Standard Products

RadHard-by-Design
RHD5901 Quad Operational Amplifier
Hi-Z Output Control

www.aeroflex.com/RHDseries

September 22, 2011

FEATURES

- Single power supply operation (3.3V to 5.0V) or dual power supply operation (±1.65 to ±2.5V)
- Radiation performance
  - Total dose: >1Mrad(Si); Dose rate = 50 - 300 rads(Si)/s
  - ELDRS Immune
  - SEL Immune >100 MeV-cm^2/mg
  - Neutron Displacement Damage >10^{14} neutrons/cm^2
- Rail-to-Rail input and output range
- Enable pin to Enable/Disable amplifiers in pairs.
- Short Circuit Tolerant
- Full military temperature range
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic SOIC
  - 16-pin, .411"L x .293"W x .090"Ht
  - Weight - 0.8 grams max

- **Aeroflex Plainview's Radiation Hardness Assurance Plan is DLA Certified to MIL-PRF-38534, Appendix G.**

GENERAL DESCRIPTION

Aeroflex's RHD5901 is a radiation hardened, single supply, quad operational amplifier with enable in a 16-pin SOIC package. The RHD5901 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5901 especially suited for the harsh environment encountered in Deep Space missions. It is guaranteed operational from -55°C to +125°C. Available screened in accordance with MIL-PRF-38534 Class K, the RHD5901 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5901 amplifiers are capable of rail-to-rail input and outputs. Performance characteristics listed are for general purpose operational 5V CMOS amplifier applications. The amplifiers will drive substantial resistive or capacitive loads and are unity gain stable under normal conditions. Resistive loads in the low kohm range can be handled without gain derating and capacitive loads of several nF can be tolerated. CMOS device drive has a negative temperature coefficient and the devices are therefore inherently tolerant to momentary shorts, although on chip thermal shutdown is not provided. All inputs and outputs are diode protected.

The devices will not latch with SEU events to above 100 MeV-cm^2/mg. Total dose degradation is minimal to above 1Mrad(Si). Displacement damage environments to neutron fluence equivalents in the mid 10^{14} neutrons per cm^2 range are readily tolerated. There is no sensitivity to low-dose rate (ELDRS) effects. SEU effects are application dependant.

The RHD5901 is configured with enable/disable control. Pairs of amplifiers are put in a power-down condition with their outputs in a high impedance state. Several useful operational amplifier configurations are supported where more than one amplifier can feed an output with others disabled.

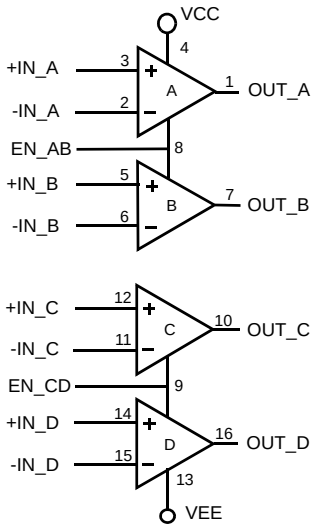
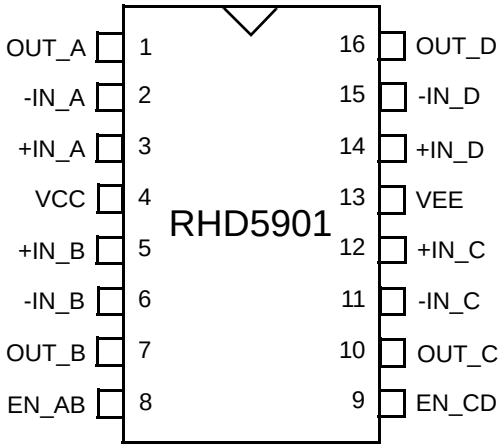


FIGURE 1: BLOCK DIAGRAM



16-Pin SOIC

FIGURE 2: PACKAGE PIN-OUT

Notes:

1. Package and lid are electrically isolated from signal pads.
2. EN_AB enables amplifiers A & B. EN_CD enables amplifiers C & D.

ABSOLUTE MAXIMUM RATINGS

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	℃
Storage Temperature Range	-65 to +150	℃
Junction Temperature	+150	℃
Supply Voltage VCC - VEE	+6.0	V
Input Voltage	VCC +0.4 VEE -0.4	V
Lead Temperature (soldering, 10 seconds)	300	℃
Thermal Resistance, Junction to Case, Θjc	7	℃/W
ESD Rating	2.0	KV
Power @ 25℃	200	mW

NOTICE: Stresses above those listed under “Absolute Maximums Rating” may cause permanent damage to the device. These are stress rating only; functional operation beyond the “Operation Conditions” is not recommended and extended exposure beyond the “Operation Conditions” may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Typical	Units
+VCC	Power Supply Voltage	3.3 to 5.0	V
VCM	Input Common Mode Range	VCC to VEE	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

(TC = -55℃ TO +125℃, +V CC = +5.0V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Offset Voltage	VOS		-2		2	mV
Input Offset Current	IOS		-10		10	pA
Input Bias Current	IB		-20		20	pA
Input Offset TempCo 2/	VIOST				10	uV/C
Common Mode Rejection Ratio	CMRR		70			dB
Power Supply Rejection Ratio	PSRR		70			dB
Output Voltage High	VOH	ROUT = 3.6 Kohms to GND	4.9			V
Output Voltage Low	VOL	ROUT = 3.6 Kohms to VCC			0.1	V
Short Circuit Output Current 2/	IO(SINK)	VOUT to VCC	-63			mA
	IO(SOURCE)	VOUT to VEE			45	mA
Slew Rate	SR	RL = 8K, Gain = 1	2.5			V/uS
Open Loop Gain 2/	AOL	No Load	100			dB
Unity Gain Bandwidth 2/	UGBW	RL = 10K	4	6.5		MHz

ELECTRICAL PERFORMANCE CHARACTERISTICS (continued)

(TC = -55℃ TO +125℃, +VCC = +5.0V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage - Enable (EN_AB, EN_CD)	VHI	High (Enabled)	70% VCC - VEE			V
	VLO	Low (Disabled)			30% VCC - VEE	V
Input Current - Enable (EN_AB, EN_CD)	IEN				100	nA
Quiescent Supply Current	ICCQ	All Amplifiers Enabled, No Load			5.5	mA
		All Amplifier Disabled			1	uA
Channel Separation 2/		RL = 2K, f = 1.0KHz	90			dB
Input-Referred Voltage Noise 2/	e_n	F = 5 kHz		15		nV/$\sqrt{\text{Hz}}$
Phase Margin 2/	Φ_m		30			Deg

Notes:

1/ Specification derated to reflect Total Dose exposure to 1 Mrad(Si) @ +25℃.

2/ Not tested. Shall be guaranteed by design, characterization, or correlation to other test parameters.

SWITCHING CHARACTERISTICS

(TC = -55℃ TO +125℃, +VCC = +5.0V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions	Min	Max	Units
Output Delay (Enabled)	$t_{ON}EN$			100	ns
Output Delay (Disabled)	$t_{OFF}EN$			100	ns

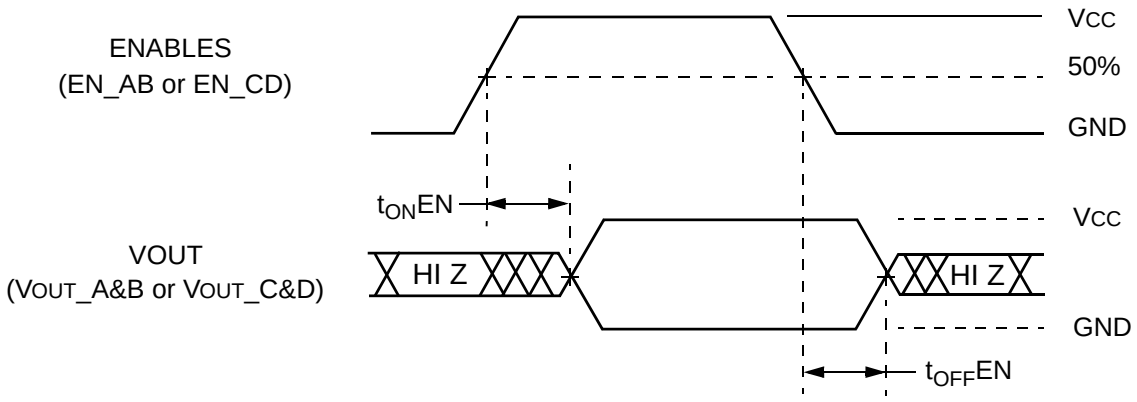


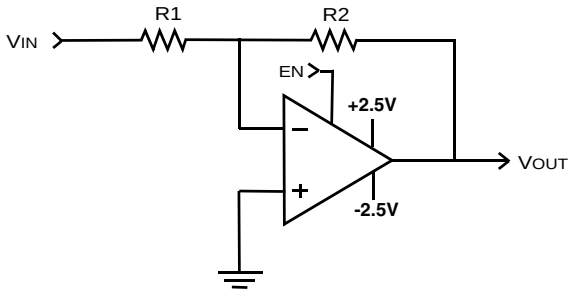
FIGURE 3: RHD5901 SWITCHING DIAGRAM

RHD5901 QUAD OPERATIONAL AMPLIFIER APPLICATION NOTES

APPLICATION NOTE 1: DUAL POWER SUPPLY AMPLIFIER

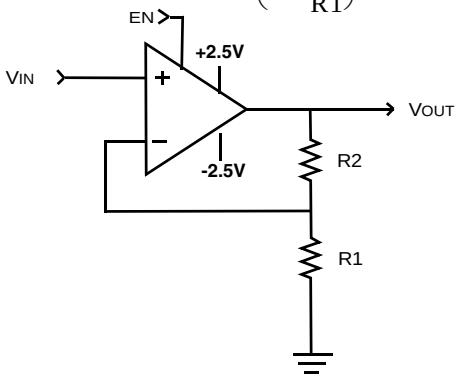
Inverting Amplifier

$$VOUT = -VIN\left(\frac{R2}{R1}\right)$$



Non Inverting Amplifier

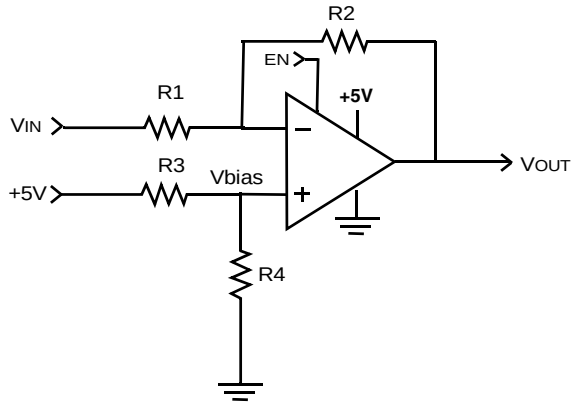
$$VOUT = VIN\left(1 + \frac{R2}{R1}\right)$$



APPLICATION NOTE 2: SINGLE POWER SUPPLY AMPLIFIER

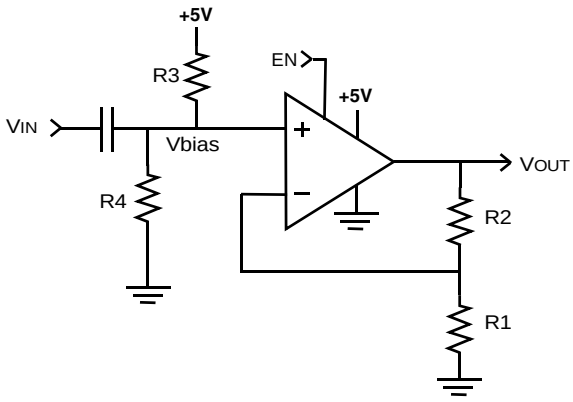
Inverting Amplifier

$$VOUT = -VIN\left(\frac{R2}{R1}\right)$$



Non Inverting Amplifier

$$VOUT = VIN\left(1 + \frac{R2}{R1}\right)$$

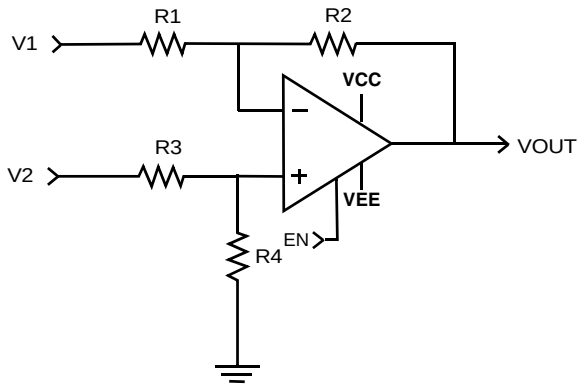


Note: For VOUT DC @ mid range of common mode voltage range, VBIAS = 2.5/(1+R2/R1), VBIAS = +5*R4/(R3+R4)

APPLICATION NOTE 3: DIFFERENTIAL INPUT AMPLIFIER

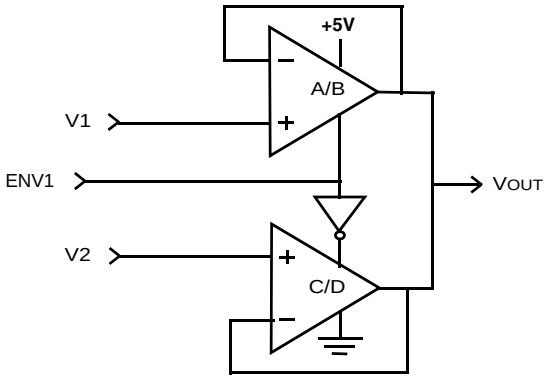
Differential Input Amplifier

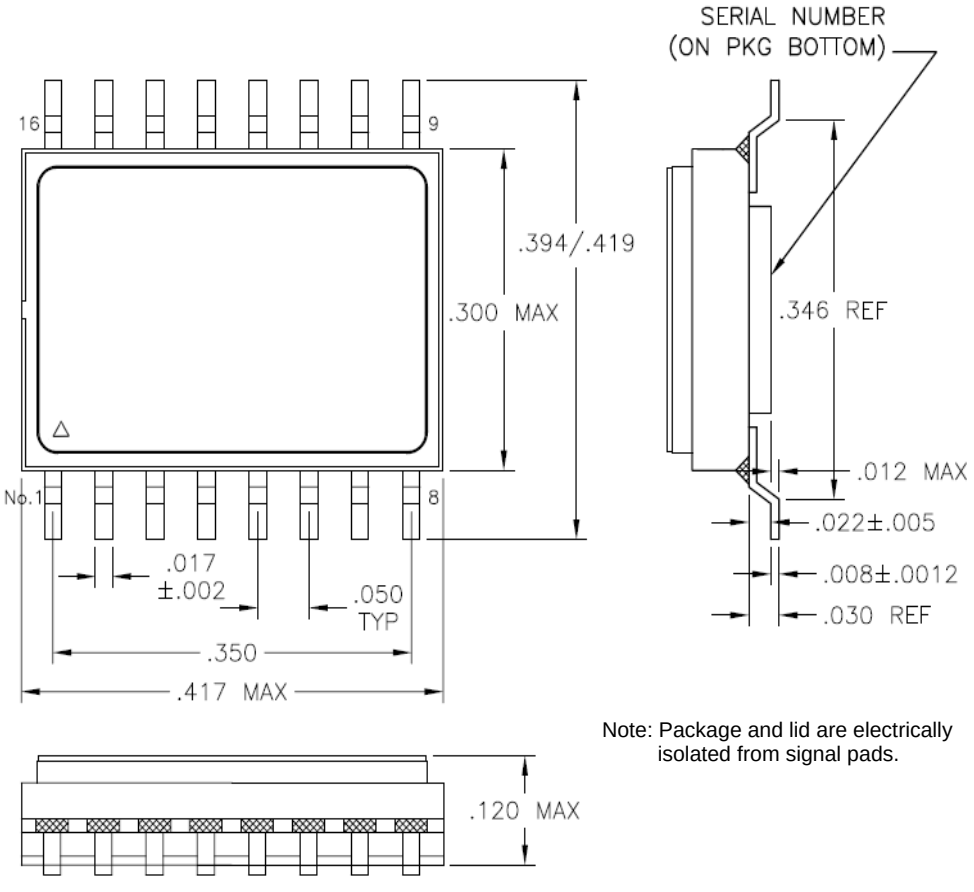
$$VOUT = \left(V2\left(\frac{R4}{R3+R4}\right)\left(1+\frac{R2}{R1}\right)\right) - \left(V1\frac{R2}{R1}\right)$$



APPLICATION NOTE 4: MULTIPLE AMPLIFIERS

Multiple Amplifiers - Selectable Output





Note: Package and lid are electrically isolated from signal pads.

FIGURE 4: PACKAGE OUTLINE

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5901-7	-	Commercial Flow, +25℃ testing only	16-pin SOIC Package
RHD5901-S	-	Military Temperature, -55℃ to +125℃ Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5901-201-1S	5962-1024102KXC	DLA SMD Pending	
RHD5901-201-2S	5962-1024102KXA		
RHD5901-901-1S	5962H1024102KXC	DLA SMD and Radiation Certification Pending	
RHD5901-901-2S	5962H1024102KXA		

EXPORT CONTROL:

This product is controlled for export under the International Traffic in Arms Regulations (ITAR). A license from the U.S. Department of State is required prior to the export of this product from the United States.

EXPORT WARNING:

Aeroflex's military and space products are controlled for export under the International Traffic in Arms Regulations (ITAR) and may not be sold or proposed or offered for sale to certain countries. (See ITAR 126.1 for complete information.)

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