

ASSP

# 1 CHANNEL 8-BIT VIDEO A/D CONVERTER

## MB40578

### ■ DESCRIPTION

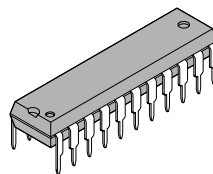
The Fujitsu MB40578 is a low power ultra-high speed video A/D converter fabricated with Fujitsu Advanced Bipolar Technology. The MB40578 also adopts the fully-parallel comparison technique (flash method) for high speed conversion and can convert wide band analog signal such as video signal to digital signal at a sampling rate of DC through 20 Mega-samples/sec. Because of such high-speed operation, the MB40578 is suitable for digital video applications such as the digital TV, video processing with computer, or radar signal processing.

### ■ FEATURES

- Resolution: 8 bits
- Linearity error:  $\pm 0.2\%$  max. (MB40578)
- Maximum conversion rate: 20 MSPS min.
- Analog input voltage: 3.0V to 5.0V
- Digital I/O level: TTL compatible
- Single power supply: +5V
- Power Dissipation: 480mW typ.
- Package: Standard 22-pin DIP Package: Suffix: -P

### ■ PACKAGE

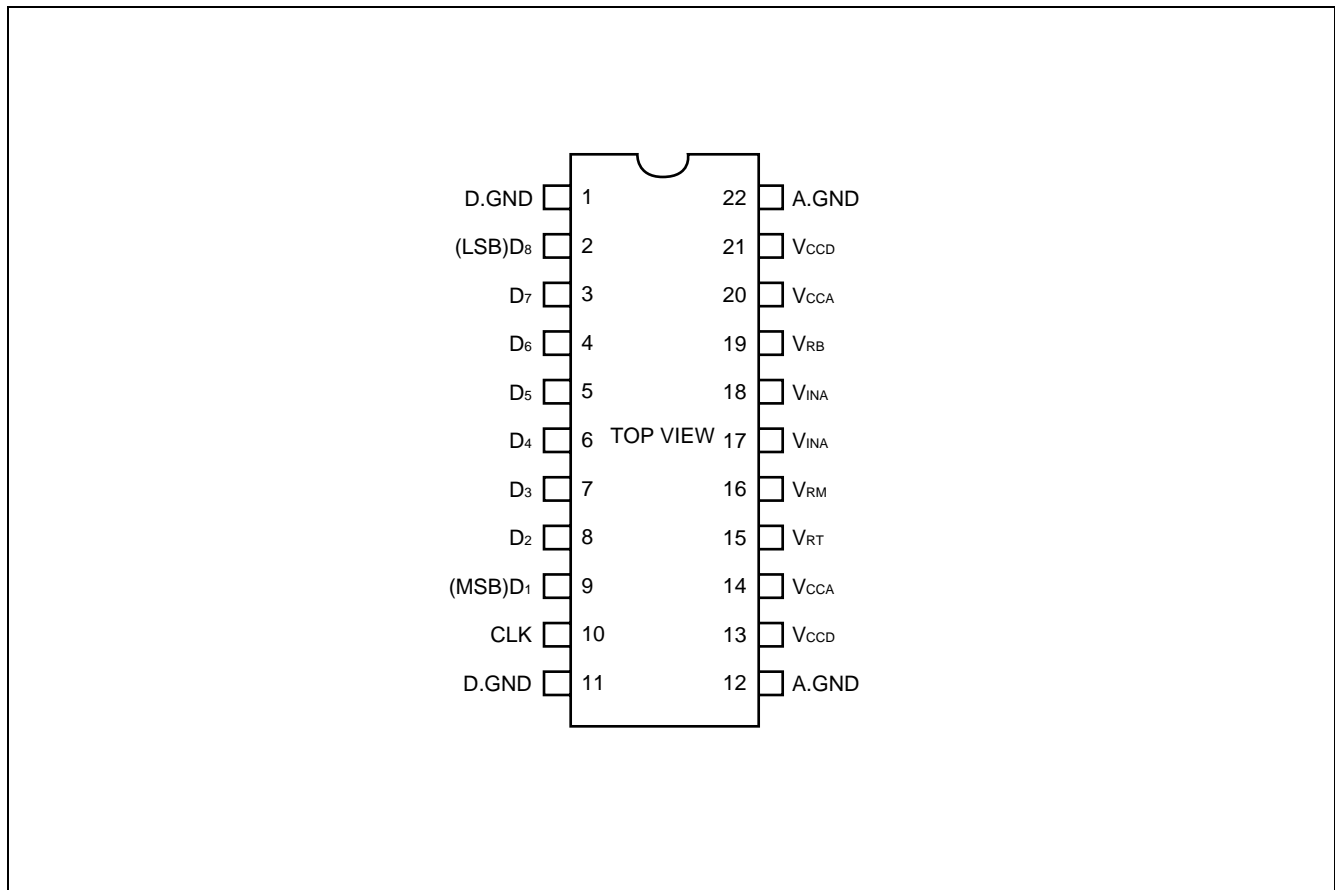
Plastic DIP, 22 pin



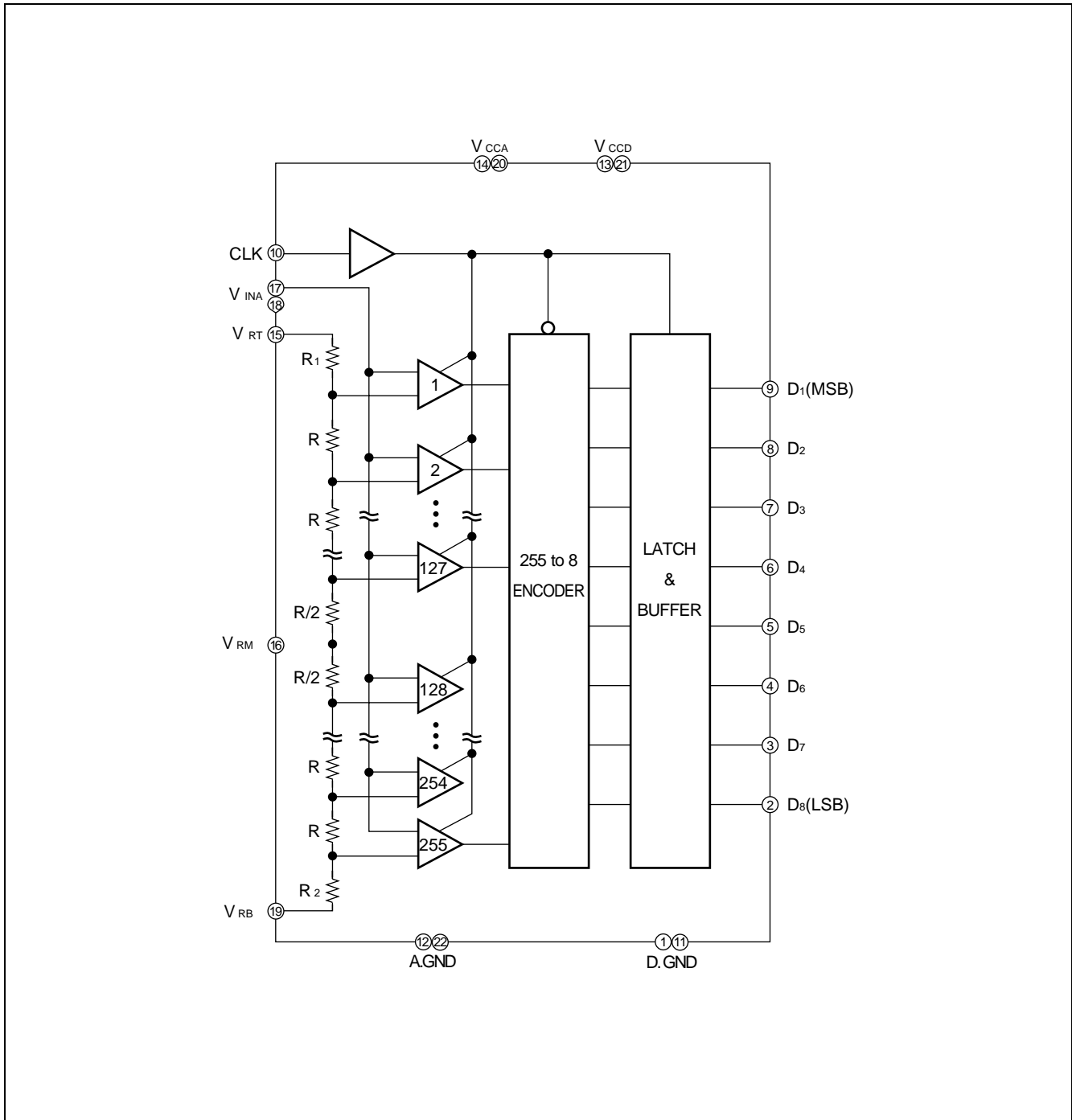
(DIP-22P-M04)

# MB40578

## ■ PIN ASSIGNMENT



## ■ BLOCK DIAGRAM



# MB40578

## ■ ABSOLUTE MAXIMUM RATINGS

| Parameter                | Symbol                               | Rating                       | Unit |
|--------------------------|--------------------------------------|------------------------------|------|
| Power supply voltage     | V <sub>CCA</sub><br>V <sub>CCD</sub> | -0.5 to +7.0                 | V    |
| Digital input voltage    | V <sub>IND</sub>                     | -0.5 to +7.0                 | V    |
| Analog input voltage     | V <sub>INA</sub>                     | -0.5 to V <sub>CC</sub> +0.5 | V    |
| Analog reference voltage | V <sub>RT</sub> , V <sub>RB</sub>    | -0.5 to V <sub>CC</sub> +0.5 | V    |
| Storage temperature      | V <sub>STG</sub>                     | -55 to +125                  | °C   |

Note: 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*1                   | V <sub>CCA</sub><br>V <sub>CCD</sub> | 4.75  | 5.00 | 5.25 | V    |
| Analog input voltage*2                   | V <sub>INA</sub>                     | 3     | —    | 5    | V    |
| Analog reference voltage (Top side)*2    | V <sub>RT</sub>                      | —     | 5    | 5.1  | V    |
| Analog reference voltage (Bottom side)*2 | V <sub>RB</sub>                      | 2.9   | 3    | —    | V    |
| Digital high-level output current        | I <sub>OHD</sub>                     | -400  | —    | —    | μA   |
| Digital low-level output current         | I <sub>OLD</sub>                     | —     | —    | 4    | mA   |
| Clock pulse width at high level          | t <sub>w+</sub>                      | 25    | —    | —    | ns   |
| Clock pulse width at low level           | t <sub>w-</sub>                      | 25    | —    | —    | ns   |
| Operating temperature                    | T <sub>a</sub>                       | 0     | —    | 70   | °C   |

Notes: \*1: Please keep V<sub>CCA</sub> and V<sub>CCD</sub> at the same potential.

\*2: V<sub>RB</sub> < V<sub>INA</sub> < V<sub>RT</sub>, V<sub>RT</sub> - V<sub>RB</sub> = 2V + 0.1V.

## ■ ELECTRICAL CHARACTERISTICS

### 1. Analog DC Characteristics

( $V_{CCA} = V_{CCD} = 5V \pm 5\%$ ,  $T_a = 0$  to  $70^\circ\text{C}$ )

| Parameter                              | Symbol    | Condition                      | Value |     |           | Unit          |
|--|-----------|--------------------------------|-------|-----|-----------|---------------|
|  |           |                                | Min   | Typ | Max       |               |
| Resolution                             |           |                                | —     | —   | 8         | bits          |
| Linearity error                        | LE        | DC                             | —     | —   | $\pm 0.2$ | %             |
| Equivalent resistance for analog input | $R_{INA}$ |                                | 50    | —   | —         | $k\Omega$     |
| Analog input capacitance               | $C_{INA}$ |                                | —     | 120 | 230       | pF            |
| Analog high-level input current        | $I_{IHA}$ |                                | —     | —   | 150       | $\mu\text{A}$ |
| Analog low-level input current         | $I_{ILA}$ |                                | —     | —   | 145       | $\mu\text{A}$ |
| Reference current                      | $I_{RB}$  | $V_{RT} = 5V$<br>$V_{RB} = 3V$ | -15   | -9  | —         | mA            |

### 2. Digital DC Characteristics

( $V_{CCA} = V_{CCD} = 5V \pm 5\%$ ,  $T_a = 0$  to  $70^\circ\text{C}$ )

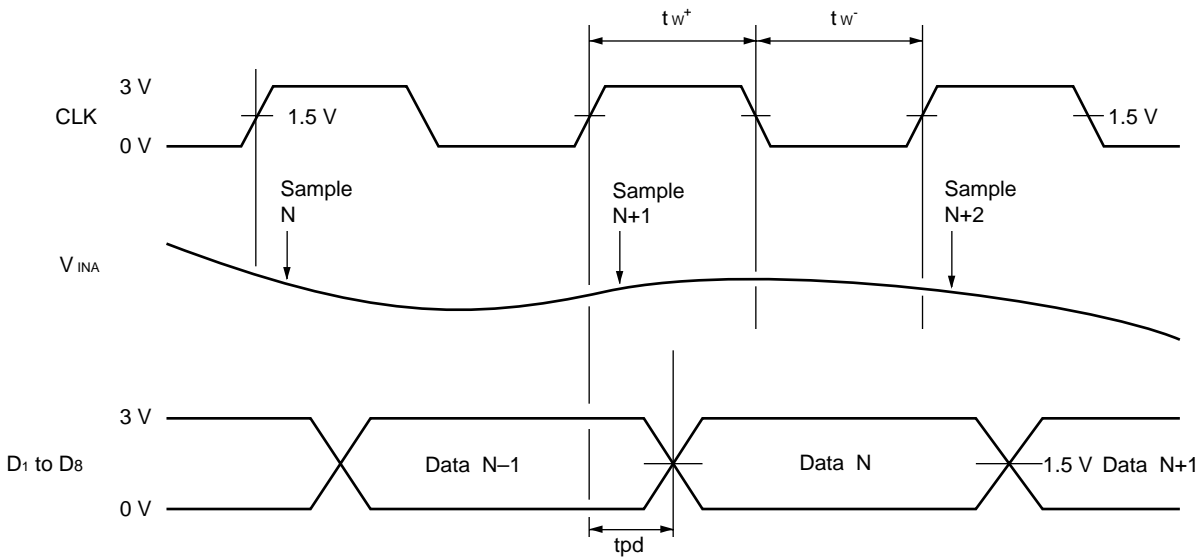
| Parameter                 | Symbol    | Condition                   | Value |     |     | Unit          |
|---------------------------|-----------|-----------------------------|-------|-----|-----|---------------|
|                           |           |                             | Min   | Typ | Max |               |
| High-level output voltage | $V_{OH}$  | $I_{OH} = -400 \mu\text{A}$ | 2.7   | —   | —   | V             |
| Low-level output voltage  | $V_{OL}$  | $I_{OL} = 1.6 \text{ mA}$   | —     | —   | 0.4 | V             |
| High-level input voltage  | $V_{IHD}$ |                             | 2     | —   | —   | V             |
| Low-level input voltage   | $V_{ILD}$ |                             | —     | —   | 0.8 | V             |
| Maximum input current     | $I_{ID}$  | $V_{ID} = 7V$               | —     | —   | 100 | $\mu\text{A}$ |
| High-level input current  | $I_{IHD}$ | $V_{IHD} = 2.7V$            | —     | 0   | 20  | $\mu\text{A}$ |
| Low level input current   | $I_{ILD}$ | $V_{ILD} = 0.4V$            | -400  | -40 | —   | $\mu\text{A}$ |
| Power supply current      | $I_{CC}$  |                             | —     | 92  | 160 | mA            |

## 3. Switching Characteristics

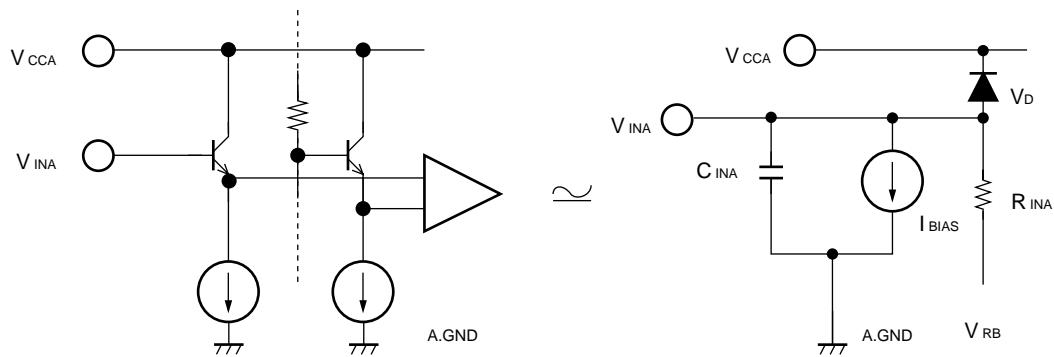
( $V_{CCA} = V_{CCD} = 5V \pm 5\%$ ,  $T_a = 0$  to  $70^\circ\text{C}$ )

| Parameter                 | Symbol | Condition | Value |     |     | Unit |
|---------------------------|--------|-----------|-------|-----|-----|------|
|                           |        |           | Min   | Typ | Max |      |
| Maximum conversion rate   | FS     |           | 20    | 30  | —   | MSPS |
| Digital output delay time | tpd    |           | 5     | 15  | 40  | ns   |

Figure 1 Timing Diagram



**Figure 2 Analog Input Equivalent Circuit**



X255 Circuits

$C_{INA}$ : Non-linear Emitter-follower Junction Capacitance

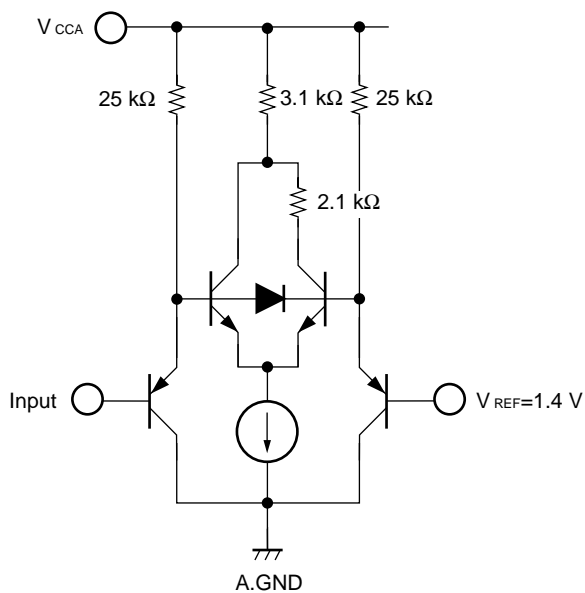
$R_{INA}$ : Linear Resistance Model for Input Current Transition by Comparator Switching:  
Infinite value for  $V_{IN} < V_{RB}$  or when CLK = High

$V_{RB}$ : Voltage at  $V_{RB}$  terminal

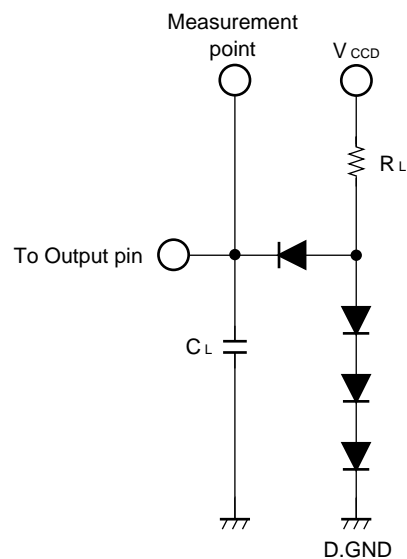
$I_{BIAS}$ : Constant Input Bias Current

$V_D$ : The base-collector junction diode of emitter-follower transistor.

**Figure 3 Digital Input Equivalent**



**Figure 4 Load Circuit for Output Buffer**



**Note**  $R_L = 2\text{ k}\Omega$

$C_L = 15\text{ pF}$  including scope and jig capacitance

Diodes: IN3064 or equivalent

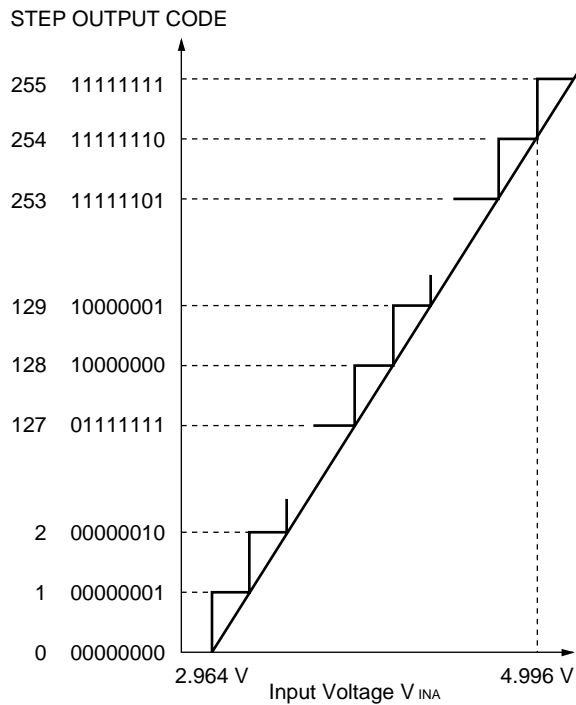
### Figure 5 Output Code

( $V_{CC}=5.0\text{ V}, V_{RT}\approx 5.0\text{ V}, V_{RB}\approx 3.0\text{ V}$ )

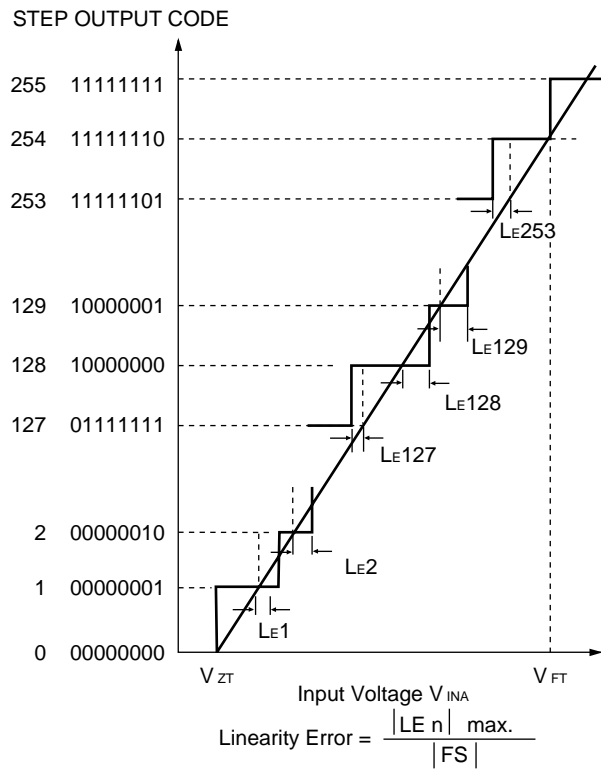
| Step | Analog Input Voltage | OUTPUT VOLTAGE(V) |
|------|----------------------|-------------------|
| 0    | 2.960 V              | 00000000          |
| 1    | 2.968 V              | 00000001          |
| ⋮    | ⋮                    | ⋮                 |
| 127  | 3.976 V              | 01111111          |
| 128  | 3.984 V              | 10000000          |
| 129  | 3.992 V              | 10000001          |
| ⋮    | ⋮                    | ⋮                 |
| 245  | 4.992 V              | 11111110          |
| 255  | 5.000 V              | 11111111          |

**Note :** Adjust  $V_{ZT}=2.964\text{ V}$  and  $V_{FT}=4.996\text{ V}$  with  $V_{RT}$  and  $V_{RB}$ . The Analog Input Voltage are the center values of each step.

### Figure 6 Ideal Conversion Characteristics



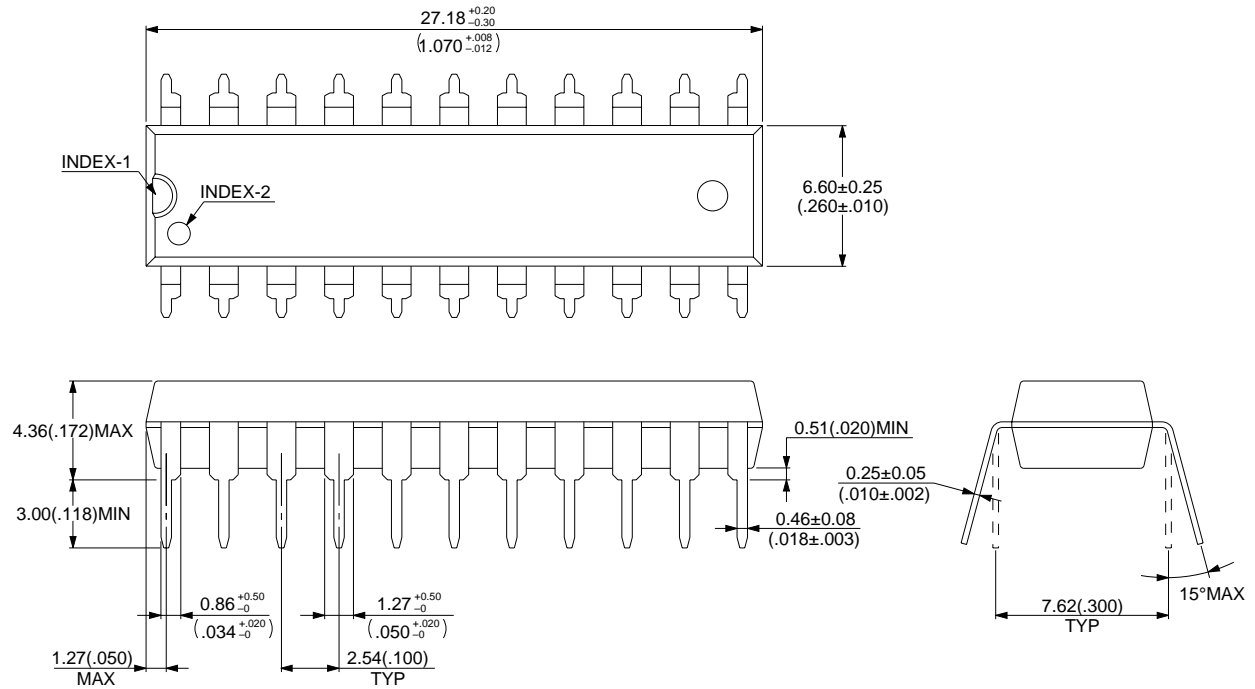
### Figure 7 Actual Conversion Characteristics





## ■ PACKAGE DIMENSION

Plastic DIP, 22 pin  
(DIP-22P-M04)



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Dimensions in mm (inch)

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