specification and use switched capacitor technology. The common carrier frequency and filter switching clock are generated on-chip using an external 4.433619MHz Xtal or clock input.
The FX304 is a low-power, single 5V CMOS device and is available in 24-pin DIL and 24-pin plastic SMD packages.

Pin Number			Functions
DIL FX304J	Quad Plastic FX304LG	PLCC FX304LS	
1	1	1	**Xtal/Clock:** 4.433619MHz Xtal or externally derived clock is injected at this pin. See Fig. 2.
2	2	2	**$\overline{\text{Xtal}}$:** Output of clock oscillator inverter.
3	3	3	**C1 Clear/$\overline{\text{Invert}}$:** Controls the operation of channel 1 modulation. See Table 1. Internal 1MΩ pull-up.
4	4	4	**C1 Filter Output:** The output of the channel 1 input filter. It is to be coupled to "C1 balanced modulator input" via a 1.0μF capacitor (C_{15}). See Fig. 2.
5	5	5	**C1 Balanced Modulator Input:** The input to channel 1 balanced modulator. Internally biased at $V_{DD}/2$, it is to be coupled to "C1 Filter Output" via a 1.0μF capacitor (C_{15}). See Fig. 2.
6	6	6	**C1 Amp Output:** Channel 1 amplifier, with external components (see Fig. 2) can be used to provide pre-emphasis, de-emphasis and/or gain in the 'Clear' path.
7	7	7	**C1 Clear Input:** The negative input of channel 1 amplifier for use in the 'Clear' path. Recommended external components shown in Fig. 2.
8	8	8	**C1 Output Enable:** Controls the status of channel 1 output. See Table 1. Internal 1MΩ pull-up.
9	9	9	**C1 Output:** The analogue output of channel 1, Internally biased at $V_{DD}/2$. Output state is dependent on channel 1 "Clear/Invert" and "Output Enable" pins. See Table 1.
10	10	10	**C1 Gain Amp Output:** The output pin of Channel 1 gain adjusting op-amp, see Fig. 2 for gain setting components.
11	11	11	**C1 Scramble Input:** The analogue signal input to channel 1 in the 'Invert' mode. This input is to a gain adjusting op-amp whose gain is set by external components. See Fig. 2.
12	12	12	**V_{SS}:** Negative Supply (GND).
13	13	13	**Bias:** The analogue bias line at $V_{DD}/2$. It should be decoupled to V_{SS} via a 1.0μF or greater capacitor. See Fig. 2.
14	14	14	**C2 Scramble Input:** The analogue signal input to channel 2 in the 'Invert' mode. This input is to a gain adjusting op-amp whose gain is set by external components. See Fig. 2.
15	15	15	**C2 Gain Amp Output:** The output pin of Channel 2 gain adjusting op-amp, see Fig. 2 for gain setting components.
16	16	16	**C2 Output:** The analogue output of channel 2, internally biased at $V_{DD}/2$. Output state is dependent on channel 2 "Clear/Invert" and "Output Enable" pins. See Table 1.
17	17	17	**C2 Output Enable:** Controls the status of channel 2 output. See Table 1. Internal 1MΩ pull-up.
18	18	18	**C2 Clear Input:** The negative input of channel 2 amplifier for use in the 'Clear ' path. Recommended external components shown in Fig. 2.
19	19	19	**C2 Amp Output:** Channel 2 amplifier with external components (see Fig. 2) can be used to provide pre-emphasis, de-emphasis and/or gain in the 'Clear' path.
20	20	20	**C2 Balanced Modulator Input:** The input to channel 2 balanced modulator. Internally biased at $V_{DD}/2$, it is to be coupled to 'C2 Filter Output' via 1.0μF capacitor (C_{12}). See Fig. 2.
21	21	21	**C2 Filter Output:** The output of the channel 2 input filter. It should be coupled to "C2 Balanced Modulator Input" via a 1.0μF capacitor (C_{12}). See Fig. 2.
22	22	22	**C2 Clear/$\overline{\text{Invert}}$:** Controls the operation of channel 2 modulation. See Table 1. Internal 1MΩ pull-up.
23	23	23	**No Connection.**
24	24	24	**V_{DD}:** A positive 5V supply.

Table 1 Output Control

Channel 1/2		
Clear/$\overline{\text{Invert}}$	**Output Enable**	**Output**
1	1	Clear
0	1	Frequency Inverted
X	0	$V_{DD}/2$



Component References		
Component	Unit Value	Note
R_1	100k	3
R_2	100k	3
R_3	200k	2
R_4	75k	2
R_5	1M	1
R_6	240k	2
R_7	330k	2
R_8	100k	3

Component References		
Component	Unit Value	Note
R_9	100k	3
C_1	0.1μ	
C_2	120p	3
C_3	1n	2
C_4	120p	2
C_5	0.1μ	
C_6	33p	1
C_7	47p	1

Component References		
Component	Unit Value	Note
C_8	2.2n	
C_9	1n	2
C_{10}	120p	3
C_{11}	0.1μ	
C_{12}	1.0μ	
C_{13}	1.0μ	
C_{14}	0.47μ	
C_{15}	1.0μ	
X_1	4.433619MHz	

Tolerance
Resistors ±10%
Capacitors ±20%

Notes:

1. *Xtal circuitry shown is in accordance with CML Application Note D/XT/1 April '86.*
2. *'Clear' channel inputs are shown with Ch1 (pre-emphasis) and Ch2 (de-emphasis) components. See figures 4 and 5.*
3. *Gain setting components for the 'scrambled paths' are shown for a gain of 0dB. See figure 6.*

Fig. 2 External Component Connections

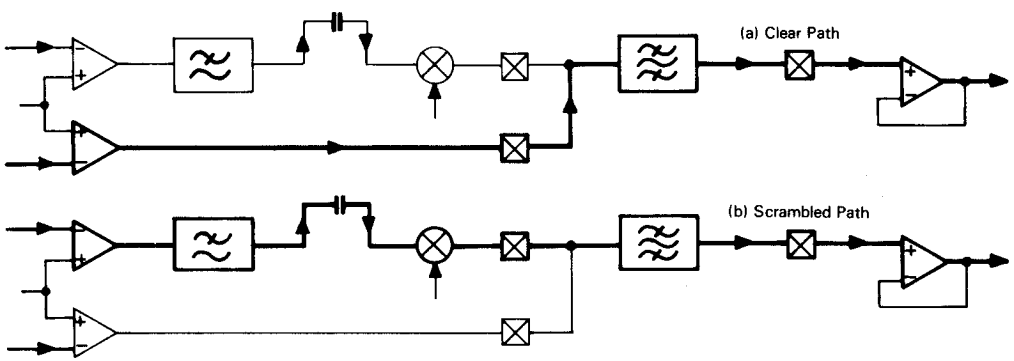


Fig. 3 Simplified Signal Paths

Specification

Absolute Maximum Ratings

Exceeding the maximum rating can result in device damage. Operation of the device outside the operating limits is not implied.

Supply voltage		−0.3V to 7.0V
Input voltage at any pin (ref V_{SS} = OV)		−0.3V to (V_{DD} + 0.3V)
Output sink/source current (supply pins)		±30mA
(other pins)		±20mA
Total device dissipation @ 25°C		800mW Max.
Derating		10mW/°C
Operating temperature range:	**FX304J**	−30°C to +85°C (Ceramic)
	FX304LG/LS	−30°C to +70°C (Plastic)
Storage temperature range:	**FX304J**	−55°C to +125°C (Ceramic)
	FX304LG/LS	−40°C to +85°C (Plastic)

Operating Limits

All characteristics measured using the following parameters unless otherwise specified:

V_{DD} = 5V, T_{amb} = 25°C, ϕ = 4.433619MHz, Audio Level Ref: 0dB = 775mVrms @ 1kHz.

Characteristics	See Note	Min.	Typ.	Max.	Unit
Static Values					
Supply Voltage	1	4.5	5.0	5.5	V
Supply Current		—	7.0	—	mA
Input Impedance (Digital)		100	—	—	kΩ
Input Impedance (Amplifiers)		1.0	10	—	MΩ
Input Impedance (Bal Mod)		—	20	—	kΩ
Output Impedance (L P Filters)		—	2.0	—	kΩ
Output Impedance (C1, C2)		—	150	800	Ω
Output Impedance (C1, C2 Amps)		—	10	—	kΩ
Inputs Logic '1'		3.5	—	—	V
Inputs Logic '0'		—	—	1.5	V
Dynamic Values:	1				
Analogue Signal Input Levels		−30	—	+6	dB
Analogue Signal Output Levels		−30	—	+6	dB
Unwanted Modulation Products	2 & 3	—	—	−40	dB
Carrier Breakthrough	2 & 3	—	−55	—	dB
Baseband Breakthrough	2 & 3	—	—	−40	dB
Carrier Frequency		—	3299	—	Hz
Analogue Output Noise	4	—	−50	—	dB
Filters:					
Input Low Pass Filter					
Cut-off Frequency (−3dB)		—	3100	—	Hz
Passband Ripple (300Hz−3kHz)		—	1.0	—	dB
Attenuation at 3.3kHz		—	30	—	dB
Attenuation at 3.6kHz		—	50	—	dB
Passband Gain		—	0.5	—	dB
Output Band Pass Filter	5				
Passband Frequencies		300		3000	Hz
Passband Ripple		—	1.0	—	dB
Low Freq. Roll-off <200Hz		12	—	—	dB/oct
High Freq. Roll-off >3.4kHz		24	—	—	dB/oct
Passband Gain		3	4	5	dB
Overall Modulated or De-Modulated Channel Response					
Passband Frequencies		300		3000	Hz
Passband Ripple		−3		+1	dB
Low Freq. Roll-off <250Hz		18	—	—	dB/oct
High Freq. Roll-off >3.4kHz		18	—	—	dB/oct
Passband Gain	5	—	2	—	dB
Distortion	2	—	2.0	—	%

Notes: *1. Dynamic Characteristics specified at 5V V_{DD}.*
2. Measured with Input Level −3dB.
3. Single Modulated Channel.
4. Short circuit input, any analogue output, in 30kHz bandwidth.
5. Op Amp gain 0dB.

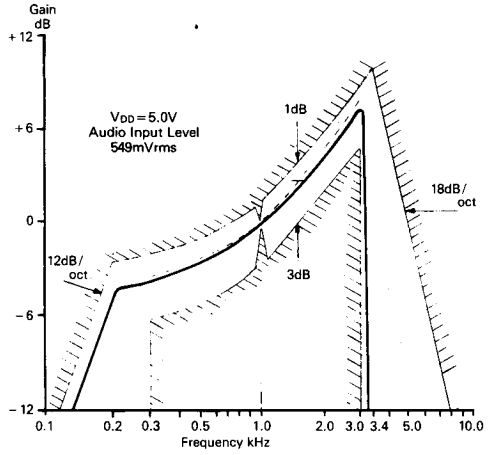


Fig. 4 Typical Audio Frequency Response of Transmit Path in 'Clear'

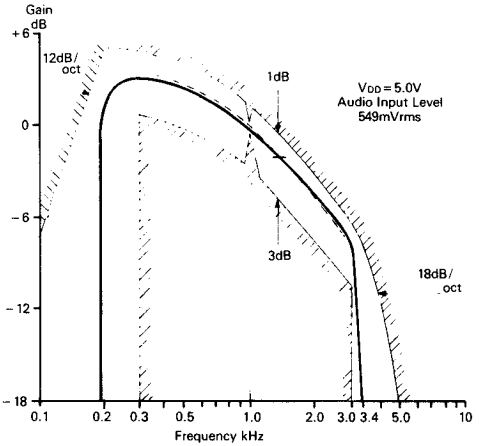


Fig. 5 Typical Audio Frequency Response of Receive Path in 'Clear'

Clear and Scramble Passbands

Gain levels on these diagrams are with respect to an audio input level of 549mVrms.

Figure 4 shows the FX304 'Clear' path response compared with the Net-C specification, using Pre-emphasis components at the input with a time constant of 200 μs. See figure 2.

Figure 5 shows the FX304 'Clear' path response compared with the Net-C specification, using De-emphasis components at the input with a time constant of 200μs. See figure 2.

Figure 6 shows the FX304 overall response of a scrambled or de-scrambled channel compared with the Net-C specification.

An attenuation of approximately 4dB from the balanced modulator and a gain of 4dB from the output bandpass filter result in 0dB Passband Gain in the 'Scramble' path.

In the 'Clear' path the 4dB gain of the output bandpass filter must be considered and compensated for by the input components (as in figure 2) for an overall Passband Gain of 0dB.

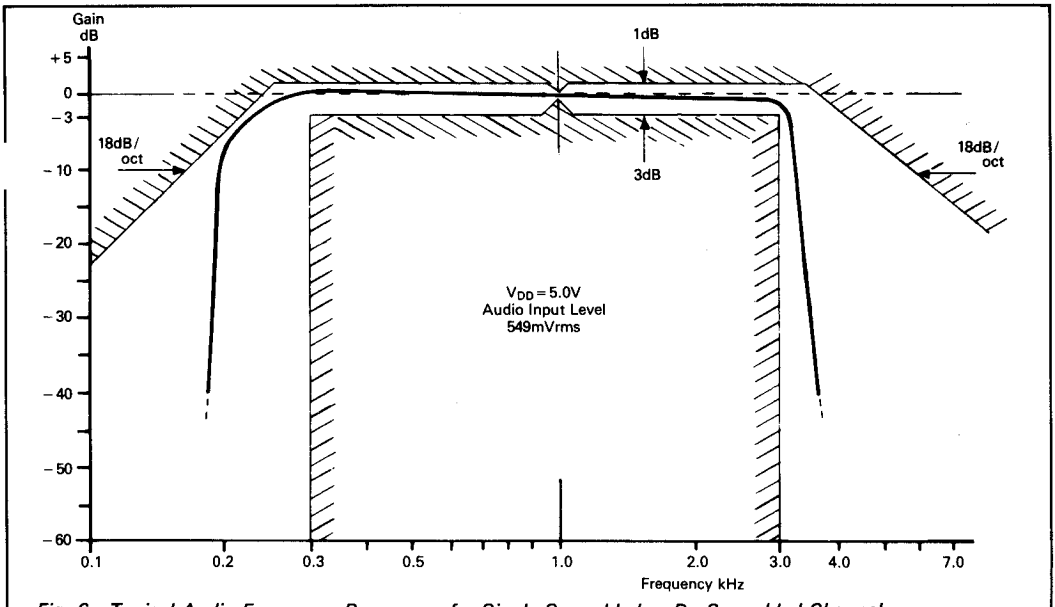


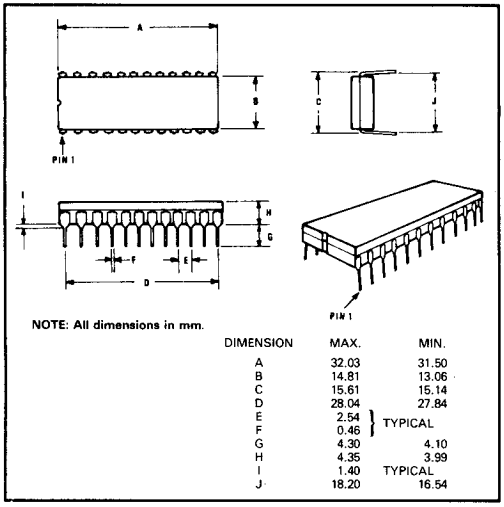
Fig. 6 Typical Audio Frequency Response of a Single Scrambled or De-Scrambled Channel

Package Outlines

The FX 304J, the cerdip package, is illustrated in figure 7. The 'LG' version is shown in figure 8 and the 'LS' version in figure 9.

To allow complete identification the FX304LG and LS packages have an indent spot adjacent to pin 1 and a chamfered corner between pins 3 and 4. Pins number anti-clockwise when viewed from the top (indent side).

Fig. 7 **FX304J** *Cerdip DIL Package*



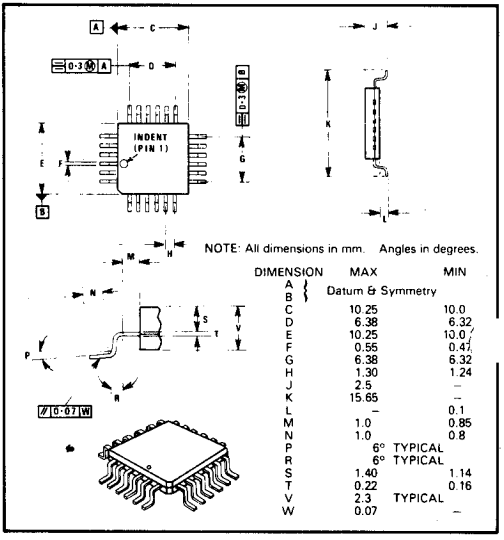
NOTE: All dimensions in mm.

DIMENSION	MAX.	MIN.
A	32.03	31.50
B	14.81	13.06
C	15.61	15.14
D	28.04	27.84
E	2.54	TYPICAL
F	0.46	
G	4.30	4.10
H	4.35	3.99
I	1.40	TYPICAL
J	18.20	16.54

Handling Precautions

The FX304J/LG/LS is a CMOS LSI circuit which includes input protection. However precautions should be taken to prevent static discharges which may cause damage.

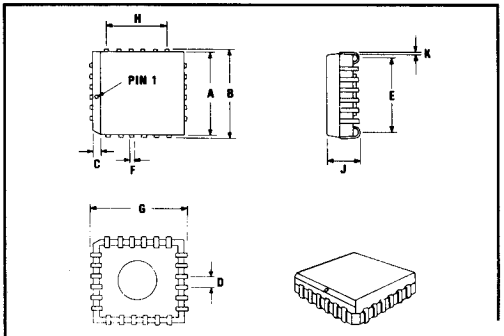
Fig. 8 **FX304LG** *Package*



NOTE: All dimensions in mm. Angles in degrees.

DIMENSION	MAX	MIN
A, B	Datum & Symmetry	
C	10.25	10.0
D	6.38	6.32
E	10.25	10.0
F	0.55	0.47
G	6.38	6.32
H	1.30	1.24
J	2.5	–
K	15.65	–
L	–	0.1
M	1.0	0.85
N	1.0	0.8
P	6° TYPICAL	
R	6° TYPICAL	
S	1.40	1.14
T	0.22	0.16
V	2.3 TYPICAL	
W	0.07	–

Fig. 9 **FX304LS** *Package*



All dimensions in mm. Angles in degrees

DIMENSION	MAX.	TYP.	MIN.	DIMENSION	MAX.	TYP.	MIN.
A	10.40		9.70	F	0.55		0.45
B	11.05		10.60	G	11.05		10.60
C		1.15 x 45°		H		6.35	
D		1.27		J	3.70		3.25
E		9.30		K	0.27		0.17

Ordering Information

FX304J	**24-pin cerdip DIL.**
FX304LG	**24-pin quad plastic encapsulated, bent and cropped.**
FX304LS	**24-lead plastic leaded chip carrier.**

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