AEROFLEX

A passion for performance.

From Aeroflex Plainview

HiRel Off-the-Shelf Products

Quad Operational Amps

Quad Comparators

Analog Multiplexers

Converters
- D-to-A
- A-to-D
- Multiplexed A-to-D

Voltage Level Translators

RadHard-by-Design

Analog Products

March 2012

Standard Products for HiRel Applications

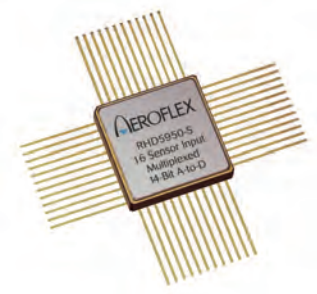
Click on Part Number for Detailed Data Sheet

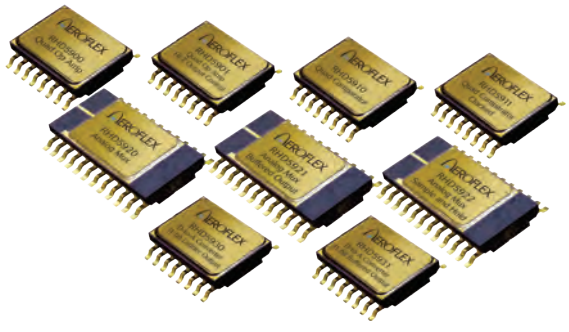
Click on Drawing Number to View SMD

Analog Function Series
RadHard-by-Design
aeroflex.com/rhdseries

	Description	Package	SMD #
	Single power supply operation: 3.3V to 5V Radiation performance: CMOS ELDRS Immune Total dose > 1 Mrad(Si) SEL Immune > 100 MeV-cm^2/mg Displacement Damage > 10^{14} neutrons/cm^2		
Quad Op Amps			
RHD5900	Quad Operational Amplifier with rail-to-rail inputs and outputs for general purpose operational amplifier applications.	16 SOIC	5962-1024101KXC
RHD5901	Quad Operational Amplifier configured with enable/disable control. Pairs of amplifiers are put in a power-down condition with their outputs in a high impedance state.	16 SOIC	5962-1024102KXC
RHD5902	Higher-speed version of RHD5901 providing wider bandwidth and faster slew rate.	16 SOIC	5962-1024103KXC
RHD5903	Quad Differential output operational amplifier. Outputs are centered at VDD/2.	20 SOIC	Pending
Quad Instrumentation Amps			
RHD5904	Quad Instrumentation Amplifier. Gain 1, output centered at VDD/2.	16 SOIC	Pending
RHD5905	Differential output version of RHD5904.	20 SOIC	Pending
Quad Comparators			
RHD5910	Quad Comparator, High Speed, for operation with dynamic signals on either or both inputs. Comparison is continuous as the circuit functions as a high gain open loop amplifier with a digital output.	16 SOIC	5962-1024201KXC
RHD5911	Quad Comparator with clocked comparator pairs to access & hold data until needed.	16 SOIC	5962-1024202KXC
RHD5912	Quad Comparator with open drain outputs.	16 SOIC	5962-1024203KXC
Analog Multiplexers			
RHD5920	16:1 analog multiplexer. Channel selection is controlled by 4-bit binary addressing and an active low enable.	24 SOIC	5962-1024301KXC
RHD5921	16:1 buffered output voltage multiplexer. Channel selection is controlled by 4-bit binary addressing and an active low enable. Multiplexed voltages are buffered by a unity gain rail-to-rail amplifier.	24 SOIC	5962-1024302KXC
RHD5922	16:1 sample-and-hold multiplexer. Channel selection is controlled by a 4-bit binary address bus. Signal aquisition is controlled by internal low leakage sample-and-hold circuitry buffered by a unity gain rail-to-rail amplifier.	24 SOIC	5962-1024303KXC
RHD5928	8:1 analog multiplexer. Channel selection is controlled by 3-bit binary addressing and an active low enable.	16 SOIC	5962-1220801KXC
RHD8541	64 channels provided by four 16:1 multiplexers. Two address busses A(0-3) and B(0-3) and four enable lines afford flexible organization.	96 CQFP	5962-1221101KXC
RHD8543	48 channels. Triple 16:1, common address inputs A(0-3), separate enable and output.	96 CQFP	5962-1221001KXC
RHD8544	32 channels. Dual 16:1, separate address inputs A(0-3) and B(0-3), separate enable and output.	56 CQFP	5962-1220901KXC
Digital-to-Analog Converters			
RHD5930	Digital to Analog Converter, 11-bit, ladder output.	16 SOIC	5962-1120801KXC
RHD5931	Digital to Analog Converter, 11-bit, buffered output.	16 SOIC	5962-1120802KXC
Analog-to-Digital Converters			
RHD5940	14-bit Analog-to-Digital Converter	24 SOIC	5962-1220701KXC
RHD5950 Multiplexed	16:1 Multiplexed, 14-bit Analog-to-Digital Converter takes 16 analog sensor signals and using 4-bit binary addressing and an enable input, selects one of the 16 analog inputs and converts the signal to 14 digital output bits. The 14-bit digital output has a tri-state control allowing the connection of multiple RHD5950s. This provides very high level of telemetry integration interfacing many sensor voltage readings to the digital processor data bus.	48 CQFP	5962-1220301KXC
Voltage Level Translators			
RHD5980	Octal Bidirectional Voltage Level Shifter	24 SOIC	5962-1221301KXC

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





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Standard Products

RadHard-by-Design
RHD5900 Quad Operational Amplifier

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
- 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 RHD5900 is a radiation hardened, single supply, quad operational amplifier in a 16-pin SOIC package. The RHD5900 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5900 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 RHD5900 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5900 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.

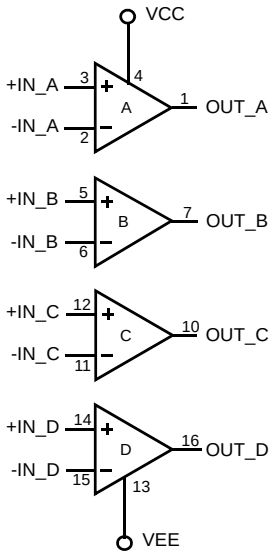
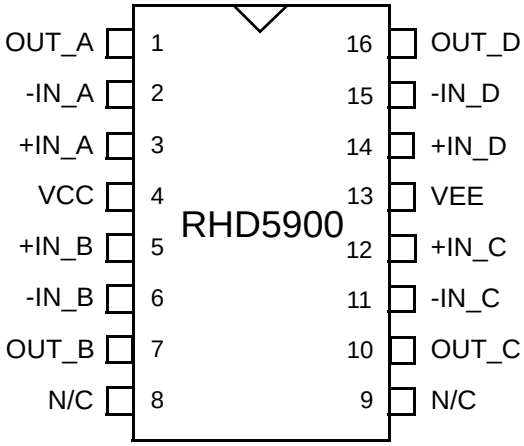


FIGURE 1: BLOCK DIAGRAM



16-Pin SOIC

FIGURE 2: PACKAGE PIN-OUT

Notes:

1. Package and lid are electrically isolated from signal pads.
2. It is recommended that N/C or no connect pins (pins 8 and 9) and lid be grounded. This eliminates or minimizes any ESD or static buildup.

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 VCC - VEE	+6.0	V
Input Voltage	VCC +0.4 VEE -0.4	V
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, Θjc	7	°C/W
ESD Rating	2.0	KV
Power @25°C	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°C TO +125°C, +VCC = +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
Quiescent Supply Current	ICCQ	No Load			5.5	mA
Channel Separation 2/		RL = 2K, f = 1.0KHz	90			dB
Input-Referred Voltage Noise 2/	e_n	F = 5 kHz		15		$nV/\sqrt{Hz}$
Phase Margin 2/	Φ_m		30			Deg

Notes:

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

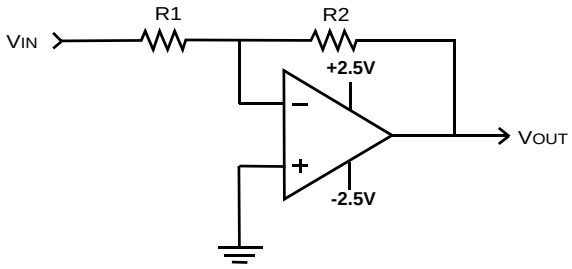
2/ Not Tested. Shall be guaranteed by design, characterization, or correlation to other test parameters.

RHD5900 QUAD OPERATIONAL AMPLIFIER APPLICATION NOTES

APPLICATION NOTE 1: DUAL POWER SUPPLY AMPLIFIER

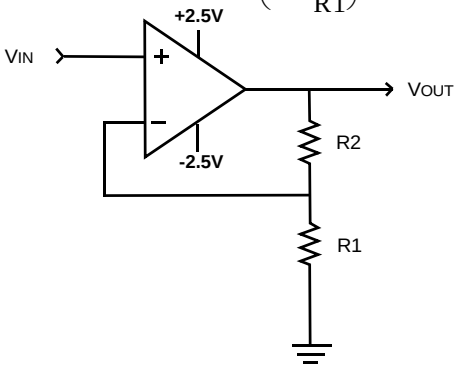
Inverting Amplifier

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



Non Inverting Amplifier

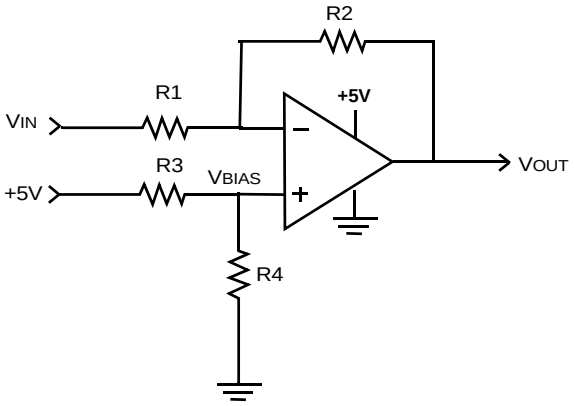
$$VOUT = VIN\left(1 + \frac{R2}{R1}\right)$$



APPLICATION NOTE 2: SINGLE POWER SUPPLY AMPLIFIER

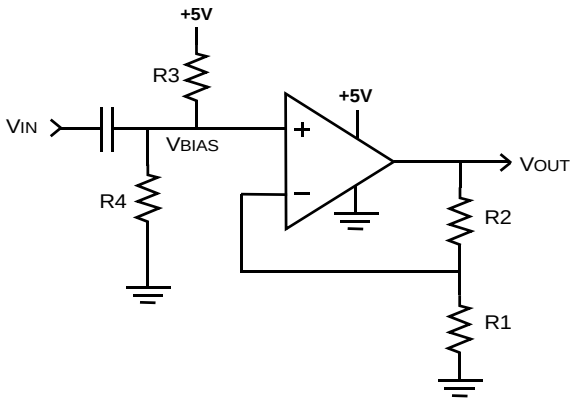
Inverting Amplifier

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



Non Inverting Amplifier

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

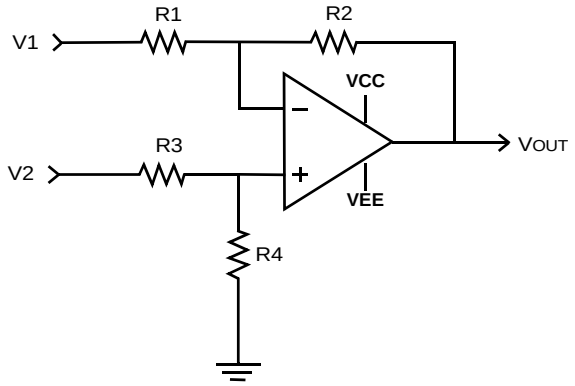


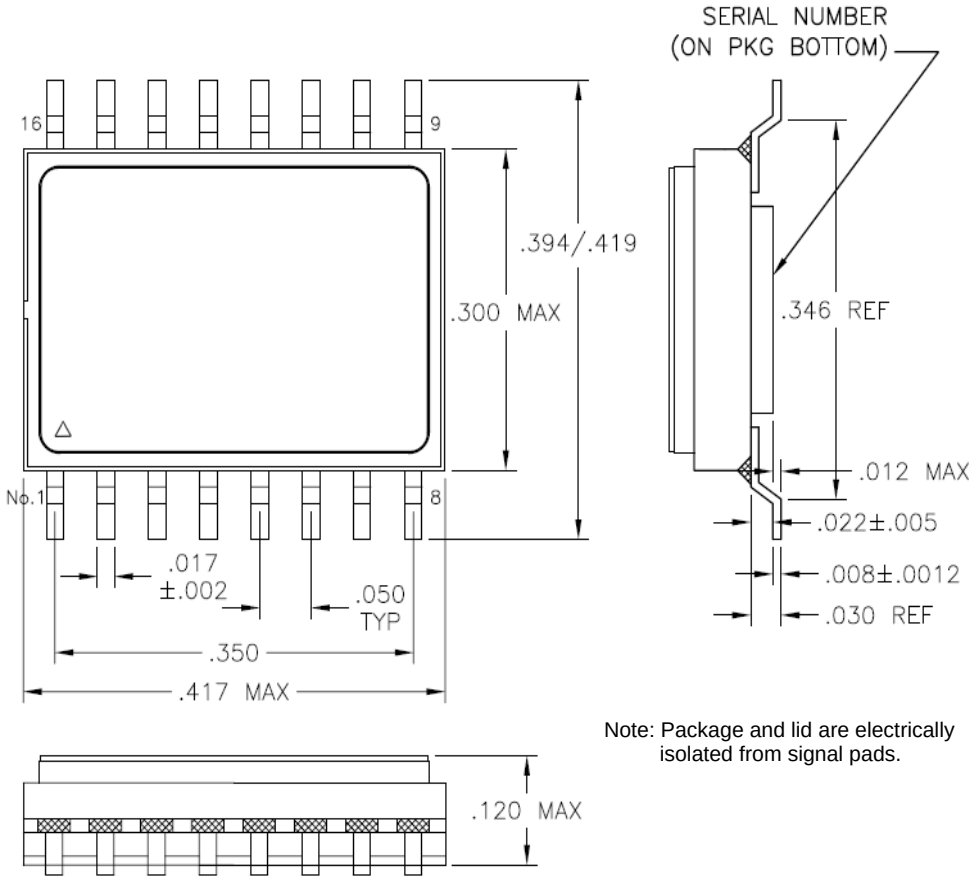
Note: For VOUT DC @ mid range of common mode voltage range, VBIAS = 2.5/(1+R2/R1), VBIAS = +5*R4/(R3+R4)

APPLICATION NOTE 3: DIFFERENTIAL INPUT AMPLIFIER

Differential Input Amplifier

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





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

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FIGURE 3: PACKAGE OUTLINE

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5900-7	-	Commercial Flow, +25°C testing only	16-pin SOIC Package
RHD5900-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5900-201-1S	5962-1024101KXC	DLA SMD Pending	
RHD5900-201-2S	5962-1024101KXA		
RHD5900-901-1S	5962H1024101KXC	DLA SMD and Radiation Certification Pending	
RHD5900-901-2S	5962H1024101KXA		

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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Fax: 321-951-4254

WEST COAST
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Fax: 949-362-2266

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AEROFLEX
A passion for performance.

Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused

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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.

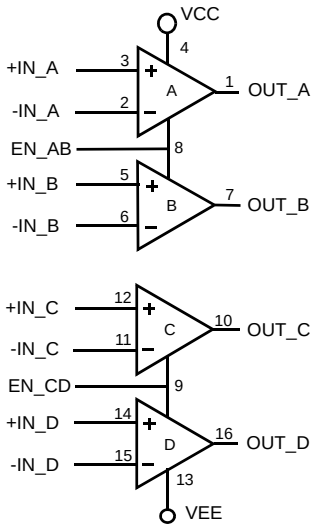
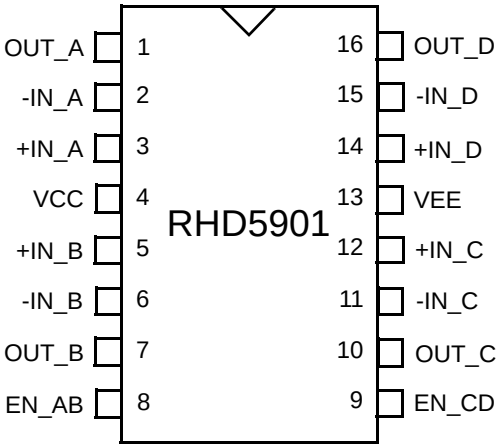


FIGURE 1: BLOCK DIAGRAM



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	°C
Storage Temperature Range	-65 to +150	°C
Junction Temperature	+150	°C
Supply Voltage VCC - VEE	+6.0	V
Input Voltage	VCC +0.4 VEE -0.4	V
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, Θjc	7	°C/W
ESD Rating	2.0	KV
Power @ 25°C	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°C TO +125°C, +VCC = +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)

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage - Enable (EN_AB, EN_CD)	V_{HI}	High (Enabled)	70% V_{CC} - V_{EE}			V
	V_{LO}	Low (Disabled)			30% V_{CC} - V_{EE}	V
Input Current - Enable (EN_AB, EN_CD)	I_{EN}				100	nA
Quiescent Supply Current	I_{CCQ}	All Amplifiers Enabled, No Load			5.5	mA
		All Amplifier Disabled			1	uA
Channel Separation 2/		R_L = 2K, f = 1.0KHz	90			dB
Input-Referred Voltage Noise 2/	e_n	F = 5 kHz		15		nV/$\sqrt{Hz}$
Phase Margin 2/	Φ_m		30			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

(T_C = -55°C TO +125°C, +V_{CC} = +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

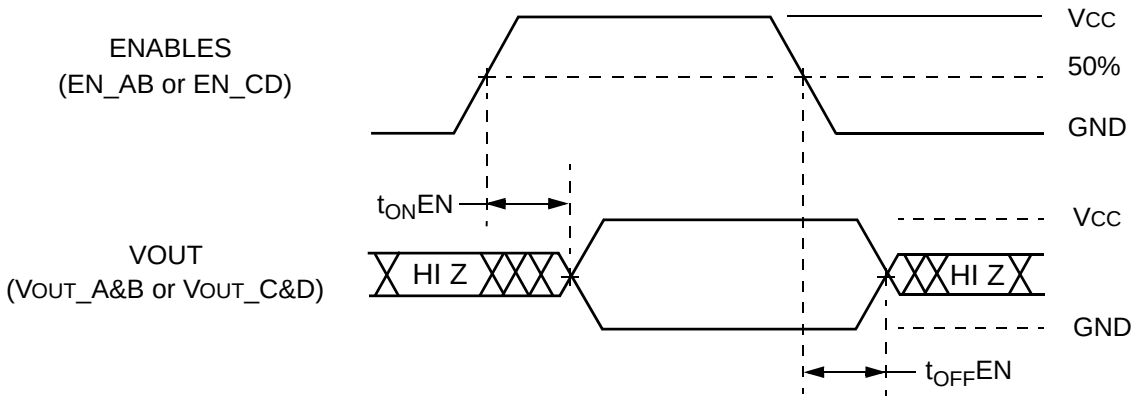


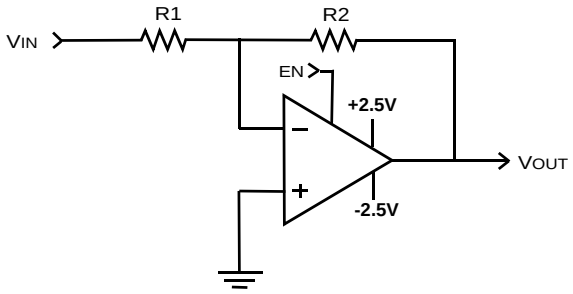
FIGURE 3: RHD5901 SWITCHING DIAGRAM

RHD5901 QUAD OPERATIONAL AMPLIFIER APPLICATION NOTES

APPLICATION NOTE 1: DUAL POWER SUPPLY AMPLIFIER

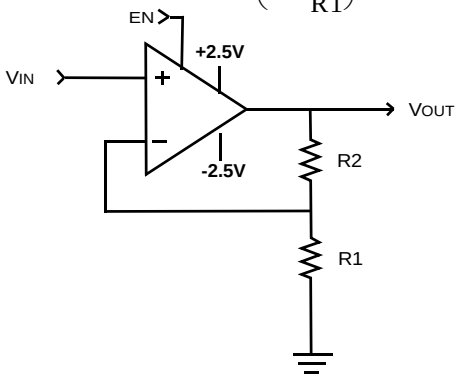
Inverting Amplifier

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



Non Inverting Amplifier

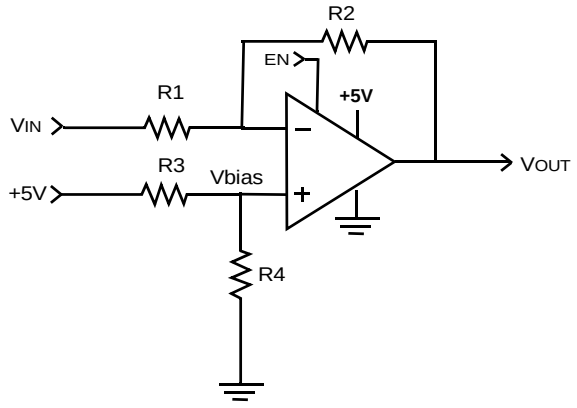
$$VOUT = VIN\left(1 + \frac{R2}{R1}\right)$$



APPLICATION NOTE 2: SINGLE POWER SUPPLY AMPLIFIER

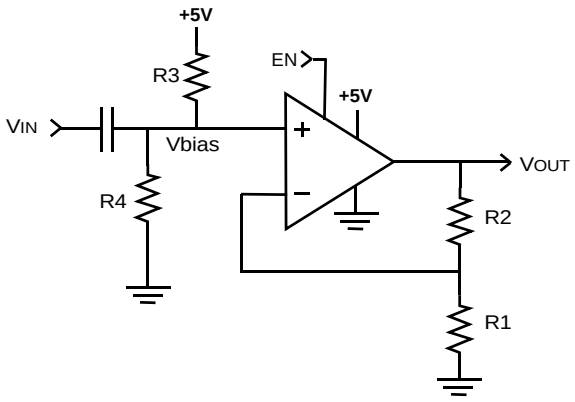
Inverting Amplifier

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



Non Inverting Amplifier

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

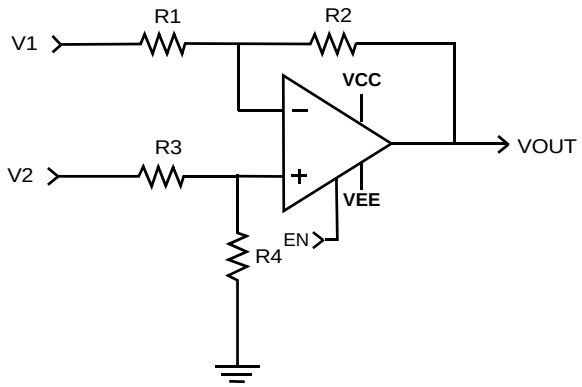


Note: For VOUT DC @ mid range of common mode voltage range, VBIAS = 2.5/(1+R2/R1), VBIAS = +5*R4/(R3+R4)

APPLICATION NOTE 3: DIFFERENTIAL INPUT AMPLIFIER

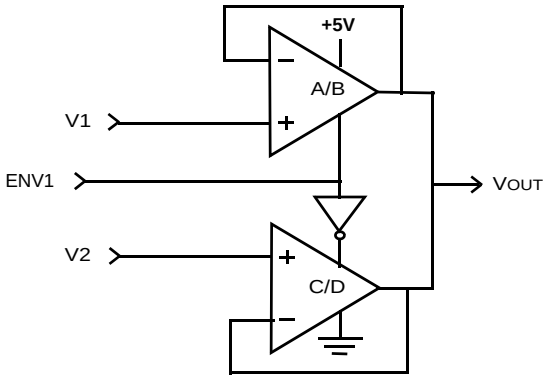
Differential Input Amplifier

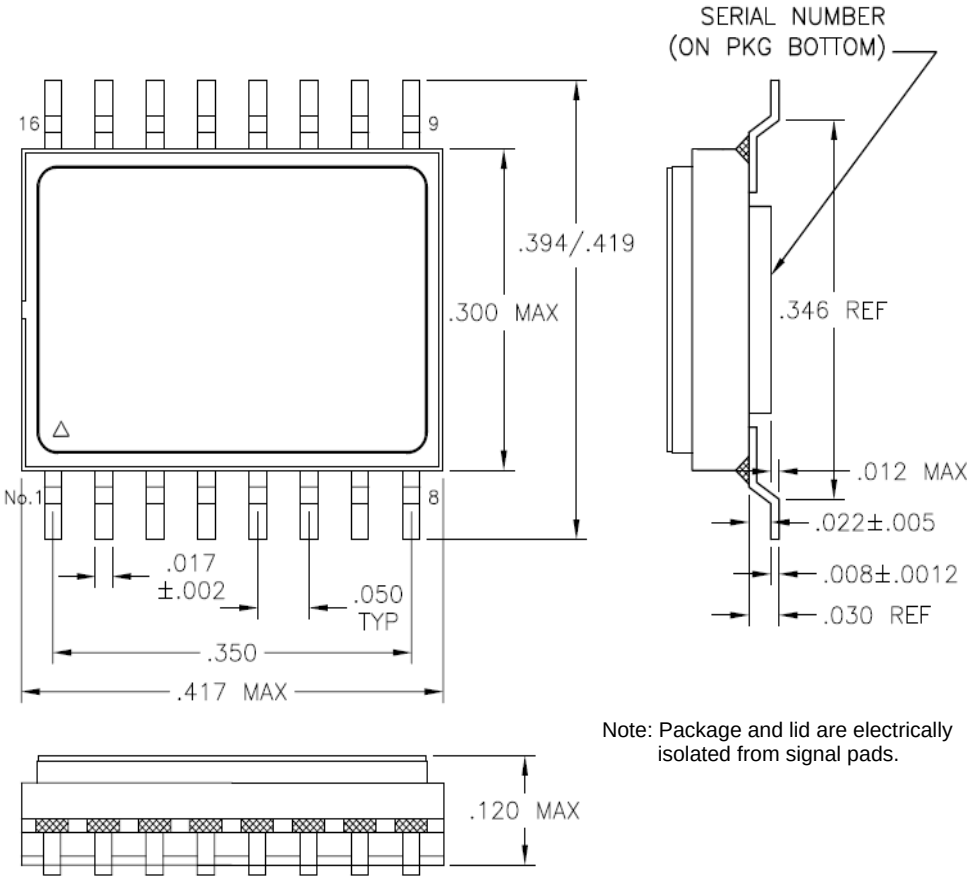
$$VOUT = \left(V2\left(\frac{R4}{R3+R4}\right)\left(1+\frac{R2}{R1}\right)\right) - \left(V1\frac{R2}{R1}\right)$$



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°C testing only	16-pin SOIC Package
RHD5901-S	-	Military Temperature, -55°C to +125°C 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:

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Standard Products

Advanced

RadHard-by-Design RHD5902 Quad Operational Amplifier High Speed with Enables

www.aeroflex.com/RHDseries

December 20, 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
- Unity Gain Bandwidth 35MHz Typical
- 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 RHD5902 is a radiation hardened, single supply, high speed quad operational amplifier with enable in a 16-pin SOIC package. The RHD5902 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5902 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 RHD5902 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5902 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 RHD5902 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.

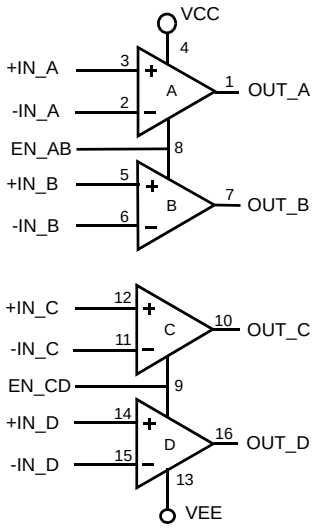
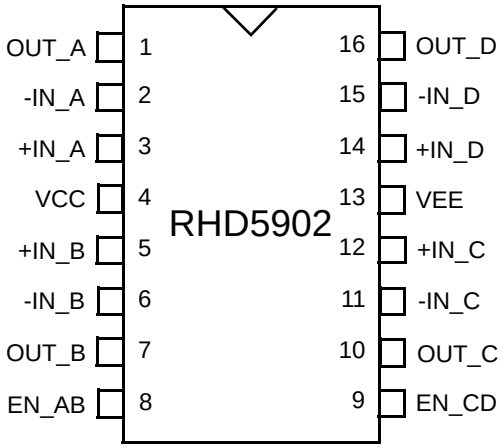


FIGURE 1: BLOCK DIAGRAM



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	°C
Storage Temperature Range	-65 to +150	°C
Junction Temperature	+150	°C
Supply Voltage VCC - VEE	+6.0	V
Input Voltage	VCC +0.4 VEE -0.4	V
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, Θjc	7	°C/W
ESD Rating	2.0	KV
Power @ 25°C	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°C TO +125°C, +VCC = +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 = 720 ohms to GND	4.9			V
Output Voltage Low	VOL	ROUT = 720 ohms to VCC			0.1	V
Short Circuit Output Current 2/	IO(SINK)	VOUT to VCC	-85			mA
	IO(SOURCE)	VOUT to VEE			50	mA
Slew Rate	SR	RL = 8K, Gain = 1	13.5			V/uS
Open Loop Gain 2/	AOL	No Load	100			dB
Unity Gain Bandwidth 2/	UGBW	RL = 10K		35		MHz

ELECTRICAL PERFORMANCE CHARACTERISTICS (continued)

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage - Enable (EN_AB, EN_CD)	V_{HI}	High (Enabled)	70% V_{CC} - V_{EE}			V
	V_{LO}	Low (Disabled)			30% V_{CC} - V_{EE}	V
Input Current - Enable (EN_AB, EN_CD)	I_{EN}				100	nA
Quiescent Supply Current	I_{CCQ}	All Amplifiers Enabled, No Load			5.5	mA
		All Amplifier Disabled			1	uA
Channel Separation 2/		R_L = 2K, f = 1.0KHz	90			dB
Input-Referred Voltage Noise 2/	e_n	F = 5 kHz		46		nV/$\sqrt{Hz}$
Phase Margin 2/	Φ_m		30			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

(T_C = -55°C TO +125°C, +V_{CC} = +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

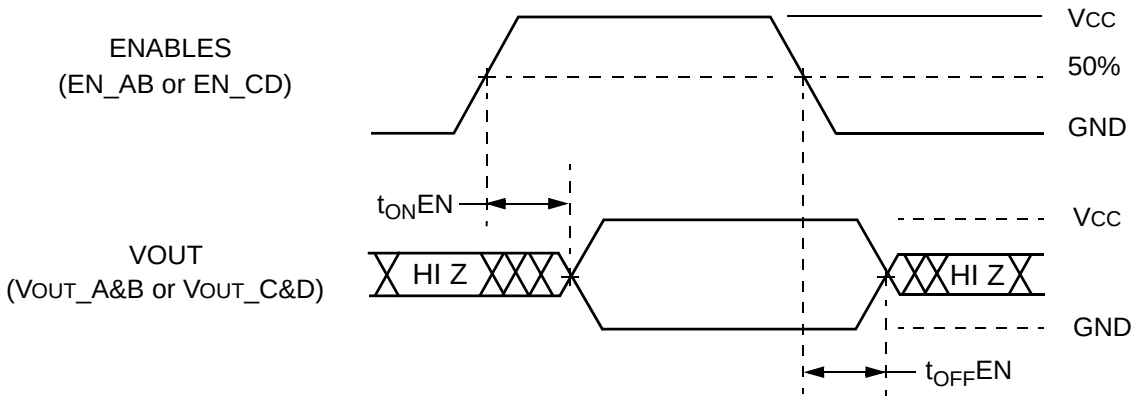


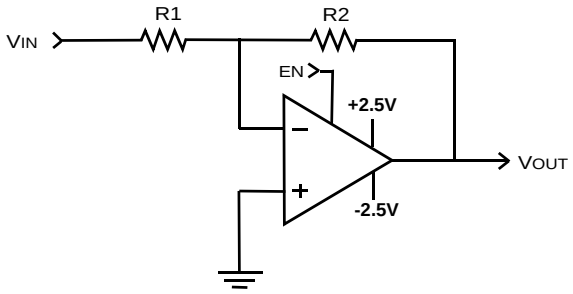
FIGURE 3: RHD5902 SWITCHING DIAGRAM

RHD5902 QUAD OPERATIONAL AMPLIFIER APPLICATION NOTES

APPLICATION NOTE 1: DUAL POWER SUPPLY AMPLIFIER

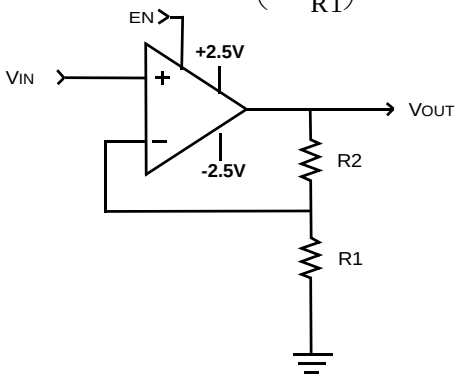
Inverting Amplifier

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



Non Inverting Amplifier

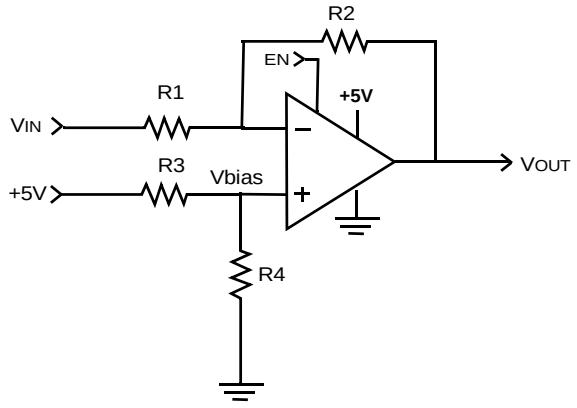
$$VOUT = VIN\left(1 + \frac{R2}{R1}\right)$$



APPLICATION NOTE 2: SINGLE POWER SUPPLY AMPLIFIER

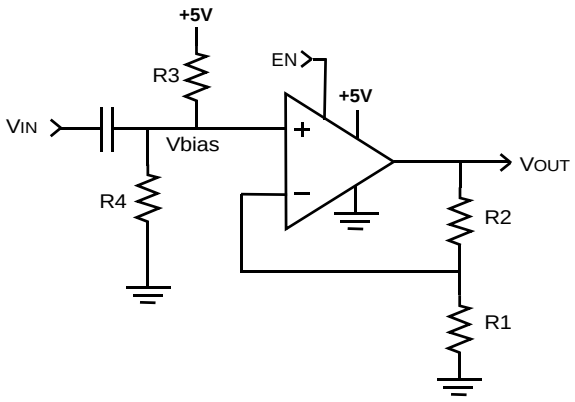
Inverting Amplifier

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



Non Inverting Amplifier

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

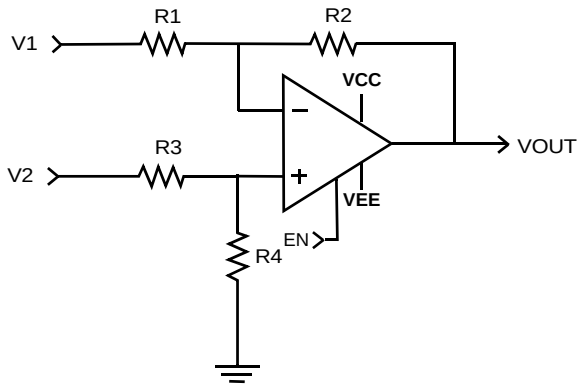


Note: For VOUT DC @ mid range of common mode voltage range, VBIAS = 2.5/(1+R2/R1), VBIAS = +5*R4/(R3+R4)

APPLICATION NOTE 3: DIFFERENTIAL INPUT AMPLIFIER

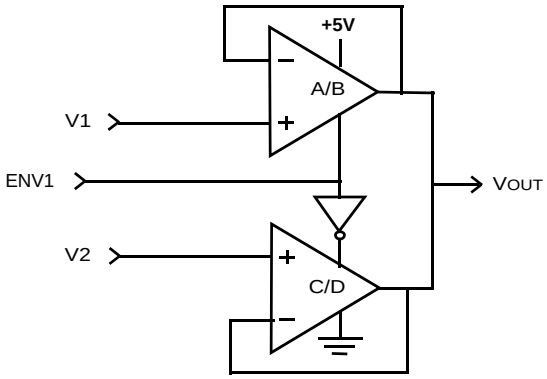
Differential Input Amplifier

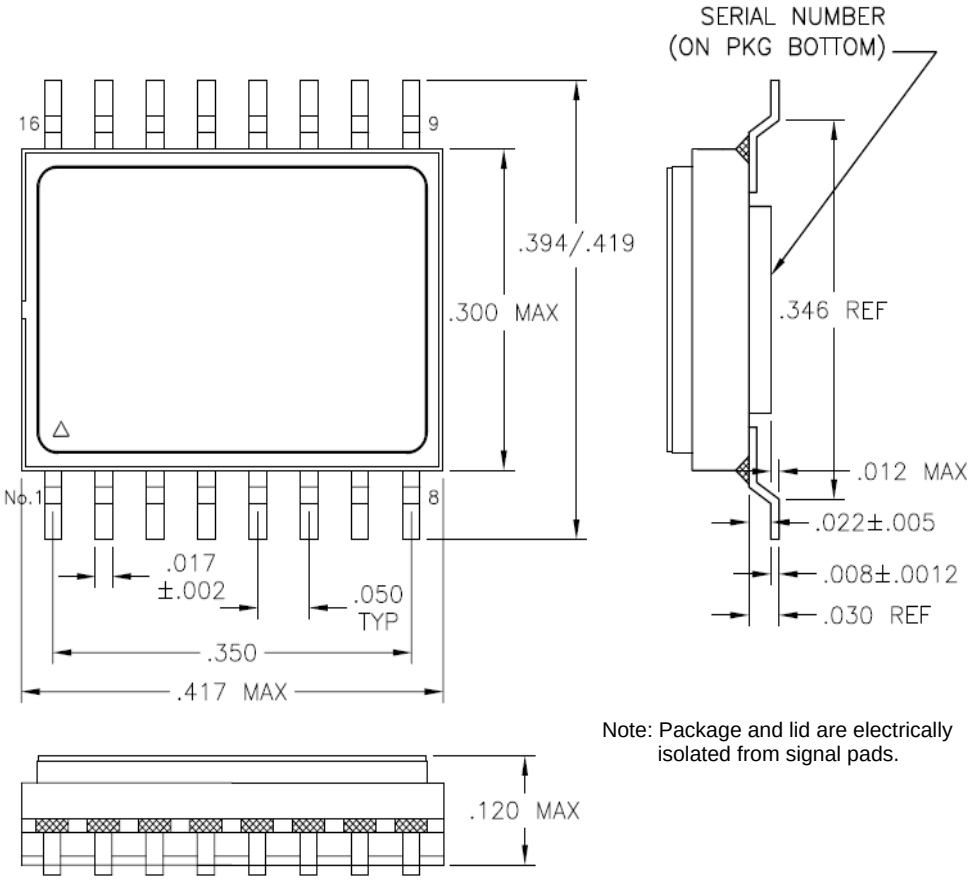
$$VOUT = \left(V2\left(\frac{R4}{R3+R4}\right)\left(1+\frac{R2}{R1}\right)\right) - \left(V1\frac{R2}{R1}\right)$$



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
RHD5902-7	-	Commercial Flow, +25°C testing only	16-pin SOIC Package
RHD5902-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5902-201-1S	5962-1024103KXC	DLA SMD Pending	
RHD5902-201-2S	5962-1024103KXA		
RHD5902-901-1S	5962H1024103KXC	DLA SMD and Radiation Certification Pending	
RHD5902-901-2S	5962H1024103KXA		

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Standard Products

Preview

RadHard-by-Design RHD5903 Quad Operational Amplifier Differential Amplifier with Enable

www.aeroflex.com/RHDseries

July 13, 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
- Differential Outputs
- 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
  - 20-pin, 0.30"W x 0.50" L x 0.12"Ht SOIC
  - Typical Weight 1.6 grams

GENERAL DESCRIPTION

Aeroflex's RHD5903 is a radiation hardened, single supply, differential, quad operational amplifier with enable in a 20-pin SOIC package. The RHD5903 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5903 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 RHD5903 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5903 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 RHD5903 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.

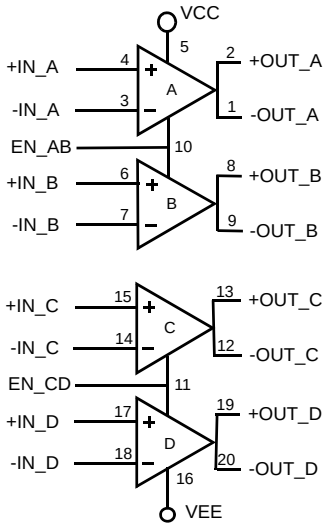
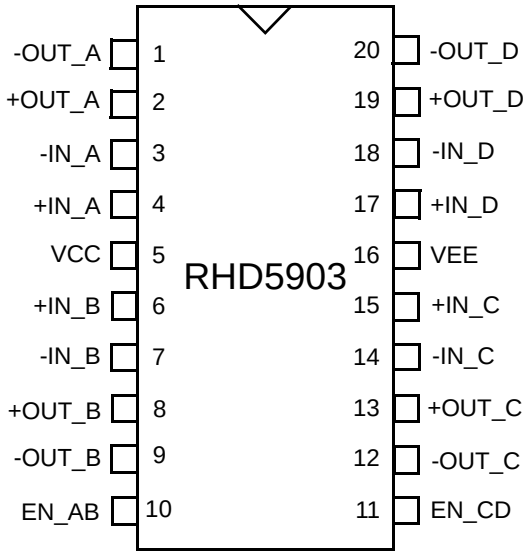


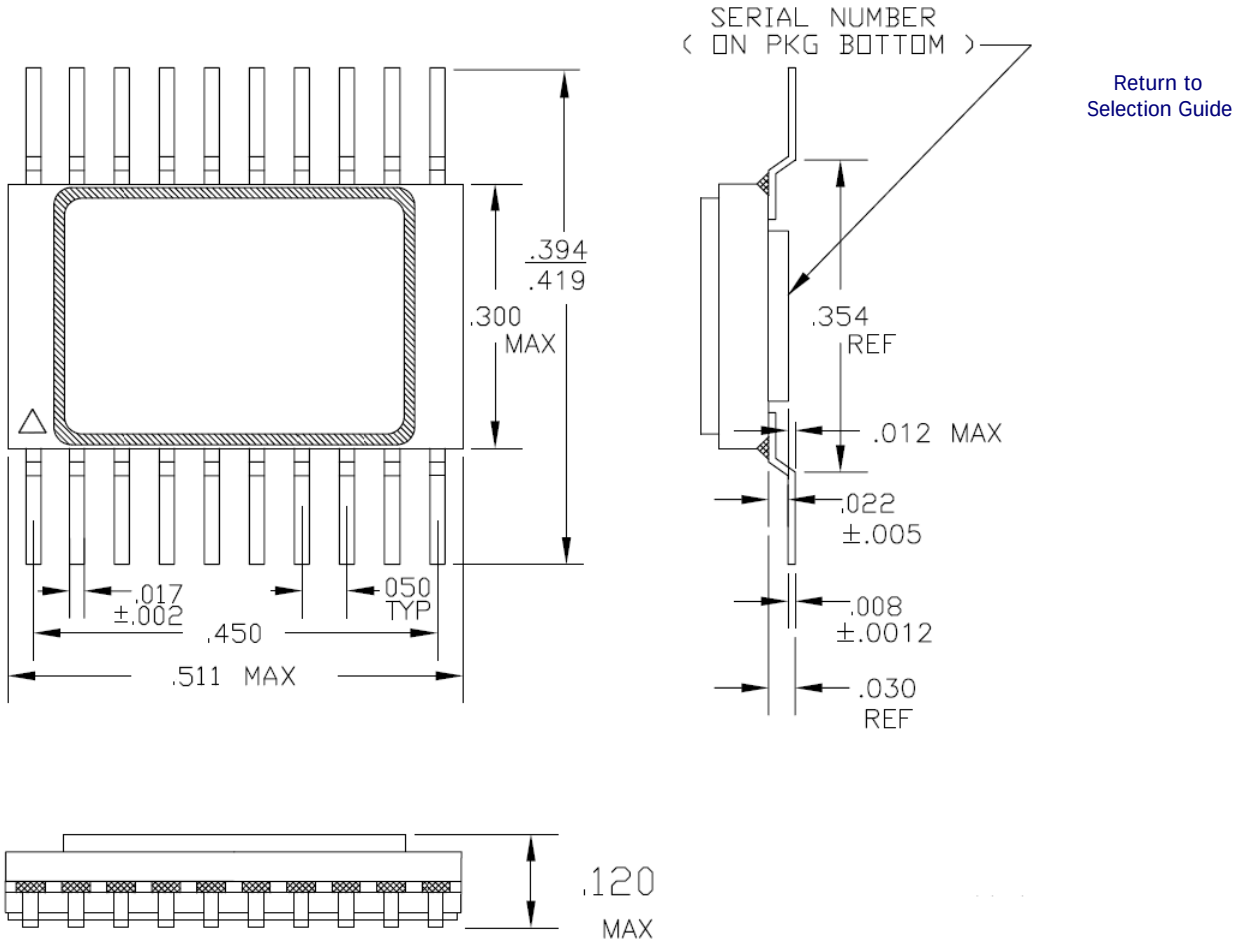
FIGURE 1: BLOCK DIAGRAM



20-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.



Return to Selection Guide

FIGURE 3: PACKAGE OUTLINE

ORDERING INFORMATION

Model	DSCC SMD #	Screening	Package
RHD5903-7	-	Commercial Flow, +25°C testing only	20-pin SOIC Package
RHD5903-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5903-201-1S	Pending	DSCC SMD Pending	
RHD5903-201-2S	Pending		
RHD5903-901-1S	Pending	DSCC SMD and Radiation Certification Pending	
RHD5903-901-2S	Pending		

EXPORT CONTROL:

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Standard Products

Preview

RadHard-by-Design
RHD5904 Quad Operational Amplifier
Instrumentation Amplifier with Enables

www.aeroflex.com/RHDseries

July 13, 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
- 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, 0.3"W x 0.4" L x 0.12"Ht SOIC
  - Typical Weight 1.2 grams

GENERAL DESCRIPTION

Aeroflex's 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°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-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 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.

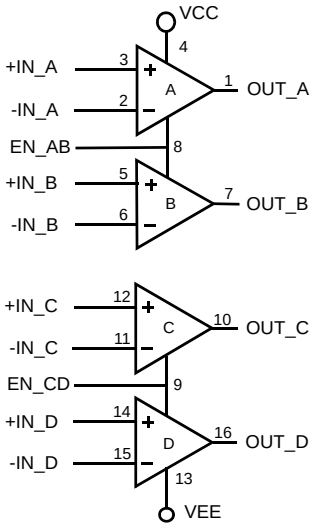
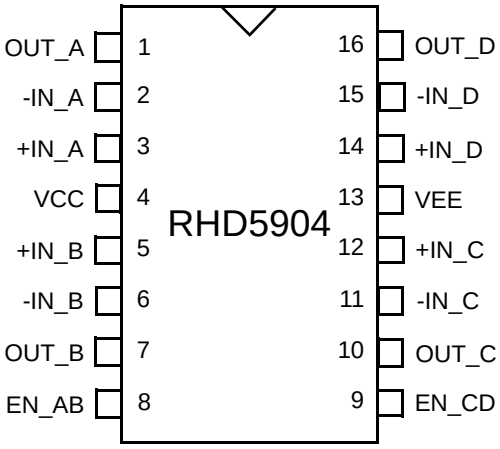


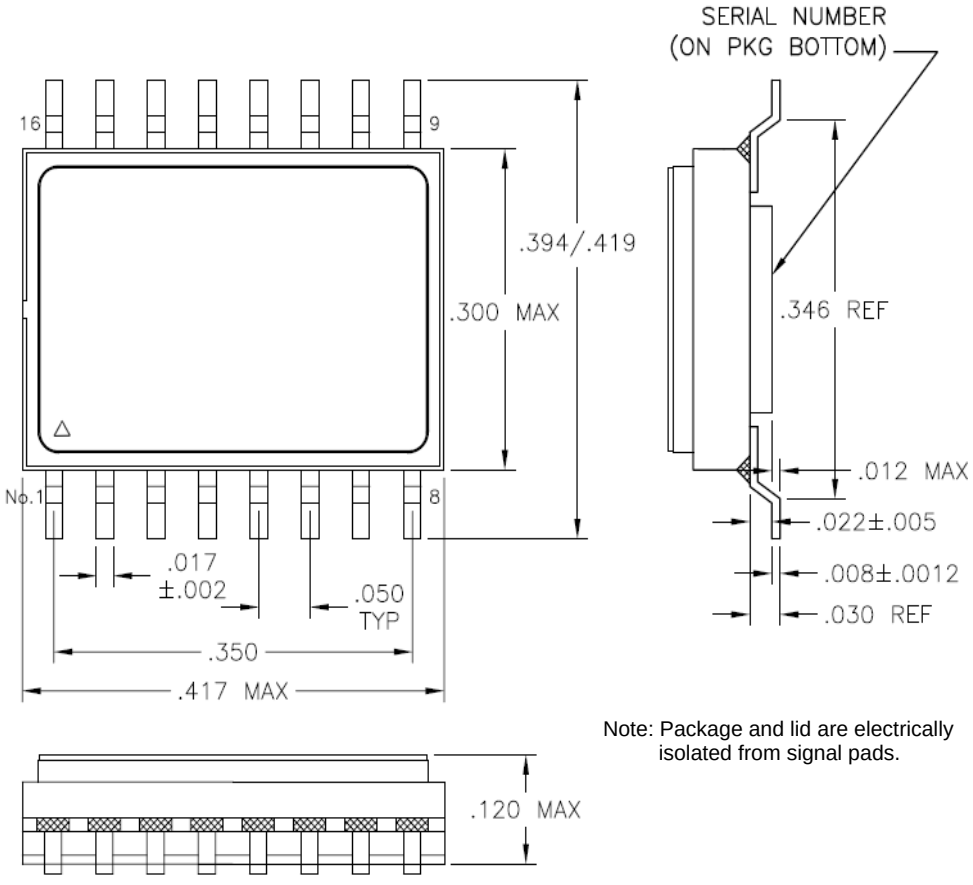
FIGURE 1: BLOCK DIAGRAM



16-Pin SOIC

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

FIGURE 2: PACKAGE PIN-OUT



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

FIGURE 3: PACKAGE OUTLINE

ORDERING INFORMATION

Model	DSCC 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	5962-1024104KXC	DSCC SMD Pending	
RHD5904-201-2S	5962-1024104KXA		
RHD5904-901-1S	5962H1024104KXC	DSCC SMD and Radiation Certification Pending	
RHD5904-901-2S	5962H1024104KXA		

EXPORT CONTROL:

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Standard Products

Preview

RadHard-by-Design RHD5905 Quad Operational Amplifier Instrumentation Differential Amplifier with Enable

www.aeroflex.com/RHDseries

July 13, 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
- Differential Outputs
- 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
  - 20-pin, 0.30"W x 0.50" L x 0.12"Ht SOIC
  - Typical Weight 1.6 grams

GENERAL DESCRIPTION

Aeroflex's RHD5905 is a radiation hardened, single supply, differential, instrumentation, quad operational amplifier with enable in a 20-pin SOIC package. The RHD5905 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5905 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 RHD5905 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5905 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 RHD5905 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.

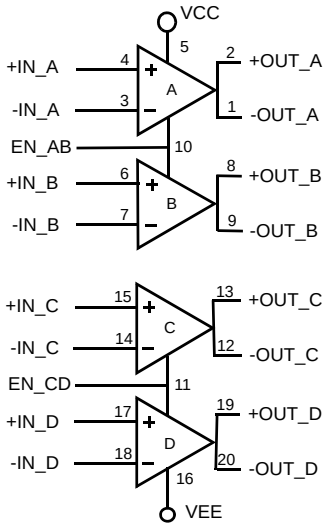
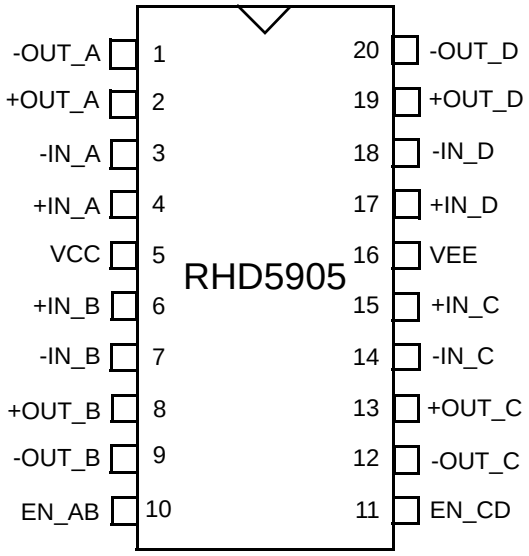


FIGURE 1: BLOCK DIAGRAM



20-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.

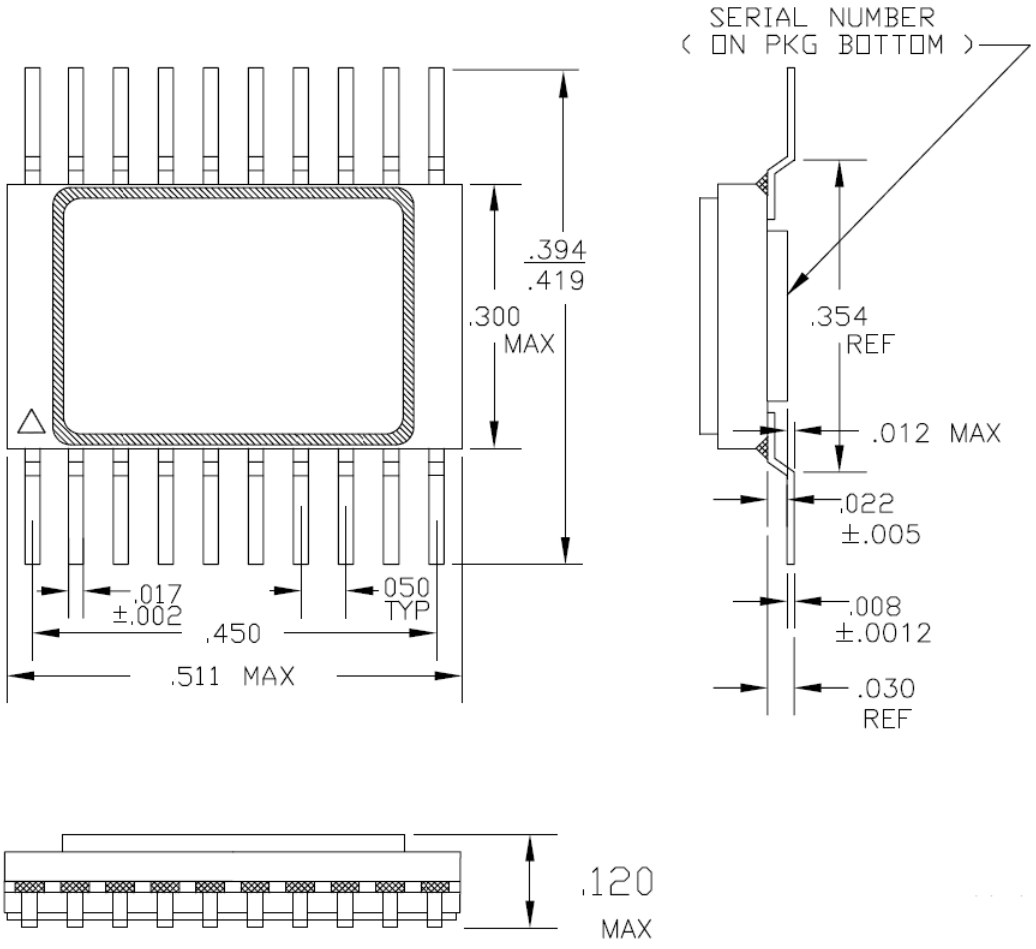


FIGURE 3: PACKAGE OUTLINE

ORDERING INFORMATION

Model	DSCC SMD #	Screening	Package
RHD5905-7	-	Commercial Flow, +25°C testing only	20-pin SOIC Package
RHD5905-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5905-201-1S	Pending	DSCC SMD Pending	
RHD5905-201-2S	Pending		
RHD5905-901-1S	Pending	DSCC SMD and Radiation Certification Pending	
RHD5905-901-2S	Pending		

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Standard Products

Preliminary

RadHard-by-Design RHD5910 Quad Comparator High Speed

www.aeroflex.com/RHDseries

March 2, 2012

FEATURES

- Single power supply operation at 3.3V or 5.0V
- 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
- 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 RHD5910 is a radiation hardened, single supply, high speed, quad comparator in a 16-pin SOIC package. The RHD5910 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5910 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 RHD5910 is ideal for demanding military and space applications.

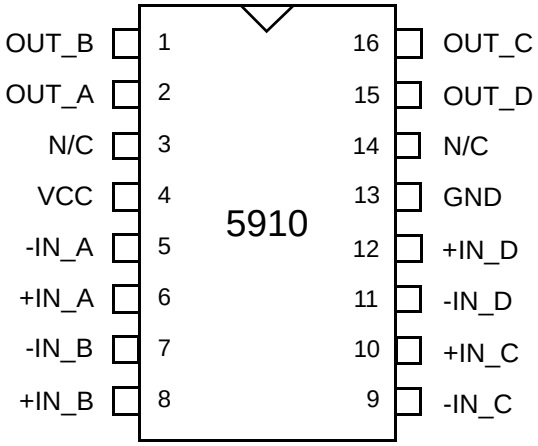
ORGANIZATION AND APPLICATION

The RHD5910 quad comparator is intended for operation with dynamic signals on either or both inputs. Comparison is 'continuous', that is, the circuit functions as high gain open loop amplifiers with a digital output. For slow input signals with small input differences the comparators can be expected to respond to small noise signals at the inputs. Feedback hysteresis is the responsibility of the user to avoid 'chattering' on system noise.

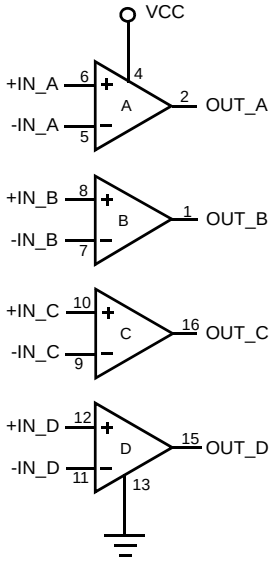
The comparator will accept signals anywhere in the included power supply range. The circuit delay is specified for a half-volt single ended or differential input step of either polarity ending in an input polarity reversal of 10mV. See Switching Diagrams.

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 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.



16-Pin SOIC



Notes:

1. Package and lid are electrically isolated from signal pads.
2. It is recommended that N/C or no connect pins (pins 3 and 14) and lid be grounded. This eliminates or minimizes any ESD or static buildup.

RHD5910: QUAD COMPARATOR

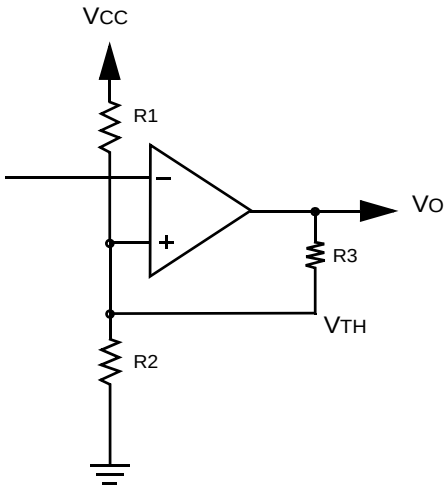
Comparator with Hysteresis

Threshold Voltage

$$V_{TH} = Vcc\frac{R2}{R1 + R2}$$

Hysteresis Calculation

$$HYS = V_O\frac{R2}{R2 + R3}$$



RHD5910: APPLICATION

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 +VCC	+6.0	V
Input Voltage	VCC +0.4 GND -0.4	V V
Lead Temperature (soldering, 10 seconds)	300	°C
ESD Rating	2.0	KV
Power @ 25°C	250	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 GND	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Offset Voltage 1/	VOS		-2		2	mV
Input Offset Current 2/	IOS		-1		1	pA
Input Bias Current 2/	IB		-2		2	pA
Input Offset TempCo 2/	VIOST				10	µV/C
Common Mode Rejection Ratio 1/	CMRR		70			dB
Power Supply Rejection Ratio 1/	PSRR		70			dB
Output Voltage High 1/	VOH	IOUT = 5mA	4.9			V
Output Voltage Low 1/	VOL	IOUT = 5mA			0.1	V
Gain 2/	A		5			V/mV
Quiescent Supply Current 1/	ICCQ				7	mA

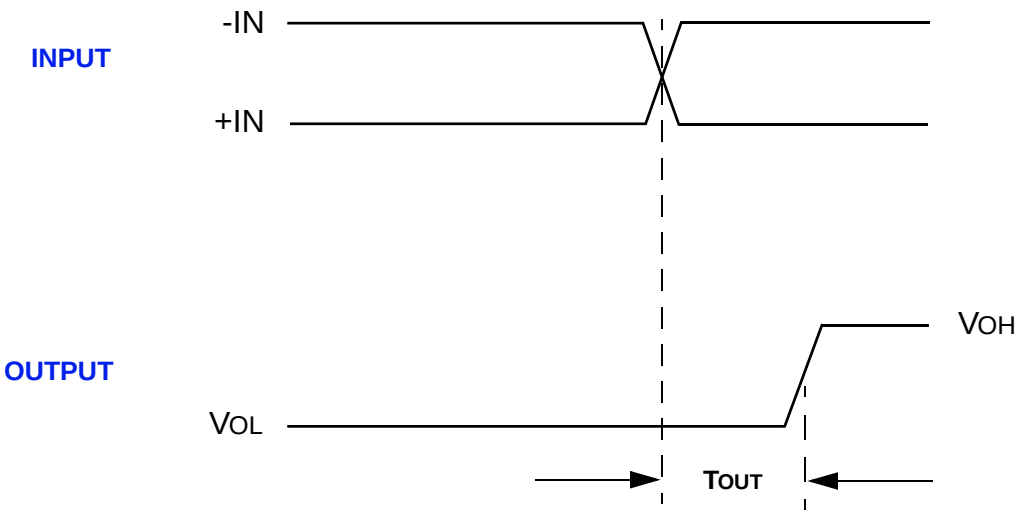
Notes: 1/ Specification derated to reflect Total Dose exposure to 1 Mrad(Si) @ 25°C.
2/ Not tested. Shall be guaranteed by design, characterization or correlation to other test parameters.

SWITCHING CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Max	Units
Output Delay	TOUT	1/		25	ns

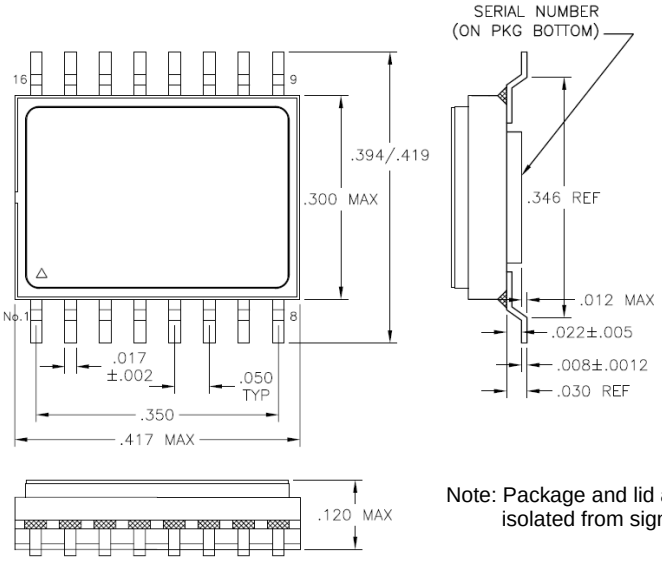
Note:
1/ The circuit delay is specified for a half-volt single ended or differential input step, of either polarity, ending in an input polarity reversal of 10mV.



RHD5910 SWITCHING DIAGRAMS

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5910-7	-	Commercial Flow, +25°C testing only	16-pin SOIC
RHD5910-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5910-201-1S	5962-1024201KXC	DLA SMD Pending	
RHD5910-201-2S	5962-1024201KXA		
RHD5910-901-1S	5962H1024201KXC	DLA SMD and Radiation Certification Pending	
RHD5910-901-2S	5962H1024201KXA		



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

PACKAGE OUTLINE

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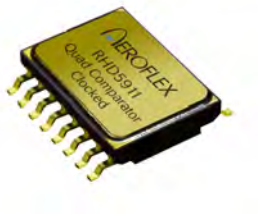
Standard Products

Preliminary

RadHard-by-Design RHD5911 Quad Comparator Clocked

www.aeroflex.com/RHDseries

March 2, 2012



FEATURES

- Single power supply operation at 3.3V or 5.0V
- 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
- Ultra low power
- 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 RHD5911 is a radiation hardened, single supply, quad clocked comparator in a 16-pin SOIC package. The RHD5911 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5911 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 RHD5911 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

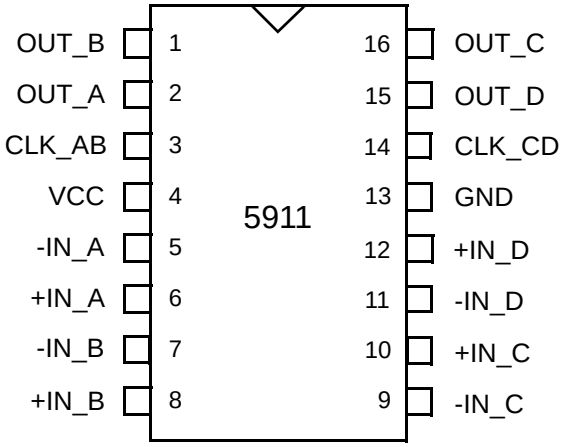
The RHD5911 quad clocked comparator is intended for operation with dynamic signals on either or both inputs. Comparison is 'clocked', that is the circuit functions as a regenerative clocked latch with a digital output. For slow input signals with small input differences the comparators can be expected to respond to small noise signals at the inputs. Feedback hysteresis is the responsibility of the user to avoid 'chattering' on system noise.

The comparators will accept signals from (GND + 0.8V) to V_{CC}. The max clocked frequency is 50MHz. The max clock-to-output delay is 10ns.

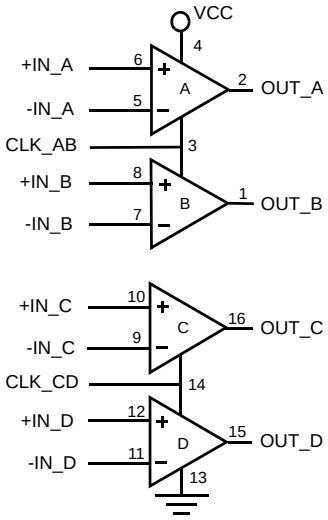
CMOS device drives have a negative temperature coefficient and the devices are therefore inherently tolerant to momentary shorts, although on chip thermal shutdown is not provided. All inputs and outputs are diode protected.

The devices will not latch with SEU events 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 RHD5911 16-pin clocked comparator allow pairs of comparators to access and hold data until needed.



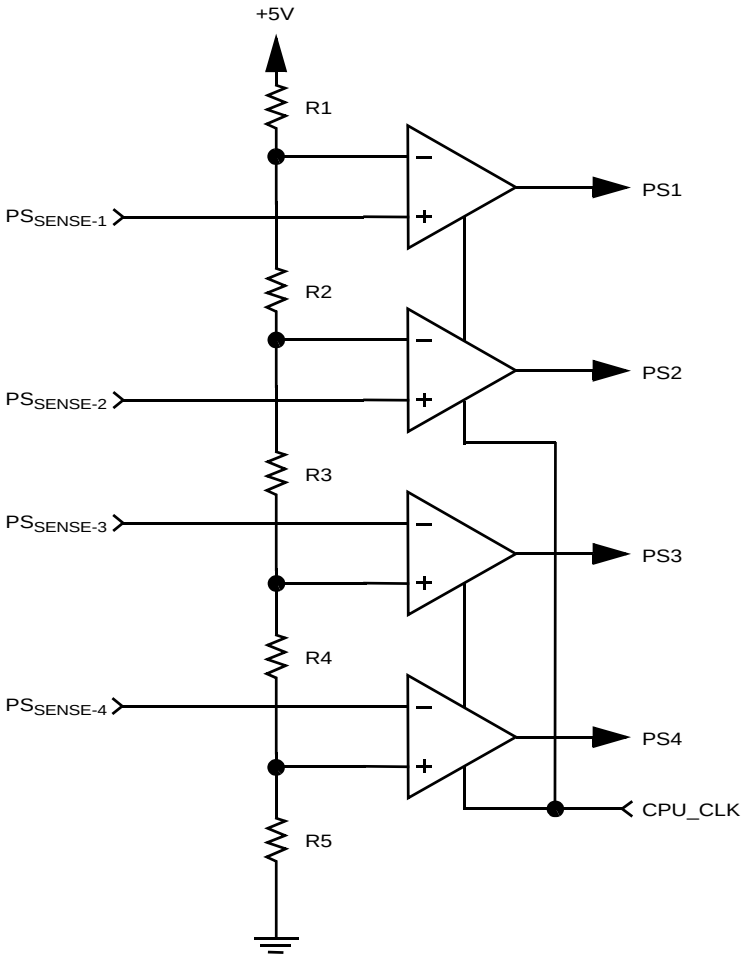
16-Pin SOIC



Notes:
1. Package and lid are electrically isolated from signal pads.
2. CLK_AB clocks comparator A & B. CLK_CD clocks comparator C & D.

RHD5911: QUAD CLOCKED COMPARATOR

Power Supply Alarm



RHD5911: QUAD CLOCKED COMPARATOR

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 +VCC	+6.0	V
Input Voltage	VCC +0.4 GND -0.4	V V
Lead Temperature (soldering, 10 seconds)	300	°C
ESD Rating	2.0	KV
Power @ 25°C	250	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 GND	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

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

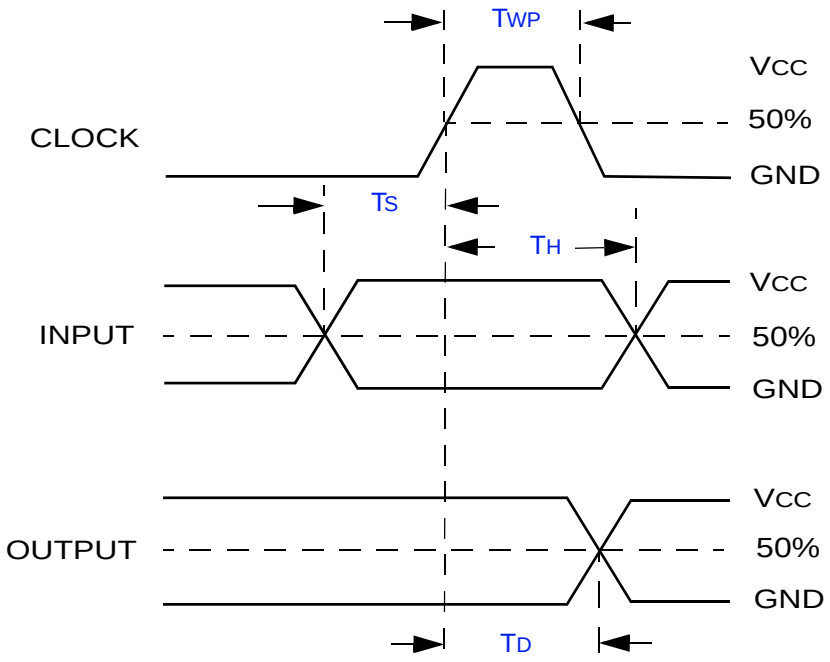
Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Offset Voltage 1/	VOS		-2		2	mV
Input Offset Current 2/	IOS		-1		1	pA
Input Bias Current 2/	IB		-2		2	pA
Input Offset TempCo 2/	VIOST				10	µV/C
Common Mode Rejection Ratio 1/	CMRR		70			dB
Power Supply Rejection Ratio 1/	PSRR		70			dB
Output Voltage High 1/	VOH	IOUT = 5mA	4.9			V
Output Voltage Low 1/	VOL	IOUT = 5mA			0.1	V
Input Voltage - Clock (CLK_AB, CLK_CD) 2/	VHI	High	70% VCC			V
Input Voltage - Clock (CLK_AB, CLK_CD) 2/	VLO	Low			30% VCC	V
Input Current - Clock (CLK_AB, CLK_CD) 2/	ICLK				1	nA
Quiescent Supply Current 1/	ICCQ				10	µA

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)

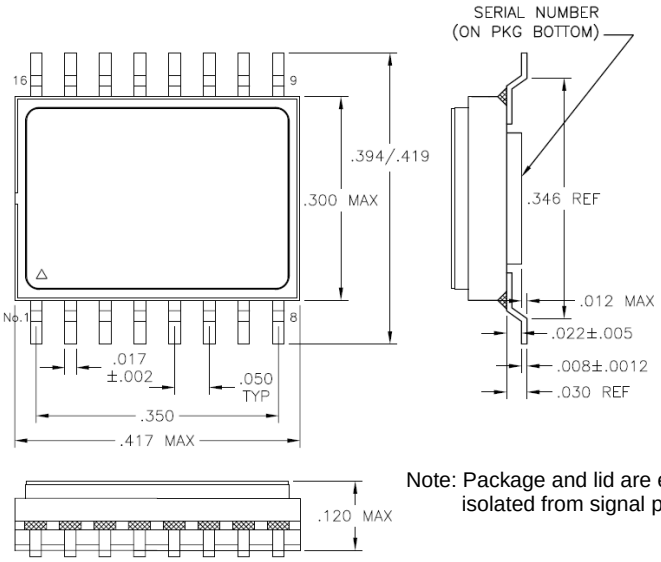
Parameter	Symbol	Conditions	Min	Max	Units
Input Setup Time	TS			1	ns
Input Hold Time	TH			5	ns
Output Delay	TD			10	ns
Clock Positive Pulse Width	TWP		100		ns
Clock Frequency	CLK			5	MHz



RHD5911 SWITCHING DIAGRAMS

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5911-7	-	Commercial Flow, +25°C testing only	16-pin SOIC
RHD5911-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5911-201-1S	5962-1024202KXC	DLA SMD Pending	
RHD5911-201-2S	5962-1024202KXA		
RHD5911-901-1S	5962H1024202KXC	DLA SMD and Radiation Certification Pending	
RHD5911-901-2S	5962H1024202KXA		



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

PACKAGE OUTLINE

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Standard Products

Preview

RadHard-by-Design RHD5912 Quad Comparator Open Drain Outputs

www.aeroflex.com/RHDseries

February 3, 2012

FEATURES

- Single power supply operation at 3.3V or 5.0V
- 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
- Short Circuit Tolerant
- Full military temperature range
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic SOIC
  - 16-pin, 0.3"W x 0.4" L x 0.12"Ht SOIC
  - Typical Weight 1.2 grams

GENERAL DESCRIPTION

Aeroflex's RHD5912 is a radiation hardened, single supply, quad comparator with open drain outputs in a 16-pin SOIC package. The RHD5912 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5912 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 RHD5912 is ideal for demanding military and space applications.

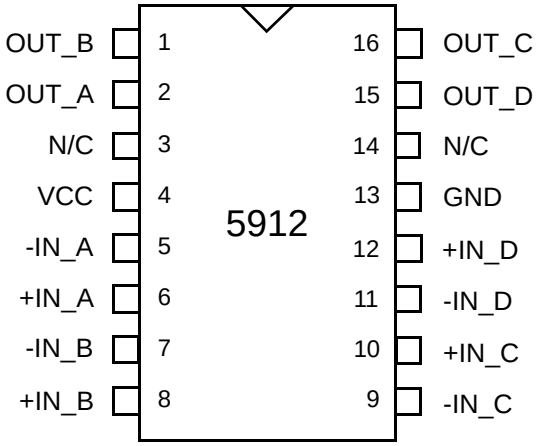
ORGANIZATION AND APPLICATION

The RHD5912 quad comparator is intended for operation with dynamic signals on either or both inputs. Comparison is 'continuous', that is, the circuit functions as high gain open loop amplifiers with a digital output. For slow input signals with small input differences the comparators can be expected to respond to small noise signals at the inputs. Feedback hysteresis is the responsibility of the user to avoid 'chattering' on system noise.

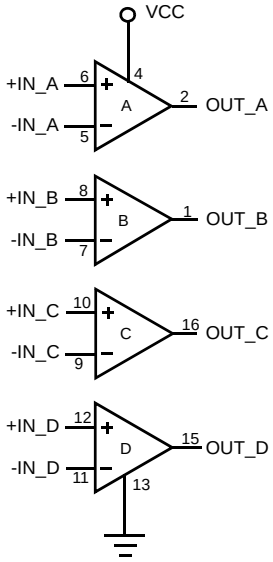
The comparator will accept signals anywhere in the included power supply range. The circuit delay is specified for a half-volt single ended or differential input step of either polarity ending in an input polarity reversal of 10mV. See Switching Diagrams.

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 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.



16-Pin SOIC



Notes:

1. Package and lid are electrically isolated from signal pads.
2. It is recommended that N/C or no connect pins (pins 3 and 14) and lid be grounded. This eliminates or minimizes any ESD or static buildup.

RHD5912: QUAD COMPARATOR

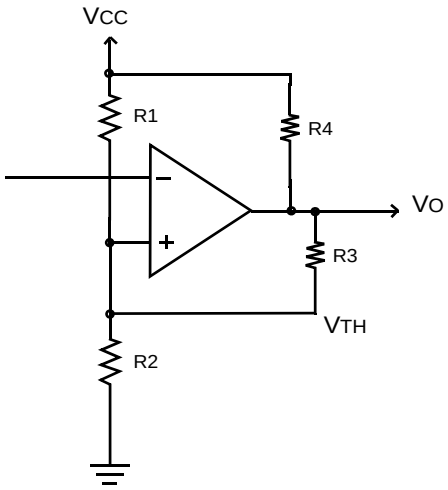
Comparator with Hysteresis

Threshold Voltage

$$V_{TH} = Vcc\frac{R2}{R1 + R2}$$

Hysteresis Calculation

$$HYS = V_O\frac{R2}{R2 + R3}$$



RHD5912: APPLICATION

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 +VCC	+6.0	V
Input Voltage	VCC +0.4 GND -0.4	V V
Lead Temperature (soldering, 10 seconds)	300	°C
ESD Rating	2.0	KV
Power @ 25°C	250	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 GND	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Offset Voltage 1/	VOS		-2		2	mV
Input Offset Current 2/	IOS		-1		1	pA
Input Bias Current 2/	IB		-2		2	pA
Input Offset TempCo 2/	VIOST				10	µV/C
Common Mode Rejection Ratio 1/	CMRR		70			dB
Power Supply Rejection Ratio 1/	PSRR		70			dB
Output Voltage High 1/	VOH	IOUT = 5mA	4.9			V
Output Voltage Low 1/	VOL	IOUT = 5mA			0.1	V
Gain 2/	A		5			V/mV
Quiescent Supply Current 1/	ICCQ				7	mA

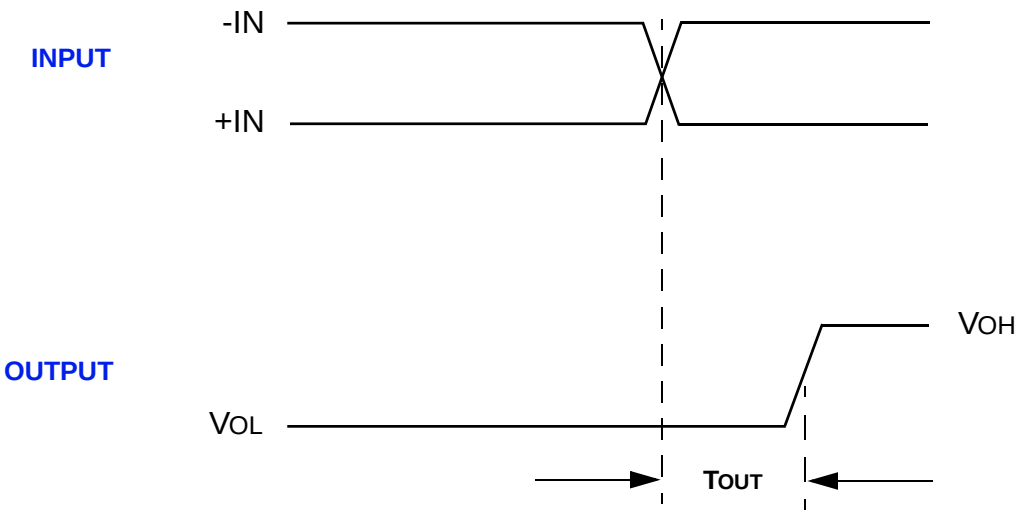
Notes: 1/ Specification derated to reflect Total Dose exposure to 1 Mrad(Si) @ 25°C.
2/ Not tested. Shall be guaranteed by design, characterization or correlation to other test parameters.

SWITCHING CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Max	Units
Output Delay	TOUT	1/		25	ns

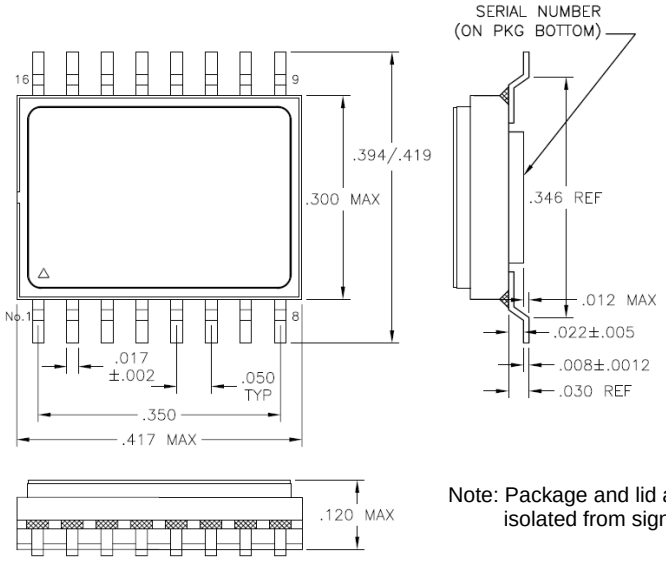
Note:
1/ The circuit delay is specified for a half-volt single ended or differential input step, of either polarity, ending in an input polarity reversal of 10mV.



RHD5912 SWITCHING DIAGRAMS

ORDERING INFORMATION

Model	DSCC SMD #	Screening	Package
RHD5912-7	-	Commercial Flow, +25°C testing only	16-pin SOIC Package
RHD5912-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5912-201-1S	5962-1024203KXC	DSCC SMD Pending	
RHD5912-201-2S	5962-1024203KXA		
RHD5912-901-1S	5962H1024203KXC	DSCC SMD and Radiation Certification Pending	
RHD5912-901-2S	5962H1024203KXA		



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

PACKAGE OUTLINE

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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AEROFLEX
A passion for performance.

Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused

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Standard Products

Preliminary

RadHard-by-Design RHD5920 Analog Multiplexer 16-Channel

www.aeroflex.com/RHDseries

March 8, 2011

FEATURES

- Single power supply operation at 3.3V to 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
- Full military temperature range
- Rail to Rail operation
- Low power consumption < 1.0mW
- One address bus (A0-3), and one enable line
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 24-pin, 0.3"W x 0.6"L x 0.12"Ht SOIC
  - Typical Weight 2 grams

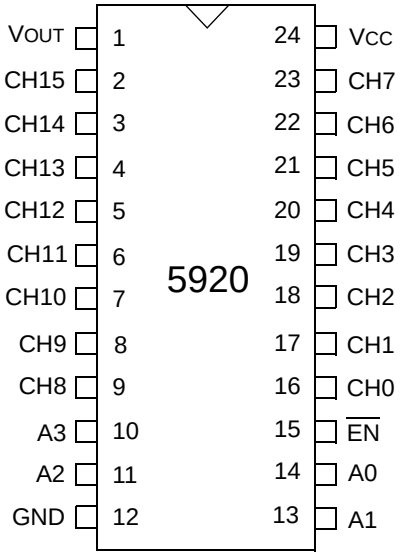
GENERAL DESCRIPTION

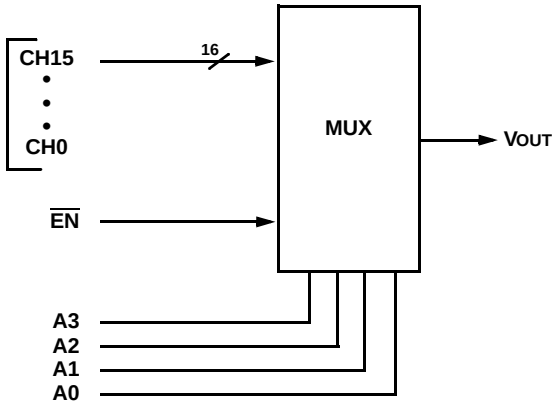
Aeroflex's RHD5920 is a radiation hardened, single supply, 16 Channel Multiplexer in a 24-pin SOIC package. The RHD5920 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5920 especially suited for 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 RHD5920 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5920 is a 16 to 1 CMOS multiplexer. Channel selection is controlled by 4 bit binary addressing and an active low enable. 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.





Notes:
1. Package and lid are electrically isolated from signal pads.

RHD5920: 16 CHANNEL ANALOG MUX

ABSOLUTE MAXIMUM RATINGS

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Supply Voltage ($+V_{CC}$)	+6.0	V
Digital Input Overvoltage (V_{EN}, V_A)	< V_{CC} +0.4 > GND -0.4	V V
Analog Input Over Voltage (CH0-CH15)	< V_{CC} +0.4 > GND -0.4	V

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
$+V_{CC}$	Power Supply Voltage	3.3 to 5.0	V
V_{EN}, V_A	Logic Low Level	30% V_{CC}	V
V_{EN}, V_A	Logic High Level	70% V_{CC}	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

(T_C = -55°C TO +125°C, $+V_{CC}$ = +5V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions		Min	Max	Units
Supply Current ($+V_{CC}$)	$+I_{CC}$	$\overline{EN}$ = 30% V_{CC}		-	10	µA
	$+I_{SBY}$	$\overline{EN}$ = 70% V_{CC}		-	10	µA
Address Input Current (A0-A3)	I_{AL}	V_A = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	I_{AH}	V_A = 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
Enable Input Current ($\overline{EN}$)	I_{ENL}	V_{EN} = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	I_{ENH}	V_{EN} = 70%V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
High Input Leakage Current (CH0-CH15)	I_{INLK_5}	V_{IN} = +5V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = 0V	+25°C	-5	5	nA
			+125°C	-50	50	nA
Low Input Leakage Current (CH0-CH15)	I_{INLK_0}	V_{IN} = 0V, V_{EN} =70% V_{CC} Output and all unused MUX inputs under test = +5V	+25°C	-5	5	nA
			+125°C	-50	50	nA
Output Leakage Current (V_{OUT})	I_{OUTLK}	V_{OUT} = +5V, V_{EN} = 70% V_{CC} , All inputs grounded except channel being tested	+25°C	-5	5	nA
			+125°C	-50	50	nA
Switch ON Resistance	R_{DSON}	V_{IN} = 0V, V_{IN} = +2.5V, V_{IN} = +5V V_{EN} = 30% V_{CC} I_{OUT} = -1mA	-55°C	-	500	Ω
			+25°C	-	750	Ω
			+125°C	-	1000	Ω

SWITCHING CHARACTERISTICS

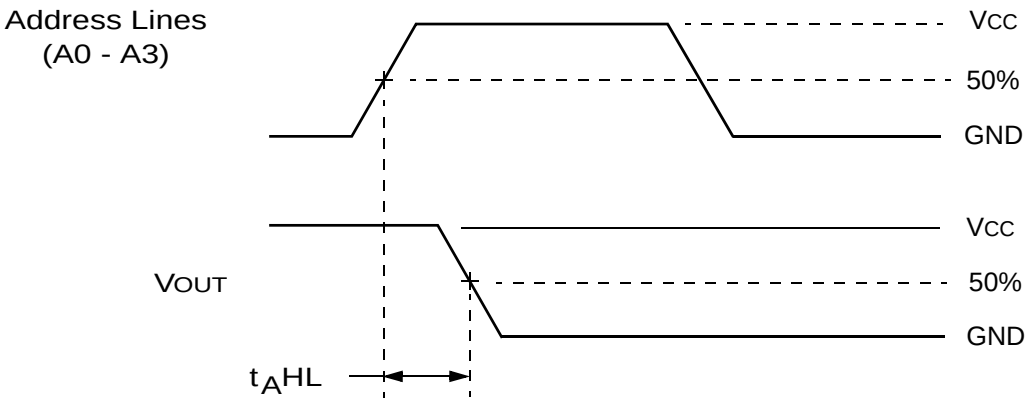
(TC = -55°C TO +125°C, +VCC = +5V -- UNLESS OTHERWISE SPECIFIED)

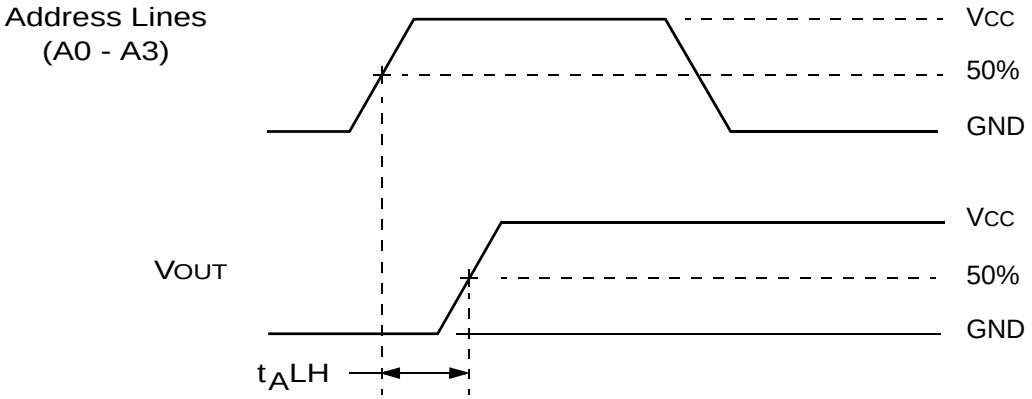
Parameter	Symbol	Conditions	Temp	Min	Max	Units
Address to Output Delay	t_AHL	VOUT High to Low Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	t_ALH	VOUT Low to High Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
Enable to Output Delay	$t_{ON}EN$	(Enabled)	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	$t_{OFF}EN$	(Disabled)	ALL	10	200	ns

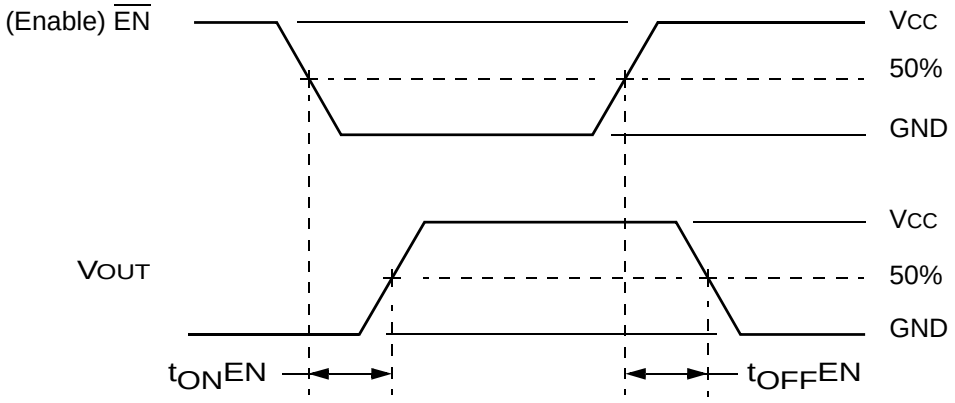
TRUTH TABLE (CH0 – CH15)

A3	A2	A1	A0	$\overline{EN}$	"ON" CHANNEL 1/
X	X	X	X	H	NONE
L	L	L	L	L	CH0
L	L	L	H	L	CH1
L	L	H	L	L	CH2
L	L	H	H	L	CH3
L	H	L	L	L	CH4
L	H	L	H	L	CH5
L	H	H	L	L	CH6
L	H	H	H	L	CH7
H	L	L	L	L	CH8
H	L	L	H	L	CH9
H	L	H	L	L	CH10
H	L	H	H	L	CH11
H	H	L	L	L	CH12
H	H	L	H	L	CH13
H	H	H	L	L	CH14
H	H	H	H	L	CH15

1/ Between (CH0-CH15) and VOUT







NOTE: f = 10KHz, Duty cycle = 50%.

RHD5920 SWITCHING DIAGRAMS

ORDERING INFORMATION

Model	DSCC SMD #	Screening	Package
RHD5920-7	-	Commercial Flow, +25°C testing only	24-pin SOIC
RHD5920-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5920-201-1S	5962-1024301KXC	DSCC SMD Pending	
RHD5920-201-2S	5962-1024301KXA		
RHD5920-901-1S	5962H1024301KXC	DSCC SMD and Radiation Certification Pending	
RHD5920-901-2S	5962H1024301KXA		

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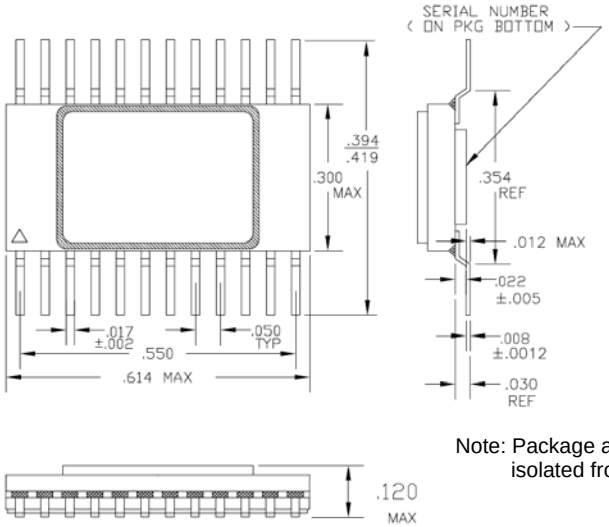

Note: Package and lid are electrically isolated from signal pads.

PACKAGE OUTLINE

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.

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Standard Products

Preliminary

RadHard-by-Design RHD5921 Analog Voltage Multiplexer 16-Channel, Buffered

www.aeroflex.com/RHDseries

March 8, 2011

FEATURES

- Single power supply operation at 3.3V to 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
- Full military temperature range
- Low Power consumption when enabled
- CMOS analog switching allows rail to rail operation and low switch impedance
- Address bus (A0-3), and one enable line
- High input impedance
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 24-pin, 0.3"W x 0.6"L x 0.12"Ht SOIC
  - Typical Weight 2 grams

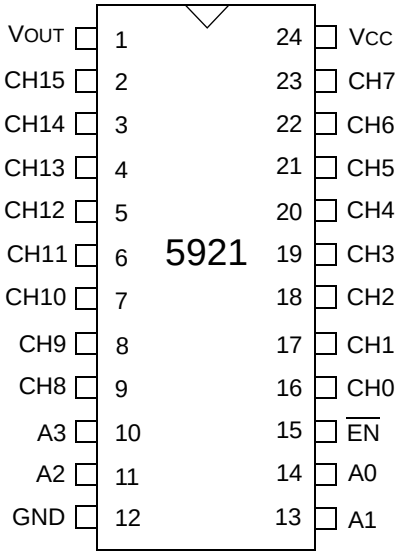
GENERAL DESCRIPTION

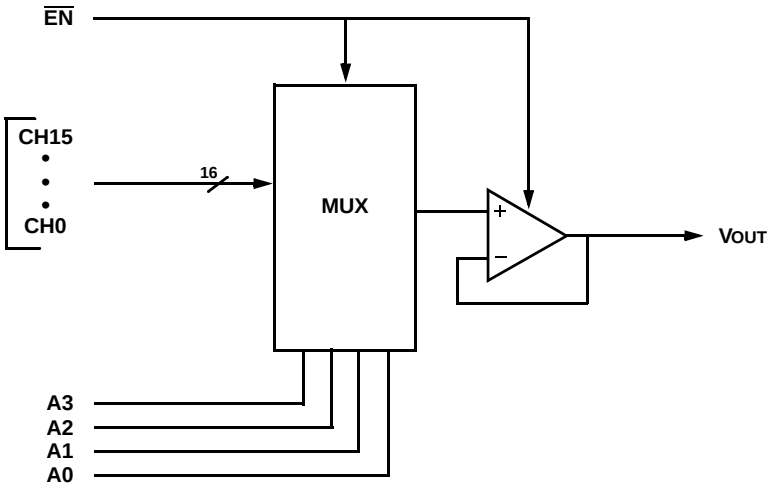
Aeroflex's RHD5921 is a radiation hardened, single supply, 16 channel buffered output multiplexer in a 24-pin SOIC package. The RHD5921 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5921 especially 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 RHD5921 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5921 is a 16 to 1 CMOS buffered output voltage multiplexer. Channel selection is controlled by 4 bit binary addressing and an active low enable. Multiplexed voltages are buffered by a unity gain CMOS Rail-to-Rail amplifier. When the RHD5921 is disabled, the chip is put into a power-down state and the output is tri-stated.

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.





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

RHD5921: 16 CHANNEL BUFFERED ANALOG MUX

ABSOLUTE MAXIMUM RATINGS

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Supply Voltage ($+V_{CC}$)	+6.0	V
Digital Input Overvoltage (V_{EN}, V_A)	< V_{CC} +0.4 > GND -0.4	V V
Analog Input Overvoltage (CH0-CH15)	< V_{CC} +0.4 > GND -0.4	V

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
$+V_{CC}$	Power Supply Voltage	3.3 to 5.0	V
V_{EN}, V_A	Logic Low Level	30% V_{CC}	V
V_{EN}, V_A	Logic High Level	70% V_{CC}	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

(T_C = -55°C TO +125°C, $+V_{CC}$ = +5V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions		Min	Max	Units
Supply Current ($+V_{CC}$)	$+I_{CC}$	$\overline{EN}$ = 30% V_{CC}		0.5	2	mA
	$+I_{SBY}$	$\overline{EN}$ = 70% V_{CC}		10	100	µA
Address Input Current (A0-A3)	I_{AL}	V_A = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	I_{AH}	V_A = 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
Enable Input Current ($\overline{EN}$)	I_{ENL}	V_{EN} = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	I_{ENH}	V_{EN} = 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
Input Leakage Current (CH0-CH15)	$+I_{INLK}$	V_{IN} = +5V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = 0V	+25°C	-5	5	nA
			+125°C	-50	50	nA
Output Leakage Current (V_{OUT})	$+I_{OUTLK}$	Tri-state, V_{EN} > 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-20	20	nA

ELECTRICAL PERFORMANCE CHARACTERISTICS (continued)

(TC = -55°C TO +125°C, +VCC = +5V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions	Min	Max	Units
Output ON Voltage	VON1	VIN = 5 Volts, RL = 10K	4.9	5.1	V
	VON2	VIN = 5 Volts, RL = 1K	4.35	4.65	V
	VON3	VIN = 3.3 Volts, RL = 10K	3.2	3.4	V

SWITCHING CHARACTERISTICS

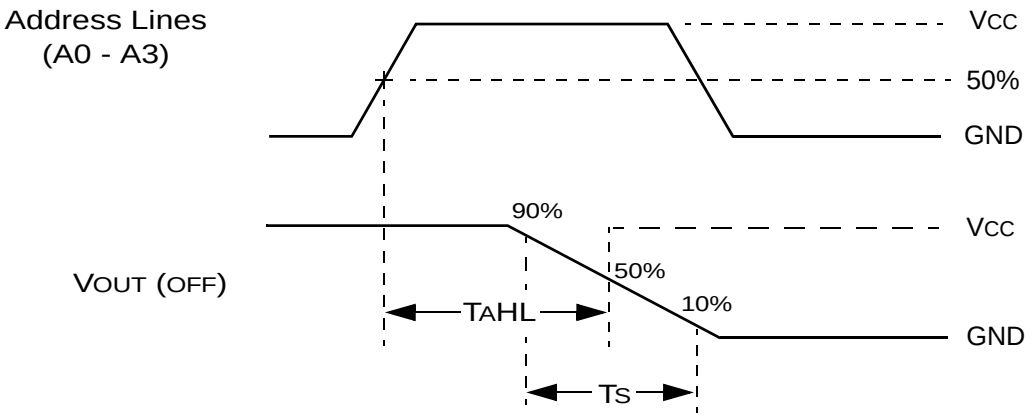
(TC = -55°C TO +125°C, +VCC = +5V -- UNLESS OTHERWISE SPECIFIED)

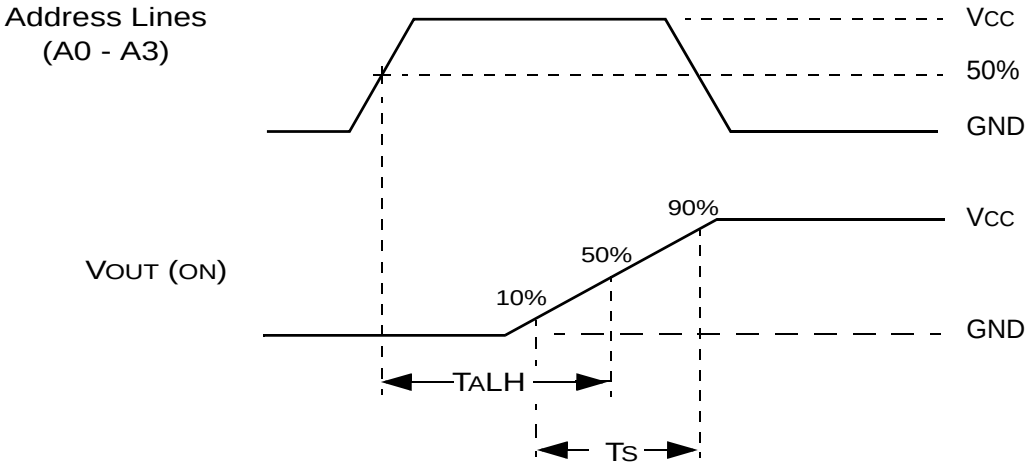
Parameter	Symbol	Conditions	Min	Max	Units
Address to Output Delay (ON, OFF)	TAHL	f = 10KHz, VIN = 5 Volts, RL = 10K	1	3	us
	TALH		1	3	us
Output Slew Rate	TS		1.8	4	V/us
Enable to Output Delay	TONEN	f = 10KHz, VIN = 5 Volts, RL = 1K	0.8	2.5	us
	TOFFEN		100	350	ns

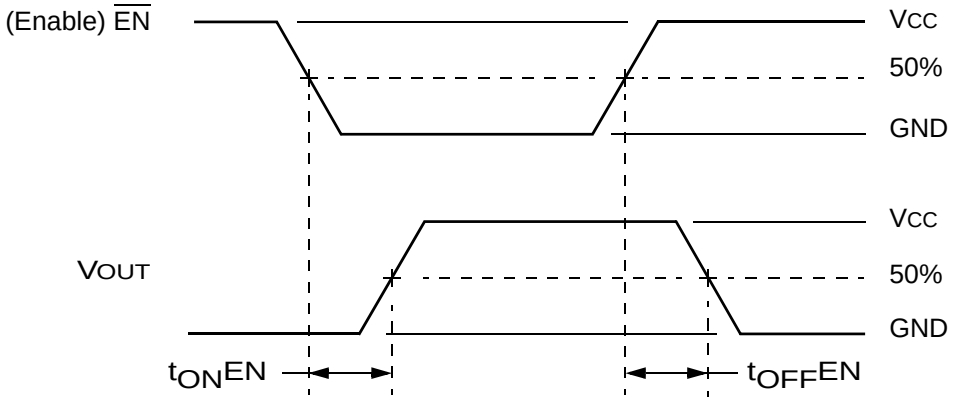
TRUTH TABLE (CH0 – CH15)

A3	A2	A1	A0	$\overline{EN}$	"ON" CHANNEL 1/
X	X	X	X	H	NONE
L	L	L	L	L	CH0
L	L	L	H	L	CH1
L	L	H	L	L	CH2
L	L	H	H	L	CH3
L	H	L	L	L	CH4
L	H	L	H	L	CH5
L	H	H	L	L	CH6
L	H	H	H	L	CH7
H	L	L	L	L	CH8
H	L	L	H	L	CH9
H	L	H	L	L	CH10
H	L	H	H	L	CH11
H	H	L	L	L	CH12
H	H	L	H	L	CH13
H	H	H	L	L	CH14
H	H	H	H	L	CH15

1/ Between (CH0-CH15) and VOUT



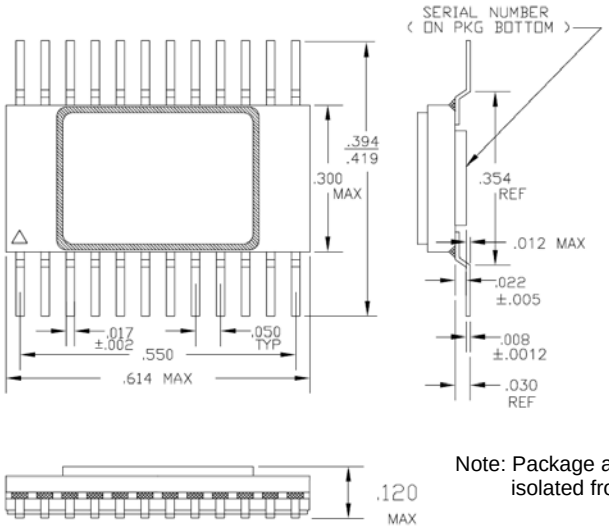




RHD5921 SWITCHING DIAGRAMS

ORDERING INFORMATION

Model	DSCC SMD #	Screening	Package
RHD5921-7	-	Commercial Flow, +25°C testing only	24-pin SOIC
RHD5921-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5921-201-1S	5962-1024302KXC	DSCC SMD Pending	
RHD5921-201-2S	5962-1024302KXA		
RHD5921-901-1S	5962H1024302KXC	DSCC SMD and Radiation Certification Pending	
RHD5921-901-2S	5962H1024302KXA		



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

PACKAGE OUTLINE

EXPORT CONTROL:

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Standard Products

Preliminary

RadHard-by-Design RHD5922 Analog Multiplexer 16-Channel, Sample-and-Hold

www.aeroflex.com/RHDseries

March 8, 2011

FEATURES

- Single power supply operation at 3.3V to 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
- Full military temperature range
- CMOS analog switching allows rail to rail operation
- Address bus (A0-3), and one sample-and-hold line
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 24-pin, 0.3"W x 0.6"L x 0.12"Ht SOIC
  - Typical Weight 2 grams

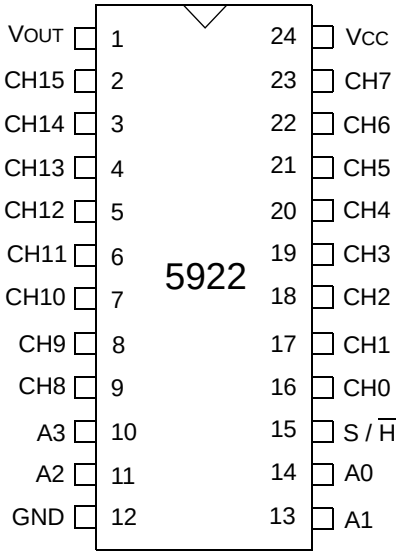
GENERAL DESCRIPTION

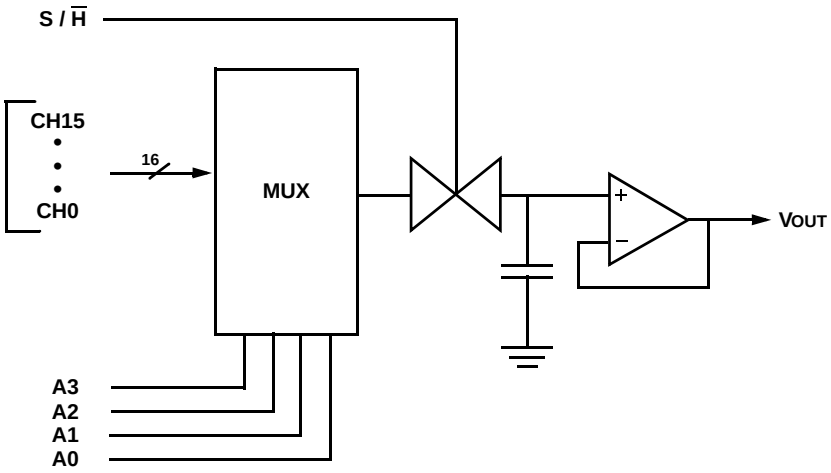
Aeroflex's RHD5922 is a radiation hardened, single supply, 16 channel sample-and-hold multiplexer in a 24-pin SOIC package. The RHD5922 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5922 especially 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 RHD5922 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5922 is a 16 to 1 CMOS sample-and-hold multiplexer. Channel selection is controlled by a 4 bit address bus. Signal aquisition is controlled by the sample-and-hold. Low internal leakage allows for droop rate as low as 0.1V/sec 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.





Notes:
1. Package and lid are electrically isolated from signal pads.

RHD5922: 16 CHANNEL SAMPLE-AND-HOLD ANALOG MUX

ABSOLUTE MAXIMUM RATINGS

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Supply Voltage (+V_{CC})	+6.0	V
Digital Input Overvoltage ($V_{S\overline{H}}$, V_A)	< V_{CC} +0.4 > GND -0.4	V V
Analog Input Over Voltage (CH0-CH15)	< V_{CC} +0.4 > GND -0.4	V

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
+V_{CC}	Power Supply Voltage	3.3 to 5.0	V
$V_{S\overline{H}}$, V_A	Logic Low Level	30% V_{CC}	V
$V_{S\overline{H}}$, V_A	Logic High Level	70% V_{CC}	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

(T_C = -55°C TO +125°C, +V_{CC}= +5V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions		Min	Max	Units
Supply Current (+V_{CC})	+I_{CC}			10	100	uA
Address Input Current (A0-A3)	I_{AL}(0-3)	V_A = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	I_{AH}(0-3)	V_A = 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
Sample-and-Hold Input Current (S / $\overline{H}$)	$I_{S\overline{H}}$	$V_{S\overline{H}}$ = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	$I_{S\overline{H}}$	$V_{S\overline{H}}$ = 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
Input Leakage Current (CH0-CH15)	+I_{INLK}	V_{IN} = +5V, $V_{S\overline{H}}$ = 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
Output ON Voltage	V_{ON}1	V_{IN} = +5V, R_L = 10K		4.9	5.1	V
	V_{ON}2	V_{IN} = +5V, R_L = 1K		4.35	4.65	V
	V_{ON}3	V_{IN} = +3.3V, R_L = 10K		3.2	3.4	V
Input Load Capacitance	C_{IN}				35	pF

SWITCHING CHARACTERISTICS

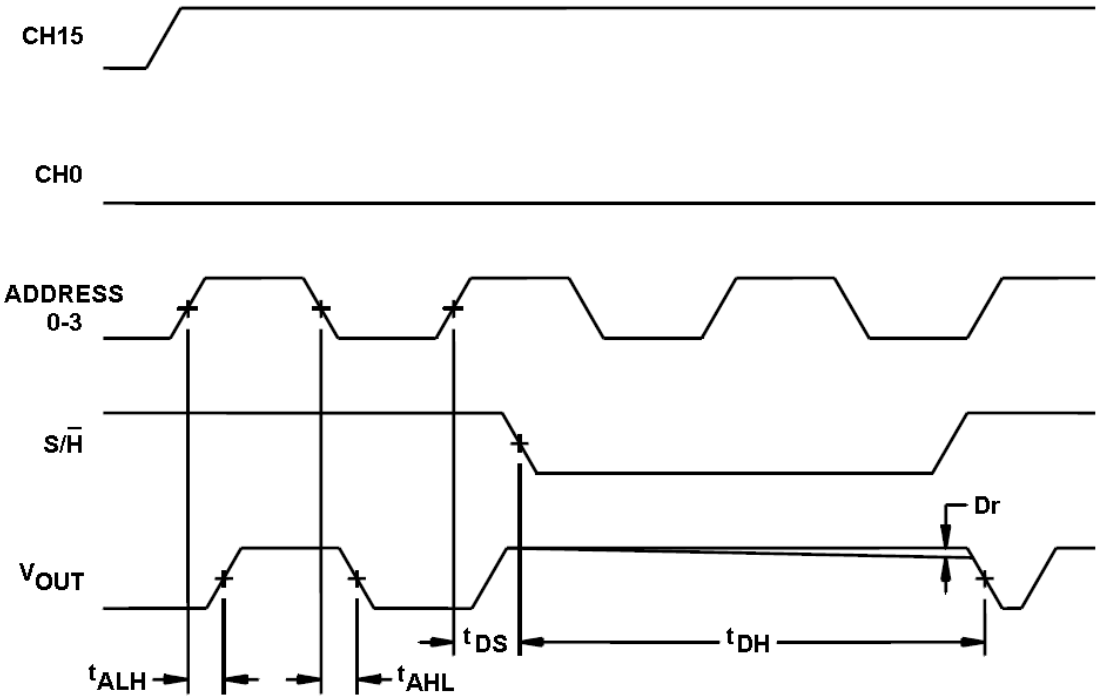
(T_C = -55°C TO +125°C, $+V_{CC}$ = +5V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions	Min	Max	Units
Address (low-to-high) to Output	t_{AHL}	f = 10KHz, V_{IN} = +5V, R_L =10kΩ	1	5	us
Address (high-to-low) to Output	t_{ALH}	f = 10KHz, V_{IN} = +5V, R_L =10kΩ	1	5	us
Droop Rate	D_R		-	0.1	V/s
Data Setup Time	t_{DS}		150	-	ns
Data Hold Time	t_{DH}		150	-	ns

TRUTH TABLE (CH0 – CH15)

A3	A2	A1	A0	"ON" CHANNEL 1/
L	L	L	L	CH0
L	L	L	H	CH1
L	L	H	L	CH2
L	L	H	H	CH3
L	H	L	L	CH4
L	H	L	H	CH5
L	H	H	L	CH6
L	H	H	H	CH7
H	L	L	L	CH8
H	L	L	H	CH9
H	L	H	L	CH10
H	L	H	H	CH11
H	H	L	L	CH12
H	H	L	H	CH13
H	H	H	L	CH14
H	H	H	H	CH15

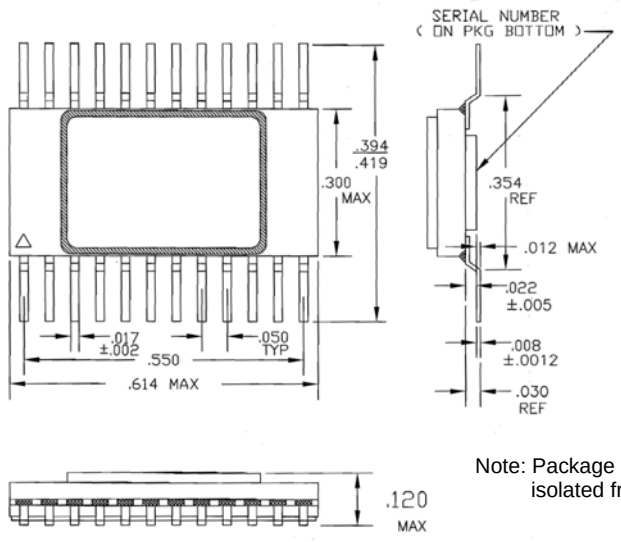
1/ Between (CH0-CH15) and V_{OUT}



RHD5922 SWITCHING DIAGRAMS

ORDERING INFORMATION

Model	DSCC SMD #	Screening	Package
RHD5922-7	-	Commercial Flow, +25°C testing only	24-pin SOIC
RHD5922-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5922-201-1S	5962-1024303KXC	DSCC SMD Pending	
RHD5922-201-2S	5962-1024303KXA		
RHD5922-901-1S	5962H1024303KXC	DSCC SMD and Radiation Certification Pending	
RHD5922-901-2S	5962H1024303KXA		



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

PACKAGE OUTLINE

EXPORT CONTROL:

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Standard Products

Preliminary

RadHard-by-Design RHD5928 Analog Multiplexer 8-Channel

www.aeroflex.com/RHDseries

August 31, 2011

FEATURES

- Single power supply operation at 3.3V to 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
- Full military temperature range
- Rail to Rail operation
- Low power consumption < 1.0mW
- One address bus (A0-2), and one enable line
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 16-pin, 0.3"W x 0.4"L x 0.12"Ht SOIC
  - Typical Weight 1.2 grams

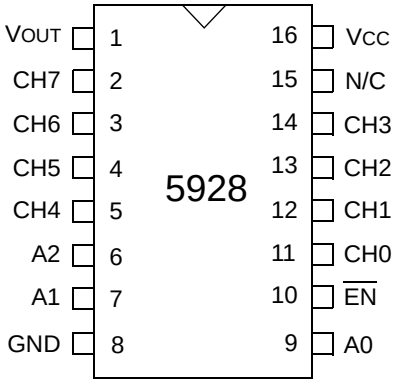
GENERAL DESCRIPTION

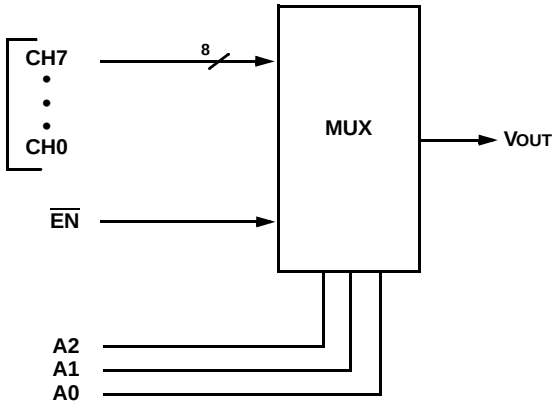
Aeroflex's RHD5928 is a radiation hardened, single supply, 8 Channel Multiplexer in a 16-pin SOIC package. The RHD5928 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5928 especially suited for 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 RHD5928 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5928 is an 8 to 1 CMOS multiplexer. Channel selection is controlled by 3 bit binary addressing and an active low enable. 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.





Notes:
1. Package and lid are electrically isolated from signal pads.

RHD5928: 8 CHANNEL ANALOG MUX

ABSOLUTE MAXIMUM RATINGS

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Supply Voltage ($+V_{CC}$)	+6.0	V
Digital Input Overvoltage (V_{EN}, V_A)	< V_{CC} +0.4 > GND -0.4	V V
Analog Input Over Voltage (CH0-CH7)	< V_{CC} +0.4 > GND -0.4	V

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
$+V_{CC}$	Power Supply Voltage	3.3 to 5.0	V
V_{EN}, V_A	Logic Low Level	30% V_{CC}	V
V_{EN}, V_A	Logic High Level	70% V_{CC}	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

(T_C = -55°C TO +125°C, $+V_{CC}$ = +5V -- UNLESS OTHERWISE SPECIFIED)

Parameter	Symbol	Conditions		Min	Max	Units
Supply Current ($+V_{CC}$)	$+I_{CC}$	$\overline{EN}$ = 30% V_{CC}		-	10	µA
	$+I_{SBY}$	$\overline{EN}$ = 70% V_{CC}		-	10	µA
Address Input Current (A0-A2)	I_{AL}	V_A = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	I_{AH}	V_A = 70% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
Enable Input Current ($\overline{EN}$)	I_{ENL}	V_{EN} = 30% V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
	I_{ENH}	V_{EN} = 70%V_{CC}	+25°C	-5	5	nA
			+125°C	-50	50	nA
High Input Leakage Current (CH0-CH7)	I_{INLK_5}	V_{IN} = +5V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = 0V	+25°C	-5	5	nA
			+125°C	-50	50	nA
Low Input Leakage Current (CH0-CH7)	I_{INLK_0}	V_{IN} = 0V, V_{EN} =70% V_{CC} Output and all unused MUX inputs under test = +5V	+25°C	-5	5	nA
			+125°C	-50	50	nA
Output Leakage Current (V_{OUT})	I_{OUTLK}	V_{OUT} = +5V, V_{EN} = 70% V_{CC} , All inputs grounded except channel being tested	+25°C	-5	5	nA
			+125°C	-50	50	nA
Switch ON Resistance	R_{DSON}	V_{IN} = 0V, V_{IN} = +2.5V, V_{IN} = +5V V_{EN} = 30% V_{CC} I_{OUT} = -1mA	-55°C	-	500	Ω
			+25°C	-	750	Ω
			+125°C	-	1000	Ω

SWITCHING CHARACTERISTICS

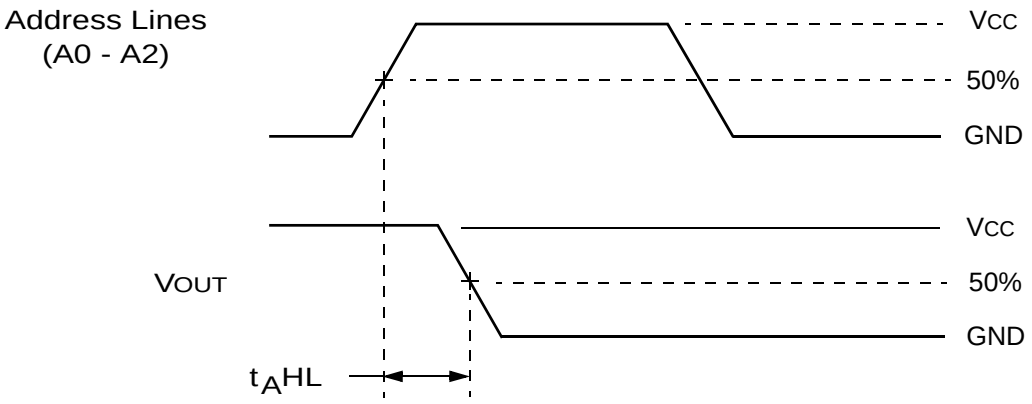
(TC = -55°C TO +125°C, +VCC = +5V -- UNLESS OTHERWISE SPECIFIED)

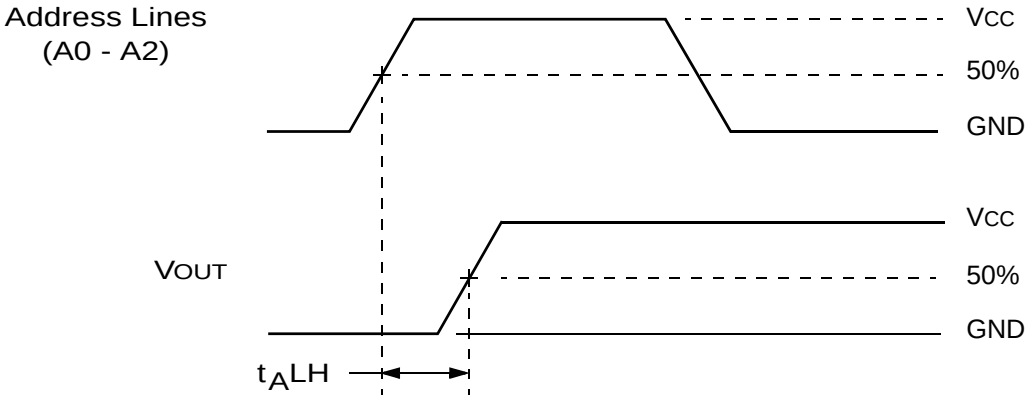
Parameter	Symbol	Conditions	Temp	Min	Max	Units
Address to Output Delay	t_AHL	VOUT High to Low Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	t_ALH	VOUT Low to High Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
Enable to Output Delay	$t_{ON}EN$	(Enabled)	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	$t_{OFF}EN$	(Disabled)	ALL	10	200	ns

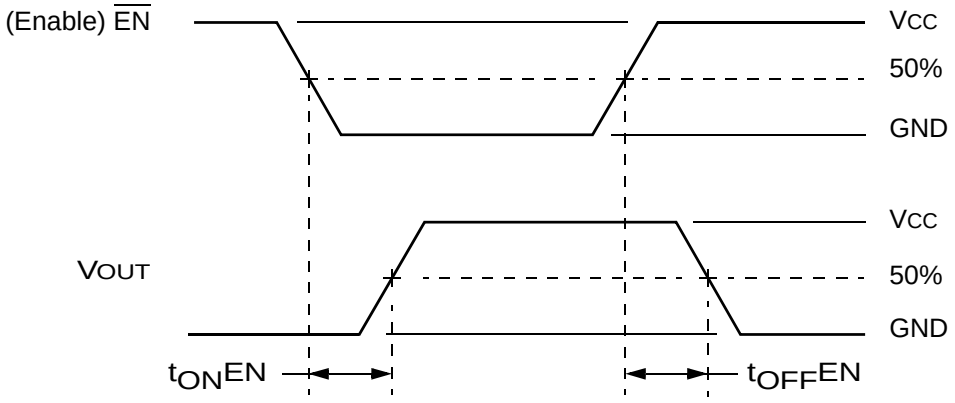
TRUTH TABLE (CH0 – CH7)

A2	A1	A0	$\overline{EN}$	"ON" CHANNEL 1/
X	X	X	H	NONE
L	L	L	L	CH0
L	L	H	L	CH1
L	H	L	L	CH2
L	H	H	L	CH3
H	L	L	L	CH4
H	L	H	L	CH5
H	H	L	L	CH6
H	H	H	L	CH7

1/ Between (CH0-CH7) and VOUT





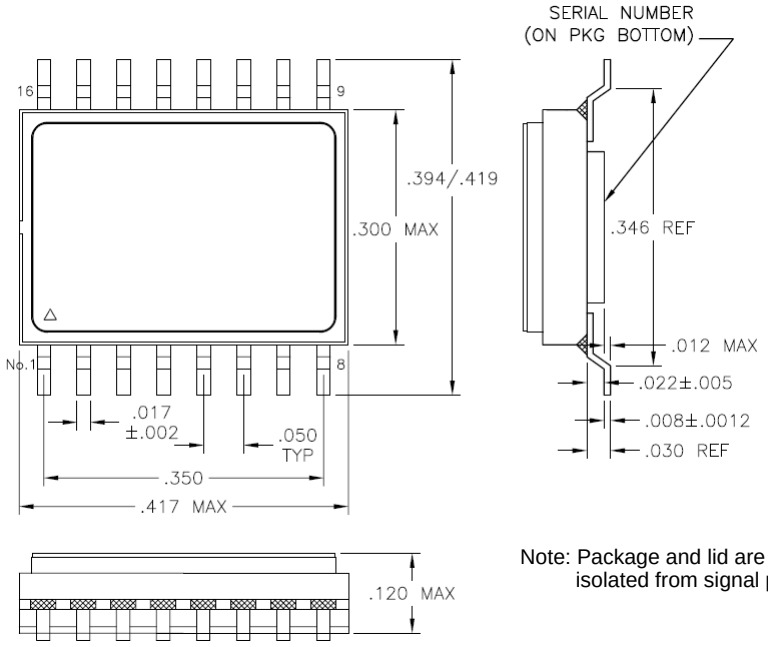


NOTE: f = 10KHz, Duty cycle = 50%.

RHD5928 SWITCHING DIAGRAMS

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5928-7	-	Commercial Flow, +25°C testing only	16-pin SOIC
RHD5928-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5928-201-1S	5962-1024304KXC	DLA SMD Pending	
RHD5928-201-2S	5962-1024304KXA		
RHD5928-901-1S	5962H1024304KXC	DLA SMD and Radiation Certification Pending	
RHD5928-901-2S	5962H1024304KXA		



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

PACKAGE OUTLINE

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Standard Products

Advanced

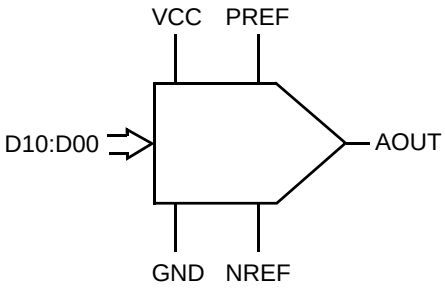
RadHard-by-Design RHD5930 Digital-to-Analog Converter 11-Bit Ladder Output

www.aeroflex.com/RHDseries

July 21, 2011

FEATURES

- 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
- 11-Bit DAC
- Single power supply operation at +3.3V to +5V
- Low Power
- Full 4-quadrant multiplying DAC
- CMOS/TTL inputs
- Full military temperature range
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic SOIC
  - 16 leads, 0.3"W x 0.4"L x 0.12Ht SOIC
  - Typical Weight 1.2 grams



SCHEMATIC SYMBOL

GENERAL DESCRIPTION

The Aeroflex 11-Bit DAC is a standard CMOS R/2R Kelvin resistor network. The digital inputs, D10(MSB) through D00(LSB), are buffered to drive single-pole double-throw CMOS switches to apply either the PREF or NREF signals to the 2R legs of the resistor network. The output is unbuffered.

PREF and NREF inputs can be any static or dynamic voltage within the power supply range. The nominal values or R and 2R are 5K and 10K respectively. The characteristic impedance of the resistor network is approximately 5K.

The voltage-output configuration of the integrated circuit can be thought of as a digitally controlled voltage with a value of PREF-NREF and an output impedance of approximately 5K. The output will swing rail-to-rail if unloaded.

The DAC can also be operated in the so-called "inverted" mode where any voltage between the power rails can be applied to the output and currents into a very low impedance (operational amplifier summing junction for example) can be obtained from the PREF and NREF ports. The sum of the currents is constant and the proportion at PREF and NREF is controlled by the digital input number.

Applications include digital potentiometers, programmable voltage sources and a large variety of other circuits that can be found in many industry references.

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
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, Θjc	10	°C/W
Supply Voltage +VCC	+6.0	V
PREF relative to NREF	+6.0	V
Digital Input Voltage	VCC +0.4 GND -0.4	V
ESD Rating	2.0	KV
Power @25°C	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

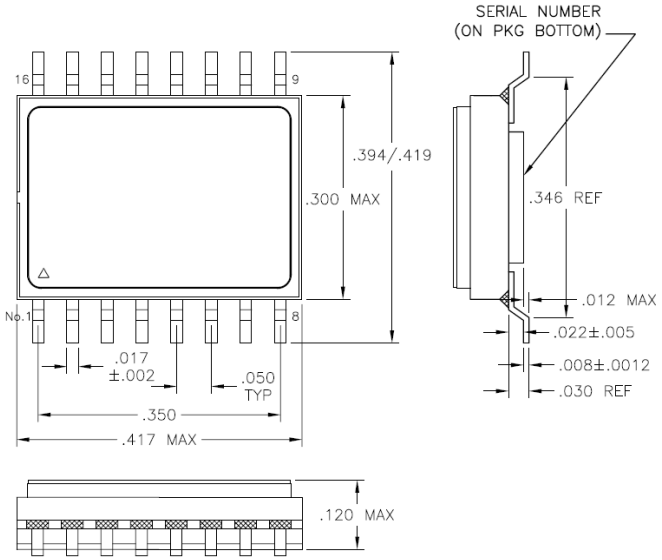
ELECTRICAL PERFORMANCE CHARACTERISTICS
(Tc = -55°C to +125°C, +Vcc = +5.0V -- Unless otherwise specified)

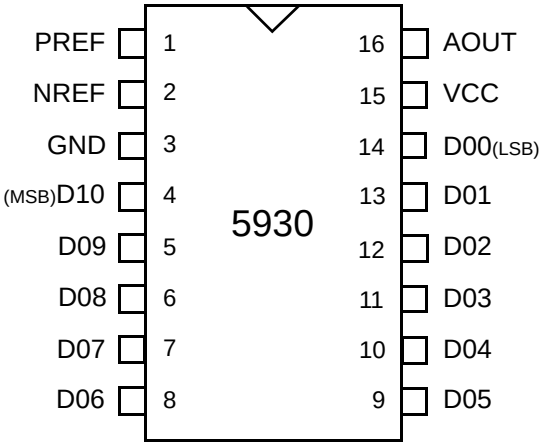
Parameter	Symbol	Conditions	Min	Typ	Max	Units
Resolution	N				11	Bits
Relative Accuracy	RA				0.25	% of FSR
Gain Error	AE				0.1	% of FSR
Output Leakage	IOL				NA	nA
Output Settling Time	TD				100	ns
PREF Input Z	ZP				5K	Ω
NREF Input Z	ZR				5K	Ω
Input Hi Voltage	VIH		2			V
Input Lo Voltage	VIL				0.8	V
Input Leakage	IIL, IIH				100	pA

Note: 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.

ORDERING INFORMATION

Model	DSCC SMD #	Screening	Package
RHD5930-7	-	Commercial Flow, +25°C testing only	16-pin SOIC Package
RHD5930-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5930-201-1S	5962-1120801KXC	DSCC SMD Pending	
RHD5930-201-2S	5962-1120801KXA		
RHD5930-901-1S	5962H1120801KXC	DSCC SMD and Radiation Certification Pending	
RHD5930-901-2S	5962H1120801KXA		





PACKAGE OUTLINE

PACKAGE PINOUT

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.

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused

Standard Products

Advanced

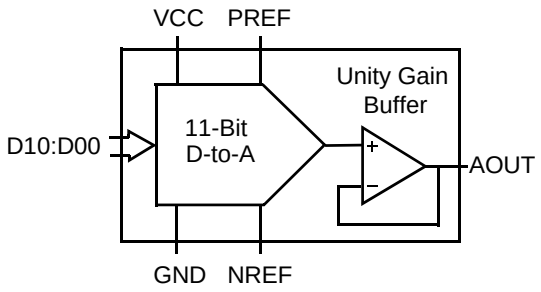
RadHard-by-Design
RHD5931 Digital-to-Analog Converter
11-Bit Buffered Output

www.aeroflex.com/RHDseries

December 13, 2011

FEATURES

- 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
- 11-Bit DAC
- Buffered Output
- Single power supply operation at +3.3V to +5V
- Low Power
- Full 4-quadrant multiplying DAC
- CMOS/TTL inputs
- Full military temperature range
- Designed for aerospace and high reliability space appl
- Packaging – Hermetic ceramic SOIC
  - 16 leads, 0.411"L x 0.293"W x 0.090"Ht
  - Typical Weight 0.8 grams



SCHEMATIC SYMBOL

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

GENERAL DESCRIPTION

The Aeroflex 11-Bit DAC is a standard CMOS R/2R Kelvin resistor network with a buffered output. The digital inputs, D10(MSB) through D00(LSB), are buffered to drive single-pole double-throw CMOS switches to apply either the PREF or NREF signals to the 2R legs of the resistor network.

PREF and NREF inputs can be any static or dynamic voltage within the power supply range. The nominal values for R and 2R are 5K and 10K respectively. The characteristic impedance of the resistor network is approximately 5K.

The voltage-output configuration of the integrated circuit can be thought of as a digitally controlled voltage with a value of PREF-NREF with a high output impedance. The output will swing rail-to-rail if unloaded.

Applications include digital potentiometers, programmable voltage sources and a large variety of other circuits that can be found in many industry references.

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
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, Θjc	10	°C/W
Supply Voltage +Vcc	+6.0	V
PREF relative to NREF	+6.0	V
Digital Input Voltage	Vcc +0.4 GND -0.4	V
ESD Rating	2.0	KV
Power @25°C	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

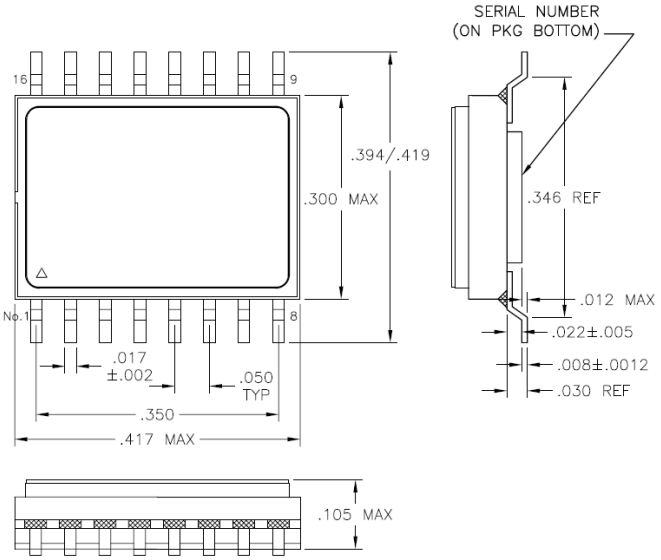
Symbol	Parameter	Typical	Units
+Vcc	Power Supply Voltage	3.3 to 5.0	V

ELECTRICAL PERFORMANCE CHARACTERISTICS
(Tc = -55°C to +125°C, +Vcc = +5.0V -- Unless otherwise specified)

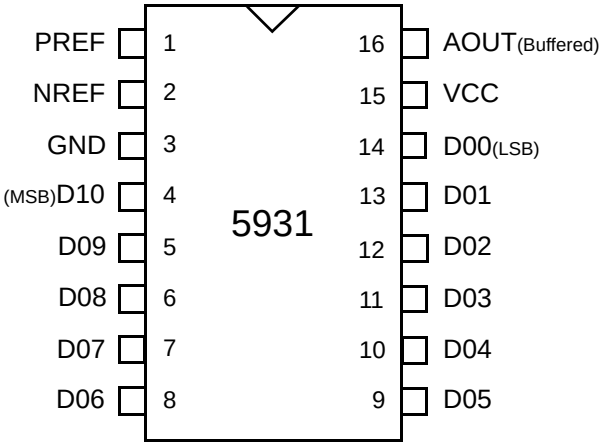
Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Current	Icc				5	mA
Resolution	N				11	Bits
Relative Accuracy	RA				0.25	% of FSR
Gain Error	AE				0.1	% of FSR
Output Leakage 2/	IOL				N/A	nA
Output Settling Time	TD				2	us
PREF Input Z 2/	ZP				5K	Ω
NREF Input Z 2/	ZR				5K	Ω
Input Hi Voltage	VIH		2			V
Input Lo Voltage	VIL				0.8	V
Input Leakage 2/	IIL, IIH				100	pA

Note: 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.

Model Number	DLA SMD #	Screening	Package
RHD5931-7	-	Commercial Flow, +25°C testing only	16-Pin Ceramic SOIC
RHD5931-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5931-201-1S	5962-1120802KXC	In accordance with DLA SMD (Pending)	
RHD5931-201-2S	5962-1120802KXA		
RHD5931-901-1S	5962H1120802KXC		
RHD5931-901-2S	5962H1120802KXA		



PACKAGE OUTLINE



PACKAGE PINOUT

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Advanced

Standard Products

RadHard-by-Design
RHD5940
14-Bit Analog to Digital Converter

www.aeroflex.com/RHDseries

January 10, 2012

FEATURES

- Single power supply operation 3.3V to 5.0V
- 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
- 14-Bit Digital Output
- Successive Approximation A-to-D
- Tri-State digital outputs
- Power Down (Sleep) mode
- Single or continuous conversion
- 20 clock conversion period
- Digital output available until the completion of the next conversion
- Busy (Prime) and End-of-Conversion status outputs
- 2000V Input/Output ESD protection
- Full military temperature range
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 24-pin, 0.614"L x 0.299"W x 0.120"Ht SOIC
  - Typical Weight 2 grams

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

GENERAL DESCRIPTION

Aeroflex's RHD5940 is a radiation hardened, single supply, 14-Bit Analog-to-Digital converter in a 24-pin SOIC package. The RHD5940 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5940 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 RHD5940 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5940 takes an analog signal and performs a 14-bit successive approximation analog-to-digital conversion in a nominal period of 20uS. The 14-Bit digital output has a tri-state control allowing the connection of multiple RHD5940s. This provides the ability to interface many voltage readings to the digital processor data bus. The full-scale range is determined by reference input voltages which will typically include any ~ 4 volt span anywhere in the power supply range (nominal 5V supply). The input impedance of the reference/span terminals is a constant 4K ohms.

Gain compression will occur near either power supply extremes but can be avoided if the references are more than 200mV away from the respective supply terminals. The input span can be less than 4 volts at the expense of ultimate resolution

The analog input impedance is primary capacitance (20pF). The input voltage charges a track-and-hold hold capacitor through transmission gates. The input bandwidth is determined by the slew rate of the hold amplifier and is adequate to allow input sampling in three clock periods (3uS nominal). The ultimate bandwidth is determined by the aperture uncertainty associated with the closing of the sample gate (approximately 5nS). The converter bandwidth is then determined by the sampling Nyquist frequency rather than the input signal; change rate (dv/dt) and the LSB weight in volts as would be the case if there were no sample and hold.

Start-Convert (STCNV_H), Busy (BUSY_L) and End-Of-Convert (EOC_H) status and control line are provided. The converter will operate in either continuous or single conversion modes. To operate in continuous mode, STCNV_H should be tied to BUSY_L. The digital output register changes at the end of a conversion and is available while BUSY_L is High. Digital input and output circuits operate from a voltage independent of the remainder of the chip such that I/O is compatible with digital systems from, less than 3.3 volts to 5 volts.

The converter divides the reference voltage into 16 segments with a linear weighted resistor network. The voltage on any segment is passed to a linear 10-bit DAC for interpolation. The architecture is inherently capable of monotonic operation. INL is ±10 LSBs. DNL is ±1/2 LSB. The sampled input voltage is compared to the output of the two stage DAC for a 14-bit successive approximation conversion.

All inputs are protected to both power supply rails by semiconductor diodes. Inputs should be constrained to Vcc +0.4 and Vee-0.4 to avoid forward biasing protection paths.

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.

Notes: - The STCNV_H is a dynamic input and should not be tied to a static voltage.

- The input signal should be low pass filtered to reduce high frequency noise

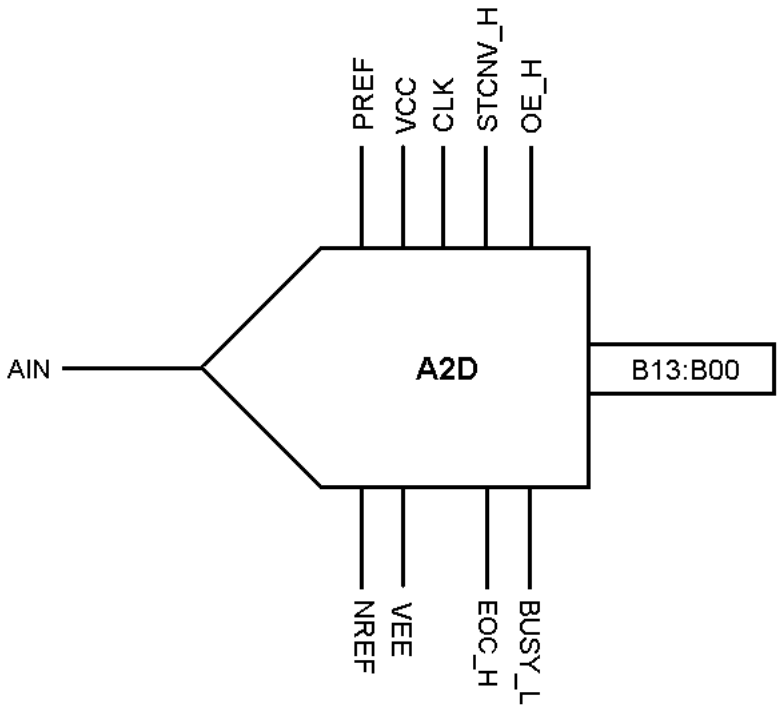


FIGURE 1: BLOCK DIAGRAM

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}	+6.0	V
Input Voltage	V_{CC} +0.4 V_{EE} -0.4	V
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, Θjc	3.5	°C/W
ESD Rating	2.0	KV
Power @25°C	TBD	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
+V_{CC}	Power Supply Voltage	5.0	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Current Sleep	ICC_S				4	mA
Supply Current Active	ICC_D				25	mA
High Analog Reference Voltage	PREF			4	5	V
Low Analog Reference Voltage	NREF		GND	1		V
Full-scale Input Range			0		PREF - NREF	V
Operating Range			-0.1		PREF - NREF +0.1	V
Input Capacitance				40		pF
Effective Number of Bits	EOB			14		BITS
Integral Non Linearity	INL			0.5		LSB
Differential Non Linearity	DNL			0.5		LSB
DC Offset					TBD	V
DC Gain			TBD			V
Input Range			1	4	5	V
Reference Input Current				1	2	mA

ELECTRICAL PERFORMANCE CHARACTERISTICS (continued)

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Maximum Sampling Rate	fSAMPLE(MAX)			25		KSPS
Conversion Time	tCONV			16		Clk Cycles
Acquisition Time	tACQ			4		Clk Cycles
Signal to Noise Ratio	SNR			TBD		dB

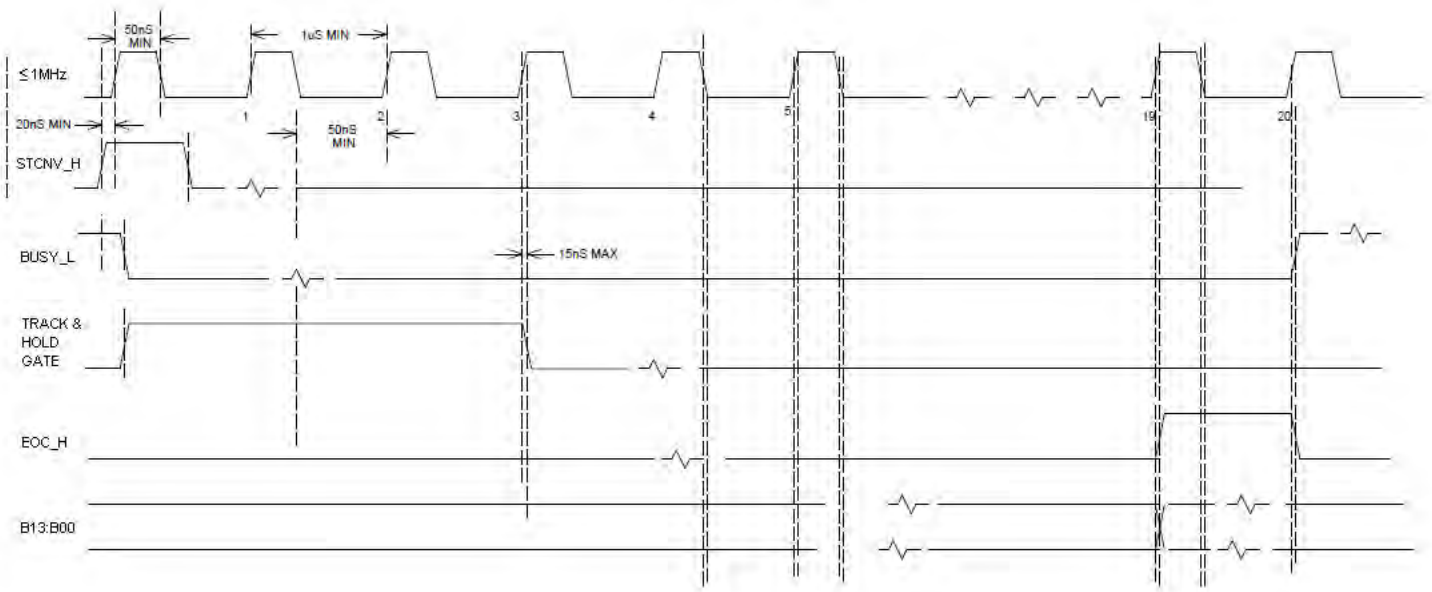


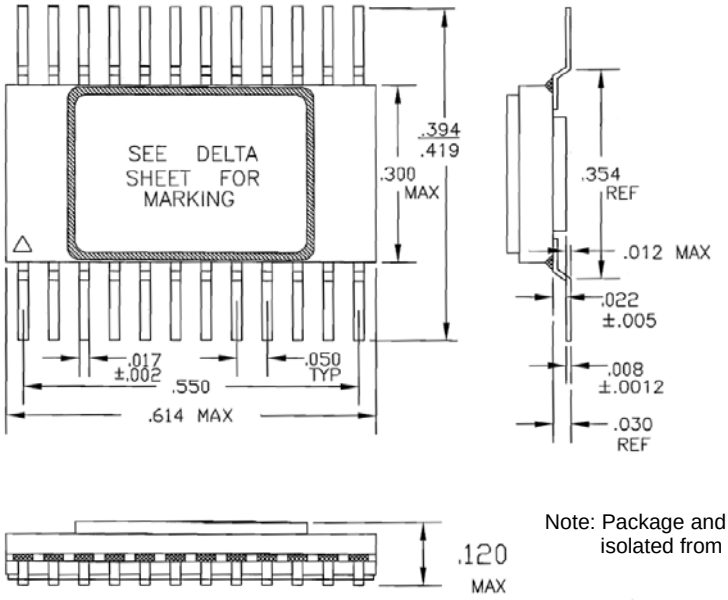
FIGURE 2: BASIC TIMING DIAGRAM

Pin #	Signal	Definition
1	AIN	Analog Input
2	NREF	Low Analog Reference Voltage
3	VCC	Supply Voltage
4	STCNV_H	Start Conversion
5	OE_H	Output Enable
6	CLK	Clock Input
7	B00	Digital Output 00
8	B01	Digital Output 01
9	B02	Digital Output 02
10	B03	Digital Output 03
11	B04	Digital Output 04
12	B05	Digital Output 05
13	B06	Digital Output 06
14	B07	Digital Output 07
15	B08	Digital Output 08
16	B09	Digital Output 09
17	B10	Digital Output 10
18	B11	Digital Output 11
19	B12	Digital Output 12
20	B13	Digital Output 13
21	EOC_H	End of Convert
22	BUSY_L	Busy
23	VEE	Supply Return
24	PREF	High Analog Reference Voltage

FIGURE 3: PACKAGE PIN-OUT AND SIGNAL DEFINITION

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5940-7	-	Commercial Flow, +25°C testing only	24-pin SOIC Package
RHD5940-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5940-201-1S	5962-1220701KXC	DLA SMD Pending	
RHD5940-201-2S	5962-1220701KXA		
RHD5940-901-1S	5962H1220701KXC	DLA SMD and Radiation Certification Pending	
RHD5940-901-2S	5962H1220701KXA		



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

FIGURE 4: PACKAGE OUTLINE

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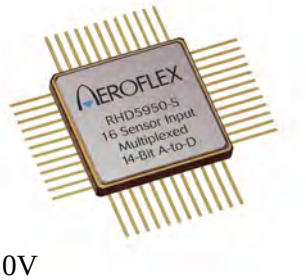
Standard Products *Advanced*

RadHard-by-Design RHD5950 16-Channel Multiplexed 14-Bit Analog-to-Digital Converter

www.aeroflex.com/RHDseries

March 2, 2012



FEATURES

- Single power supply operation 3.3V to 5.0V
- 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
- 16-Channel Input Multiplexer
- Successive Approximation A-to-D
- Level Shifting Digital I/O Receiver/Drivers allow interfaces to 5.0 or 3.3 volt logic
- Tri-State digital outputs
- Power Down (Sleep) mode
- Single or continuous conversion
- 20 clock conversion period
- Digital output available until the completion of the next conversion
- Multiplexer address is latched on first clock rising edge of a cycle
- Busy (Prime) and End-of-Conversion status outputs
- 2000V Input/Output ESD protection
- Full military temperature range
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic Ceramic
  - 48 leads, 0.750"Sq x 0.115"Ht quad flat pack
  - Weight - 6 grams max
- **Aeroflex Plainview's Radiation Hardness Assurance Plan is DLA Certified to MIL-PRF-38534, Appendix G.**

GENERAL DESCRIPTION

Aeroflex's RHD5950 is a radiation hardened, single supply, 16-Channel Multiplexed Analog-to-Digital converter in a 48-pin Ceramic Quad Flat Package. The RHD5950 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5950 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 RHD5950 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5950 takes 16 analog sensor signals and using 4 address inputs and an enable input, selects one of the 16 analog inputs and performs a 14-bit successive approximation analog-to-digital conversion in a nominal period of 20uS. The 14-bit digital output has a tri-state control allowing the connection of multiple RHD5950s. This provides the ability to interface many sensor voltage readings to the digital processor data bus. The full-scale range is determined by reference input voltages which will typically include any ~ 4 volt span anywhere in the power supply range (nominal 5V supply). The input impedance of the reference/span terminals is a constant 4K ohms.

Gain compression will occur near either power supply extremes but can be avoided if the references are more than 200mV away from the respective supply terminals. The input span can be less than 4 volts at the expense of ultimate resolution

The analog channels input impedance is primary capacitance (20pF). The input voltage charges a track-and-hold hold capacitor through transmission gates. The input bandwidth is determined by the slew rate of the hold amplifier and is adequate to allow input sampling in three clock periods (3uS nominal). The ultimate bandwidth is determined by the aperture uncertainty associated with the closing of the sample gate (approximately 5nS). The converter bandwidth is then determined by the sampling Nyquist frequency rather than the input signal; change rate (dv/dt) and the LSB weight in volts as would be the case if there were no sample and hold.

Start-Convert (STCNV_H), Busy (BUSY_L) and End-Of-Convert (EOC_H) status and control line are provided. The converter will operate in either continuous or single conversion modes. To operate in continuous mode, STCNV_H should be tied to BUSY_L. The digital output register changes at the end of a conversion and is available while BUSY_L is High. Digital input and output circuits operate from a voltage independent of the remainder of the chip such that I/O is compatible with digital systems from, less than 3.3 volts, to 5 volts.

The converter divides the reference voltage into 16 segments with a linear weighted resistor network. The voltage on any segment is passed to a linear 10-bit DAC for interpolation. The architecture is inherently capable of monotonic operation. INL is ±10 LSBs. DNL is ±1/2 LSB. The sampled input voltage is compared to the output of the two stage DAC for a 14-bit successive approximation conversion.

All inputs are protected to both power supply rails by semiconductor diodes. Inputs should be constrained to Vcc +0.4 and Vee-0.4 to avoid forward biasing protection paths.

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.

Notes: - The STCNV_H is a dynamic input and should not be tied to a static voltage.

- The input signals should be low pass filtered to reduce high frequency noise

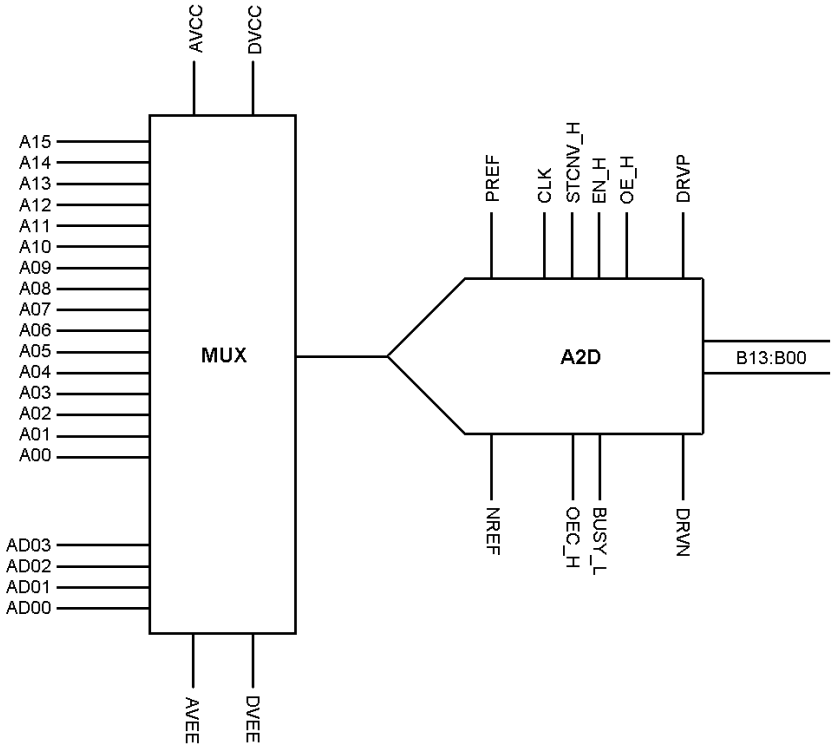


FIGURE 1: BLOCK DIAGRAM

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 VCC - VEE	+6.0	V
Input Voltage	VCC +0.4 VEE -0.4	V
Lead Temperature (soldering, 10 seconds)	300	°C
Thermal Resistance, Junction to Case, Θjc	3.5	°C/W
ESD Rating	2.0	KV
Power @25°C	TBD	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
+AVCC	Analog Power Supply Voltage	5.0	V
+DVCC	Digital Power Supply Voltage	5.0	V
DRVP	Digital Output High Reference Level	3.3 to 5.0	V
DRVN	Digital Output Low Reference Level	GND	V

ELECTRICAL PERFORMANCE CHARACTERISTICS

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Digital Supply Current Sleep	$D_{ICC}S$				1	mA
Digital Supply Current Active	$D_{ICC}A$				1	mA
Analog Supply Current Sleep	$A_{ICC}S$				2	mA
Analog Supply Current Active	$A_{ICC}A$				10	mA
Digital IO Supply Current Sleep	$DIO_{ICC}S$				1	mA
Digital IO Supply Current Active	$DIO_{ICC}A$				10	mA
High Analog Reference Voltage	PREF			4	5	V
Low Analog Reference Voltage	NREF		GND	1		V
Full-scale Input Range			0		PREF - NREF	V
Operating Range			-0.1		PREF - NREF +0.1	V
Input Capacitance				40		pF
Effective Number of Bits	EOB			14		BITS
Integral Non Linearity	INL			10		LSB
Differential Non Linearity	DNL			0.5		LSB
DC Offset					TBD	V
DC Gain			TBD			V
Channel Isolation			TBD			dB
Input Range			1	4	5	V
Reference Input Current				1	2	mA

ELECTRICAL PERFORMANCE CHARACTERISTICS (continued)

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

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Maximum Sampling Rate	fSAMPLE(MAX)			25		KSPS
Conversion Time	tCONV			16		Clk Cycles
Acquisition Time	tACQ			4		Clk Cycles
Signal to Noise Ratio	SNR			TBD		dB
Multiplexer Settling Time	tS			TBD		nS

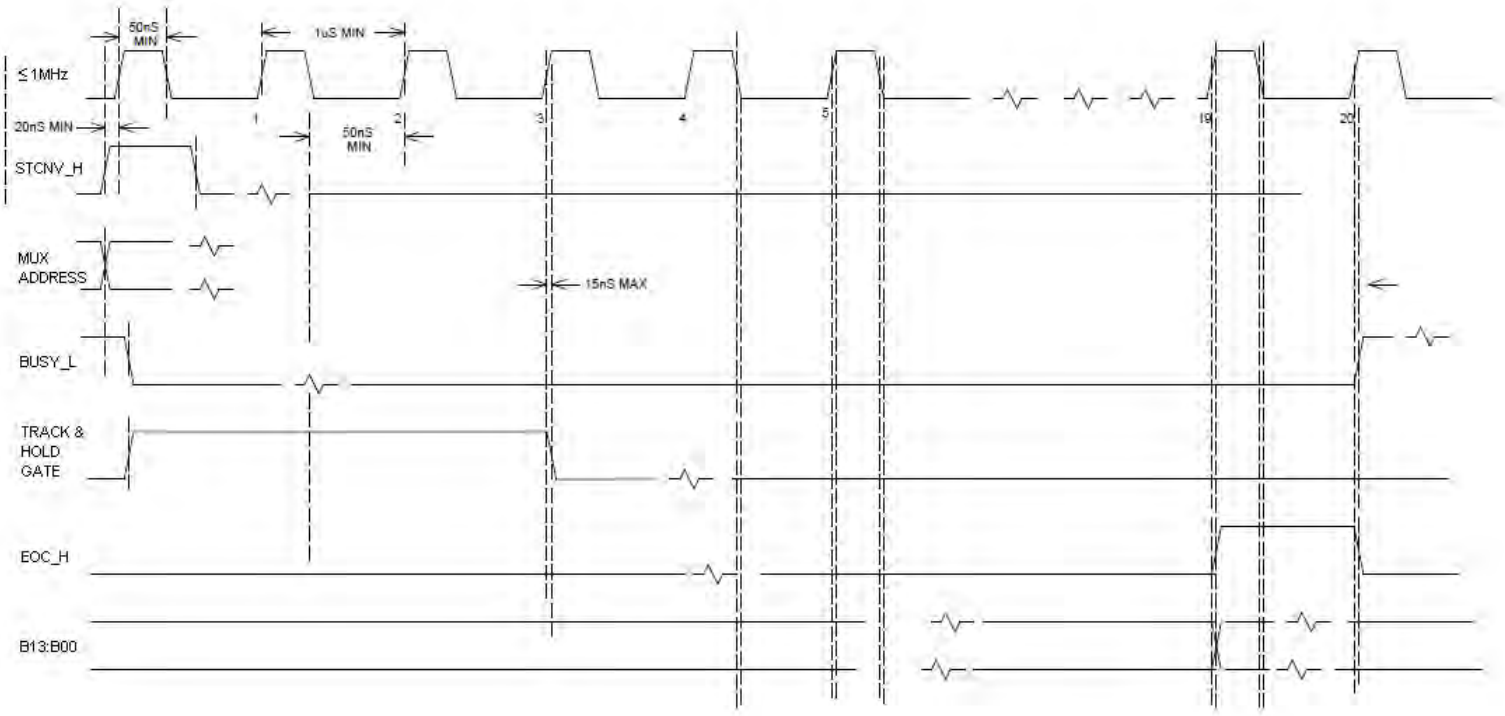


FIGURE 2: BASIC TIMING DIAGRAM

Pin #	Signal	Definition	Pin #	Signal	Definition
1	AIN01	Analog Multiplexer Input 01	25	B11	Digital Output 11
2	AIN00	Analog Multiplexer Input 00	26	B12	Digital Output 12
3	NREF	Low Analog Reference Voltage	27	B13	Digital Output 13
4	AVCC	Analog Supply Voltage	28	EOC_H	End of Convert
5	DVCC	Digital Supply Voltage	29	BUSY_L	Busy
6	AD03	Multiplexer Address 03	30	DRVN	Digital Output Low Reference Level
7	AD02	Multiplexer Address 02	31	DRVP	Digital Output High Reference Level
8	AD01	Multiplexer Address 01	32	DVEE	Digital Supply Return
9	AD00	Multiplexer Address 00	33	AVEE	Analog Supply Return
10	STCNV_H	Start Conversion	34	PREF	High Analog Reference Voltage
11	EN	Multiplexer Enable	35	AIN15	Analog Multiplexer Input 15
12	OE	Output Enable	36	AIN14	Analog Multiplexer Input 14
13	CLK	Clock Input	37	AIN13	Analog Multiplexer Input 13
14	B00	Digital Output 00	38	AIN12	Analog Multiplexer Input 12
15	B01	Digital Output 01	39	AIN11	Analog Multiplexer Input 11
16	B02	Digital Output 02	40	AIN10	Analog Multiplexer Input 10
17	B03	Digital Output 03	41	AIN09	Analog Multiplexer Input 09
18	B04	Digital Output 04	42	AIN08	Analog Multiplexer Input 08
19	B05	Digital Output 05	43	AIN07	Analog Multiplexer Input 07
20	B06	Digital Output 06	44	AIN06	Analog Multiplexer Input 06
21	B07	Digital Output 07	45	AIN05	Analog Multiplexer Input 05
22	B08	Digital Output 08	46	AIN04	Analog Multiplexer Input 04
23	B09	Digital Output 09	47	AIN03	Analog Multiplexer Input 03
24	B10	Digital Output 10	48	AIN02	Analog Multiplexer Input 02

FIGURE 3: PACKAGE PIN-OUT AND SIGNAL DEFINITION

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5950-7	-	Commercial Flow, +25°C testing only	48-lead CQFP
RHD5950-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5950-201-1S	5962-1220301KXC	DLA SMD Pending	
RHD5950-201-2S	5962-1220301KXA		
RHD5950-901-1S	5962H1220301KXC	DLA SMD and Radiation Certification Pending	
RHD5950-901-2S	5962H1220301KXA		

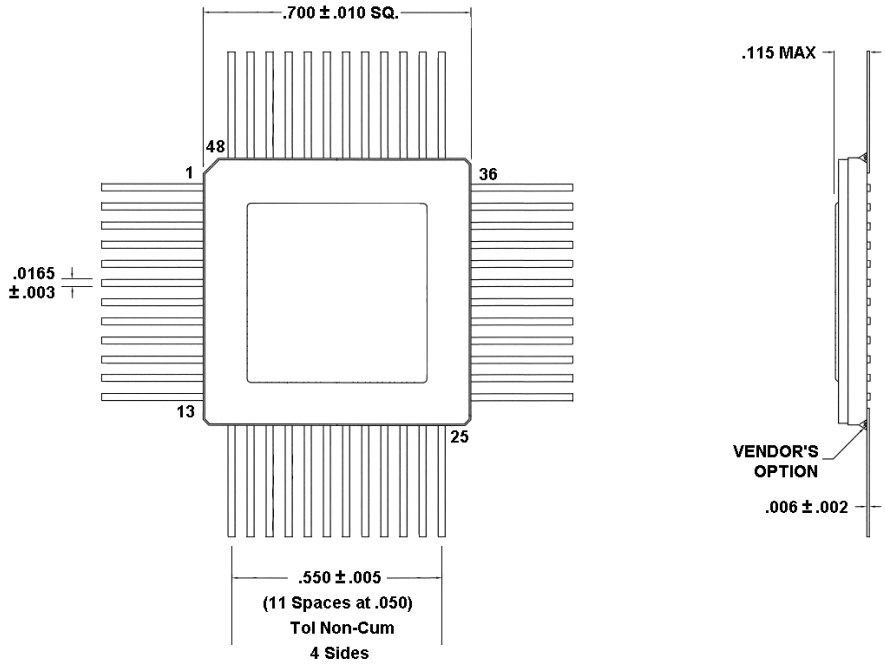


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FIGURE 4: PACKAGE OUTLINE

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:

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Standard Products

Preview

RadHard-by-Design RHD5980 Octal Bus Transceiver Bidirectional Voltage Level Shifter

www.aeroflex.com/RHDseries

January 23, 2012

FEATURES

- Bidirectional Voltage translator with two separate supply rails.
- 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
- Full military temperature range
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic SOIC
  - 24-pin, .614"L x .299"W x .120"Ht
  - Weight - 2.0 grams max

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

GENERAL DESCRIPTION

Aeroflex's RHD5980 is a radiation hardened, Octal Level Shifter in a 24-pin SOIC package. The RHD5980 design uses specific circuit topology and layout methods to mitigate total ionizing dose effects and single event latchup. These characteristics make the RHD5980 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 RHD5980 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD5980 Octal Level Shifter is a radiation hard replacement for the industry standard Bidirectional Voltage Translators. It is capable of level shifting from the A-to-B or B-to-A input ports for nominal logic voltages on either port of 5.0 or 3.3 volts.

The RHD5980 can level shift from 5.0V to 3.3V or 3.3V to 5.0V, and also buffer from 5.0V to 5.0V or 3.3V to 3.3V. Ports A and B can be inputs or outputs depending on the value of DIR_AB_H.

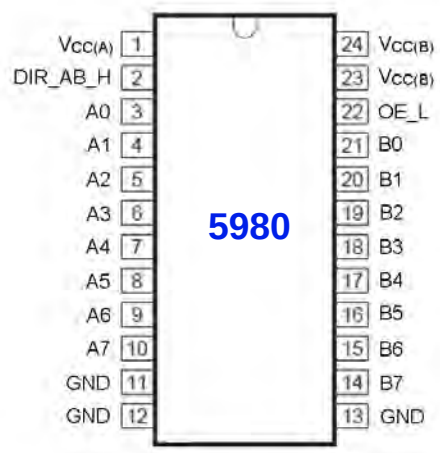
Control inputs are the standard tri-state enable (OE_L active low) and direction control DIR_AB_H where a HIGH logic steers data from A-to-B and active LOW steers the data from B-to-A.

The control inputs are powered from VCCA and accept inputs at the A bus logic levels (either 3.3V or 5.0V). All delay parameters are less than 10nS over full -55°C to +125°C military temperature range and logic levels. All bus and control inputs have Schmitt trigger buffers to implement low-to-high transition at approximately 60% of the corresponding logic supply and high-to-low transition at approximately 40% providing considerable noise immunity for slow input signals

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.

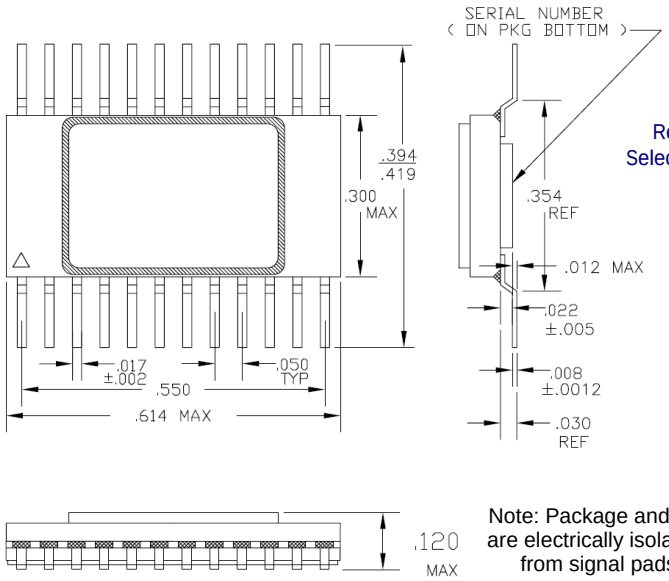
ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD5980-7	-	Commercial Flow, +25°C testing only	24-pin SOIC Package
RHD5980-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD5980-201-1S	Pending	DLA SMD Pending	
RHD5980-201-2S	Pending		
RHD5980-901-1S	Pending	DLA SMD and Radiation Certification Pending	
RHD5980-901-2S	Pending		



24-Pin SOIC

FIGURE 1: PACKAGE PIN-OUT



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

FIGURE 2: PACKAGE OUTLINE

EXPORT CONTROL:

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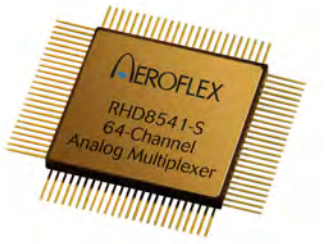
Standard Products

Preliminary

RadHard-by-Design
RHD8541 64-Channel Analog Multiplexer

www.aeroflex.com/RHDseries

February 28, 2012



FEATURES

- 64 channels provided by four 16-channel multiplexers
- Single power supply operation at +3.3V to +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
- Full military temperature range
- Low power consumption < 4.0mW
- CMOS analog switching allows rail to rail operation and low switch impedance
- Two address busses A(0-3) & B(0-3) and four enable lines afford flexible organization
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 96 leads, 1.320"Sq x 0.200"Ht quad flat pack
  - Weight - 15 grams max
- **Aeroflex Plainview's Radiation Hardness Assurance Plan is DLA Certified to MIL-PRF-38534, Appendix G.**

GENERAL DESCRIPTION

Aeroflex's RHD8541 is a radiation hardened, single supply, 64-Channel Multiplexer MCM (multi-chip module). The RHD8541 design uses specific circuit topology and layout methods to mitigate total ionization dose effects and single event latchup. These characteristics make the RHD8541 especially suited for the harsh environment encountered in Deep Space missions. It is available in a 96 lead High Temperature Co-Fired Ceramic (HTCC) Quad Flatpack (CQFP). It is guaranteed operational from -55°C to +125°C. Available screened in accordance with MIL-PRF-38534 Class K, the RHD8541 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD8541 consists of four, single supply, 16-Channel Multiplexers arranged as shown in the Block Diagram. The RHD8541 design is inherently radiation tolerant.

The device will not latch with SEU events to above 100MeV-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.

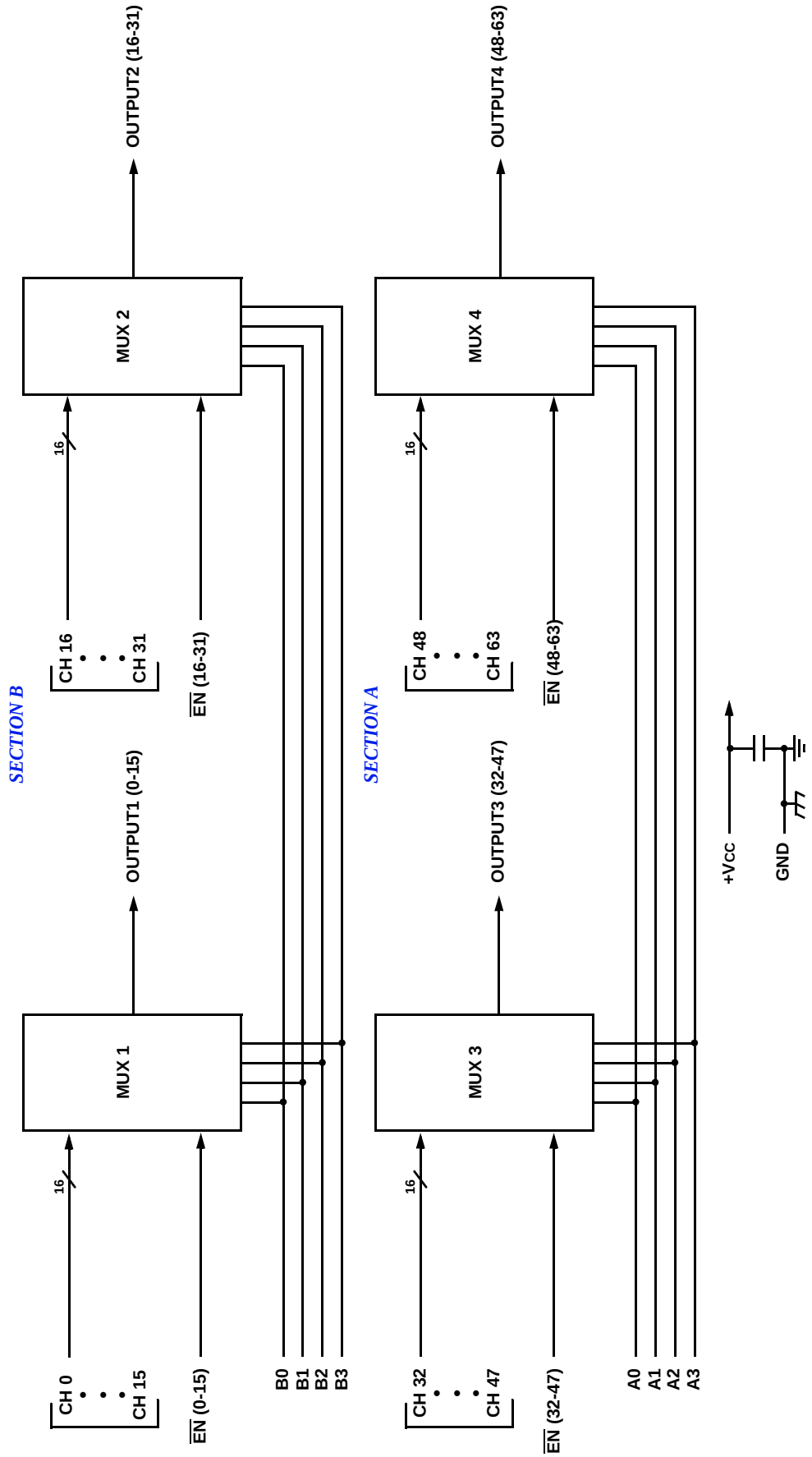
A SECTION

Thirty-two (32) channels addressable by bus A(0-3), in two 16-channel blocks, each block enabled separately.

B SECTION

Thirty-two (32) channels addressable by bus B(0-3), in two 16-channel blocks, each block enabled separately.

RHD8541 64 – CHANNEL ANALOG MUX BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS 1/

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Supply Voltage +V_{CC} (Pin 44)	+3.0 to +6.0	V
Digital Input Overvoltage V_{EN} (Pins 5, 6, 91, 92), V_A (Pins 1, 3, 93, 95), V_B (Pins 2, 4, 94, 96)	< V_{CC} +0.4 > GND -0.4	V V
Analog Input Over Voltage V_{IN} (CH0-CH63)	< V_{CC} +0.4 > GND -0.4	V

Notes:

1/ All measurements are made with respect to ground.

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 1/

Symbol	Parameter	Typical	Units
+V_{CC}	Power Supply Voltage	3.3 to 5.0	V
V_{ENL}, V_{AL}	Logic Low Level	30% V_{CC}	V
V_{ENH}, V_{AH}	Logic High Level	70% V_{CC}	V

DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/

(Tc = -55°C to +125°C, +V_{CC} = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions	Min	Max	Units
Supply Current +V_{CC}	+I_{CC}	$\overline{EN}$ = 30% V_{CC}	0	40	µA
	+I_{SBY}	$\overline{EN}$ = 70% V_{CC}	0	40	µA
Address Input Current A(0-3)	I_{AL}(0-3)$_A$	V_A = 30% V_{CC}	-100	100	nA
	I_{AH}(0-3)$_A$	V_A = 70% V_{CC}	-100	100	nA
	I_{AL}(0-3)$_B$	V_B = 30% V_{CC}	-100	100	nA
	I_{AH}(0-3)$_B$	V_B = 70% V_{CC}	-100	100	nA
Enable Input Current $\overline{EN}$	I_{ENL}(0-15)	V_{EN}(0-15) = 30% V_{CC}	-50	50	nA
	I_{ENH}(0-15)	V_{EN}(0-15) = 70% V_{CC}	-50	50	nA
	I_{ENL}(16-31)	V_{EN}(16-31) = 30% V_{CC}	-50	50	nA
	I_{ENH}(16-31)	V_{EN}(16-31) = 70% V_{CC}	-50	50	nA
	I_{ENL}(32-47)	V_{EN}(32-47) = 30% V_{CC}	-50	50	nA
	I_{ENH}(32-47)	V_{EN}(32-47) = 70% V_{CC}	-50	50	nA
	I_{ENL}(48-63)	V_{EN}(48-63) = 30% V_{CC}	-50	50	nA
	I_{ENH}(48-63)	V_{EN}(48-63) = 70% V_{CC}	-50	50	nA

DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/ (continued)

(Tc = -55°C to +125°C, +VCC = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions		Min	Max	Units
High Input Leakage Current (CH0-CH63)	I_{INLK_5}	V_{IN} = +5V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = 0V		-50	50	nA
Low Input Leakage Current (CH0-CH63)	I_{INLK_0}	V_{IN} = 0V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = +5V		-50	50	nA
Output Leakage Current V_{OUT} (pins 25,26, 68 & 70)	I_{OUTLK}	V_{OUT} = +5V, V_{EN} = 70% V_{CC}, All inputs grounded except channel being tested. 3/, 4/		-50	50	nA
Switch ON Resistance OUTPUTS (pins 25,26, 68 & 70) 6/	$R_{DS(ON)}$	V_{IN} = 0V, V_{IN} = +2.5V, V_{IN} = +5V V_{EN} = 30% V_{CC} I_{OUT} = -1mA 2/, 3/, 5/	-55°C	-	500	Ω
			+25°C	-	750	Ω
			+125°C	-	1000	Ω

Notes:

1/ Measure inputs sequentially. Ground all unused inputs of the device under test. V_A is the applied input voltage to the address lines A(0-3). V_B is the applied input voltage to the address lines B(0-3).

2/ V_{IN} is the applied input voltage to the input channels (CH0-CH63).

3/ V_{EN} is the applied input voltage to the enable lines $\overline{EN}$(0-15), $\overline{EN}$(16-31), $\overline{EN}$(32-47) and $\overline{EN}$(48-63).

4/ V_{OUT} is the applied input voltage to the output lines OUTPUT1(0-15), OUTPUT2(16-31), OUTPUT3(32-47) and OUTPUT4(48-63).

5/ Negative current is the current flowing out of each of the MUX pins. Positive current is the current flowing into each MUX pin.

6/ The RHD8541 cannot be operated with analog inputs below 0 volts.

7/ Not tested, guaranteed to the specified limits.

SWITCHING CHARACTERISTICS

(Tc = -55°C to +125°C, +VCC = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions	Temp	Min	Max	Units
Address to Output Delay	t_AHL	V_{OUT} High to Low Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	t_ALH	V_{OUT} Low to High Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
Enable to Output Delay	$t_{ON}EN$	V_{EN} = 30% V_{CC} (Enabled)	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	$t_{OFF}EN$	V_{EN} = 70% V_{CC} (Disabled)	ALL	10	200	ns

TRUTH TABLE (CH0 – CH15)

B3	B2	B1	B0	$\overline{EN}$(0-15)	"ON" CHANNEL 1/
X	X	X	X	H	NONE
L	L	L	L	L	CH0
L	L	L	H	L	CH1
L	L	H	L	L	CH2
L	L	H	H	L	CH3
L	H	L	L	L	CH4
L	H	L	H	L	CH5
L	H	H	L	L	CH6
L	H	H	H	L	CH7
H	L	L	L	L	CH8
H	L	L	H	L	CH9
H	L	H	L	L	CH10
H	L	H	H	L	CH11
H	H	L	L	L	CH12
H	H	L	H	L	CH13
H	H	H	L	L	CH14
H	H	H	H	L	CH15

1/ Between (CH0-CH15) and OUTPUT1(0-15)

TRUTH TABLE (CH16 – CH31)

B3	B2	B1	B0	$\overline{EN}$(16-31)	"ON" CHANNEL 2/
X	X	X	X	H	NONE
L	L	L	L	L	CH16
L	L	L	H	L	CH17
L	L	H	L	L	CH18
L	L	H	H	L	CH19
L	H	L	L	L	CH20
L	H	L	H	L	CH21
L	H	H	L	L	CH22
L	H	H	H	L	CH23
H	L	L	L	L	CH24
H	L	L	H	L	CH25
H	L	H	L	L	CH26
H	L	H	H	L	CH27
H	H	L	L	L	CH28
H	H	L	H	L	CH29
H	H	H	L	L	CH30
H	H	H	H	L	CH31

2/ Between (CH16-CH31) and OUTPUT2 (16-31)

TRUTH TABLE (CH32 – CH47)

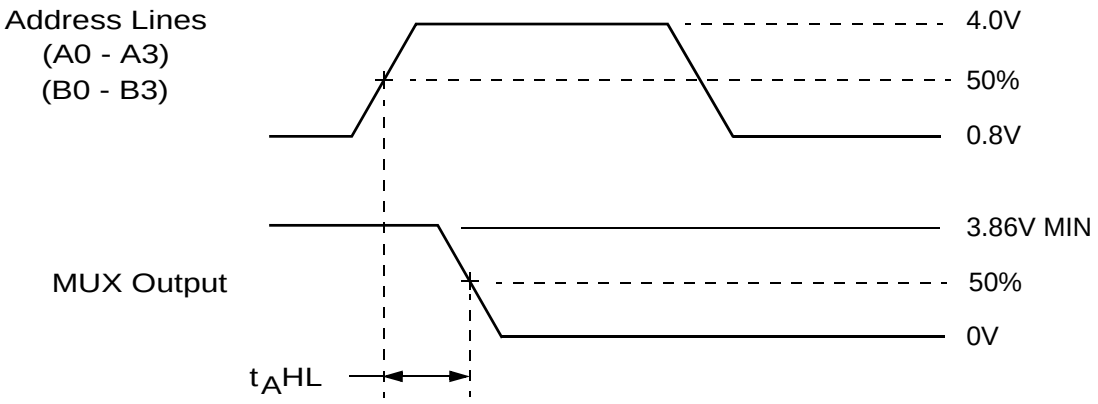
A3	A2	A1	A0	$\overline{EN}$(32-47)	"ON" CHANNEL 3/
X	X	X	X	H	NONE
L	L	L	L	L	CH32
L	L	L	H	L	CH33
L	L	H	L	L	CH34
L	L	H	H	L	CH35
L	H	L	L	L	CH36
L	H	L	H	L	CH37
L	H	H	L	L	CH38
L	H	H	H	L	CH39
H	L	L	L	L	CH40
H	L	L	H	L	CH41
H	L	H	L	L	CH42
H	L	H	H	L	CH43
H	H	L	L	L	CH44
H	H	L	H	L	CH45
H	H	H	L	L	CH46
H	H	H	H	L	CH47

3/ Between (CH32-CH47) and OUTPUT3 (32-47)

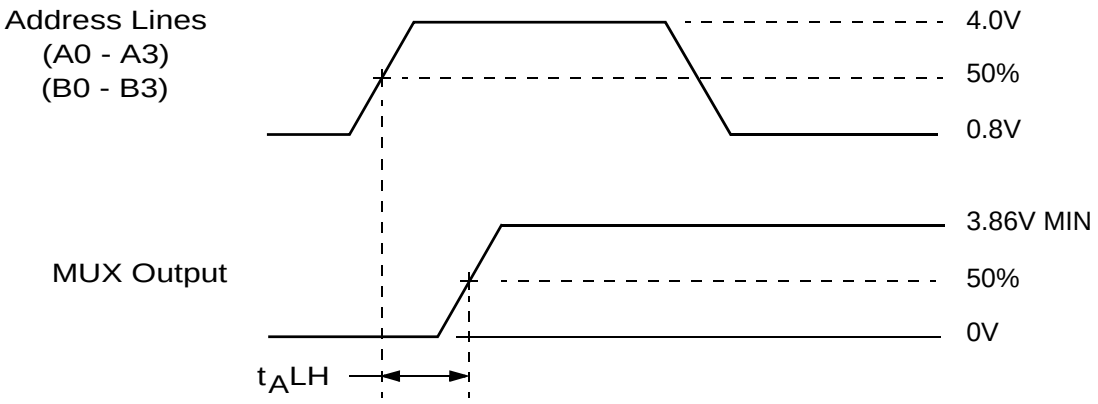
TRUTH TABLE (CH48 – CH63)

A3	A2	A1	A0	$\overline{EN}$(48-63)	"ON" CHANNEL 4/
X	X	X	X	H	NONE
L	L	L	L	L	CH48
L	L	L	H	L	CH49
L	L	H	L	L	CH50
L	L	H	H	L	CH51
L	H	L	L	L	CH52
L	H	L	H	L	CH53
L	H	H	L	L	CH54
L	H	H	H	L	CH55
H	L	L	L	L	CH56
H	L	L	H	L	CH57
H	L	H	L	L	CH58
H	L	H	H	L	CH59
H	H	L	L	L	CH60
H	H	L	H	L	CH61
H	H	H	L	L	CH62
H	H	H	H	L	CH63

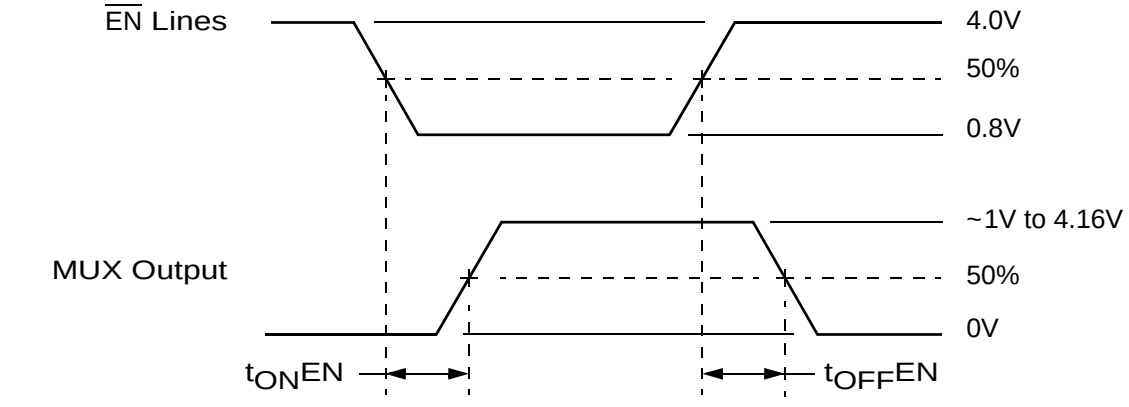
4/ Between (CH48-CH63) and OUTPUT4 (48-63)



Definition of t_AHL



Definition of t_ALH



Definition of $t_{ON}EN$ and $t_{OFF}EN$

NOTE: f = 10KHz, Duty cycle = 50%.

RHD8541 SWITCHING DIAGRAMS

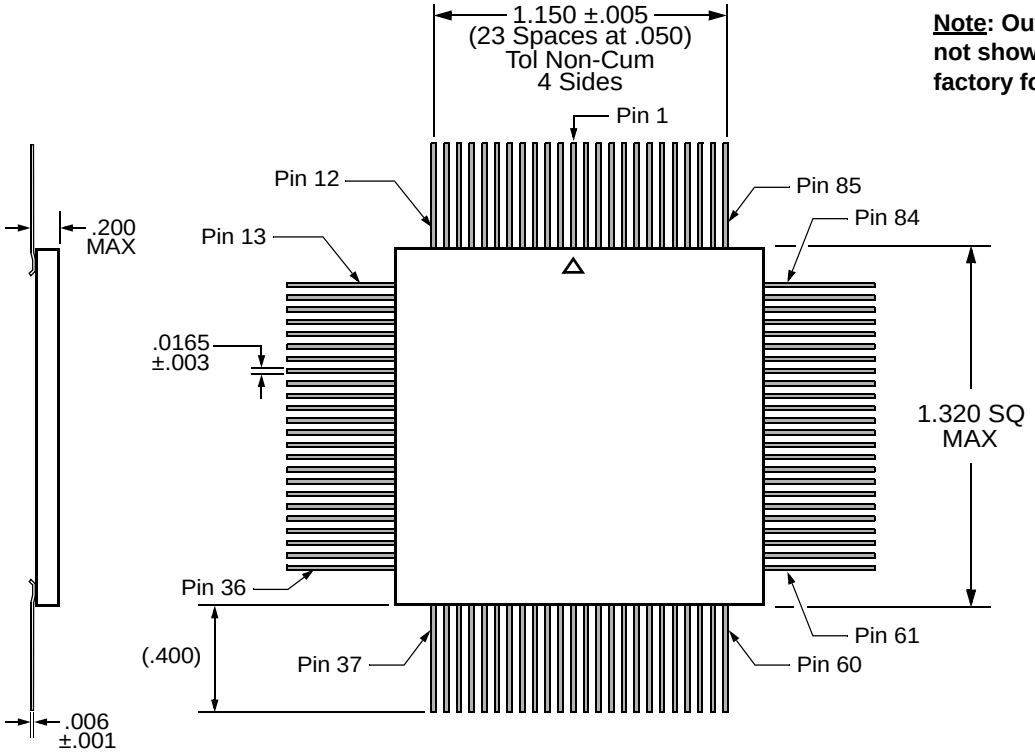
PIN NUMBERS & FUNCTIONS

RHD8541 – 96 Leads Ceramic QUAD Flat Pack					
Pin #	**Function**	**Pin #**	**Function**	**Pin #**	**Function**
1	A2	33	CH11	65	CH49
2	B2	34	CH27	66	CH48
3	A3	35	CH12	67	NC
4	B3	36	CH28	68	Output4 (48-63)
5	$\overline{EN}$ (0-15)	37	CH13	69	NC
6	$\overline{EN}$ (16-31)	38	CH29	70	Output3 (32-47)
7	CH0	39	CH14	71	GND
8	CH16	40	CH30	72	GND
9	CH1	41	CH15	73	CH47
10	CH17	42	CH31	74	CH46
11	CH2	43	NC	75	CH45
12	CH18	44	+V_{CC}	76	CH44
13	CH3	45	NC	77	CH43
14	CH19	46	NC	78	CH42
15	CH4	47	NC	79	CH41
16	CH20	48	NC	80	CH40
17	CH5	49	NC	81	CH39
18	CH21	50	CASE GND	82	CH38
19	CH6	51	CH63	83	CH37
20	CH22	52	CH62	84	CH36
21	CH7	53	CH61	85	CH35
22	CH23	54	CH60	86	CH34
23	GND	55	CH59	87	CH33
24	GND	56	CH58	88	CH32
25	Output1 (0-15)	57	CH57	89	GND
26	Output2 (16-31)	58	CH56	90	GND
27	CH8	59	CH55	91	$\overline{EN}$ (48-63)
28	CH24	60	CH54	92	$\overline{EN}$ (32-47)
29	CH9	61	CH53	93	A0
30	CH25	62	CH52	94	B0
31	CH10	63	CH51	95	A1
32	CH26	64	CH50	96	B1

NOTE: It is recommended that all "NC" or "no connect" pins be grounded. This eliminates or minimizes any ESD or static buildup.

ORDERING INFORMATION

Model Number	DLA SMD #	Screening	Package
RHD8541-7	-	Commercial Flow, +25°C testing only	QUAD Flat Pack
RHD8541-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD8541-201-1S	5962-1221101KXC	DLA SMD Pending	
RHD8541-901-1S	5962H1221101KXC	DLA SMD and Radiation Certification Pending	



Note: Outside ceramic tie bars not shown for clarity. Contact factory for details.

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FLAT PACKAGE OUTLINE

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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Standard Products

Preliminary

RadHard-by-Design
RHD8543 48-Channel Analog Multiplexer

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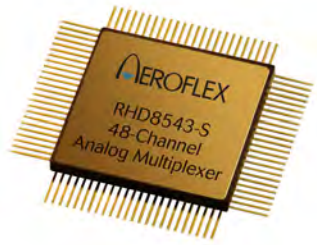
February 28, 2012



FEATURES

- 48 Channels provided by three 16-channel multiplexers
- Single power supply operation at +3.3V to +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
- Full military temperature range
- Low power consumption < 3.0mW
- CMOS analog switching allows rail to rail operation and low switch impedance
- Address Bus A(0-3), and three enable lines afford flexible organization
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 96 Leads, 1.320"Sq x 0.200"Ht quad flat pack
  - Weight - 15 grams max
- **Aeroflex Plainview's Radiation Hardness Assurance Plan is DLA Certified to MIL-PRF-38534, Appendix G.**

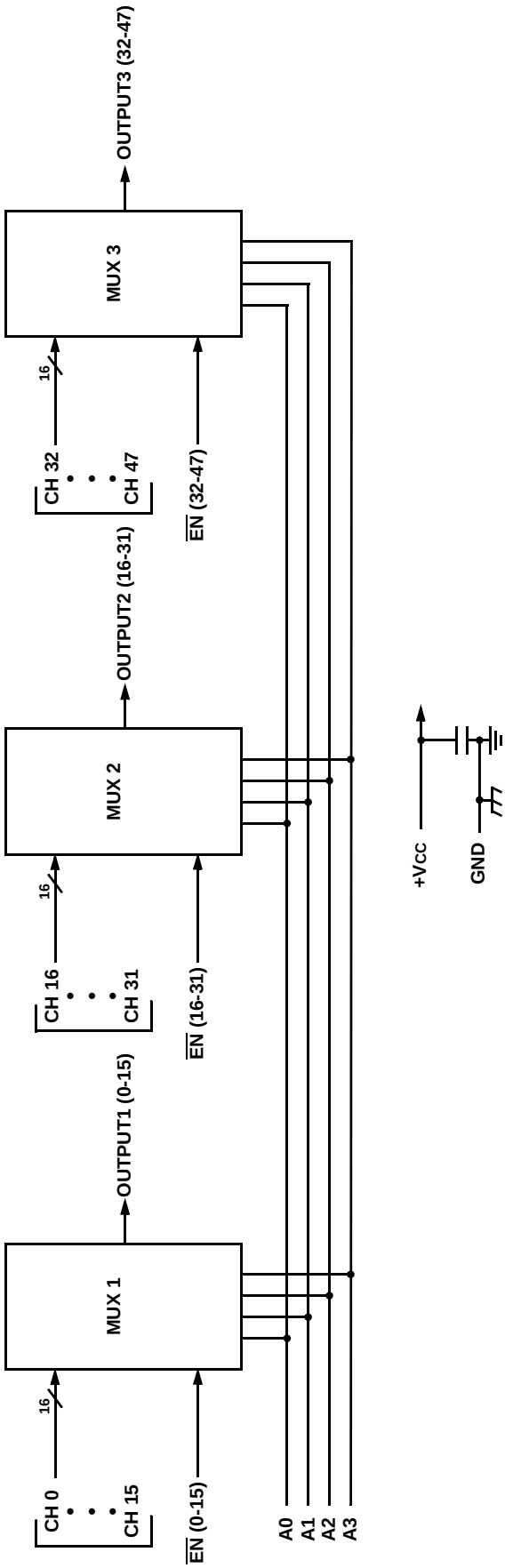
GENERAL DESCRIPTION

Aeroflex's RHD8543 is a radiation hardened, single supply, 48-Channel Multiplexer MCM (multi-chip module). The RHD8543 design uses specific circuit topology and layout methods to mitigate total ionization dose effects and single event latchup. These characteristics make the RHD8543 especially suited for the harsh environment encountered in Deep Space missions. It is available in a 96 lead High Temperature Co-Fired Ceramic (HTCC) Quad Flatpack (CQFP). It is guaranteed operational from -55°C to +125°C. Available screened in accordance with MIL-PRF-38534 Class K, the RHD8543 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

The RHD8543 consists of three, single supply, 16-Channel Multiplexers arranged as shown in the Block Diagram. The Address Bus and three Enable lines provide for 48 channels addressable by bus A(0-3), in three 16-channel blocks, each block enabled separately. Each block connects the addressed channel to one output. The RHD8543 design is inherently radiation tolerant.

The device will not latch with SEU events to above 100MeV-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.



RHD8543 48 – CHANNEL ANALOG MUX BLOCK DIAGRAM

ABSOLUTE MAXIMUM RATINGS 1/

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-55 to +150	°C
Supply Voltage +VCC (Pin 44)	 +3.0 to +6.0	 V
Digital Input Overvoltage VEN (Pins 5, 91, 92), VA (Pins 1, 3, 95, 96)	< VCC +0.4 > GND -0.4	V V
Analog Input Over Voltage VIN (CH0-CH47)	< VCC +0.4 > GND -0.4	V

Notes:
1/ All measurements are made with respect to ground.

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 effect device reliability.

RECOMMENDED OPERATING CONDITIONS 1/

Symbol	Parameter	Typical	Units
+VCC	Power Supply Voltage	3.3 to 5.0	V
VEN, VAL	Logic Low Level	30% VCC	V
VEN, VAH	Logic High Level	70% VCC	V

DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/

(Tc = -55°C to +125°C, +VCC = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions	Min	Max	Units
Supply Current +VCC	+ICC	$\overline{EN}$ = 30% VCC	0	30	µA
	+ISBY	$\overline{EN}$ = 70% VCC	0	30	µA
Address Input Current A(0-3)	IAL(0-3)	VA = 30% VCC	-150	150	nA
	IAH(0-3)	VA = 70% VCC	-150	150	nA
Enable Input Current $\overline{EN}$	IENL(0-15)	VEN(0-15) = 30% VCC	-50	50	nA
	IENH(0-15)	VEN(0-15) = 70% VCC	-50	50	nA
	IENL(16-31)	VEN(16-31) = 30% VCC	-50	50	nA
	IENH(16-31)	VEN(16-31) = 70% VCC	-50	50	nA
	IENL(32-47)	VEN(32-47) = 30% VCC	-50	50	nA
	IENH(32-47)	VEN(32-47) = 70% VCC	-50	50	nA

DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/ (con't)

(Tc = -55°C to +125°C, +V_{CC} = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions		Min	Max	Units
High Input Leakage Current (CH0-CH47)	I_{INLK_5}	V_{IN} = +5V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = 0V		-50	50	nA
Low Input Leakage Current (CH0-CH47)	I_{INLK_0}	V_{IN} = 0V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = +5V		-50	50	nA
Output Leakage Current V_{OUT} (pins 25, 68 & 70)	I_{OUTLK}	V_{OUT} = +5V, V_{EN} = 70% V_{CC}, All inputs grounded except channel being tested. 3/, 4/		-50	50	nA
Switch ON Resistance OUTPUTS (pins 25, 68 & 70) 6/	$R_{DS(ON)}$	V_{IN} = 0V, V_{IN} = +2.5V, V_{IN} = +5V V_{EN} = 30% V_{CC} I_{OUT} = -1mA 2/, 3/, 5/	-55°C	-	500	Ω
			+25°C	-	750	Ω
			+125°C	-	1000	Ω

Notes:

1/ Measure inputs sequentially. Ground all unused inputs of the device under test. V_A is the applied input voltage to the address lines A(0-3).
2/ V_{IN} is the applied input voltage to the input channels CH0-CH47.
3/ V_{EN} is the applied input voltage to the enable lines $\overline{EN}$(0-15), $\overline{EN}$(16-31) and $\overline{EN}$(32-47).
4/ V_{OUT} is the applied input voltage to the output lines OUTPUT1(0-15), OUTPUT2(16-31) and OUTPUT3(32-47).
5/ Negative current is the current flowing out of each of the MUX pins. Positive current is the current flowing into each MUX pin.
6/ The RHD8543 cannot be operated with analog inputs below 0 volts.
7/ Not tested, guaranteed to the specified limits.

SWITCHING CHARACTERISTICS

(Tc = -55°C to +125°C, +V_{CC} = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions		Min	Max	Units
Address to Output Delay	t_AHL	V_{OUT} High to Low Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	t_ALH	V_{OUT} Low to High Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
Enable to Output Delay	$t_{ON}EN$	V_{EN} = 30% V_{CC} (Enabled)	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	$t_{OFF}EN$	V_{EN} = 70% V_{CC} (Disabled)	ALL	10	200	ns

TRUTH TABLE (CH0 – CH15)

A3	A2	A1	A0	$\overline{EN}$(0-15)	"ON" CHANNEL 1/
X	X	X	X	H	NONE
L	L	L	L	L	CH0
L	L	L	H	L	CH1
L	L	H	L	L	CH2
L	L	H	H	L	CH3
L	H	L	L	L	CH4
L	H	L	H	L	CH5
L	H	H	L	L	CH6
L	H	H	H	L	CH7
H	L	L	L	L	CH8
H	L	L	H	L	CH9
H	L	H	L	L	CH10
H	L	H	H	L	CH11
H	H	L	L	L	CH12
H	H	L	H	L	CH13
H	H	H	L	L	CH14
H	H	H	H	L	CH15

1/ Between (CH0-CH15) and OUTPUT1 (0-15)

TRUTH TABLE (CH16 – CH31)

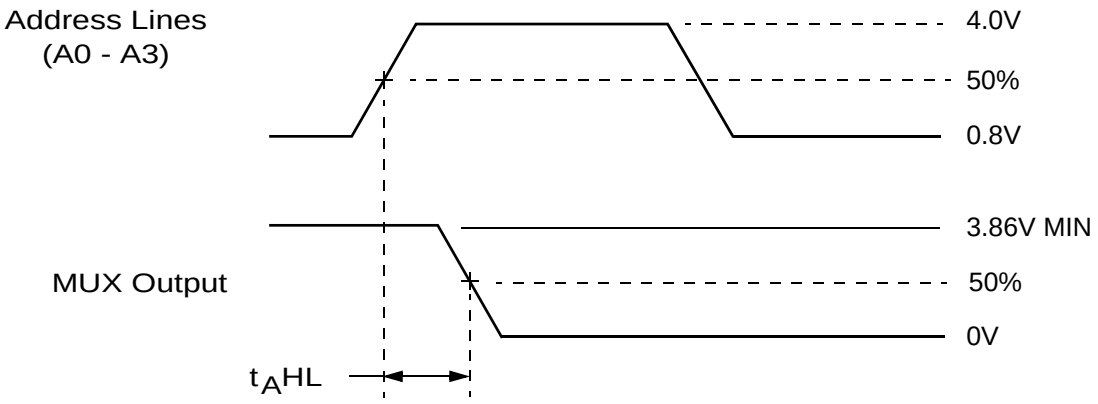
A3	A2	A1	A0	$\overline{EN}$(16-31)	"ON" CHANNEL 2/
X	X	X	X	H	NONE
L	L	L	L	L	CH16
L	L	L	H	L	CH17
L	L	H	L	L	CH18
L	L	H	H	L	CH19
L	H	L	L	L	CH20
L	H	L	H	L	CH21
L	H	H	L	L	CH22
L	H	H	H	L	CH23
H	L	L	L	L	CH24
H	L	L	H	L	CH25
H	L	H	L	L	CH26
H	L	H	H	L	CH27
H	H	L	L	L	CH28
H	H	L	H	L	CH29
H	H	H	L	L	CH30
H	H	H	H	L	CH31

2/ Between (CH16-CH31) and OUTPUT2 (16-31)

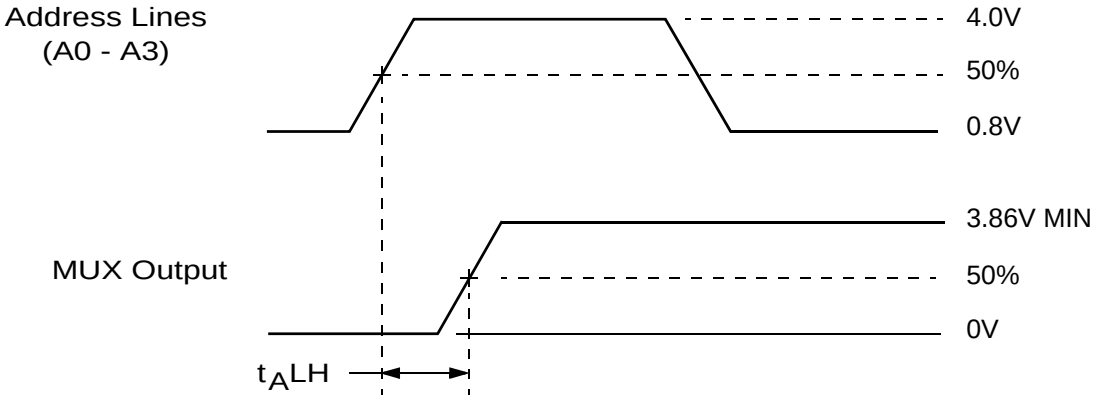
TRUTH TABLE (CH32 – CH47)

A3	A2	A1	A0	$\overline{EN}$(32-47)	"ON" CHANNEL 3/
X	X	X	X	H	NONE
L	L	L	L	L	CH32
L	L	L	H	L	CH33
L	L	H	L	L	CH34
L	L	H	H	L	CH35
L	H	L	L	L	CH36
L	H	L	H	L	CH37
L	H	H	L	L	CH38
L	H	H	H	L	CH39
H	L	L	L	L	CH40
H	L	L	H	L	CH41
H	L	H	L	L	CH42
H	L	H	H	L	CH43
H	H	L	L	L	CH44
H	H	L	H	L	CH45
H	H	H	L	L	CH46
H	H	H	H	L	CH47

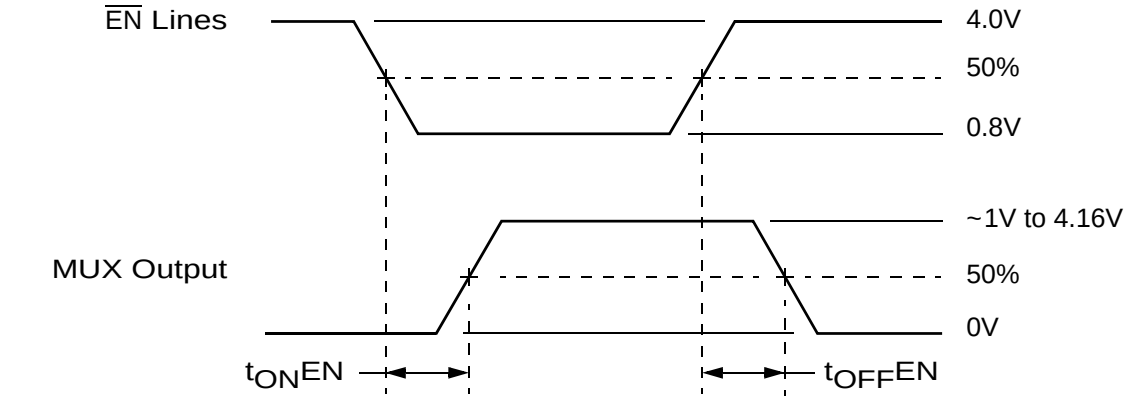
3/ Between (CH32-CH47) and OUTPUT3 (32-47)



Definition of t_AHL



Definition of t_ALH



Definition of $t_{ON}EN$ and $t_{OFF}EN$

NOTE: f = 10KHz, Duty cycle = 50%.

RHD8543 SWITCHING DIAGRAMS

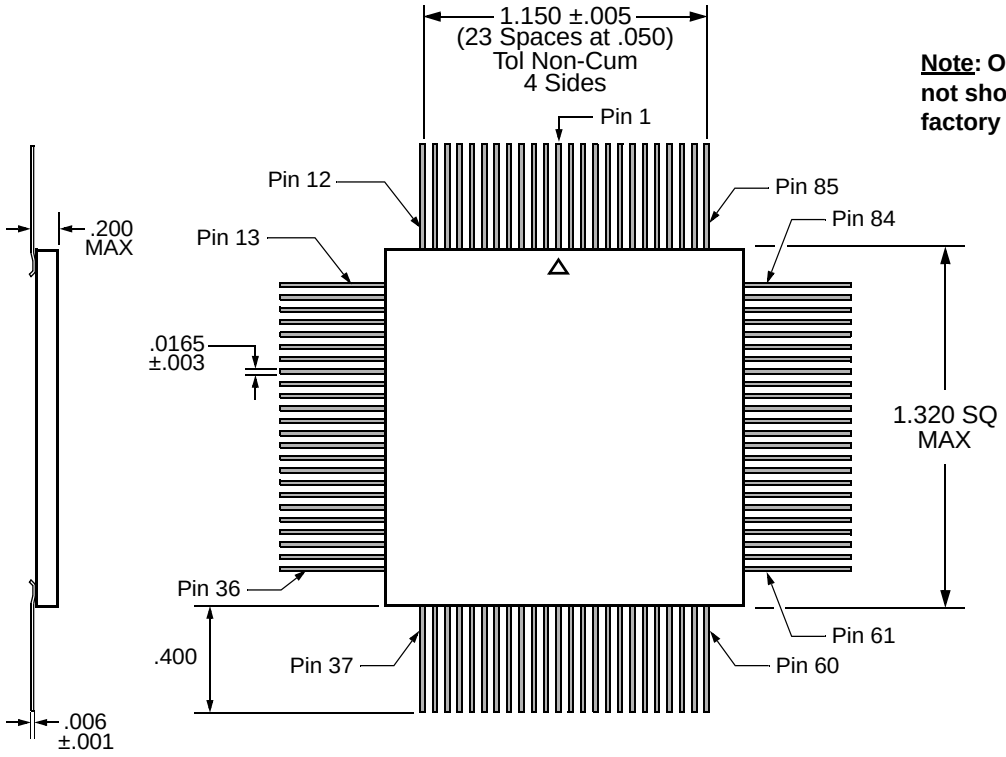
LEAD NUMBERS & FUNCTIONS

RHD8543 – 96 Leads Ceramic QUAD Flat Pack					
Pin #	**Function**	**Pin #**	**Function**	**Pin #**	**Function**
1	A2	33	CH11	65	CH33
2	NC	34	NC	66	CH32
3	A3	35	CH12	67	NC
4	NC	36	NC	68	Output3 (32-47)
5	$\overline{EN}$(0-15)	37	CH13	69	NC
6	NC	38	NC	70	Output2 (16-31)
7	CH0	39	CH14	71	GND
8	NC	40	NC	72	GND
9	CH1	41	CH15	73	CH31
10	NC	42	NC	74	CH30
11	CH2	43	NC	75	CH29
12	NC	44	+Vcc	76	CH28
13	CH3	45	NC	77	CH27
14	NC	46	NC	78	CH26
15	CH4	47	NC	79	CH25
16	NC	48	NC	80	CH24
17	CH5	49	NC	81	CH23
18	NC	50	CASE GND	82	CH22
19	CH6	51	CH47	83	CH21
20	NC	52	CH46	84	CH20
21	CH7	53	CH45	85	CH19
22	NC	54	CH44	86	CH18
23	GND	55	CH43	87	CH17
24	GND	56	CH42	88	CH16
25	Output1 (0-15)	57	CH41	89	GND
26	NC	58	CH40	90	GND
27	CH8	59	CH39	91	$\overline{EN}$(32-47)
28	NC	60	CH38	92	$\overline{EN}$(16-31)
29	CH9	61	CH37	93	A0
30	NC	62	CH36	94	NC
31	CH10	63	CH35	95	A1
32	NC	64	CH34	96	NC

NOTE: It is recommended that all "NC or "no connect pin" be grounded. This eliminates or minimizes any ESD or static buildup.

ORDERING INFORMATION

Model Number	DLA SMD #	Screening	Package
RHD8543-7	-	Commercial Flow, +25°C testing only	QUAD Flat Pack
RHD8543-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD8543-201-1S	5962-1221001KXC	DLA SMD Pending	
RHD8543-901-1S	5962H1221001KXC	DLA SMD and Radiation Certification Pending	



Note: Outside ceramic tie bars not shown for clarity. Contact factory for details.

FLAT PACKAGE OUTLINE

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Preliminary

RadHard-by-Design
RHD8544 Dual 16-Channel Analog Multiplexer

www.aeroflex.com/RHDseries

February 28, 2012

FEATURES

- 32 Channels provided by two independent 16-channel multiplexers
- Single power supply operation at +3.3V to +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
- Full military temperature range
- Low power consumption < 2.0mW
- CMOS analog switching allows rail to rail operation and low switch impedance
- Separate address busses A(0-3) & B(0-3) and enable $\overline{EN}$(0-15) & $\overline{EN}$(16-31)
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 56 leads, 0.800"Sq x 0.200"Ht quad flat pack
  - Weight - 6 grams max
- **Aeroflex Plainview's Radiation Hardness Assurance Plan is DLA Certified to MIL-PRF-38534, Appendix G.**

GENERAL DESCRIPTION

Aeroflex's RHD8544 is a radiation hardened, single supply, dual 16-Channel Multiplexer MCM (multi-chip module). The RHD8544 design uses specific circuit topology and layout methods to mitigate total ionization dose effects and single event latchup. These characteristics make the RHD8544 especially suited for the harsh environment encountered in Deep Space missions. It is available in a 96 lead High Temperature Co-Fired Ceramic (HTCC) Quad Flatpack (CQFP). It is guaranteed operational from -55°C to +125°C. Available screened in accordance with MIL-PRF-38534 Class K, the RHD8544 is ideal for demanding military and space applications.

ORGANIZATION AND APPLICATION

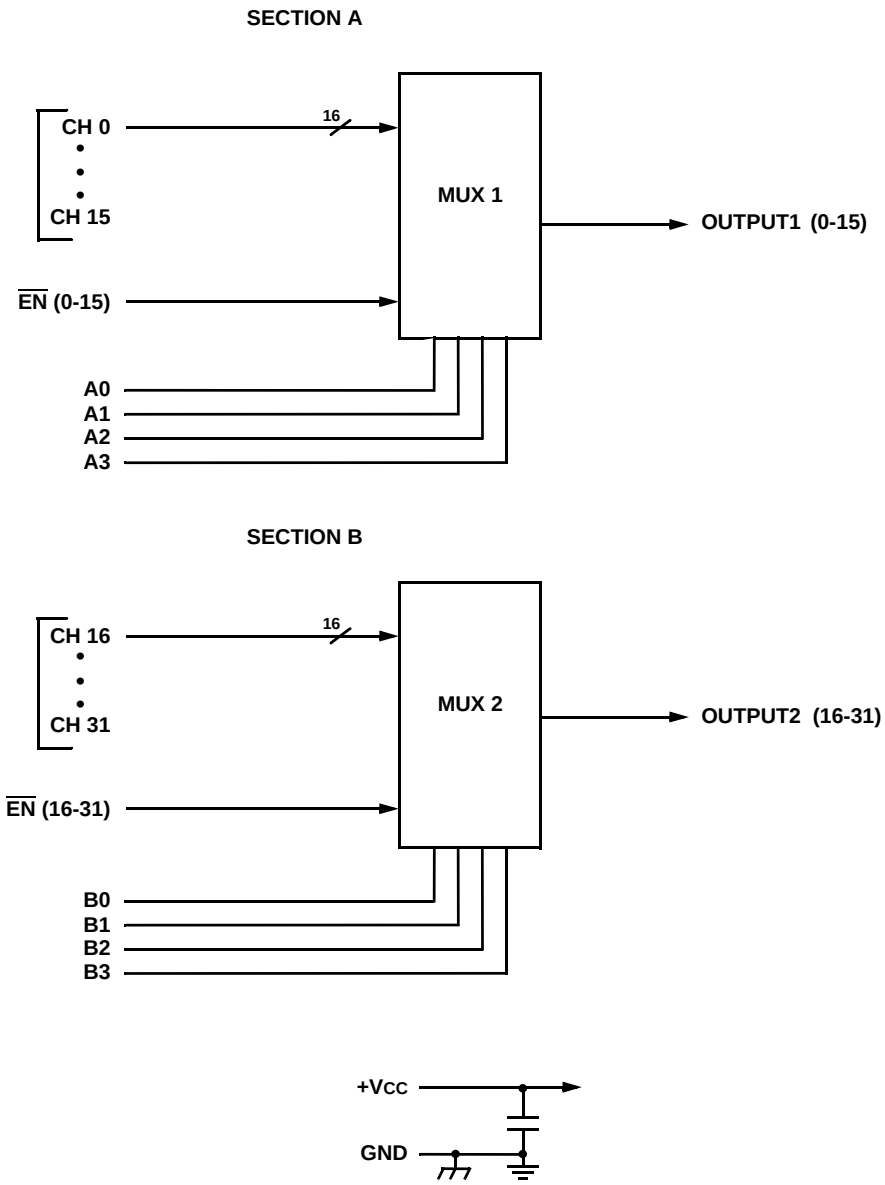
The RHD8544 consists of two independent 16-channel multiplexers arranged as shown in the block diagram.

A Section

Sixteen (16) channels addressable by bus A(0-3), enabled by $\overline{EN}$(0-15) and outputted on Output1(0-15).

B Section

Sixteen (16) channels addressable by bus B(0-3), enabled by $\overline{EN}$(16-31) and outputted on Output2(16-31).



RHD8544: DUAL 16-CHANNEL ANALOG MUX BLOCK DIAGRAM

ABSOLUTE MAXIMUM RATINGS 1/

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Supply Voltage +V_{CC} (Pin 18)	+3.0 to +6.0	V
Digital Input Overvoltage V_{EN}0-15 (Pin 13), V_{EN}16-31 (Pin 44), V_A (Pins 14, 15, 16, 17), V_B (Pins 40, 41, 42, 43)	< V_{CC} +0.4 > GND -0.4	V V
Analog Input Over Voltage V_{IN} (CH0-CH31)	< V_{CC} +0.4 > GND -0.4	V

Notes:
1/ All measurements are made with respect to ground.

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 1/

Symbol	Parameter	Typical	Units
+V_{CC}	Power Supply Voltage	3.3 to 5.0	V
V_{ENL}, V_{AL}	Logic Low Level	30% V_{CC}	V
V_{ENH}, V_{AH}	Logic High Level	70% V_{CC}	V

DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/

(Tc = -55°C to +125°C, +V_{CC} = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions	Min	Max	Units
Supply Current +V_{CC}	+I_{CC}	$\overline{EN}$ = 30% V_{CC}	0	20	µA
	+I_{SBY}	$\overline{EN}$ = 70% V_{CC}	0	20	µA
Address Input Current A(0-3), B(0-3)	I_{AL}(0-3)$_A$	V_A = 30% V_{CC}	-50	50	nA
	I_{AH}(0-3)$_A$	V_A = 70% V_{CC}	-50	50	nA
	I_{AL}(0-3)$_B$	V_B = 30% V_{CC}	-50	50	nA
	I_{AH}(0-3)$_B$	V_B = 70% V_{CC}	-50	50	nA
Enable Input Current $\overline{EN}$	I_{ENL}(0-15)	V_{EN}(0-15) = 30% V_{CC}	-50	50	nA
	I_{ENH}(0-15)	V_{EN}(0-15) = 70% V_{CC}	-50	50	nA
	I_{ENL}(16-31)	V_{EN}(16-31) = 30% V_{CC}	-50	50	nA
	I_{ENH}(16-31)	V_{EN}(16-31) = 70% V_{CC}	-50	50	nA

DC ELECTRICAL PERFORMANCE CHARACTERISTICS 1/ (continued)

(Tc = -55°C to +125°C, +V_{CC} = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions		Min	Max	Units
High Input Leakage Current (CH0-CH31)	I_{INLK_5}	V_{IN} = +5V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = 0V		-50	50	nA
Low Input Leakage Current (CH0-CH31)	I_{INLK_0}	V_{IN} = 0V, V_{EN} =70% V_{CC}, Output and all unused MUX inputs under test = +5V		-50	50	nA
Output Leakage Current V_{OUT} (pins 12 & 45)	I_{OUTLK}	V_{OUT} = +5V, V_{EN} = 70% V_{CC}, All inputs grounded except channel being tested. 3/, 4/		-50	50	nA
Switch ON Resistance OUTPUTS (pins 12 & 45) 6/	$R_{DS(ON)}$	V_{IN} = 0V, V_{IN} = +2.5V, V_{IN} = +5V V_{EN} = 30% V_{CC} I_{OUT} = -1mA 2/, 3/, 5/	-55°C	-	500	Ω
			+25°C	-	750	Ω
			+125°C	-	1000	Ω

Notes:

1/ Measure inputs sequentially. Ground all unused inputs of the device under test. V_A is the applied input voltage to the address lines A(0-3). V_B is the applied input voltage to the address lines B(0-3).

2/ V_{IN} is the applied input voltage to the input channels (CH0-CH31).

3/ V_{EN} 0-15 is the applied input voltage to the enable line $\overline{EN}$ (0-15). V_{EN} 16-31 is the applied input voltage to the enable line $\overline{EN}$ (16-31)

4/ V_{OUT} is the applied input voltage to the output lines OUTPUT1 (0-15), OUTPUT2 (16-31)

5/ Negative current is the current flowing out of each of the MUX pins. Positive current is the current flowing into each MUX pin.

6/ Not tested, guaranteed to the specified limits.

SWITCHING CHARACTERISTICS

(Tc = -55°C to +125°C, +V_{CC} = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions	Temp	Min	Max	Units
Address to Output Delay	t_AHL	V_{OUT} High to Low Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	t_ALH	V_{OUT} Low to High Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
Enable to Output Delay	$t_{ON}EN$	V_{EN} = 30% V_{CC} (Enabled)	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	$t_{OFF}EN$	V_{EN} = 70% V_{CC} (Disabled)	ALL	10	200	ns

TRUTH TABLE (CH0–CH15)

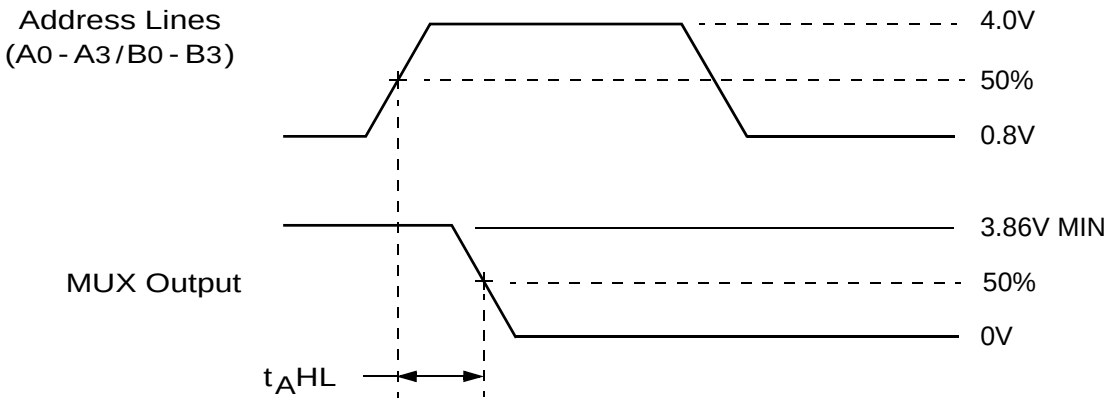
A3	A2	A1	A0	$\overline{EN}$ (0-15)	"ON" CHANNEL, 1/ (OUTPUT 1)
X	X	X	X	H	NONE
L	L	L	L	L	CH0
L	L	L	H	L	CH1
L	L	H	L	L	CH2
L	L	H	H	L	CH3
L	H	L	L	L	CH4
L	H	L	H	L	CH5
L	H	H	L	L	CH6
L	H	H	H	L	CH7
H	L	L	L	L	CH8
H	L	L	H	L	CH9
H	L	H	L	L	CH10
H	L	H	H	L	CH11
H	H	L	L	L	CH12
H	H	L	H	L	CH13
H	H	H	L	L	CH14
H	H	H	H	L	CH15

1/ Between (CH0-CH15) and OUTPUT1 (0-15)

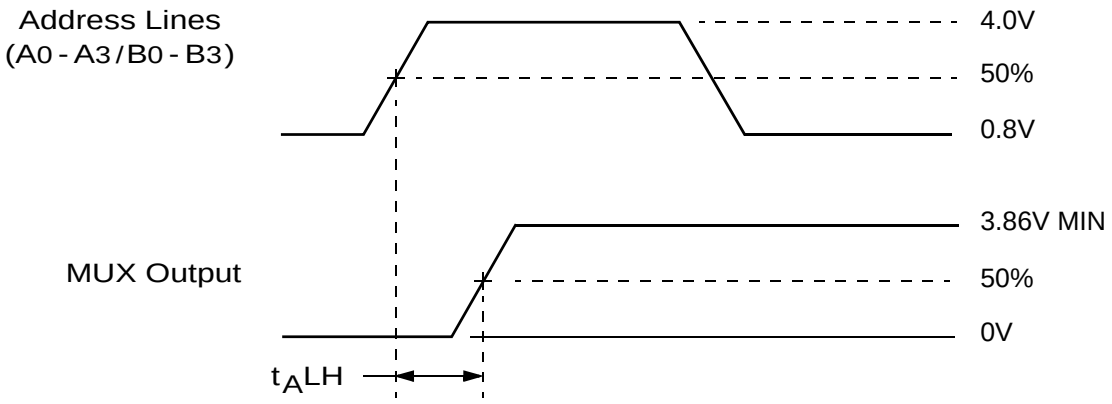
TRUTH TABLE (CH16–CH31)

B3	B2	B1	B0	$\overline{EN}$ (16-31)	"ON" CHANNEL, 2/ (OUTPUT 2)
X	X	X	X	H	NONE
L	L	L	L	L	CH16
L	L	L	H	L	CH17
L	L	H	L	L	CH18
L	L	H	H	L	CH19
L	H	L	L	L	CH20
L	H	L	H	L	CH21
L	H	H	L	L	CH22
L	H	H	H	L	CH23
H	L	L	L	L	CH24
H	L	L	H	L	CH25
H	L	H	L	L	CH26
H	L	H	H	L	CH27
H	H	L	L	L	CH28
H	H	L	H	L	CH29
H	H	H	L	L	CH30
H	H	H	H	L	CH31

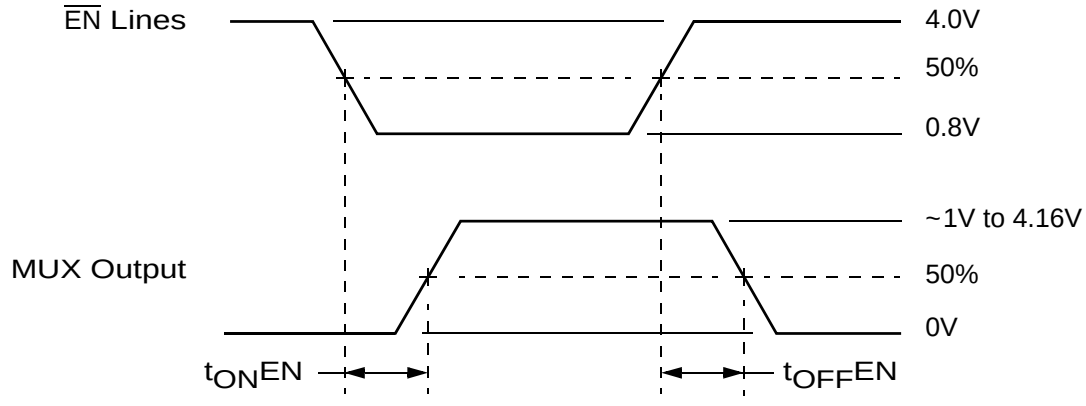
2/ Between (CH16-CH31) and OUTPUT2 (16-31)



Definition of t_AHL



Definition of t_ALH



Definition of $t_{ON}EN$ and $t_{OFF}EN$

NOTE: f = 10KHz, Duty cycle = 50%.

RHD8544 SWITCHING DIAGRAMS

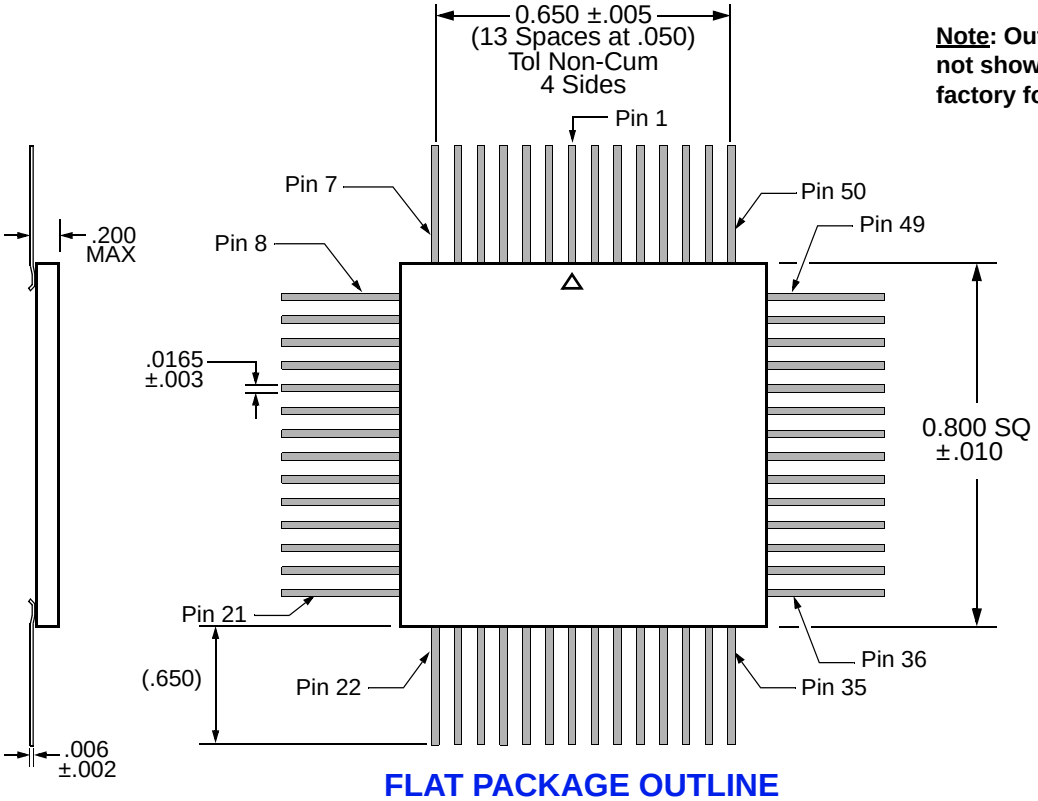
PIN NUMBERS & FUNCTIONS

RHD8544 – 56 Leads Ceramic QUAD Flat Pack			
Pin #	**Function**	**Pin #**	**Function**
1	CH0	29	CH31
2	CH1	30	CH30
3	CH2	31	CH29
4	CH3	32	CH28
5	CH4	33	CH27
6	CH5	34	CH26
7	GND	35	GND
8	GND	36	GND
9	CH6	37	CH25
10	CH7	38	CH24
11	CASE GND	39	GND
12	OUTPUT1 (0-15)	40	B3
13	$\overline{EN}$ (0-15)	41	B2
14	A0	42	B1
15	A1	43	B0
16	A2	44	$\overline{EN}$ (16-31)
17	A3	45	OUTPUT2 (16-31)
18	+V_{CC}	46	GND
19	CH15	47	CH16
20	CH14	48	CH17
21	GND	49	GND
22	GND	50	GND
23	CH13	51	CH18
24	CH12	52	CH19
25	CH11	53	CH20
26	CH10	54	CH21
27	CH9	55	CH22
28	CH8	56	CH23

Notes:
1. It is recommended that all "NC" or "no connect pin", be grounded. This eliminates or minimizes any ESD or static buildup.
2. Package lid is internally connected to circuit ground (Pins 7, 8, 11, 21, 22, 35, 36, 39, 46, 49, 50).

ORDERING INFORMATION

Model	DLA SMD #	Screening	Package
RHD8544-7	-	Commercial Flow, +25°C testing only	QUAD Flat Pack
RHD8544-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD8544-201-1S	5962-1220901KXC	DLA SMD Pending	
RHD8544-901-1S	5962H1220901KXC	DLA SMD and Radiation Certification Pending	



Note: Outside ceramic tie bars not shown for clarity. Contact factory for details.

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FLAT PACKAGE OUTLINE

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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REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

"Preliminary Draft 04/05/11"

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Selection Guide

REV																				
SHEET																				
REV																				
SHEET																				
REV STATUS				REV																
OF SHEETS				SHEET	1	2	3	4	5	6	7	8	9	10	11					

PMIC N/A

PREPARED BY
Steve L. Duncan

DLA LAND AND MARITIME
COLUMBUS, OHIO 43218-3990
http://www.dscc.dla.mil/

STANDARD MICROCIRCUIT DRAWING

THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE

CHECKED BY
Greg Cecil

APPROVED BY
Charles F. Saffle

DRAWING APPROVAL DATE

MICROCIRCUIT, HYBRID, QUAD OPERATIONAL AMPLIFIER, RADIATION HARDENED

AMSC N/A

REVISION LEVEL

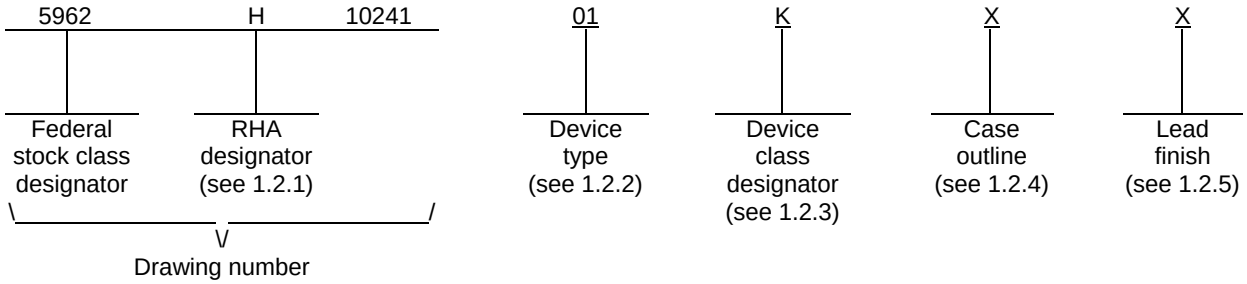
SIZE	CAGE CODE	
A	**67268**	**5962-10241**

SHEET 1 OF 11

1. SCOPE

1.1 Scope. This drawing documents five product assurance classes as defined in paragraph 1.2.3 and MIL-PRF-38534. A choice of case outlines and lead finishes which are available and are reflected in the Part or Identifying Number (PIN). When available, a choice of radiation hardness assurance levels are reflected in the PIN.

1.2 PIN. The PIN shall be as shown in the following example:



1.2.1 Radiation hardness assurance (RHA) designator. RHA marked devices shall meet the MIL-PRF-38534 specified RHA levels and shall be marked with the appropriate RHA designator. A dash (-) indicates a non-RHA device.

1.2.2 Device type(s). The device type(s) identify the circuit function as follows:

Device type	Generic number	Circuit function
01	RHD5900	Radiation Hardened, Quad operational amplifier
02	RHD5901	Radiation Hardened, Quad operational amplifier, Hi-Z output control

1.2.3 Device class designator. This device class designator shall be a single letter identifying the product assurance level. All levels are defined by the requirements of MIL-PRF-38534 and require QML Certification as well as qualification (Class H, K, and E) or QML Listing (Class G and D). The product assurance levels are as follows:

Device class	Device performance documentation
K	Highest reliability class available. This level is intended for use in space applications.
H	Standard military quality class level. This level is intended for use in applications where non-space high reliability devices are required.
G	Reduced testing version of the standard military quality class. This level uses the Class H screening and In-Process Inspections with a possible limited temperature range, manufacturer specified incoming flow, and the manufacturer guarantees (but may not test) periodic and conformance inspections (Group A, B, C and D).
E	Designates devices which are based upon one of the other classes (K, H, or G) with exception(s) taken to the requirements of that class. These exception(s) must be specified in the device acquisition document; therefore the acquisition document should be reviewed to ensure that the exception(s) taken will not adversely affect system performance.
D	Manufacturer specified quality class. Quality level is defined by the manufacturers internal, QML certified flow. This product may have a limited temperature range.

1.2.4 Case outline(s). The case outline(s) are as designated in MIL-STD-1835 and as follows:

Outline letter	Descriptive designator	Terminals	Package style
X	See figure 1	16	Flat package with formed leads

1.2.5 Lead finish. The lead finish shall be as specified in MIL-PRF-38534.

1.3 Absolute maximum ratings. 1/

Supply voltage (V_{CC}) range	+3.0 V dc to +6.0 V dc
Input voltage (V_{IN}) range	V_{CC} +0.4 V, GND -0.4 V
Junction temperature (T_J)	+150°C
Power @ +25°C	200 mW
Thermal resistance, Junction to Case (Θ_{JC})	7° C/W
Storage temperature range	-65°C to +150°C
Lead temperature (soldering, 10 seconds)	+300°C

1.4 Recommended operating conditions.

Supply voltage (V_{CC}) range	+3.3 V dc to +5.0 V dc
Input Common Mode (V_{CM}) range	V_{CC} to GND
Case operating temperature range (T_C)	-55°C to +125°C

1.5 Radiation features

Maximum total dose available (dose rate = 50 - 300 rads(Si)/s):	
	1 Mrads(Si)
Enhanced Low Dose Rate Sensitvity (ELDRS)	Immuned
Single Event Latchup (SEL)	> 100 MeV-cm^2/mg 2/
Neutron irradiation	> 1 x 10^{14} neutrons/cm^2 3/

2. APPLICABLE DOCUMENTS

2.1 Government specification, standards, and handbooks. The following specification, standards, and handbooks form a part of this drawing to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-38534 - Hybrid Microcircuits, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1835 - Interface Standard for Electronic Component Case Outlines.

1/ Stresses above the absolute maximum ratings may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
2/ This limit is guaranteed by design or process, but not production tested unless otherwise specified by the customer through the purchase order or contract.
3/ Guaranteed, but not tested.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-103 - List of Standard Microcircuit Drawings.
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Item requirements. The individual item performance requirements for device classes D, E, G, H, and K shall be in accordance with MIL-PRF-38534. Compliance with MIL-PRF-38534 shall include the performance of all tests herein or as designated in the device manufacturer's Quality Management (QM) plan or as designated for the applicable device class. The manufacturer may eliminate, modify or optimize the tests and inspections herein, however the performance requirements as defined in MIL-PRF-38534 shall be met for the applicable device class. In addition, the modification in the QM plan shall not affect the form, fit, or function of the device for the applicable device class.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38534 and herein.

3.2.1 Case outline(s). The case outline(s) shall be in accordance with 1.2.4 herein and figure 1.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 2.

3.2.3 Logic diagram(s). The logic diagram(s) shall be as specified on figure 3.

3.2.5 Switching diagram(s). The switching diagram(s) shall be as specified on figure 4 .

3.2.6 Radiation exposure circuit. The radiation exposure circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing and acquiring activity upon request.

3.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table I and shall apply over the full specified operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are defined in table I.

3.5 Marking of device(s). Marking of device(s) shall be in accordance with MIL-PRF-38534. The device shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's vendor similar PIN may also be marked.

3.6 Data. In addition to the general performance requirements of MIL-PRF-38534, the manufacturer of the device described herein shall maintain the electrical test data (variables format) from the initial quality conformance inspection group A lot sample, for each device type listed herein. Also, the data should include a summary of all parameters manually tested, and for those which, if any, are guaranteed. This data shall be maintained under document revision level control by the manufacturer and be made available to the preparing activity (DLA Land and Maritime -VA) upon request.

3.7 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to supply to this drawing. The certificate of compliance (original copy) submitted to DLA Land and Maritime -VA shall affirm that the manufacturer's product meets the performance requirements of MIL-PRF-38534 and herein.

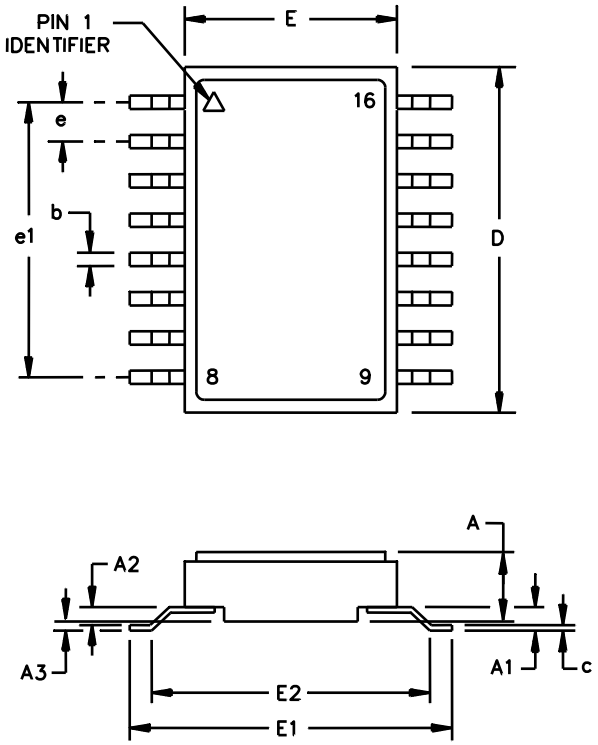
3.8 Certificate of conformance. A certificate of conformance as required in MIL-PRF-38534 shall be provided with each lot of microcircuits delivered to this drawing.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ 2/ $-55°C \le T_C \le +125°C$ V_{CC} = +5.0 V unless otherwise specified	Group A subgroups	Device types	Limits		Unit
					Min	Max	
Input offset voltage	V_{OS}		1,2,3	All	-2	2	mV
Input offset current	I_{OS}		1,2,3	All	-1	1	pA
Input bias current 3/	I_B		1,2,3	All	-2	2	pA
Input offset temperature 3/ coefficient	V_{IOST}		1,2,3	All		10	µV/C
Common Mode Rejection Ratio	CMRR		4,5,6	All	70		dB
Power supply rejection ratio	PSRR		4,5,6	All	70		dB
Output voltage high	V_{OH}	I_{OUT} = 3 mA	1,2,3	All	4.9		V
Output voltage low	V_{OL}	I_{OUT} = 3 mA	1,2,3	All		0.1	V
Short circuit output current 3/	$I_{O(SINK)}$	V_{OUT} to V_{CC}	1,2,3	All	-63		mA
	$I_{O(SOURCE)}$	V_{OUT} to GND				45	
Slew rate	SR	R_L = 8 kΩ	9,10,11	All	2.5		V/µs
Open loop gain	A_{OL}	No Load	4,5,6	All	90		dB
Unity gain bandwidth	UGBW	R_L = 10 kΩ	4,5,6	All	5		MHz
Quiescent supply current	I_{CCQ}	All amplifiers enabled, no loads	1,2,3	All		5.5	mA
		All amplifiers disabled		02		1.0	µA
Enable input voltage high	V_{HI}	HI = enabled	1,2,3	02	.7 V_{CC}		V
Enable input voltage low	V_{LO}	LO = disabled	1,2,3	02		.3 V_{CC}	V
Enable input current	I_{EN}		1,2,3	02		100	nA
Channel separation 3/	CH_{SEP}	R_L = 2 kΩ, f = 1.0 kHz	4,5,6	All	90		dB
Output enable delay	$t_{ON}EN$	See figure 4	9,10,11	02		100	ns
Output disable delay	$t_{OFF}EN$		9,10,11	02		100	ns

1/ These devices have been characterized at level H of irradiation. Pre and post irradiation values meet the limits as specified in table I. When performing post irradiation electrical measurements for any RHA level, T_C = +25°C.
2/ For radiation features see paragraph 1.5 herein.
3/ Not tested. Shall be guaranteed by design, characterization, or correlation to other test parameters.

Case X.



Symbol	Inches		Millimeters	
	Min	Max	Min	Max
A		.120		3.08
A1	.030 REF		0.76 REF	
A2	.017	.027	0.43	0.69
A3		.012		0.30
b	.015	.019	0.38	0.48
c	.007	.009	0.18	0.23
D		.417		15.60
e	.050 BSC		1.27 BSC	
e1	.350 BSC		8.90 BSC	
E		.300		7.62
E1	.394	.419	10.01	10.64
E2	.346 REF		8.79 REF	

NOTE:
1. The U.S. preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. Package and lid are electrically isolated from signal pads.

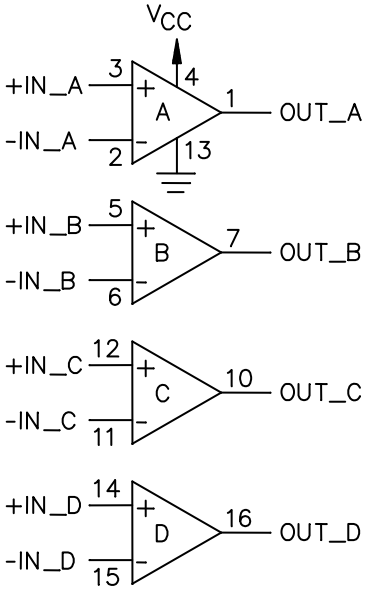
FIGURE 1. Case outline.

Device types	01	02
Case outline	X	
Terminal number	Terminal symbol	
1	OUT_A	OUT_A
2	-IN_A	-IN_A
3	+IN_A	+IN_A
4	V_{CC}	V_{CC}
5	+IN_B	+IN_B
6	-IN_B	-IN_B
7	OUT_B	OUT_B
8	No Connection	EN_AB
9	No Connection	EN_CD
10	OUT_C	OUT_C
11	-IN_C	-IN_C
12	+IN_C	+IN_C
13	GND	GND
14	+IN_D	+IN_D
15	-IN_D	-IN_D
16	OUT_D	OUT_D

NOTE: EN_AB enables amplifiers A and B, EN_CD enables amplifiers C and D.

FIGURE 2. Terminal connections.

DEVICE TYPE 01



DEVICE TYPE 02

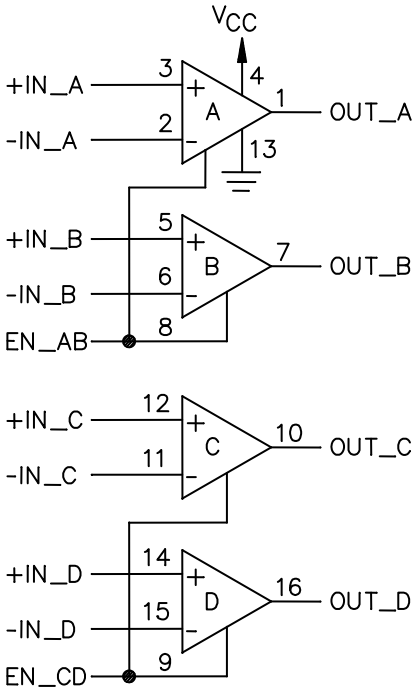


FIGURE 3. Logic diagram(s).

DEVICE TYPE 02 ONLY

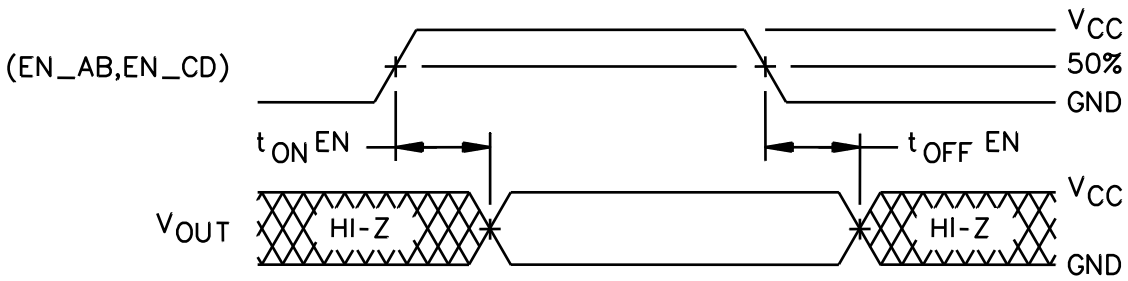


FIGURE 4. Switching diagrams.

TABLE II. Electrical test requirements.

MIL-PRF-38534 test requirements	Subgroups (in accordance with MIL-PRF-38534, group A test table)
Interim electrical parameters	1,2,3,4,5,6,9,10,11
Final electrical parameters	1*2,3,4,5,6,9,10,11
Group A test requirements	1,2,3,4,5,6,9,10,11
Group C end-point electrical parameters	1,2,3,4,5,6,9,10,11
End-point electrical parameters for Radiation Hardness Assurance (RHA) devices	1

* PDA applies to subgroup 1.

4. VERIFICATION

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38534 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38534. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1015 of MIL-STD-883.

b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 Conformance and periodic inspections. Conformance inspection (CI) and periodic inspection (PI) shall be in accordance with MIL-PRF-38534 and as specified herein.

4.3.1 Group A inspection (CI). Group A inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. Tests shall be as specified in table II herein.

b. Subgroups 7, 8A , and 8B shall be omitted.

4.3.2 Group B inspection (PI). Group B inspection shall be in accordance with MIL-PRF-38534.

4.3.3 Group C inspection (PI). Group C inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. End-point electrical parameters shall be as specified in table II herein.

b. Steady-state life test, method 1005 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1005 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1005 of MIL-STD-883.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

4.3.4 Group D inspection (PI). Group D inspection shall be in accordance with MIL-PRF-38534.

4.3.5 Radiation Hardness Assurance (RHA) inspection. RHA qualification is required for those devices with the RHA designator as specified herein. End-point electrical parameters for radiation hardness assurance (RHA) devices shall be specified in table II. Radiation testing will be in accordance with the qualifying activity (DSCC-VQ) approved plan and with MIL-PRF-38534, Appendix G.

4.3.5.1 Total dose irradiation testing. Total dose irradiation testing shall be in accordance with MIL-STD-883 method 1019, condition A and as specified herein. Sample testing in accordance with table I shall be performed on a representative device type (similar device) at initial qualification and after any design or process changes which may affect the RHA response. Sample size is a minimum of 8 devices (4 biased and 4 not biased). This sample testing is repeated for each new combination for wafers of active elements on the most complex device.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38534.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

6.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated as specified in MIL-PRF-38534.

6.4 Record of users. Military and industrial users shall inform DLA Land and Maritime when a system application requires configuration control and the applicable SMD to that system. DLA Land and Maritime will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronic devices (FSC 5962) should contact DLA Land and Maritime-VA, telephone (614) 692-0547.

6.5 Comments. Comments on this drawing should be directed to DLA Land and Maritime-VA, Columbus, Ohio 43218-3990, or telephone (614) 692-1081.

6.6 Sources of supply. Sources of supply are listed in MIL-HDBK-103 and QML-38534. The vendors listed in MIL-HDBK-103 and QML-38534 have submitted a certificate of compliance (see 3.7 herein) to DLA Land and Maritime-VA and have agreed to this drawing.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE:

Approved sources of supply for SMD 5962-10241 are listed below for immediate acquisition information only and shall be added to MIL-HDBK-103 and QML-38534 during the next revisions. MIL-HDBK-103 and QML-38534 will be revised to include the addition or deletion of sources. The vendors listed below have agreed to this drawing and a certificate of compliance has been submitted to and accepted by DLA Land and Maritime -VA. This information bulletin is superseded by the next dated revisions of MIL-HDBK-103 and QML-38534. DLA Land and Maritime maintains an online database of all current sources of supply at http://www.dscc.dla.mil/Programs/Smcr/.

Standard microcircuit drawing PIN 1/	Vendor CAGE number	Vendor similar PIN 2/
5962-1024101KXA	88379	RHD5900-201-2S
5962H1024101KXA	88379	RHD5900-901-2S
5962-1024101KXC	88379	RHD5900-201-1S
5962H1024101KXC	88379	RHD5900-901-1S
5962-1024202KXA	88379	RHD5901-201-2S
5962H1024102KXA	88379	RHD5901-901-2S
5962-1024102KXC	88379	RHD5901-201-1S
5962H1024102KXC	88379	RHD5901-901-1S

1/ The lead finish shown for each PIN representing a hermetic package is the most readily available from the manufacturer listed for that part. If the desired lead finish is not listed contact the Vendor to determine its availability.

2/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.

Vendor CAGE number	Vendor name and address
88379	Aeroflex Plainview Incorporated, (Aeroflex Microelectronics Solutions) 35 South Service Road Plainview, NY 11803-4193

REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

"Preliminary Draft 04/05/11"

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REV STATUS				REV																
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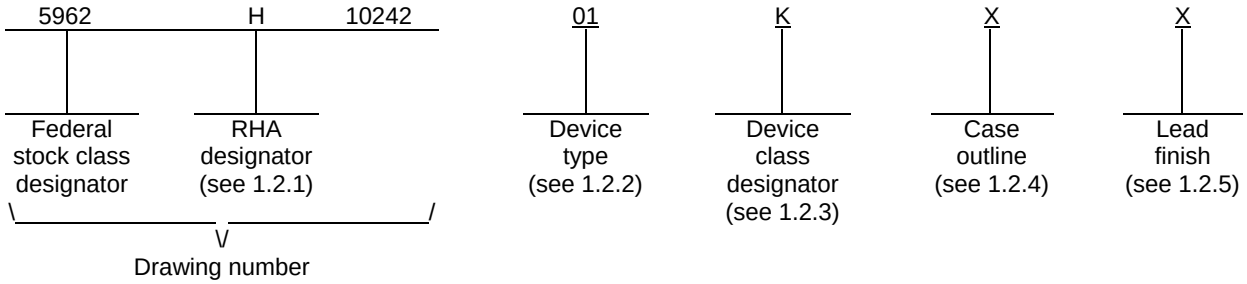
PMIC N/A	PREPARED BY Steve L. Duncan	**DLA LAND AND MARITIME** **COLUMBUS, OHIO 43218-3990** http://www.dscc.dla.mil/
STANDARD MICROCIRCUIT DRAWING THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE	CHECKED BY Greg Cecil	
	APPROVED BY Charles F. Saffle	**MICROCIRCUIT, HYBRID, QUAD COMPARATOR, RADIATION HARDENED**
AMSC N/A	DRAWING APPROVAL DATE REVISION LEVEL	SIZE: A; CAGE CODE: **67268**; **5962-10242** SHEET 1 OF 11

1. SCOPE

1.1 Scope. This drawing documents five product assurance classes as defined in paragraph 1.2.3 and MIL-PRF-38534. A choice of case outlines and lead finishes which are available and are reflected in the Part or Identifying Number (PIN). When available, a choice of radiation hardness assurance levels are reflected in the PIN.

1.2 PIN. The PIN shall be as shown in the following example:



1.2.1 Radiation hardness assurance (RHA) designator. RHA marked devices shall meet the MIL-PRF-38534 specified RHA levels and shall be marked with the appropriate RHA designator. A dash (-) indicates a non-RHA device.

1.2.2 Device type(s). The device type(s) identify the circuit function as follows:

Device type	Generic number	Circuit function
01	RHD5910	Radiation Hardened, Quad Comparator
02	RHD5911	Radiation Hardened, Quad Comparator, Clocked

1.2.3 Device class designator. This device class designator shall be a single letter identifying the product assurance level. All levels are defined by the requirements of MIL-PRF-38534 and require QML Certification as well as qualification (Class H, K, and E) or QML Listing (Class G and D). The product assurance levels are as follows:

Device class	Device performance documentation
K	Highest reliability class available. This level is intended for use in space applications.
H	Standard military quality class level. This level is intended for use in applications where non-space high reliability devices are required.
G	Reduced testing version of the standard military quality class. This level uses the Class H screening and In-Process Inspections with a possible limited temperature range, manufacturer specified incoming flow, and the manufacturer guarantees (but may not test) periodic and conformance inspections (Group A, B, C and D).
E	Designates devices which are based upon one of the other classes (K, H, or G) with exception(s) taken to the requirements of that class. These exception(s) must be specified in the device acquisition document; therefore the acquisition document should be reviewed to ensure that the exception(s) taken will not adversely affect system performance.
D	Manufacturer specified quality class. Quality level is defined by the manufacturers internal, QML certified flow. This product may have a limited temperature range.

1.2.4 Case outline(s). The case outline(s) are as designated in MIL-STD-1835 and as follows:

Outline letter	Descriptive designator	Terminals	Package style
X	See figure 1	16	Flat package with formed leads

1.2.5 Lead finish. The lead finish shall be as specified in MIL-PRF-38534.

1.3 Absolute maximum ratings. 1/

Supply voltage (V_{CC}) range	+3.0 V dc to +6.0 V dc
Input voltage (V_{IN}) range	V_{CC} +0.4 V, GND -0.4 V
Junction temperature (T_J)	+150°C
Power @ +25°C	250 mW
Storage temperature range	-65°C to +150°C
Lead temperature (soldering, 10 seconds)	+300°C

1.4 Recommended operating conditions.

Supply voltage (V_{CC}) range	+3.3 V dc to +5.0 V dc
Input Common Mode (V_{CM}) range	V_{CC} to GND
Case operating temperature range (T_C)	-55°C to +125°C

1.5 Radiation features 2/ 3/

Maximum total dose available (dose rate = 50 - 300 rads(Si)/s):	
	1 Mrads(Si)
Enhanced Low Dose Rate Sensitvity (ELDRS)	Immuned
Single Event Latchup (SEL)	> 100 MeV-cm^2/mg 2/
Neutron irradiation	> 1 x 10^{14} neutrons/cm^2 3/

2. APPLICABLE DOCUMENTS

2.1 Government specification, standards, and handbooks. The following specification, standards, and handbooks form a part of this drawing to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-38534 - Hybrid Microcircuits, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1835 - Interface Standard for Electronic Component Case Outlines.

1/ Stresses above the absolute maximum ratings may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
2/ This limit is guaranteed by design or process, but not production tested unless otherwise specified by the customer through the purchase order or contract.
3/ Guaranteed, but not tested.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-103 - List of Standard Microcircuit Drawings.
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Item requirements. The individual item performance requirements for device classes D, E, G, H, and K shall be in accordance with MIL-PRF-38534. Compliance with MIL-PRF-38534 shall include the performance of all tests herein or as designated in the device manufacturer's Quality Management (QM) plan or as designated for the applicable device class. The manufacturer may eliminate, modify or optimize the tests and inspections herein, however the performance requirements as defined in MIL-PRF-38534 shall be met for the applicable device class. In addition, the modification in the QM plan shall not affect the form, fit, or function of the device for the applicable device class.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38534 and herein.

3.2.1 Case outline(s). The case outline(s) shall be in accordance with 1.2.4 herein and figure 1.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 2.

3.2.3 Logic diagram(s). The logic diagram(s) shall be as specified on figure 3.

3.2.4 Switching diagram(s). The switching diagram(s) shall be as specified on figure 4 .

3.2.5 Radiation exposure circuit. The radiation exposure circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing and acquiring activity upon request.

3.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table I and shall apply over the full specified operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are defined in table I.

3.5 Marking of device(s). Marking of device(s) shall be in accordance with MIL-PRF-38534. The device shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's vendor similar PIN may also be marked.

3.6 Data. In addition to the general performance requirements of MIL-PRF-38534, the manufacturer of the device described herein shall maintain the electrical test data (variables format) from the initial quality conformance inspection group A lot sample, for each device type listed herein. Also, the data should include a summary of all parameters manually tested, and for those which, if any, are guaranteed. This data shall be maintained under document revision level control by the manufacturer and be made available to the preparing activity (DLA Land and Maritime -VA) upon request.

3.7 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to supply to this drawing. The certificate of compliance (original copy) submitted to DLA Land and Maritime -VA shall affirm that the manufacturer's product meets the performance requirements of MIL-PRF-38534 and herein.

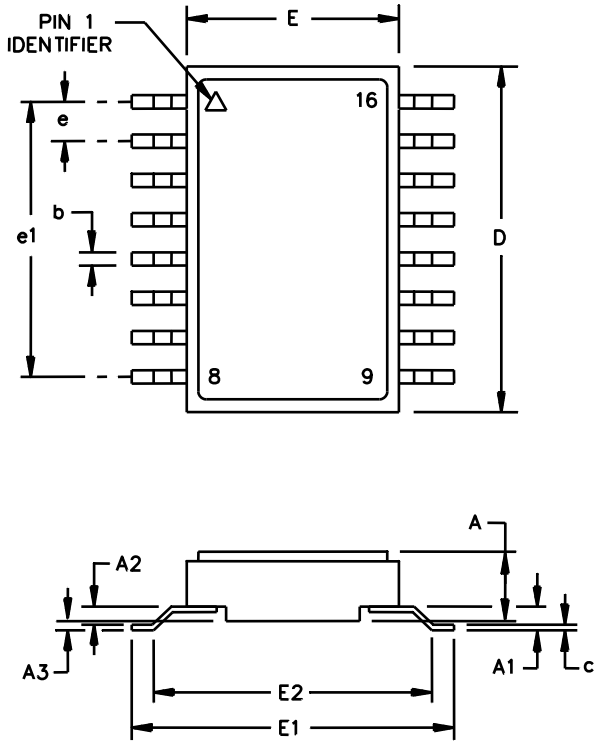
3.8 Certificate of conformance. A certificate of conformance as required in MIL-PRF-38534 shall be provided with each lot of microcircuits delivered to this drawing.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ 2/ $-55°C \le T_C \le +125°C$ V_{CC} = +5.0 V unless otherwise specified	Group A subgroups	Device types	Limits		Unit
					Min	Max	
Input offset voltage	V_{OS}		1,2,3	All	-2	2	mV
Input offset current	I_{OS}		1,2,3	All	-1	1	pA
Input bias current 3/	I_B		1,2,3	All	-2	2	pA
Input offset temperature 3/ coefficient	V_{IOST}		1,2,3	All		10	µV/C
Common Mode Rejection Ratio	CMRR		4,5,6	All	70		dB
Power supply rejection ratio	PSSR		4,5,6	01,02	70		dB
Output voltage high	V_{OH}	I_{OUT} = 3 mA	1,2,3	All	4.9		V
Output voltage low	V_{OL}	I_{OUT} = 3 mA	1,2,3	All		0.1	V
Gain 3/	A		4,5,6	01	5		V/mV
Quiescent supply current	I_{CCQ}		1,2,3	01		7.0	mA
				02		10	µA
Clock input voltage high	V_{HI}		1,2,3	02	.7 V_{CC}		V
Clock input voltage low	V_{LO}		1,2,3	02		.3 V_{CC}	V
Clock input current	I_{CLK}		1,2,3	02		1	nA
Output delay	t_{OUT}		9,10,11	01		25	ns
Input setup time	t_S		9,10,11	02		1	ns
Input hold time	t_H		9,10,11	02		5	ns
Output delay	t_D		9,10,11	02		10	ns
Clock positive pulse width	t_{WP}		9,10,11	02	100		ns
Clock frequency	CLK		9,10,11	02		5	MHz

1/ These devices have been characterized at level H of irradiation. Pre and post irradiation values meet the limits as specified in table I. When performing post irradiation electrical measurements for any RHA level, T_C = +25°C.
2/ For radiation features see paragraph 1.5 herein.
3/ Not tested. Shall be guaranteed by design, characterization, or correlation to other test parameters.

Case X.



Symbol	Inches		Millimeters	
	Min	Max	Min	Max
A		.120		3.08
A1	.030 REF		0.76 REF	
A2	.017	.027	0.43	0.69
A3		.012		0.30
b	.015	.019	0.38	0.48
c	.007	.009	0.18	0.23
D		.417		15.60
e	.050 BSC		1.27 BSC	
e1	.350 BSC		8.90 BSC	
E		.300		7.62
E1	.394	.419	10.01	10.64
E2	.346 REF		8.79 REF	

NOTE:
1. The U.S. preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. The package and lid are electrically isolated from signal pads.

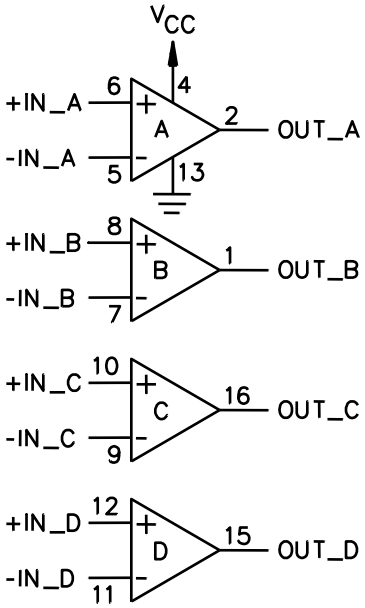
FIGURE 1. Case outline.

Device types	01	02
Case outline	X	
Terminal number	Terminal symbol	
1	OUT_B	OUT_B
2	OUT_A	OUT_A
3	No Connection	CLK_AB
4	V_{CC}	V_{CC}
5	-IN_A	-IN_A
6	+IN_A	+IN_A
7	-IN_B	-IN_B
8	+IN_B	+IN_B
9	-IN_C	-IN_C
10	+IN_C	+IN_C
11	-IN_D	-IN_D
12	+IN_D	+IN_D
13	GND	GND
14	No Connection	CLK_CD
15	OUT_D	OUT_D
16	OUT_C	OUT_C

NOTE: CLK_AB clocks comparator A and B, CLK_CD clocks comparator C and D.

FIGURE 2. Terminal connections.

DEVICE TYPE 01



DEVICE TYPE 02

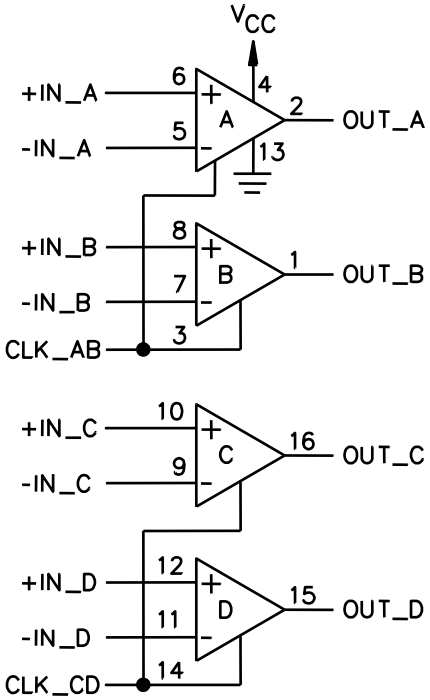
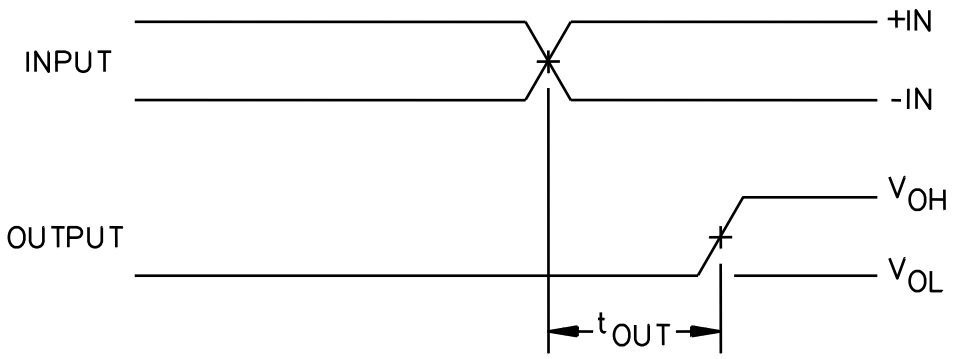


FIGURE 3. Logic diagram(s).

DEVICE 01



NOTE: For device type 01, the circuit delay is specified for a half-volt single ended or differential input step, of either polarity, ending in an input polarity reversal of 10mV.

DEVICE TYPE 02

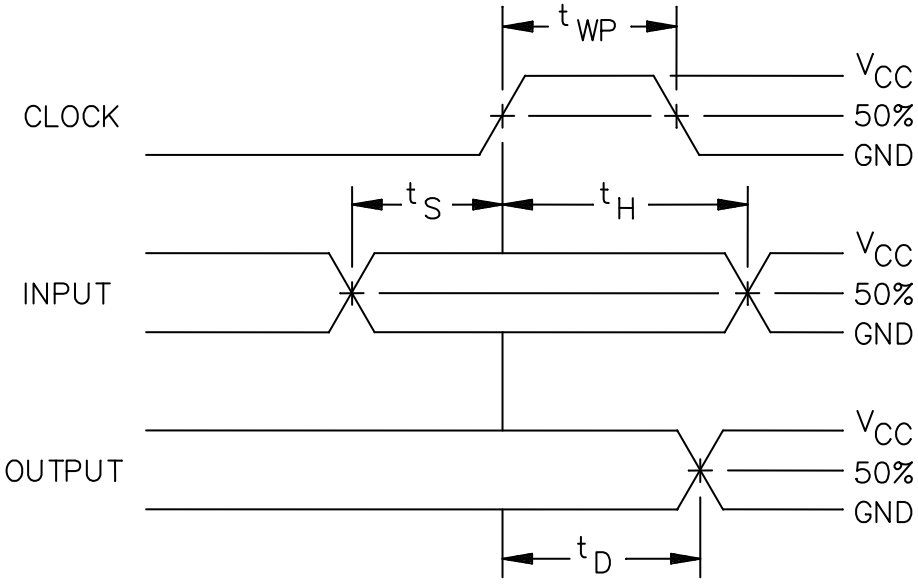


FIGURE 4. Switching diagrams.

TABLE II. Electrical test requirements.

MIL-PRF-38534 test requirements	Subgroups (in accordance with MIL-PRF-38534, group A test table)
Interim electrical parameters	1,2,3,4,5,6,9,10,11
Final electrical parameters	1*2,3,4,5,6,9,10,11
Group A test requirements	1,2,3,4,5,6,9,10,11
Group C end-point electrical parameters	1,2,3,4,5,6,9,10,11
End-point electrical parameters for Radiation Hardness Assurance (RHA) devices	1

* PDA applies to subgroup 1.

4. VERIFICATION

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38534 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38534. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1015 of MIL-STD-883.

b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 Conformance and periodic inspections. Conformance inspection (CI) and periodic inspection (PI) shall be in accordance with MIL-PRF-38534 and as specified herein.

4.3.1 Group A inspection (CI). Group A inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. Tests shall be as specified in table II herein.

b. Subgroups 7, 8A , and 8B shall be omitted.

4.3.2 Group B inspection (PI). Group B inspection shall be in accordance with MIL-PRF-38534.

4.3.3 Group C inspection (PI). Group C inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. End-point electrical parameters shall be as specified in table II herein.

b. Steady-state life test, method 1005 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1005 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1005 of MIL-STD-883.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

4.3.4 Group D inspection (PI). Group D inspection shall be in accordance with MIL-PRF-38534.

4.3.5 Radiation Hardness Assurance (RHA) inspection. RHA qualification is required for those devices with the RHA designator as specified herein. End-point electrical parameters for radiation hardness assurance (RHA) devices shall be specified in table II. Radiation testing will be in accordance with the qualifying activity (DLA Land and Maritime -VQ) approved plan and with MIL-PRF-38534, Appendix G.

4.3.5.1 Total dose irradiation testing. Total dose irradiation testing shall be in accordance with MIL-STD-883 method 1019, condition A and as specified herein. Sample testing in accordance with table I shall be performed on a representative device type (similar device) at initial qualification and after any design or process changes which may affect the RHA response. Sample size is a minimum of 8 devices (4 biased and 4 not biased). This sample testing is repeated for each new combination for wafers of active elements on the most complex device.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38534.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

6.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated as specified in MIL-PRF-38534.

6.4 Record of users. Military and industrial users shall inform DLA Land and Maritime when a system application requires configuration control and the applicable SMD to that system. DLA Land and Maritime will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronic devices (FSC 5962) should contact DLA Land and Maritime-VA, telephone (614) 692-0547.

6.5 Comments. Comments on this drawing should be directed to DLA Land and Maritime-VA, Columbus, Ohio 43218-3990, or telephone (614) 692-1081.

6.6 Sources of supply. Sources of supply are listed in MIL-HDBK-103 and QML-38534. The vendors listed in MIL-HDBK-103 and QML-38534 have submitted a certificate of compliance (see 3.7 herein) to DLA Land and Maritime-VA and have agreed to this drawing.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE:

Approved sources of supply for SMD 5962-10242 are listed below for immediate acquisition information only and shall be added to MIL-HDBK-103 and QML-38534 during the next revisions. MIL-HDBK-103 and QML-38534 will be revised to include the addition or deletion of sources. The vendors listed below have agreed to this drawing and a certificate of compliance has been submitted to and accepted by DLA Land and Maritime -VA. This information bulletin is superseded by the next dated revisions of MIL-HDBK-103 and QML-38534. DLA Land and Maritime maintains an online database of all current sources of supply at http://www.dscc.dla.mil/Programs/Smcr/.

Standard microcircuit drawing PIN 1/	Vendor CAGE number	Vendor similar PIN 2/
5962-1024201KXA	88379	RHD5910-201-2S
5962H1024201KXA	88379	RHD5910-901-2S
5962-1024201KXC	88379	RHD5910-201-1S
5962H1024201KXC	88379	RHD5910-901-1S
5962-1024202KXA	88379	RHD5911-201-2S
5962H1024202KXA	88379	RHD5911-901-2S
5962-1024202KXC	88379	RHD5911-201-1S
5962H1024202KXC	88379	RHD5911-901-1S

1/ The lead finish shown for each PIN representing a hermetic package is the most readily available from the manufacturer listed for that part. If the desired lead finish is not listed contact the Vendor to determine its availability.

2/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.

Vendor CAGE number	Vendor name and address
88379	Aeroflex Plainview Incorporated, (Aeroflex Microelectronics Solutions) 35 South Service Road Plainview, NY 11803-4193

REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

"Preliminary Draft 03-22-11"

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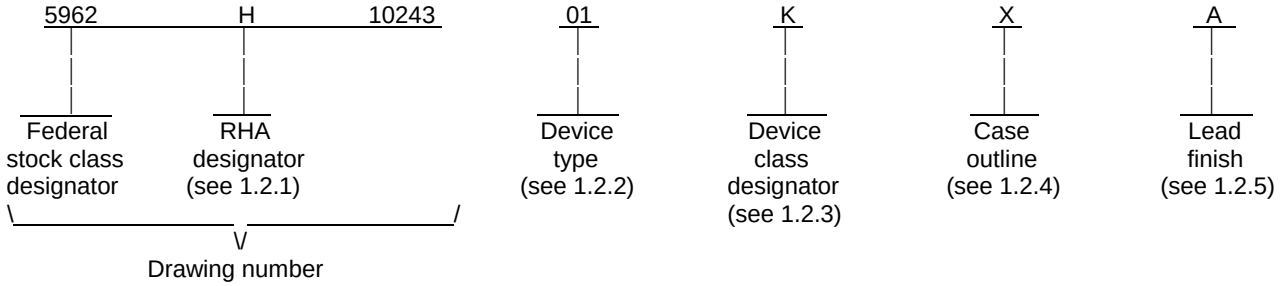
REV STATUS				REV																
OF SHEETS				SHEET			1	2	3	4	5	6	7	8	9	10	11	12	13	14

PMIC N/A	PREPARED BY Steve Duncan	**DLA LAND AND MARITIME** **COLUMBUS, OHIO 43218-3990** http://www.dscc.dla.mil/
STANDARD MICROCIRCUIT DRAWING THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE AMSC N/A	CHECKED BY Greg Cecil	
	APPROVED BY Charles F. Saffle	**MICROCIRCUIT, HYBRID, LINEAR, ANALOG MULTIPLEXER, 16 CHANNEL, +3.3 TO +5 VOLT, RADIATION HARDENED**
	DRAWING APPROVAL DATE	
	REVISION LEVEL	SIZE: A; CAGE CODE: **67268**; **5962-10243**
		SHEET 1 OF 17

1. SCOPE

1.1 Scope. This drawing documents five product assurance classes as defined in paragraph 1.2.3 and MIL-PRF-38534. A choice of case outlines and lead finishes which are available and are reflected in the Part or Identifying Number (PIN). When available, a choice of radiation hardness assurance levels are reflected in the PIN.

1.2 PIN. The PIN shall be as shown in the following example:



1.2.1 Radiation hardness assurance (RHA) designator. RHA marked devices shall meet the MIL-PRF-38534 specified RHA levels and shall be marked with the appropriate RHA designator. A dash (-) indicates a non-RHA device.

1.2.2 Device type(s). The device type(s) identify the circuit function as follows:

Device type	Generic number	Circuit function
01	RHD5920	Radiation hardened ,16 channel, analog multiplexer
02	RHD5921	Radiation hardened ,16 channel, analog voltage multiplexer buffered
03	RHD5922	Radiation hardened 16 channel, analog mutiplexer, sample-and-hold

1.2.3 Device class designator. This device class designator shall be a single letter identifying the product assurance level. All levels are defined by the requirements of MIL-PRF-38534 and require QML Certification as well as qualification (Class H, K, and E) or QML Listing (Class G and D). The product assurance levels are as follows:

Device class	Device performance documentation
K	Highest reliability class available. This level is intended for use in space applications.
H	Standard military quality class level. This level is intended for use in applications where non-space high reliability devices are required.
G	Reduced testing version of the standard military quality class. This level uses the Class H screening and In-Process Inspections with a possible limited temperature range, manufacturer specified incoming flow, and the manufacturer guarantees (but may not test) periodic and conformance inspections (Group A, B, C, and D).
E	Designates devices which are based upon one of the other classes (K, H, or G) with exception(s) taken to the requirements of that class. These exception(s) must be specified in the device acquisition document; therefore the acquisition document should be reviewed to ensure that the exception(s) taken will not adversely affect system performance.
D	Manufacturer specified quality class. Quality level is defined by the manufacturers internal, QML certified flow. This product may have a limited temperature range.

1.2.4 Case outline(s). The case outline(s) are as designated in MIL-STD-1835 and as follows:

Outline letter	Descriptive designator	Terminals	Package style
X	See figure 1	24	Ceramic quad flat pack

1.2.5 Lead finish. The lead finish shall be as specified in MIL-PRF-38534.

1.3 Absolute maximum ratings. 1/

Supply voltage (V_{CC})	+6.0 V dc
Digital input overvoltage range:	
V_{EN} , V_A (device types 01 and 02)	(< V_{CC} + .4)V, (> GND - .4)V
$V_{S\overline{H}}$ V_A (device type 03)	(< V_{CC} + .4)V, (> GND - .4)V
Analog input overvoltage range	(< V_{CC} + .4)V, (> GND - .4)V
Thermal resistance junction-to-case (θ_{JC})	5 °C/W
Storage temperature	-65°C to +150°C
Lead temperature (soldering, 10 seconds)	+300°C

1.4 Recommended operating conditions.

Supply voltage range (V_{CC})	+3.3 V to +5 V dc
Logic low level voltage :	
V_{EN},V_A (device types 01 and 02)	.3 V_{CC}
$V_{S\overline{H}}$,V_A (device type 03)	.3 V_{CC}
Logic high level voltage:	
V_{EN},V_A (device types 01 and 02)	.7 V_{CC}
$V_{S\overline{H}}$,V_A (device type 03)	.7 V_{CC}
Case operating temperature range (T_C)	-55°C to +125°C

1.5 Radiation features.

Maximum total dose available (dose rate = 50 - 300 rads(Si)/s):	
	1 Mrad(Si)
Enhanced Low Dose Rate Sensitvity (ELDRS)	Immuned
Single Event Latchup (SEL)	> 100 MeV-cm^2/mg 2/
Neutron irradiation	> 1 x 10^{14} neutrons/cm^2 3/

1/ Stresses above the absolute maximum ratings may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
2/ This limit is guaranteed by design or process, but not production tested unless otherwise specified by the customer through the purchase order or contract.
3/ Guaranteed, but not tested.

2. APPLICABLE DOCUMENTS

2.1 Government specification, standards, and handbooks. The following specification, standards, and handbooks form a part of this drawing to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-38534 - Hybrid Microcircuits, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1835 - Interface Standard Electronic Component Case Outlines.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-103 - List of Standard Microcircuit Drawings.
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Item requirements. The individual item performance requirements for device classes D, E, G, H, and K shall be in accordance with MIL-PRF-38534. Compliance with MIL-PRF-38534 shall include the performance of all tests herein or as designated in the device manufacturer's Quality Management (QM) plan or as designated for the applicable device class. The manufacturer may eliminate, modify or optimize the tests and inspections herein, however the performance requirements as defined in MIL-PRF-38534 shall be met for the applicable device class. In addition, the modification in the QM plan shall not affect the form, fit, or function of the device for the applicable device class.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38534 and herein.

3.2.1 Case outline(s). The case outline(s) shall be in accordance with 1.2.4 herein and figure 1.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 2.

3.2.3 Truth table(s). The truth table(s) shall be as specified on figure 3.

3.2.4 Switching test waveform(s). The switching test waveform(s) shall be as specified on figure 4.

3.2.5 Block diagram. The block diagram(s) shall be as specified on figure 5.

3.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table I and shall apply over the full specified operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are defined in table I.

3.5 Marking of device(s). Marking of device(s) shall be in accordance with MIL-PRF-38534. The device shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's vendor similar PIN may also be marked.

3.6 Data. In addition to the general performance requirements of MIL-PRF-38534, the manufacturer of the device described herein shall maintain the electrical test data (variables format) from the initial quality conformance inspection group A lot sample, for each device type listed herein. Also, the data should include a summary of all parameters manually tested, and for those which, if any, are guaranteed. This data shall be maintained under document revision level control by the manufacturer and be made available to the preparing activity (DLA Land and Maritime -VA) upon request.

3.7 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to supply to this drawing. The certificate of compliance (original copy) submitted to DLA Land and Maritime -VA shall affirm that the manufacturer's product meets the performance requirements of MIL-PRF-38534 and herein.

3.8 Certificate of conformance. A certificate of conformance as required in MIL-PRF-38534 shall be provided with each lot of microcircuits delivered to this drawing.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ 2/ $-55°C \le T_C \le +125°C$ V_{CC} = +5 V unless otherwise specified	Group A subgroups	Device types	Limits		Unit
					Min	Max	
Supply currents	$+I_{CC}$	$\overline{EN}$ = .3 V_{CC}	1,2,3	01	0	10	µA
				02	0.5	2	mA
				03	10	100	µA
	$+I_{SBY}$	$\overline{EN}$ = .7 V_{CC}	1,2,3	01	0	10	µA
				02	10	100	
Address input currents	I_{AL}	V_A = .3 V_{CC}	1	All	-5	5	nA
			2	All	-50	50	
	I_{AH}	V_A = .7 V_{CC}	1	All	-5	5	nA
			2	All	-50	50	
Enable input current	I_{ENL}	V_{EN} = .3 V_{CC}	1	01,02	-5	5	nA
			2		-50	50	
	I_{ENH}	V_{EN} = .7 V_{CC}	1	01,02	-5	5	nA
			2		-50	50	
Sample -and-Hold input current	$I_{S\overline{H}}$	$V_{S\overline{H}}$ = .3 V_{CC}	1	03	-5	5	nA
			2		-50	50	
		$V_{S\overline{H}}$ = .7 V_{CC}	1		-5	5	
			2		-50	50	
Input leakage current (CH0 - CH15)	I_{INLK5}	V_{IN} = +5 V, V_{EN} = .7 V_{CC}, output and all unused MUX inputs under test = +0 V	1	01,02	-5	5	nA
			2		-50	50	
		V_{IN} = +5 V,$V_{S\overline{H}}$ = .7 V_{CC}	1	03	-5	5	
			2		-50	50	
	I_{INLK0}	V_{IN} = +5 V, V_{EN} = .7 V_{CC}, output and all unused MUX inputs under test = +5 V	1	01	-5	5	nA
			2		-50	50	

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ 2/ $-55°C \le T_C \le +125°C$ V_{CC} = +5 V unless otherwise specified	Group A subgroups	Device types	Limits		Unit
					Min	Max	
Output leakge current	I_{OUTLK}	V_{IN} = +5 V, V_{EN} = .7 V_{CC}, All inputs grounded except channel being tested	1	01	-5	5	nA
			2		-50	50	
		Tri-state, V_{EN} > .7 V_{CC}	1	02	-5	5	
			2		-20	20	
Output on voltage	V_{ON1}	V_{IN} = +5 V, R_L = 10 kΩ	1,2,3	02,03	4.9	5.1	V
	V_{ON2}	V_{IN} = +5 V, R_L = 1 kΩ			4.35	4.65	
	V_{ON3}	V_{IN} = +3.3 V, R_L = 10 kΩ			3.2	3.4	
Input load capacitance	C_{IN}		1,2,3	03		35	pF
Switch ON resistance	R_{DSON}	V_{IN} = 0 V, +2.5 V, +5 V, V_{EN} = .3 V_{CC}, I_{OUT} = -1 mA	1	01		750	Ω
			2			1000	
			3			500	
Address to output delay	t_AHL	R_L = 10 kΩ, C_L = 50 pF, See figure 4	9,11	01	10	150	ns
			10		10	200	
			9,10,11	02,03	1	5	µs
	t_ALH	R_L = 10 kΩ, C_L = 50 pF, See figure 4	9,11	01	10	150	ns
			10		10	200	
			9,10,11	02,03	1	5	µs
	$t_{ON}EN$	R_L = 1 kΩ, C_L = 50 pF, See figure 4	9,11	01	10	150	ns
			10		10	200	
			9,10,11	02	.8	2.5	µs
	$t_{OFF}EN$	R_L = 1 kΩ, C_L = 50 pF, See figure 4	9,10,11	01	10	200	ns
				02	100	350	
Droop rate	D_R	R_L = 1 kΩ, C_L = 50 pF, See figure 4	9,10,11	03		0.1	V/s
Data setup time	t_{DS}	R_L = 1 kΩ, C_L = 50 pF, See figure 4	9,10,11	03	150		ns
Data hold time	t_{DH}	R_L = 1 kΩ, C_L = 50 pF, See figure 4	9,10,11	03	150		ns
Output slew rate	t_S		9,10,11	02	1.8	4	V/µs

See footnotes at top of next page.

TABLE I. Electrical performance characteristics - Continued.

1/ These devices have been characterized at level H of irradiation. Pre and post irradiation values meet the limits as specified in table I. When performing post irradiation electrical measurements for any RHA level, T_C = +25°C.

2/ For radiation features see paragraph 1.5 herein.

Case outline X.

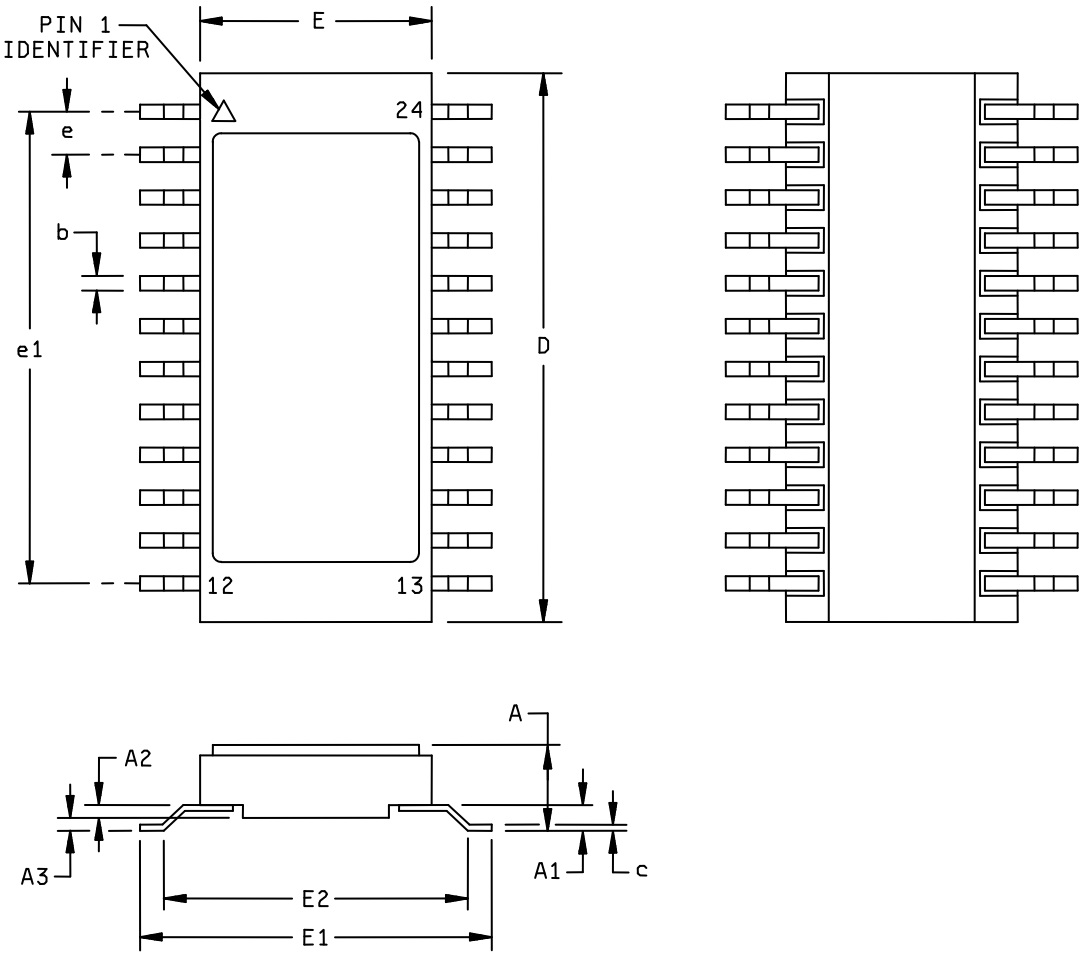


FIGURE 1. Case outline(s).

Case outline X - Continued.

Symbol	Inches		Millimeters	
	Min	Max	Min	Max
A	.049	.061	1.24	1.55
A1	.030 REF		.76 REF	
A2	.017	.027	.43	.69
A3		.012		.30
b	.015	.019	.38	.48
c	.0068	.0092	.173	.234
D	.598	.614	15.19	15.60
e	.050 BSC		1.27 BSC	
e1	.544	.556	13.82	14.12
E	.287	.299	7.29	7.59
E1	.394	.419	10.01	10.64
E2	.354 REF		8.99 REF	

NOTES:
1. The U.S. preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. The package and lid are electrically isolated from signal pads.

FIGURE 1. Case outline - Continued.

Device types	01and 02	03
Case outlines	X	
Terminal number	Terminal symbol	Terminal symbol
1	V_{OUT}	V_{OUT}
2	CH15	CH15
3	CH14	CH14
4	CH13	CH13
5	CH12	CH12
6	CH11	CH11
7	CH10	CH10
8	CH9	CH9
9	CH8	CH8
10	A3	A3
11	A2	A2
12	GND	GND
13	A1	A1
14	A0	A0
15	$\overline{EN}$	S/$\overline{H}$
16	CH0	CH0
17	CH1	CH1
18	CH2	CH2
19	CH3	CH3
20	CH4	CH4
21	CH5	CH5
22	CH6	CH6
23	CH7	CH7
24	V_{CC}	V_{CC}

FIGURE 2. Terminal connections.

Truth table (CH0-CH15)					
A3	A2	A1	A0	$\overline{EN}$ 1/	"ON" Channel 2/
X	X	X	X	H	None 1/
L	L	L	L	L	CH0
L	L	L	H	L	CH1
L	L	H	L	L	CH2
L	L	H	H	L	CH3
L	H	L	L	L	CH4
L	H	L	H	L	CH5
L	H	H	L	L	CH6
L	H	H	H	L	CH7
H	L	L	L	L	CH8
H	L	L	H	L	CH9
H	L	H	L	L	CH10
H	L	H	H	L	CH11
H	H	L	L	L	CH12
H	H	L	H	L	CH13
H	H	H	L	L	CH14
H	H	H	H	L	CH15

1/ For device types 01 and 02 only.
2/ Between (CH0-CH15) and V_{out}.

FIGURE 3. Truth table.

DEVICE TYPE 01

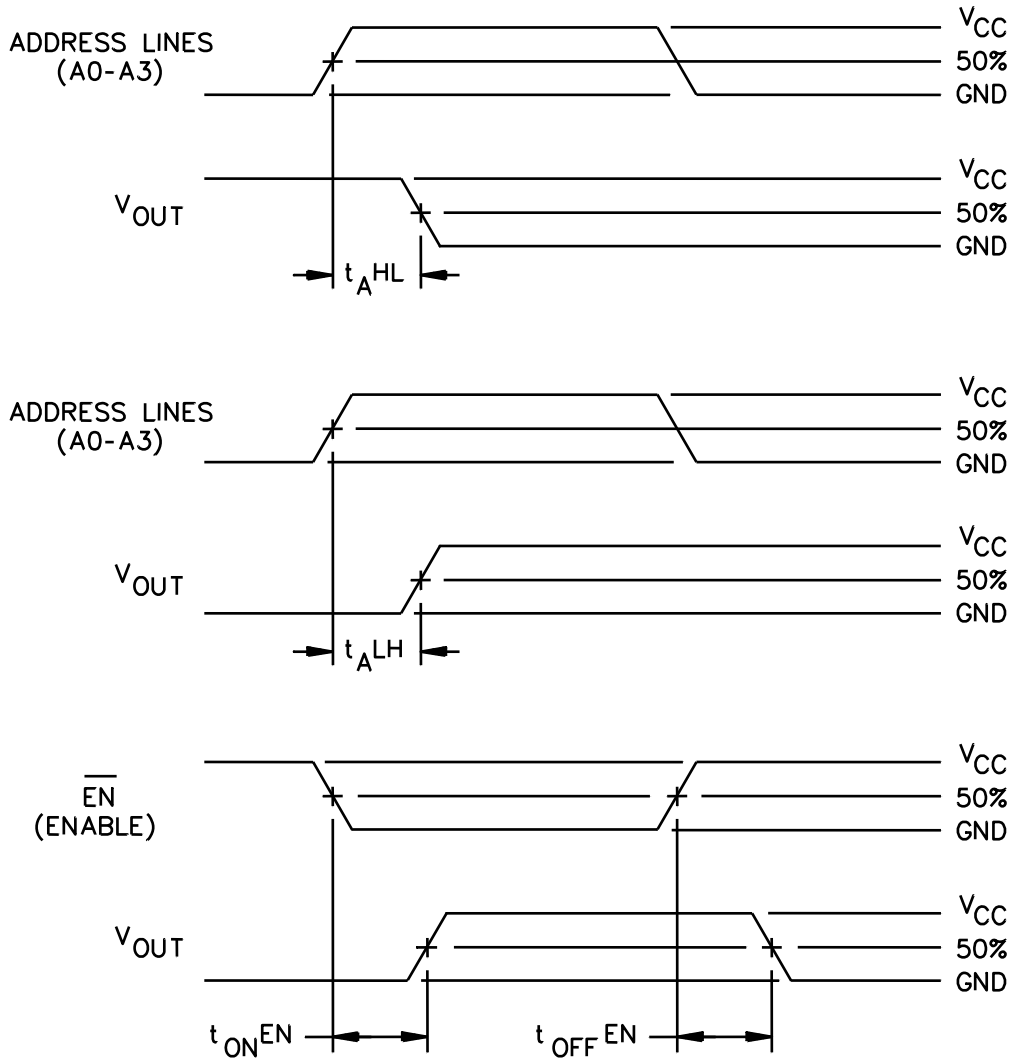


FIGURE 4. Switching test waveform(s).

DEVICE TYPE 02

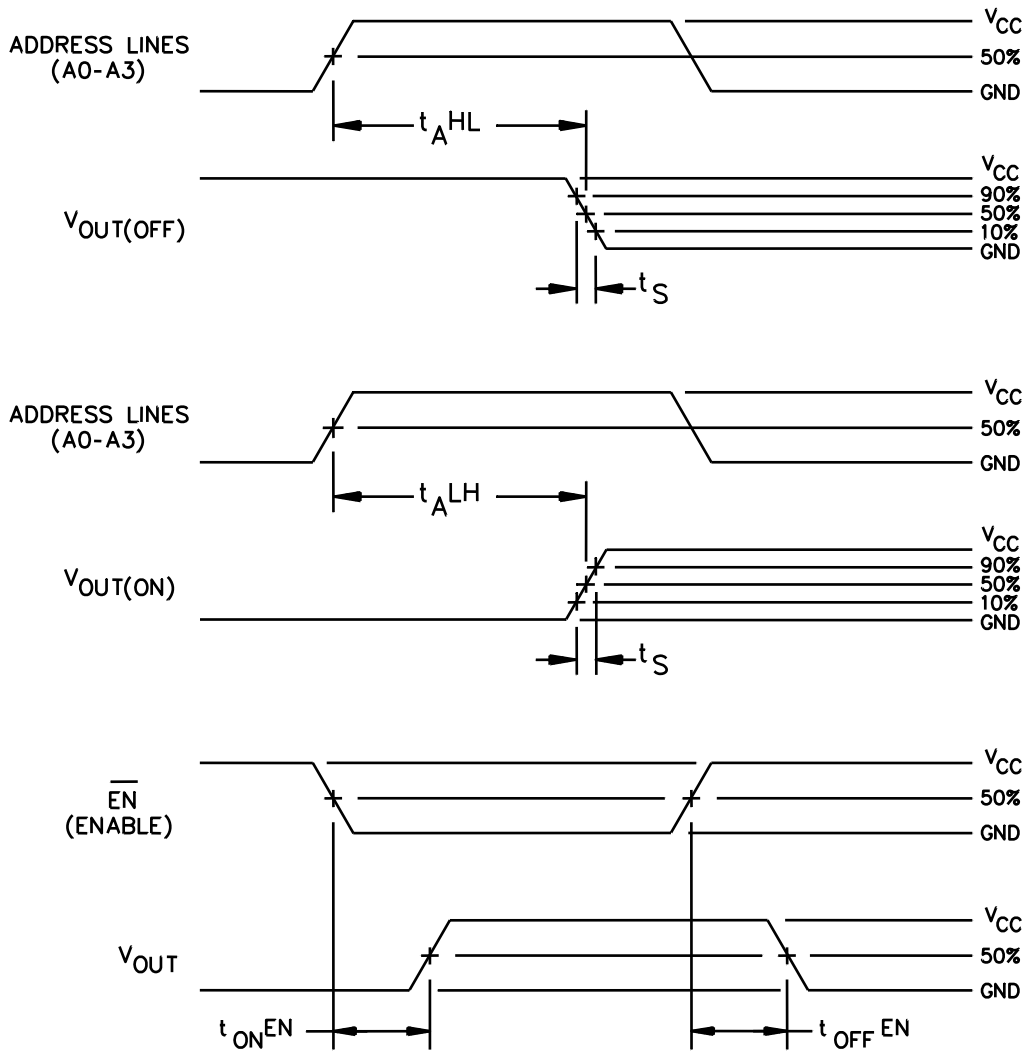


FIGURE 4. Switching test waveform(s) - Continued.

DEVICE TYPE 03

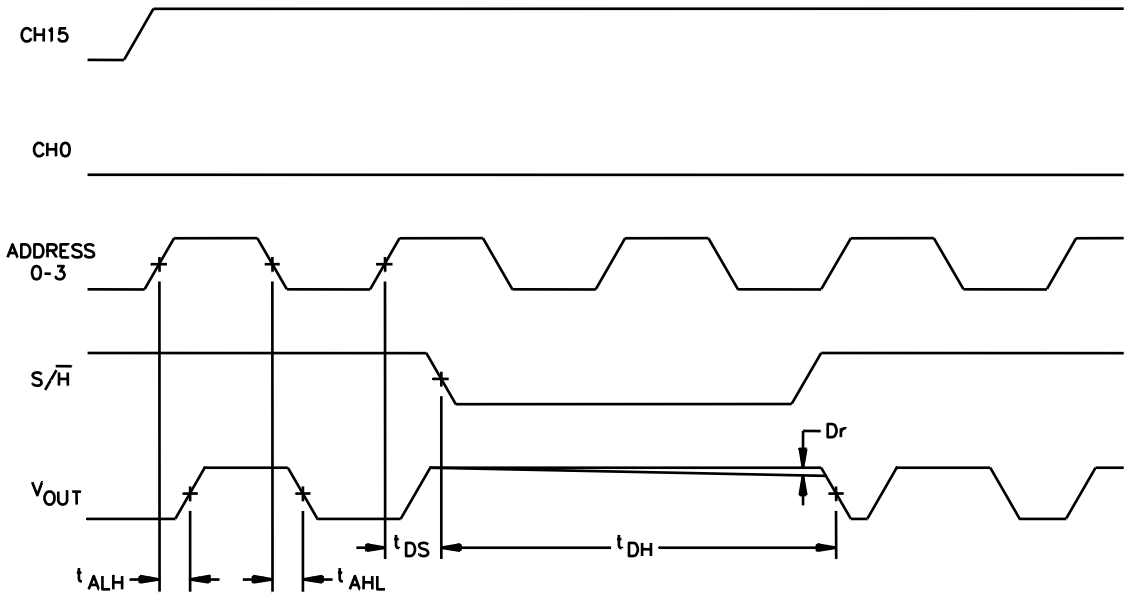
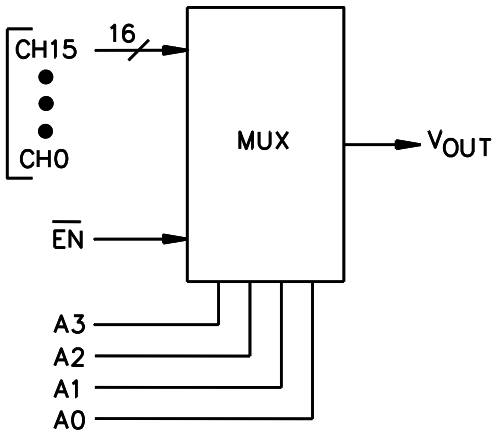


FIGURE 4. Switching test waveform(s) - Continued.

DEVICE TYPE 01



DEVICE TYPE 02

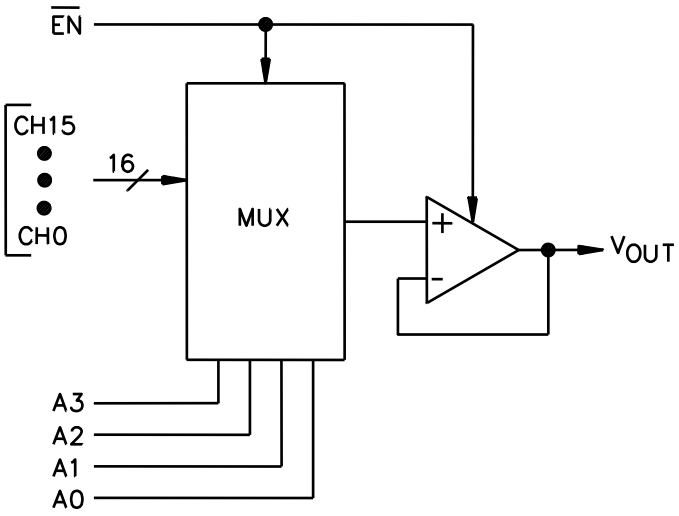


FIGURE 5. Block Diagram.

DEVICE TYPE 03

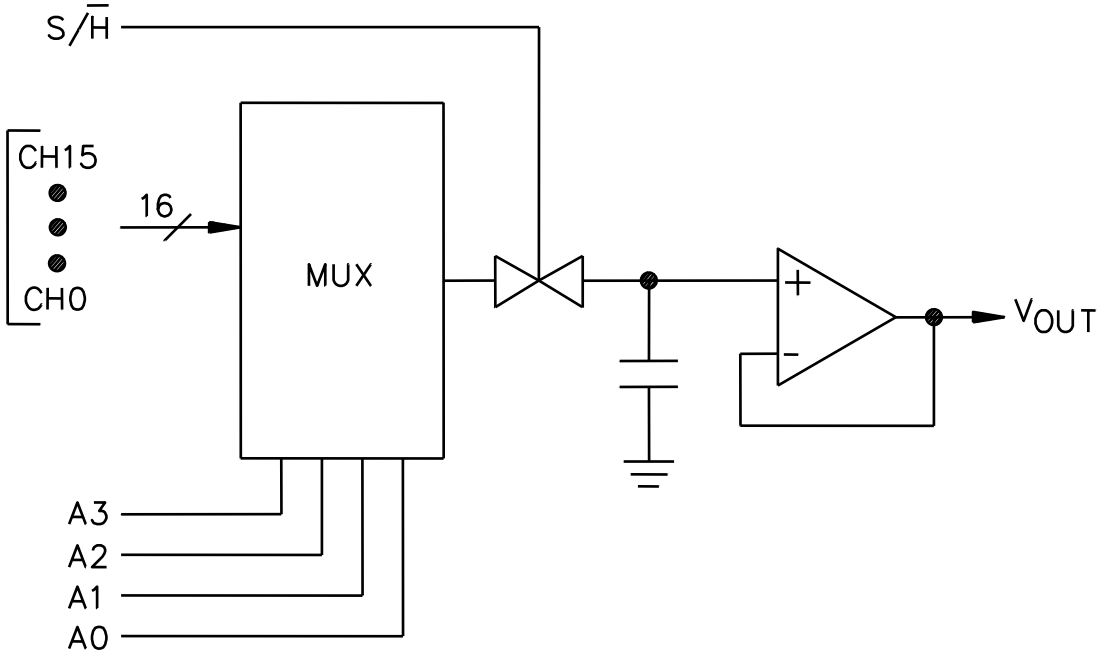


FIGURE 5. Block diagram - Continued.

TABLE II. Electrical test requirements.

MIL-PRF-38534 test requirements	Subgroups (in accordance with MIL-PRF-38534, group A test table)
Interim electrical parameters	1,9
Final electrical parameters	1*,2,3,9,10,11
Group A test requirements	1,2,3,9,10,11
Group C end-point electrical parameters	1,2,3,9,10,11
End-point electrical parameters for radiation hardness assurance (RHA) devices	1

* PDA applies to subgroup 1.

4. VERIFICATION

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38534 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38534. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1015 of MIL-STD-883.

b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 Conformance and periodic inspections. Conformance inspection (CI) and periodic inspection (PI) shall be in accordance with MIL-PRF-38534 and as specified herein.

4.3.1 Group A inspection (CI). Group A inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. Tests shall be as specified in table II herein.

b. Subgroups 4, 5, 6, 7, and 8 shall be omitted.

4.3.2 Group B inspection (PI). Group B inspection shall be in accordance with MIL-PRF-38534.

4.3.3 Group C inspection (PI). Group C inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. End-point electrical parameters shall be as specified in table II herein.

b. Steady-state life test, method 1005 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1005 of MIL-STD-883.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

4.3.4 Group D inspection (PI). Group D inspection shall be in accordance with MIL-PRF-38534.

4.3.5 Radiation Hardness Assurance (RHA) inspection. RHA qualification is required for those devices with the RHA designator as specified herein. End-point electrical parameters for radiation hardness assurance (RHA) devices shall be specified in table II. Radiation testing will be in accordance with the qualifying activity (DLA Land and Maritime -VQ) approved plan and with MIL-PRF-38534, Appendix G.

4.3.5.1 Total dose irradiation testing. Total dose irradiation testing shall be in accordance with MIL-STD-883 method 1019, condition A and as specified herein. Sample testing in accordance with table I shall be performed on a representative device type (similar device) at initial qualification and after any design or process changes which may affect the RHA response. Sample size is a minimum of 8 devices (4 biased and 4 not biased). This sample testing is repeated for each new combination for wafers of active elements on the most complex device.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38534.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

6.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated as specified in MIL-PRF-38534.

6.4 Record of users. Military and industrial users shall inform DLA Land and Maritime when a system application requires configuration control and the applicable SMD. DLA Land and Maritime will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronic devices (FSC 5962) should contact DLA Land and Maritime -VA, telephone (614) 692-0544.

6.5 Comments. Comments on this drawing should be directed to DLA Land and Maritime -VA, Columbus, Ohio 43218-3990, or telephone (614) 692-1081.

6.6 Sources of supply. Sources of supply are listed in MIL-HDBK-103 and QML-38534. The vendors listed in MIL-HDBK-103 and QML-38534 have submitted a certificate of compliance (see 3.7 herein) to DSCC-VA and have agreed to this drawing.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE:

Approved sources of supply for SMD 5962-10243 are listed below for immediate acquisition information only and shall be added to MIL-HDBK-103 and QML-38534 during the next revisions. MIL-HDBK-103 and QML-38534 will be revised to include the addition or deletion of sources. The vendors listed below have agreed to this drawing and a certificate of compliance has been submitted to and accepted by DLA Land and Maritime -VA. This information bulletin is superseded by the next dated revisions of MIL-HDBK-103 and QML-38534. DLA Land and Maritime maintains an online database of all current sources of supply at http://www.dscc.dla.mil/Programs/Smcr/.

Standard microcircuit drawing PIN 1/	Vendor CAGE	Vendor similar PIN 2/
5962-1024301KXA	88379	RHD5920-201-2S
5962H1024301KXA	88379	RHD5920-901-2S
5962-1024301KXC	88379	RHD5920-201-1S
5962H1024301KXC	88379	RHD5920-901-1S
5962-1024302KXA	88379	RHD5921-201-2S
5962H1024302KXA	88379	RHD5921-201-2S
5962-1024302KXC	88379	RHD5921-201-1S
5962H1024302KXC	88379	RHD5921-201-1S
5962-1024303KXA	88379	RHD5922-201-2S
5962H1024303KXA	88379	RHD5922-201-2S
5962-1024303KXC	88379	RHD5922-201-1S
5962H1024303KXC	88379	RHD5922-201-1S

1/ The lead finish shown for each PIN representing a hermetic package is the most readily available from the manufacturer listed for that part. If the desired lead finish is not listed contact the Vendor to determine its availability.

2/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.

Vendor CAGE number	Vendor name and address
88379	Aeroflex Plainview Incorporated, (Aeroflex Microelectronics Solutions) 35 South Service Road Plainview, NY 11803-4193

REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

"Preliminary Draft 12/02/2011"

Return to
Selection Guide

REV																			
SHEET																			
REV																			
SHEET																			

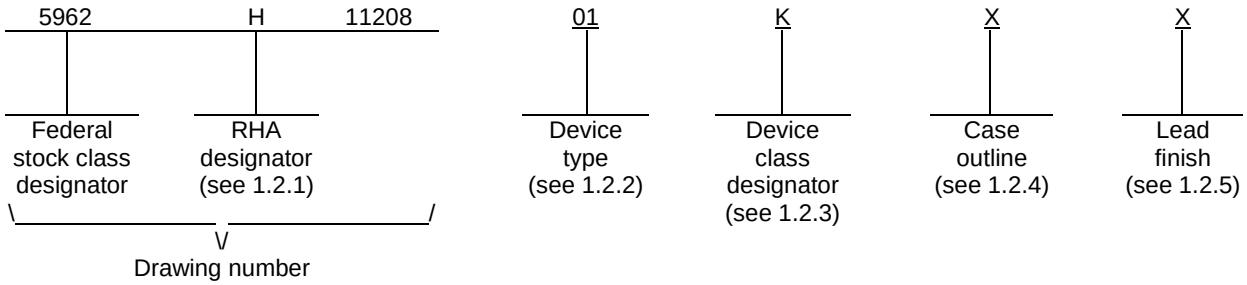
REV STATUS	REV														
OF SHEETS	SHEET	1	2	3	4	5	6	7	8	9	10	11			

PMIC N/A	PREPARED BY	**DLA LAND AND MARITIME** **COLUMBUS, OHIO 43218-3990** http://www.landandmaritime.dla.mil/
STANDARD MICROCIRCUIT DRAWING THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE AMSC N/A	CHECKED BY	
	APPROVED BY	**MICROCIRCUIT, HYBRID, LINEAR, 11-BIT, DIGITAL TO ANALOG CONVERTER, CMOS**
	DRAWING APPROVAL DATE	
	REVISION LEVEL	SIZE: A; CAGE CODE: **67268**; **5962-11208**
		SHEET 1 OF 11

1. SCOPE

1.1 Scope. This drawing documents five product assurance classes as defined in paragraph 1.2.3 and MIL-PRF-38534. A choice of case outlines and lead finishes which are available and are reflected in the Part or Identifying Number (PIN). When available, a choice of radiation hardness assurance levels are reflected in the PIN.

1.2 PIN. The PIN shall be as shown in the following example:



1.2.1 Radiation hardness assurance (RHA) designator. RHA marked devices shall meet the MIL-PRF-38534 specified RHA levels and shall be marked with the appropriate RHA designator. A dash (-) indicates a non-RHA device.

1.2.2 Device type(s). The device type(s) identify the circuit function as follows:

Device type	Generic number	Circuit function
01	RHD5930	Digital-to-Analog converter,11-bit, Ladder output
02	RHD5931	Digital-to-Analog converter,11-bit, Buffered output

1.2.3 Device class designator. This device class designator shall be a single letter identifying the product assurance level. All levels are defined by the requirements of MIL-PRF-38534 and require QML Certification as well as qualification (Class H, K, and E) or QML Listing (Class G and D). The product assurance levels are as follows:

Device class	Device performance documentation
K	Highest reliability class available. This level is intended for use in space applications.
H	Standard military quality class level. This level is intended for use in applications where non-space high reliability devices are required.
G	Reduced testing version of the standard military quality class. This level uses the Class H screening and In-Process Inspections with a possible limited temperature range, manufacturer specified incoming flow, and the manufacturer guarantees (but may not test) periodic and conformance inspections (Group A, B, C and D).
E	Designates devices which are based upon one of the other classes (K, H, or G) with exception(s) taken to the requirements of that class. These exception(s) must be specified in the device acquisition document; therefore the acquisition document should be reviewed to ensure that the exception(s) taken will not adversely affect system performance.
D	Manufacturer specified quality class. Quality level is defined by the manufacturers internal, QML certified flow. This product may have a limited temperature range.

1.2.4 Case outline(s). The case outline(s) are as designated in MIL-STD-1835 and as follows:

Outline letter	Descriptive designator	Terminals	Package style
X	See figure 1	16	Flat package with formed leads

1.2.5 Lead finish. The lead finish shall be as specified in MIL-PRF-38534.

1.3 Absolute maximum ratings. 1/

Supply voltage (V_{CC})	+6.0 V dc
Input voltage (V_{IN}) range	V_{CC} +0.4 V, GND -0.4 V
PREF relative to NREF	+6.0 V
Junction temperature (T_J)	+150°C
Power at +25°C	250 mW
Thermal resistance, junction-to-case (θ_{JC})	10°C/W
Storage temperature range	-65°C to +150°C
Lead temperature (soldering, 10 seconds)	+300°C

1.4 Recommended operating conditions.

Supply voltage range (V_{CC})	+3.3 V dc to +5.0 V dc
Case operating temperature range (T_C)	-55°C to +125°C

1.5 Radiation features.

Maximum total dose available (dose rate = 50 - 300 rads(Si)/s):	
	1 Mrads(Si)
Enhanced Low Dose Rate Sensitvity (ELDRS)	CMOS Immune
Single Event Latchup (SEL)	> 100 MeV-cm^2/mg 2/
Neutron Displacement Damage	> 1 x 10^{14} neutrons/cm^2 2/

2. APPLICABLE DOCUMENTS

2.1 Government specification, standards, and handbooks. The following specification, standards, and handbooks form a part of this drawing to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-38534 - Hybrid Microcircuits, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1835 - Interface Standard for Electronic Component Case Outlines.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-103 - List of Standard Microcircuit Drawings.
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

_____

1/ Stresses above the absolute maximum ratings may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
2/ This limit is guaranteed by design or process, but not production tested.

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Item requirements. The individual item performance requirements for device classes D, E, G, H, and K shall be in accordance with MIL-PRF-38534. Compliance with MIL-PRF-38534 shall include the performance of all tests herein or as designated in the device manufacturer's Quality Management (QM) plan or as designated for the applicable device class. The manufacturer may eliminate, modify or optimize the tests and inspections herein, however the performance requirements as defined in MIL-PRF-38534 shall be met for the applicable device class. In addition, the modification in the QM plan shall not affect the form, fit, or function of the device for the applicable device class.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38534 and herein.

3.2.1 Case outline(s). The case outline(s) shall be in accordance with 1.2.4 herein and figure 1.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 2.

3.2.3 Radiation exposure circuits. The radiation exposure circuits shall be as specified on figure 3.

3.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table I and shall apply over the full specified operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are defined in table I.

3.5 Marking of device(s). Marking of device(s) shall be in accordance with MIL-PRF-38534. The device shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's vendor similar PIN may also be marked.

3.6 Data. In addition to the general performance requirements of MIL-PRF-38534, the manufacturer of the device described herein shall maintain the electrical test data (variables format) from the initial quality conformance inspection group A lot sample, for each device type listed herein. Also, the data should include a summary of all parameters manually tested, and for those which, if any, are guaranteed. This data shall be maintained under document revision level control by the manufacturer and be made available to the preparing activity (DLA Land and Maritime -VA) upon request.

3.7 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to supply to this drawing. The certificate of compliance (original copy) submitted to DLA Land and Maritime -VA shall affirm that the manufacturer's product meets the performance requirements of MIL-PRF-38534 and herein.

3.8 Certificate of conformance. A certificate of conformance as required in MIL-PRF-38534 shall be provided with each lot of microcircuits delivered to this drawing.

4. VERIFICATION

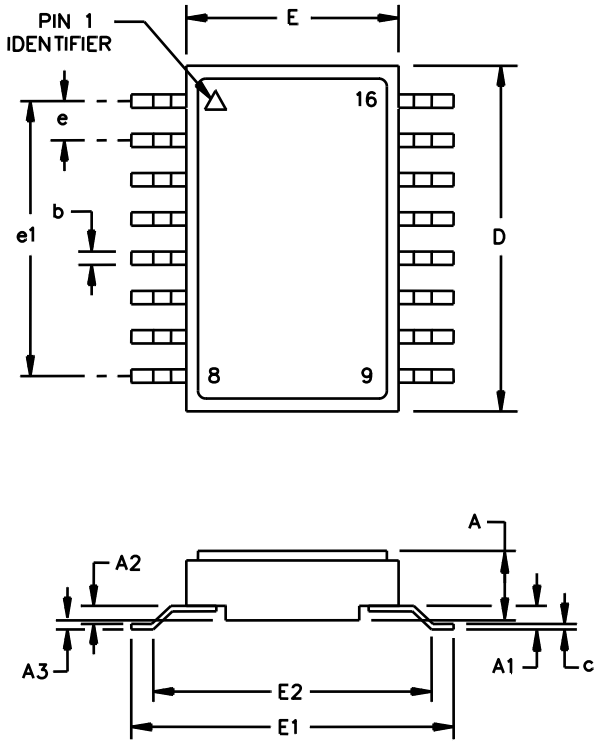
4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38534 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ 2/ $-55°C \le T_C \le +125°C$ $V_{CC} = +5.0$ V unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Resolution	N		1,2,3	01,02		11	Bits
Relative accuracy	R_A		1,2,3	01,02		0.25	% of FSR
Gain error	A_E		1,2,3	01,02		0.1	% of FSR
Output leakage	I_{OL}		1,2,3	01,02			nA
Output settling time	T_D		1,2,3	01,02		100	ns
PREF input Z	Z_P		1,2,3	01,02		5	kΩ
NREF input Z	Z_R		1,2,3	01,02		5	kΩ
Input high voltage	V_{IH}		1,2,3	01,02	2		V
Input low voltage	V_{IL}		1,2,3	01,02		0.8	V
Input leakge	I_{II}, I_{IH}		1,2,3	01,02		100	pA

1/ These devices have been tested to the requirements of RHA designator level "H". Specification derated to reflect high dose rate (Method 1019, condition A of MIL-STD-883) to 100 Krad(Si) at +25°C.
2/ For radiation features see paragraph 1.5 herein.

Case X.



Symbol	Inches		Millimeters	
	Min	Max	Min	Max
A		.120		3.08
A1	.030 REF		0.76 REF	
A2	.017	.027	0.43	0.69
A3		.012		0.30
b	.015	.019	0.38	0.48
c	.007	.009	0.18	0.23
D		.417		15.60
e	.050 BSC		1.27 BSC	
e1	.350 BSC		8.90 BSC	
E		.300		7.62
E1	.394	.419	10.01	10.64
E2	.346 REF		8.79 REF	

NOTE:
1. The U.S. preferred system of measurement is the metric SI. This item was designed using inch-pound units of measurement. In case of problems involving conflicts between the metric and inch-pound units, the inch-pound units shall rule.
2. The package and lid are electrically isolated from signal pads.

FIGURE 1. Case outline.

Device types	01	02
Case outline	X	
Terminal number	Terminal symbol	
1	PREF	PREF
2	NREF	NREF
3	GND	GND
4	D10 (MSB)	D10 (MSB)
5	D09	D09
6	D08	D08
7	D07	D07
8	D06	D06
9	D05	D05
10	D04	D04
11	D03	D03
12	D02	D02
13	D01	D01
14	D00 (LSB)	D00 (LSB)
15	V_{CC}	V_{CC}
16	AOUT	AOUT (Buffered)

FIGURE 2. Terminal connections.

FIGURE 3. Radiation exposure circuit(s).

TABLE II. Electrical test requirements.

MIL-PRF-38534 test requirements	Subgroups (in accordance with MIL-PRF-38534, group A test table)
Interim electrical parameters	1, 2, 3
Final electrical parameters	1*, 2, 3
Group A test requirements	1, 2, 3
Group C end-point electrical parameters	1, 2, 3
End-point electrical parameters for Radiation Hardness Assurance (RHA) devices	1

* PDA applies to subgroup 1.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38534. The following additional criteria shall apply:

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1015 of MIL-STD-883.

b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 Conformance and periodic inspections. Conformance inspection (CI) and periodic inspection (PI) shall be in accordance with MIL-PRF-38534 and as specified herein.

4.3.1 Group A inspection (CI). Group A inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. Tests shall be as specified in table II herein.

b. Subgroups 4, 5, 6, 7, 8A, 8B, 9, 10, and 11 shall be omitted.

4.3.2 Group B inspection (PI). Group B inspection shall be in accordance with MIL-PRF-38534.

4.3.3 Group C inspection (PI). Group C inspection shall be in accordance with MIL-PRF-38534 and as follows:

a. End-point electrical parameters shall be as specified in table II herein.

b. Steady-state life test, method 1005 of MIL-STD-883.

(1) Test condition A, B, C, or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to either DLA Land and Maritime -VA or the acquiring activity upon request. Also, the test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1005 of MIL-STD-883.

(2) T_A as specified in accordance with table I of method 1005 of MIL-STD-883.

(3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

4.3.4 Group D inspection (PI). Group D inspection shall be in accordance with MIL-PRF-38534.

4.3.5. Radiation hardness assurance (RHA). RHA qualification is required only for those devices with the RHA designator as specified herein. See table IIIA and table IIIB.

Table IIIA. Radiation Hardness Assurance Method Table.

RHA method employed	**Testing at 2X rated total dose**		**Worst Case Analysis Performed No**				**End points after dose is achieved includes minimum maximum, and room temperatures**	
	Element Level	Hybrid Device Level	Includes temperature effects	Combines temperature and radiation effects	Combines total dose and displacement effects	End-of-life	Element Level	Hybrid device level
	No	Yes	N/A	N/A	N/A	N/A	No	N/A

Table IIIB. Hybrid level and element level test table.

	Radiation Test								
	Total Dose			**Heavy Ion**		**Proton**		**Neutron**	
	Low Dose Rate	High Dose Rate (HDR)	ELDRS	SEU (upset)	SEL (latch-up)	Low Energy	High Energy	SEE (upset)	Displacement Damage (DD)
CMOS IC	N/A	X (1 Mrad)	G	(N)	G	(N)	(N)	(N)	G

NOTES:
X = Radiation testing done (Level)
G = Guaranteed by design or process.
(N) = Not yet tested
N/A = Not applicable for this SMD

4.3.5.1 Radiation Hardness Assurance (RHA) inspection. RHA qualification is required for those devices with the RHA designator as specified herein. End-point electrical parameters for radiation hardness assurance (RHA) devices shall be specified in table II. Radiation testing will be in accordance with the qualifying activity (DLA Land and Maritime -VQ) approved plan and with MIL-PRF-38534, Appendix G.

a. The hybrid device manufacturer shall establish procedures controlling component radiation testing, and shall establish radiation test plans used to implement component lot qualification during procurement. Test plans and test reports shall be filed and controlled in accordance with the manufacturer's configuration management system.

b. The hybrid device manufacturer shall designate a RHA program manager to oversee component lot qualification, and to monitor design changes for continued compliance to RHA requirements.

4.3.5.1.1 Hybrid level qualification.

4.3.5.1.1.1 Qualification by similarity. A family is defined by the family model designator e.g. RHD. All parts with this designator share a common design and use the same active element. Device type 5962H1120801KXC was tested and all other devices on this SMD are qualified by similarity.

4.3.5.1.1.2 Total dose irradiation testing. A minimum of eight samples for one representative of this hybrid device is tested at initial qualification and after any design or process changes which may affect the RHA response of the device type. Four biased and four unbiased are tested at High Dose Rate (HDR) in accordance with condition A of method 1019 of MIL-STD-883 to 100 krad(Si).

4.3.5.1.2 Component level qualification.

4.3.5.1.2.1 Total Ionizing Dose Irradiation. Testing every initial wafer lot of this hybrid device will be tested at HDR in accordance with condition C (dose rate of 10-300 rad(Si)/s) of method 1019 of MIL-STD-883.

4.3.5.2 Lot Acceptance. Each lot of active elements shall be evaluated for acceptance in accordance with MIL-PRF-38534 and herein.

4.3.5.2.1 Total Ionizing Dose. Every wafer lot of this hybrid device will be RLAT (Radiation Lot Acceptance Testing) tested at HDR in accordance with condition C (dose rate of 10-300 rad(Si)/s) of method 1019 of MIL-STD-883. A minimum of 5 biased samples and 5 unbiased samples will be tested. 0.9900/90% statistics are applied to the device parameter degradations which are compared against established limits for lot acceptance.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38534.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

6.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated as specified in MIL-PRF-38534.

6.4 Record of users. Military and industrial users shall inform DLA Land and Maritime when a system application requires configuration control and the applicable SMD to that system. DLA Land and Maritime will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronic devices (FSC 5962) should contact DLA Land and Maritime-VA, telephone (614) 692-0547.

6.5 Comments. Comments on this drawing should be directed to DLA Land and Maritime-VA, Columbus, Ohio 43218-3990, or telephone (614) 692-1081.

6.6 Sources of supply. Sources of supply are listed in MIL-HDBK-103 and QML-38534. The vendors listed in MIL-HDBK-103 and QML-38534 have submitted a certificate of compliance (see 3.7 herein) to DLA Land and Maritime-VA and have agreed to this drawing.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE:

Approved sources of supply for SMD 5962-11208 are listed below for immediate acquisition information only and shall be added to MIL-HDBK-103 and QML-38534 during the next revisions. MIL-HDBK-103 and QML-38534 will be revised to include the addition or deletion of sources. The vendors listed below have agreed to this drawing and a certificate of compliance has been submitted to and accepted by DLA Land and Maritime -VA. This information bulletin is superseded by the next dated revisions of MIL-HDBK-103 and QML-38534. DLA Land and Maritime maintains an online database of all current sources of supply at http://www.landandmaritime.dla.mil/Programs/Smcr/.

Standard microcircuit drawing PIN 1/	Vendor CAGE number	Vendor similar PIN 2/
5962-1120801KXA	88379	RHD5930-201-2S
5962H1120801KXA	88379	RHD5930-901-2S
5962-1120801KXC	88379	RHD5930-201-1S
5962H1120801KXC	88379	RHD5930-901-1S
5962-1120802KXA	88379	RHD5931-201-2S
5962H1120802KXA	88379	RHD5931-901-2S
5962-1120802KXA	88379	RHD5931-201-1S
5962H1120802KXC	88379	RHD5931-901-1S

1/ The lead finish shown for each PIN representing a hermetic package is the most readily available from the manufacturer listed for that part. If the desired lead finish is not listed contact the Vendor to determine its availability.

2/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.

Vendor CAGE number	Vendor name and address
88379	Aeroflex Plainview Incorporated, (Aeroflex Microelectronics Solutions) 35 South Service Road Plainview, NY 11803

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