FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-28207-2E

ASSP for Image Processing

CMOS

A/D Converter (1-channel, 8-bit, 20MHz)

MB40C568

■ DESCRIPTION

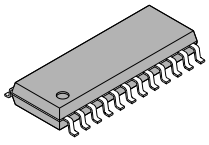
The MB40C568 is a high-speed A/D converter using high-speed CMOS process technology.

■ FEATURES

- Resolution: 8 bits
- Linearity error: ±0.20% (Typ.)
- Maximum conversion rate: 20 MSPS (Min.)
- Power supply voltage: Analog section +5.0 V
  Digital section +3.0 V or +5.0 V
- Digital input voltage range: TTL level
- Digital output voltage range: CMOS level compatible
- Analog input voltage range: 0.5 to 4 V (with 2 Vp-p)
- Analog input capacity: 15 pF (Typ.)
- Power consumption: 50 mW (Typical:@f_{CLK} = 20 MHz, AV_{DD} = 5 V, DV_{DD} = 3 V)
  60 mW (Typical:@f_{CLK} = 20 MHz, AV_{DD} = DV_{DD} = 5 V)
- Additional function: Reference voltage generator circuit: V_{REFT} = 3 V, V_{REFB} = 1 V
- Package options: SOP24, SSOP24

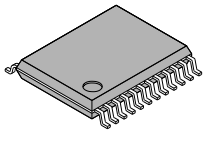
■ PACKAGES

24-pin, Plastic SOP



(FPT-24P-M01)

24-pin, Plastic SSOP

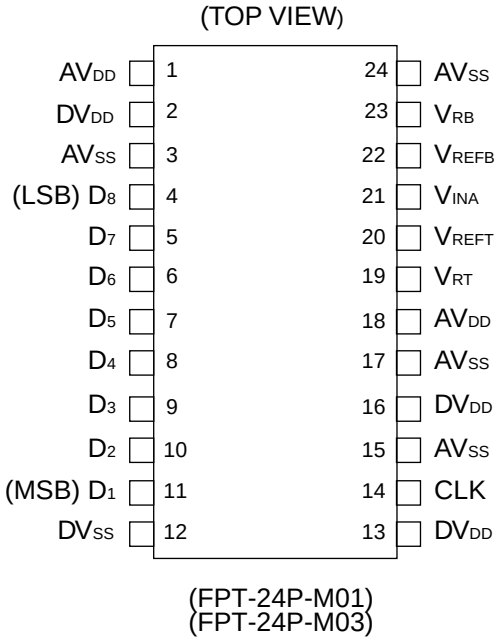


(FPT-24P-M03)

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

MB40C568

■ PIN ASSIGNMENT



(FPT-24P-M01)
(FPT-24P-M03)

■ PIN DESCRIPTION

Pin No.	Pin name	Functions
1, 18	AV_{DD}	Analog power supply pins (+5 V)
2, 13, 16	DV_{DD}	Digital power supply pins (+3 or +5 V)
3, 15, 17, 24	AV_{SS}	Analog power ground pins (0 V)
12	DV_{SS}	Digital power ground pin (0 V)
4 to 11	D_1 to D_8	Digital output pins. D_1: MSB, D_8: LSB
14	CLK	Clock input pin
21	V_{INA}	Analog input pin. Input range: V_{RB} to V_{RT} (2 Vp-p between 0.5 to 4 V)
19	V_{RT}	Reference voltage input pin (3 V)
20	V_{REFT}	Reference voltage output pin. When connected to V_{RT}, the pin generates $0.6 \times AV_{DD}$ (3 V).
23	V_{RB}	Reference voltage input pin (1 V)
22	V_{REFB}	Reference voltage output pin. When connected to V_{RB}, the pin generates $0.2 \times AV_{DD}$ (1 V).

Values within ( ) are typical values.

■ NOTES ON USE

- Be sure to bypass the AV_{DD}, DV_{DD}, V_{RT} and V_{RB} pins to the ground using a high-frequency capacitor. The high-frequency capacitor should be connected as near the pin as possible.
- Provide four clocks or more immediately after the power up to prevent current dissipation due to the indeterminate internal logic.

■ ABSOLUTE MAXIMUM RATINGS (See WARNING)

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	AV_{DD}, DV_{DD}	–0.3	7.0	V
Input voltage	CLK, V_{INA} V_{RT}, V_{RB}	–0.3	AV_{DD}+0.3	V
Output voltage	D_1 to D_8	–0.3	DV_{DD}+0.3	V
Storage temperature	Tstg	–55	+125	°C

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Analog input voltage	V_{INA}	V_{RB}	–	V_{RT}	V
Analog reference voltage: T	V_{RT}	–	–	4.00	V
Analog reference voltage: B	V_{RB}	0.50	–	–	V
Analog reference voltage range	V_{RT}–V_{RB}	1.90	2.00	2.10	V
Digital "H" level input voltage	V_{IHD}	2.4	–	–	V
Digital “L” level input voltage	V_{ILD}	–	–	0.8	V
Digital input current	I_{ID}	–	–	5	µA
Clock frequency	f_{CLK}	0.1	–	20	MHz
Minimum “H” level clock pulse width	tw^+	22.5	–	–	ns
Minimum “L” level clock pulse width	tw^-	22.5	–	–	ns
Operating temperature range	Ta	–20	–	70	°C

WARNING: Recommended operating conditions are normal operating ranges for the semiconductor device. All the device’s electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representative beforehand.

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- **When using a single power supply**

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Power supply voltage	AV_{DD}, DV_{DD}	4.75	5.00	5.25	V

- **When using dual power supplies**

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Power supply voltage	AV_{DD}	4.75	5.00	5.25	V
	DV_{DD}	2.70	3.00	3.30	V

WARNING: Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representative beforehand.

■ ELECTRICAL CHARACTERISTICS (Using a Single Power Supply)

DC Characteristics

(1) Analog section

(AV_{DD} = DV_{DD} = 4.75 V to +5.25 V, Ta = –20°C to +70°C)

Parameter		Symbol	Value			Unit
			Min.	Typ.	Max.	
Resolution		–	–	8	–	bit
Linearity error	DC precision	LE	–	±0.20	±0.30	%
Differential linearity error		DLE	–	±0.12	±0.20	%
Analog input capacity		C_{INA}	–	15	–	pF
Reference voltage: T		V_{REFT}	–	0.6 × AV_{DD}	–	V
Reference voltage: B		V_{REFB}	–	0.2 × AV_{DD}	–	V
Reference current		I_{RB}	–16.0	–8.0	–2.0	mA
Analog power supply current		AI_{DD}	–	8.0	14.0	mA
Digital power supply current		DI_{DD}	–	4.0	7.0	mA

(2) Digital section

(AV_{DD} = DV_{DD} = 4.75 V to +5.25 V, Ta = –20°C to +70°C)

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Digital “H” level output voltage	V_{OHD}	4.2	–	DV_{DD}	V
Digital “L” level output voltage	V_{OLD}	–	–	0.4	V
Digital “H” level output current	I_{OH}	–400	–	–	µA
Digital “L” level output current	I_{OL}	–	–	1.6	mA

(3) Switching section

(AV_{DD} = DV_{DD} = 4.75 V to +5.25 V, Ta = –20°C to +70°C)

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Maximum conversion rate	fs	20	–	–	MSPS
Digital output delay time	tpd	0	5	20	ns

■ ELECTRICAL CHARACTERISTICS (Using Dual Power Supplies)

DC Characteristics

(1) Analog section

(AV_{DD} = 4.75 V to +5.25 V, DV_{DD} = 2.70 V to +3.30 V Ta = –20°C to +70°C)

Parameter		Symbol	Value			Unit
			Min.	Typ.	Max.	
Resolution		–	–	8	–	bit
Linearity error	DC precision	LE	–	±0.20	±0.30	%
Differential linearity error		DLE	–	±0.12	±0.20	%
Analog input capacity		C_{INA}	–	15	–	pF
Reference voltage: T		V_{REFT}	–	0.6 × AV_{DD}	–	V
Reference voltage: B		V_{REFB}	–	0.2 × AV_{DD}	–	V
Reference current		I_{RB}	–16.0	–8.0	–2.0	mA
Analog power supply current		AI_{DD}	–	8.0	14.0	mA
Digital power supply current		DI_{DD}	–	3.0	5.0	mA

(2) Digital section

(AV_{DD} = 4.75 V to +5.25 V, DV_{DD} = 2.70 V to +3.30 V Ta = –20°C to +70°C)

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Digital “H” level output voltage	V_{OHD}	2.4	–	DV_{DD}	V
Digital “L” level output voltage	V_{OLD}	–	–	0.4	V
Digital “H” level output current	I_{OH}	–400	–	–	µA
Digital “L” level output current	I_{OL}	–	–	1.6	mA

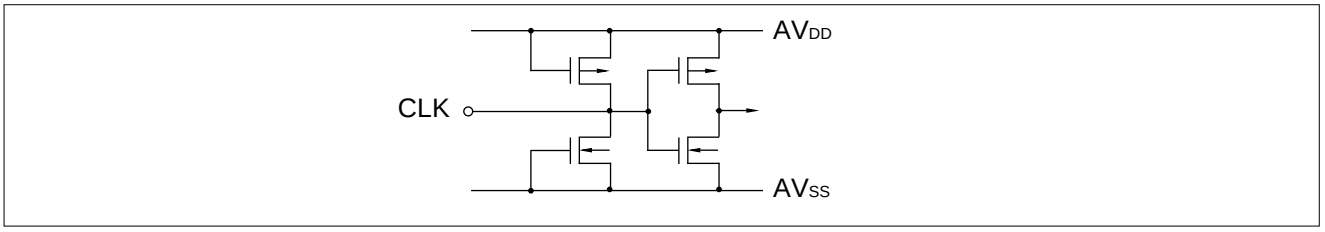
(3) Switching section

(AV_{DD} = 4.75 V to +5.25 V, DV_{DD} = 2.70 V to +3.30 V Ta = –20°C to +70°C)

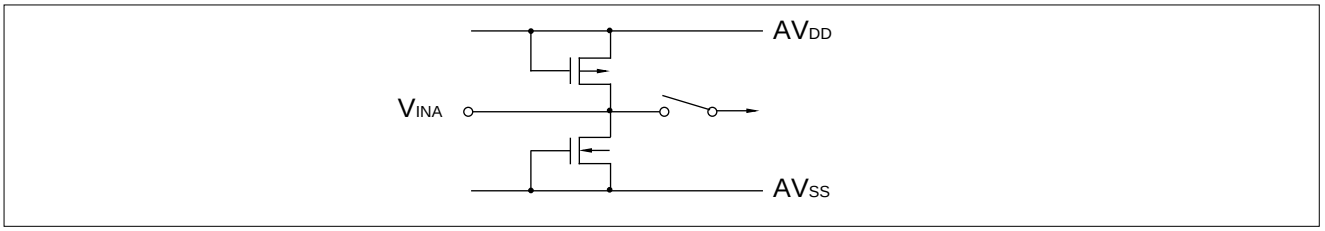
Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Maximum conversion rate	fs	20	–	–	MSPS
Digital output delay time	tpd	0	6	25	ns

■ EQUIVALENT CIRCUIT

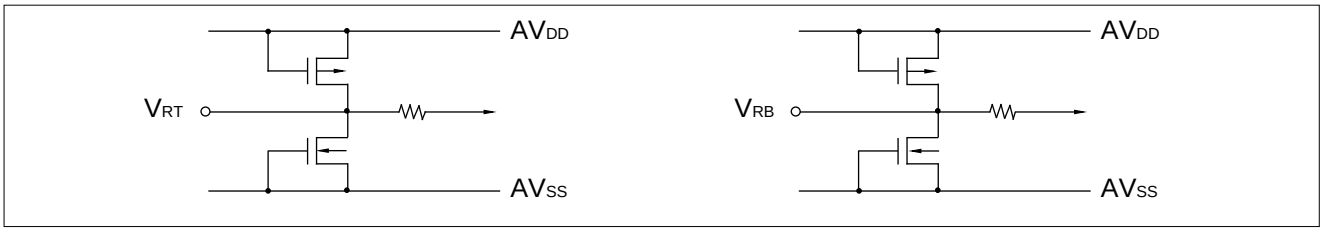
• Clock input



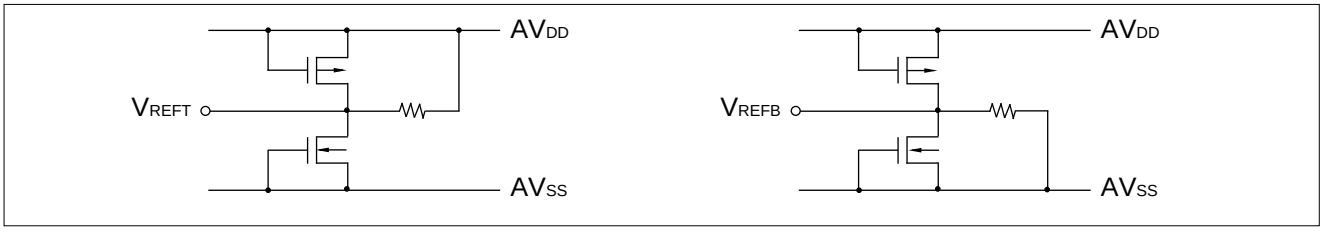
• Analog input



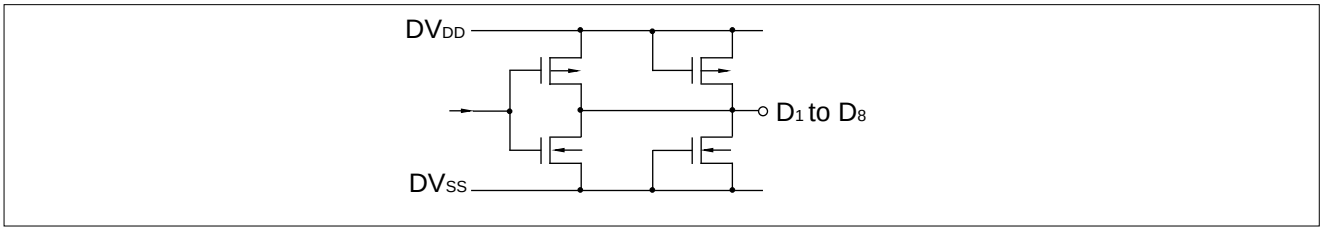
• Reference voltage input



• Reference voltage output



• Digital output



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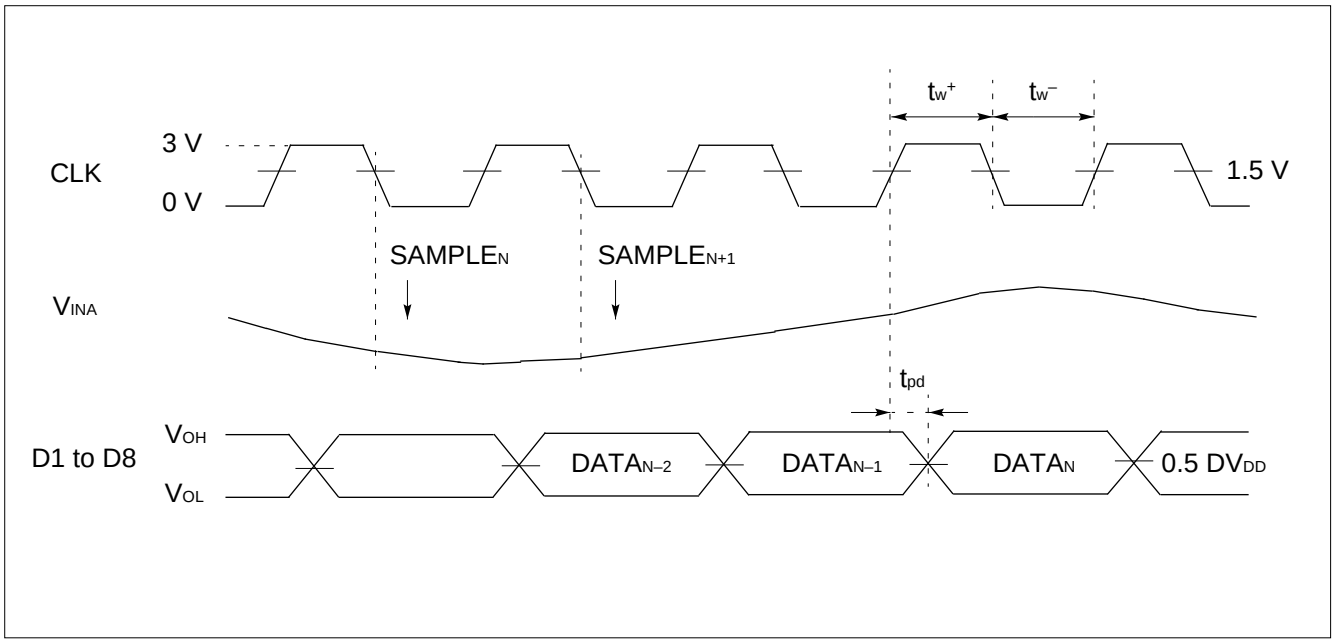
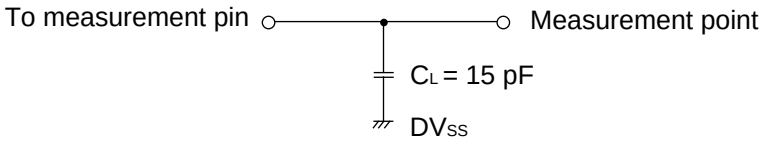
■ TIMING CHART



■ DIGITAL OUTPUT BUFFER LOAD CIRCUIT



(Note) C_L value includes the floating capacitance of the jig and probe.

■ ORDERING INFORMATION

Part number	Package	Remarks
MB40C568PF	24-pin, Plastic SOP (FPT-24P-M01)	
MB40C568PFV	24-pin, Plastic SSOP (FPT-24P-M03)	

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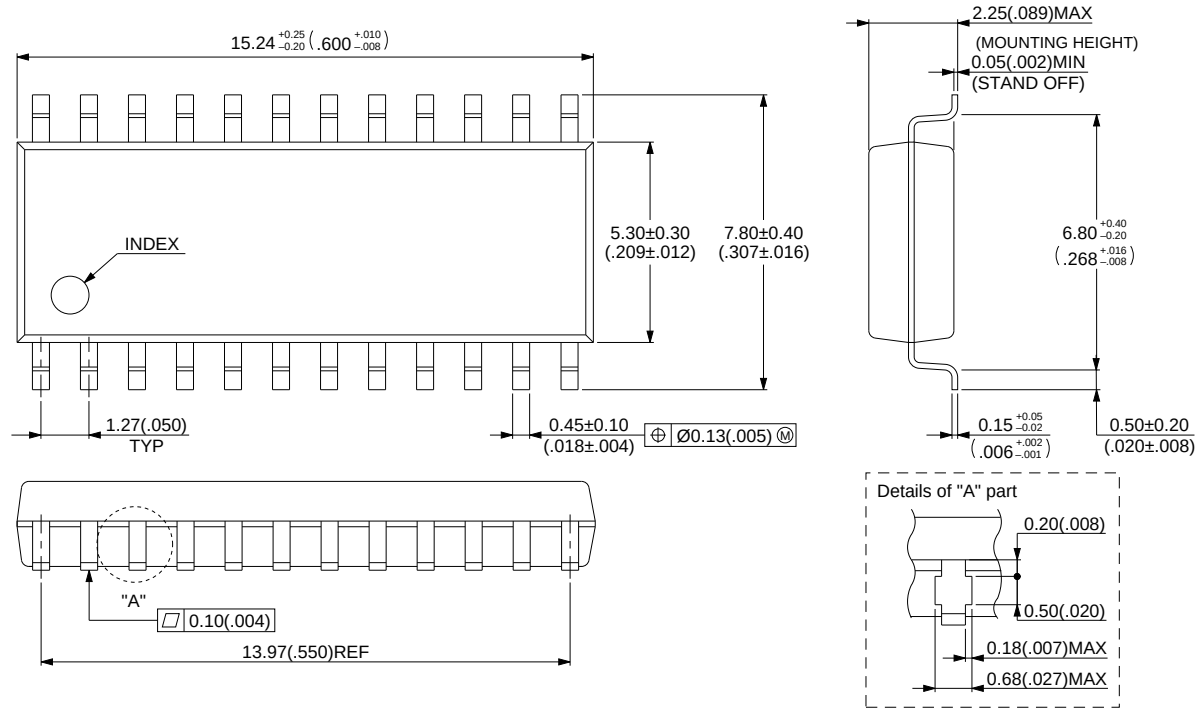
■ PACKAGE DIMENSIONS

24-pin, Plastic SOP
(FPT-24P-M01)



Dimensions in mm (inches).

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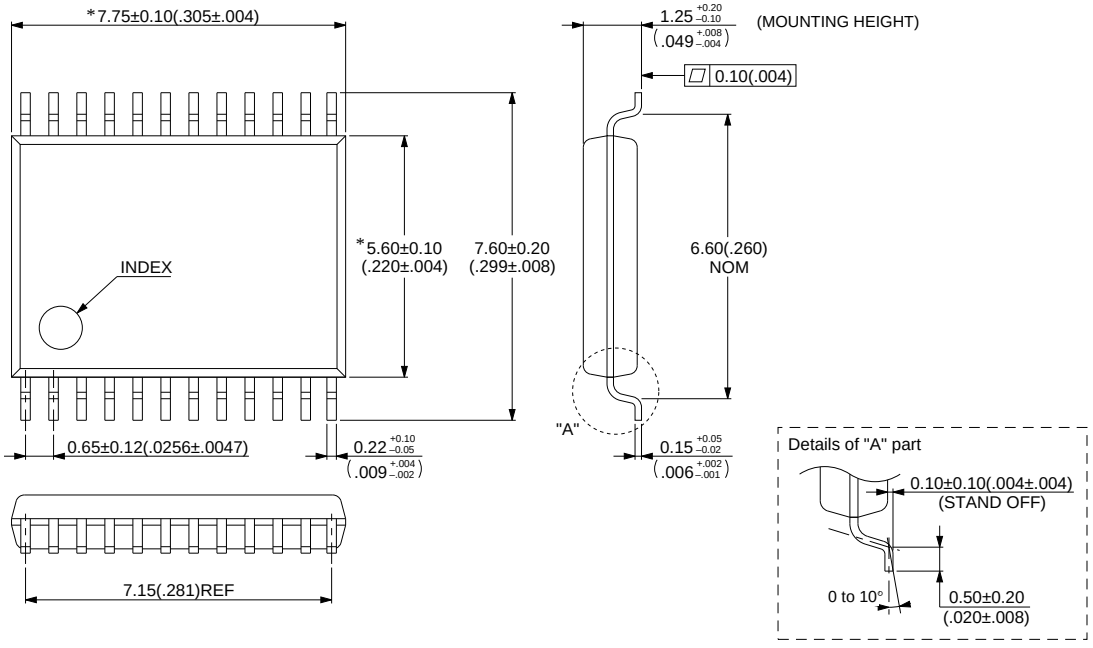
24-pin, Plastic SSOP
(FPT-24P-M03)

*: These dimensions do not include resin protrusion.



Dimensions in mm (inches).

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