

ASSP

# 3-Channel 8-Bit RGB D/A Converter

## MB40978

### DESCRIPTION

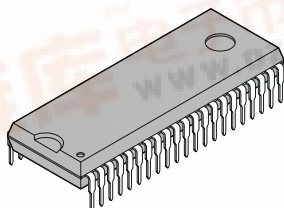
The Fujitsu MB40978 is a 8-bit ultra high speed digital to analog converter for video frequency band fabricated by Fujitsu Advanced Bipolar Technology. Owing to adoption of RGB 3-channel input/output, it is suitable for digital TV, graphic display etc.

### FEATURES

- Resolution : 8bits
- Linearity :  $\pm 0.2\%$  max.
- Maximum Conversion Rate : 60MSPS min.
- Analog Output Voltage Range :  $V_{CC}$  to  $V_{CC} - 1(V)$
- Digital Input Voltage : TTL Compatible
- Single Power Supply Voltage : +5.0V
- Power Dissipation : 350mW typ.
- Package : Plastic DIP Package (Suffix: -P)  
: Plastic Flat Package (Suffix: -PFQ)

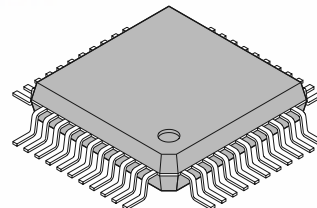
### PACKAGES

42 pin, Plastic SH-DIP



(DIP-42P-M02)

44 pin, Plastic FPT

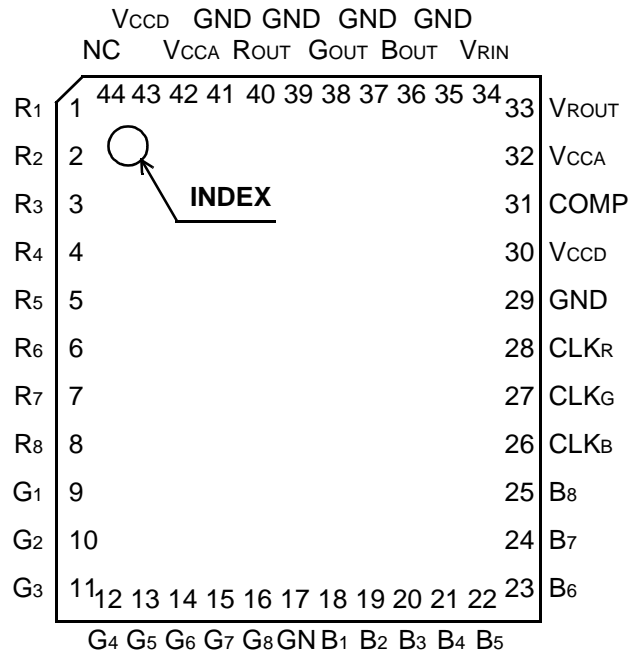
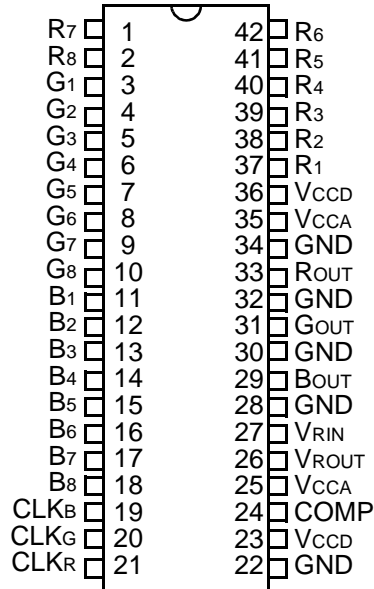


(FPT-44P-M11)

# MB40978

## ■ PIN ASSIGNMENTS

(TOP VIEW)

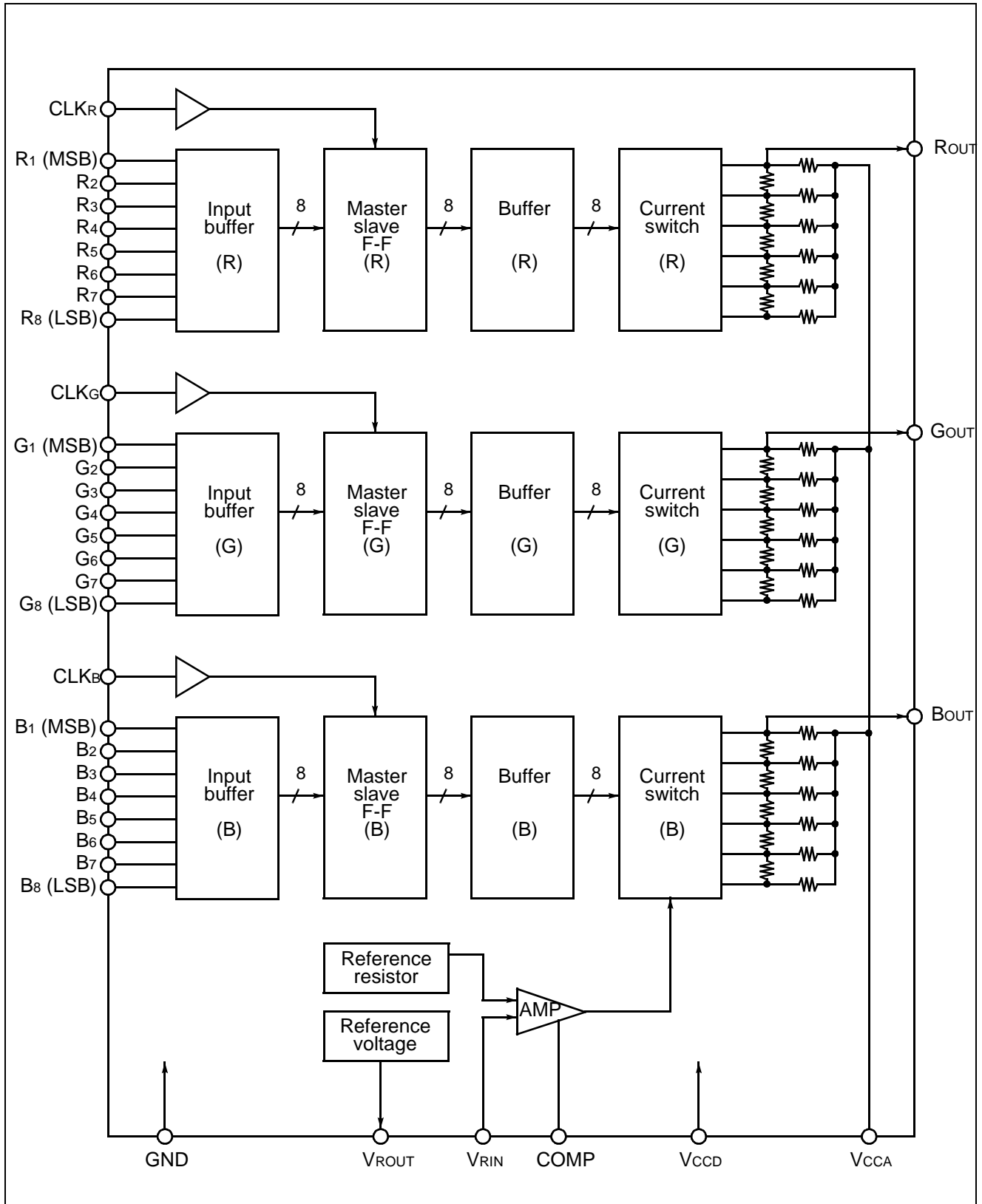


## ■ PIN DESCRIPTION

| Pin Number         |                        | Symbol   | Description   |
|--------------------|------------------------|----------|---|
| DIP                | QFP                    |          |   |
| 1, 2, 37 to 42     | 1 to 8                 | R1 to R8 | R-channel Digital Signal Inputs<br>V <sub>IH</sub> =2.0V min.<br>V <sub>IL</sub> =0.8V max.                   |
| 3 to 10            | 9 to 16                | G1 to G8 | G-channel Digital Signal Inputs   |
| 11 to 18           | 18 to 25               | B1 to B8 | B-channel Digital Signal Inputs   |
| 33                 | 40                     | ROUT     | R-channel Analog Signal Output  |
| 31                 | 38                     | GOUT     | G-channel Analog Signal Output  |
| 29                 | 36                     | BOUT     | B-channel Analog Signal Output  |
| 21                 | 28                     | CLKR     | R-channel Clock Input<br>V <sub>IH</sub> =2.0V min.<br>V <sub>IL</sub> =0.8V max.                             |
| 20                 | 27                     | CLKG     | G-channel Clock Input   |
| 19                 | 26                     | CLKB     | B-channel Clock Input   |
| 27                 | 34                     | VRIN     | Reference Voltage Input   |
| 26                 | 33                     | VROUT    | Reference Voltage Output  |
| 24                 | 31                     | COMP     | This pin is provided to connect a phase compensation capacitance. 1μF min capacitor is connected between GND. |
| 25, 35             | 32, 42                 | VCCA     | Power Supply for Analog Circuit 5V ±5%  |
| 23, 36             | 30, 43                 | VCCD     | Power Supply for Digital Circuit 5V ±5%   |
| 22, 28, 30, 32, 34 | 17, 29, 35, 37, 39, 41 | GND      | Ground  |
| —                  | 44                     | N.C.     | No connection   |

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## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

| Parameter                | Symbol             | Rating                  | Unit |
|--------------------------|--------------------|-------------------------|------|
| Power supply voltage     | $V_{CCA}, V_{CCD}$ | -0.5 to +7.0            | V    |
| Analog reference voltage | $V_{RIN}$          | -0.5 to $V_{CCA} + 0.5$ | V    |
| Digital input voltage    | $V_{ID}$           | -0.5 to +7.0            | V    |
| Storage temperature      | $T_{STG}$          | -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             | $V_{CCA}, V_{CCD}$<br>( $V_{CCA} - V_{CCD}$ ) | 4.75<br>(-0.2) | 5.0  | 5.25<br>(0.2) | V    |
| Analog reference voltage         | $V_{RIN}$                                     | 3.70           | 4.00 | 4.30          | V    |
| Digital high-level input voltage | $V_{IHD}$                                     | 2.0            | —    | —             | V    |
| Digital low-level voltage        | $V_{ILD}$                                     | —              | —    | 0.8           | V    |
| Clock frequency                  | $f_{CLK}$                                     | —              | —    | 60            | MHz  |
| Set-up time                      | $t_s$   | 10             | —    | —             | ns   |
| Hold time                        | $t_H$   | 4.0            | —    | —             | ns   |
| Minimum high pulse width         | $t_{W+}$                                      | 7.5            | —    | —             | ns   |
| Minimum low pulse width          | $t_{W-}$                                      | 7.5            | —    | —             | ns   |
| Phase compensation capacitance   | $C_{COPM}$                                    | 1.0            | —    | —             | μF   |
| Operating temperature            | $T_a$   | 0              | —    | 70            | °C   |

Note:  $V_{CCA} - V_{REF} \leq 1.2V$

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## ■ ELECTRICAL CHARACTERISTICS

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

| Parameter                        | Symbol     | Condition   | Value          |           |           | Unit     |
|----------------------------------|------------|---|----------------|-----------|-----------|----------|
|                                  |            |   | Min.           | Typ.      | Max.      |          |
| Resolution                       | —          | —   | —              | —         | 8         | Bits     |
| Linearity error                  | LE         | —   | —              | —         | $\pm 0.2$ | %        |
| Reference input current          | $I_{RIN}$  | $V_{RIN}, V_{ROUT}$ Short                             | —              | —         | 10        | $\mu A$  |
| Reference output voltage         | $V_{ROUT}$ | $V_{CC}=5.00V$  | 3.900          | 4.000     | 4.100     | V        |
| Digital high-level input current | $I_{IHD}$  | $V_{IHD}=2.7V$  | —              | —         | 20        | $\mu A$  |
| Digital low-level input current  | $I_{ILD}$  | $V_{ILD}=0.4V$  | -100           | —         | —         | $\mu A$  |
| RGB output voltage ratio         | FSR        | —   | 0              | 2         | 6         | %        |
| Full-scale output voltage        | $V_{OFS}$  | $V_{CCA}=5.000V$<br>$V_{RIN}, V_{ROUT}$ Short         | $V_{CCA} - 15$ | $V_{CCA}$ | —         | mV       |
| Zero-scale output voltage        | $V_{OZS}$  | $V_{CCA}=V_{CCD}=5.000V$<br>$V_{RIN}=4.00V$           | 3.944          | 4.004     | 4.064     | V        |
|                                  |            | $V_{CCA}=V_{CCD}=5.000V$<br>$V_{RIN}, V_{ROUT}$ Short | 3.884          | 4.004     | 4.124     | V        |
| Output resistance                | $R_o$      | —   | —              | 240       | —         | $\Omega$ |
| Power supply current             | $I_{CC}$   | $V_{CC}=5.25V$<br>$V_{RIN}, V_{ROUT}$ Short           | —              | *70       | 102       | mA       |

Note:  $V_{CCA} = V_{CCD} = 5.00V$

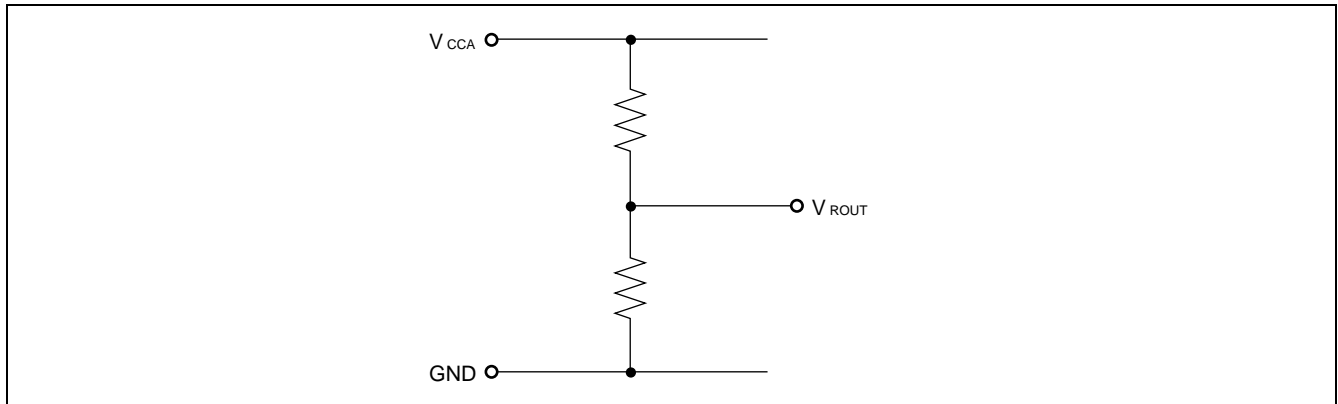
## ■ SWITCHING CHARACTERISTICS

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

| Parameter               | Symbol                 | Value |      |      | Unit |
|-------------------------|------------------------|-------|------|------|------|
|                         |                        | Min.  | Typ. | Max. |      |
| Maximum conversion rate | $F_s$                  | 60    | —    | —    | MSPS |
| Output delay time       | $t_{PLH}$<br>$t_{PHL}$ | —     | 10   | —    | ns   |
| Output rise time        | $t_r$                  | —     | 5    | —    | ns   |
| Output fall time        | $t_f$                  | —     | 5    | —    | ns   |

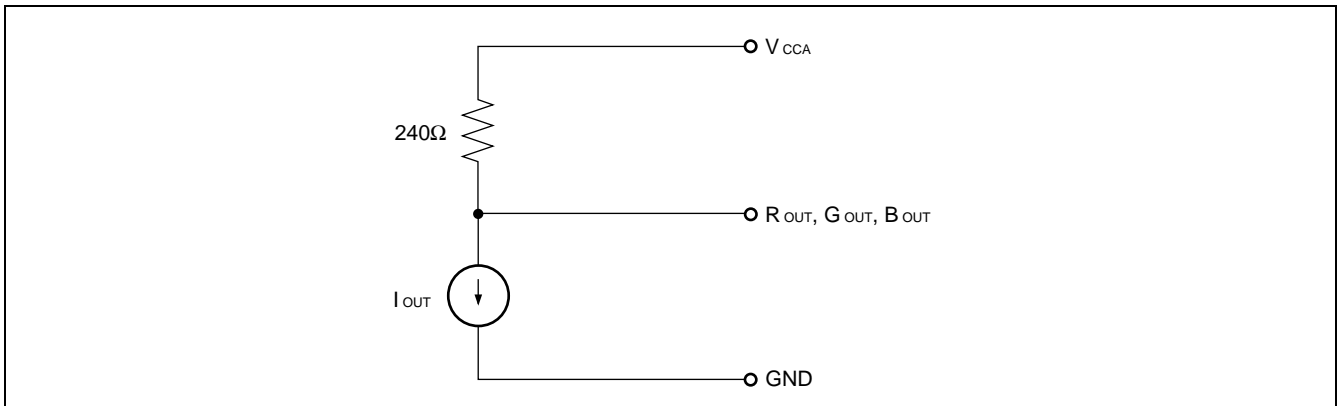
## ■ REFERENCE VOLTAGE OUTPUT EQUIVALENT CIRCUIT

- $V_{ROUT}$

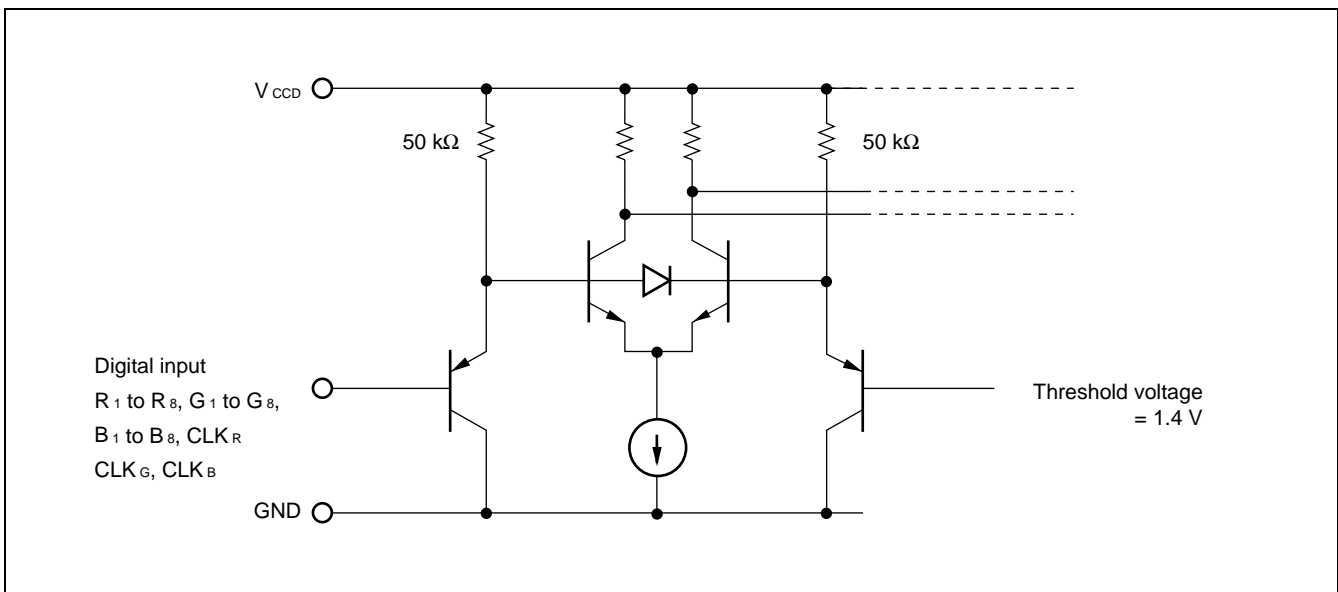


## ■ ANALOG OUTPUT EQUIVALENT CIRCUIT

- $R_{OUT}$ ,  $G_{OUT}$ ,  $B_{OUT}$

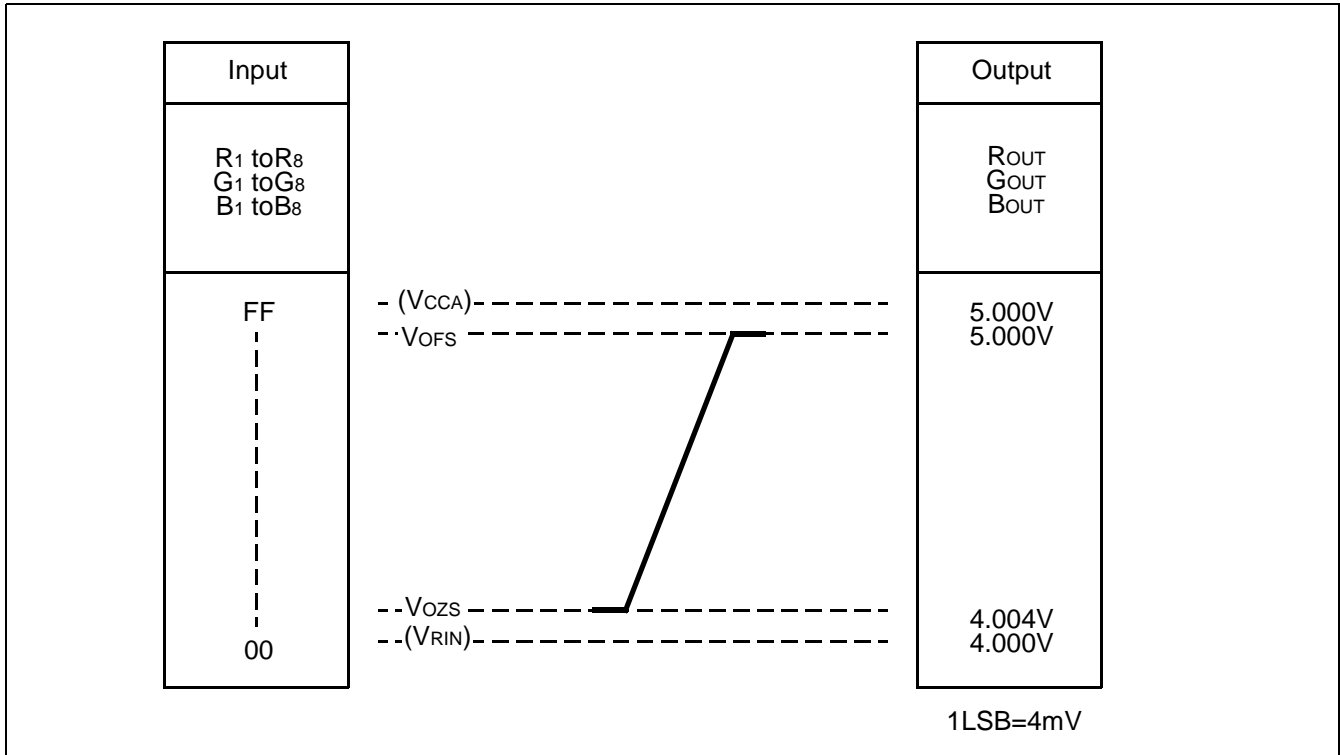


## ■ DIGITAL INPUT EQUIVALENT CIRCUIT

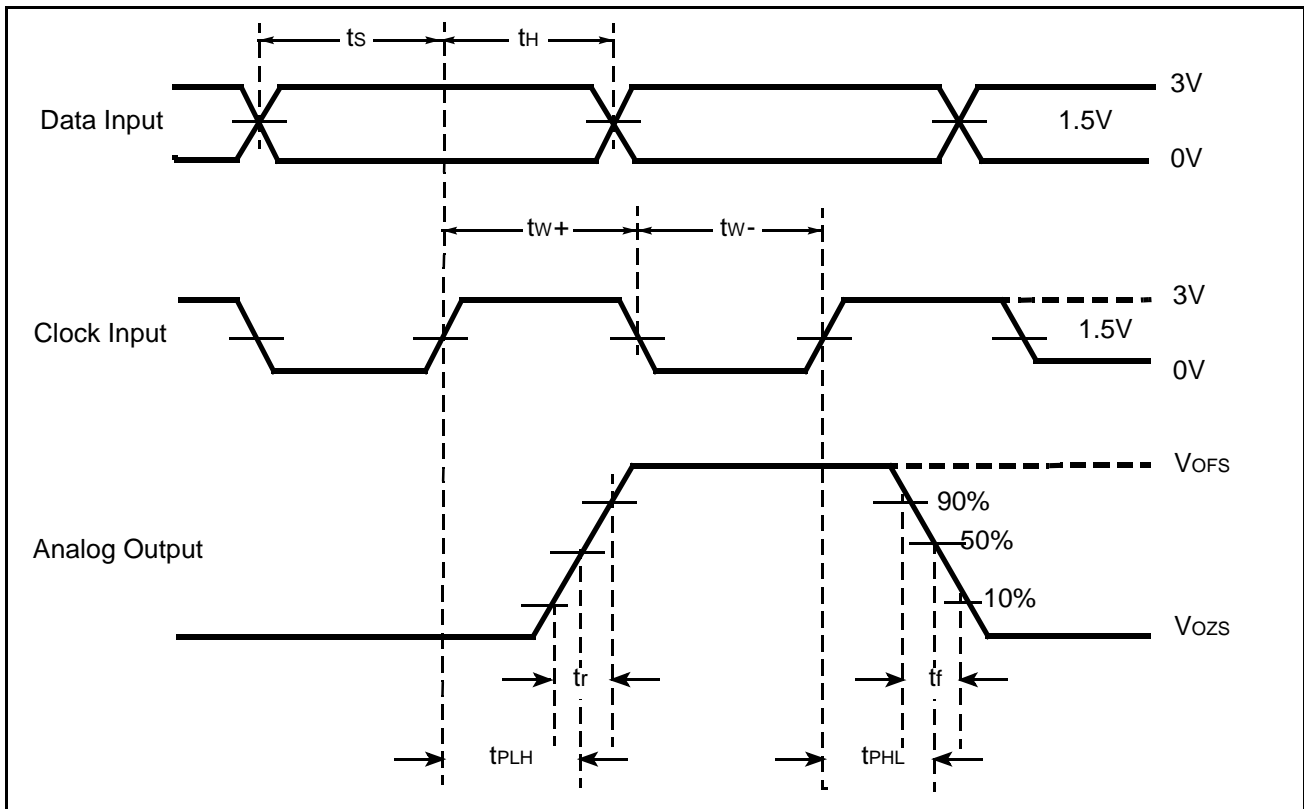


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## ■ DAC OUTPUT VOLTAGE



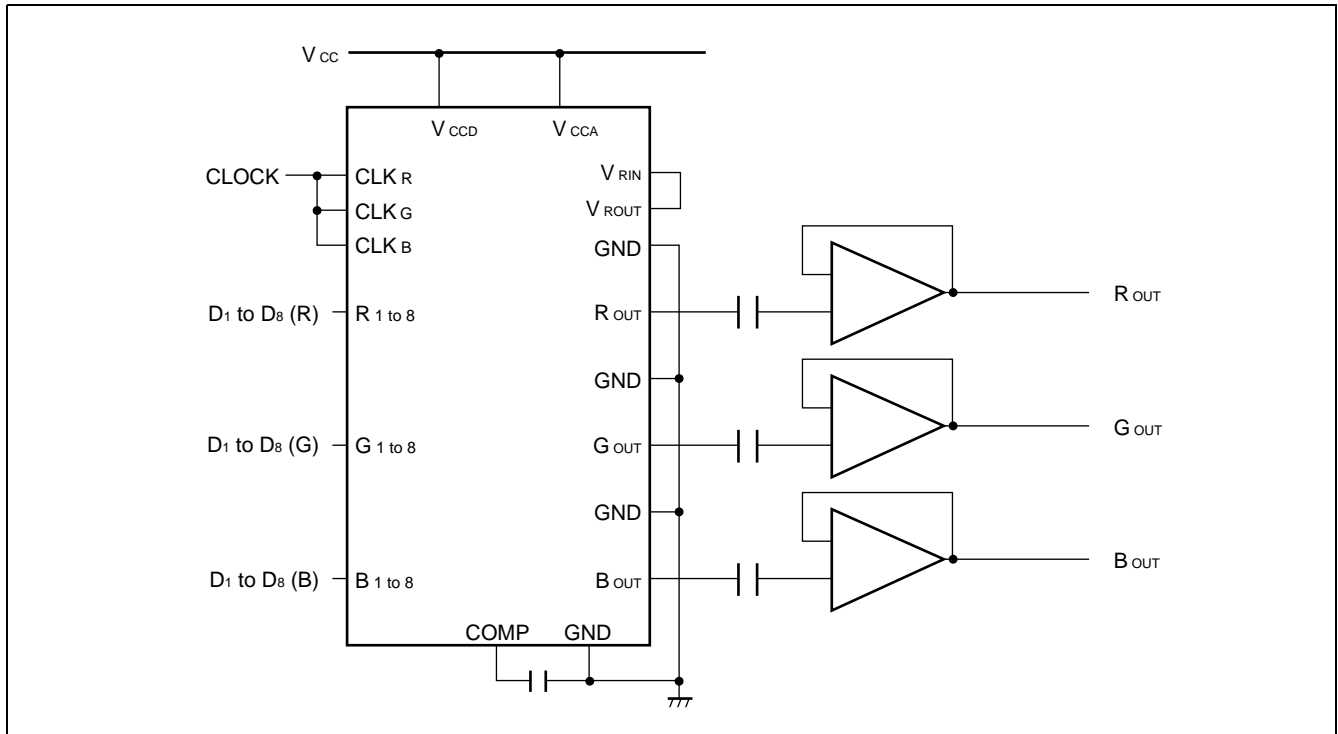
## ■ TIMING DIAGRAM



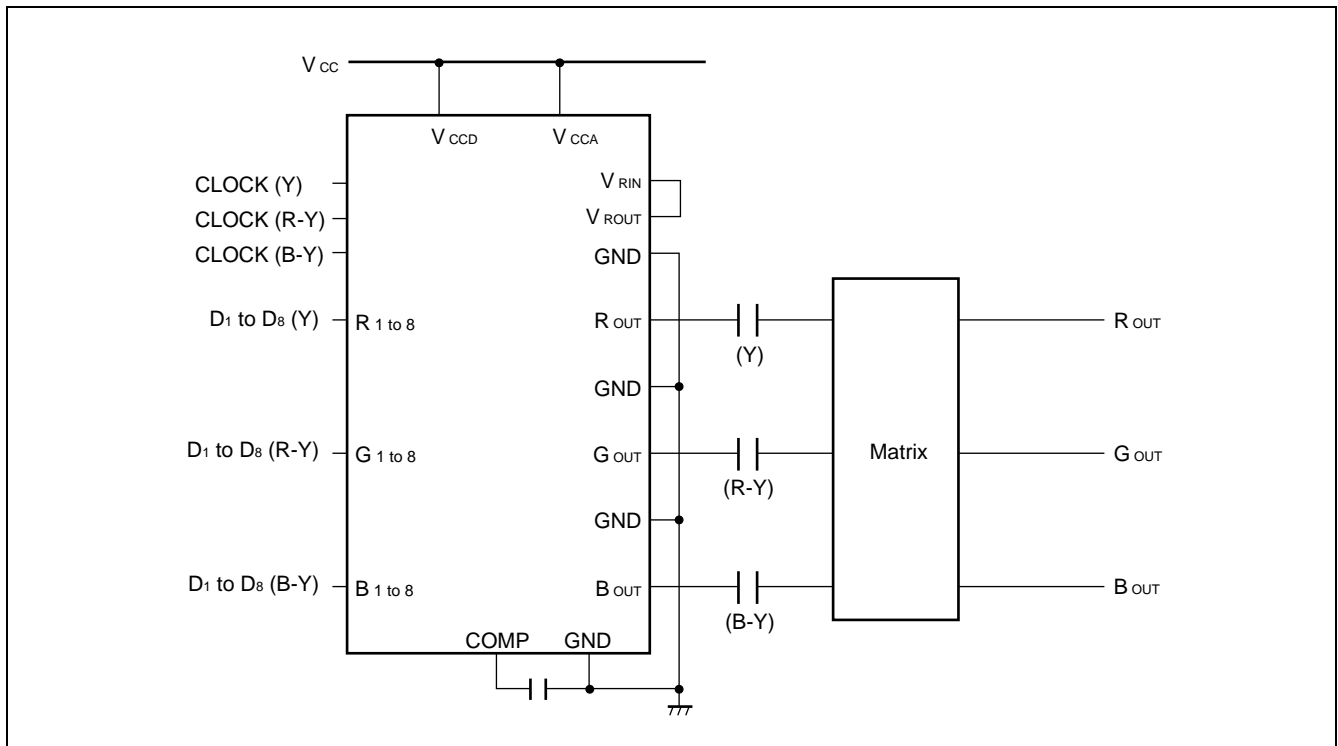


## APPLICATION EXAMPLES

### 1. RGB Signal Process



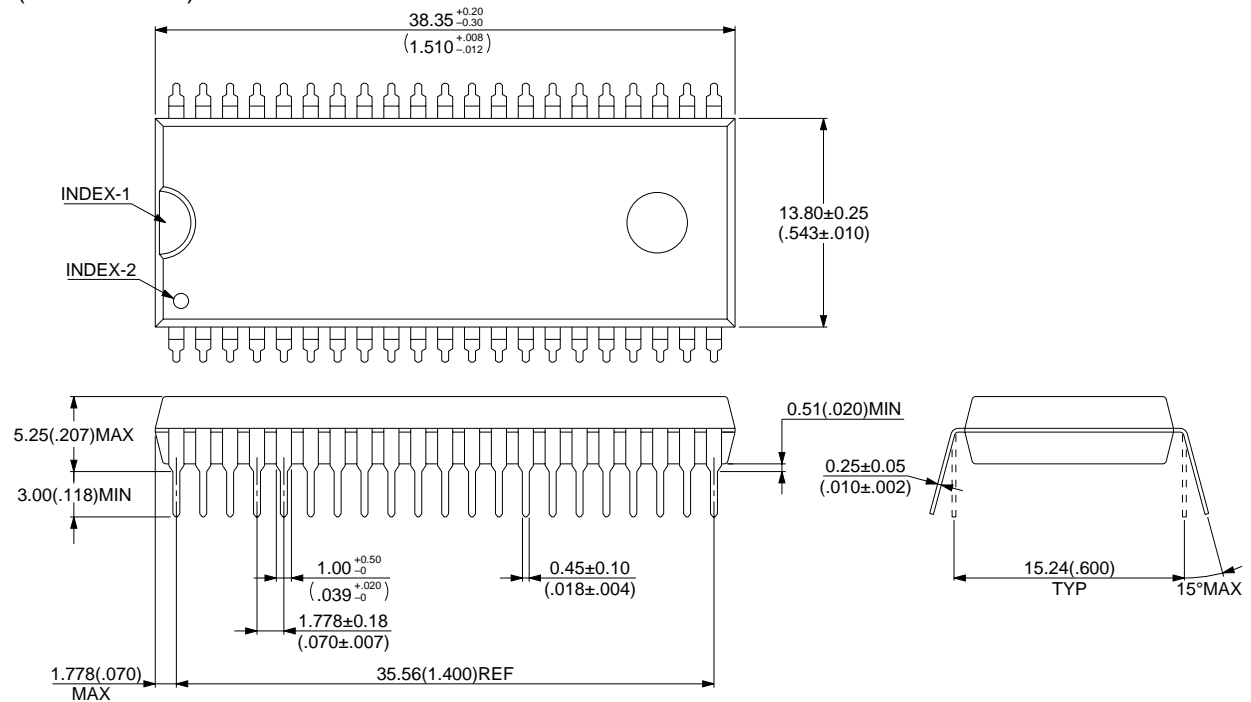
### 2. Component Signal Processing



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## ■ PACKAGE DIMENSIONS

42 pin, Plastic DIP  
(DIP-42P-M02)



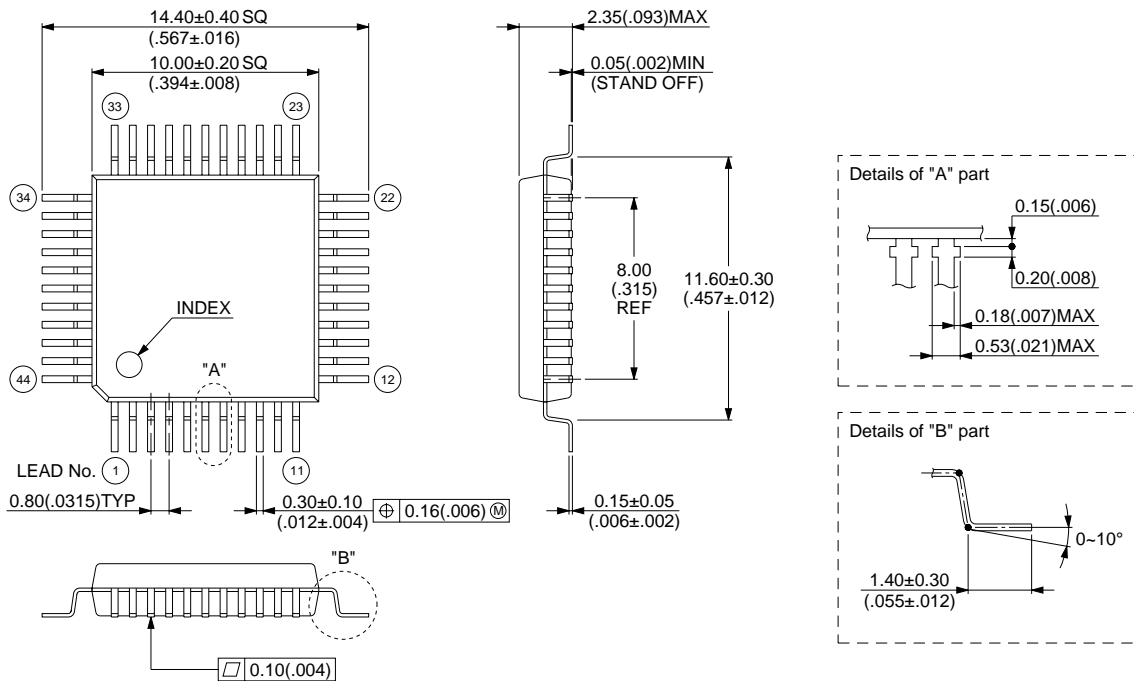
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Dimensions in mm (inches).

(Continued)

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44 pin, Plastic FPT  
(FPT-44P-M11)



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Dimensions in mm (inches).

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