

## **Two Dimensional Convolver**

The Intersil HSP48908/883 is a high speed Two Dimensional Convolver which provides a single chip implementation of a video data rate 3 x 3 kernel convolution on two dimensional data. It eliminates the need for external data storage through the use of the on-chip row buffers which are programmable for row lengths up to 1024 pixels.

There are internal register banks for storing two independent 3 x 3 filter kernels, thus, facilitating the implementation of adaptive filters and multiple filter operations on the same data. The pixel data path also includes an on-chip ALU for performing real-time arithmetic and logical pixel point operations.

Data is provided to the HSP48908/883 in a raster scan noninterlaced fashion, and is internally buffered on images up to 1024 pixels wide for the 3 x 3 convolution operation. Images with larger rows and convolution with larger kernel sizes can be accommodated by using external row buffers and/or multiple HSP48908/883s. Coefficient and pixel input data are 8-bit signed or unsigned integers, and the 20-bit convolver output guarantees no overflow for kernel sizes up to 4 x 4. Larger kernel sizes can be implemented however, since the filter coefficients will normally be less than their maximum 8-bit values.

The HSP48908/883 is manufactured using an advanced CMOS process, and is a low power fully static design. The configuration of the device is controlled through a standard microprocessor interface and all inputs/outputs are TTL compatible.

## **Features**

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Single Chip 3 x 3 Kernel Convolution
- Programmable On-Chip Row Buffers
- DC to 27MHz Clock Rate
- Cascadable for Larger Kernels and Images
- On-Chip 8-Bit ALU
- Dual Coefficient Mask Registers, Switchable in a Single Clock Cycle
- 8-Bit Signed or Unsigned Input and Coefficient Data
- 20-Bit Extended Precision Output
- Standard  $\mu$ P Interface

## **Applications**

- Image Filtering
- Edge Detection
- Adaptive Filtering
- Real Time Video Filter

## **Ordering Information**

<b>PART NUMBER</b>	<b>TEMP. RANGE (°C)</b>	<b>PACKAGE</b>	<b>PKG. NO.</b>
HSP48908GM-20/883	-55 to 125	84 Ld PGA	CMGA3-84
HSP48908GM-27/883	-55 to 125	84 Ld PGA	CMGA3-84

Pinouts

84 PIN PGA  
TOP VIEW

11	CASO6	DOUT0	DOUT1	GND	DOUT5	DOUT6	DOUT8	DOUT10	DOUT12	DOUT13	DOUT15
10	CASO4	CASO5	CASO7	DOUT2	DOUT4	DOUT9	GND	DOUT11	DOUT14	GND	DOUT17
9	CASO3	GND			DOUT3	DOUT7	V <sub>CC</sub>			DOUT16	DOUT18
8	CASO1	CASO2								DOUT19	GND
7	$\overline{OE}$	GND	V <sub>CC</sub>						CASI1	$\overline{FRAME}$	CASI0
6	DIN1	CASO0	DIN0						CASI2	V <sub>CC</sub>	$\overline{RESET}$
5	DIN2	DIN3	DIN4						CASI5	CASI4	CASI3
4	DIN5	DIN6								CASI7	CASI6
3	DIN7	CIN1			CIN9	HOLD	$\overline{LD}$			CASI10	CASI8
2	CIN0	CIN3	CIN4	CIN7	GND	V <sub>CC</sub>	A2	EALU	CASI13	CASI11	CASI9
1	CIN2	CIN5	CIN6	CIN8	CLK	A1	$\overline{CS}$	A0	CASI15	CASI14	CASI12
	A	B	C	D	E	F	G	H	J	K	L

**Absolute Maximum Ratings**

Supply Voltage . . . . . +8.0V  
 Input, Output or I/O Voltage Applied . . . . . GND -0.5V to  $V_{CC}$  +0.5V  
 ESD Classification . . . . . Class 1

**Operating Conditions**

Temperature Range . . . . . -55°C to 125°C  
 Voltage Range . . . . . +4.5V to +5.5V

**Thermal Information**

Thermal Resistance (Typical, Note 1)  $\theta_{JA}$  (°C/W)  $\theta_{JC}$  (°C/W)  
 PGA Package . . . . . 35.0 6.0  
 Maximum Package Power Dissipation at 125°C  
 PGA Package . . . . . 1.45W  
 Maximum Storage Temperature Range . . . . . -65°C to 150°C  
 Maximum Junction Temperature . . . . . 175°C  
 Maximum Lead Temperature (Soldering 10s) . . . . . 300°C

**Die Characteristics**

Number of Transistors or Gates . . . . . 190,000 Transistors

**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.  $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

**TABLE 1. DC ELECTRICAL PERFORMANCE SPECIFICATIONS**

PARAMETER	SYMBOL	TEST CONDITIONS	GROUP A SUB-GROUP	TEMPERATURE (°C)	MIN	MAX	UNITS
Logical One Input Voltage	$V_{IH}$	$V_{CC} = 5.5V$	1, 2, 3	$-55 \leq T_A \leq 125$	2.2	-	V
Logical Zero Input Voltage	$V_{IL}$	$V_{CC} = 4.5V$	1, 2, 3	$-55 \leq T_A \leq 125$	-	0.8	V
Clock Input High	$V_{IHC}$	$V_{CC} = 5.5V$	1, 2, 3	$-55 \leq T_A \leq 125$	3.0	-	V
Clock Input Low	$V_{ILC}$	$V_{CC} = 4.5V$	1, 2, 3	$-55 \leq T_A \leq 125$	-	0.8	V
Output HIGH Voltage	$V_{OH}$	$I_{OH} = 400mA$ , $V_{CC} = 4.75V$ (Note 2)	1, 2, 3	$-55 \leq T_A \leq 125$	2.6	-	V
Output LOW Voltage	$V_{OL}$	$I_{OL} = +2.0mA$ , $V_{CC} = 4.5V$ (Note 2)	1, 2, 3	$-55 \leq T_A \leq 125$	-	0.4	V
Input Leakage Current	$I_I$	$V_{IN} = V_{CC}$ or GND, $V_{CC} = 5.5V$	1, 2, 3	$-55 \leq T_A \leq 125$	-10	+10	$\mu A$
Output or I/O Leakage Current	$I_O$	$V_{OUT} = V_{CC}$ or GND $V_{CC} = 5.5V$	1, 2, 3	$-55 \leq T_A \leq 125$	-10	+10	$\mu A$
Standby Power Supply Current	$I_{CCSB}$	$V_{IN} = V_{CC}$ or GND, $V_{CC} = 5.5V$ , Outputs Open (Note 5)	1, 2, 3	$-55 \leq T_A \leq 125$	-	500	$\mu A$
Operating Power Supply Current	$I_{CCOP}$	$f = 20.0MHz$ , $V_{CC} = 5.5V$ Outputs Open, (Note 3, 5)	1, 2, 3	$-55 \leq T_A \leq 125$	-	160.0	mA
Functional Test	FT	(Notes 4, 5)	7, 8	$-55 \leq T_A \leq 125$	-	-	-

**NOTES:**

2. Interchanging of force and sense conditions is permitted.
3. Operating supply current is proportional to frequency, typical rating is 8.0mA/MHz.
4. Tested as follows:  $f = 1MHz$ ,  $V_{IH} = 2.6$ ,  $V_{IL} = 0.4$ ,  $V_{OH} \geq 1.5V$ ,  $V_{OL} \leq 1.5V$ ,  $V_{IHC} = 3.4V$ , and  $V_{ILC} = 0.4V$ .
5. Loading is as specified in the test load circuit with  $C_L = 40pF$ .

TABLE 2. AC ELECTRICAL PERFORMANCE SPECIFICATIONS

Device Tested at:  $V_{CC} = 5.0V \pm 10\%$ ,  $T_A = -55^{\circ}C$  to  $125^{\circ}C$  (Note 9)

PARAMETER	SYMBOL	NOTES	GROUP A SUBGROUP	TEMP ( $^{\circ}C$ )	-27 (27MHz)		-20 (20MHz)		UNITS
					MIN	MAX	MIN	MAX	
Clock Period	$t_{CYCLE}$		9, 10, 11	$-55 \leq T_A \leq 125$	37	-	50	-	ns
Clock Pulse Width High	$t_{PWH}$		9, 10, 11	$-55 \leq T_A \leq 125$	15	-	20	-	ns
Clock Pulse Width Low	$t_{PWL}$		9, 10, 11	$-55 \leq T_A \leq 125$	15	-	20	-	ns
Data Input Setup Time	$t_{DS}$		9, 10, 11	$-55 \leq T_A \leq 125$	16	-	17	-	ns
Data Input Hold Time	$t_{DH}$		9, 10, 11	$-55 \leq T_A \leq 125$	0	-	0	-	ns
Clock to Data Out	$t_{OUT}$		9, 10, 11	$-55 \leq T_A \leq 125$	-	19	-	28	ns
Address Setup Time	$t_{AS}$		9, 10, 11	$-55 \leq T_A \leq 125$	15	-	15	-	ns
Address Hold Time	$t_{AH}$		9, 10, 11	$-55 \leq T_A \leq 125$	0	-	0	-	ns
Configuration Data Setup Time	$t_{CDS}$		9, 10, 11	$-55 \leq T_A \leq 125$	17	-	20	-	ns
Configuration Data Hold Time	$t_{CDH}$		9, 10, 11	$-55 \leq T_A \leq 125$	0	-	0	-	ns
$\overline{LD}$ Pulse Width	$t_{LPW}$		9, 10, 11	$-55 \leq T_A \leq 125$	15	-	20	-	ns
$\overline{LD}$ Setup Time	$t_{LCS}$	Note 6	9, 10, 11	$-55 \leq T_A \leq 125$	30	-	37	-	ns
CIN7-0 Setup to CLK	$t_{CS}$		9, 10, 11	$-55 \leq T_A \leq 125$	17	-	20	-	ns
CIN7-0 Hold to CLK	$t_{CH}$		9, 10, 11	$-55 \leq T_A \leq 125$	0	-	0	-	ns
$\overline{CS}$ Setup to $\overline{LD}$	$t_{CSS}$		9, 10, 11	$-55 \leq T_A \leq 125$	0	-	0	-	ns
$\overline{CS}$ Setup to $\overline{LD}$	$t_{CSH}$		9, 10, 11	$-55 \leq T_A \leq 125$	0	-	0	-	ns
$\overline{RESET}$ Pulse Width	$t_{RPW}$		9, 10, 11	$-55 \leq T_A \leq 125$	37	-	50	-	ns
$\overline{FRAME}$ Setup to Clock	$t_{FS}$	Note 7	9, 10, 11	$-55 \leq T_A \leq 125$	25	-	30	-	ns
$\overline{FRAME}$ Pulse Width	$t_{FPW}$		9, 10, 11	$-55 \leq T_A \leq 125$	37	-	50	-	ns
EALU Setup Time	$t_{ES}$		9, 10, 11	$-55 \leq T_A \leq 125$	15	-	17	-	ns
EALU Hold Time	$t_{EH}$		9, 10, 11	$-55 \leq T_A \leq 125$	0	-	0	-	ns
HOLD Setup Time	$t_{HS}$		9, 10, 11	$-55 \leq T_A \leq 125$	13	-	14	-	ns
HOLD Hold Time	$t_{HH}$		9, 10, 11	$-55 \leq T_A \leq 125$	2	-	2	-	ns
Output Enable Time	$t_{EN}$	Note 8	9, 10, 11	$-55 \leq T_A \leq 125$	-	19	-	28	ns

## NOTES:

- This specification applies only to the case where the HSP48908/883 is being written to during an active convolution cycle. It must be met in order to achieve predictable results at the next rising clock edge. In most applications, the configuration data and coefficients are loaded asynchronously and the  $t_{LCS}$  Specification may be disregarded.
- While  $\overline{FRAME}$  is an asynchronous signal, it must be deasserted a minimum of  $t_{FS}$  ns prior to the rising clock edge which is to begin loading pixel data for a new frame.
- Transition is measured at  $\pm 200mV$  from steady state voltage with loading as specified in test load circuit with  $C_L = 40pF$ .
- AC Testing is performed as follows: Input levels (CLK input) 4.0V and 0V, input levels (all other inputs) 0V and 3.0V, timing reference levels (CLK) = 2.0V, (others) = 1.5V. Output load per test load circuit with  $C_L = 40pF$ . Output transition is measured at  $V_{OH} \geq 1.5V$  and  $V_{OL} \leq 1.5V$ .

TABLE 3. ELECTRICAL PERFORMANCE SPECIFICATIONS

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMP (°C)	-27		-20		UNITS
					MIN	MAX	MIN	MAX	
Input Capacitance	$C_{IN}$	$V_{CC} = \text{Open}$ $f = 1\text{MHz}$ , all measurements are referenced to device GND	10	$T_A = 25$	-	10	-	10	pF
Output Capacitance	$C_O$	$V_{CC} = \text{Open}$ $f = 1\text{MHz}$ , all measurements are referenced to device GND	10	$T_A = 25$	-	12	-	12	pF
Output Disable Time	$t_{OZ}$		10, 11	$-55 \leq T_A \leq 125$	-	35	-	40	ns
Output Rise Time	$t_r$	From 0.8V to 2.0V	10, 11	$-55 \leq T_A \leq 125$	-	6	-	6	ns
Output Fall Time	$t_f$	From 2.0V to 0.8V	10, 11	$-55 \leq T_A \leq 125$	-	6	-	6	ns

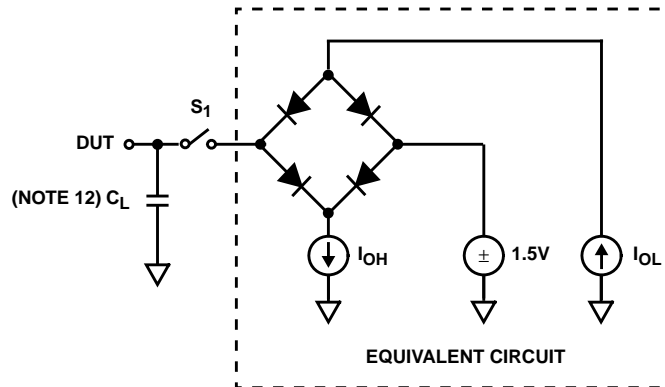
NOTES:

- 10. Parameters listed in Table 3 are controlled via design or process parameters and are not directly tested. These parameters are characterized upon initial design and after major process and/or design changes.
- 11. Loading is as specified in the test load circuit with  $C_L = 40\text{pF}$ .

TABLE 4. ELECTRICAL TEST REQUIREMENTS

CONFORMANCE GROUPS	METHOD	SUBGROUPS
Initial Test	100%/5004	-
Interim Test	100%/5004	-
PDA	100%	1
Final Test	100%	2, 3, 8A, 8B, 10, 11
Group A	-	1, 2, 3, 7, 8A, 8B, 9, 10, 11
Groups C and D	Samples/5005	1, 7, 9

**Test Load Circuit**



NOTES:

- 12. Includes stray and jig capacitance.
- 13. Switch  $S_1$  Open for  $I_{CCSB}$  and  $I_{CCOP}$  Tests.

**Burn-In Circuit**

11	CASO6	DOUT0	DOUT1	GND	DOUT5	DOUT6	DOUT8	DOUT10	DOUT12	DOUT13	DOUT15
10	CASO4	CASO5	CASO7	DOUT2	DOUT4	DOUT9	GND	DOUT11	DOUT14	GND	DOUT17
9	CASO3	GND			DOUT3	DOUT7	V <sub>CC</sub>			DOUT16	DOUT18
8	CASO1	CASO2								DOUT19	GND
7	$\overline{OE}$	GND	V <sub>CC</sub>						CASI1	$\overline{FRAME}$	CASI0
6	DIN1	CASOd	DIN0						CASI2	V <sub>CC</sub>	$\overline{RESET}$
5	DIN2	DIN3	DIN4						CASI6	CASI14	CASI13
4	DIN5	DIN6								CASI7	CASI16
3	DIN7	CIN1			CIN9	HOLD	$\overline{LD}$			CASI10	CASI18
2	CIN0	CIN3	CIN4	CIN7	GND	V <sub>CC</sub>	A2	EALU	CASI13	CASI11	CASI19
1	CIN2	CIN5	CIN6	CIN8	CLK	A1	$\overline{CS}$	A0	CASI15	CASI14	CASI12
	A	B	C	D	E	F	G	H	J	K	L

## PGA BURN-IN SCHEMATIC

PIN NAME	PGA PIN	BURN-IN SIGNAL	PIN NAME	PGA PIN	BURN-IN SIGNAL	PIN NAME	PGA PIN	BURN-IN SIGNAL
CIN2	A1	F13	POUT1	C11	V <sub>CC</sub> /2	CASI.13	J2	F5
CIN0	A2	F12	CIN8	D1	F14	CASI.5	J5	F5
DIN7	A3	F7	CIN7	D2	F12	CASI.2	J6	F2
DIN5	A4	F5	POUT2	D10	V <sub>CC</sub> /2	CASI.1	J7	F1
DIN2	A5	F2	GND	D11	GND	POUT14	J10	V <sub>CC</sub> /2
DIN1	A6	F1	CLK	E1	F0	POUT12	J11	V <sub>CC</sub> /2
OE	A7	F10	GND	E2	GND	CASI.14	K1	F6
CASO.1	A8	V <sub>CC</sub> /2	CIN9	E3	F14	CASI.11	K2	F3
CASO.3	A9	V <sub>CC</sub> /2	POUT3	E9	V <sub>CC</sub> /2	CASI.10	K3	F2
CASO.4	A10	V <sub>CC</sub> /2	POUT4	E10	V <sub>CC</sub> /2	CASI.7	K4	F7
CASO.6	A11	V <sub>CC</sub> /2	POUT5	E11	V <sub>CC</sub> /2	CASI.4	K5	F4
CIN5	B1	F12	A1	F1	F13	V <sub>CC</sub>	K6	V <sub>CC</sub>
CIN3	B2	F13	V <sub>CC</sub>	F2	V <sub>CC</sub>	FRAME	K7	F15
CIN1	B3	F12	HOLD	F3	F14	POUT19	K8	V <sub>CC</sub> /2
DIN6	B4	F6	POUT7	F9	V <sub>CC</sub> /2	POUT16	K9	V <sub>CC</sub> /2
DIN3	B5	F3	POUT9	F10	V <sub>CC</sub> /2	GND	K10	GND
CASO.0	B6	V <sub>CC</sub> /2	POUT6	F11	V <sub>CC</sub> /2	POUT13	K11	V <sub>CC</sub> /2
GND	B7	GND	CS	G1	F12	CASI.12	L1	F4
CASO.2	B8	V <sub>CC</sub> /2	A2	G2	F14	CASI.9	L2	F1
GND	B9	GND	LOAD	G3	F11	CASI.8	L3	F0
CASO.5	B10	V <sub>CC</sub> /2	V <sub>CC</sub>	G9	V <sub>CC</sub>	CASI.6	L4	F6
POUT0	B11	V <sub>CC</sub> /2	GND	G10	GND	CASI.3	L5	F3
CIN6	C1	F13	POUT8	G11	V <sub>CC</sub> /2	RESET	L6	F16
CIN4	C2	F13	A0	H1	F12	CASI.0	L7	F0
DIN4	C5	F4	EALU	H2	F8	GND	L8	GND
DIN0	C6	F0	POUT11	H10	V <sub>CC</sub> /2	POUT18	L9	V <sub>CC</sub> /2
V <sub>CC</sub>	C7	V <sub>CC</sub>	POUT10	H11	V <sub>CC</sub> /2	POUT17	L10	V <sub>CC</sub> /2
CASO.7	C10	V <sub>CC</sub> /2	CASI.15	J1	F7	POUT15	L11	V <sub>CC</sub> /2

## NOTES:

14. V<sub>CC</sub>/2 (2.7 ±10%) used for outputs only.
15. 47kΩ (±20%) resistor connected to all pins except V<sub>CC</sub> and GND.
16. V<sub>CC</sub> = 5.5 ±0.5V.
17. 0.1μF (minimum) capacitor between V<sub>CC</sub> and GND per position.
18. F0 = 100kHz ±10%, F1 - F0/2, F2 = F1/2...F11 = F10/2, 40 - 60% duty cycle.
19. Input Voltage Limits: V<sub>IL</sub> = 0.8V maximum, V<sub>IH</sub> = 4.5V ±10%.

**Die Characteristics****DIE DIMENSIONS:**

341 mils x 322 mils x 19 mils ±1 mil

**METALLIZATION:**

Type: Si - Al or Si-Al-Cu  
 Thickness: 8kÅ

**WORST CASE CURRENT DENSITY:**2 x 10<sup>5</sup> A/cm<sup>2</sup>**GLASSIVATION:**

Type: Nitrox  
 Thickness: 10kÅ

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