CMOS LSI

LC89602

Audio Decoder LSI for Mini-Disk Playback

Preliminary

Overview

The LC89602 is an audio decoder LSI for mini-disk playback units. This LSI implements the processing that precedes the D/A converter in playback-only mini-disk players. That is, the LC89602 receives data in sound frame units from a mini-disk data decoder LSI (such as the Sanyo LC89610), expands the audio signal and decoder that signal directly to a D/A converter. This audio expander LSI accepts audio data that has been compressed by a factor of about 5 to 1, and expands that data to audio data that is equivalent to that from a CD player, namely 16-bit quantized data with a 44.1 kHz sampling frequency. Since this expansion consists of complex operations involving discrete cosine transformations and digital filtering, if the computations performed on this 16-bit data were performed with a 16-bit precision, the arithmetic errors associated with the calculations would result in arithmetic noise in the lower bits and a full 16 bits of precision would not be acquired. Inversely, increasing the number of registers and the bus width to improve the precision of the arithmetic would increase the size of the circuit and the power required. The LC89602 was optimized to achieve both the low power required by portable units as well as the high-precision arithmetic required by home units.

Features

- Stereo audio expansion implemented in a single chip
- High-precision arithmetic using a 24-bit multiplier
- Expanded dynamic range provided by a block floating-point circuit
- Two output systems and independent attenuators built in
- Digital audio outputs with a 20-bit data width and digital audio interface outputs
- Low power design implemented in a 0.8 μm CMOS process
- CCB CPU interface
- Low-voltage operation (V_{DD} = 3.6 to 5.5 V)
- Package: QIP80E

Package Dimensions

unit: mm

3174-QFP80E

[LC89602]

SANYO: QIP80E
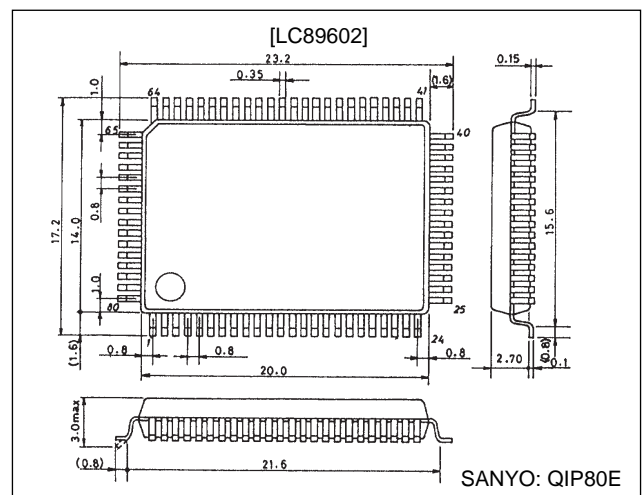
Specifications

Absolute Maximum Ratings at $V_{SS} = 0$ V

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max	Ta = 25°C	−0.3 to 7.0	V
I/O voltages	V_I, V_O	Ta = 25°C	−0.3 to V_{DD} + 0.3	V
Operating temperature	Topr		−30 to +70	°C
Storage temperature	Tstg		−55 to +125	°C
Soldering temperature resistance		10 seconds (pins only)	260	°C

Allowable Operating Conditions at Ta = –30 to 70°C, $V_{SS} = 0$ V

Parameter	Symbol	Conditions	min	typ	max	Unit
Supply voltage	V_{DD}		3.6		5.5	V
Input voltage	V_{IN}		0		V_{DD}	V

DC Characteristics at Ta = –30 to 70°C, $V_{SS} = 0$ V, $V_{DD} = 4.5$ to 5.5 V

Parameter	Symbol	Conditions	min	typ	max	Unit
Input high-level voltage	$V_{IH}1$	$\overline{RESET}$, CCB, CE, CL, TP0	0.8 V_{DD}			V
Input low-level voltage	$V_{IL}1$	$\overline{RESET}$, CCB, CE, CL, TP0			0.2 V_{DD}	V
Input high-level voltage	$V_{IH}2$	Except for $\overline{RESET}$, CCB, CE, CL, and TP0	0.7 V_{DD}			V
Input low-level voltage	$V_{IL}2$	Except for $\overline{RESET}$, CCB, CE, CL, and TP0			0.3 V_{DD}	V
Output high-level voltage	V_{OH}	I_{OH} = 3 mA, except for DO	2.4			V
Output low-level voltage	V_{OL}	I_{OL} = 3 mA			0.4	V

Block Diagram

$\overline{SWR}$, $\overline{SACK}$, SDIN7 to 0 $\overline{SREQ}$
SEPF

Input Data
Interface

Dequantization

SYNC
L/R, ERR

CE, CL
DI, CCB

CPU Interface

IMDCT

DO

DPLAY
$\overline{DPAUSE}$

Synthesis Filter

Attenuate

$\overline{RESET}$
CLKI

Output Data
Interface

ENH

BCO, WDCO, LRCO, ADOUT, BDOUT, DDOUT
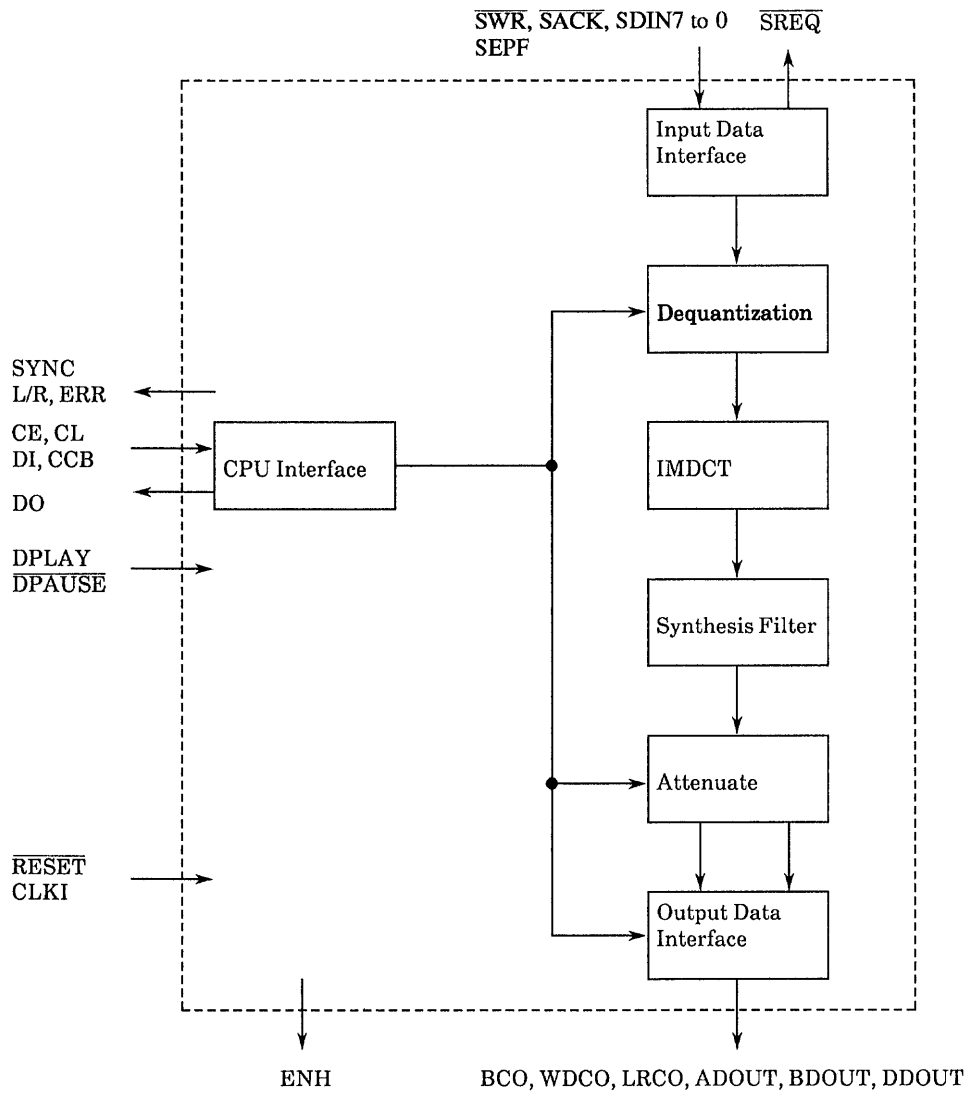
Pin Assignment
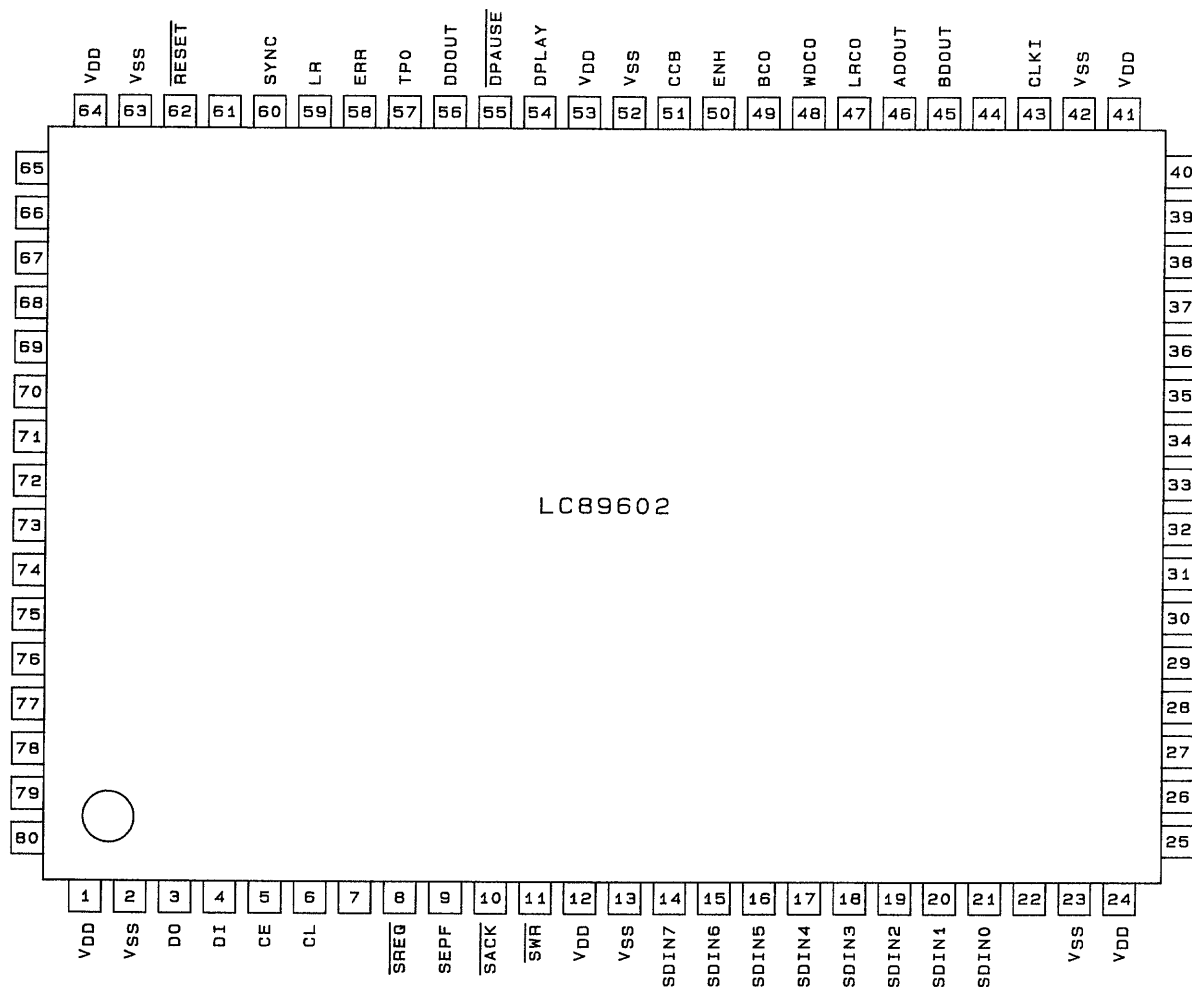
Top view

A03486

Pin Functions

Pin No.	Symbol	I/O	Function
1	V$_{DD}$	—	Power supply
2	V$_{SS}$	—	Ground
3	DO	O	CPU interface data output
4	DI	I	CPU interface data input
5	CE	I	CPU interface chip enable input
6	CL	I	CPU interface clock input
7	—	—	Unused
8	$\overline{SREQ}$	O	Sound block data request output
9	SEPF	I	Sound block data empty flag input
10	$\overline{SACK}$	I	Sound block data acknowledge input
11	$\overline{SWR}$	I	Sound block data write clock input
12	V$_{DD}$	—	Power supply
13	V$_{SS}$	—	Ground
14	SDIN7	I	Sound block data input
15	SDIN6	I	Sound block data input
16	SDIN5	I	Sound block data input
17	SDIN4	I	Sound block data input
18	SDIN3	I	Sound block data input
19	SDIN2	I	Sound block data input
20	SDIN1	I	Sound block data input
21	SDIN0	I	Sound block data input
22	—	—	Unused
23	V$_{SS}$	—	Ground
24	V$_{DD}$	—	Power supply
25	—	—	Unused
26	—	—	Unused
27	—	—	Unused
28	—	—	Unused
29	—	—	Unused
30	—	—	Unused
31	—	—	Unused
32	—	—	Unused
33	—	—	Unused
34	—	—	Unused
35	—	—	Unused
36	—	—	Unused
37	—	—	Unused
38	—	—	Unused
39	—	—	Unused
40	—	—	Unused
41	V$_{DD}$	—	Power supply
42	V$_{SS}$	—	Ground
43	CLKI	I	System clock input
44	—	—	Unused
45	BDOUT	O	Serial audio data output B
46	ADOUT	O	Serial audio data output A
47	LRCO	O	LR clock output
48	WDCO	O	Word clock output
49	BCO	O	Bit clock output
50	ENH	O	De-emphasis specifier output

Continued from preceding page.

Pin No.	Symbol	I/O	Function
51	CCB	I	CPU interface type specifier input
52	V_{SS}	—	Ground
53	V_{DD}	—	Power supply
54	DPLAY	I	Playback specifier input
55	$\overline{DPAUSE}$	I	Stop specifier input
56	DDOUT	O	Digital audio interface output
57	TP0	I	Test input
58	ERR	O	Error specifier output
59	L/R	O	Stereo expansion period output
60	SYNC	O	Sound frame clock output
61	—	—	Unused
62	$\overline{RESET}$	I	Reset input
63	V_{SS}	—	Ground
64	V_{DD}	—	Power supply
65	—	—	Unused
66	—	—	Unused
67	—	—	Unused
68	—	—	Unused
69	—	—	Unused
70	—	—	Unused
71	—	—	Unused
72	—	—	Unused
73	—	—	Unused
74	—	—	Unused
75	—	—	Unused
76	—	—	Unused
77	—	—	Unused
78	—	—	Unused
79	—	—	Unused
80	—	—	Unused