

ASSP

# TV/VCR D/A Converter (3 ch, 8 bit)

## MB86029

### DESCRIPTION

The MB86029 is a 3-channel high-speed CMOS 8-bit D/A converter for TV and VCR application. The MB86029 features on-chip voltage reference, pedestal insertion, and power-down circuits, and a maximum conversion speed of 60 MSPS for digital TV and graphic display application.

### FEATURES

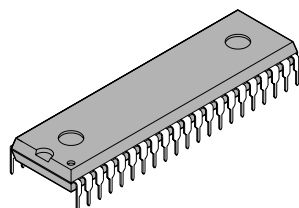
- Functions
  - Maximum conversion speed: 60 MSPS max.
  - Current output mode
  - Output current adjusted by external resistor
  - Pedestal insertion
  - Power-down function
  - On-chip reference power supply (External reference power supply can be used.)
- Conversion

Characteristics	Load resistance		
	37.5Ω	75Ω	150Ω
Output voltage amplitude	0.80V	1.60V	1.60V
Conversion speed	60 MPSP	30 MPSP	20 MPSP

- Supply voltage
  - Single +5 V supply
- Current consumption
  - Typical stage: 500 mW
  - Power-down mode: 20 mW max.

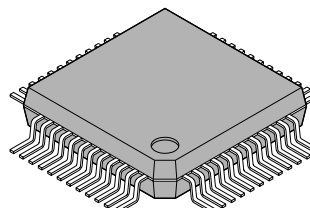
### PACKAGES

42 pin, Plastic DIP



(DIP-42P-M03)

48 pin, Plastic QFP



(FPT-48P-M16)

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.

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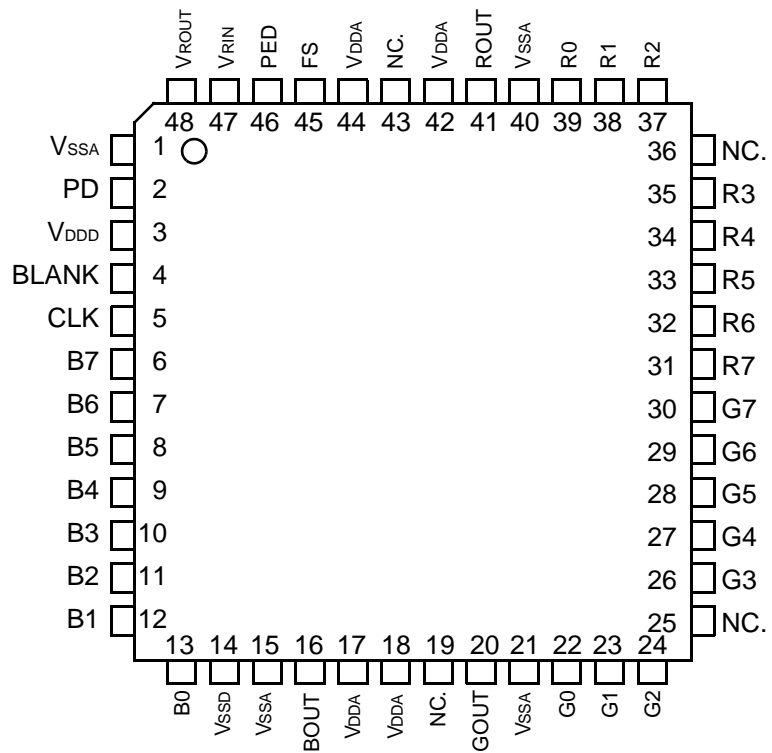
## ■ PIN ASSIGNMENTS

(TOP VIEW)



(DIP-42P-M03)

(TOP VIEW)



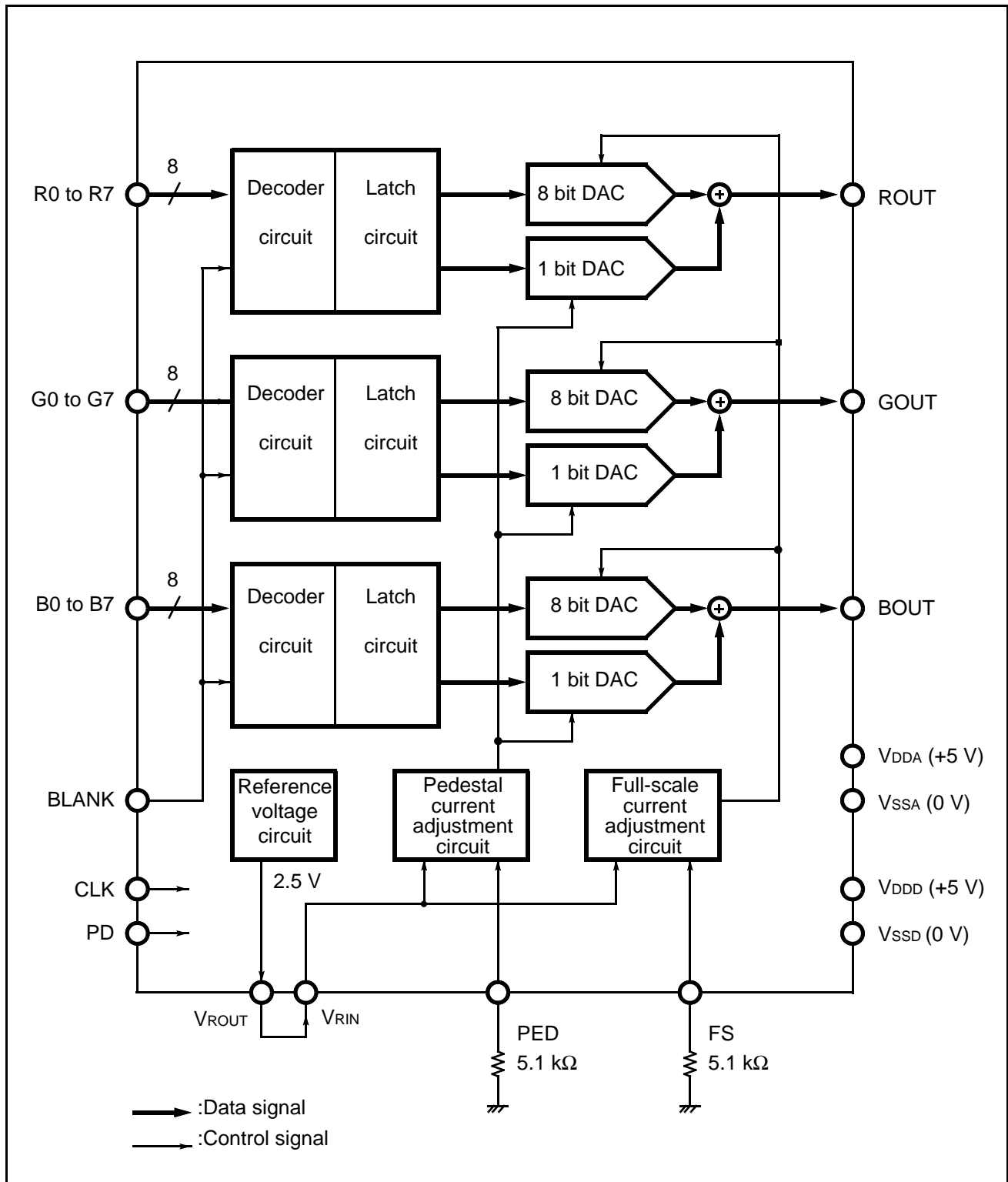
(FPT-48P-M16)

## ■ PIN DESCRIPTIONS

Circuit	Pin No.		Symbol	I/O	Pin Name	Function
	DIP	FPT				
Power supply circuit	10, 11, 32, 33	17, 18, 42, 44	V <sub>DDA</sub>	—	Analog power supply	Analog power supply +5V
	13, 30	1, 15, 21, 40	V <sub>SSA</sub>	—	Analog ground	Analog power supply ground
	39	3	V <sub>DDD</sub>	—	Digital power supply	Digital power supply +5 V
	8	14	V <sub>SSD</sub>	—	Digital ground	Digital power supply ground
Input circuit	22 to 29	39 to 37, 35 to 31	R0 to R7	I	Digital signal input	Digital signal input.  MSB : R7, G7, B7 LSB : R0, G0, B0
	14 to 21	22 to 24, 26 to 30	G0 to G7	I		
	1 to 7, 42	13 to 6	B0 to B7	I		
	38	2	PD	I	Power-down control	High : Power-down mode Low : Operating
	41	5	CLK	I	Clock input	Data is read in, and analog signal is output on the falling edge of the CLK.
	40	4	BLANK	I	Pedestal control	High : Pedestal output Low : No pedestal
	36	47	V <sub>RIN</sub>	I	External voltage reference	For connection of an external reference voltage (2.5 V typ.)
Output circuit	31	41	ROUT	O	Analog output	Analog RGB output
	12	20	GOUT	O		
	9	16	BOUT	O		
	34	45	FS	O	Full-scale current adjustment	The full-scale current is adjusted by an external resistor connected between this pin and the GND pin.
	35	46	PED	O	Pedestal current adjustment	The pedestal current is adjusted by an external resistor connected between this pin and the GND pin.
	37	48	V <sub>ROUT</sub>	O	Reference voltage output	On-chip 2.5 V reference output

# MB86029

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

( $V_{SSD} = V_{SSA} = 0\text{ V}$ ,  $T_a = +25^\circ\text{C}$ )

Parameter	Symbol	Rating	Unit
Power supply voltage	$V_{DD}^*$	-0.3 to +7.0	V
Analog power supply current	$I_{DDA}$	-10 to +200	mA
Analog ground current	$I_{SSA}$	-10 to +50	mA
Digital supply current	$I_{DDD}$	-200 to +10	mA
Digital ground current	$I_{SSD}$	-10 to +50	mA
Analog output current	$I_o$	-10 to +30	mA
Digital input/output current	$I_{I/O}$	-10 to +10	mA
Input/output voltage	$V_{I/O}$	-0.3 to $V_{DD} + 0.3$	V
Storage temperature	$T_{stg}$	-40 to +125	$^\circ\text{C}$

\* :  $V_{DD} = V_{DDD} = V_{DDA}$

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

( $V_{SSD} = V_{SSA} = 0\text{ V}$ )

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Power supply voltage	$V_{DD}^*$	4.75	5.00	5.25	V
Reference power supply input voltage	$V_{RIN}$	2.2	2.5	2.8	V
Low-level digital input voltage	$V_{IL}$	0	—	0.8	V
High-level digital input voltage	$V_{IH}$	2.2	—	$V_{DD}$	V
Ambient operating temperature	$T_{op}$	0	25	70	$^\circ\text{C}$

\* :  $V_{DD} = V_{DDD} = V_{DDA}$

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## ■ ELECTRICAL CHARACTERISTICS

### 1. DC Characteristics

( $V_{DD}^* = 4.75$  to  $5.25$  V,  $V_{RIN} = 2.5$  V,  $V_{SSD} = V_{SSA} = 0$  V,  $T_a = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ )

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Nonlinearity	LE	See the table below for conditions 1	—	—	$\pm 1$	LSB
Differential linearity	DE	See the table below for conditions 1	—	—	$\pm 1$	LSB
Full-scale current	$I_{FS}$	See the table below for conditions 1	18.0	20.0	22.0	mA
		See the table below for conditions 2	18.0	20.0	22.0	
		See the table below for conditions 3	9.2	10.2	11.2	
Pedestal current	$I_{PED}$	See the table below for conditions 1	1.12	1.25	1.38	mA
		See the table below for conditions 2	1.12	1.25	1.38	
		See the table below for conditions 3	0.57	0.64	0.71	
Channel to channel matching error	DM	$I_{FS}$ average variation between channels under Condition 1	—	—	5.0	%FSR
Output voltage range	$V_{OC}$	—	0	—	1.6	V
Supply current	$I_D$	See the table below for conditions 1	—	100	120	mA
		See the table below for conditions 2	—	100	120	
		See the table below for conditions 3	—	60	70	
Reference output voltage	$V_{ROUT}$	—	2.4	2.5	2.6	V

\* :  $V_{DD} = V_{DDD} = V_{DDA}$

#### • Output voltage setting conditions

Conditions	Output voltage amplitude	$R_{FS}^*$	$R_{PED}^*$	Load resistance	Maximum conversion speed
Condition 1 (Typical condition)	0.8 V	5.1 k $\Omega$	5.1 k $\Omega$	37.5 $\Omega$	60 MSPS
Condition 2	1.6 V	5.1 k $\Omega$	5.1 k $\Omega$	75 k $\Omega$	30 MSPS
Condition 3	1.6 V	10 k $\Omega$	10 k $\Omega$	150 k $\Omega$	20 MSPS

\* : The output voltage amplitude can be adjusted with slight changes in external resistances.

## 2. AC Characteristics

( $V_{DD}^* = 4.75$  to  $5.25$  V,  $V_{RIN} = 2.5$  V,  $V_{SSD} = V_{SSA} = 0$  V,  $T_a = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ )

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Output rise time	$t_r$	—	—	—	2	ns
Output fall time	$t_f$	—	—	—	2	ns
High-level pulse width	$t_{WH}$	—	6	—	—	ns
Low-level pulse width	$t_{WL}$	—	6	—	—	ns
Clock signal period	$t_{ck}$	—	16.6	—	—	ns
Setup time	$t_{su}$	—	8	—	—	ns
Hold time	$t_h$	—	2	—	—	ns
Output propagation delay time	$t_d$	—	—	20	—	ns
Settling time	$t_s$	See the table below for conditions 1	—	15	—	ns
		See the table below for conditions 2	—	30	—	
		See the table below for conditions 3	—	50	—	
Output transition time	$t_{rLH}$	See the table below for conditions 1	—	—	6	ns
		See the table below for conditions 2	—	—	12	
		See the table below for conditions 3	—	—	20	
Output transition time	$t_{rHL}$	See the table below for conditions 1	—	—	6	ns
		See the table below for conditions 2	—	—	12	
		See the table below for conditions 3	—	—	20	

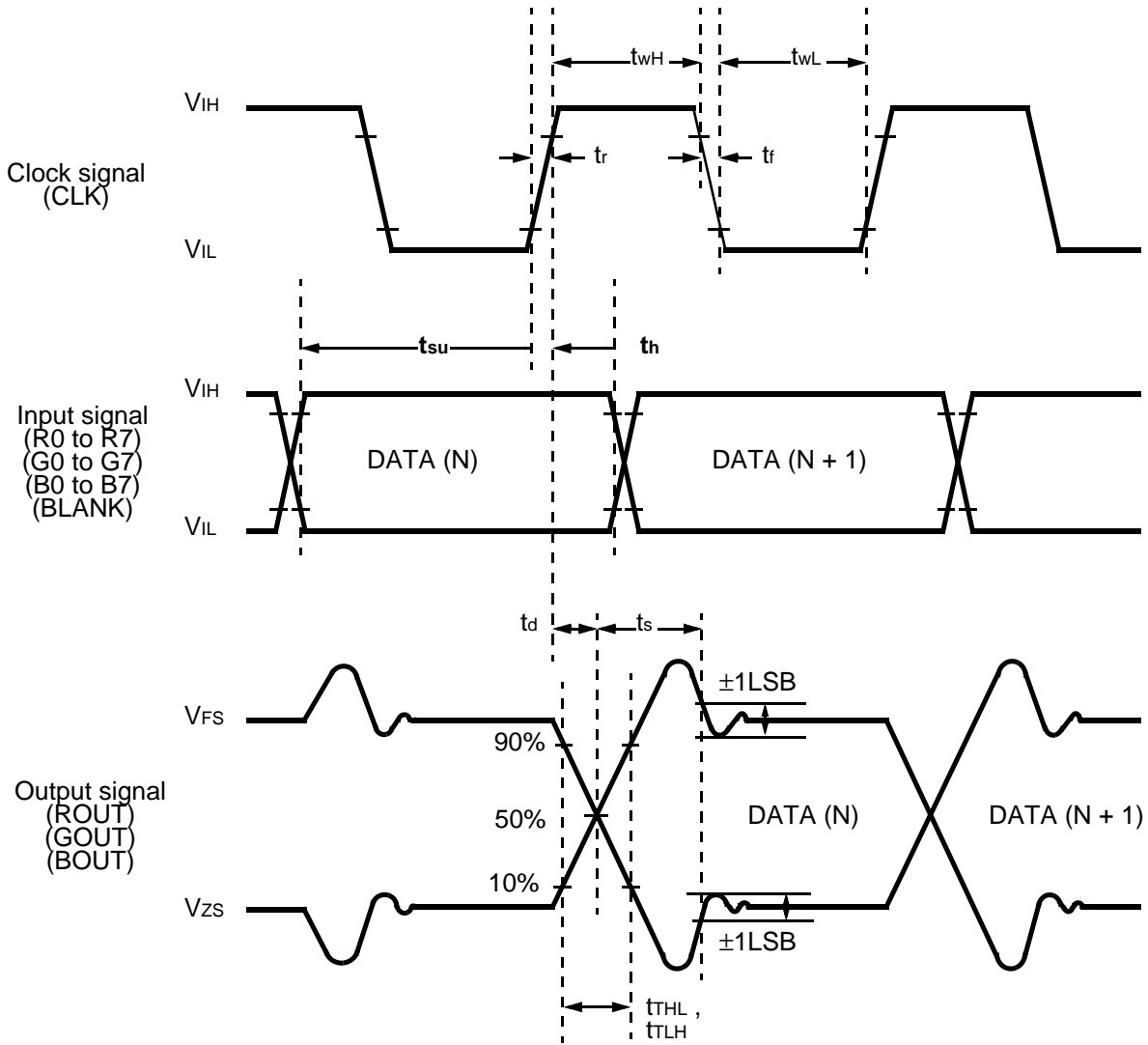
\* :  $V_{DD} = V_{DDD} = V_{DDA}$

### • Output voltage setting conditions

Conditions	Output voltage amplitude	$R_{FS}^*$	$R_{PED}^*$	Load resistance	Maximum conversion speed
Condition 1 (Typical condition)	0.8 V	5.1 k $\Omega$	5.1 k $\Omega$	37.5 $\Omega$	60 MSPS
Condition 2	1.6 V	5.1 k $\Omega$	5.1 k $\Omega$	75 k $\Omega$	30 MSPS
Condition 3	1.6 V	10 k $\Omega$	10 k $\Omega$	150 k $\Omega$	20 MSPS

\* : The output voltage amplitude can be adjusted with slight changes in external resistances.

## ■ TIMING CHART



**Note:** R0 to R7, G0 to G7, B0 to B7 are read on the rising edge of the clock.



## ■ OUTPUT VOLTAGE CALCULATION

The DAC output voltage can be calculated from the load resistance, external resistors, and reference voltage values.

$$V_o \text{ [mV]} = R_L \text{ [\Omega]} \times \left( \frac{K_{FS}}{R_{FS} \text{ [k}\Omega\text{]}} \times X + \frac{K_{PED}}{R_{PED} \text{ [k}\Omega\text{]}} \times B \right) \times V_{RIN} \text{ [V]}$$

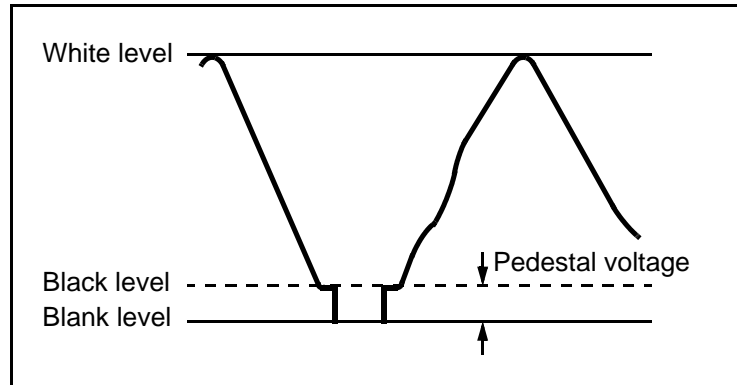
- X = \$00 to \$FF digital signal input code
- B = 0 (Without Pedestal voltage)  
= 1 (With pedestal voltage)
- K<sub>FS</sub> = 0.16 (Constant)
- K<sub>PED</sub> = 2.56 (Constant)
- R<sub>L</sub> = Load resistance
- R<sub>FS</sub>, R<sub>PED</sub> = External resistors
- V<sub>RIN</sub> = Reference voltage

## ■ OUTPUT VOLTAGE CHARACTERISTICS

### 1. With Pedestal

- Table of equation for output voltage code
- Output waveform chart

Output voltage	Code	BLANK
800.0 mV	\$FF	"H"
⋮	⋮	⋮
425.1 mV	\$80	"H"
⋮	⋮	⋮
47.2 mV	\$00	"H"
0.0 mV	\$00	"L"

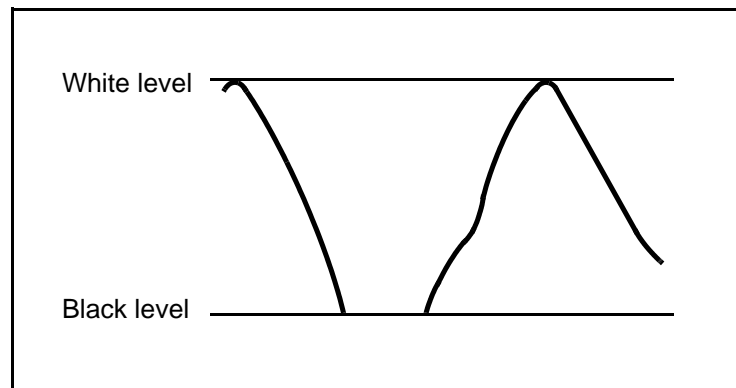


[Condition]  $R_{FS} = R_{PED} = 5.1 \text{ k}\Omega$ ,  $V_{RIN} = 2.5 \text{ V}$ ,  $R_L = 75 \Omega$   
 (According to the above conditions, 1 LSB = approx. 3.0 mV)

### 2. Without Pedestal

- Table of equation for output voltage code
- Output waveform chart

Output voltage	Code	BLANK
752.8 mV	\$FF	"L"
⋮	⋮	⋮
377.9 mV	\$80	"L"
⋮	⋮	⋮
0.0 mV	\$00	"L"



[Condition]  $R_{FS} = R_{PED} = 5.1 \text{ k}\Omega$ ,  $V_{RIN} = 2.5 \text{ V}$ ,  $R_L = 75 \Omega$   
 (According to the above conditions, 1 LSB = approx. 3.0 mV)

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## ■ SPECIFICATION OF ANALOG OUTPUT CURRENT

### 1. Pedestal Current Not Output

Analog output current	Digital input code								
	D7	D6	D5	D4	D3	D2	D1	D0	BLANK
0	0	0	0	0	0	0	0	0	0
$I_{FS} \times \frac{1}{255}$	0	0	0	0	0	0	0	1	0
$I_{FS} \times \frac{2}{255}$	0	0	0	0	0	0	1	0	0
$I_{FS} \times \frac{3}{255}$	0	0	0	0	0	0	1	1	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
$I_{FS} \times \frac{253}{255}$	1	1	1	1	1	1	0	1	0
$I_{FS} \times \frac{254}{255}$	1	1	1	1	1	1	1	0	0
$I_{FS} \times \frac{255}{255}$	1	1	1	1	1	1	1	1	0

$I_{FS}$  : Full-scale current

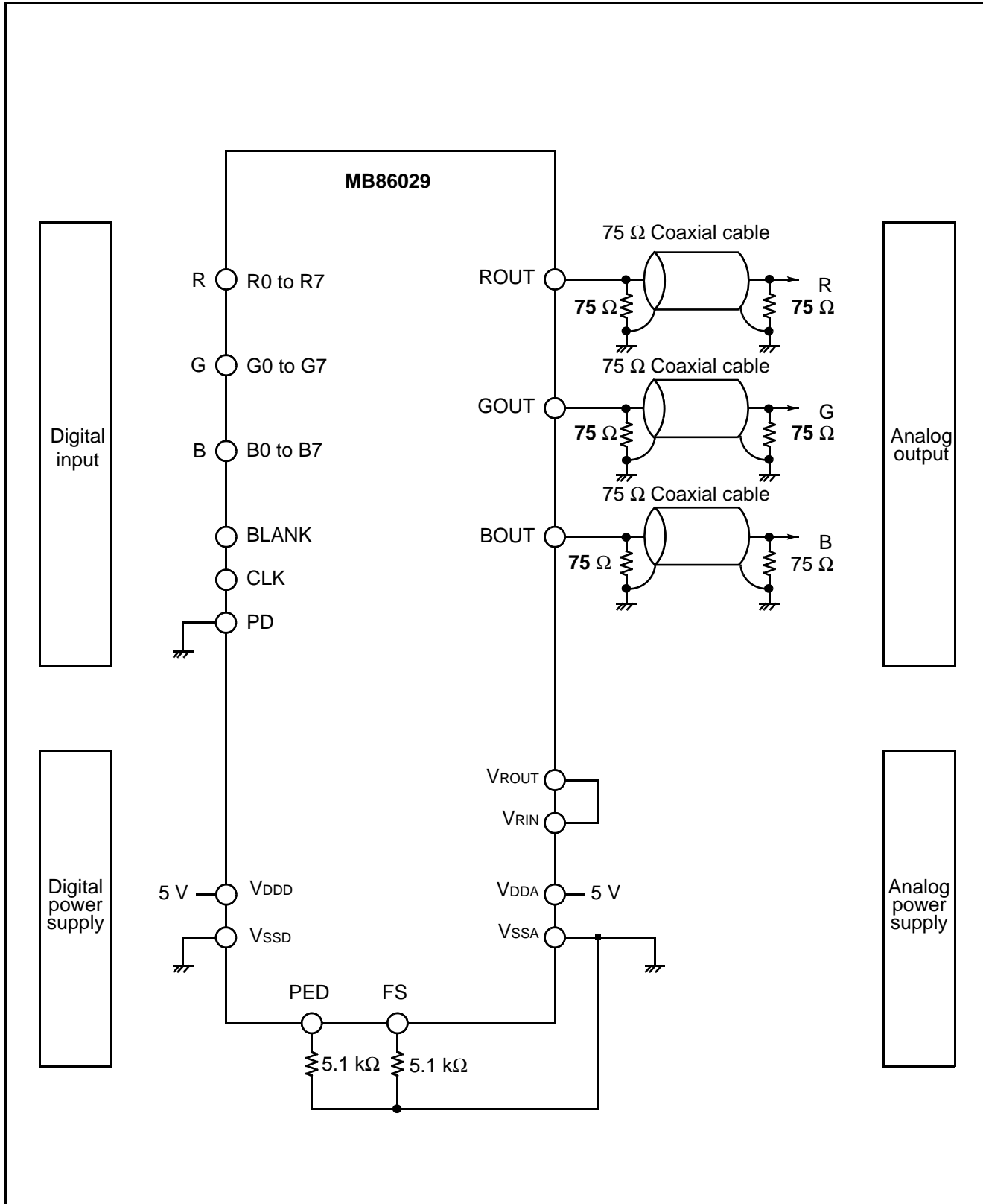
### 2. Pedestal Current Not Output

Analog output current	Digital input code								
	D7	D6	D5	D4	D3	D2	D1	D0	BLANK
$I_{PED}$	0	0	0	0	0	0	0	0	0
$I_{PED} + I_{FS} \times \frac{1}{255}$	0	0	0	0	0	0	0	1	0
$I_{PED} + I_{FS} \times \frac{2}{255}$	0	0	0	0	0	0	1	0	0
$I_{PED} + I_{FS} \times \frac{3}{255}$	0	0	0	0	0	0	1	1	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
$I_{PED} + I_{FS} \times \frac{253}{255}$	1	1	1	1	1	1	0	1	0
$I_{PED} + I_{FS} \times \frac{254}{255}$	1	1	1	1	1	1	1	0	0
$I_{PED} + I_{FS} \times \frac{255}{255}$	1	1	1	1	1	1	1	1	0

$I_{FS}$  : Full-scale current

$I_{PED}$  : Pedestal current

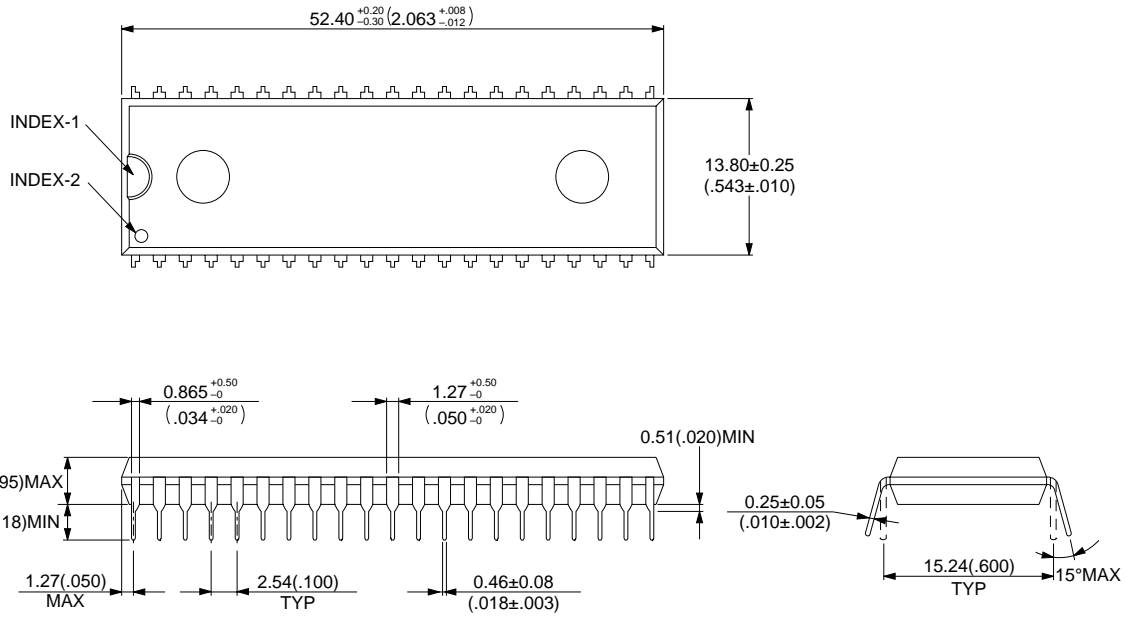
## APPLICATION CIRCUIT



# MB86029

## ■ PACKAGE DIMENSIONS

42 pin, Plastic DIP  
(DIP-42P-M03)

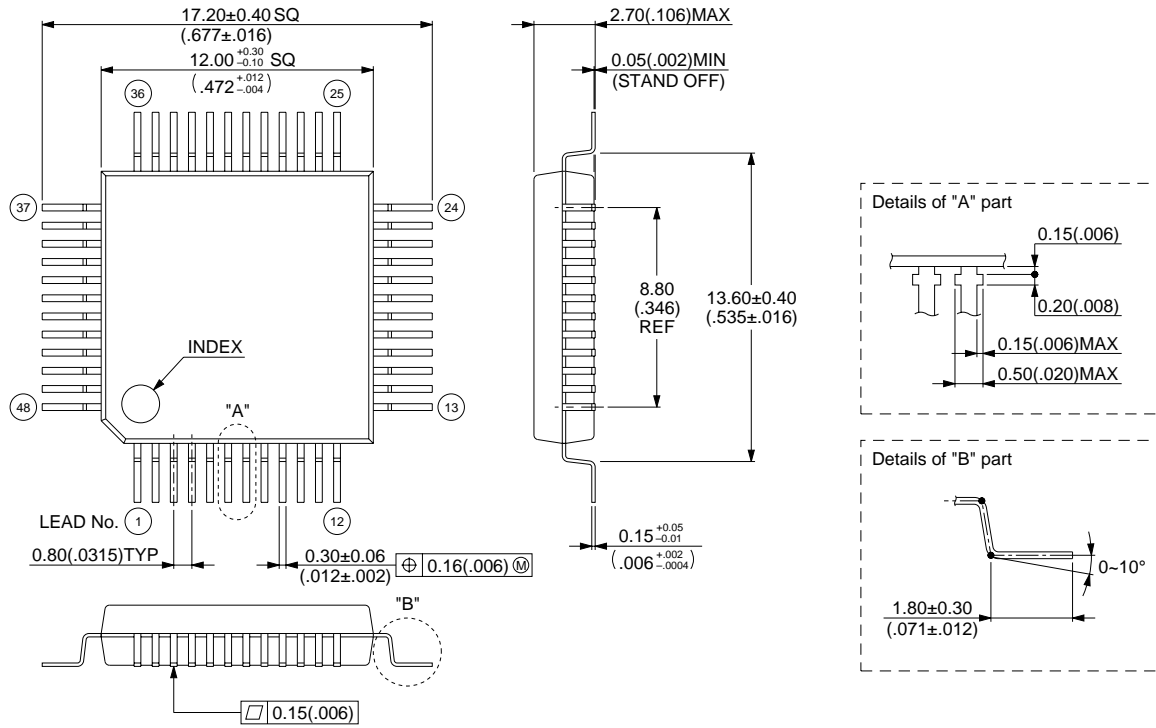


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Dimensions in mm (inch).

(Continued)

48 pin, Plastic FPT  
(FPT-48P-M16)



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Dimensions in mm (inch).

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