QX2012
QXpander™ Processor

QSOUND® MITSUMI

Device Specifications - Preliminary Information

General Description

The Qxpander™ (QX2000 chip series) is a bipolar analog stereo enhancement processor using the patented Qxpander™ technique to produce a spatial or widened stereo image from ordinary left and right channel inputs or from a mono input. The QX2012 provides variable spread of the spatial or widened stereo image. Enhancement is achieved without any initial encoding of the input signals and no additional speakers are required.

Digital Controls

The QX2012 can be configured for a mono or stereo input type using the digital control input $M/\overline{S}$. Configuring for a mono input activates the internal mono to stereo simulator.

The QX2012 can be bypassed using the digital control input $QEN/\overline{BYP}$. This allows the stereo input signal to pass through the chip unaltered.

The QX2012 is fabricated using bipolar technology and is available in plastic 24 pin SDIP. Other package options may be offered upon request.

Features

- Produce a wide sound image (with variable spread) from normal stereo input
- Accepts mono input and creates stereo, spatially enhanced output
- No encoding of input signals is required
- Two digital control signals for input type and bypass control
- Low noise: 75 uV_{RMS}.
- High SNR: 83 dB (typical)

Applications

- Television sound systems (Stereo).
- Hardware applications for desktop PCs
- Multimedia speaker systems.
- Video Games.

Note: The device data in these specifications are based on engineering samples, and are preliminary. QX2012 specifications are subject to change without notice.

Pin Assignment

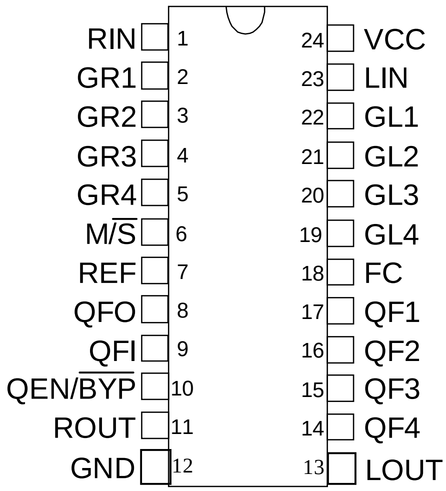

Figure 1: SDIP-24 Pin Assignment

Principles of Operation.

In ordinary stereo systems, the stereo image is formed between the left and right speakers, and is confined by the speaker positions (i.e., the "sound stage" is located between the two speakers). QXpander™ is designed to form the stereo image beyond the speakers, thus enlarging the "sound stage".

Using the spread control, the level of the stereo enhancement (width emphasis) can be adjusted to satisfy the listener. Figure 2 shows the spatial response of the QXpander™

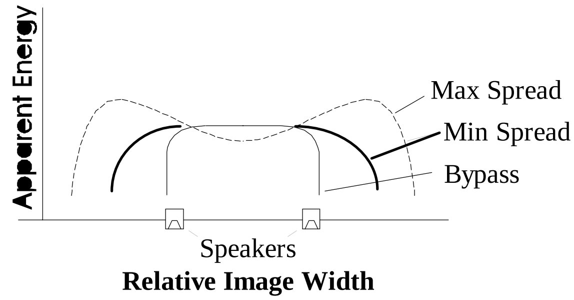

Figure 2: QX2012 Spatial Response

Normally, the QXpander™ is used in the preamplifier stage between the source and the stereo amplifier stages used to drive the speakers. The QXpander™ enhancements can be disabled using the bypass control allowing the unchanged input signal to pass through to the amplifier stages. The Qxpander™ can also accept a mono input signal and creates a spatially enhanced stereo output.

$M/\overline{S}$	**Input**
0	Stereo
1	Mono

Table 1: Input Type Control

QEN/$\overline{BYP}$	**Function**
0	Bypass
1	QSound

Table 2: Qsound, Bypass Control

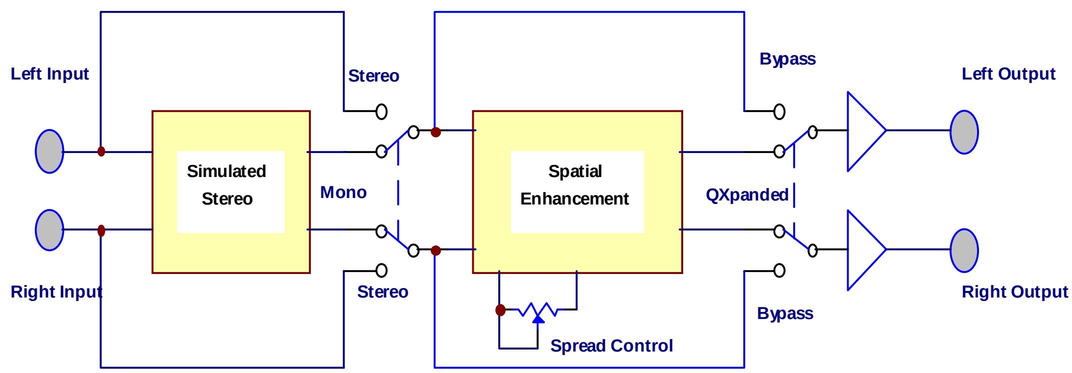

Figure 3: QXpander™ Simplified Block Diagram

Absolute Maximum Ratings*

Information subject to change without notice.

Symbol	Parameter	Min	Max	Unit
V_{CC}	DC Power Supply		15	V
V_{INA}	Analog Input Voltage	0	Vcc	V
V_{IND}	Digital Input Voltage	0	5.0	V
P_D	Power Dissipation, SDIP24		1000	mW
T_A	Operating Temperature	0	70	°C
T_{stg}	Storage Temperature	-40	+125	°C

Warning: Operation of the device at or beyond these limits may result in permanent damage to the device.

Table 3: Maximum Operating Conditions

Recommended Operating Conditions

Parameter	Symbol	Rating	Unit
Supply Voltage	$V_{CC,op}$	4.5 ~ 12.0	V
Operating Temperature	T_{opr}	-20 ~ +75	°C

Table 4: Recommended Operating Conditions

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Digital Characteristics

Vcc = +5 to +12 VDC unless otherwise noted. GND = 0 VDC, T_A = +25 °C

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IH}	High-Level Input Voltage	V_{CC} = +9.0 V	2.1		5.0	V
V_{IL}	Low-Level Input Voltage		0	0.4	0.7	V
I_{IH}	High-Level Input Current	V_{CC} = +9.0 V V_{IH} = 5.0 V			350	uA
I_{IL}	Low-Level Input Current	V_{IL} = 0.0 V			-10	uA

Notes: Digital inputs should be driven with levels between 0V and +5 V relative to GND.

Table 5: Digital Signal Conditions

Analog Characteristics:

(V_{CC} = 9V, T_A = +25 °C, V_{byp} = 5V, LIN=RIN=0V_{RMS}, unless otherwise specified.)

Parameter	TC	Sym	Min	Typ	Max	Unit
Supply Current		I_{CC}		20	26	mA
Input Impedance		R_I	21	30	39	kΩ
Input Voltage, Analog,1	1	$V_{in,1}$	1.0	1.4		V_{RMS}
Input Voltage, Analog,2	2	$V_{in,2}$	0.5	0.7		V_{RMS}
Voltage Gain, QXpander,1	3	$G_{qx,1}$	1.5	3.5	5.5	dB
Voltage Gain, QXpander,2	4	$G_{qx,2}$	-2.0	0	2.0	dB
Voltage Gain, QXpander,3	5	$G_{qx,3}$	1.5	3.5	5.5	dB
Voltage Gain, QXpander,4	6	$G_{qx,4}$	-2.0	0	2.0	dB
Voltage Gain, Bypass,1	7	$G_{by,1}$	-7.5	-5.5	-3.5	dB
Voltage Gain, Bypass,2	8	$G_{by,2}$	-7.5	-5.5	-3.5	dB
Total Harmonic Distortion, QXpander	9	THD_{qx}		0.4	1.0	%
Total Harmonic Distortion, Bypass	10	THD_{by}		0.4	0.8	%
Output Noise Voltage, QXpander	11	$V_{no,qx}$		75	150	μV_{RMS}
Output Noise Voltage, Bypass	12	$V_{no,by}$		20	40	μV_{RMS}
Signal-Noise Ratio, QXpander		SNR	75	83		dB
Signal-Noise Ratio, Bypass		SNR	88	94		dB
Channel Balance	13	CB	-1.5	0	+1.5	dB
BYP Terminal Voltage, H	14	$V_{by,h}$	2.1			V
BYP Terminal Voltage, L	15	$V_{by,l}$			0.7	V
BYP Terminal Current, H	16	$I_{by,h}$			350	μA
BYP Terminal Current, L	17	$I_{by,l}$	-10			μA

Insertion Loss	10			-7		dB
Power Supply Rejection Ratio		PSRR		50		dB
Output Voltage, Analog		V_{OUT}		1.0		V_{RMS}
Output Current, Analog		I_{OUT}			10	mA
Load Resistance		R_L	10			kΩ
Load Capacitance		C_L			1000	pF
Usable Bandwidth		BW	20		20000	Hz

Table 6: Analog Characteristics

Test Conditions:

1. f=1kHz, LIN and RIN 0° phase difference, and output voltage T.H.D. no greater than 1%.
2. f=1kHz, LIN and RIN 180° phase difference, and output voltage T.H.D. no greater than 1%.
3. LIN=1 V_{RMS}, 1 kHz, RIN=0 V, at LOUT.
4. LIN=1 V_{RMS}, 1 kHz, RIN=0 V, at ROUT.
5. LIN=0 V, RIN=1 V_{RMS}, 1 kHz, at ROUT.
6. LIN=0 V, RIN=1 V_{RMS}, 1 kHz, at LOUT.
7. LIN=1 V_{RMS}, 1 kHz, RIN=0 V, V_{BYP}=0V, at LOUT.
8. LIN=0 V, RIN=1 V_{RMS}, 1 kHz, V_{BYP}=0V, at ROUT.
9. Total Harmonic Distortion (THD) at LOUT and ROUT (QXpander active):
   a) LIN = 1 V_{RMS} , RIN = 0 V.
   b) LIN = 0 V, RIN = 1 V_{RMS}.
10. Test Condition 8, V_{BYP} = 0V (Bypass)
11. BW = 20 ~ 20000 Hz, LIN = RIN = 0 V, A curve, QXpander™ active: at LOUT and ROUT.
12. BW = 20 ~ 20000 Hz, LIN = RIN = 0 V, A curve, V_{BYP} = 0 V (Bypass): at LOUT and ROUT.
13. LIN = RIN = 1 V_{RMS} , 1 kHz, V_{BYP} = 0 V (Bypass), ROUT - LOUT (R - L).
14. High-level input voltage of BYP terminal, QXpander™ mode, maximum spread
15. Low-level input voltage of BYP terminal, Bypass mode, no spread (normal stereo).
16. Input current of BYP terminal, V_{BYP}=5V
17. Input current of BYP terminal, V_{BYP}=0V

Package Data

Ordering Code	Package Code	Package Type
QX2012-P24C	P24	PLASTIC SDIP

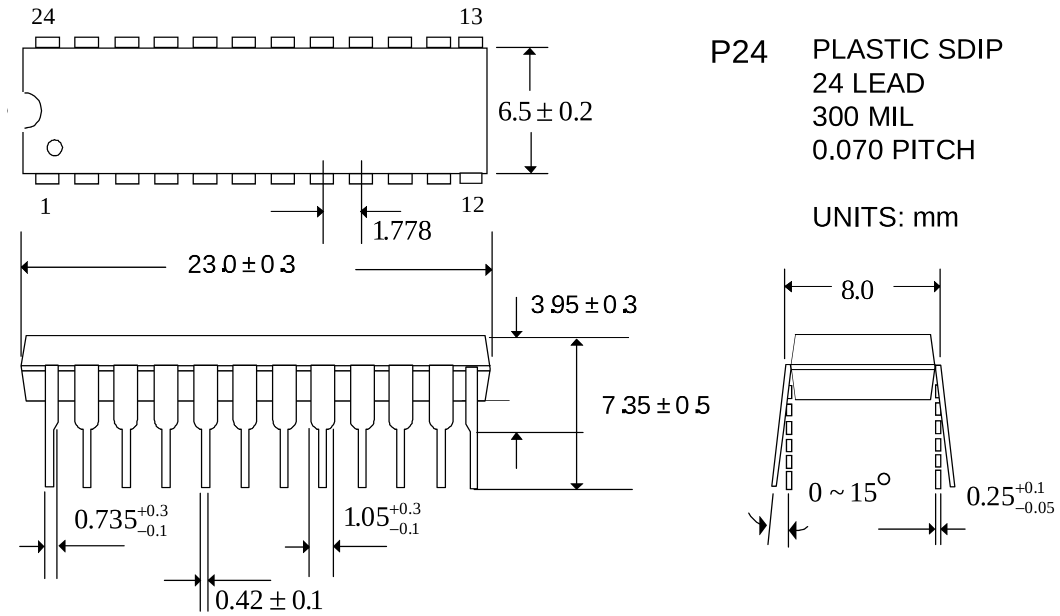

Figure 4: SDIP24 Package Option

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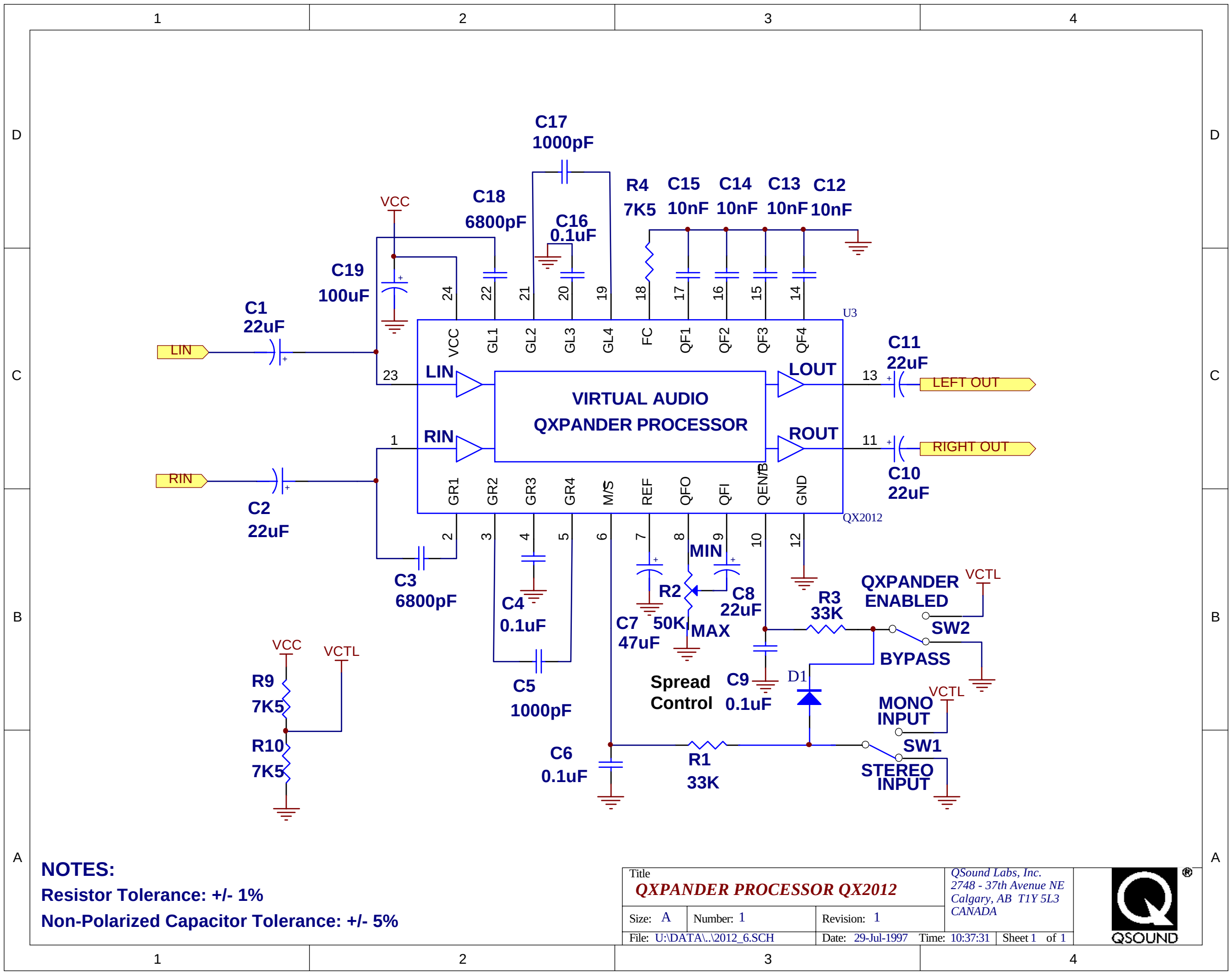

Figure 5: QX2012 QXpander™ Typical Application

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