

ASSP for Image Processing

CMOS

A/D Converter (1-channel, 8-bit, 45MHz)

MB40C558

DESCRIPTION

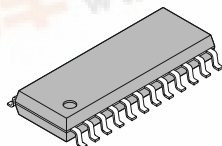
The MB40C558 is a high-speed A/D converter using high-speed CMOS process technology.

FEATURES

- Resolution: 8 bits
- Linearity error: $\pm 0.20\%$ (Typ.)
- Maximum conversion rate: 45 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 3 V (with 2 Vp-p)
- Analog input capacity: 15 pF (Typ.)
- Power consumption: 110 mW (Typical: @f_{CLK} = 45 MHz, AV_{DD} = 5 V, DV_{DD} = 3 V)
135 mW (Typical: @f_{CLK} = 45 MHz, AV_{DD} = 5 V, DV_{DD} = 3 V)
- Additional function: Reference voltage generator circuit: V_{REFT} = 3 V, V_{REFB} = 1 V
- Package options: SOP24, SSOP24

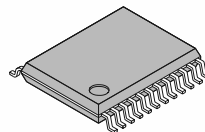
PACKAGES

24-pin, Plastic SOP



(FPT-24P-M01)

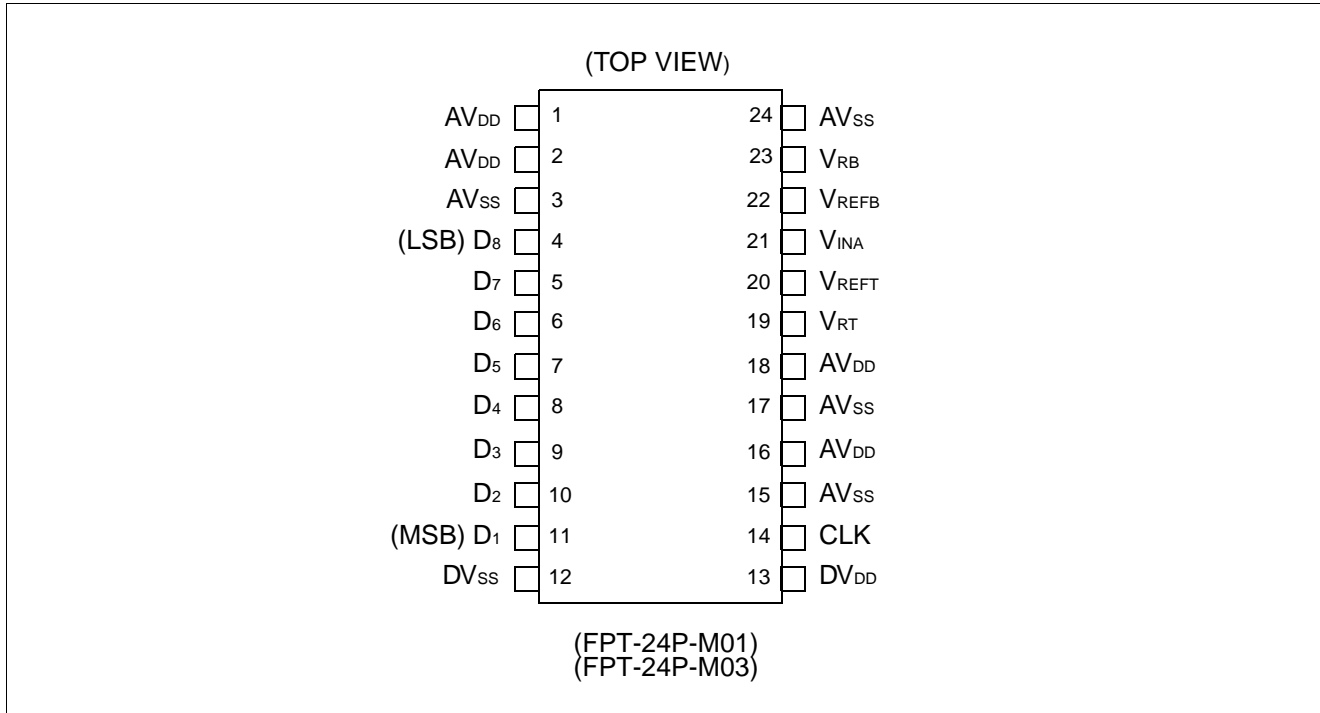
24-pin, Plastic SSOP



(FPT-24P-M03)

MB40C558

PIN ASSIGNMENT



PIN DESCRIPTION

| Pin No. | Pin name | Functions |
|---------------|----------------------------------|---|
| 1, 2, 16, 18 | AV _{DD} | Analog power supply pins (+5 V) |
| 13 | DV _{DD} | Digital power supply pin (+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 V _{p-p} between 0.5 to 3 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 × 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 × 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 | T _{stg} | -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} | — | — | 3.00 | 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 | — | 45 | MHz |
| Minimum "H" level clock pulse width | tw ⁺ | 10.0 | — | — | ns |
| Minimum "L" level clock pulse width | tw ⁻ | 10.0 | — | — | ns |
| Operating temperature range | T _a | -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.

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■ ELECTRICAL CHARACTERISTICS (Using a Single Power Supply)

DC Characteristics

(1) Analog section

($AV_{DD} = DV_{DD} = 4.75\text{ V to }+5.25\text{ V}$, $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$)

| 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} | — | 18.0 | 31.0 | mA |
| Digital power supply current | | DI _{DD} | — | 9.0 | 15.0 | mA |

(2) Digital section

($AV_{DD} = DV_{DD} = 4.75\text{ V to }+5.25\text{ V}$, $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$)

| 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

($AV_{DD} = DV_{DD} = 4.75\text{ V to }+5.25\text{ V}$, $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$)

| Parameter | Symbol | Value | | | Unit |
|---------------------------|--------|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| Maximum conversion rate | fs | 45 | — | — | MSPS |
| Digital output delay time | tpd | 0 | 5 | 14 | ns |

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■ ELECTRICAL CHARACTERISTICS (Using Dual Power Supplies)

DC Characteristics

(1) Analog section

($AV_{DD} = 4.75\text{ V to }+5.25\text{ V}$, $DV_{DD} = 2.70\text{ V to }+3.30\text{ V}$ $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$)

| 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} | — | 18.0 | 31.0 | mA |
| Digital power supply current | | DI _{DD} | — | 6.0 | 10.0 | mA |

(2) Digital section

($AV_{DD} = 4.75\text{ V to }+5.25\text{ V}$, $DV_{DD} = 2.70\text{ V to }+3.30\text{ V}$ $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$)

| 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 |

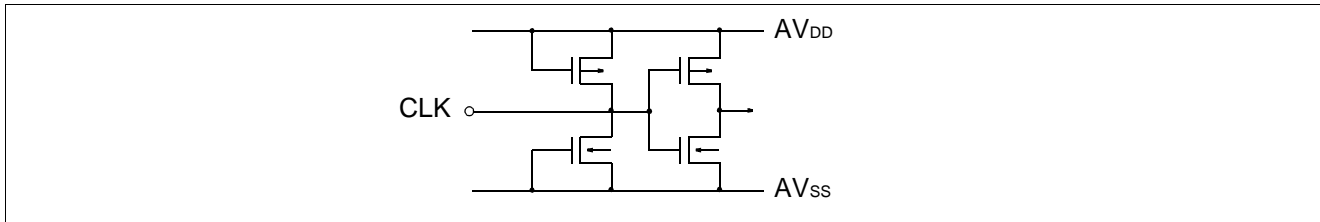
(3) Switching section

($AV_{DD} = 4.75\text{ V to }+5.25\text{ V}$, $DV_{DD} = 2.70\text{ V to }+3.30\text{ V}$ $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$)

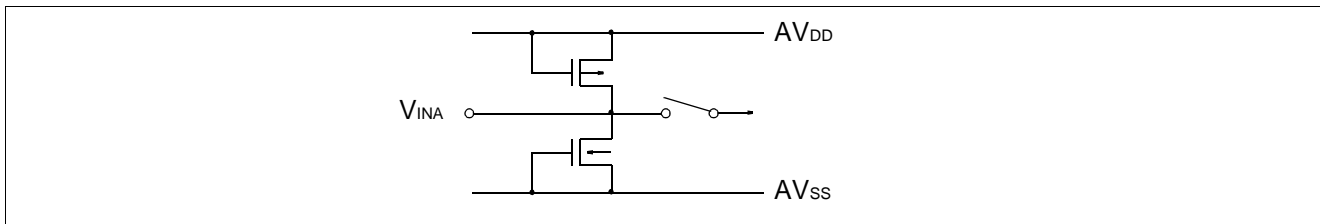
| Parameter | Symbol | Value | | | Unit |
|---------------------------|--------|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| Maximum conversion rate | fs | 45 | — | — | MSPS |
| Digital output delay time | tpd | 0 | 6 | 15 | ns |

■ EQUIVALENT CIRCUIT

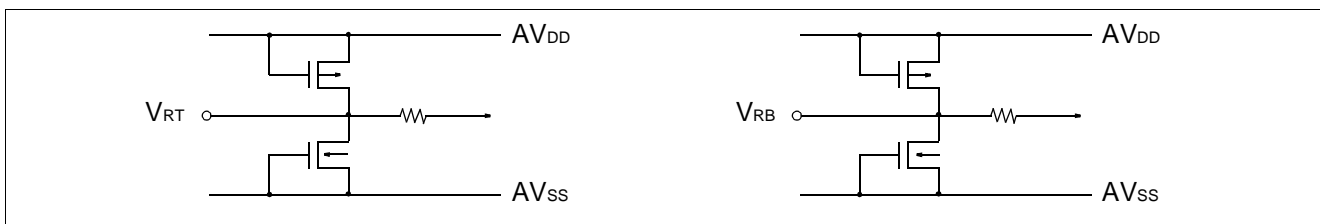
• Clock input



• Analog input



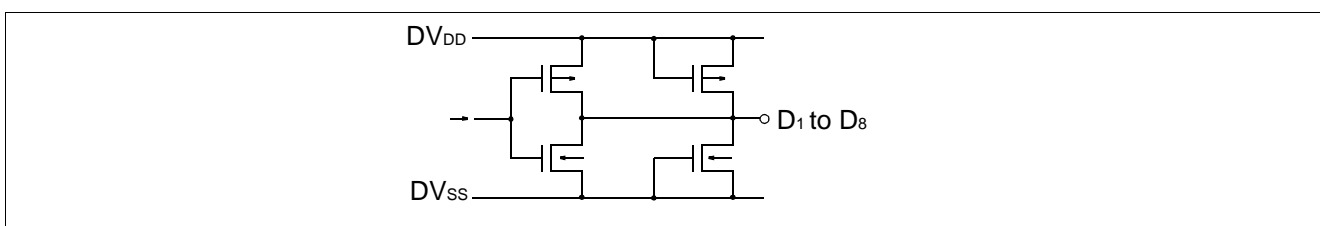
• Reference voltage input



• Reference voltage output

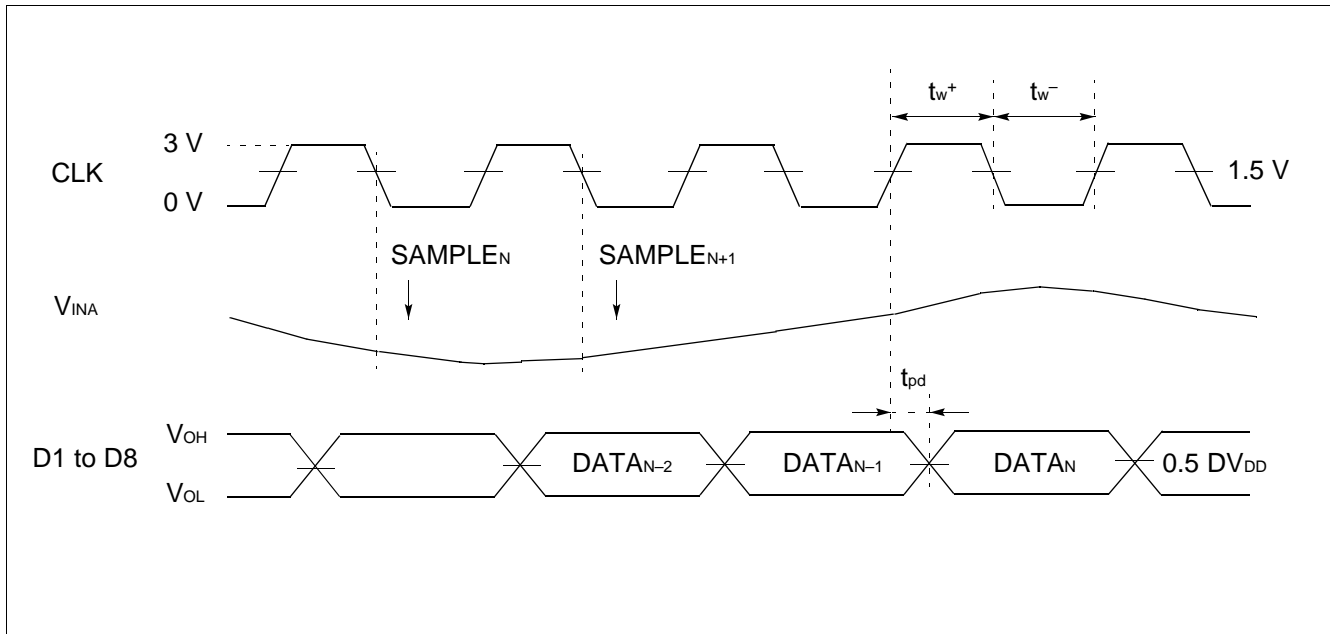


• Digital output

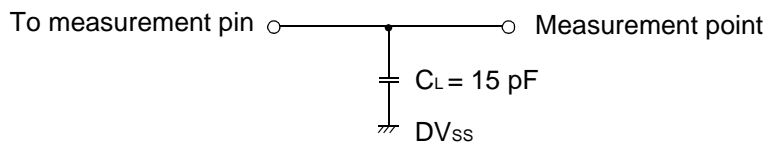


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■ TIMING CHART



■ DIGITAL OUTPUT BUFFER LOAD CIRCUIT



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

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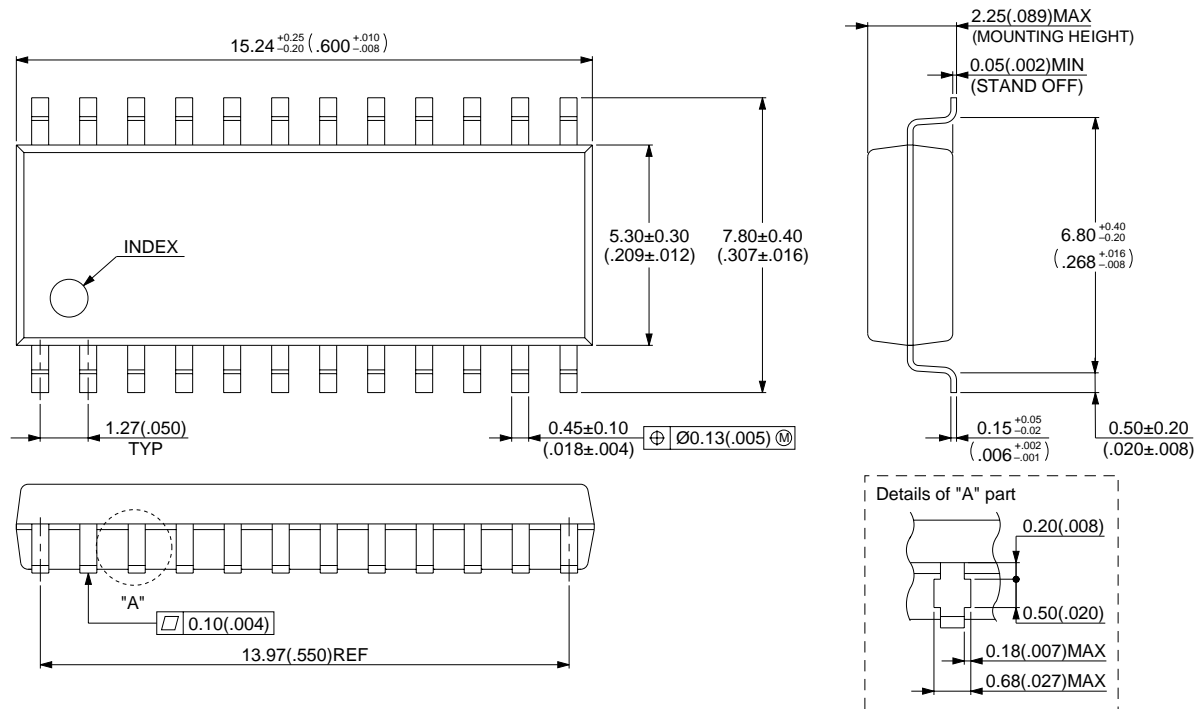
■ ORDERING INFORMATION

| Part number | Package | Remarks |
|-------------|---------------------------------------|---------|
| MB40C558PF | 24-pin, Plastic SOP (FPT-24P-M01) | |
| MB40C558PFV | 24-pin, Plastic SSOP (FPT-24P-M03) | |

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■ PACKAGE DIMENSIONS

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



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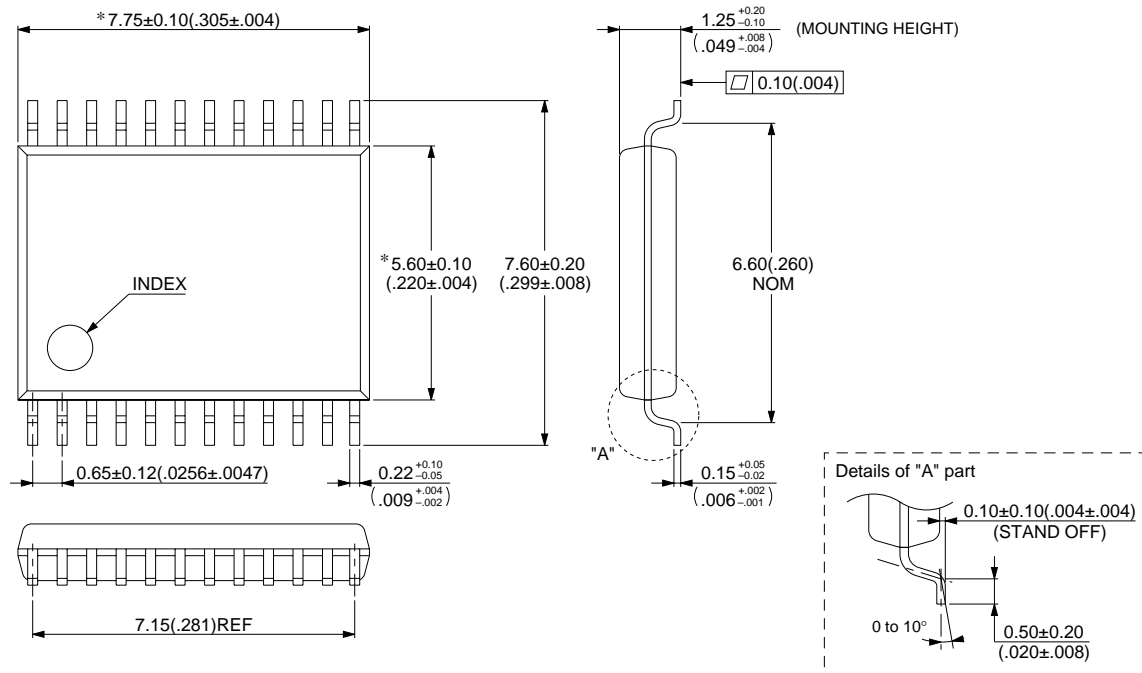
Dimensions in mm (inches).

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(FPT-24P-M03)

*: These dimensions do not include resin protrusion.



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