

Radiation Hardened, Dual, High Speed, Low Power Video Operational Amplifier with Output Disable

The HS-1245RH is a radiation hardened dual high speed, low power current feedback amplifier built with Intersil's proprietary complementary bipolar UHF-1 (DI bonded wafer) process. These devices are QML approved and are processed and screened in full compliance with MIL-PRF-38535.

This amplifier features individual TTL/CMOS compatible disable controls, which when pulled low, reduce the supply current and force the output into a high impedance state. This allows easy implementation of simple, low power video switching and routing systems. Component and composite video systems also benefit from this op amp's excellent gain flatness, and good differential gain and phase specifications. Multiplexed A/D applications will also find the HS-1245RH useful as the A/D driver/multiplexer.

Specifications for Rad Hard QML devices are controlled by the Defense Supply Center in Columbus (DSCC). The SMD numbers listed here must be used when ordering.

Detailed Electrical Specifications for these devices are contained in SMD 5962-96832. A "hot-link" is provided on our homepage for downloading.
www.intersil.com/spacedefense/space.asp

Ordering Information

ORDERING NUMBER	INTERNAL MKT. NUMBER	TEMP. RANGE (°C)
5962F9683201VCA	HS1-1245RH-Q	-55 to 125
5962F9683201VCC	HS1B-1245RH-Q	-55 to 125

Features

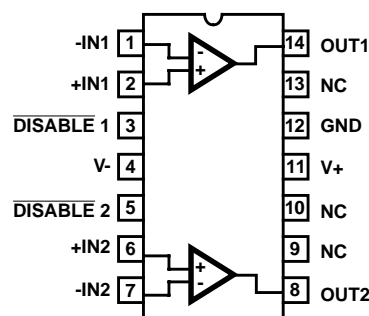
- Electrically Screened to SMD # 5962-96832
- QML Qualified per MIL-PRF-38535 Requirements
- MIL-PRF-38535 Class V Compliant
- Low Supply Current 5.9mA (Typ)
- Wide -3dB Bandwidth. 530MHz (Typ)
- High Slew Rate. 1050V/μs (Typ)
- Excellent Gain Flatness (to 50MHz). ±0.11dB (Typ)
- Excellent Differential Gain 0.02% (Typ)
- Excellent Differential Phase 0.03 Degree (Typ)
- High Output Current 60mA (Typ)
- Individual Output Enable/Disable
- Output Enable / Disable Time. 160ns/20ns (Typ)
- Total Gamma Dose. 300kRAD(Si)
- Latch Up. None (DI Technology)

Applications

- Multiplexed Flash A/D Driver
- RGB Multiplexers and Preamps
- Video Switching and Routing
- Pulse and Video Amplifiers
- Wideband Amplifiers
- Hand Held and Miniaturized RF Equipment
- Battery Powered Communications

Pinout

**HS-1245RH (CERDIP) GDIP1-T14
 OR
 HS-1245RH (SBDIP) CDIP2-T14
 TOP VIEW**



Application Information

Optimum Feedback Resistor

Although a current feedback amplifier's bandwidth dependency on closed loop gain isn't as severe as that of a voltage feedback amplifier, there can be an appreciable decrease in bandwidth at higher gains. This decrease may be minimized by taking advantage of the current feedback amplifier's unique relationship between bandwidth and R_F . All current feedback amplifiers require a feedback resistor, even for unity gain applications, and R_F , in conjunction with the internal compensation capacitor, sets the dominant pole of the frequency response. Thus, the amplifier's bandwidth is inversely proportional to R_F . The HS-1245RH design is optimized for a 560Ω R_F at a gain of +2. Decreasing R_F decreases stability, resulting in excessive peaking and overshoot (Note: Capacitive feedback will cause the same problems due to the feedback impedance decrease at higher frequencies). At higher gains the amplifier is more stable, so R_F can be decreased in a trade-off of stability for bandwidth.

The table below lists recommended R_F values for various gains, and the expected bandwidth. For good channel-to-channel gain matching, it is recommended that all resistors (termination as well as gain setting) be $\pm 1\%$ tolerance or better. Note that a series input resistor, on +IN, is required for a gain of +1, to reduce gain peaking and increase stability.

GAIN (A_{CL})	R_F (Ω)	BANDWIDTH (MHz)
-1	510	230
+1	560 (+ $R_S = 560\Omega$)	290
+2	560	530

Non-Inverting Input Source Impedance

For best operation, the D.C. source impedance looking out of the non-inverting input should be $\geq 50\Omega$. This is especially important in inverting gain configurations where the non-inverting input would normally be connected directly to GND.

Optional GND Pin for TTL Compatibility

The HS-1245RH derives an internal GND reference for the digital circuitry as long as the power supplies are symmetrical about GND. The GND reference is used to ensure the TTL compatibility of the $\overline{DISABLE}$ inputs. With symmetrical supplies the GND pin (Pin 12) may be floated, or connected directly to GND. If asymmetrical supplies (e.g. +10V, 0V) are utilized, and TTL compatibility is desired, the GND pin must be connected to GND.

PC Board Layout

The frequency response of this amplifier depends greatly on the amount of care taken in designing the PC board. **The use of low inductance components such as chip resistors and chip capacitors is strongly recommended, while a solid ground plane is a must!**

Attention should be given to decoupling the power supplies. A large value ($10\mu F$) tantalum in parallel with a small value ($0.1\mu F$) chip capacitor works well in most cases.

Terminated microstrip signal lines are recommended at the input and output of the device. Capacitance directly on the output must be minimized, or isolated as discussed in the next section.

Care must also be taken to minimize the capacitance to ground seen by the amplifier's inverting input (-IN). The larger this capacitance, the worse the gain peaking, resulting in pulse overshoot and possible instability. To this end, it is recommended that the ground plane be removed under traces connected to -IN, and connections to -IN should be kept as short as possible.

Driving Capacitive Loads

Capacitive loads, such as an A/D input, or an improperly terminated transmission line will degrade the amplifier's phase margin resulting in frequency response peaking and possible oscillations. In most cases, the oscillation can be avoided by placing a resistor (R_S) in series with the output prior to the capacitance.

Figure 1 details starting points for the selection of this resistor. The points on the curve indicate the R_S and C_L combinations for the optimum bandwidth, stability, and settling time, but experimental fine tuning is recommended. Picking a point above or to the right of the curve yields an overdamped response, while points below or left of the curve indicate areas of underdamped performance.

R_S and C_L form a low pass network at the output, thus limiting system bandwidth well below the amplifier bandwidth of 290MHz (for $A_V = +1$). By decreasing R_S as C_L increases (as illustrated in the curves), the maximum bandwidth is obtained without sacrificing stability. Even so, bandwidth does decrease as you move to the right along the curve. For example, at $A_V = +1$, $R_S = 62\Omega$, $C_L = 40pF$, the overall bandwidth is limited to 180MHz, and bandwidth drops to 70MHz at $A_V = +1$, $R_S = 8\Omega$, $C_L = 400pF$.

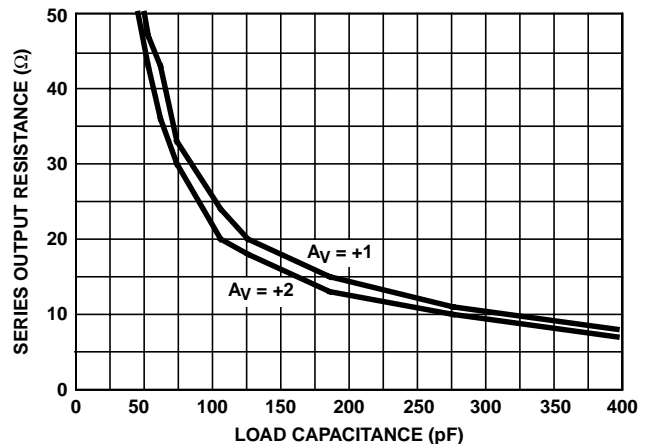
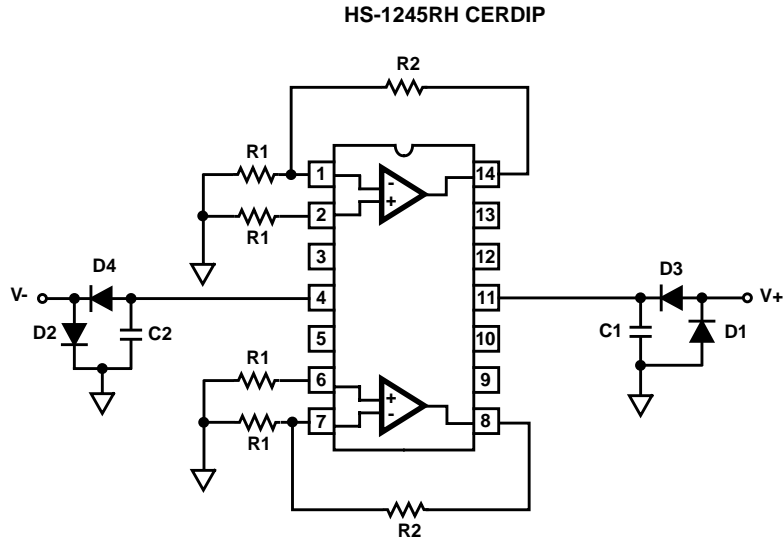


FIGURE 1. RECOMMENDED SERIES OUTPUT RESISTOR vs LOAD CAPACITANCE

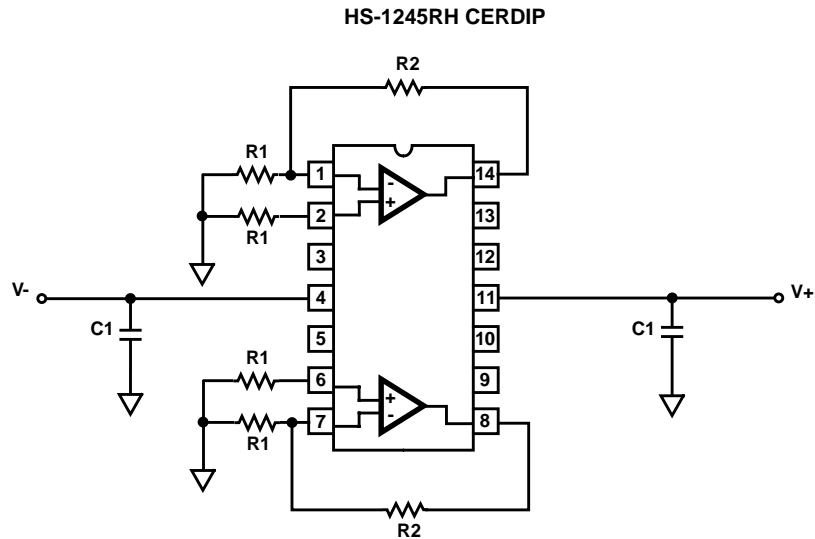
Burn-In Circuit



NOTES:

1. R1 = 1kΩ, ±5%, 1/4W min (Per Socket)
2. R2 = 10kΩ, ±5%, 1/4W min (Per Socket)
3. C1 = 0.01μF (Per Socket) or 0.1μF (Per Row) Minimum
4. D1, D2 = 1N4002 or Equivalent (Per Board)
5. D3, D4 = 1N4002 or Equivalent (Per Socket)
6. (-V) + (+V) = 11V ±1.0V
7. 10mA < (I_{CC}, I_{EE}) < 16mA
8. -750mV < V_{OUT} < +750mV

Irradiation Circuit



NOTES:

9. R1 = 1kΩ, ±5%
10. R2 = 10kΩ, ±5%
11. C1 = 0.01μF
12. V+ = +5.0V ±0.5V
13. V- = -5.0V ±0.5V

HS-1245RH

Die Characteristics

DIE DIMENSIONS:

69 mils x 92 mils x 19 mils ± 1 mil
1750 x 2330 x 355 μm $\pm 25.4 \mu\text{m}$

INTERFACE MATERIALS:

Glassivation:

Type: Nitride
Thickness: 4kÅ ± 0.5 kÅ

Top Metallization:

Type: Metal 1: AlCu(2%)/TiW
Type: Metal 2: AlCu(2%)
Thickness: Metal 1: 8kÅ ± 0.4 kÅ
Thickness: Metal 2: 16kÅ ± 0.8 kÅ

Substrate:

UHF-1X, Bonded Wafer, DI

Backside Finish:

Silicon

ASSEMBLY RELATED INFORMATION:

Substrate Potential (Powered Up):

Floating

ADDITIONAL INFORMATION:

Worst Case Current Density:

$< 2 \times 10^5 \text{ A/cm}^2$

Transistor Count:

150

Metallization Mask Layout



NOTE: This is an optional GND pad. Users may set a GND reference, via this pad, to ensure the TTL compatibility of the DISABLE inputs when using asymmetrical supplies (e.g., $V+ = 10\text{V}$, $V- = 0\text{V}$). See the "Application Information" section for details.

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