ZR7386014

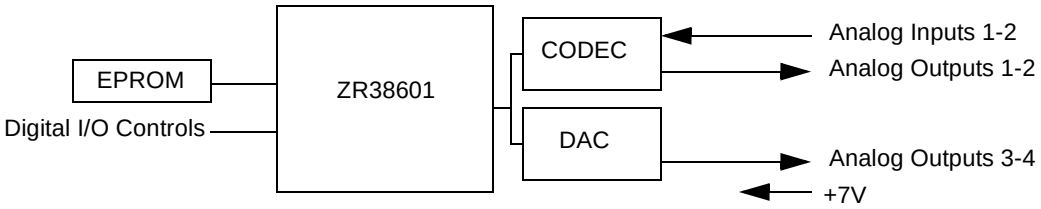
DATA SHEET

ZBRIDGE *RICHMOND* REFERENCE DESIGN

FEATURES

- Dolby Digital & MPEG 2 Channel Decoding
  - Dolby Digital 2/0/1, 2/2/0, 3/1/0
  - Dolby Pro Logic 3/1/0
  - MPEG 2 Channel 2/0/1
  - Stereo input plus 4 analog output channels
  - Power & Play demo mode - no host required
  - Full control with external host micro-controller
  - Proven, production-ready design example
  - Low cost components used throughout
  - Free electrical & mechanical documentation
- Wide selection of *SiliconSoftware*™ available
- Bass Management Standard
- Ideal for digital crossover networks & equalization filters
- Exclusive Virtual Multichannel Digital™ - VMD™
- Speaker & Headphone Virtual 3-D Surround Processing
  - A3D™ (Aureal)
  - Dolby Virtual Surround™
  - N-2-2™ (Spatializer)
  - QSurround™(QSound)
  - TruSurround™(SRS)
  - VMax™(Harman)

Richmond Block Diagram



INTRODUCTION

The ZR7386014 *Richmond* is the new member of Zoran's ZBridge family of reference designs featuring the ZR38601 and ZR38650 Digital Audio Processors. These two processors add important new features to the Zoran's industry standard ZR38600: a processing speed of 50 MIPS (up from 40 MIPS), and the Z2C two-wire serial port.

The ZBridge family currently consists of:

Golden Gate	ZR73865001
San Mateo	ZR7386012[1]
Richmond	ZR7386014
Motherboard	ZR73865002MB

All known decoding of digital audio signals can be met with this family. All processors run the extensive library of certified *SiliconSoftware*™ applications, and are fully supported by Zoran's Audio Products Team. *SiliconSoftware* are applications for the ZR38600 family of programmable digital audio processors by Zoran and qualified third-parties, and guaranteed to run perfectly.

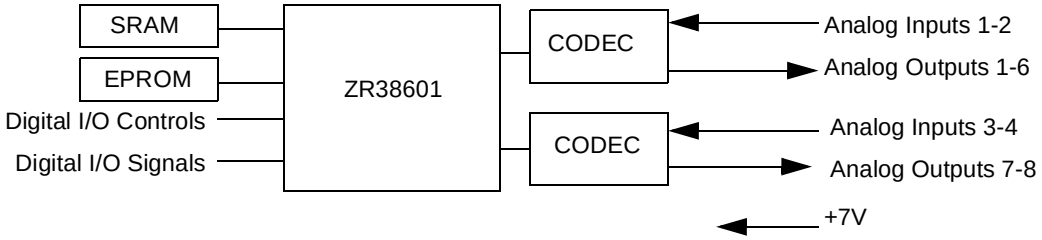
Each of the ZBridge reference designs is available as a ready to use, miniature pc board that may be plugged into the users main board, or the Mother Board (ZR73865002MB). All three Z-Bridge designs share this common mother board, which containing useful interface signal buffers and other conveniences that will speed host product development and integration. ZBridge reference designs and the mother board give the user examples of working processor and interface circuitry that meet stringent consumer audio industry standards and the various licensing authorities.

To speed users *Time To Market*, Zoran supplies schematics, layouts, parts lists, and design data to qualified OEM customers at no charge. This data sheet describes the Richmond model, as shown in the block diagram above. See page 2 for the block diagrams of the other ZBridge family members.

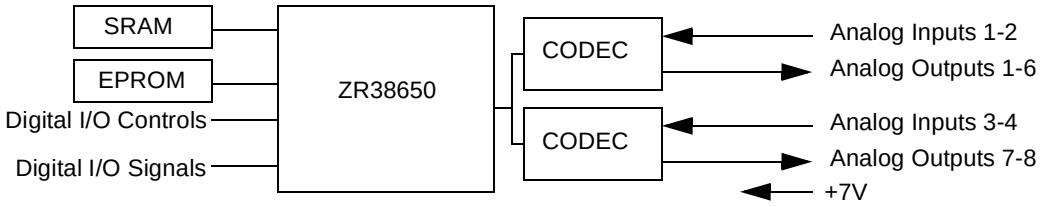
1. Availbale June , 2000

Block Diagrams of the ZBridge Family

San Mateo
ZR7386012



Golden Gate
ZR73865011



GENERAL INFORMATION

Richmond: An Application of the ZR38601

As shown on page 1, Richmond is an application of the ZR38601, which is code-compatible with the ZR38600, the popular and proven industry-standard programmable Digital Audio Processor. Costly memory interfaces are eliminated by glue-less connection to the external address and data pins of the EPROM, which contains may contain a customer-specific self-booting shell program, as well as other applications not already present in the ZR38601's on-chip ROM.

Speed and Software Compatibility

The new ZR38601 runs applications developed for the ZR38600 20 per cent faster and with little or no modification. Both Dolby Digital 5.1 and MPEG 2-channel decoding are built-in and *Bass Management* was added. The ZR38601 retains the 4 stereo pair output/3 stereo pair input capability standard to Zoran's former models. The Richmond supports applications requiring SPDIF plus two analog inputs, and gives 4 analog output channels when the stereo DAC is also present (not mandatory for 2 channel output). Crossover filters and equalization are just two of the post-decoding digital signal processing may be run with the surplus MIPS. If more input or output channels are required, consider using the San Mateo, Golden Gate, or the EZ5.1 reference design (See the ZR7386011 Data Sheet).

Built-in S/P-DIF Receiver & Transmitter

The ZR38601's on-chip S/P-DIF[2] interfaces ensures compatibility with digital signals from a wide range of consumer products, such as DVD-Video players, CD players with PCM output, PC riser cards and main boards. Miniature encoder and mode switches located on the mother board are connected to the GPIO pins of the ZR7386014, enabling a wide variety of applications to be selected from their respective EPROM locations, and up to 16 contextual variations may be selected within each program. These switches are primarily for development and demonstration purposes, and are not required in applications that include a host micro-controller for commanding different operating modes. GPIO's may be used to advantage when a minimum of modes are needed.

Power & Signal Interface

A power supply that provides +7V@ 0.4A to the Richmond should be connected. On board regulators provide +3.3V to the ZR38601, and +5V for the CODEC and DAC. Pre- and post-amplification of CODEC analog inputs and outputs is located on the mother board. In new layouts, caution should be taken to insure the correct interfacing. The mother board contains a convenient headphone output, with controls to vary both the headphone output signal level and L/R balance. For more information, see the Mother Board data sheet, ZR7386502MB.

NOTICE

The dc component of both the analog input and output terminals of the CODEC and DAC ride at approximately +2.6V, so dc blocking capacitors on analog inputs and outputs are MANDATORY. The input impedance is approximately 40 kilohms, and the worst case analog load should be kept above 10 kilohms. Keeping the ac input level below 1V rms (0 dB) will insure that there is no clipping of the CODEC's A/D converter.

Boot-up

Most commercial applications will make use a micro controller to utilize the versatility of the ZR38601. The Richmond may be operated in simpler designs *without* a micro controller by using a boot program in the EPROM. Reset must be effected externally after power-up. The mother board contains a reset IC and sequencing delays. In final platforms, the reset function is the responsibility of the designer.

Table 1: J1 Pin Functions

Function	Pin
Analog Ground	1
Left Output	2
Right Output	3
Left Input	4
Right Input	5
Left Surround Output	6
Right Surround Output	7
Analog Ground	8
+7.0 V	9
+7.0 V	10
!RST Reset when released from Power Ground	11
GPIO2	12
GPIO3	13
GPIO4	14
Power Ground	15
S/P-DIF Input	16
!XINT (GPIO0)	17
GPIO1	18
GPIO5	19
S/P-DIF Output (nc)	20

NOTE: S/N 1-20 ARE PINNED OUT DIFFERENTLY (SHOWN IN PARENTHESIS)

EPROM

Unless specified, the on-board socketed OTP (One Time Programmable) EPROM will contain a self-boot shell, and Zoran or third party application programs sufficient to perform AC-3 two channel decoding of the S/P-DIF stream. This self-booting feature greatly simplifies demonstration, evaluation, and off-line testing of the sub-assembly. In a typical application, the EPROM may contain other *SiliconSoftware*™ applications developed by Zoran and various third party developers.[3] All applications

2. Sony/Philips Digital Interchange Format
3. Licensing may be required.

programs not on-chip may be down-loaded to the ZR38601 from other system memory locations by the host, eliminating a separate OTP EPROM from production designs. When an OTP EPROM is used in production, the socket should be eliminated for maximum reliability. Designers and product managers should remove all unneeded components from the Richmond design before computing the cost from the supplied Bill of Materials (BOM).

Input & Output Signals

Analog inputs and the digital S/P-DIF signals are connected to the main pin header J1 as shown in Table 1. Serial data from a host micro-controller may be connected to header JP1, whose pin functions are shown in Table 2. A suitable buffer may be required, at the discretion of the user.

Concurrent Processing

In addition to built-in digital audio decoding software, features such as music modes, virtual surround processing (such as VMD™) for speakers and headphones, karaoke, and filtering chores may be implemented with the surplus MIPS.

Summing digital and analog audio sources: Concurrent analog and digital processing enables Richmond to digitize the stereo analog inputs from a PC sound card, and add them to the decoded inputs from a digital input such as a S/P-DIF source of Dolby Digital or PCM audio. This implementation would allow PC audio to be combined with DVD-Video sound from a DVD-ROM player, which is becoming of interest to the PC game developers.

Filter implementation: Another useful concurrent application of the Richmond is to perform cross-over filter and equalization for loudspeakers and their enclosures. This will not only save the cost of the analog components, but offers more precise performance, essentially free of temperature-dependent and aging, and agincinvarient with temperature and component aging. The characteristics of a digital filter is determined only by software and the stability of the crystal-controlled clock.

High MIPS applications: Applications requiring more than 50 MIPS may be satisfied by combining two processors. Multiple digital input and outputs enable the task load to be shared with high efficiency. To further facilitate such applications, a good choice is the Golden Gate reference design, which may be cascaded by plugging the boards together using a mating connector. Contact Zoran's Audio Applications specialists to determine which ZBridge reference designs is most appropriate and most cost effective for your application. .

Embedded Operation

Designers may easily embed the Richmond board into their own mother board after proving functionality for their ZR38601 application. Interfacing is facilitated by the GPIO pins or through the serial digital interfaces (I2S). The ZR38601 offers a choice of Z2C (Zoran 2-wire Control) or the standard SPI bus.

Licensing and Approvals

Licensing is not required by customers that use the ZR38601 for general purpose DSP applications. Many application programs in the SiliconSoftwareTM library are supplied by Zoran free of charge. For example, VMD™ (Virtual Multichannel Digital™) algorithm[4] is available for qualified customers license-free and royalty-free. Note: when the ZR38601 uses firmwear or software technology that requires licensing, approval by the relevant licensing authority must preceed production shipments. Specifically, when Dolby or DTS technologies are used in the end product offered for sale, licensing, testing and approval of the production model will be necessary. First-time licensees should allow adequate time for the negotiation and approval phase with the licensors to avoid delays in product introduction.

Dolby Implementation Approval: As with previous reference designs, Zoran will submit the ZR7386014 design to Dolby Laboratories for an Implementation License. When approved, this may shorten the time to market for products which embed the Richmond design as-is, or replicate and otherwise use it as a plug-in sub-assembly.

Local standards: It remains the sole responsibility of the OEM using the ZR38601, or any other digital audio signal processor, to comply with relevant standards set by local authorities. Note that unlike analog audio circuits, the high frequency waveforms used in DSP can result in conducted and/or radiated noise at the clock rate, harmonics thereof, sub-multiples of the clock rate, and harmonics thereof. Attention to printed wiring layouts and lead orientations may help, but shielding may also be necessary.

Table 2: JP1 Pin Description

	ZR38601 Name & Function	JP1
!SS	SPI host serial Slave Select input. Also, at !RESET defines Z2CADR of Z2C address	1
SCK /SCL	SPI host Serial interface ClocK input or Slave CLock input for Z2C	2
SI	Host Serial interface data Input	3
SO/ SDA	SPI host Serial interface data Output or Serial DAta for Z2C.	4

Ordering Information

Qualified OEM's[5] may purchase small quantities of the Richmond board and receive design information by using the ordering part number system shown in Table 3. The base unit, ZR7386014-1 contains only the VMD™ algorithm, which processes two analog inputs and outputs two analog virtual surround signals.

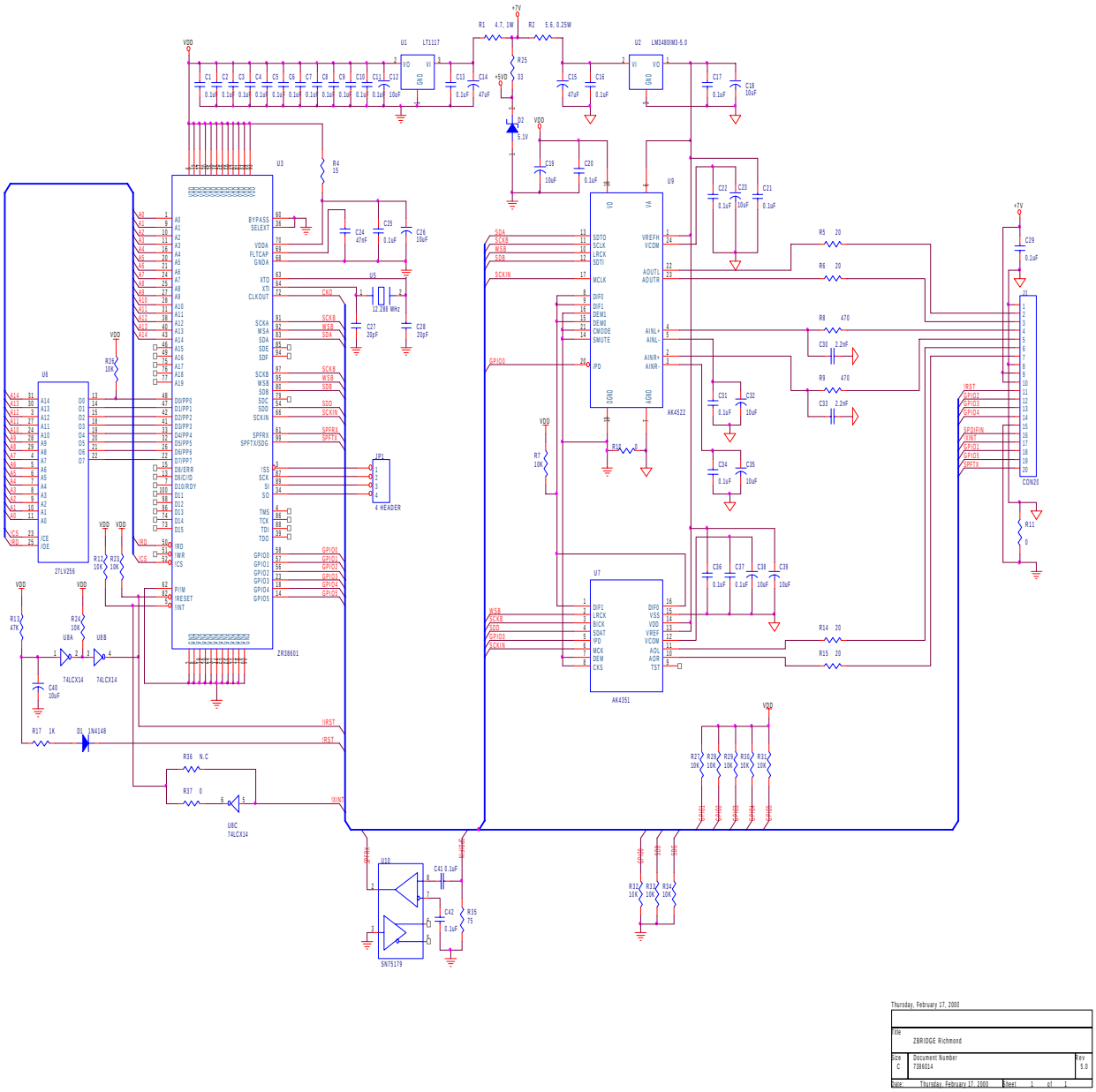
Your Customized EPROM

After you have discussed your application with us, we may prepare a uniquely identified EPROM so that your order may be promptly filled. Please contact Audio Applications[6] or Customer Service[7] for specifying and ordering assistance.

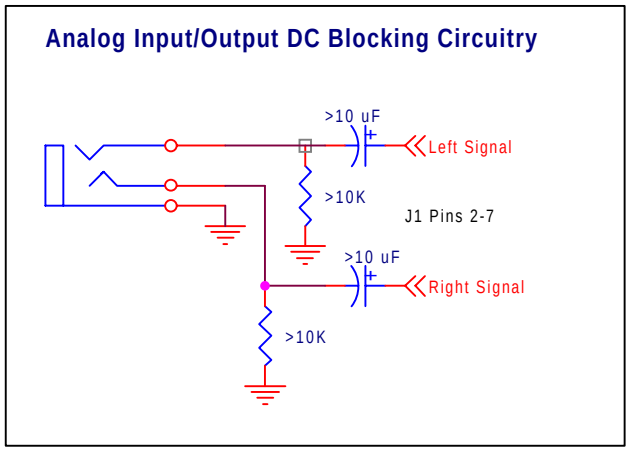
4. VMD is available at no charge to qualified OEM customers. VMD is an advanced "Surround from Stereo" algorithm that needs no special encoding
5. Licensing is not required for ordering an evaluation board, but some Silicon Software partners may require non-disclosure agreements be in place.
6. (408) 919-4280
7. (408) 919-4231

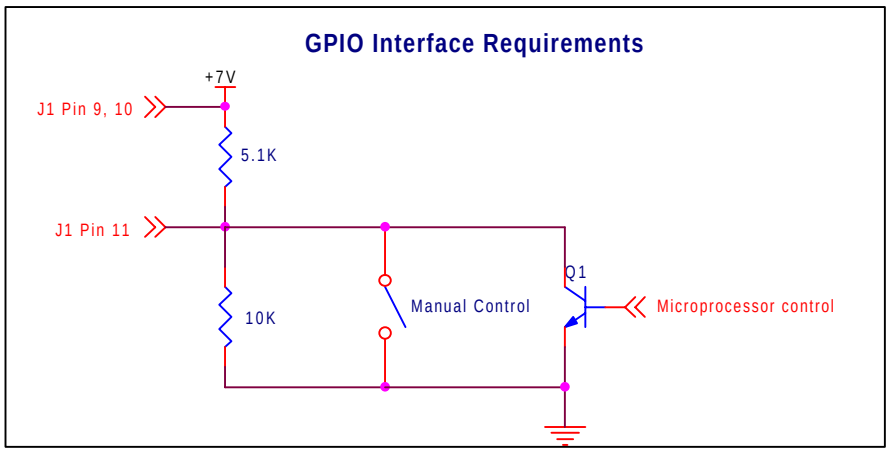
Richmond Schematic

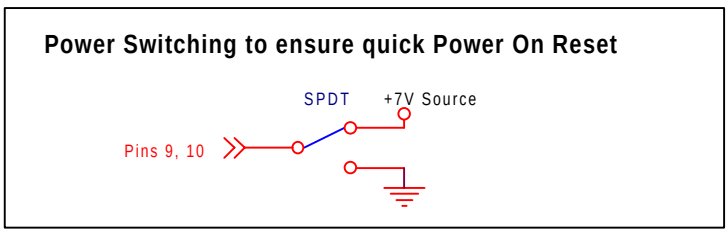
The following schematic and Bill of Materials is available to qualified OEMs in .pdf and Orcad.dsn formats upon request. R10 & R11 are not stuffed when shipped.



Recommended input and output interface circuits

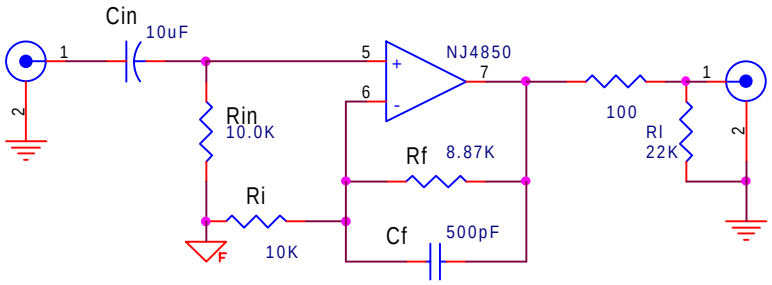




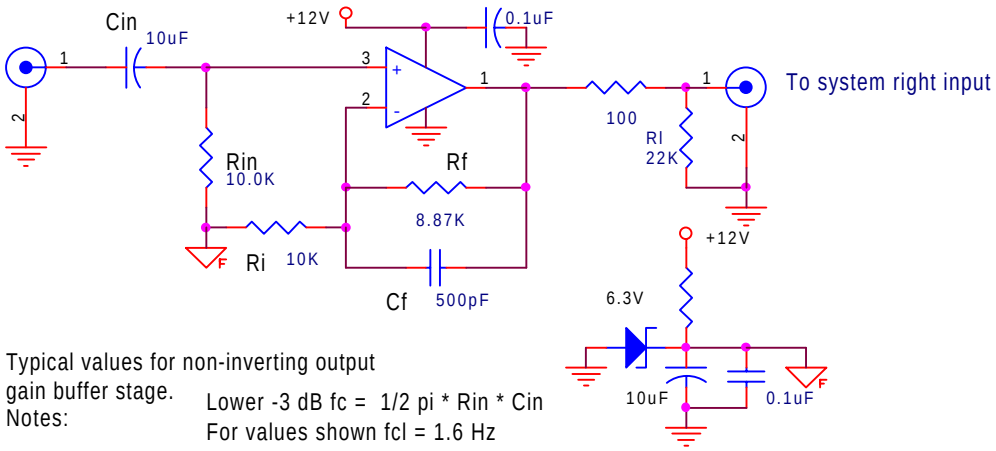


SUGGESTED OUTPUT SIGNAL AMPLIFIER/BUFFER

From Richmond left output



From Richmond right output

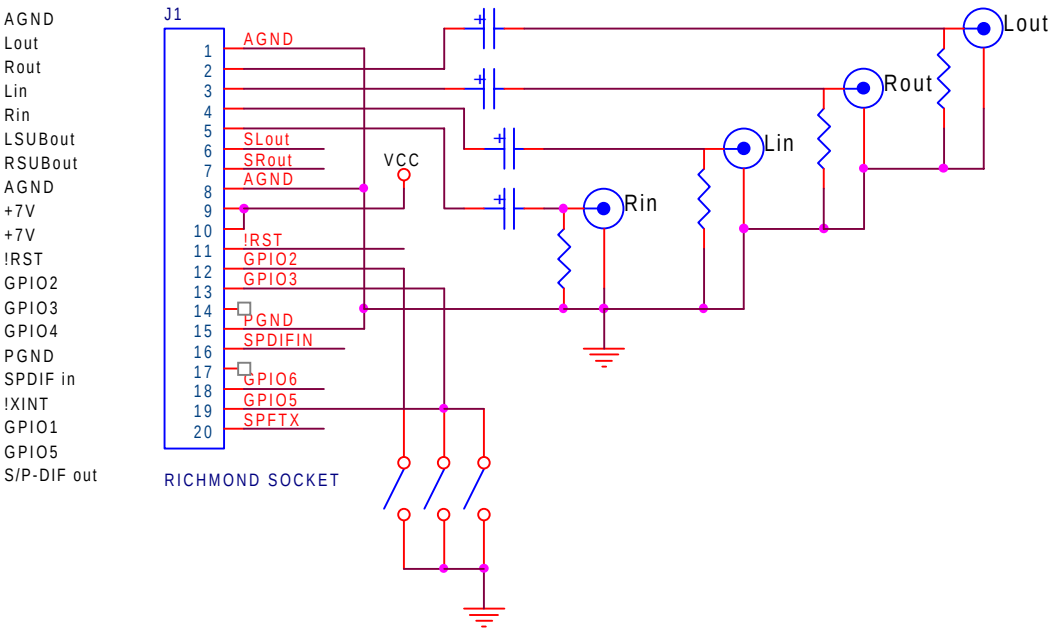


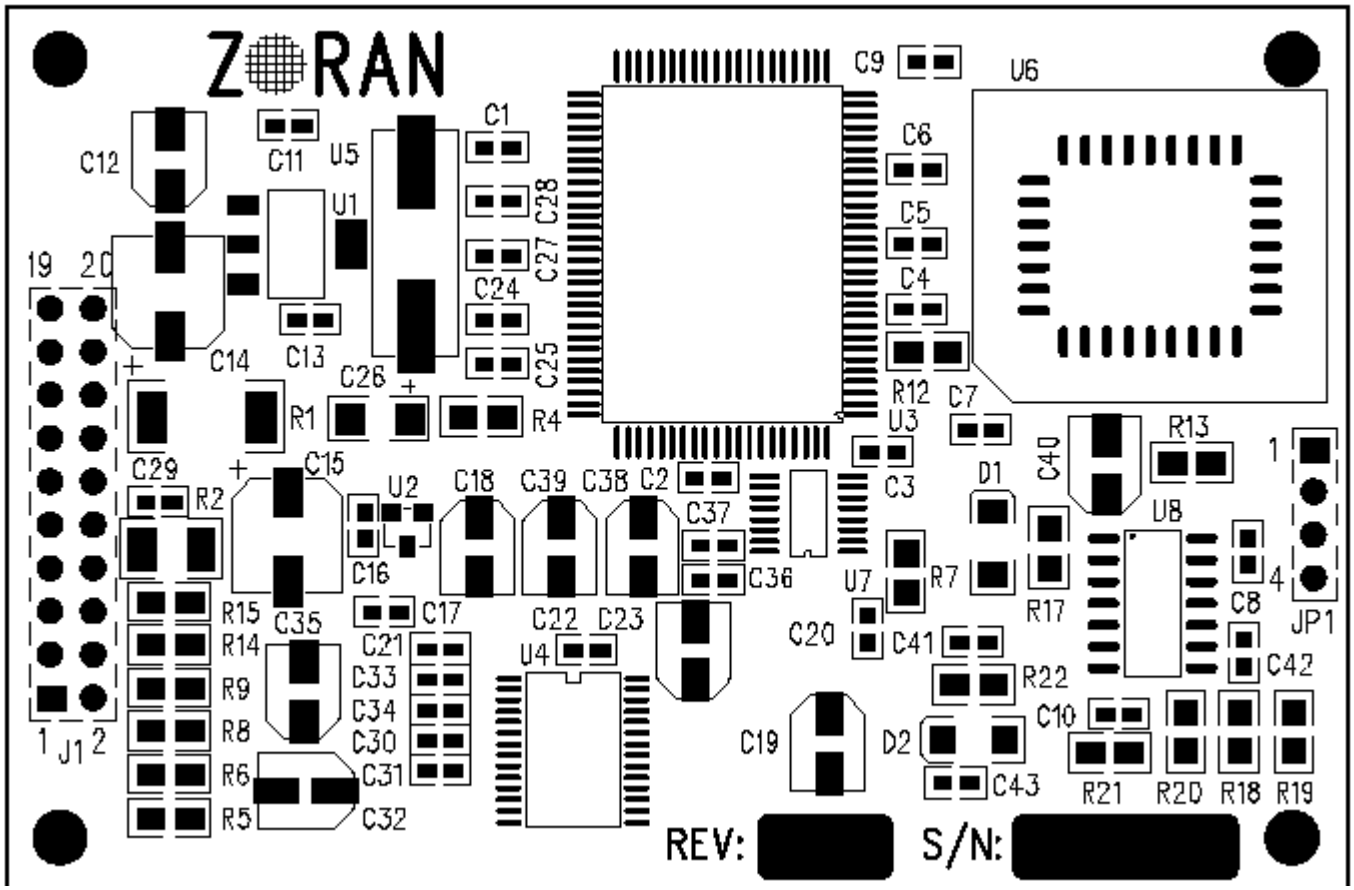
Typical values for non-inverting output gain buffer stage.

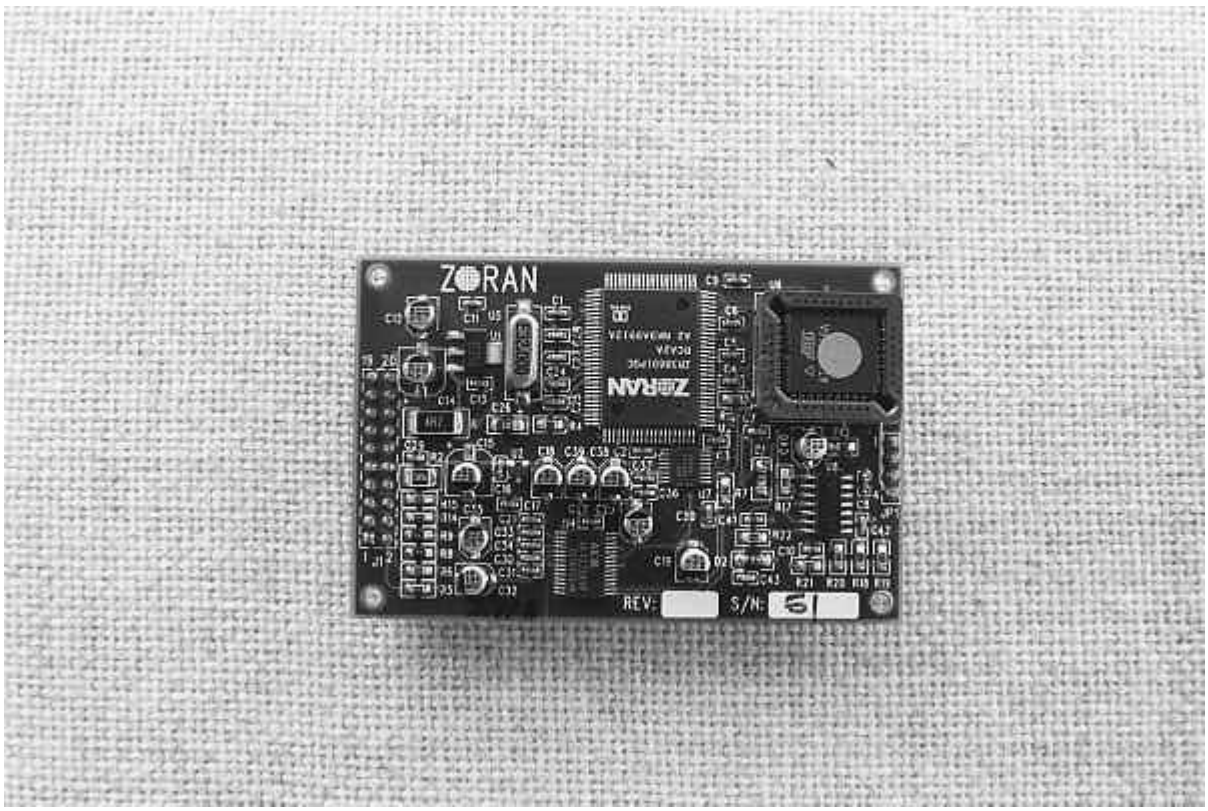
Notes:

Lower -3 dB fc = 1/2 pi * Rin * Cin
For values shown fcl = 1.6 Hz
Upper -3 dB fcu = 1/2 pi* Rf* Cf
For values shown, fcu = 37 kHz
Rin must be 10 kilohms or higher
DC blocking capacitors Cin are mandatory

Connections showing switches & DC blocking




ZORAN
C12
C11
U5
C1
U1
C28
C27
C24
C25
C14
C13
C26
R1
R4
C29
R2
C15
U2
C18
C39
C38
C2
C37
C36
C16
C17
C21
C33
C34
C30
C31
C32
C35
R15
R14
R9
R8
R6
R5
C22
C23
U4
C9
C6
C5
C4
R12
U3
C3
U6
C7
C40
R13
D1
R17
U8
U7
R7
C20
C41
R22
C8
C42
C10
C19
D2
C43
R21
R20
R18
R19
JP1
J1
REV:
S/N: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Documentation

This Reference Design is one application of the ZR38601. The ZR38601 Data Sheet provides additional information including the complete function command and response operation as well as electrical, timing and physical specifications. Additional information may be found in the ZR38650 Hardware Manual, which includes information on the ZR38601. The complete source of information on the core's programmed operation and instruction set is the "ZR38000 Family Users Manual and Programming Reference". Also available are the "ZR38600 Simulator User's Manual" and the "ZR38600 Assembler/Linker User's Manual."

Demonstration / Development Board

For product development, we recommend the ZR38600 Demonstration Board, P/N ZR738381 which is also a stand-alone Dolby AC-3 and MPEG audio decoder. The board, which has been upgraded to the ZR38601, is equipped with three high-quality, 20-bit stereo DAC's and one 20-bit stereo ADC for microphone or line input. The input bitstream is fed to the board in S/PDIF format or PCM. Both optical and coaxial interfaces are available and supported. Decoding and operating functions are selected via push buttons and a large LCD display is provided for status information. This board is used extensively by software developers, and includes many features that will save time. PC interface is standard parallel or serial port, for controlling operation with the standard function commands and responses and for loading of custom programs. An ICE interface is also available on the board.

Software Development Kit

Two software development tools provide all that is necessary to write, assemble, link, simulate, and debug programs in native ZR38001 code for the ZR38601. They run on a Pentium™ PC under Microsoft Windows 95™. The ZR38000 Family Assembler/Linker translates the assembly language code, including macros, to object code which can be linked with data files and other object code to generate a complete executable program file. The ZR38600 Family Simulator accurately executes the program file while permitting full displays of registers and memory along with single-step operation and breakpoints for debugging. Both are of modern design being highly interactive and with macro and symbolic naming support throughout. The ZR38601is software compatible with Zoran's previous generation ZR38600 family devices.

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