

# *ASSP Image Processing*

## BIPOLAR

# A/D Converter

(1-channel, 8-bit low-power model with built-in clamp circuit)

# MB40568

## ■ DESCRIPTION

The MB40568 is an all-parallel (flash type) A/D converter for 8-bit video applications, and uses high-speed bipolar process technology for low-power consumption and high-speed conversion.

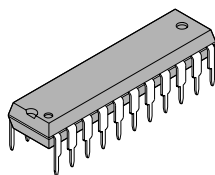
This A/D converter is capable of converting analog signals into digital signals at a rate of DC to 20 MSPS (megasamples per second). Additional circuitry including a clamp circuit and reference voltage generator circuits are build in, to make the MB40568 ideally suited for video signal processing.

## ■ FEATURES

- Resolution: 8 bits
- Linearity error:  $\pm 0.15$  % typ.
- Maximum conversion rate: 20 MSPS min.
- Analog input voltage: 0 to 3 V in 2  $V_{P-P}$  (clamp circuit)  
3 to 5 V (without clamp circuit)
- Digital input/output level: TTL Levels
- Power supply voltage: +5 V single power supply
- Power dissipation: 200 mW typ.

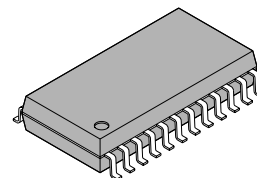
## ■ PACKAGES

22-pin Plastic SK-DIP



(DIP-22P-M04)

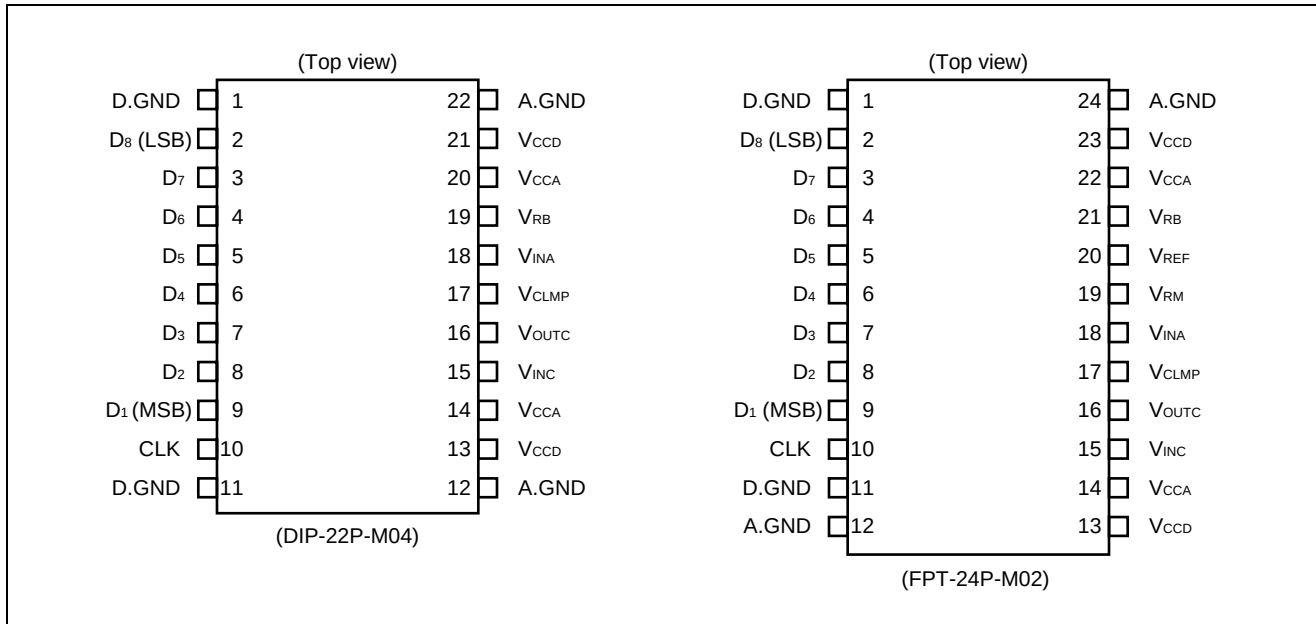
24-pin Plastic SOP



(FPT-24P-M02)

# MB40568

## PIN ASSIGNMENTS



## PIN DESCRIPTIONS

| Pin no. |        | Symbol                           | Function                                                                                                                                                                                   |
|---------|--------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DIP     | SOP    |                                  |                                                                                                                                                                                            |
| 1, 11   | 1, 11  | D.GND                            | Ground pin<br>Should be connected to the analog system ground.                                                                                                                             |
| 2 to 9  | 2 to 9 | D <sub>8</sub> to D <sub>1</sub> | Digital signal output pin                                                                                                                                                                  |
| 10      | 10     | CLK                              | Clock input pin                                                                                                                                                                            |
| 12, 22  | 12, 24 | A.GND                            | Ground pin<br>Should be connected to the analog system ground.                                                                                                                             |
| 13, 21  | 13, 23 | V <sub>CCD</sub>                 | Power supply voltage input pin<br>Also functions as V <sub>CCA</sub> power supply, and should be in the same voltage level as V <sub>CCA</sub> pin.                                        |
| 14, 20  | 14, 22 | V <sub>CCA</sub>                 | Power supply voltage input pin<br>Also functions as V <sub>CCD</sub> power supply, and should be in the same voltage level as V <sub>CCD</sub> pin.                                        |
| 15      | 15     | V <sub>INC</sub>                 | Clamp circuit input pin<br>The clamp circuit is a diode-clamp type sync chip clamp circuit.<br>Should be shorted to ground if the clamp circuit is not used.                               |
| 16      | 16     | V <sub>OUTC</sub>                | Clamp circuit output pin<br>A capacitor of at least 1 $\mu$ F should be connected between this pin and the V <sub>CLMP</sub> pin.<br>Should be left open if the clamp circuit is not used. |

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## MB40568

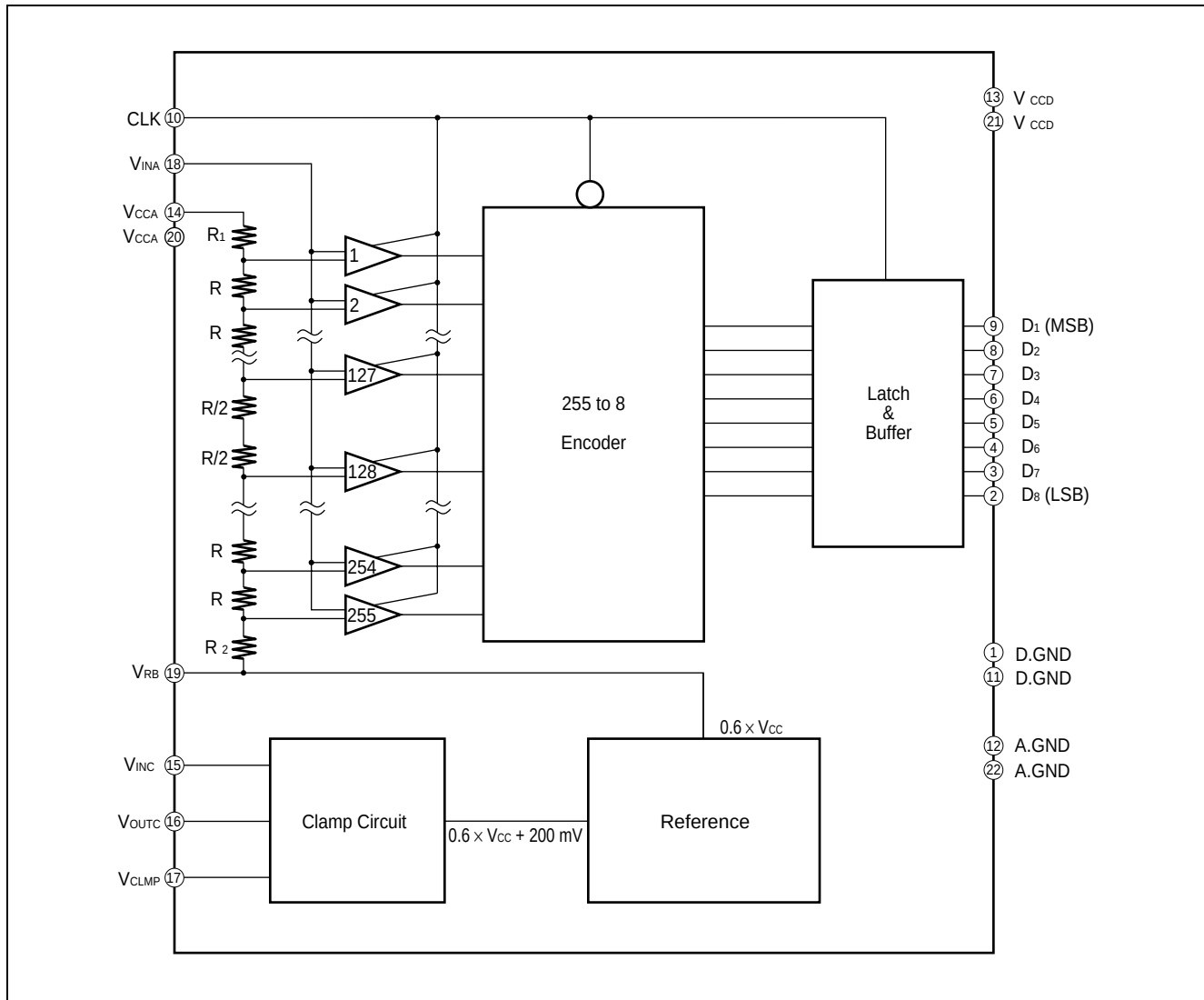
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| Pin no. |     | Symbol     | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------|-----|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DIP     | SOP |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 17      | 17  | $V_{CLMP}$ | Clamp voltage output pin<br>A capacitor of at least 1 $\mu F$ should be connected between this pin and the $V_{OUTC}$ pin.<br>Should be left open if the clamp circuit is not used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 18      | 18  | $V_{INA}$  | Analog signal input pin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 19      | —   | $V_{RB}$   | Analog reference voltage pin<br>In the DIP model, this pin is internally connected to the reference circuit.<br>Always be sure that a capacitor is connected immediately next to the IC, between this pin and the ground. The capacitor must be at least 1 $\mu F$ with excellent frequency characteristics.                                                                                                                                                                                                                                                                                                                                           |
| —       | 19  | $V_{RM}$   | Reference voltage monitor pin<br>Set to the midpoint of resistance between $V_{CCA}$ and $V_{RB}$ .<br>Should be left open in normal use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| —       | 20  | $V_{REF}$  | Reference voltage output pin<br>Should be left open when no reference voltage source is used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| —       | 21  | $V_{RB}$   | Analog reference voltage input pin<br>When an internal reference voltage source is used, this pin should be shorted to the $V_{REF}$ pin. In this case, always be sure that a capacitor is connected immediately next to the IC, between this pin and the ground. The capacitor must be at least 1 $\mu F$ with excellent frequency characteristics.<br>When an external reference voltage source is used, this pin will carry a current of up to 8.5 mA, therefore it is necessary to use a voltage source with sufficient sync capacity.<br>A capacitor connection should also be used similar to that used with internal reference voltage sources. |

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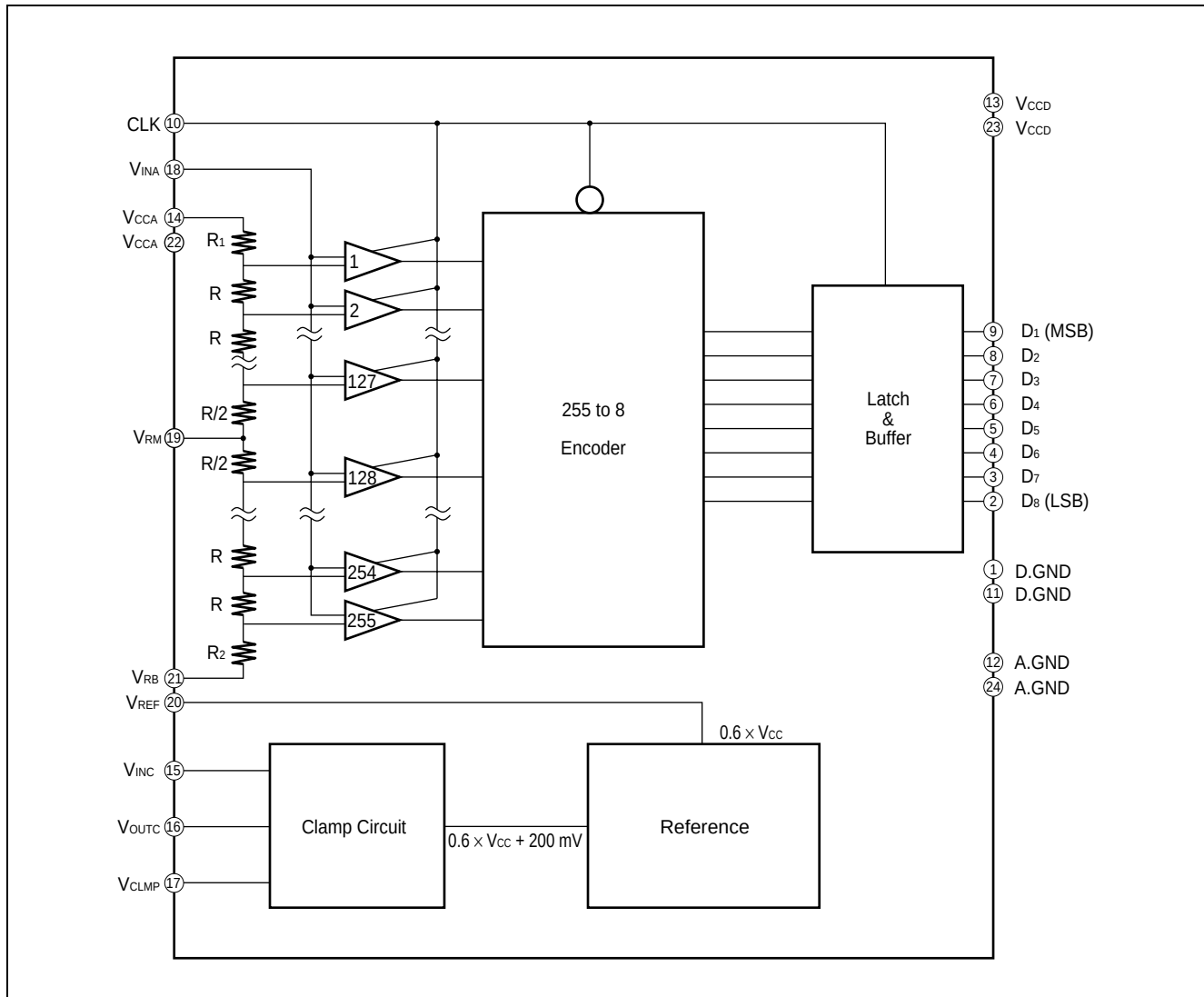
## ■ BLOCK DIAGRAMS

### 1. SK-DIP



## MB40568

## 2. SOP



# MB40568

## ■ ABSOLUTE MAXIMUM RATINGS (See WARNING)

| Parameter                   | Symbol             | Rating                 | Unit |
|-----------------------------|--------------------|------------------------|------|
| Power supply voltage        | $V_{CCA}, V_{CCD}$ | -0.5 to +7.0           | V    |
| Digital input voltage       | $V_{IND}$          | -0.5 to +7.0           | V    |
| Analog input voltage        | $V_{INA}$          | -0.5 to $V_{CC} + 0.5$ | V    |
| Analog reference voltage*   | $V_{RB}$           | -0.5 to $V_{CC} + 0.5$ | V    |
| Clamp circuit input voltage | $V_{INC}$          | -0.5 to $V_{CC} + 0.5$ | V    |
| Storage temperature         | $T_{stg}$          | -55 to +125            | °C   |

\* : Package : SOP

$V_{CCA} = 2.0 \pm 0.1$  V,  $V_{RB} = 2.0 \pm 0.1$  V

**WARNING:** Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ■ RECOMMENDED OPERATING CONDITIONS

| Parameter                                 | Symbol             | Value    |      |           | Unit |
|-------------------------------------------|--------------------|----------|------|-----------|------|
|                                           |                    | Min.     | Typ. | Max.      |      |
| Power supply voltage* <sup>1</sup>        | $V_{CCA}, V_{CCD}$ | 4.75     | 5.00 | 5.25      | V    |
| Analog input voltage                      | $V_{INA}$          | $V_{RB}$ | —    | $V_{CCA}$ | V    |
| Analog reference voltage* <sup>2</sup>    | $V_{RB}$           | 2.75     | 3    | 3.25      | V    |
| Clamp circuit input voltage* <sup>3</sup> | $V_{INC}$          | 0        | —    | 3         | V    |
| Clamp capacitance                         | $C_{CLMP}$         | 1        | —    | —         | μF   |
| Digital high-level output voltage         | $I_{OH}$           | -400     | —    | —         | μA   |
| Digital low-level output voltage          | $I_{OL}$           | —        | —    | 1.6       | mA   |
| Clock pulse width at high-level           | $t_{w^+}$          | 22.5     | —    | —         | ns   |
| Clock pulse width at low-level            | $t_{w^-}$          | 22.5     | —    | —         | ns   |
| Operating temperature                     | $T_{op}$           | 0        | —    | 70        | °C   |

\*1:  $V_{CCA}$  and  $V_{CCD}$  must be used in the same voltage level.

\*2: Package : SOP

$V_{CCA} = 2.0 \pm 0.1$  V,  $V_{RB} = 2.0 \pm 0.1$  V

\*3:  $V_{INC}$  must have an amplitude of  $V_{CCA} - V_{CLMP}$

## MB40568

## ■ ELECTRIC CHARACTERISTICS

## 1. DC Characteristics

## (1) Analog DC Characteristics

(V<sub>CCA</sub> = V<sub>CCD</sub> = 4.75 to 5.25 V, Ta = 0°C to +70°C)

| Parameter                          | Symbol            | Value                         |                       |                               | Unit | Remarks                                                              |
|------------------------------------|-------------------|-------------------------------|-----------------------|-------------------------------|------|----------------------------------------------------------------------|
|                                    |                   | Min.                          | Typ.                  | Max.                          |      |                                                                      |
| Resolution                         | —                 | —                             | —                     | 8                             | bits |                                                                      |
| Linearity error*                   | LE                | —                             | ±0.15                 | ±0.3                          | %    | DC Accuracy                                                          |
| Equivalent analog input resistance | R <sub>INA</sub>  | 300                           | —                     | —                             | kΩ   | $R_{INA} = \frac{V_{CCA} - V_{RB}}{I_{IHA} - I_{ILA}}$               |
| Analog input capacitance           | C <sub>INA</sub>  | —                             | 40                    | 50                            | pF   | f <sub>INA</sub> = 1MHz                                              |
| Analog high-level input current    | I <sub>IHA</sub>  | —                             | —                     | 45                            | μA   | V <sub>INA</sub> = V <sub>CCA</sub>                                  |
| Analog low-level input current     | I <sub>ILA</sub>  | —                             | —                     | 40                            | μA   | V <sub>INA</sub> = V <sub>RB</sub>                                   |
| Clamp circuit input current        | I <sub>INC</sub>  | −600                          | −200                  | —                             | μA   | V <sub>INC</sub> = 0 V                                               |
| Reference voltage                  | V <sub>RB</sub>   | 0.6 × V <sub>CC</sub><br>−0.1 | 0.6 × V <sub>CC</sub> | 0.6 × V <sub>CC</sub><br>+0.1 | V    | SK-DIP22P package                                                    |
|                                    | V <sub>REF</sub>  |                               |                       |                               |      | SOP24P package<br>Short between V <sub>REF</sub> and V <sub>RB</sub> |
| Clamp voltage                      | V <sub>CLMP</sub> | —                             | V <sub>RB</sub> + 0.2 | —                             | V    |                                                                      |
| Reference current                  | I <sub>RB</sub>   | −8.5                          | −5.5                  | −3.0                          | mA   | SOP24P package                                                       |

\* : V<sub>CCA</sub> = V<sub>CCD</sub> = 5.00 V, Ta = +25°C

## (2) Digital DC Characteristics

(V<sub>CCA</sub> = V<sub>CCD</sub> = 4.75 to 5.25 V, Ta = 0°C to +70°C)

| Parameter                         | Symbol           | Value |      |      | Unit | Remarks                   |
|-----------------------------------|------------------|-------|------|------|------|---------------------------|
|                                   |                  | Min.  | Typ. | Max. |      |                           |
| Digital high-level output voltage | V <sub>OH</sub>  | 2.7   | —    | —    | V    | I <sub>OH</sub> = −400 μA |
| Digital low-level output voltage  | V <sub>OL</sub>  | —     | —    | 0.4  | V    | I <sub>OL</sub> = 1.6 mA  |
| Digital high-level input voltage  | V <sub>IHD</sub> | 2.0   | —    | —    | V    |                           |
| Digital low-level input voltage   | V <sub>ILD</sub> | —     | —    | 0.8  | V    |                           |
| Maximum input current             | I <sub>ID</sub>  | —     | —    | 100  | μA   | V <sub>ID</sub> = 7 V     |
| High-level input current          | I <sub>IHD</sub> | —     | 0    | 20   | μA   | V <sub>IHD</sub> = 2.7 V  |
| Digital low-level input current   | I <sub>ILD</sub> | −100  | −10  | —    | μA   | V <sub>ILD</sub> = 0.4 V  |
| Power supply current              | I <sub>CC</sub>  | —     | 40*  | 85   | mA   |                           |

\* : V<sub>CCA</sub> = V<sub>CCD</sub> = 5.00 V, Ta = +25°C

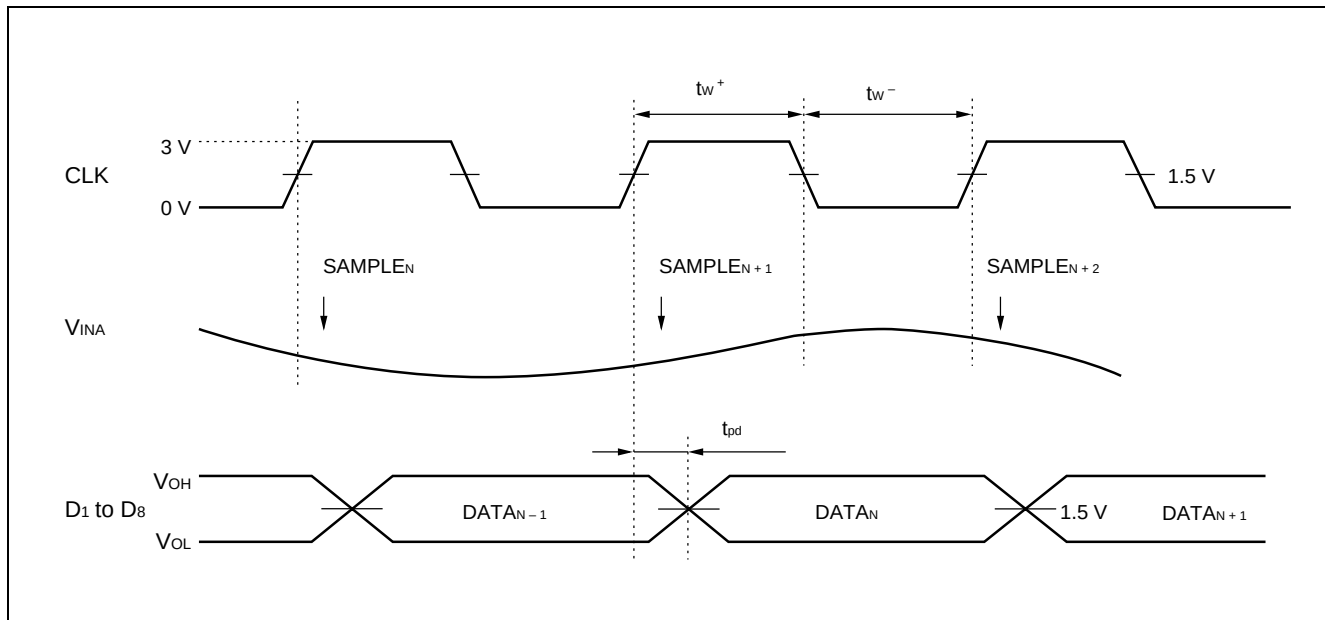
# MB40568

## 2. Switching Characteristics

( $V_{CCA} = V_{CCD} = 4.75$  to  $5.25$  V,  $T_a = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ )

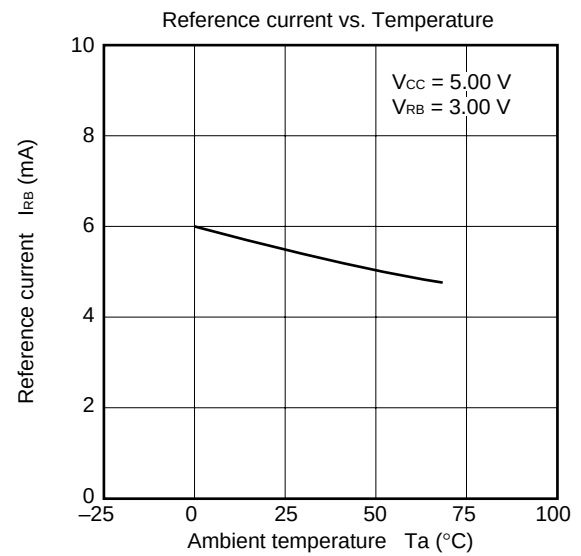
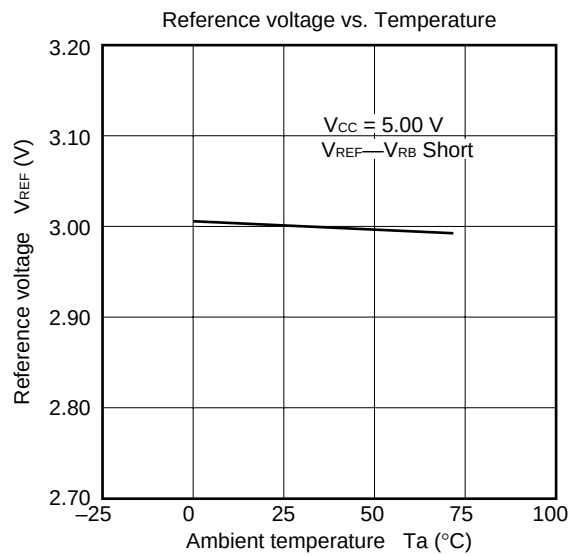
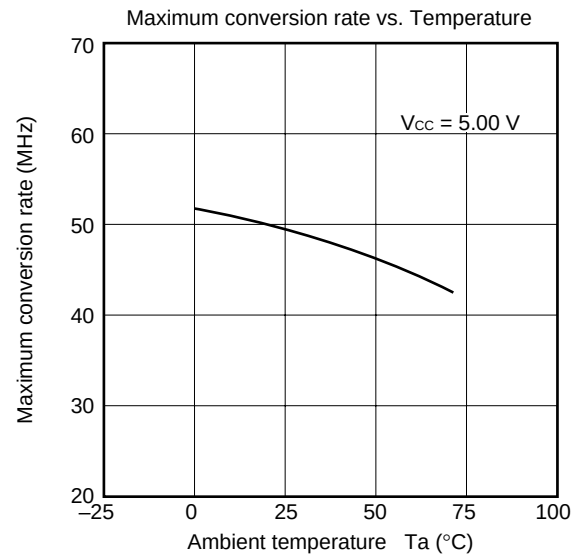
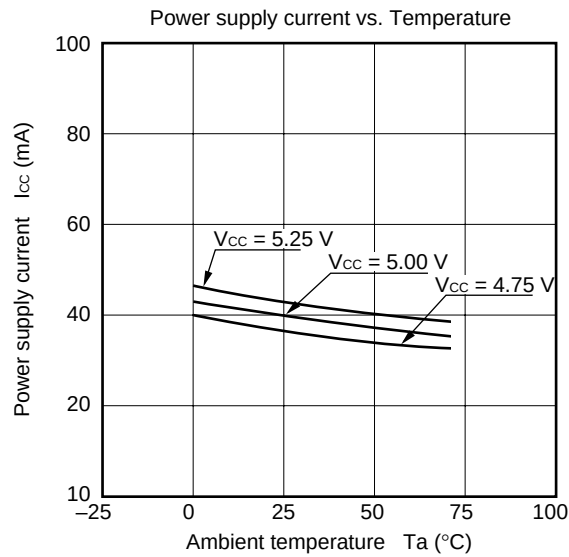
| Parameter                 | Symbol   | Value |      |      | Unit |
|---------------------------|----------|-------|------|------|------|
|                           |          | Min.  | Typ. | Max. |      |
| Maximum conversion rate   | $f_s$    | 20    | —    | —    | MSPS |
| Digital output delay time | $t_{pd}$ | 8     | 15   | 30   | ns   |

### ■ TIMING DIAGRAM





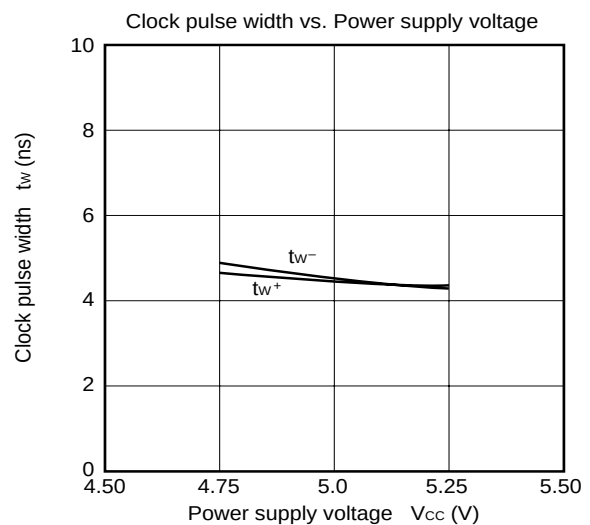
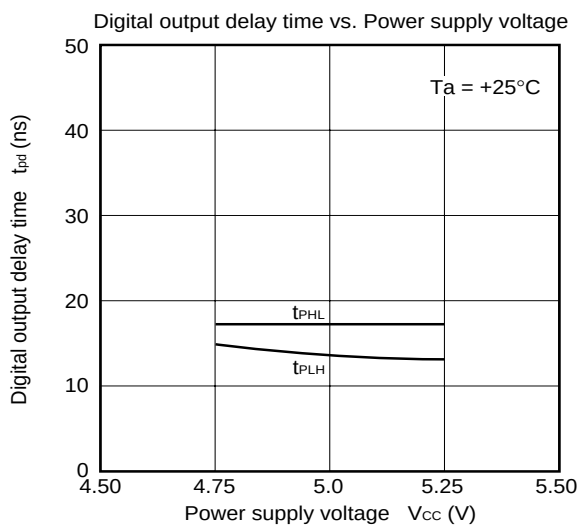
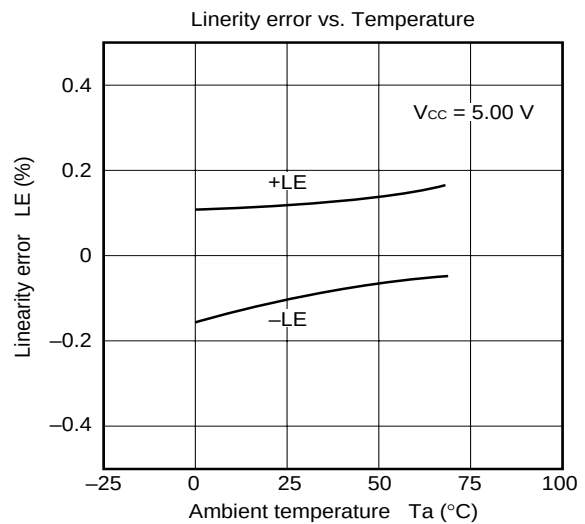
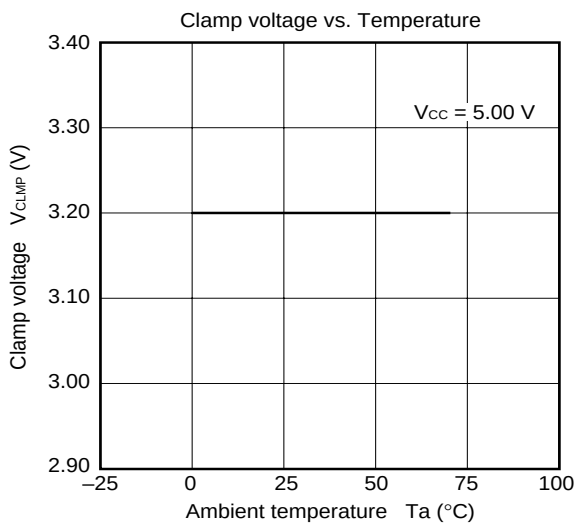
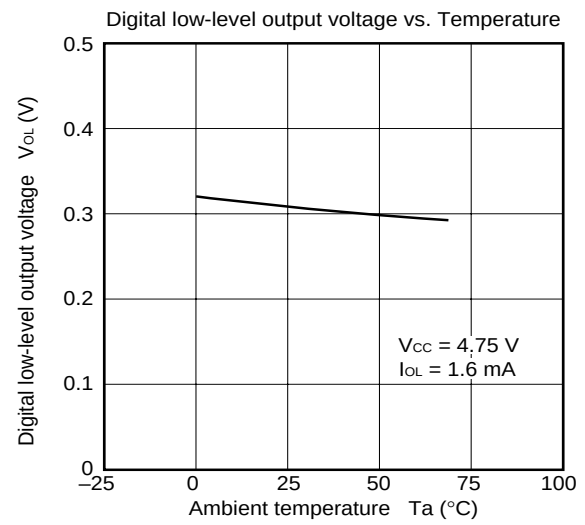
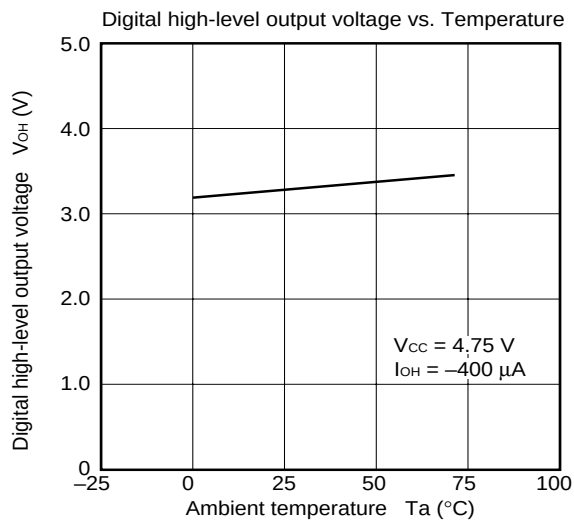
# TYPICAL CHARACTERISTIC CURVES



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## MB40568

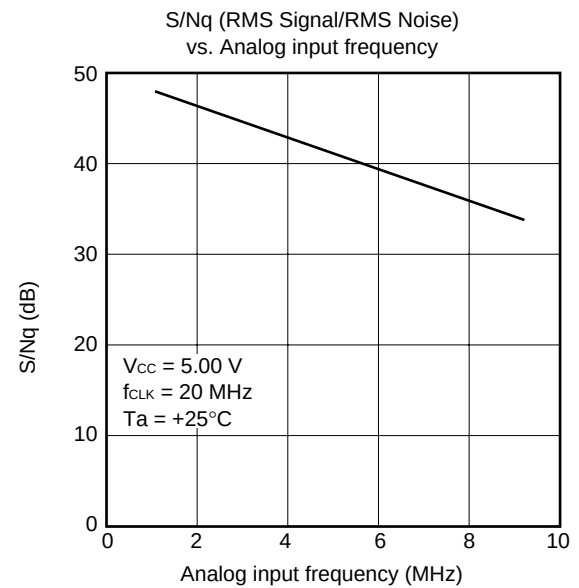
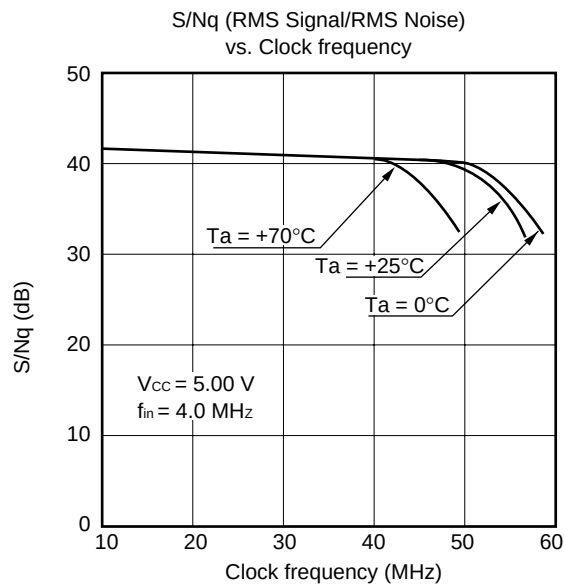
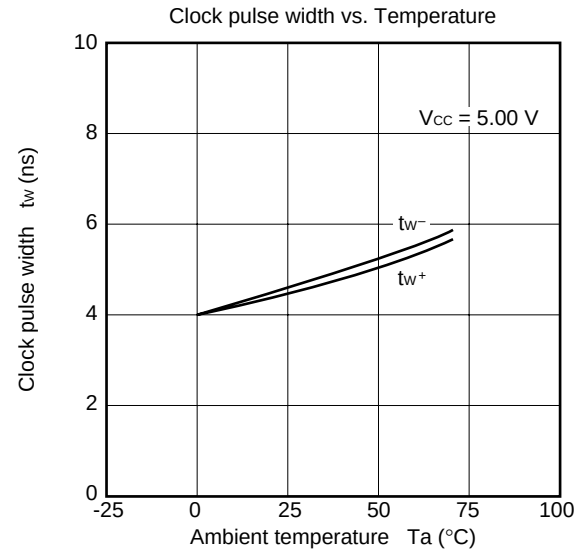
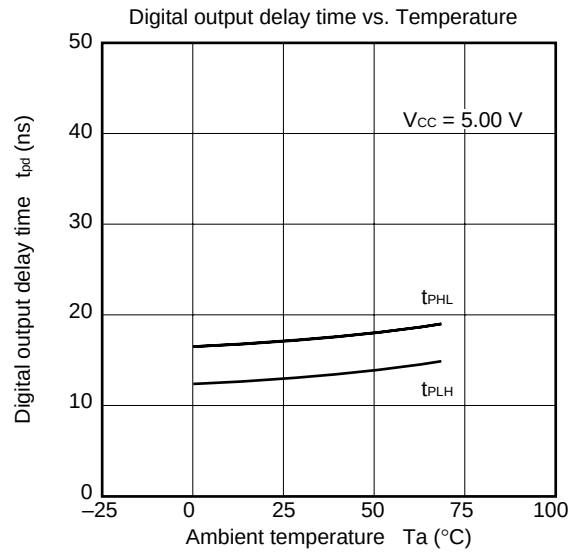
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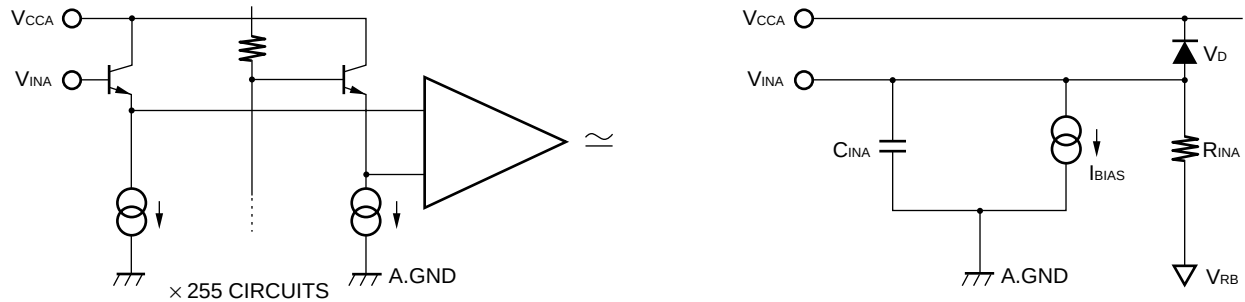
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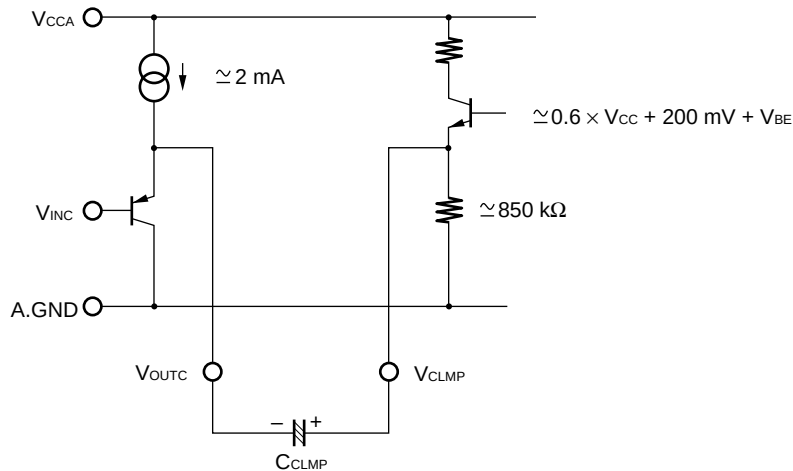
## ■ EQUIVALENT CIRCUIT

### 1. Analog Input Equivalent Circuit

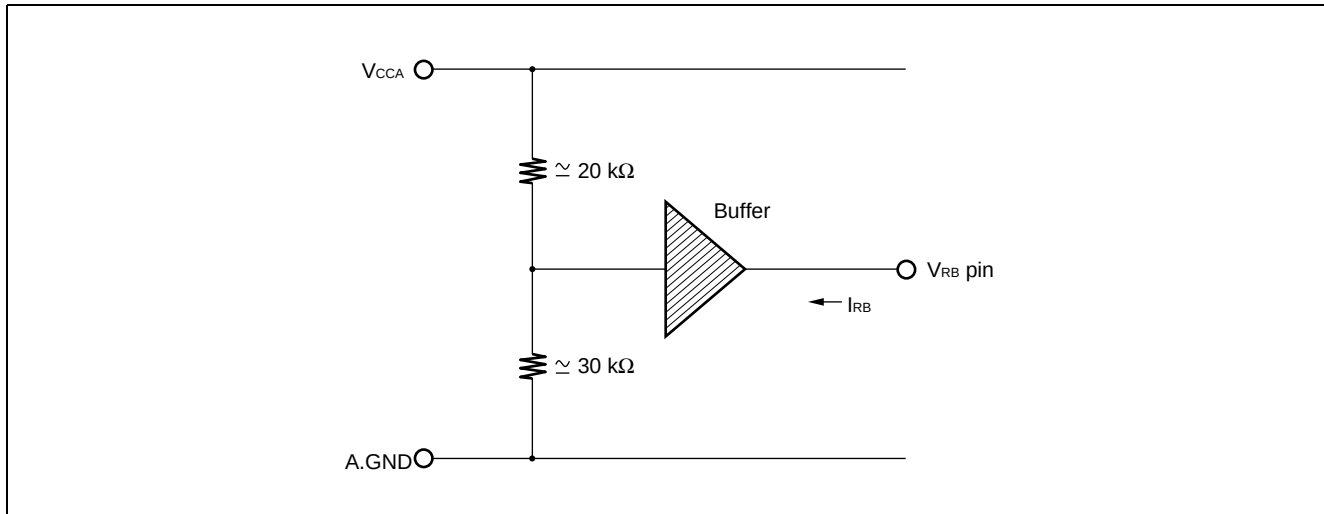


$C_{INA}$  : Non-linear Emitter-Follower Junction Capacitance  
 $R_{INA}$  : Linear Resistance Model for Input Current Transition by Comparator Switching  
           Infinite value for  $V_{INA} < V_{RB}$  or when CLK + High  
 $V_{RB}$  : Voltage at  $V_{RB}$  terminal.  
 $I_{BIAS}$  : Constant Input Bias Current  
 $V_D$  : The base-collector junction diode of emitter-follower transistor

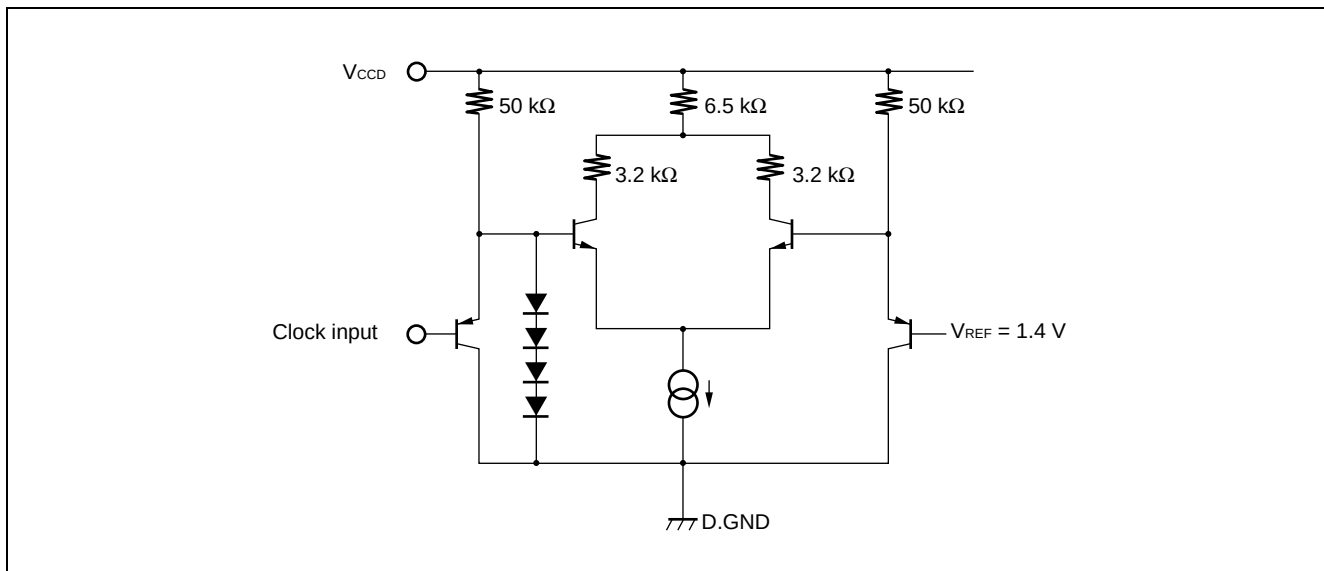
### 2. Equivalent Circuit of Clamp Circuit Block



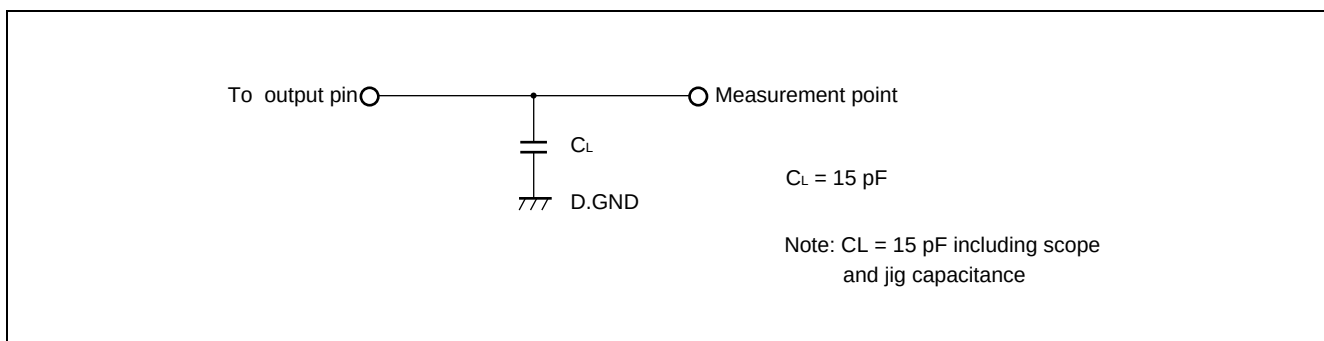
### 3. Equivalent Circuit of Reference Circuit Block



### 4. Digital Input Equivalent Circuit



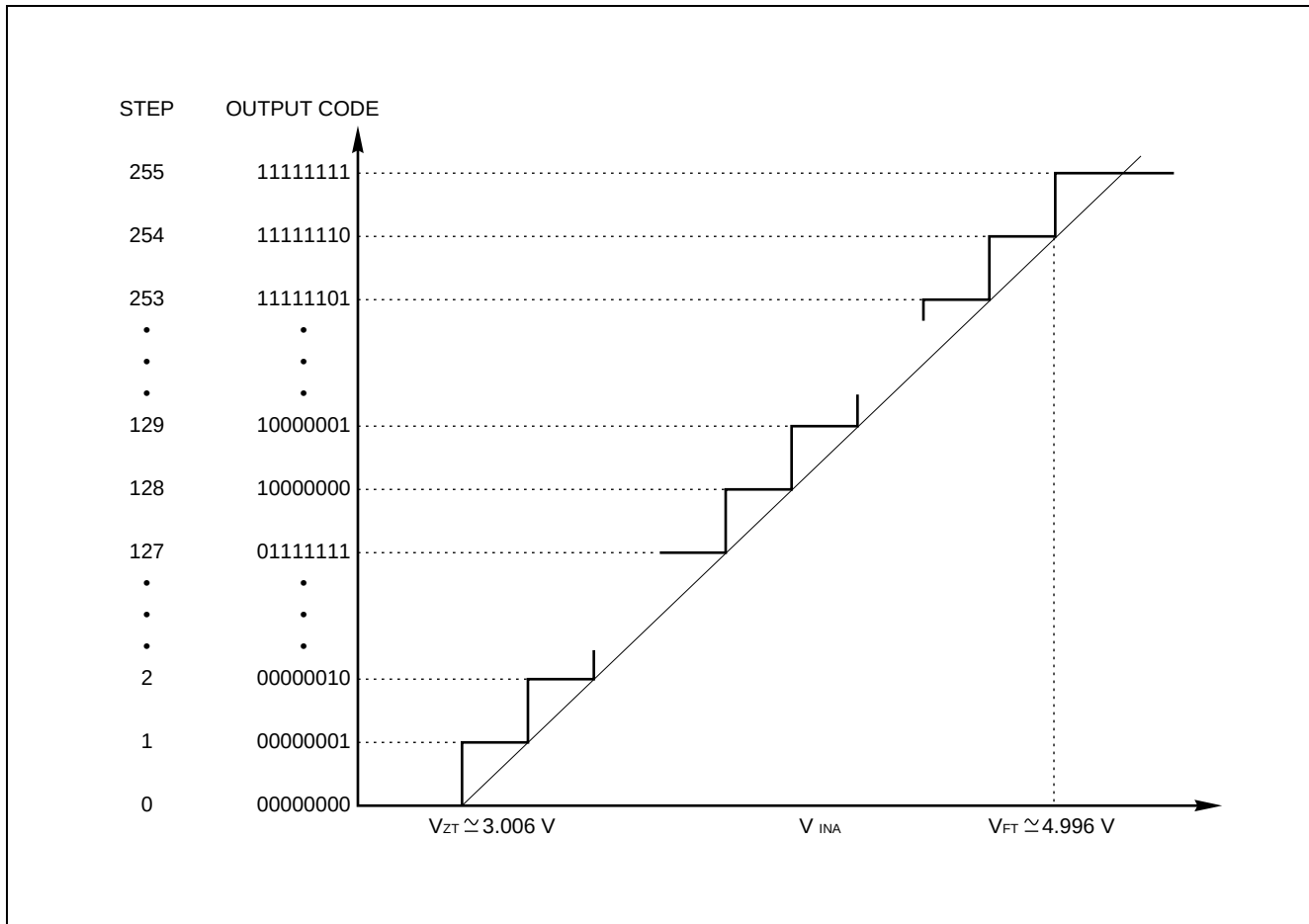
### 5. Load Circuit for Output Buffer



# MB40568

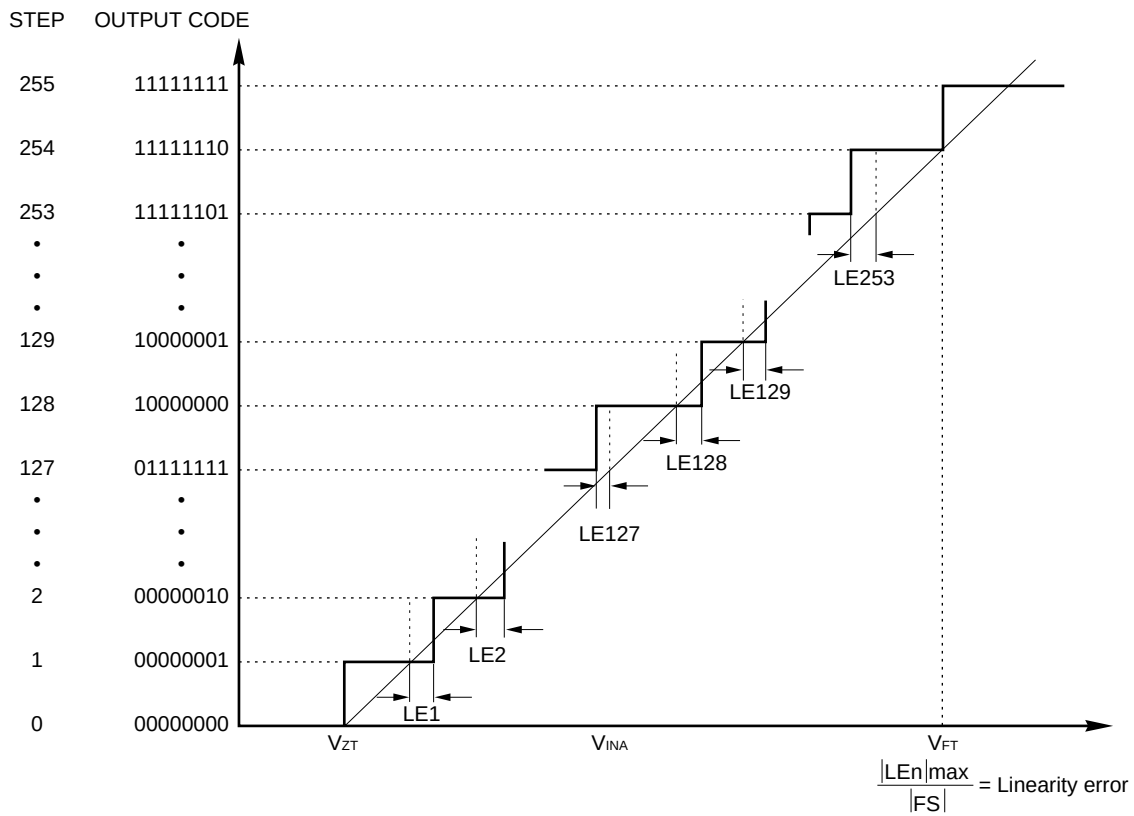
## ■ LINEARITY ERROR

### 1. Ideal Conversion Characteristics



The values for  $V_{ZT}$  and  $V_{FT}$  are typical values under conditions that  $V_{CCA} = V_{CCD} = 5.000 \text{ V}$  and  $V_{RB} = 3.000 \text{ V}$ .

## 2. Actual Conversion Characteristics



# MB40568

## ■ CLAMP CIRCUIT OPERATION

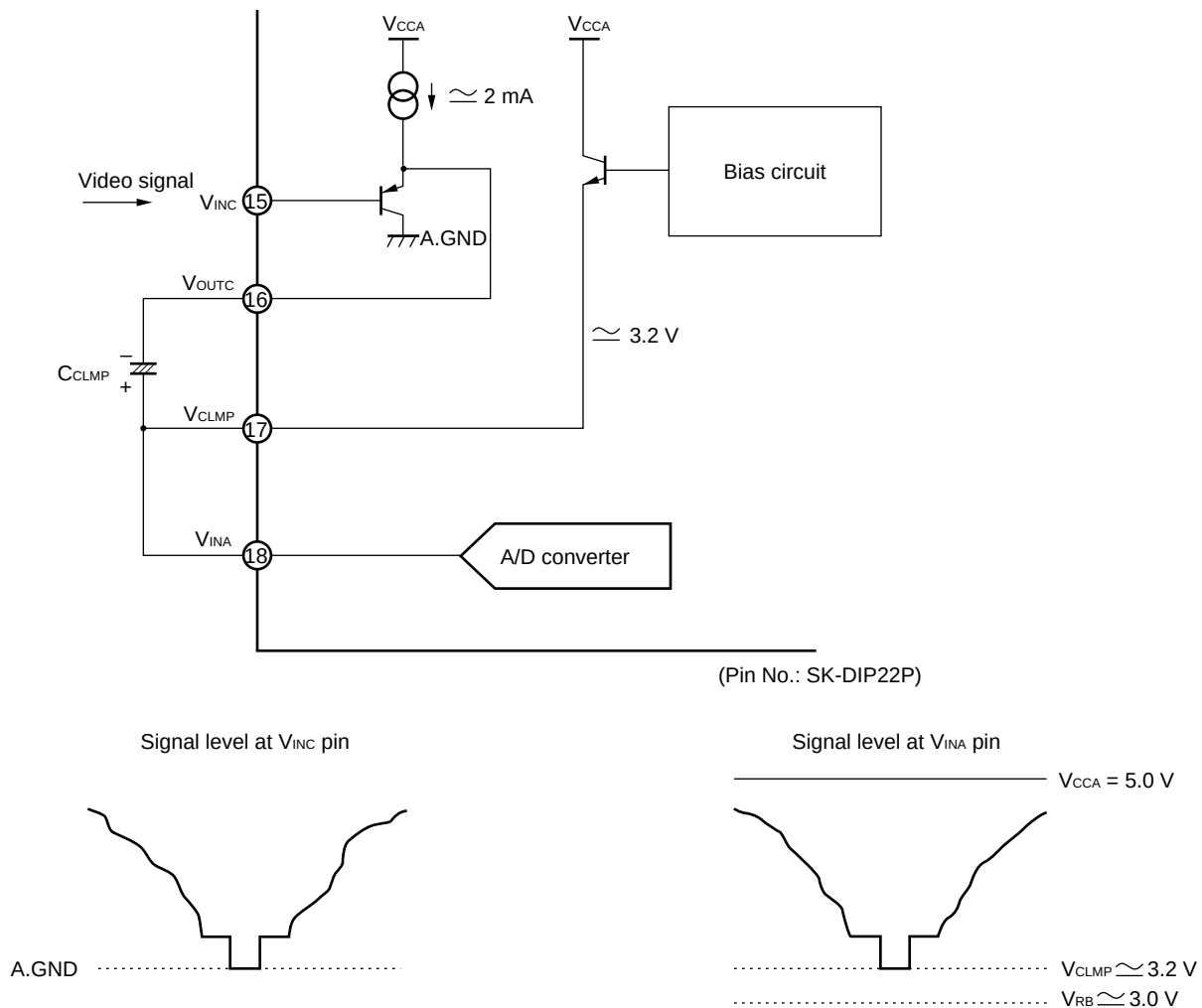
The MB40568's internal clamp circuit is a peak-detection type circuit, which clamps compound synchronized signals using the lowest sync point as clamp voltage ( $V_{CLMP}$ ) (see illustration below).

The clamp voltage is set at  $0.6 \times V_{CC} + 0.2 \text{ V}$  (typical).

If the clamp circuit is not used, the signal pins should be handled as follows:

| Pin name   | Description    |
|------------|----------------|
| $V_{INC}$  | Connect to GND |
| $V_{OUTC}$ | Leave open     |
| $V_{CLMP}$ | Leave open     |

### • Clamp Circuit

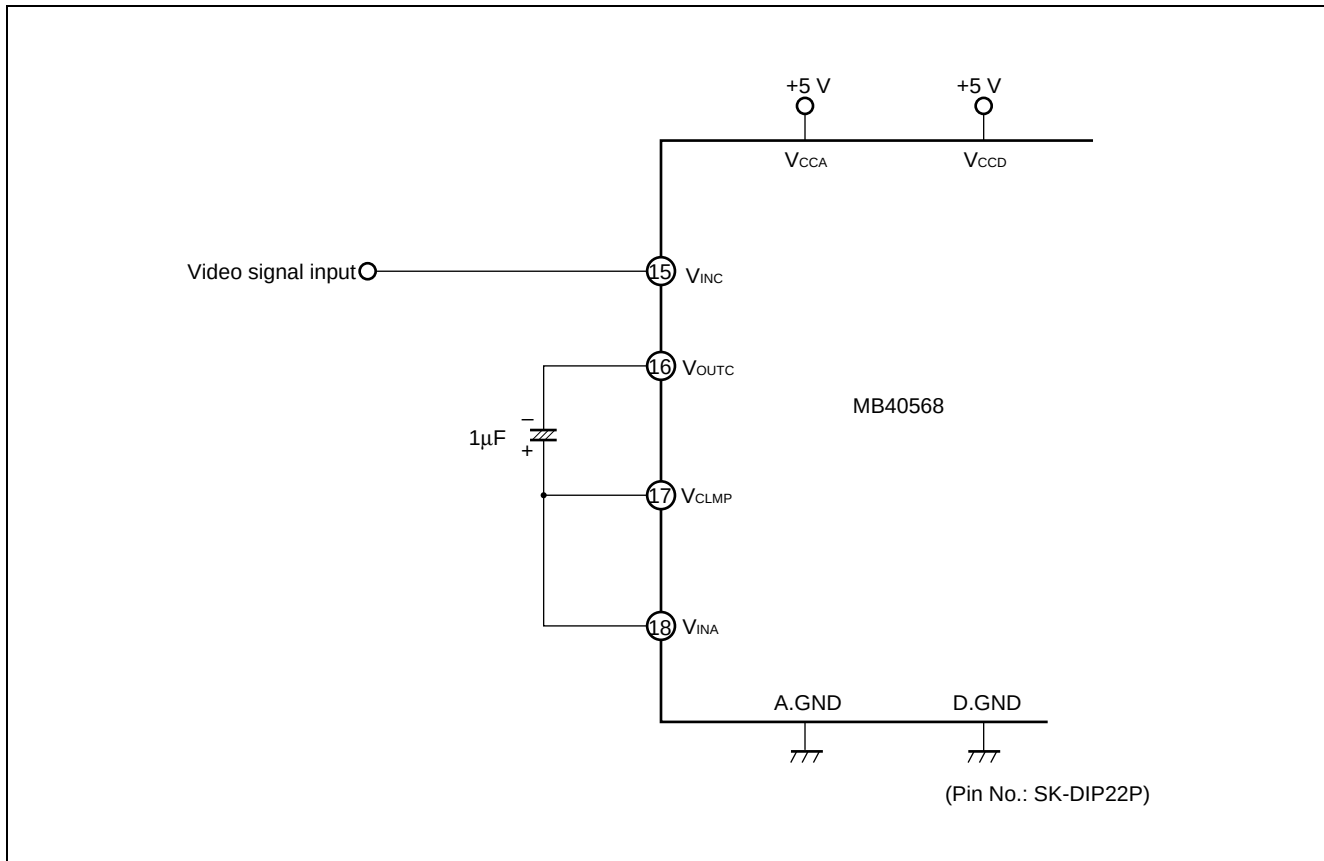




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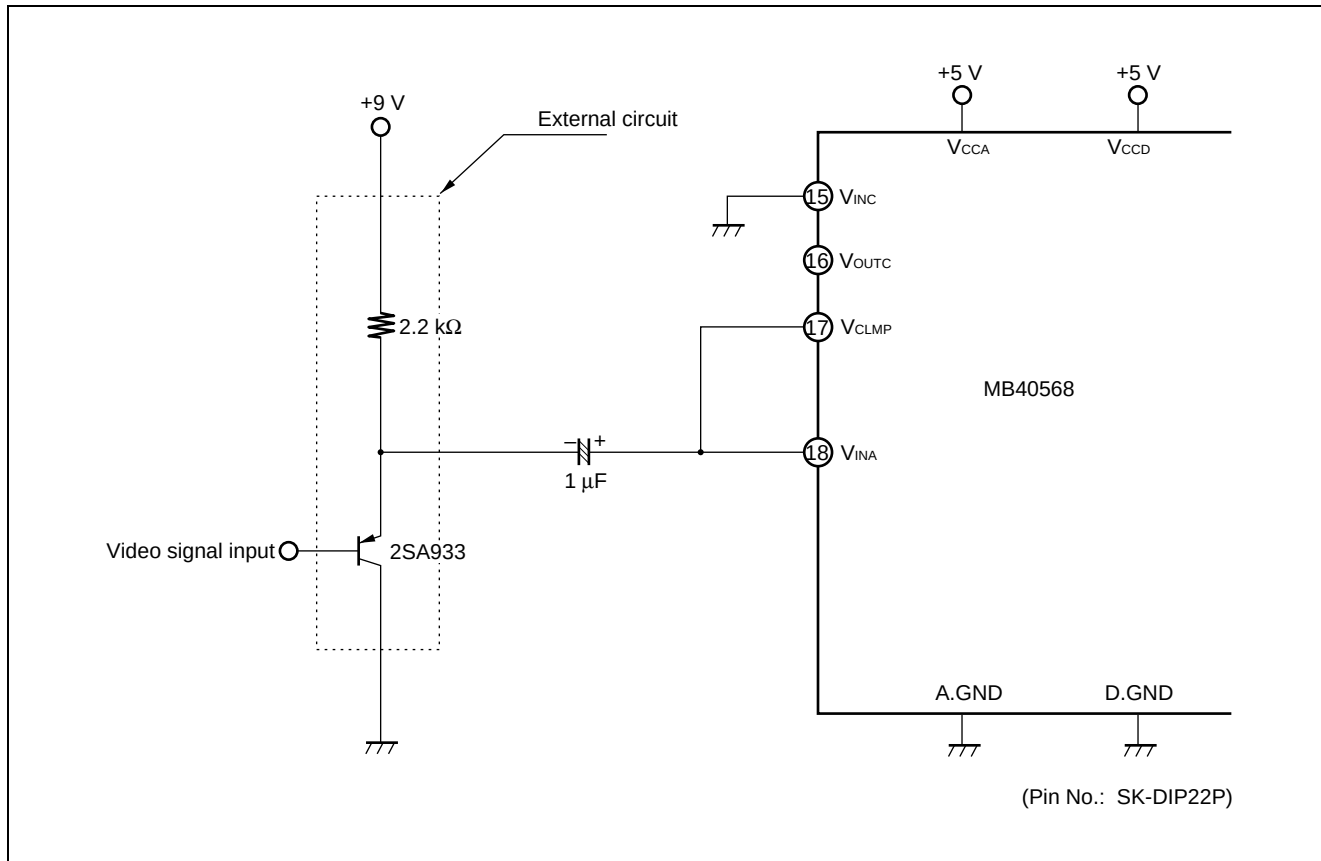
## ■ TYPICAL CONNECTION EXAMPLES

### 1. On-Chip Input PNP Transistor Utilized



# MB40568

## 2. Input PNP Transistor of Clamp Circuit is Put Externally



# MB40568

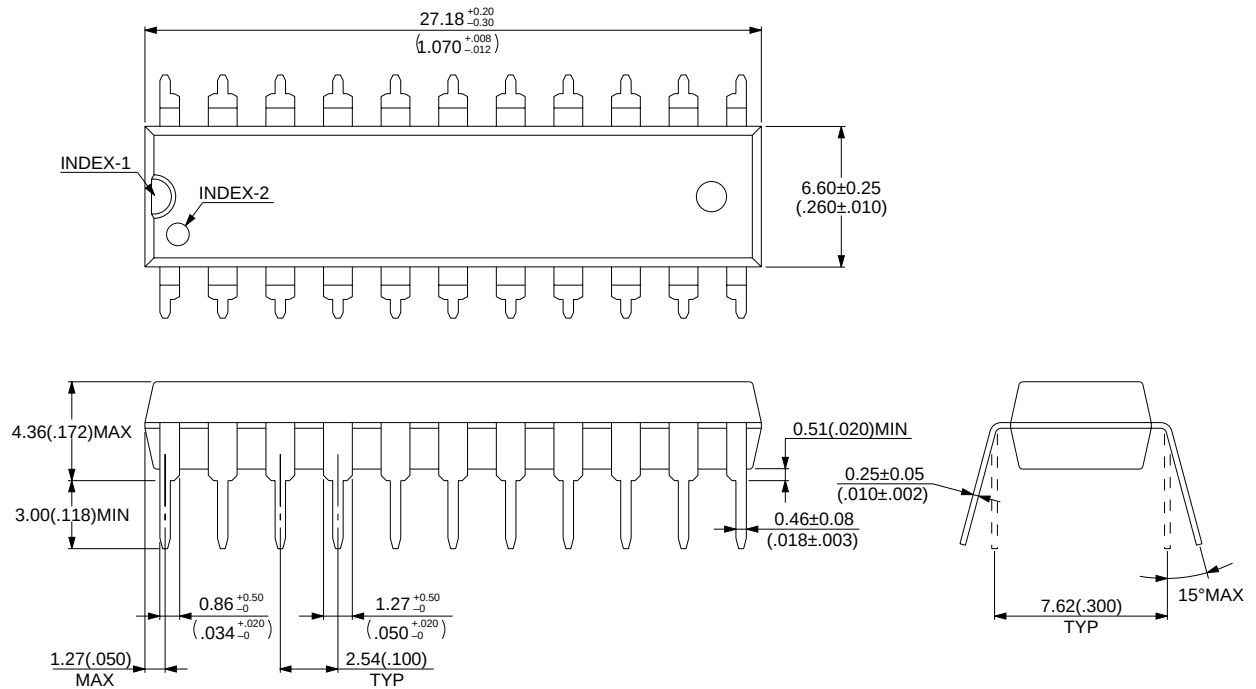
## ■ ORDERING INFORMATION

| Part number | Package                                | Remarks |
|-------------|----------------------------------------|---------|
| MB40568P-SK | 20 pin Plastic SK-DIP<br>(DIP-20P-M04) |         |
| MB40568PF   | 24 pin Plastic SOP<br>(FPT-24P-M02)    |         |

# MB40568

## ■ PACKAGE DIMENSIONS

20-pin Plastic SK-DIP  
(DIP-22P-M04)



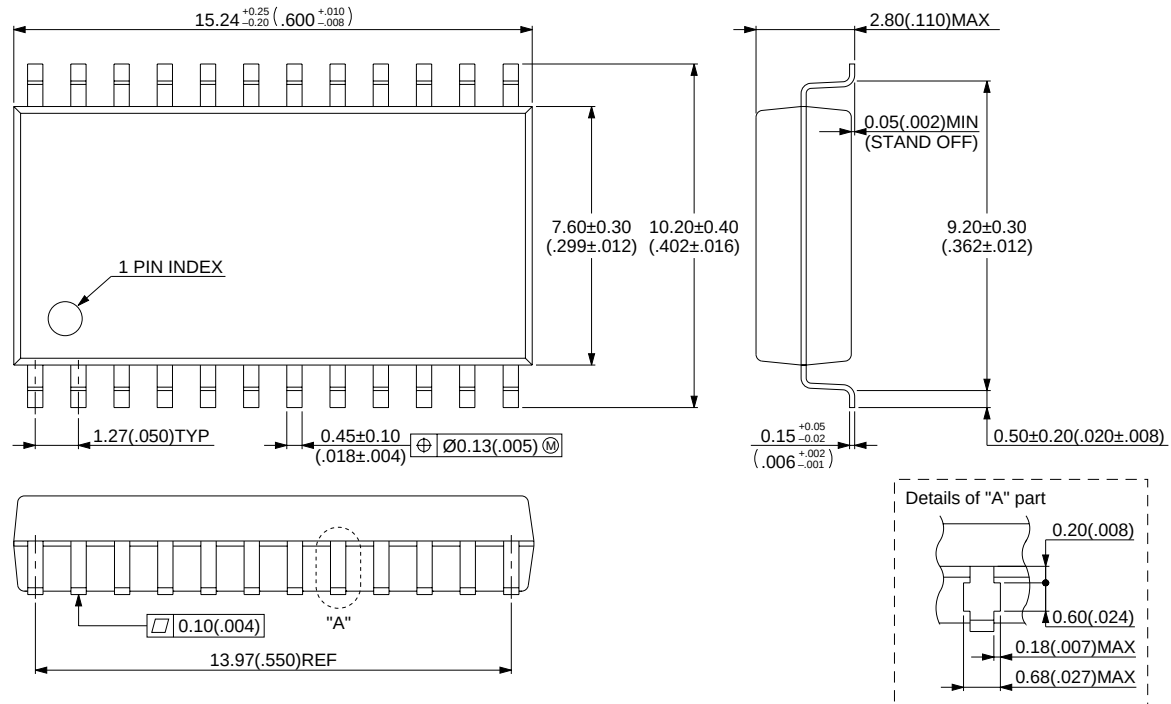
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Dimensions in mm (inches)

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## MB40568

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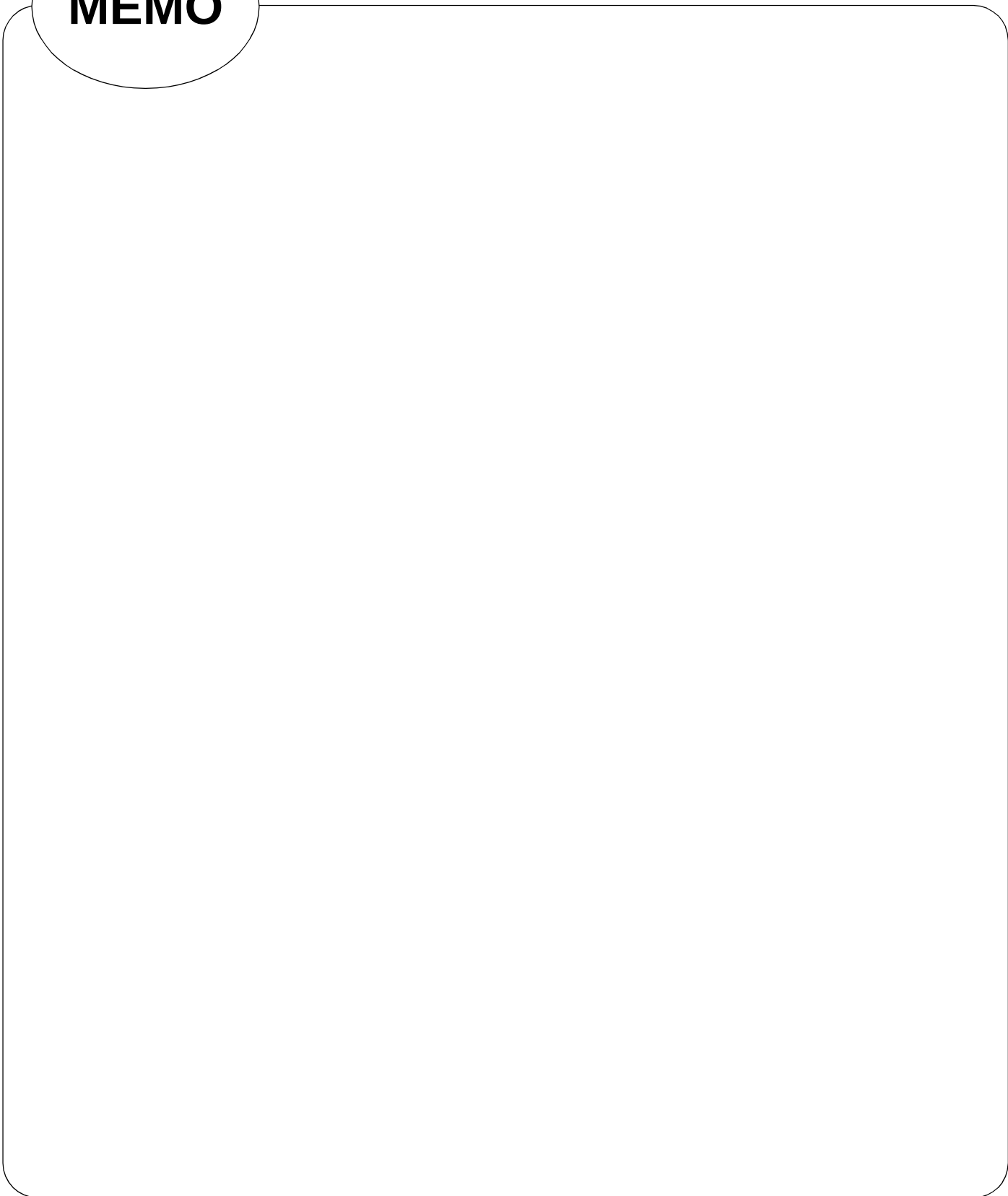
24-pin Plastic SOP  
(FPT-24P-M02)

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Dimensions in mm (inches)

**MB40568**

**MEMO**



**MEMO**

# MB40568

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