HI2309

Triple 10-Bit, 50 MSPS, 3-Channel D/A Converter

January 1998

NOT RECOMMENDED FOR NEW DESIGNS
See HI3050
or contact our Technical Support Center at
1-888-INTERSIL or www.intersil.com/tsc

Features

- Resolution . . . . . Triple 10-Bit
- Maximum Conversion Speed 50MHz
- RGB 3-Channel Input/Output
- Differential Linearity Error . . . . . ±0.5 LSB
- Low Power Consumption . . . . . 200mW (200Ω Load for $2V_{P-P}$ Output)
- Power Supply . . . . . +5V Single
- Low Glitch
- Direct Replacement for Sony CXD2309

Applications

- Digital TV
- Graphics Display
- High Resolution Color Graphics
- Video Reconstruction
- Instrumentation
- Image Processing
- I/Q Modulation

Description

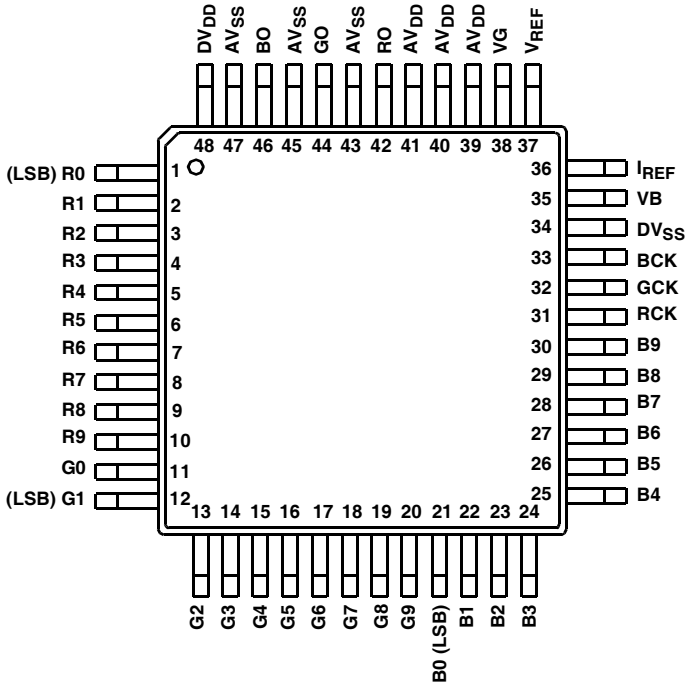
The HI2309 is a triple 10-bit, high-speed, CMOS D/A converter designed for video band use. It has three separate, 10-bit, pixel inputs, one each for red, green, and blue video data. A single 5.0V power supply and pixel clock input is all that is required to make the device operational. A bias voltage generator is internal. Each channel clock input can be controlled individually, or connected together as one. The HI2309 also has BLANK video control signal.

Ordering Information

PART NUMBER	TEMP. RANGE (^oC)	PACKAGE	PKG. NO.
HI2309JCQ	-20 to 75	48 Ld MQFP	Q48.12x12-S

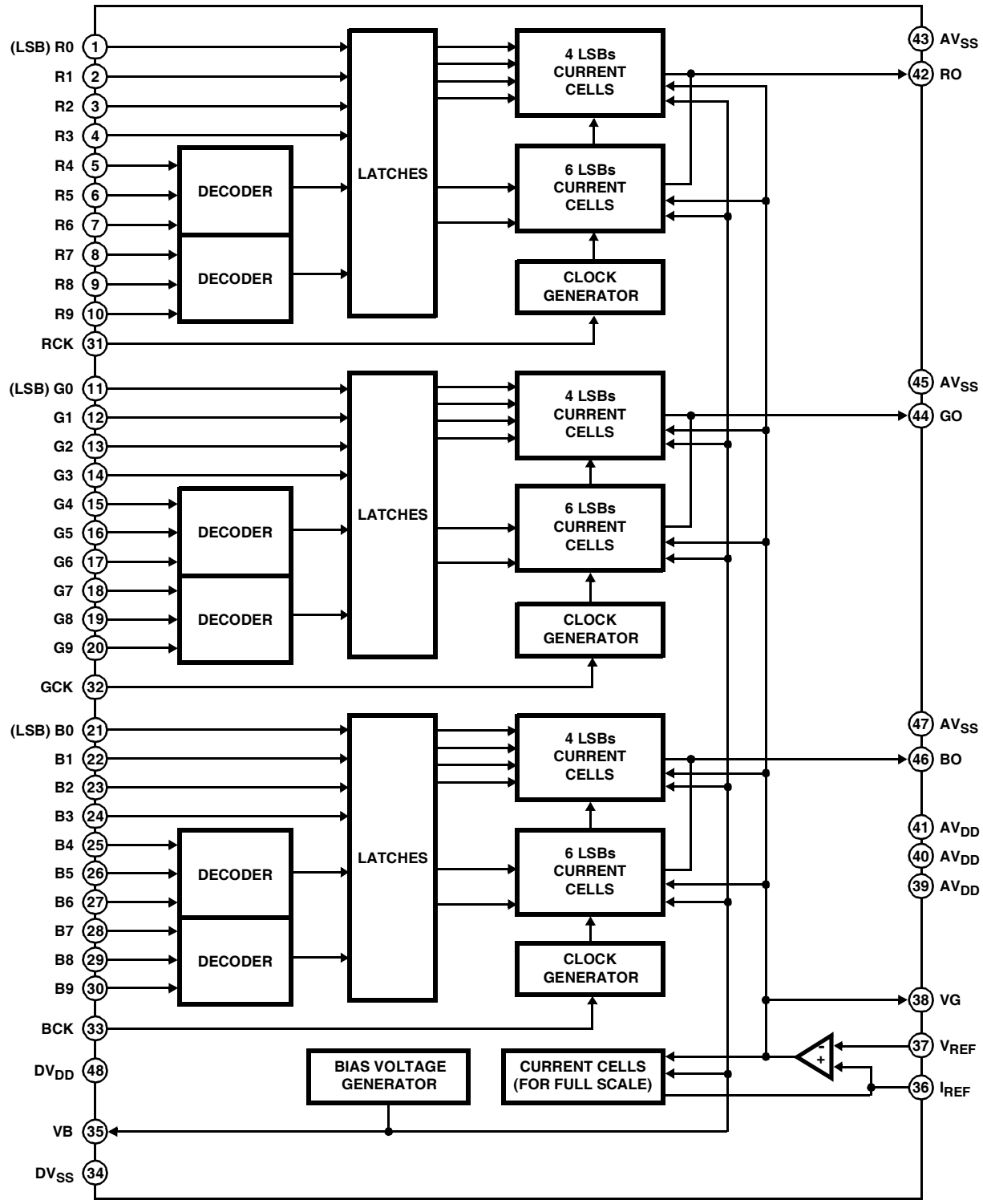
Pinout

HI2309 (MQFP)
TOP VIEW

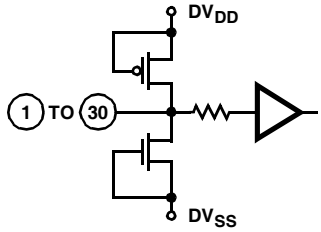
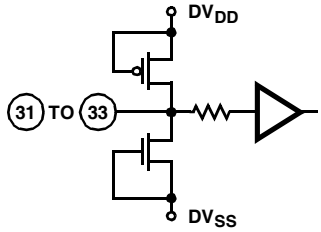
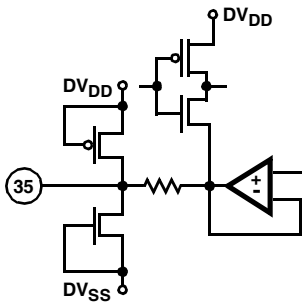
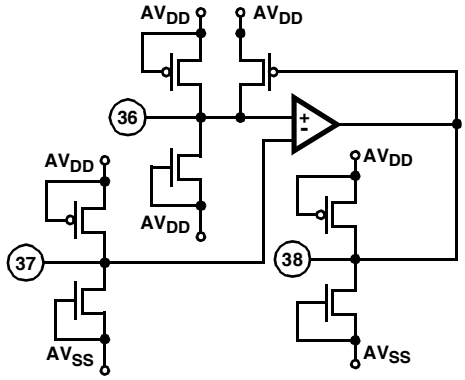
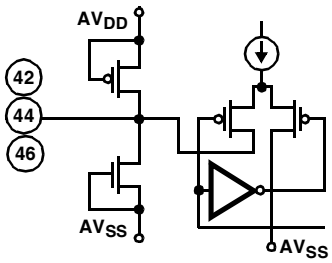


File Number **4118.2**

Functional Block Diagram



Pin Descriptions

PIN NO.	SYMBOL	EQUIVALENT CIRCUIT	DESCRIPTION
1 to 10	R0 to R9		Digital Input.
11 to 20	G0 to G9		
21 to 30	B0 to B9		
31	RCLK		Clock pin.
32	GCLK		
33	BCLK		
34	DV_{SS}		Digital GND.
35	VB		Connect an approximately 0.1µF capacitor.
36	I_{REF}		Connect a “16R” resistor which is 16 times the output resistance “R”.
37	V_{REF}		Sets an output full scale value.
38	VG		Connect an approximately 0.1µF capacitor.
39 to 41	AV_{DD}		Analog V_{DD}.
42	RO		Current Output. Output can be obtained by connecting a resistor (200Ω typical).
44	GO		
46	BO		
43, 45, 47	AV_{DD}		Analog GND.
47, 48	DV_{DD}		Digital V_{DD}.

Absolute Maximum Ratings $T_A = 25^oC$

Supply Voltage (V_{DD}) 7V
Input Voltage (V_{IN}) . . . . . V_{DD} to V_{SS}
Output Current (I_{OUT}) . . . . . .0mA to 15mA
Storage Temperature . . . . . -55°C 150°C

Operating Conditions

Supply Voltage
AV_{DD}, AV_{SS} . . . . . 4.75V to 5.25V
DV_{DD}, DV_{SS} . . . . . 4.75V to 5.25V
Reference Input Voltage (V_{REF}) . . . . . .0.5V to 2.0V
Clock Pulse Width
t_{PW1} . . . . . 10ns (Min)
t_{PW0} . . . . . 10ns (Min)
Temperature Range (T_{OPR}) . . . . . -20°C to 75°C

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} (°C/W)
MQFP Package	94

Maximum Junction Temperature (Plastic Package) . . . . . 150°C
Maximum Storage Temperature Range . . . . . -65°C to 150°C
Maximum Lead Temperature (Soldering 10s) . . . . . 300°C
(Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications f_{CLK} = 50MHz, V_{DD} = 5V, R = 200Ω, V_{REF} = 2.0V, $T_A = 25^oC$

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Resolution		n		-	10	-	Bit
Maximum Conversion Speed		f_{MAX}		50	-	-	MHz
Linearity Error		E_L		-2.0	-	2.0	LSB
Differential Linearity Error		E_D		-0.5	-	0.5	LSB
Output Full Scale Voltage		V_{FS}		1.8	1.92	2.0	V
Output Full Scale Current		I_{FS}		9.0	9.6	10	mA
Output Offset Voltage		V_{OS}		-	-	1	mV
Supply Current		I_{DD}		-	40	50	mA
Digital Input Current	High Level	I_{IH}		-	-	5	µA
	Low Level	I_{IL}		-5	-	-	µA
Digital Input Voltage	High Level	V_{IH}	DV_{DD} = 4.75 to 5.25V	2.15	-	-	V
	Low Level	V_{IL}	DV_{DD} - 4.75 to 5.25V	-	-	0.85	V
Precision Guaranteed Output Voltage Range		V_{OC}		1.8	1.92	2.0	V
Setup Time		t_S		6	-	-	ns
Hold Time		t_H		3	-	-	ns
Propagation Delay Time		t_{PD}		-	14	-	ns
Glitch Energy		GE	For R_{OUT} = 100Ω, $1V_{P-P}$ Output	-	50	-	pV/s
Cross Talk		CT	For 10MHz Sine Wave Output	40	42	-	dB
SNR		SNR	For 1MHz Sine Wave Output	50	55	-	dB

NOTE:

2. Output full scale ratio = $\left| \frac{\text{Full scale voltage for each channel}}{\text{Average of full scale voltage for each channel}} - 1 \right| \times 100\%$.

Test Circuits

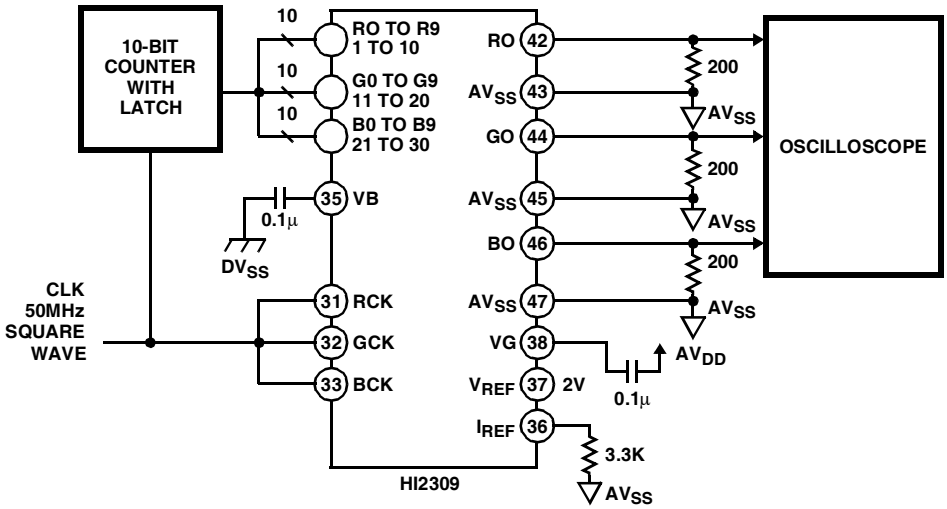


FIGURE 1. MAXIMUM CONVERSION RATE TEST CIRCUIT

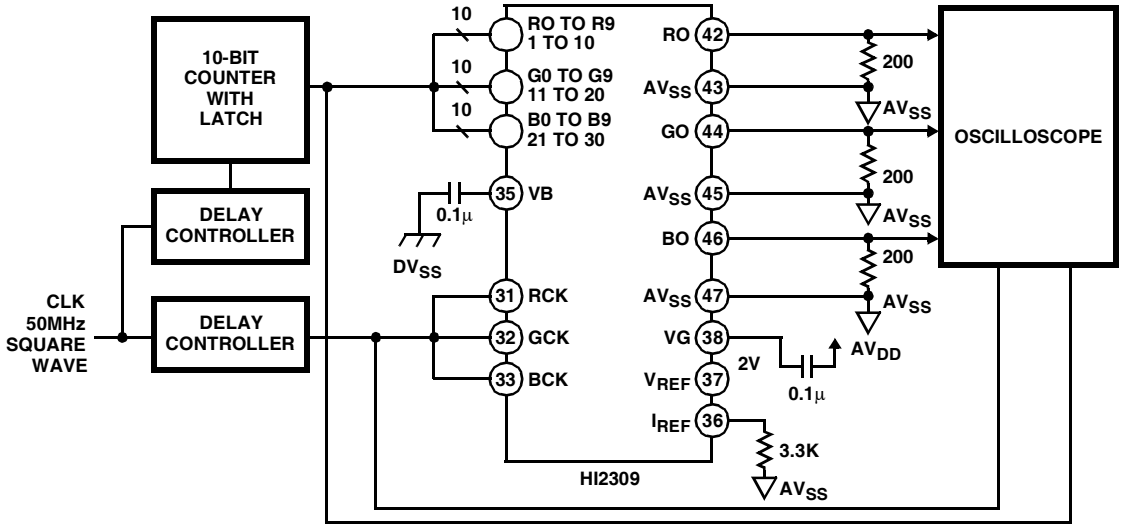


FIGURE 2. SETUP HOLD TIME GLITCH ENERGY TEST CIRCUIT

Test Circuits (Continued)

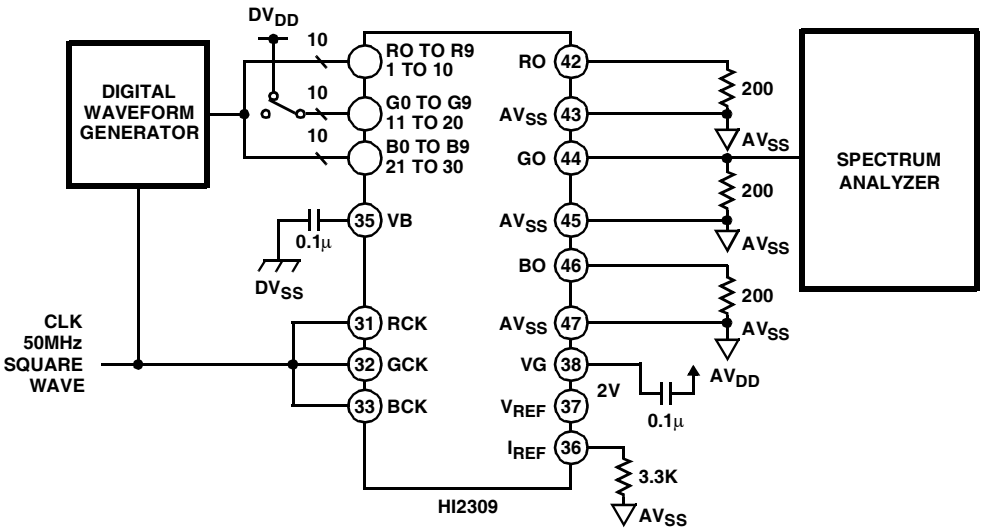


FIGURE 3. CROSS TALK TEST CIRCUIT

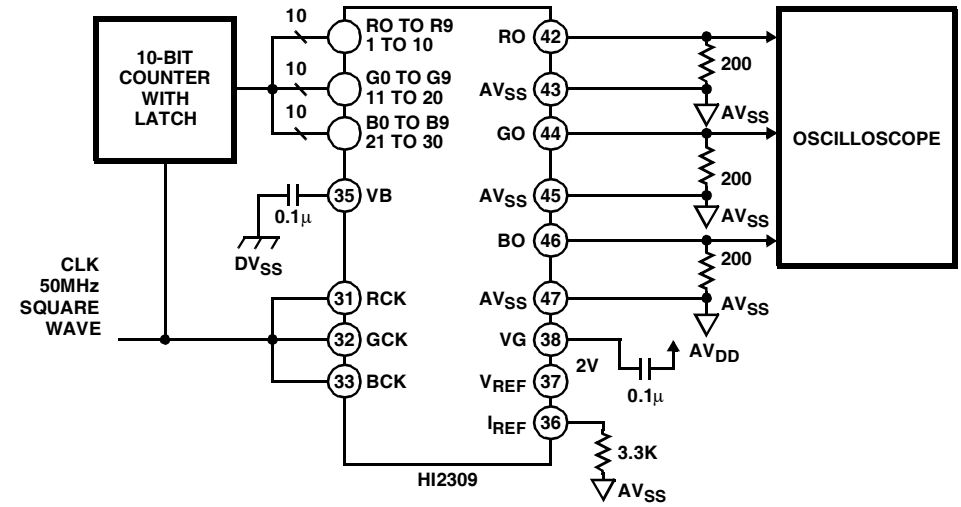


FIGURE 4. DC CHARACTERISTICS TEST CIRCUIT

Test Circuits (Continued)

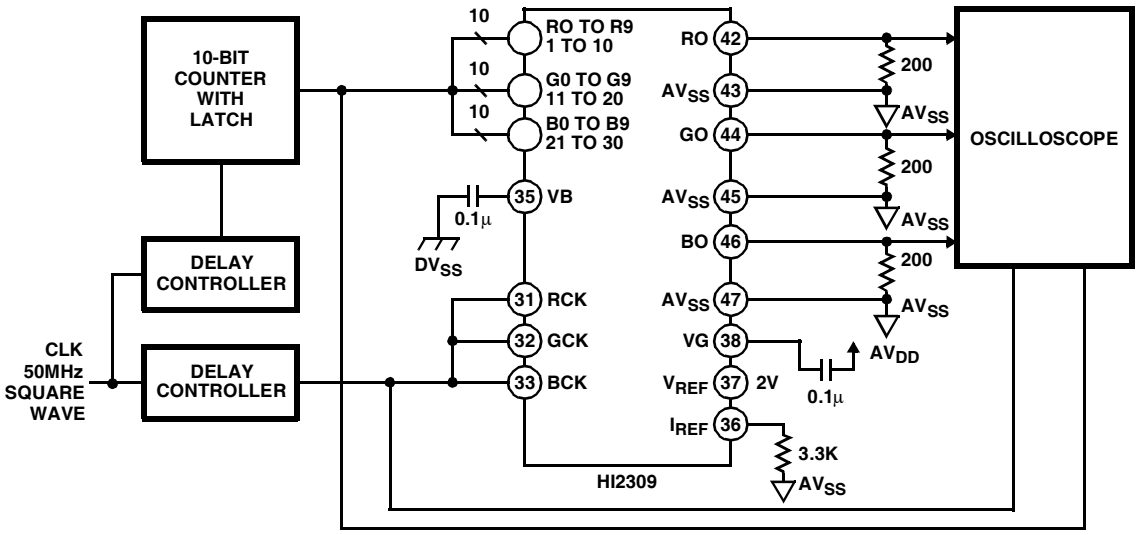


FIGURE 5. PROPAGATION DELAY TIME TEST CIRCUIT

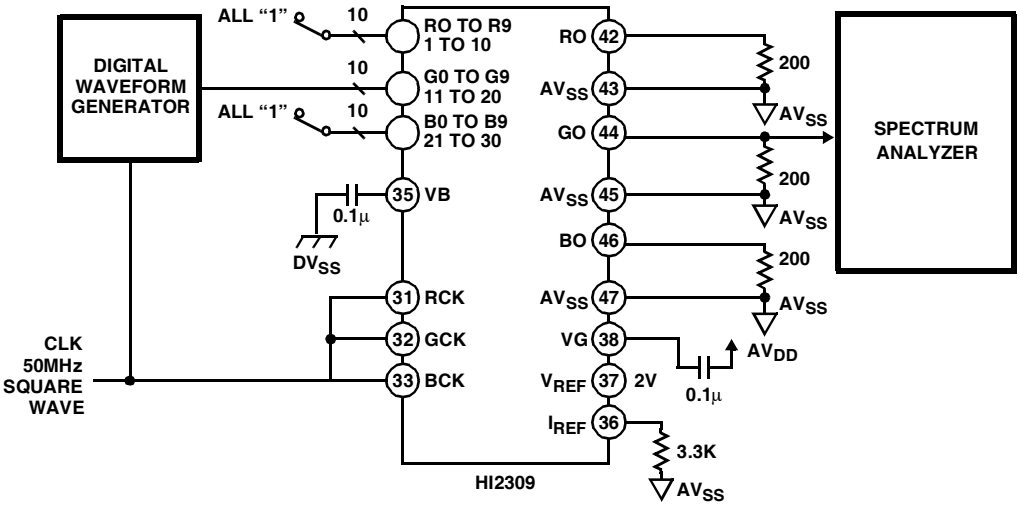
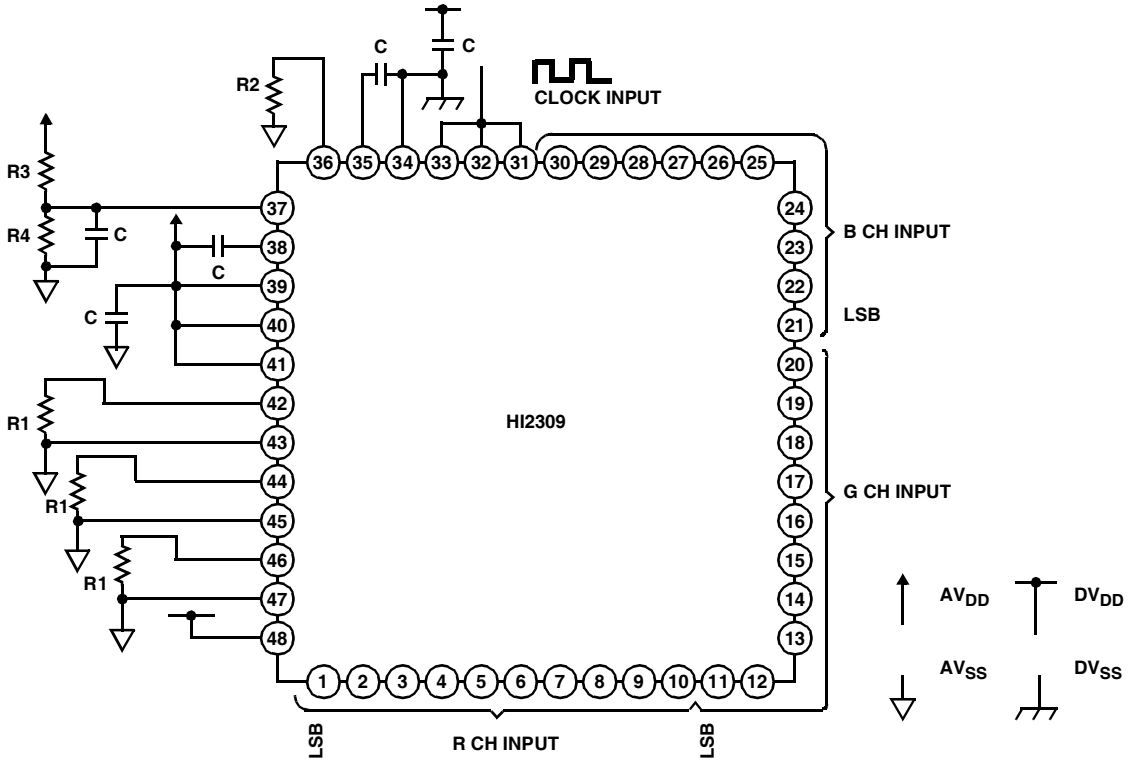


FIGURE 6. SNR TEST CIRCUIT

Application Circuit



- When the power supply (AV_{DD} and DV_{DD} is 5.0.
- R1 - 200Ω.
- R2 = 3.3kΩ.
- R3 = 3.0kΩ.
- R4 = 2.0kΩ.
- C = 0.1μF.

Application circuits shown are typical examples illustrating the operation of the devices. Intersil cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

Typical Performance Curves

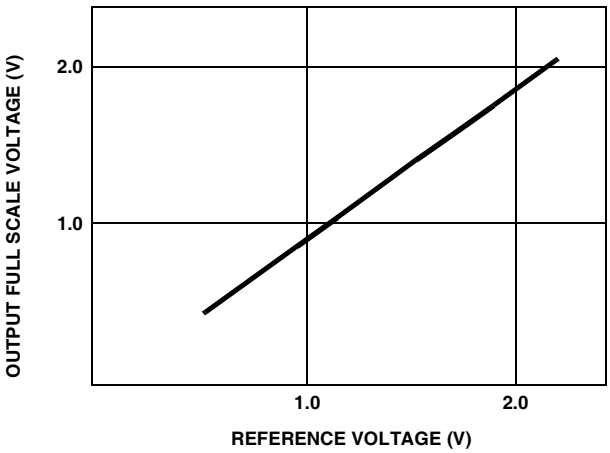


FIGURE 7. OUTPUT FULL SCALE VOLTAGE vs REFERENCE VOLTAGE

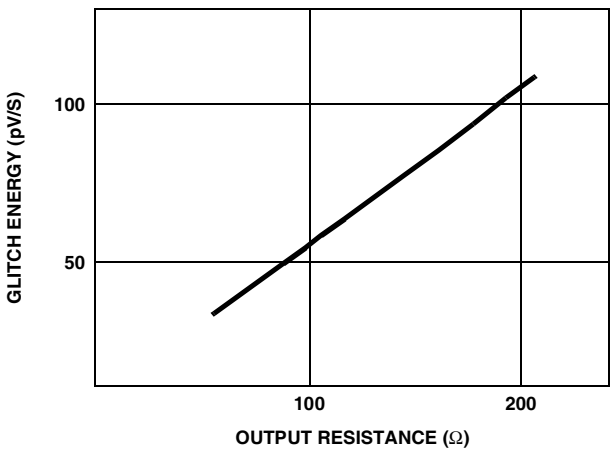


FIGURE 8. OUTPUT RESISTANCE vs GLITCH ENERGY

Typical Performance Curves (Continued)

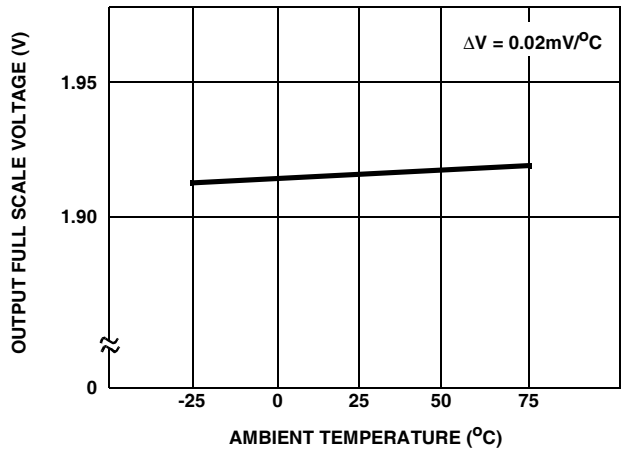


FIGURE 9. OUTPUT FULL SCALE VOLTAGE vs AMBIENT TEMPERATURE

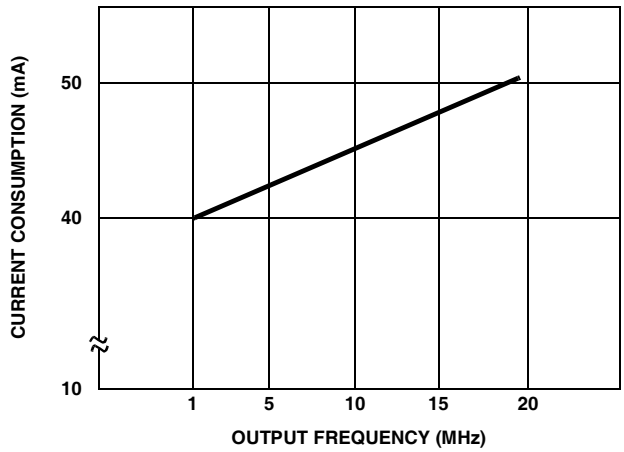


FIGURE 10. OUTPUT FREQUENCY vs CURRENT CONSUMPTION

Standard Measurement Conditions and Description

V_{DD} = 5.0V.

V_{REF} = 2.0V.

R = 200Ω.

16R = 3.3kΩ.

T_A = 25°C.

V_{REF} in Figure 9 is fixed to $2V_{DC}$ without resistor dividing.

Input data in Figure 10 = all “0” and “1” of rectangular wave, clock frequency = 50MHz for a total value of three channels.

Notes On Operation

Selecting the Output Resistance:

HI2309 is a current output type D/A converter. To create the output voltage, connect the resistor to the current output pin.

Specifications:

Output full scale voltage V_{FS} Max = 2.0 [V].

Output full scale current I_{FS} Max = 10 [mA].

Calculate the output resistance from $V_{FS} = I_{FS}$ x R. Connect a resistance sixteen times the output resistance to the reference current pin I_{REF}. In some cases, this value may not exist, a similar value can be used instead.

Note that the V_{FS} will be the following:

$V_{FS} = V_{REF}$ x 16 R/R’.

R is the resistor to be connected to the IO and R’ is the resistor to be connected to the I_{REF}. Power consumption can be reduced by increasing the resistance, but this will on the contrary, increase the glitch energy and data setting time. Set the best values according to the purpose of use.

Correlation Between Data and Clock:

For HI2309 to display the desired performance as a D/A converter, the data transmitted from outside and the clock must be synchronized properly. Adjust the setup time (t_S) and hold time (t_H) as specified in “Electrical Characteristics.”

V_{DD}, V_{SS}:

Separate the analog and digital signals around the device to reduce noise effects. Bypass the V_{DD} pin to each GND with a 0.1μF ceramic capacitor as near as possible to the pin for both digital and analog signals.

Latch Up:

The AV_{DD} and DV_{DD} pins must be able to share the same power supply of the board. This is to prevent latch up caused by potential difference between the two pins when the power is turned on.

I_{REF} Pin:

The I_{REF} pin is very sensitive to improve the AC Characteristics. Pay attention for capacitance component not to attach to this pin because its output may become unstable.

VG Pin:

It is recommended to use a 1μF capacitor to improve the AC Characteristics, though the typical capacitance value externally connected to the V_G Pin is 0.1μF.