

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

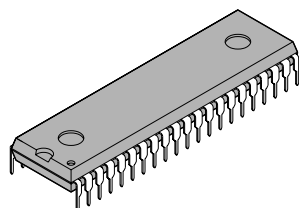
- Functions
 - Maximum conversion speed: 60 MSPS max.
 - Current output mode
 - Output current adjusted by external resistor
 - Pedestal insertion
 - Power-down function
 - On-chip reference power supply (External reference power supply can be used.)
- Conversion

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.

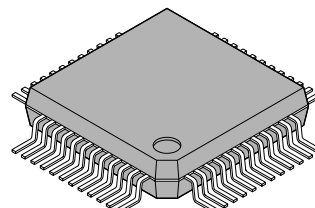
PACKAGES

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.

MB86029

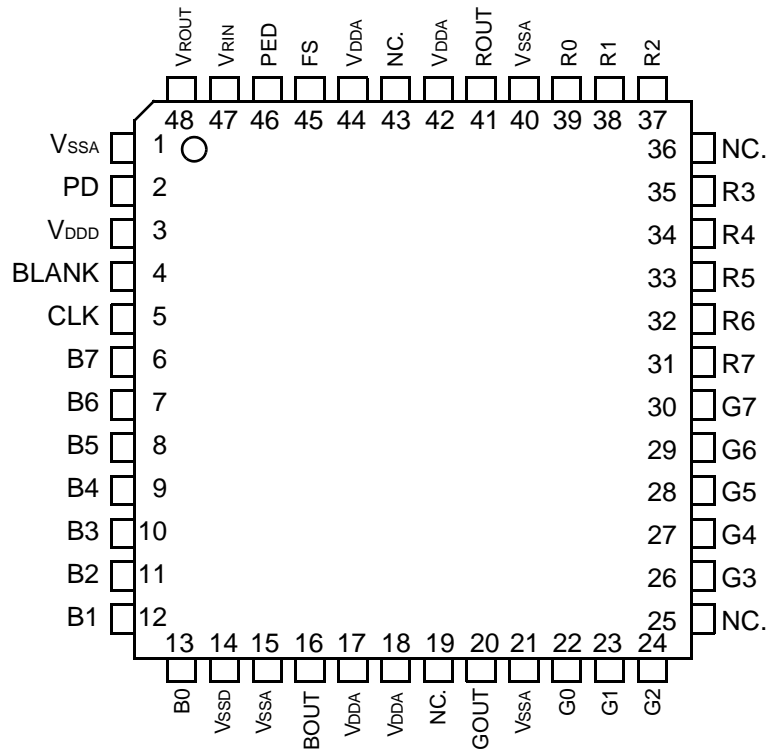
■ PIN ASSIGNMENTS

(TOP VIEW)



(DIP-42P-M03)

(TOP VIEW)



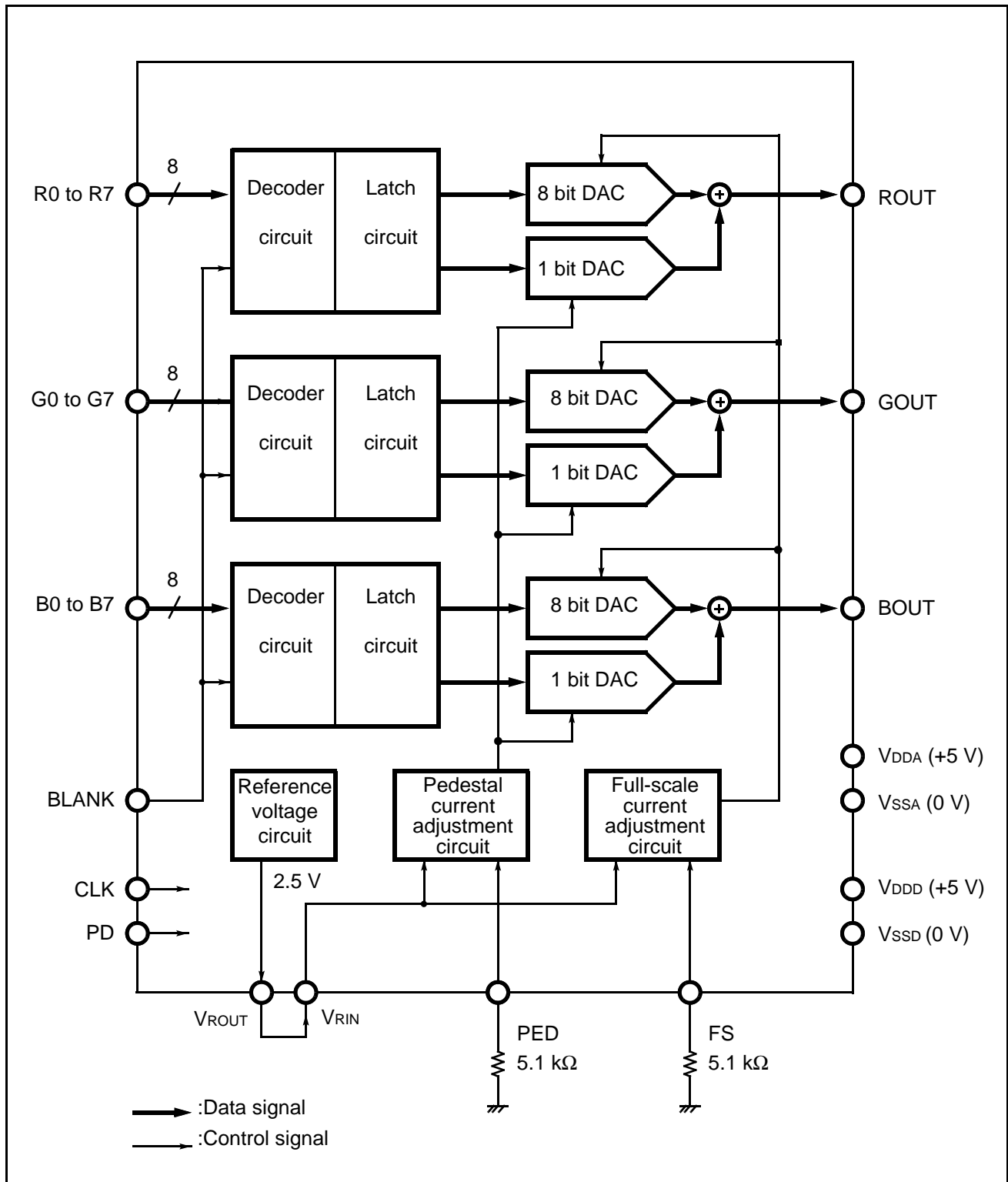
(FPT-48P-M16)

■ 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 _{DDA}	—	Analog power supply	Analog power supply +5V
	13, 30	1, 15, 21, 40	V _{SSA}	—	Analog ground	Analog power supply ground
	39	3	V _{DDD}	—	Digital power supply	Digital power supply +5 V
	8	14	V _{SSD}	—	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 _{RIN}	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 _{ROUT}	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	$^\circ\text{C}$

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

MB86029

■ 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	—	—	± 1	LSB
Differential linearity	DE	See the table below for conditions 1	—	—	± 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 Ω	5.1 k Ω	37.5 Ω	60 MSPS
Condition 2	1.6 V	5.1 k Ω	5.1 k Ω	75 k Ω	30 MSPS
Condition 3	1.6 V	10 k Ω	10 k Ω	150 k Ω	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	

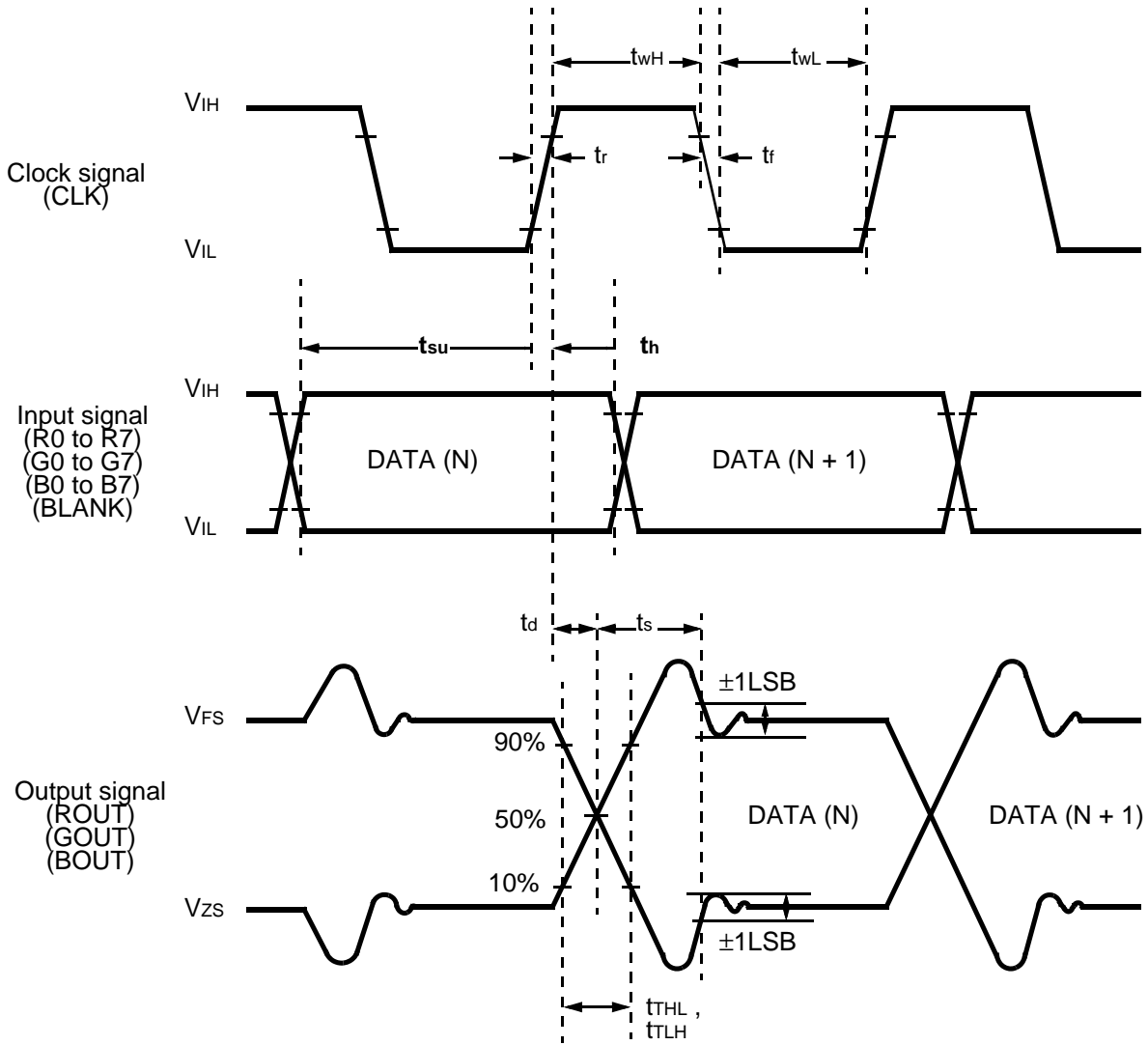
* : $V_{DD} = V_{DDD} = V_{DDA}$

• 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 Ω	5.1 k Ω	37.5 Ω	60 MSPS
Condition 2	1.6 V	5.1 k Ω	5.1 k Ω	75 k Ω	30 MSPS
Condition 3	1.6 V	10 k Ω	10 k Ω	150 k Ω	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.

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

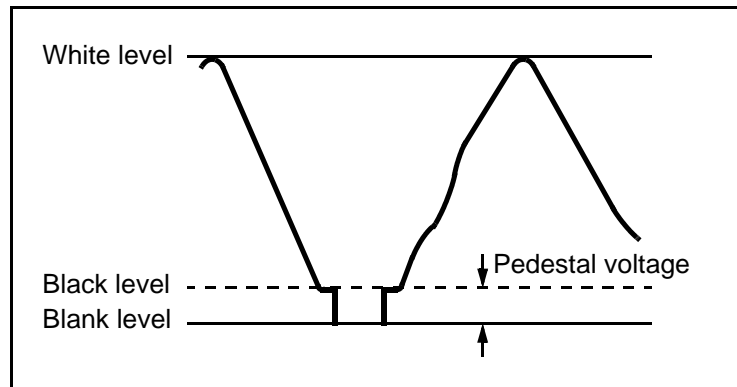
- X = \$00 to \$FF digital signal input code
- B = 0 (Without Pedestal voltage)
= 1 (With pedestal voltage)
- K_{FS} = 0.16 (Constant)
- K_{PED} = 2.56 (Constant)
- R_L = Load resistance
- R_{FS}, R_{PED} = External resistors
- V_{RIN} = Reference voltage

■ 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"

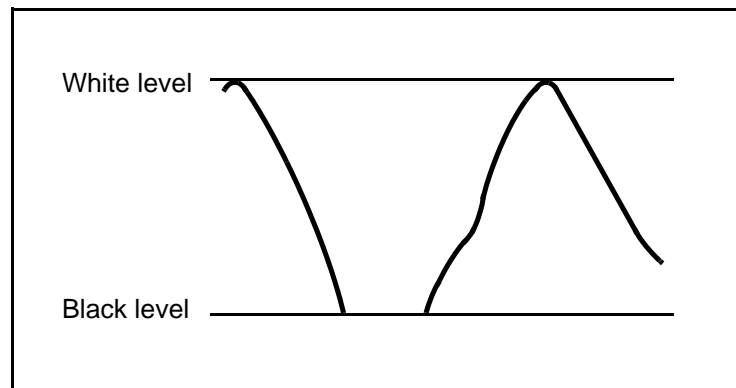


[Condition] $R_{FS} = R_{PED} = 5.1 \text{ k}\Omega$, $V_{RIN} = 2.5 \text{ V}$, $R_L = 75 \Omega$
 (According to the above conditions, 1 LSB = approx. 3.0 mV)

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)

MB86029

■ 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

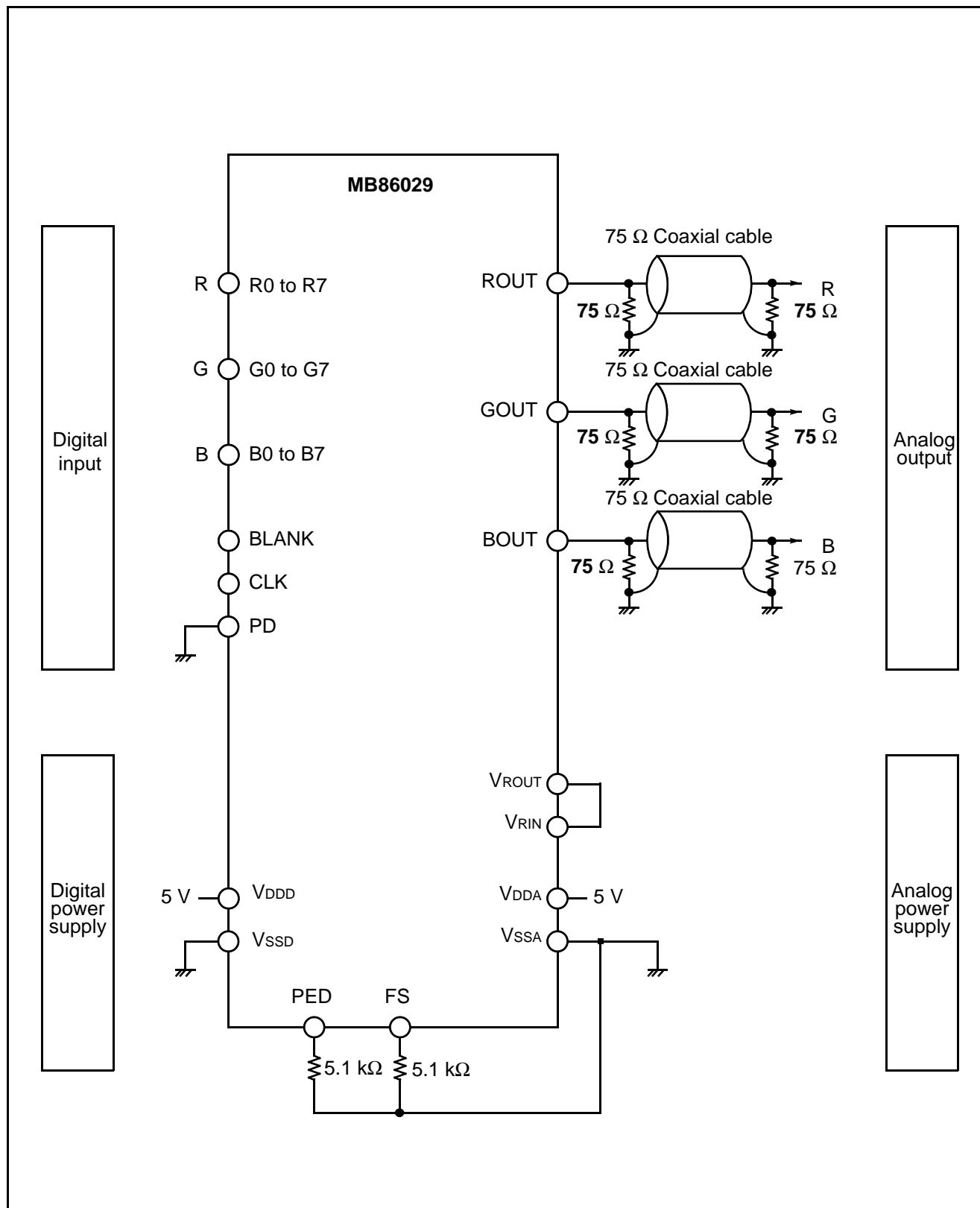
2. Pedestal Current Not Output

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

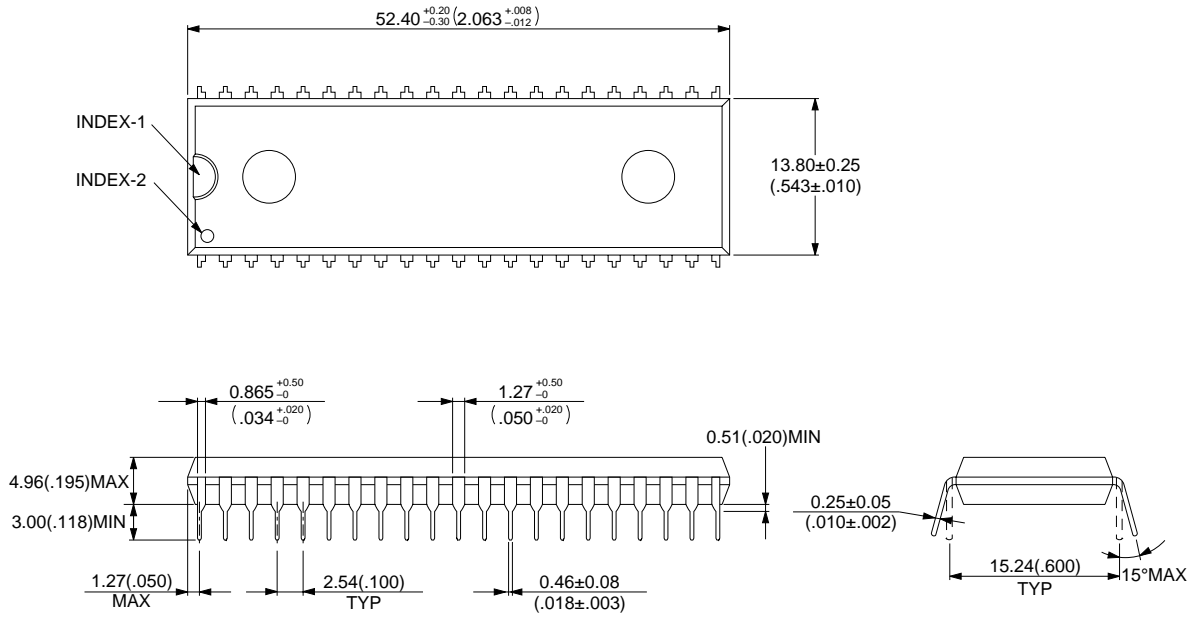
APPLICATION CIRCUIT



MB86029

■ PACKAGE DIMENSIONS

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

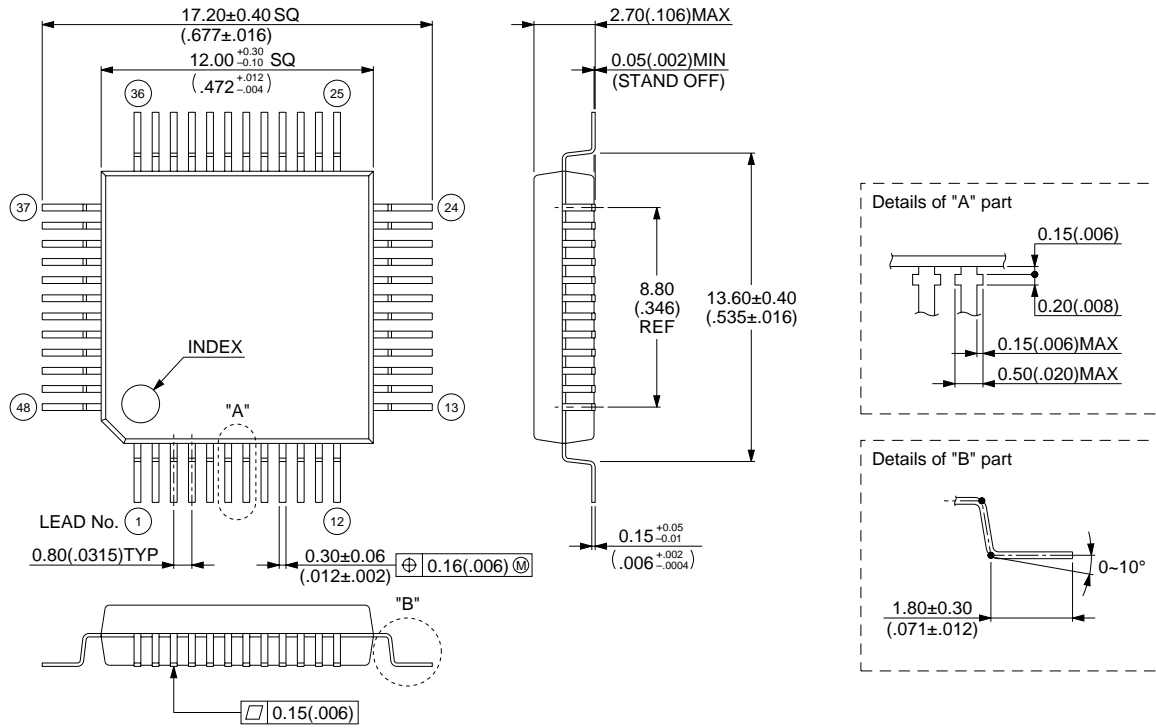


© 1994 FUJITSU LIMITED D42009S-2C-2

Dimensions in mm (inch).

(Continued)

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



© 1994 FUJITSU LIMITED F48026S-1C-1

Dimensions in mm (inch).

FUJITSU LIMITED

For further information please contact:

Japan

FUJITSU LIMITED
Corporate Global Business Support Division
Electronic Devices
KAWASAKI PLANT, 4-1-1, Kamikodanaka
Nakahara-ku, Kawasaki-shi
Kanagawa 211-88, Japan
Tel: (044) 754-3753
Fax: (044) 754-3329

North and South America

FUJITSU MICROELECTRONICS, INC.
Semiconductor Division
3545 North First Street
San Jose, CA 95134-1804, U.S.A.
Tel: (408) 922-9000
Fax: (408) 432-9044/9045

Europe

FUJITSU MIKROELEKTRONIK GmbH
Am Siebenstein 6-10
63303 Dreieich-Buchsschlag
Germany
Tel: (06103) 690-0
Fax: (06103) 690-122

Asia Pacific

FUJITSU MICROELECTRONICS ASIA PTE. LIMITED
#05-08, 151 Lorong Chuan
New Tech Park
Singapore 556741
Tel: (65) 281 0770
Fax: (65) 281 0220

All Rights Reserved.

The contents of this document are subject to change without notice. Customers are advised to consult with FUJITSU sales representatives before ordering.

The information and circuit diagrams in this document presented as examples of semiconductor device applications, and are not intended to be incorporated in devices for actual use. Also, FUJITSU is unable to assume responsibility for infringement of any patent rights or other rights of third parties arising from the use of this information or circuit diagrams.

FUJITSU semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION:

Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with FUJITSU sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

Any semiconductor devices have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

If any products described in this document represent goods or technologies subject to certain restrictions on export under the Foreign Exchange and Foreign Trade Control Law of Japan, the prior authorization by Japanese government should be required for export of those products from Japan.