

# MAS9184A

## 12 X 8-bit D to A Converter

- 12-bit serial data input
- Highly stable output buffer
- Serial data output for Daisy-Chaining

### DESCRIPTION

The MAS9184 is a CMOS structured integrated circuit with 12 built-in D to A converter channels and 12 corresponding output buffer operational amplifiers. A simple 3-wire serial interface transfers

digital data from the micro controller. The output buffers operate in the entire voltage range from ground to the positive power supply rail.

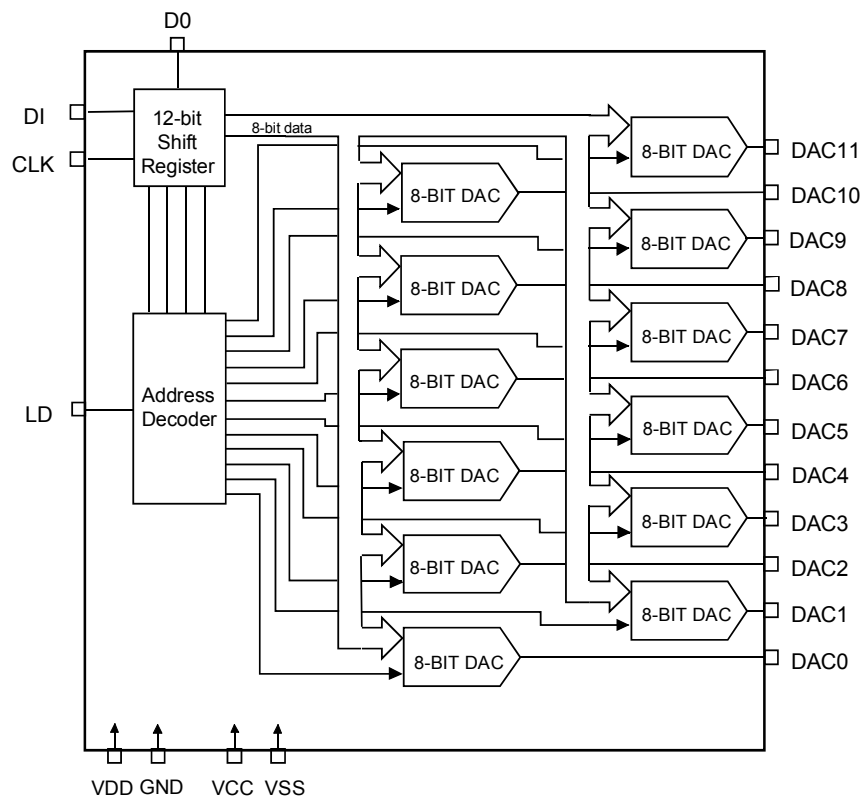
### FEATURES

- Twelve 8-bit DACs on a single monolithic chip
- Voltage level output
- SO 20 package
- Single +5V supply
- Power-on reset

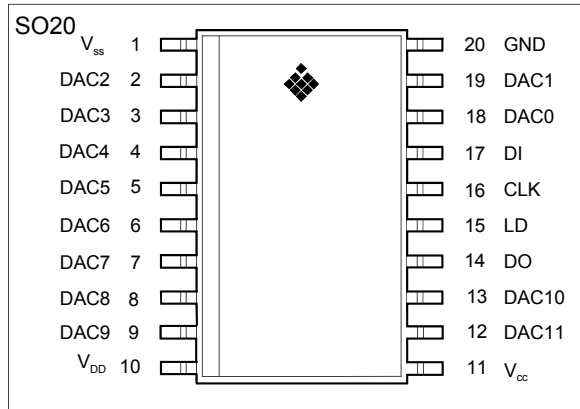
### APPLICATION

- High resolution monitors
- Automatic gain control
- Trimmer replacement

### BLOCK DIAGRAM



## PIN CONFIGURATION



## PIN DESCRIPTION

Pin name	SO	Function
V <sub>SS</sub>	1	D/A converter low level reference voltage input terminal
DAC2	2	8-bit D/A converter output terminal
DAC3	3	8-bit D/A converter output terminal
DAC4	4	8-bit D/A converter output terminal
DAC5	5	8-bit D/A converter output terminal
DAC6	6	8-bit D/A converter output terminal
DAC7	7	8-bit D/A converter output terminal
DAC8	8	8-bit D/A converter output terminal
DAC9	9	8-bit D/A converter output terminal
V <sub>DD</sub>	10	D-A converter high level reference voltage input terminal
V <sub>CC</sub>	11	Power supply terminal
DAC10	12	8-bit D/A converter output terminal
DAC11	13	8-bit D/A converter output terminal
DO	14	Serial data output terminal
LD	15	Latch data terminal
CLK	16	Serial clock input terminal
DI	17	Serial data input terminal
DAC0	18	8-bit D/A converter output terminal
DAC1	19	8-bit D/A converter output terminal
GND	20	Digital and analog ground

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**ABSOLUTE MAXIMUM RATINGS**


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Parameter	Symbol	Conditions	Min	Max	Unit
Supply Voltage	$V_{CC}$		-0.3	7.0	V
High level reference voltage	$V_{DD}$		-0.3	7.0	V
Digital input voltage	$V_{in}$		-0.3	$V_{CC}+0.3$	V
Output voltage	$V_{out}$		-0.3	$V_{CC}+0.3$	V
Power dissipation	$P_D$			150	mW
Operating temperature	$T_{amb}$		-20	+85	°C
Storage temperature	$T_S$		-55	+125	°C

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**RECOMMENDED OPERATION CONDITIONS**


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( $V_{CC}=V_{DD}=5V\pm 10\%$ ,  $GND=V_{SS}=0V$ ,  $T_a=-20\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	$V_{CC}$		4.5	5.0	5.5	V
Supply current	$I_{CC}$	CLK = 1MHz		2.5		mA
Input leakage current	$I_{ILK}$	$V_{in}=0V$ to $V_{CC}$	-10		10	uA

## ELECTRICAL CHARACTERISTICS

### ◆ Digital inputs

( $V_{CC} = V_{DD} = 5V \pm 10\%$ ,  $GND = V_{SS} = 0V$ ,  $T_a = -20\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input low voltage	$V_{IL}$				$3.0V_{CC}$	V
Input high voltage	$V_{IH}$		$0.7V_{CC}$			V

### ◆ Digital outputs

( $V_{CC} = V_{DD} = 5V \pm 10\%$ ,  $GND = V_{SS} = 0V$ ,  $T_a = -20\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output low voltage	$V_{OL}$	$I_{OL} = 400\mu\text{A}$			0.4	V
Output high voltage	$V_{OH}$	$I_{OH} = -400\mu\text{A}$	$V_{CC}-0.4$			V

### ◆ Analog outputs

( $V_{CC} = V_{DD} = 5V \pm 10\%$ ,  $GND = V_{SS} = 0V$ ,  $T_a = -20\text{ }^\circ\text{C}$  to  $+85\text{ }^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reference voltage pin current	$I_{DD}$		30	50	80	$\mu\text{A}$
D/A high level reference voltage range	$V_{DD}$		3.0		$V_{CC}$	V
D/A low level reference voltage range	$V_{SS}$		GND		$V_{CC}-3.0$	V
Buffer amplifier output voltage range	$V_{AO}$	$I_{AO} = 100\mu\text{A}$	0.1		$V_{CC}-0.1$	V
		$I_{AO} = 500\mu\text{A}$	0.2		$V_{CC}-0.2$	V
Buffer amplifier output drive range	$I_{AO}$		-5.0		5.0	mA
Differential nonlinearity	$S_{DL}$		-1.0		1.0	LSB
Nonlinearity	$S_L$		-1.5		1.5	LSB
Zero code error	$S_{ZERO}$		-1.0		1.0	LSB
Full scale error	$S_{FULL}$		-1.0		1.0	LSB
Output capacitive load	$C_L$				0.1	$\mu\text{F}$
Buffer amplifier output impedance	$R_O$			5		$\Omega$

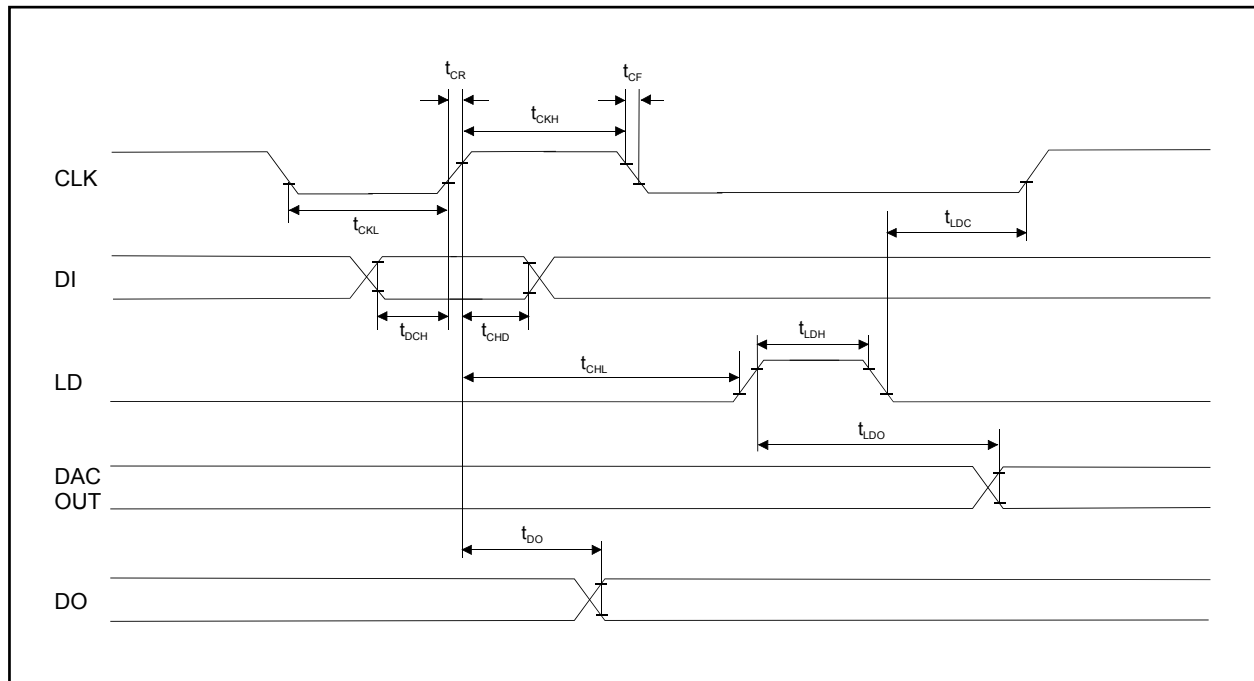
## ELECTRICAL CHARACTERISTICS

### ◆ AC Characteristics

( $V_{CC} = V_{DD} = 5V \pm 10\%$ ,  $GND = V_{SS} = 0V$ ,  $T_a = -20^\circ C$  to  $+85^\circ C$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Clock 'L' pulse width	$t_{CKL}$		100			ns
Clock 'H' pulse width	$t_{CKH}$		100			ns
Rise time	$t_{CR}$				200	ns
Fall time	$t_{CF}$				200	ns
Data setup time	$t_{DCH}$		30			ns
data hold time	$t_{CHD}$		70			ns
LD setup time	$t_{CHL}$		200			ns
LD hold time	$t_{LDC}$		100			ns
LD 'H' pulse width	$t_{LDH}$		100			ns
Data output delay time	$t_{DO}$		70		350	ns
D/A output settling time	$t_{LDD}$				300	ns
Power-on reset level	$V_{CC}$		2.4	3.0	3.3	V

### ◆ Timing diagram



## TIMING

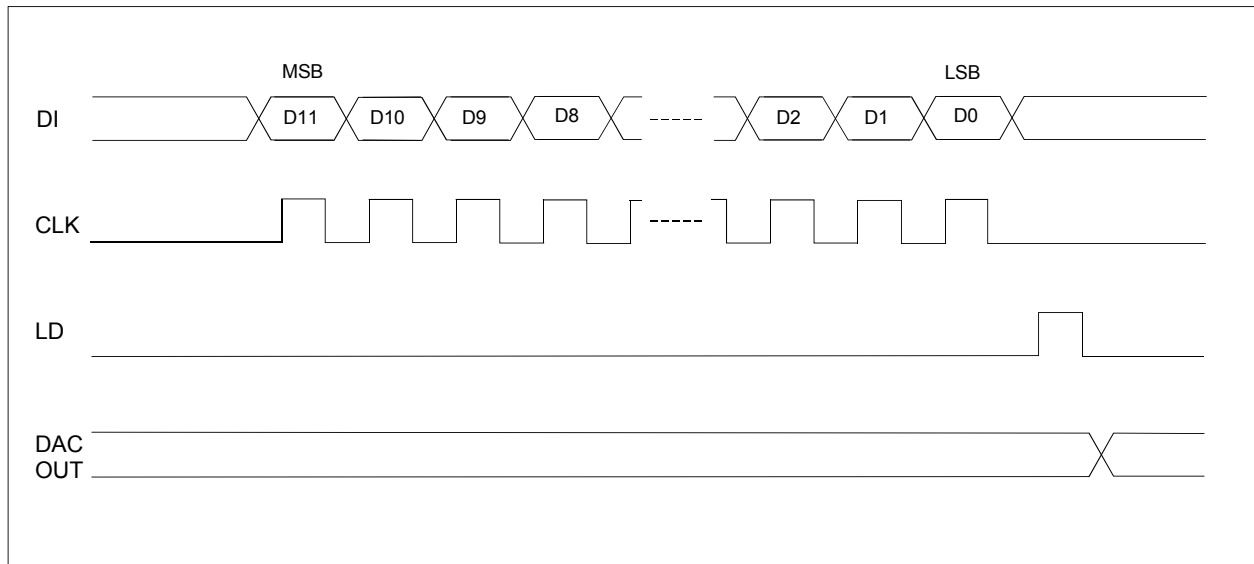
### ◆ Data format

Address Data				Selected
D11	D10	D9	D8	DAC
0	0	0	0	X
1	0	0	0	DAC0
0	1	0	0	DAC1
1	1	0	0	DAC2
0	0	1	0	DAC3
1	0	1	0	DAC4
0	1	1	0	DAC5
1	1	1	0	DAC6
0	0	0	1	DAC7
1	0	0	1	DAC8
0	1	0	1	DAC9
1	1	0	1	DAC10
0	0	1	1	DAC11
1	0	1	1	X
0	1	1	1	X
1	1	1	1	X

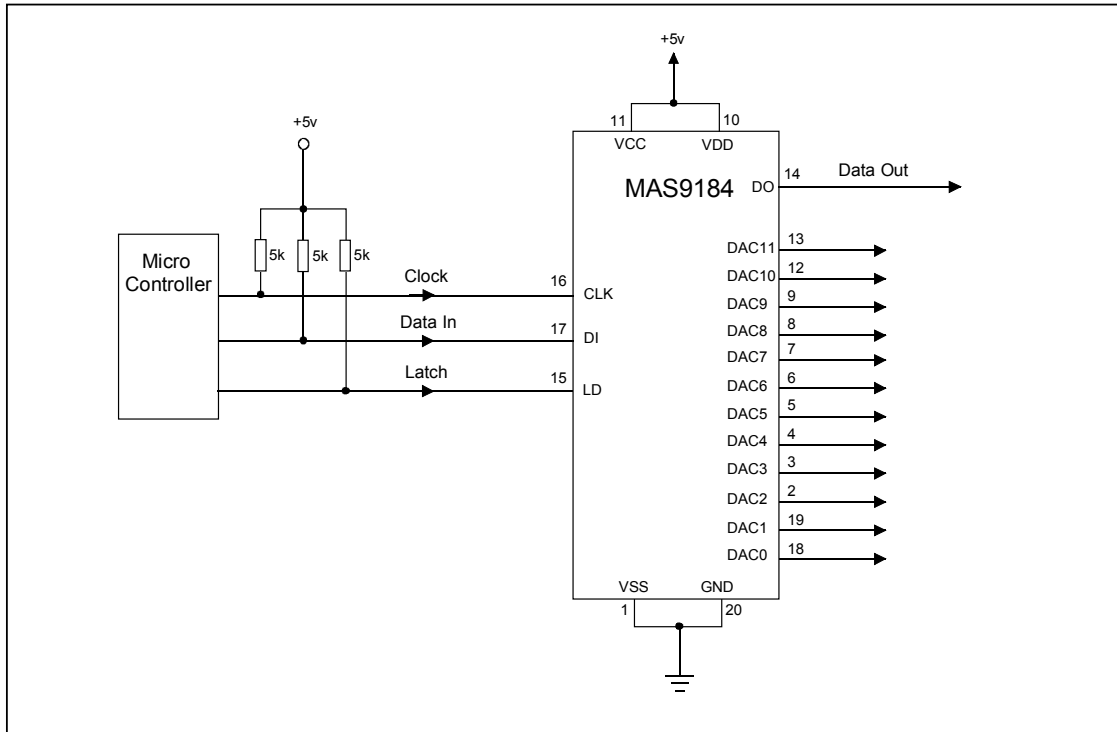
X = Don't care condition

DAC Data								DAC Output Level
D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	0	0	0	0	$V_{SS}$
0	0	0	0	0	0	0	1	$(V_{DD}-V_{SS})/256x1+V_{SS}$
0	0	0	0	0	0	1	0	$(V_{DD}-V_{SS})/256x2+V_{SS}$
0	0	0	0	0	0	1	1	$(V_{DD}-V_{SS})/256x3+V_{SS}$
0	0	0	0	0	1	0	0	$(V_{DD}-V_{SS})/256x4+V_{SS}$
0	0	0	0	0	1	0	1	$(V_{DD}-V_{SS})/256x5+V_{SS}$
0	0	0	0	0	1	1	0	$(V_{DD}-V_{SS})/256x6+V_{SS}$
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
1	1	1	1	1	0	0	1	$(V_{DD}-V_{SS})/256x249+V_{SS}$
1	1	1	1	1	0	1	0	$(V_{DD}-V_{SS})/256x250+V_{SS}$
1	1	1	1	1	0	1	1	$(V_{DD}-V_{SS})/256x251+V_{SS}$
1	1	1	1	1	1	0	0	$(V_{DD}-V_{SS})/256x252+V_{SS}$
1	1	1	1	1	1	0	1	$(V_{DD}-V_{SS})/256x253+V_{SS}$
1	1	1	1	1	1	1	0	$(V_{DD}-V_{SS})/256x254+V_{SS}$
1	1	1	1	1	1	1	1	$(V_{DD}-V_{SS})/256x255+V_{SS}$

### ◆ Data format Timing

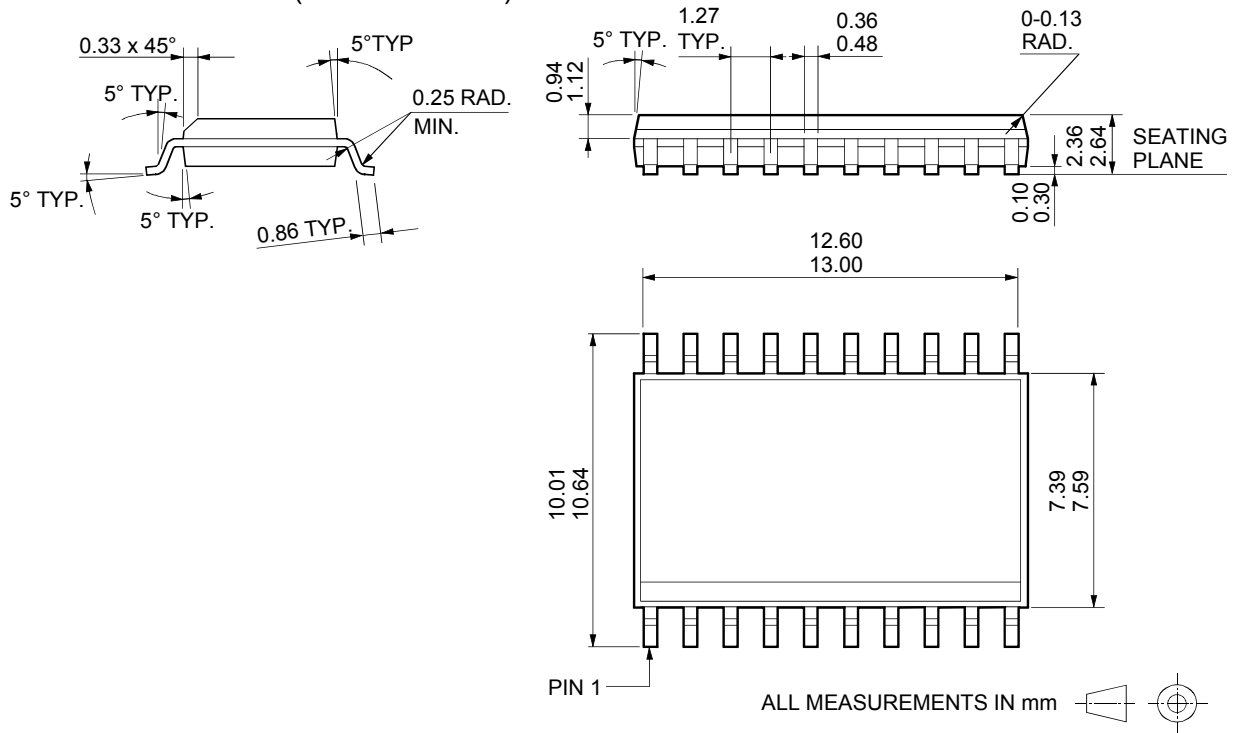


**APPLICATION AND TEST CIRCUIT INFORMATION**



**PACKAGE OUTLINES**

**20 LEAD SO OUTLINE (300 MIL BODY)**





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## ORDERING INFORMATION

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Product Code	Product	Package	Comments
MAS9184AS	12 x 8-bit D to A Converter	20 Pin SO 0.3"	
MAS9184AS-T	12 x 8-bit D to A Converter	20 Pin SO 0.3"	T&R

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## LOCAL DISTRIBUTOR

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