Ordering number : EN *5428A

CMOS LSI

LC89086M

8 Bit A/D Converter

Preliminary

Overview

The LC89086M is a low-power high-speed 8-bit serial-parallel A/D converter fabricated in a high-speed CMOS process.

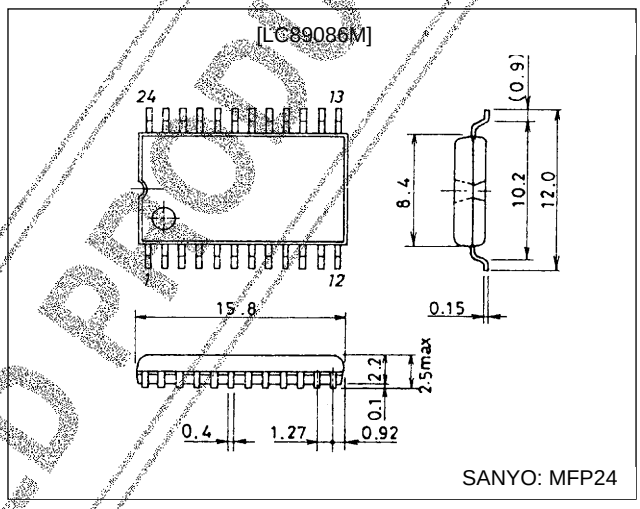
Features

- Resolution: 8 bits (with an overflow output)
- Maximum conversion rate: 20M samples per second
- Error: Less than ±1.0 LSB
- Power supply: +5-V single-voltage power supply
- Power dissipation: 150 mW (typical)
- Analog input voltage range: V_{SS} to V_{DD}
- Digital output voltage: 3 state TTL level

Package Dimensions

unit: mm

3155-MFP24



Specifications

Absolute Maximum Ratings at Ta = 25°C, DV_{SS} = AV_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max		–0.3 to +7.0	V
Input voltage	V_{IN} max		–0.3 to V_{DD} +0.3	V
Operating temperature	Topr		–30 to +70	°C
Storage temperature	Tstg		–40 to +125	°C

Recommended Operating Conditions

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{DD}		4.5	5.0	5.5	V
Operating ambient temperature	Ta		–30		+70	°C

Electrical Characteristics

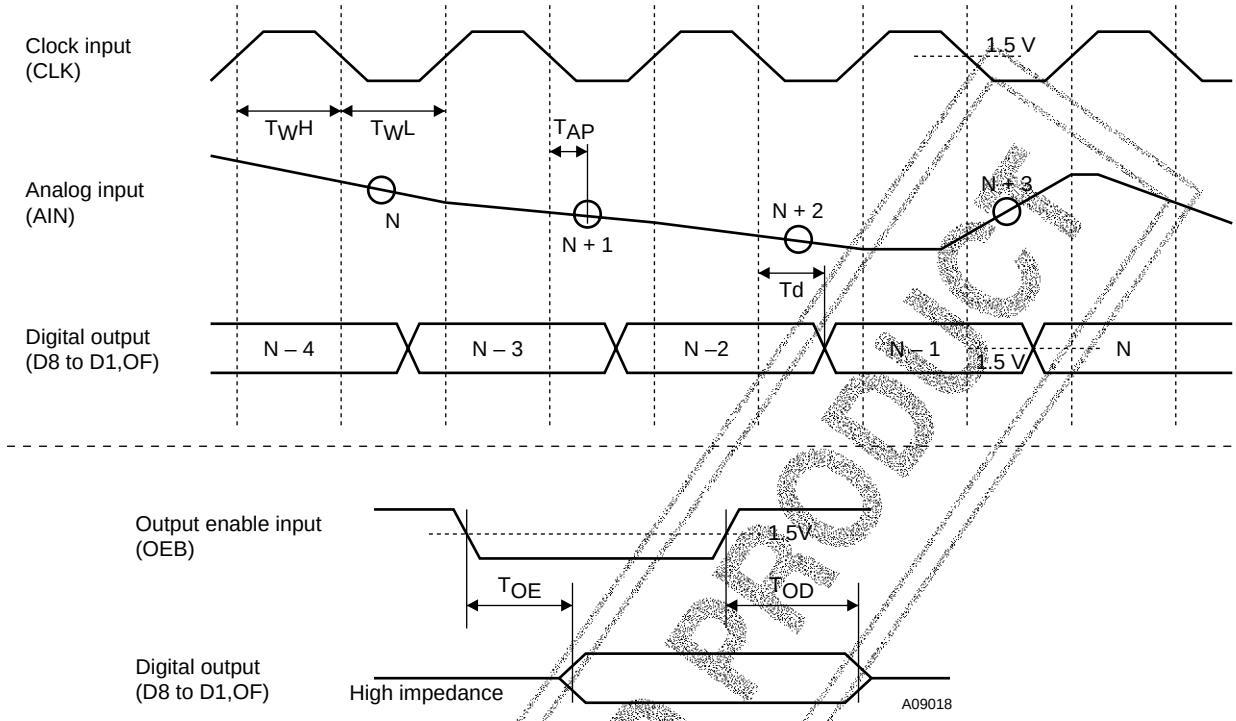
Electrical DC Characteristics at Ta = –30 to +70°C, AV_{DD} = DV_{DD} = 4.5 to 5.5 V, AV_{SS} = DV_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Reference resistance	Rref	VrefH (pin 5) – VrefL (pin 8)	210	300	390	Ω
Analog input capacitance	C_{AIN}			30		pF
Analog input resistance	R_{AIN}			10		MΩ
Reference high-level input voltage	VrefH	When VrefHO (pin 4) and VrefLO (pin 9) are unused.	VrefL + 2.0		V_{DD}	V
Reference low-level input voltage	VrefL	When VrefHO (pin 4) and VrefLO (pin 9) are unused.	0		VrefH – 2.0	V
Reference high-level output voltage	VrefH	When VrefHO (pin 4) and VrefLO (pin 9) are used, and AV_{DD} = DV_{DD} = 5 V	1.9	2.0	2.1	V
Reference low-level output voltage	VrefL	When VrefHO (pin 4) and VrefLO (pin 9) are used, and AV_{DD} = DV_{DD} = 5 V	–0.05	0	+0.05	V
Analog input voltage	V_{AIN}		VrefL		VrefH	V
Digital high-level voltage	V_{IH}		2.2		V_{DD} +0.3	V
Digital low-level voltage	V_{IL}		–0.3		+0.8	V
Digital high-level output current	I_{OH}	V_{OH} = V_{DD} – 0.4 V	–2			mA
Digital low-level output current	I_{OL}	V_{OL} = 0.4 V	2			mA

Electrical AC Characteristics 1 at Ta = –30 to +70°C, AV_{DD} = DV_{DD} = 4.5 to 5.5 V, AV_{SS} = DV_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Clock high-level period	T_{WH}		23			ns
Clock low-level period	T_{WL}		23			ns
Analog input acquisition time	T_{AP}		10	20	30	ns
Digital output data delay time	Td	C load = 30 pF	15	30	45	ns
Digital output data enable time	T_{OE}	C load = 30 pF	2	5	10	ns
Digital output data disable time	T_{OD}	C load = 30 pF	2	5	10	ns

Timing Chart



The analog signal (AIN) is acquired on the falling edge of the clock input (CLK). The acquired analog signal is converted to a digital code and is output from the digital outputs (D8 to D1, OF) on the clock falling edge delayed three clock cycles from the clock cycle in which the analog signal was acquired.

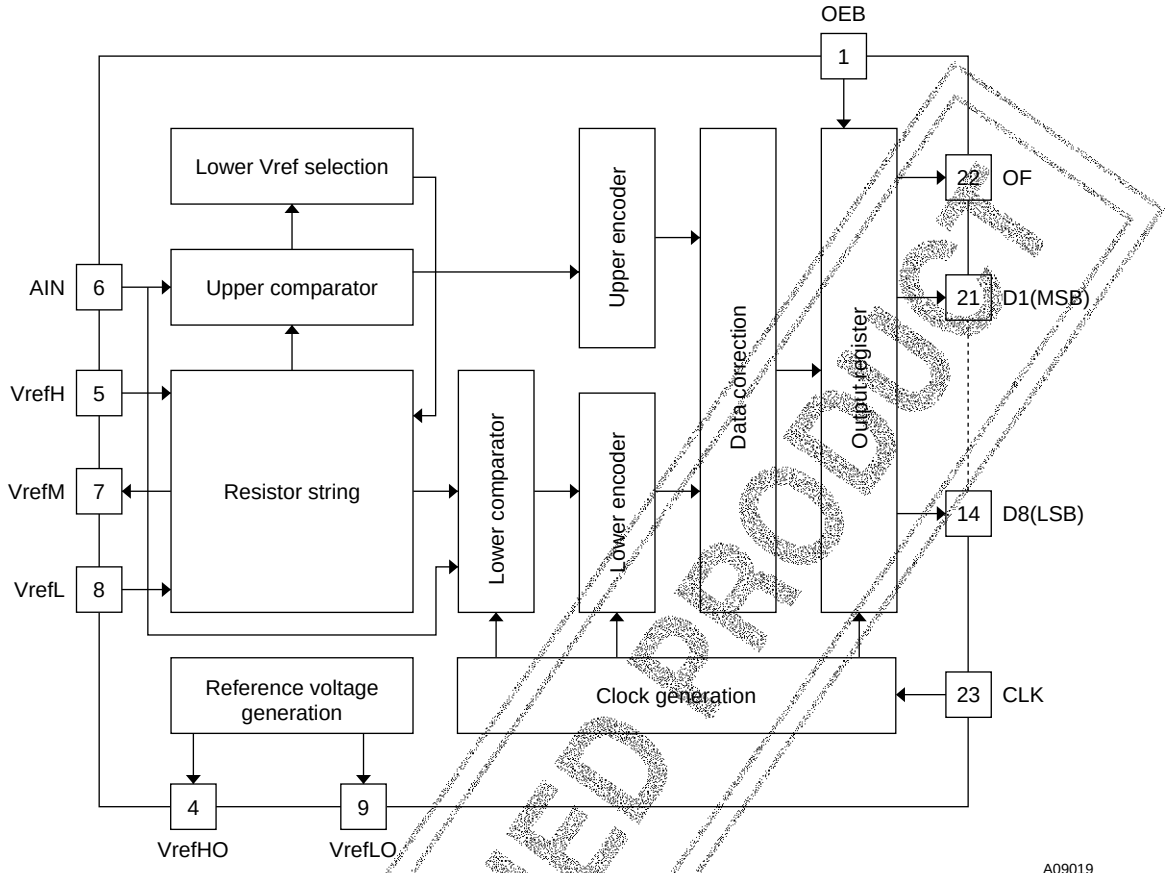
Electrical AC Characteristics 2

at Ta = 25°C, AV_{DD} = DV_{DD} = 5 V, AV_{SS} = DV_{SS} = 0 V, VrefH = 2 V, VrefL = 0 V

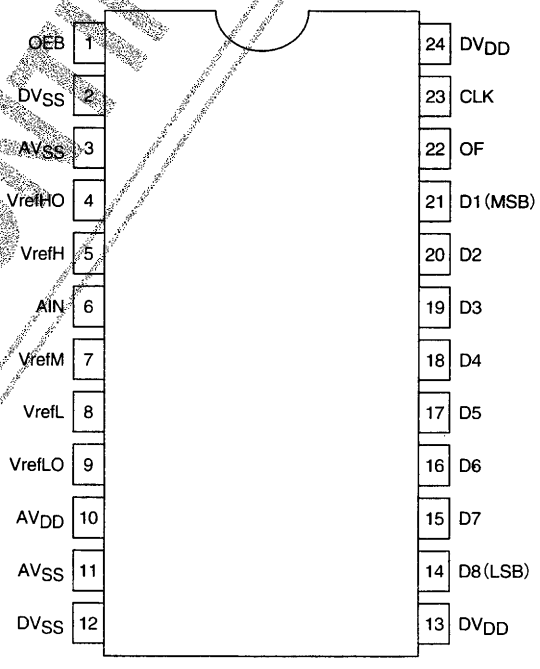
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Resolution	Res				8	bit
Maximum conversion rate	Fs				20	MSPS
Linearity error	LE	DC accuracy			±1.0	LSB
Differential linearity error	DLE	DC accuracy			±1.0	LSB
Offset voltage	V_{offset}	DC accuracy	10	50	90	mV
Power dissipation	Pd	Fs = 20 MSPS		150	220	mW

Note: Test circuits must conform to the sample application circuit.

Block Diagram



Pin Assignment



Top view

Pin Functions

Pin No.	Pin name	I/O	Function
1	OEB	I	Digital output enable input High: high-impedance Low: Normal operation
2	DV_{SS}		Digital ground
3	AV_{SS}		Analog ground
4	Vref HO	O	Internal reference voltage (high) generation. Shorting this pin to VrefH (pin 5) generates a voltage of 2.0 V. This pin must be left open when the internally generated potential is not used.
5	Vref H	I	Reference voltage input (high)
6	AIN	I	Analog input
7	Vref M	O	Reference voltage intermediate level tap.
8	Vref L	I	Reference voltage input (low)
9	Vref LO	O	Internal reference voltage (low) generation. Shorting this pin to VrefL (pin 8) generates a voltage of 0 V. This pin must be left open when the internally generated potential is not used.
10	AV_{DD}		Analog power supply
11	AV_{SS}		Analog ground
12	DV_{SS}		Digital ground
13	DV_{DD}		Digital power supply
14	D8	O	Digital output (LSB)
15	D7	O	Digital output
16	D6	O	Digital output
17	D5	O	Digital output
18	D4	O	Digital output
19	D3	O	Digital output
20	D2	O	Digital output
21	D1	O	Digital output (MSB)
22	OF	O	Digital output (Overflow)
23	CLK	I	Clock input
24	DV_{DD}		Digital power supply

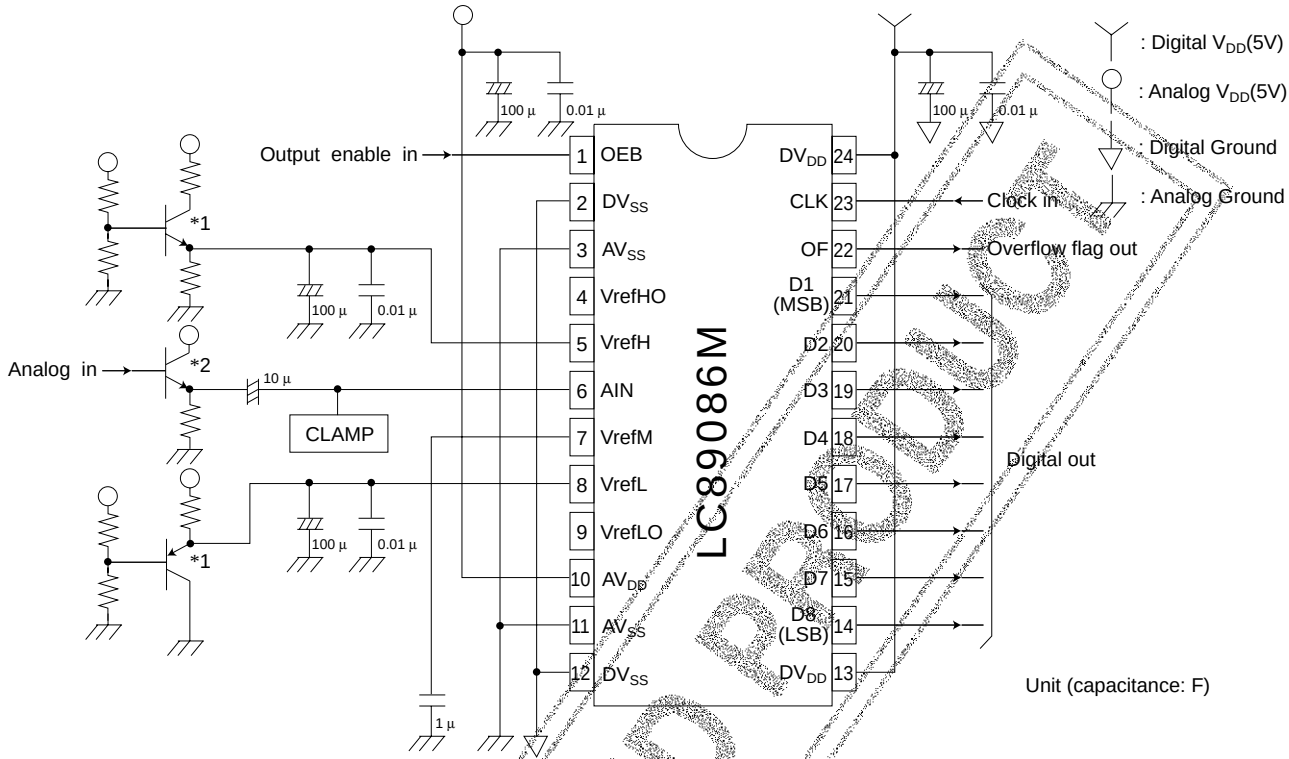
Note: There must be no potential difference between the digital system and analog system V_{DD} and V_{SS} power supply potentials.

I/O Code Table

The table below lists the relationship between the input and output when VrefH and VrefL are set up so that the zero transient voltage is 0.000 V and the full-scale transient voltage is 2.008V.

Analog input	Digital output								
V_{AIN} (V)	OF	D1	D2	D3	D4	D5	D6	D7	D8
Up to 0.000	0	0	0	0	0	0	0	0	0
Up to 0.008	0	0	0	0	0	0	0	0	0
Up to 0.016	0	0	0	0	0	0	0	0	1
Up to 0.024	0	0	0	0	0	0	0	1	0
Up to 0.032	0	0	0	0	0	0	0	1	1
to									
Up to 0.992	0	0	1	1	1	1	1	1	0
Up to 1.000	0	0	1	1	1	1	1	1	1
Up to 1.008	0	1	0	0	0	0	0	0	0
Up to 1.016	0	1	0	0	0	0	0	0	1
to									
Up to 1.992	0	1	1	1	1	1	1	0	1
Up to 2.000	0	1	1	1	1	1	1	1	0
Up to 2.008	0	1	1	1	1	1	1	1	1
Over 2.008	1	1	1	1	1	1	1	1	1

Sample Application Circuit



Note 1. The value of the reference resistor is about 300 Ω. When this circuit is used with (VrefH – VrefL) = 2 V, a current of 6.7 mA will flow. Use an operational amplifier or emitter follower with at least this current capacity.

2. The analog input impedance is lower for AC inputs. Therefore, an operational amplifier or emitter follower with a high slew rate and a wide bandwidth must be used in the previous stage output, and the impedance must be reduced to under 100 Ω.