

FEATURES

- Single power supply operation (3.3V to 5.0V) or dual power supply operation (± 1.65 to $\pm 2.5V$)
- Radiation performance
 - Total dose: >1 Mrad(Si); Dose rate = 50-300 rad(Si)/s
 - ELDRS Immune
 - SEL Immune >100 MeV-cm²/mg
 - Neutron Displacement Damage $>10^{14}$ neutrons/cm²
- High Speed
- 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, .417"L x .300"W x 0.120"Ht SOIC
 - Typical Weight 0.8 grams

- Radiation Hardness Assurance Plan: DLA Certified to MIL-PRF-38534, Appendix G.**

GENERAL DESCRIPTION

The RHD5904 is a radiation hardened, single supply, high speed, quad operational amplifier with enable in a 16-pin SOIC package. The RHD5904 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5904 especially suited for the harsh environment encountered in Deep Space missions. It is guaranteed operational from -55°C to $+125^{\circ}\text{C}$. Available screened in accordance with MIL-PRF-38534 Class K, the RHD5904 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5904 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-cm²/mg. Total dose degradation is minimal to above 1 Mrad(Si). Displacement damage environments to neutron fluence equivalents in the mid 10^{14} neutrons per cm² range are readily tolerated. There is no sensitivity to low-dose rate (ELDRS) effects. SEU effects are application dependent.

The RHD5904 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.

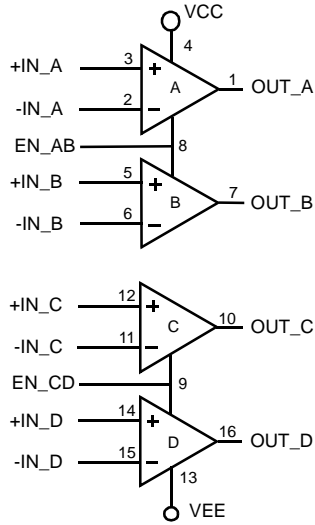


FIGURE 1: BLOCK DIAGRAM

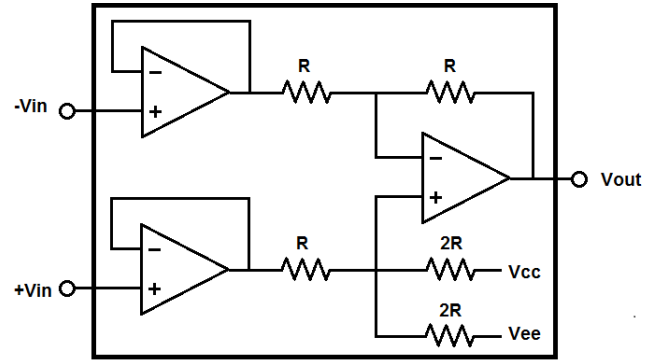


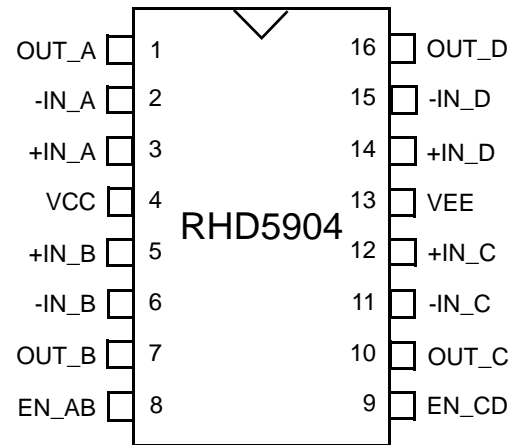
FIGURE 1A: SECTION DIAGRAM

Notes:

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

Pin	Signal Name	Definition
1	OUT_A	Output of Amplifier A.
2	-IN_A	Inverting input of Amplifier A.
3	+IN_A	Non-Inverting input of Amplifier A.
4	VCC	+ Voltage Supply.
5	+IN_B	Non-Inverting input of Amplifier B.
6	-IN_B	Inverting input of Amplifier B.
7	OUT_B	Output of Amplifier B.
8	EN_AB	A Logic Low will disable Amplifiers A & B so that the outputs are high impedance.
9	EN_CD	A Logic Low will disable Amplifiers C & D so that the outputs are high impedance.
10	OUT_C	Output of Amplifier C.
11	-IN_C	Inverting input of Amplifier C.
12	+IN_C	Non-Inverting input of Amplifier C.
13	VEE	-Voltage Supply.
14	+IN_D	Non-Inverting input of Amplifier D.
15	-IN_D	Inverting input of Amplifier D.
16	OUT_D	Output of Amplifier D.

TABLE 1: PIN-OUT DESCRIPTION



16-Pin SOIC

FIGURE 2: PACKAGE PIN-OUT

ABSOLUTE MAXIMUM RATINGS

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Junction Temperature	+150	°C
Supply Voltage V _{CC} - V _{EE}	+7.0	V
Input Voltage	V _{CC} +0.4 V _{EE} -0.4	V
Input Current	±10	mA
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, θ_{jc}	7	°C/W
Power @ 25°C	200	mW

NOTICE: Stresses above those listed under "Absolute Maximum Ratings" 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
+V _{CC}	Power Supply Voltage	3.3 to 5.0	V
V _{CM}	Input Common Mode Range	V _{CC} to V _{EE}	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

(T_C = -55°C TO +125°C, +V_{CC} = +5.0V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions	Min	Max	Units
Input Offset Voltage	V _{OS}		-2	2	mV
Input Offset Current	I _{OS}		-10	10	pA
Input Bias Current	I _B		-20	20	pA
Input Offset TempCo $\frac{\Delta}{\Delta T}$	V _I OST			10	uV/C
Common Mode Rejection Ratio	CMRR		70		dB
Power Supply Rejection Ratio	PSRR		70		dB
Output Voltage High	V _{OH}	R _{OUT} = 3.6 Kohms to GND	4.9		V
Output Voltage Low	V _{OL}	R _{OUT} = 3.6 Kohms to V _{CC}		0.1	V
Short Circuit Output Current $\frac{\Delta}{\Delta T}$	I _{O(SINK)}	V _{OUT} to V _{CC}	-63		mA
	I _{O(SOURCE)}	V _{OUT} to V _{EE}		45	mA
Slew Rate	SR	R _L = 8K	2.5		V/uS
Open Loop Gain $\frac{\Delta}{\Delta T}$	AOL	No Load	100		dB
Unity Gain Bandwidth	UGBW	R _L = 10K	5		MHz

ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

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

Parameter	Symbol	Conditions	Min	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	ICCG	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 = 1 kHz		TBD	V/ $\sqrt{\text{Hz}}$
Phase Margin 2/	Φ_m		TBD		Deg

Notes:

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

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

SWITCHING CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Max	Units
Output Delay (Enabled)	t _{ONEN}			100	ns
Output Delay (Disabled)	t _{OFFEN}			100	ns

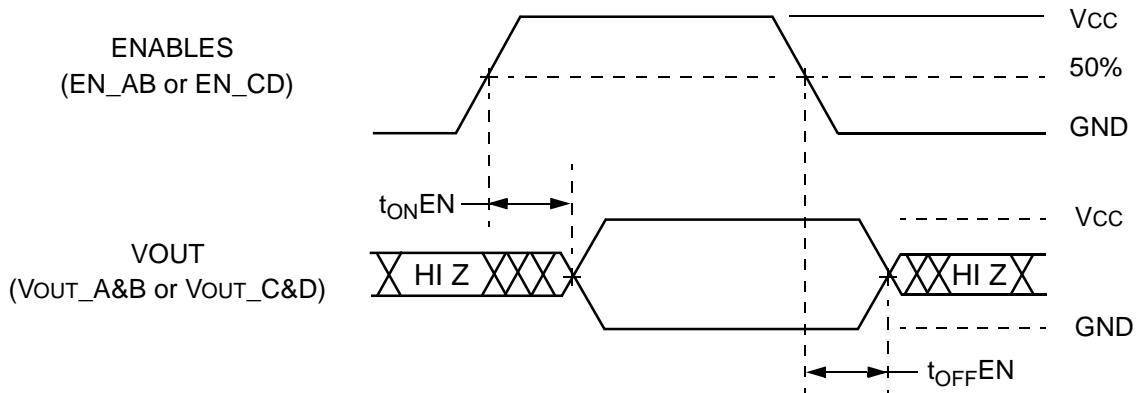


FIGURE 3: RHD5904 SWITCHING DIAGRAM

Multiple Amplifiers - Selectable Output

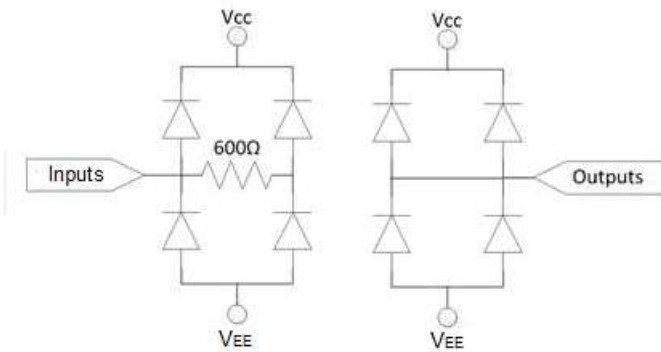
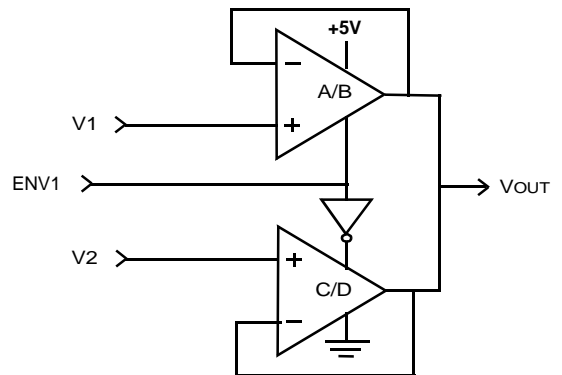
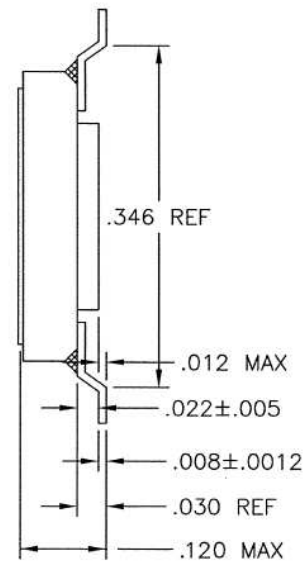
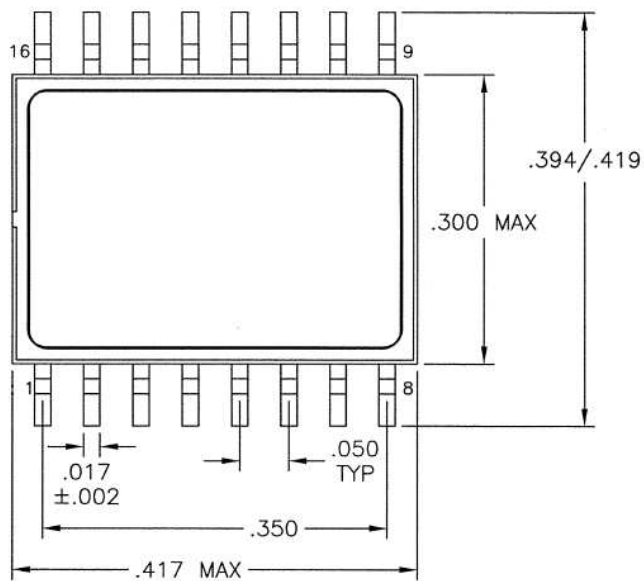


FIGURE 4: PROTECTION DIODES



**APPLICATION NOTE:
MULTIPLE AMPLIFIERS**



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

FIGURE 5: PACKAGE OUTLINE

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5904-7	-	Commercial Flow, +25°C testing only	16-pin SOIC Package
RHD5904-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5904-201-1S	5962-1221301KXC	DLA SMD Pending	
RHD5904-201-2S	5962-1221301KXA		
RHD5904-901-1S	5962H1221301KXC	DLA SMD and Radiation Certification Pending	
RHD5904-901-2S	5962H1221301KXA		

REVISION HISTORY

Date	Revision	Change Description
12/16/2016	B	Import into Cobham format. Update package height dimension, add figure 1a section diagram, update absolute max supply voltage, add absolute max input current, remove ESR rating, remove 'Typ' column, revise application notes, add protection diode figure, update the SMD number, update export statement.

Datasheet Definition

Advanced Datasheet - Product In Development

Preliminary Datasheet - Shipping Prototype

Datasheet - Shipping QML & Reduced Hi-Rel



EXPORT CONTROL:

This product is controlled for export under the Export Administration Regulations (EAR), 15 CFR Parts 730-774. A license from the Department of Commerce may be required prior to the export of this product from the United States.

Cobham Semiconductor Solutions
35 S. Service Road
Plainview, NY 11803

E: info-ams@cobham.com
T: 800 645 8862

COBHAM

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