NIPPON PRECISION CIRCUITS LTD.

SM6102P/S

8-bit, Flash A/D Converter

OVERVIEW

The SM6102 is a high-speed, 8-bit A/D converter fabricated in Molybdenum-gate CMOS. It uses a 2-step flash conversion method and features low current consumption.

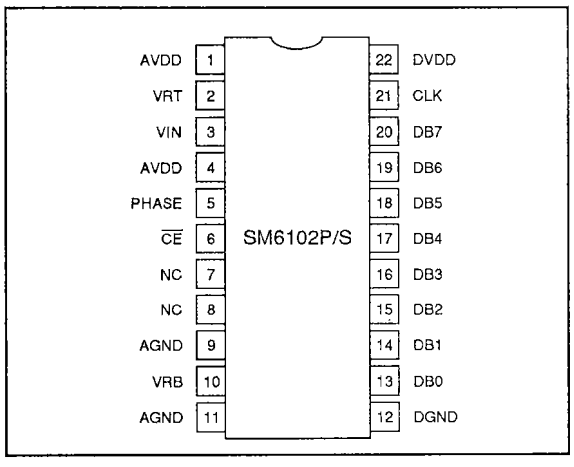
FEATURES

- 8-bit resolution
- 8 MSPS maximum conversion rate
- 1.5 LSB non-linearity error (when $V_{RT} - V_{RB}$ = 2.0 V)
- 1.0 LSB non-linearity error (when $V_{RT} - V_{RB}$ = 5.0 V)
- Low current consumption
- Monotonic with guaranteed no code omission
- External sample-and-hold circuit not required
- Built-in output latch
- Output tristate control pin
- Single 5 V supply
- 22-pin plastic DIP (SM6102P) and 22-pin plastic SOP (SM6102S)
- Molybdenum-gate CMOS process

APPLICATIONS

- High-speed facsimile machines
- Data acquisition systems
- High-speed, low-current applications

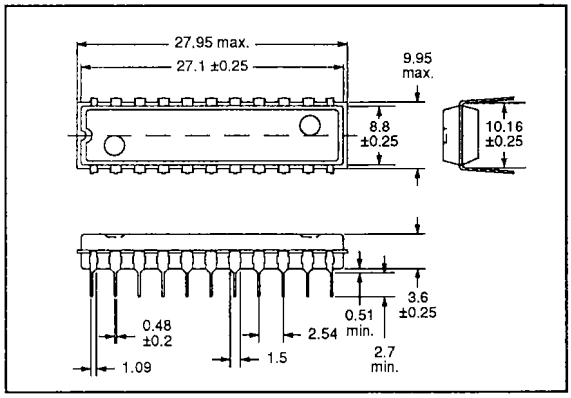
PINOUT



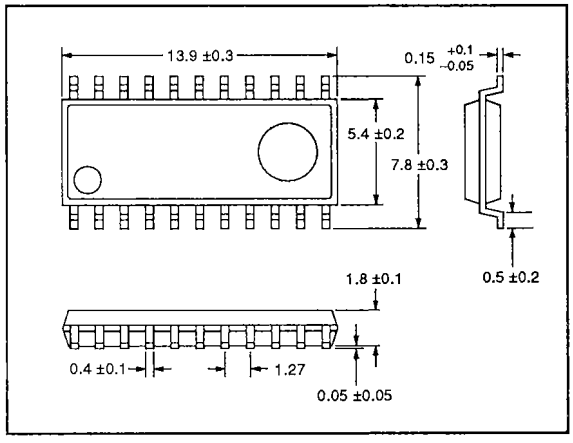
PACKAGE DIMENSIONS

Unit: mm

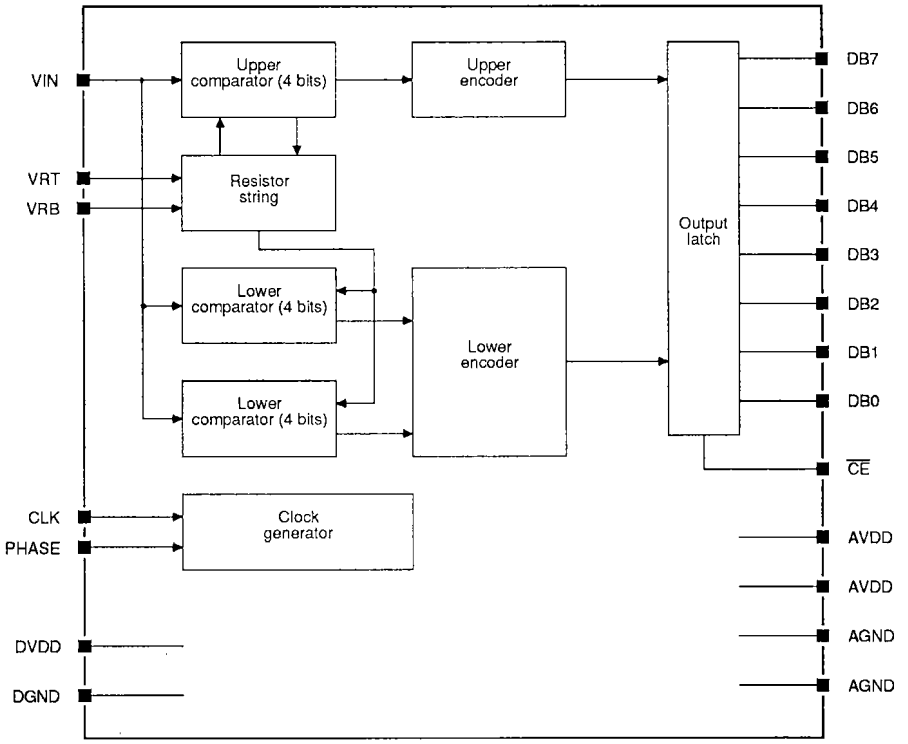
22-pin DIP



22-pin SOP



BLOCK DIAGRAM



PIN DESCRIPTION

Number	Name	Description
1	AVDD	Analog supply
2	VRT	Reference voltage (top end)
3	VIN	Analog input
4	AVDD	Analog supply
5	PHASE	Clock polarity switch control
6	$\overline{CE}$	Output tristate control
7	NC	No connection
8	NC	No connection
9	AGND	Analog ground
10	VRB	Reference voltage (bottom end)
11	AGND	Analog ground
12	DGND	Digital ground
13	DB0	Converter data output bit 0 (LSB)
14	DB1	Converter data output bit 1
15	DB2	Converter data output bit 2
16	DB3	Converter data output bit 3
17	DB4	Converter data output bit 4
18	DB5	Converter data output bit 5

Number	Name	Description
19	DB6	Converter data output bit 6
20	DB7	Converter data output bit 7 (MSB)
21	CLK	Clock input
22	DVDD	Digtal supply

SPECIFICATIONS

Absolute Maximum Ratings

V_{GND} = 0 V

Parameter	Symbol	Rating	Unit
Supply voltage range	V_{DD}	–0.3 to 7.0	V
Input voltage range	V_{IN}	–0.3 to V_{DD} + 0.3	V
Output voltage range	V_{OUT}	–0.3 to V_{DD} + 0.3	V
Storage temperature range	T_{stg}	–40 to 125	deg. C
Power dissipation	P_D	350	mW
Soldering temperature	T_{sld}	260	deg. C
Soldering time	t_{sld}	10	s

Recommended Operating Conditions

V_{GND} = 0 V

Parameter	Symbol	Rating			Unit
		min	typ	max	
Supply voltage	V_{DD}	4.75	5.0	5.25	V
Reference voltage (top end)	V_{RT}	V_{RB} + 2.0	–	V_{DD} + 0.1	V
Reference voltage (bottom end)	V_{RB}	–0.1	–	V_{RT} – 2.0	V
Analog full scale	V_{RT} – V_{RB}	2.0	–	–	V
Operating temperature	T_{opr}	–20	–	70	deg. C

DC Electrical Characteristics

V_{DD} = 5 V ±5%, f_{CLK} = 8 MHz, T_a = –20 to 70 deg. C unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
HIGH-level digital input voltage	V_{IH}		3. 5	–	–	V
LOW-level digital input voltage	V_{IL}		–	–	1.0	V
HIGH-level digital input current	I_{IH}	V_{IN} = V_{DD}	–	–	2	µA
LOW-level digital input current	I_{IL}	V_{IN} = 0 V	–2	–	–	µA
HIGH-level digital output voltage	V_{OH}	I_{OH} = –0.4 mA	2.7	–	–	V
LOW-level digital output voltage	V_{OL}	I_{OL} = 1.6 mA	–	–	0.4	V
HIGH-level tristate output leakage current	I_{OHL}	V_O = V_{DD}	–	–	3	µA

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
LOW-level tristate output leakage current	I_{OLL}	V_O = 0 V	–3	–	–	µA
Analog input resistance	R_{VIN}	V_{IN} = DC	1	–	–	MΩ
Analog input capacitance	C_{VIN}		–	30	–	pF
Reference resistance	R_{REF}	V_{RT} to V_{RB}	260	400	600	Ω
Current consumption	I_{DD}		–	20	30	mA

AC Electrical Characteristics

V_{DD} = 5 V ±5%, T_a = –20 to 70 deg. C unless otherwise noted

Parameter	Symbol	Rating			Unit
		min	typ	max	
CLK HIGH-level pulsewidth	t_{PWH}	60	–	5000	ns
CLK LOW-level pulsewidth	t_{PWL}	60	–	5000	ns
Aperture time	t_A	–	10	–	ns
Digital output delay time	t_D	–	25	40	ns
Conversion speed	FS	–	–	8	MSPS

Converter Characteristics

V_{DD} = 5 V ±5%, T_a = –20 to 70 deg. C unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Resolution	RES		–	–	8	Bits
Non-linearity error	NL	V_{RT} – V_{RB} = 2 V, V_{IN} = DC	–	–	±1.5	LSB
		V_{RT} – V_{RB} = 5 V, V_{IN} = DC	–	–	±1.0	
Differential non-linearity error	DNL	V_{RT} – V_{RB} = 2 V, V_{IN} = DC	–	–	±1.0	LSB
		V_{RT} – V_{RB} = 5 V, V_{IN} = DC	–	–	±0.75	

FUNCTIONAL DESCRIPTION

Converter Operation

The SM6102P/S uses a 2-step flash conversion method where one step sets the upper four bits and the next sets the lower four bits. The lower comparator comprises two circuits, A and B, which operate alternately at a rate set by the input clock frequency.

When PHASE = LOW

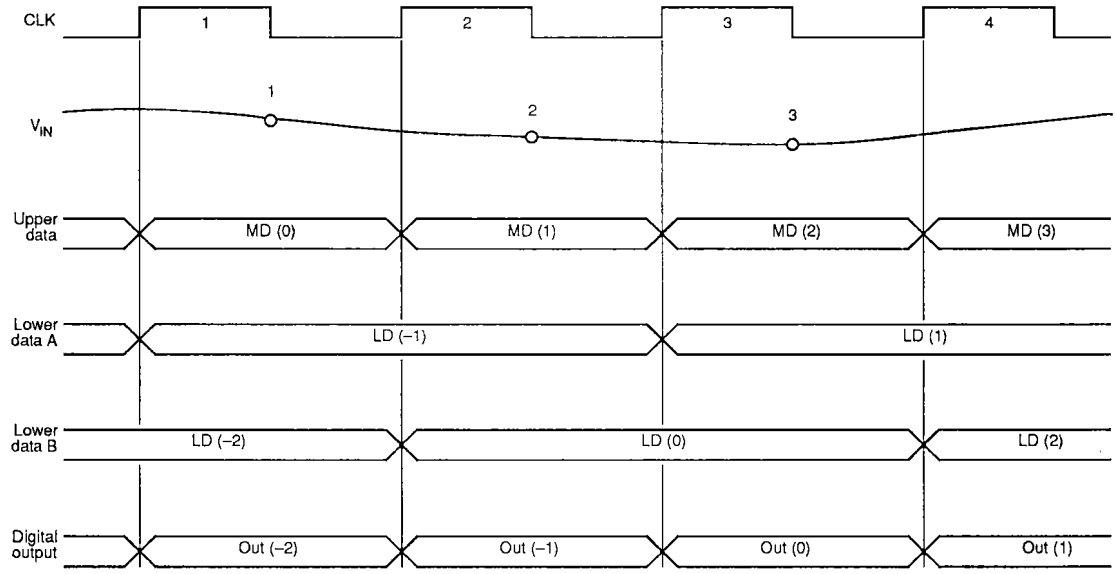
When CLK is HIGH, the upper and lower comparator (block A, for example) threshold voltages are balanced automatically. The analog input is then sampled on the first falling edge of CLK. On the second rising edge of CLK, the upper four bits are

set and the upper comparator sets the threshold voltage for the lower comparator. The lower four bits are set on the third rising edge of CLK. On the fourth rising edge of CLK, the upper and lower bits are re-combined and converted. The conversion, therefore, takes 2.5 clock cycles from the input sampling to the converter data output.

Lower comparator B operates identically to comparator A except that it is shifted by one clock cycle.

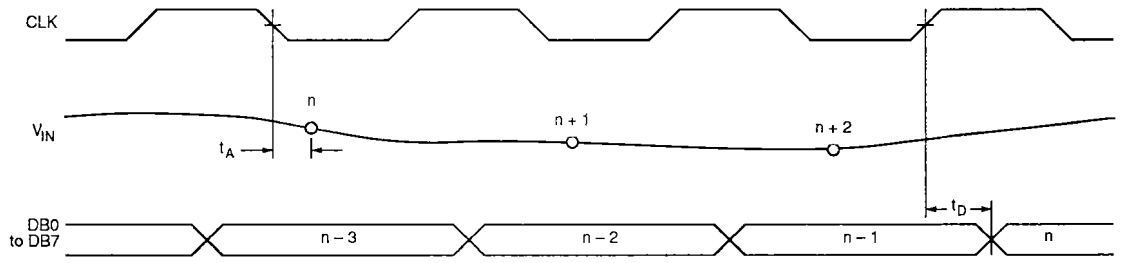
When PHASE = HIGH

The converter operates similarly as when PHASE is LOW, except that the CLK signal has opposite polarity.

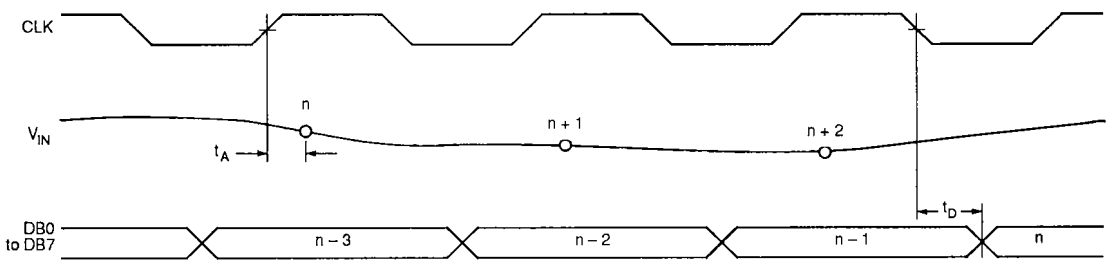


Converter Timing

PHASE = LOW



PHASE = HIGH



Output Tristate Control

$\overline{CE}$	DB0 to DB7
LOW	Enable
HIGH	High impedance

Output Codes

Analog input voltage (V)	Output code								Decimal steps
	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
0.00	0	0	0	0	0	0	0	0	0
0.01	0	0	0	0	0	0	0	1	1
0.02	0	0	0	0	0	0	1	0	2
0.03	0	0	0	0	0	0	1	1	3
0.04	0	0	0	0	0	1	0	0	4
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
2.51	1	1	1	1	1	0	1	1	251
2.52	1	1	1	1	1	1	0	0	252
2.53	1	1	1	1	1	1	0	1	253
2.54	1	1	1	1	1	1	1	0	254
2.55	1	1	1	1	1	1	1	1	255

Notes

1. The analog input voltage shown is the center voltage for each step.
2. V_{RT} and V_{RB} are adjusted such that the zero transition is 0.005 V and full-scale is 2.545 V.

DEVICE HANDLING PRECAUTIONS

1. Parallel electrolytic and ceramic filter capacitors should be connected to the supply and reference voltage pins.
2. The system ground should be connected to a single, common Earth.
3. As far as practicable, the analog input should be kept free of digital noise. For example, analog input wire on the printed circuit board should be screened by AGND.
4. The SM6102 uses CMOS chopper comparators where the analog input is alternately connected and disconnected from the input circuits. The analog inputs should, therefore, have a low impedance. Also, input buffering is recommended.

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