

**ASSP**

# 1 Channel 8-bit A/D Converter

## MB40528

### ■ DESCRIPTION

The MB40528 is a full parallel comparison (flash) type 8-bit resolution analog-to-digital converter, designed for various video and image processing applications.

The MB40528 has 8-bit resolution 1 channel A/D converter. Input analog data are converted into digital data by the A/D converter in minimum 60 Mega samples per seconds (MSPS).

The analog data is provided in a range of DC +3V to +5V (2Vp-p level) and the output digital data in TTL level.

The MB40528 is fabricated by the Fujitsu's advanced bipolar process and housed in a 20-pin plastic DIP.

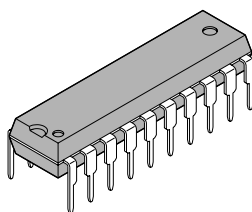
The MB40528 is suitable for various video and image applications.

### ■ FEATURES

- Conversion method : Full parallel comparison type
- 8-bit x 1 channel A/D converter
- Max. 60 MHz input clock frequency providing 60 MSPS data conversion rate
- Linearity error : Typical +/-0.15%
- Analog input voltage range : 3V to 5V (2Vp-p level)
- Digital input/output voltage level : TTL level
- On-chip reference voltage generator
- Low power consumption : Typical 400mW
- Single +5V power supply
- Operating temperature range : -20°C to +70°C
- Fujitsu's advanced bipolar process

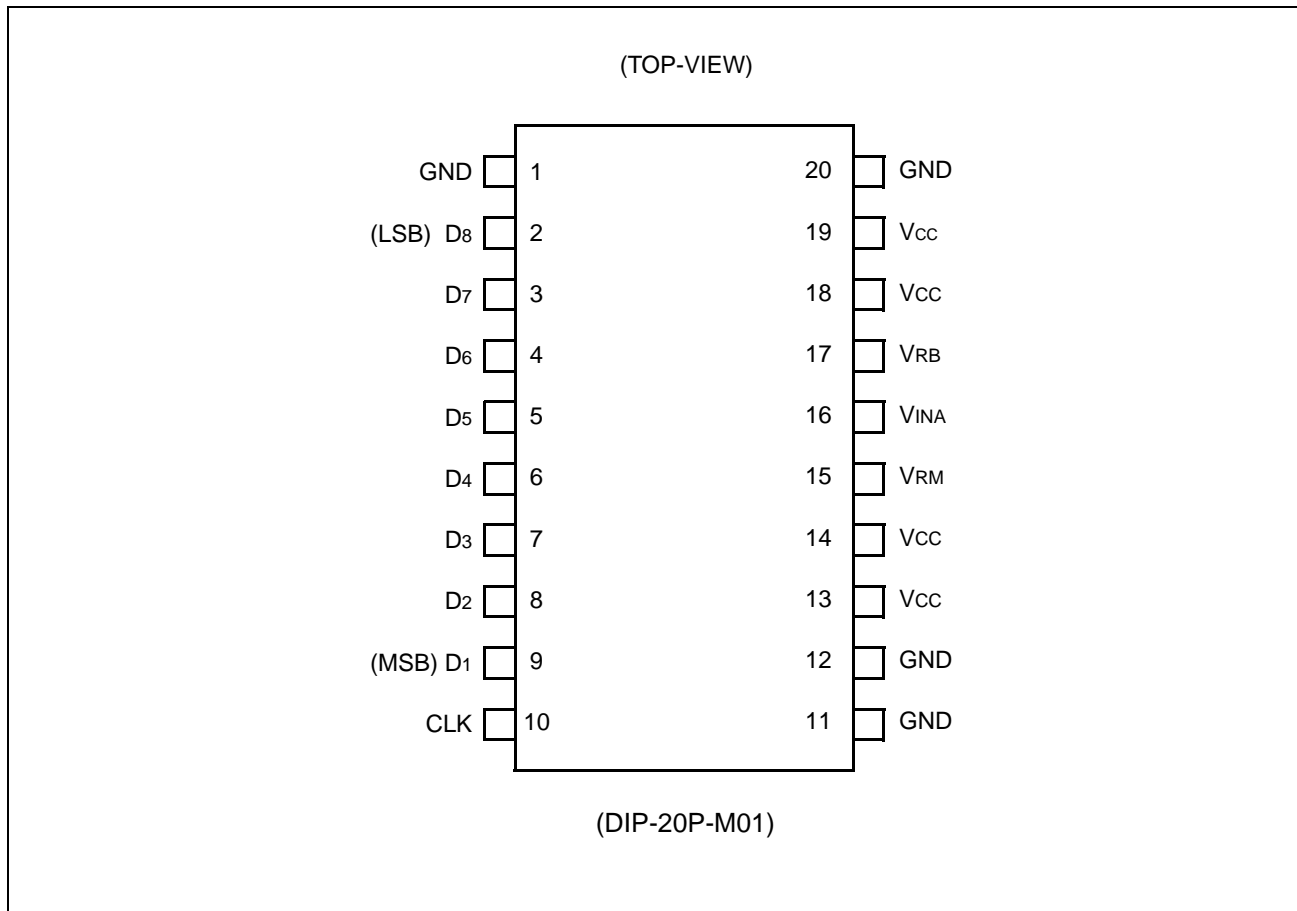
### ■ PACKAGE

20-pin Plastic DIP



(DIP-20P-M01)

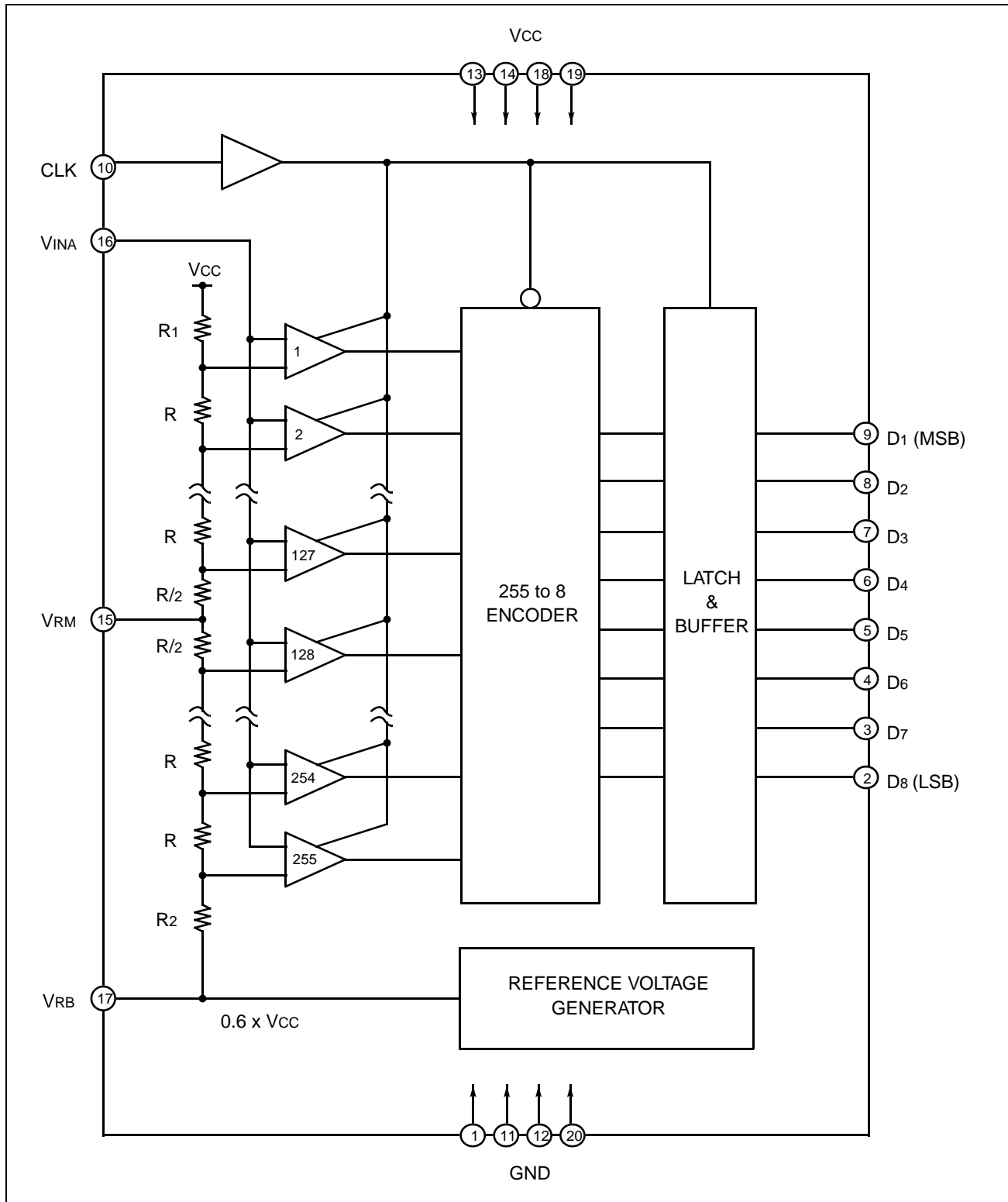
## ■ PIN ASSIMENT



## ■ PIN DESCRIPTION

Pin No.	Symbol	Type	Pin name	Description
16	VINA	I	Analog signal input pin	The analog data to be converted is input to this pin. The input voltage range is 3V to 5V (VRB to VCC).
10	CLK	I	Clock input pin	The input voltage is a TTL level.
9 to 2	D <sub>1</sub> to D <sub>8</sub>	O	Digital signal output pin	8-bit resolution A/D converter outputs. The output voltage is a TTL level. Also, D <sub>1</sub> pin is an MSB and D <sub>8</sub> pin is a LSB.
17	VRB	O	Reference voltage output pin	This pin outputs 0.6 x VCC [V] (Typ. 3V). An 1μF or more capacitor having superior frequency characteristic should be connected to this pin. The capacitor must be connected near the device.
15	VRM	O	An intermediate voltage output pin	An intermediate voltage between VCC and VRB (Typ. 4V) is output from this pin. Normally this pin is left open.
13, 14, 18, 19	VCC	-	+5 V DC power supply pins	Connect to the power supply pin.
1, 11, 12, 20	GND	-	Ground pins	Connect to the ground line.

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

(GND = 0 V)

Parameter	Symbol	Condition	Rating		Unit
			Min.	Max.	
Supply Voltage	VCC	–	-0.5	+7.0	V
Analog Input Voltage	VINA	–	-0.5	VCC +0.5	V
Digital Input Voltage	VIND	–	-0.5	+7.0	V
Storage Temperature	Tstg	–	-55	+125	°C

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

## ■ RECOMMENDED OPERATING CONDITIONS

(GND = 0 V)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Supply Voltage	VCC	–	4.75	5.00	5.25	V
Analog Input Voltage	VINA	–	VRB	–	VCC	V
Digital “H” Level Input Voltage	VIHD	–	2.0	–	–	V
Digital “L” Level Input Voltage	VILD	–	–	–	0.8	V
Digital “H” Level Output Current	IOH	–	-400	–	–	μA
Digital “L” Level Output Current	IOL	–	–	–	1.6	mA
Clock Frequency	fCLK	–	–	–	60	MHz
Minimum Clock “H” Level Pulse Width	twH	–	7.0	–	–	ns
Minimum Clock “L” Level Pulse Width	twL	–	8.0	–	–	ns
Operating Ambient Temperature	Ta	–	-20	–	70	°C

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device’s electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.

## ■ ELECTRICAL CHARACTERISTICS

### 1. DC CHARACTERISTICS

#### (1) Analog Block

(V<sub>CC</sub> = 4.75 V to 5.25 V, GND = 0 V, T<sub>a</sub> = -20°C to +70°C)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Resolution	–	–	–	8	–	bit
Linearity Error	LE	DC Accuracy	–	±0.15	±0.3	%
Differential Linearity Error	DLE	DC Accuracy	–	±0.12	–	%
Analog Input Equivalent Resistor	R <sub>INA</sub>	–	0.2	1.5	–	MΩ
Analog Input Capacitance	C <sub>INA</sub>	–	–	40	–	pF
Analog “H” Level Input Current	I <sub>IHA</sub>	V <sub>INA</sub> = V <sub>CC</sub>	–	–	210	μA
Analog “L” Level Input Current	I <sub>IILA</sub>	V <sub>INA</sub> = V <sub>REF</sub>	–	–	200	μA
Reference Voltage	V <sub>RB</sub>	–	0.6×V <sub>CC</sub> -0.1	0.6×V <sub>CC</sub>	0.6×V <sub>CC</sub> +0.1	V
Supply Current	I <sub>CC</sub>	–	–	80*	150	mA

\* : V<sub>CC</sub> = 5.0V, T<sub>a</sub> = +25°C

#### (2) Digital Block

(V<sub>CC</sub> = 4.75 V to 5.25 V, GND = 0 V, T<sub>a</sub> = -20°C to +70°C)

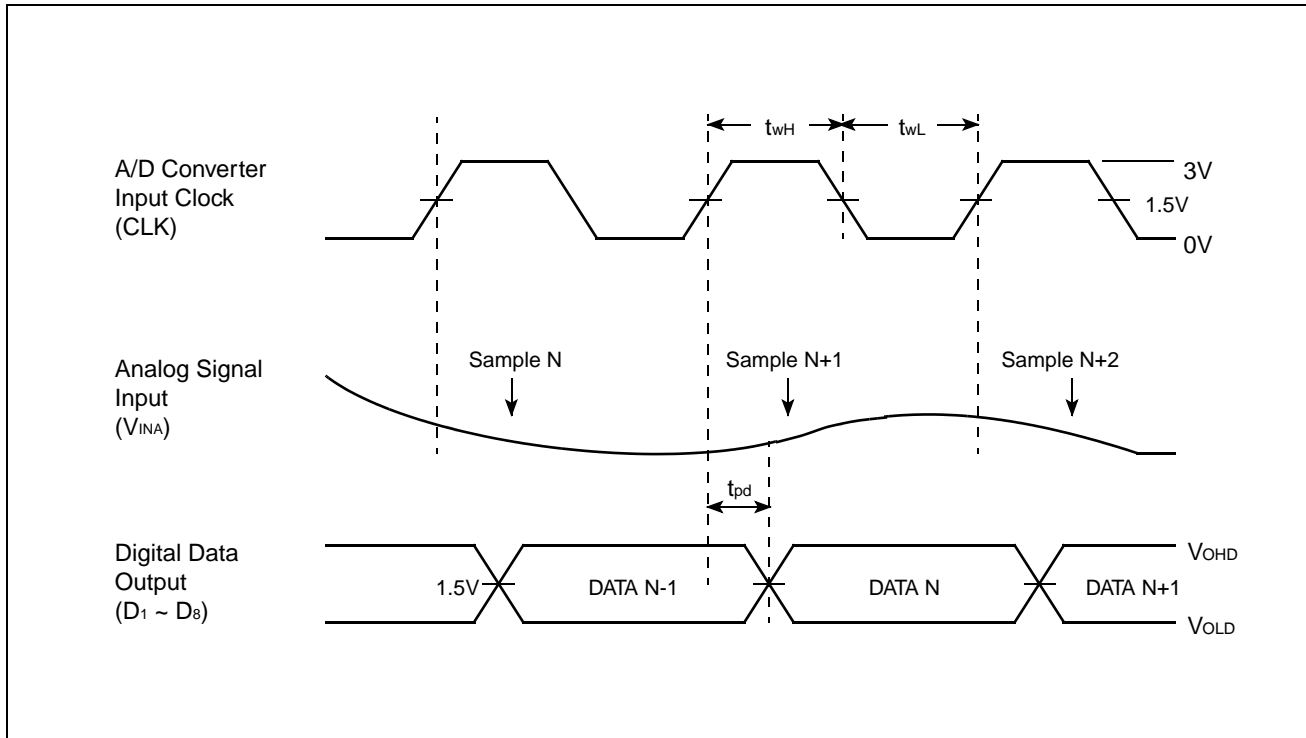
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Digital “H” Level Output Voltage	V <sub>OHD</sub>	I <sub>OH</sub> = -400μA	2.7	–	–	V
Digital “L” Level Output Voltage	V <sub>OLD</sub>	I <sub>OL</sub> = 1.6mA	–	–	0.4	V
Digital “H” Level Input Voltage	V <sub>IHD</sub>	–	2.0	–	–	V
Digital “L” Level Input Voltage	V <sub>ILD</sub>	–	–	–	0.8	V
Digital “H” Level Input Current	I <sub>IHD</sub>	–	–	–	20	μA
Digital “L” Level Input Current	I <sub>IILD</sub>	–	-100	–	–	μA

### 2. AC CHARACTERISTICS

(V<sub>CC</sub> = 4.75 V to 5.25 V, GND = 0 V, T<sub>a</sub> = -20°C to +70°C)

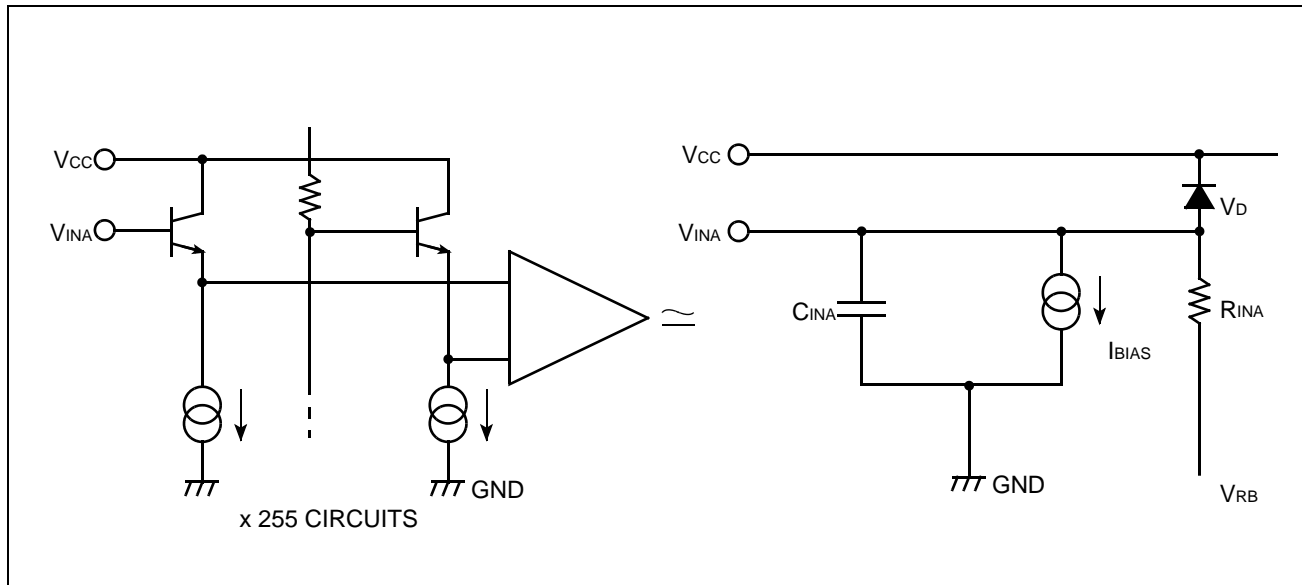
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Maximum Conversion Rate	f <sub>s</sub>	–	60	–	–	MSPS
Digital Output Delay Time	t <sub>pd</sub>	–	5.0	8.5	15	ns

## ■ AC TIMING CHART



■ EQUIVALENT CIRCUITS

Figure 1. Analog Input Equivalent Circuit



C<sub>INA</sub>: Non-linear Emitter-follower Junction Capacitance

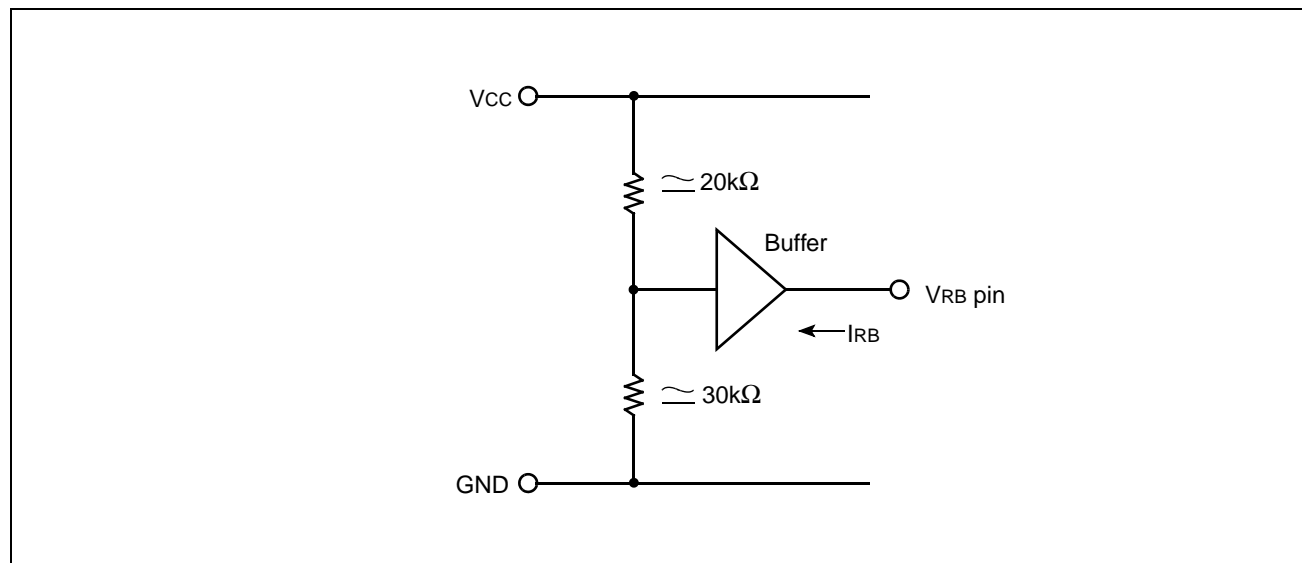
R<sub>INA</sub>: Linear Resistance Model for Input Current Transition by Comparator Switching:  
finite value for V<sub>INA</sub> < V<sub>RB</sub> or when CLK = "H" level

V<sub>RB</sub>: Voltage at V<sub>RB</sub> pin (Not the V<sub>RB</sub> pin itself)

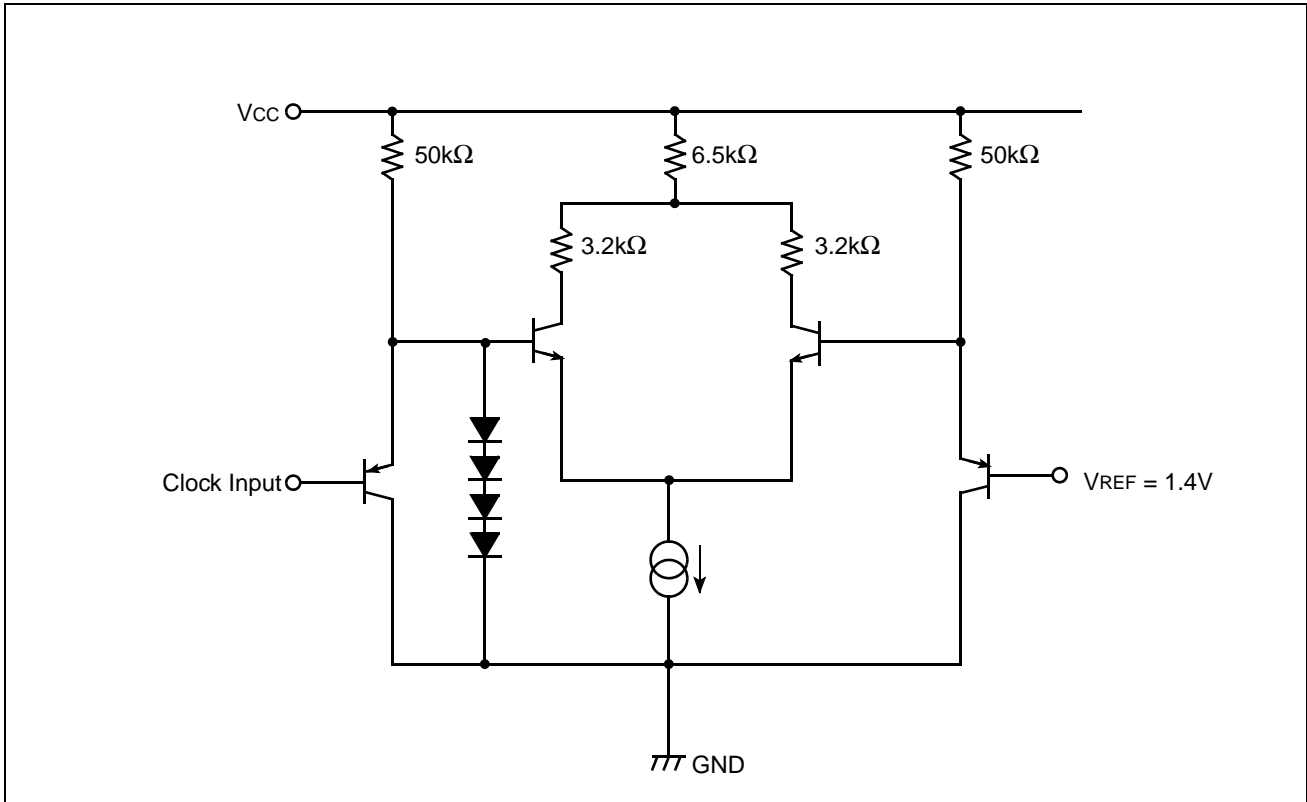
I<sub>BIAS</sub>: Constant Input Bias Current

V<sub>D</sub>: The base-collector junction diode of emitter-follower transistor.

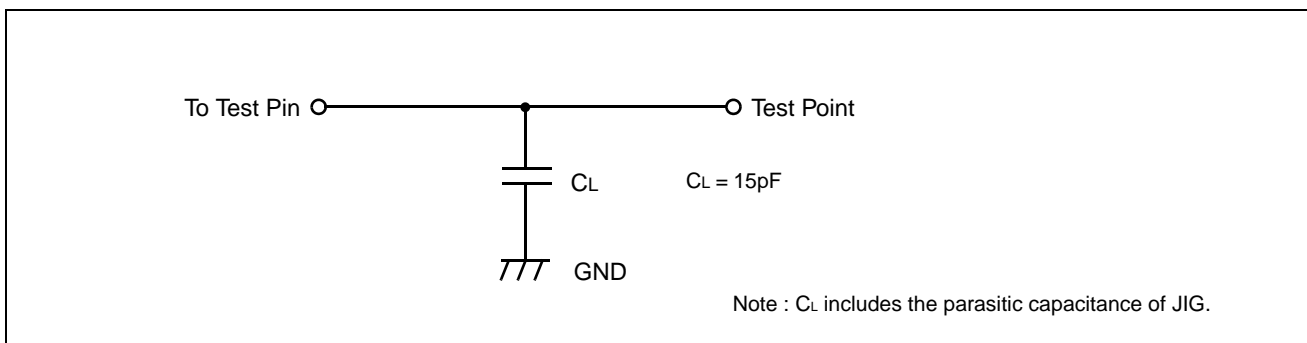
Figure 2. Reference Voltage Circuit



**Figure 3. Digital Input Equivalent Circuit**

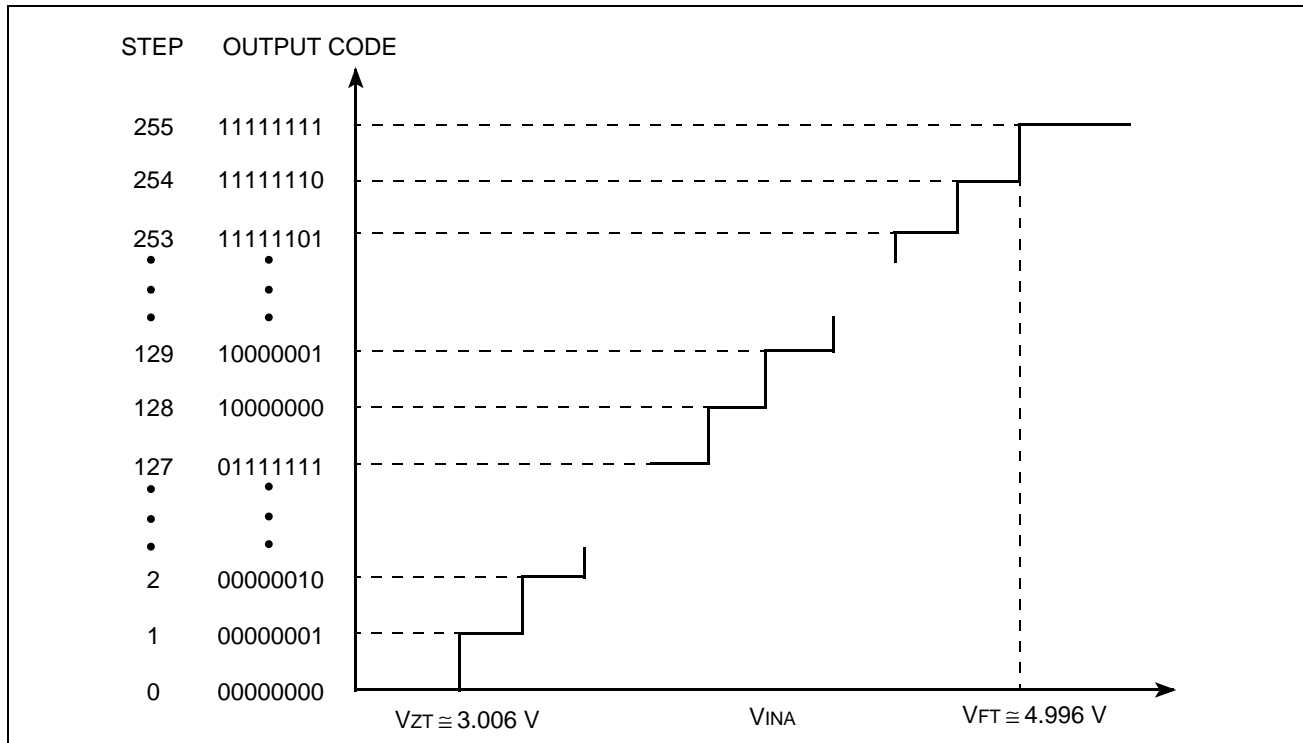


**Figure 4. Output Buffer Load Circuit**



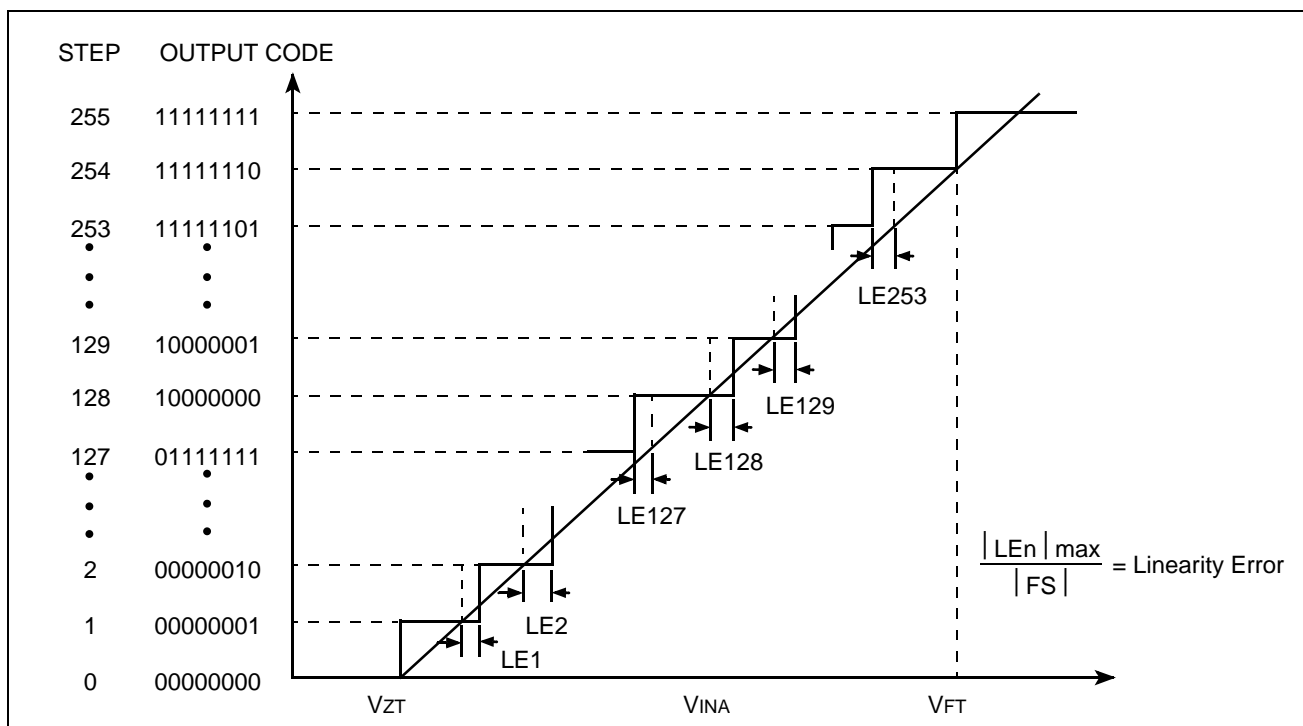
■ LINEARITY ERROR

1. Ideal Conversion Characteristic



VZT and VFT are the typical values when VCC = 5.000 V and VRB = 3.000 V.

2. Actual Conversion Characteristic



NOTE: Refer to "■ RECOMMENDED OPERATING CONDITIONS" for a range of VINA inputs.

# MB40528

## ■ NOTES ON USE

### 1. Power Supply Patterns of the PCB

The power supply wire patterns ( $V_{CC}$  and GND patterns) of the PCB should be designed as wide as possible in order to reduce parasitic impedance.

Also, the  $V_{CC}$  and GND patterns which are connected to the  $V_{CC}$  and GND pins of the device must be handled and designed as analog system pattern and so, their circuit patterns must be separate from digital system patterns of other peripheral devices.

### 2. Switching Noise

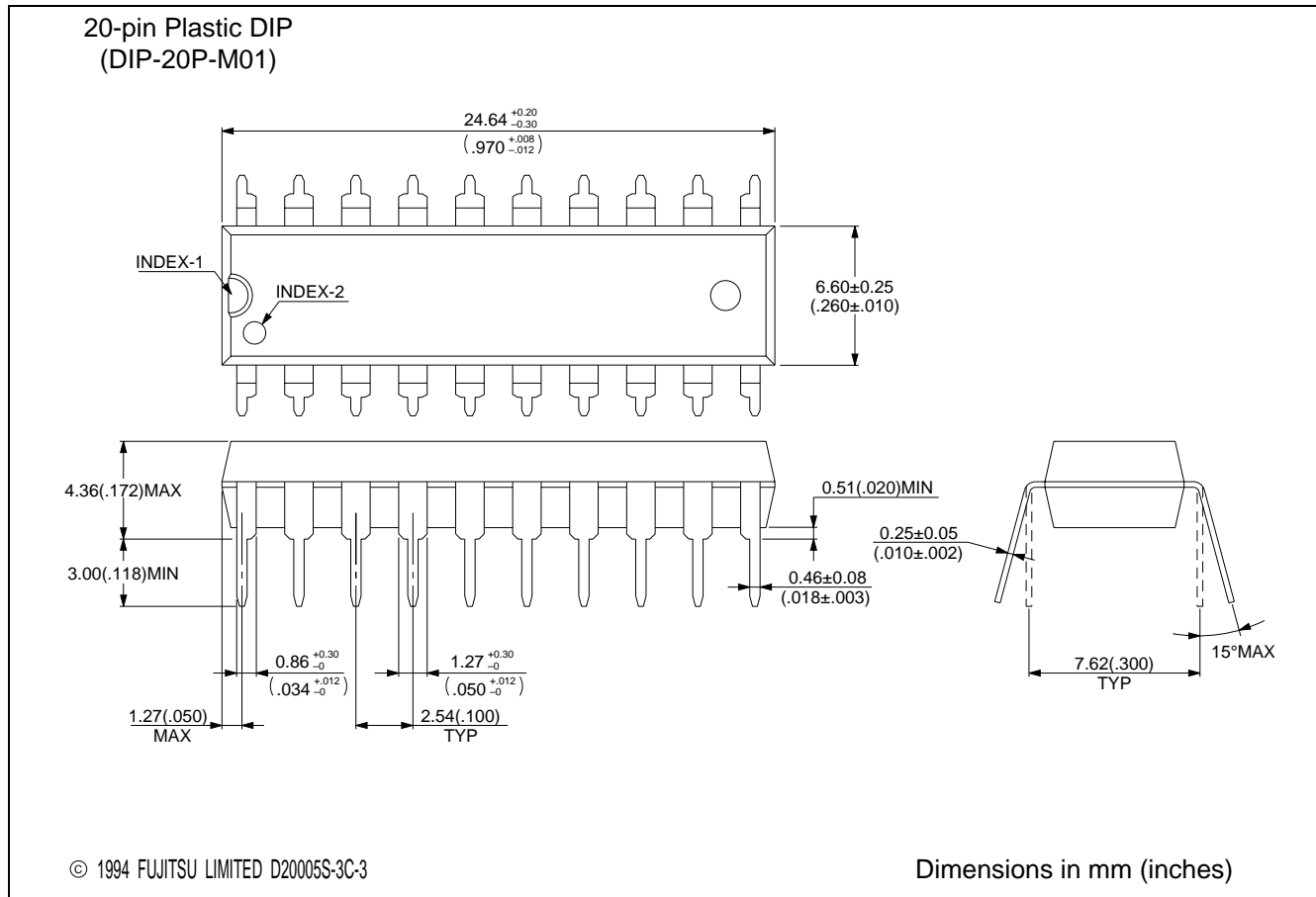
In order to reduce switching noise as much as possible, high-frequency bypass capacitor must be connected between  $V_{CC}$  and GND pins and  $V_{RB}$  and GND pins.

In this case, the capacitor should be connected to the pins as near as possible.

## ■ ORDERING INFORMATION

Part number	Package	Remarks
MB40528P	20-pin Plastic DIP (DIP-20P-M01)	

## ■ PACKAGE DIMENSION



## FUJITSU LIMITED

*For further information please contact:*

### **Japan**

FUJITSU LIMITED  
Marketing Division  
Electronic Devices  
Shinjuku Dai-Ichi Seimei Bldg. 7-1,  
Nishishinjuku 2-chome, Shinjuku-ku,  
Tokyo 163-0721, Japan  
Tel: +81-3-5322-3353  
Fax: +81-3-5322-3386

<http://edevice.fujitsu.com/>

### **North and South America**

FUJITSU MICROELECTRONICS, INC.  
3545 North First Street,  
San Jose, CA 95134-1804, U.S.A.  
Tel: +1-408-922-9000  
Fax: +1-408-922-9179

Customer Response Center  
*Mon. - Fri.: 7 am - 5 pm (PST)*  
Tel: +1-800-866-8608  
Fax: +1-408-922-9179

<http://www.fujitsumicro.com/>

### **Europe**

FUJITSU MICROELECTRONICS EUROPE GmbH  
Am Siebenstein 6-10,  
D-63303 Dreieich-Buchsschlag,  
Germany  
Tel: +49-6103-690-0  
Fax: +49-6103-690-122

<http://www.fme.fujitsu.com/>

### **Asia Pacific**

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

<http://www.fmal.fujitsu.com/>

### **Korea**

FUJITSU MICROELECTRONICS KOREA LTD.  
1702 KOSMO TOWER, 1002 Daechi-Dong,  
Kangnam-Gu, Seoul 135-280  
Korea  
Tel: +82-2-3484-7100  
Fax: +82-2-3484-7111

F0108

© FUJITSU LIMITED Printed in Japan

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 are 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.

The products described in this document are designed, and manufactured as contemplated for general use, including without limitation, ordinary industrial use, general office use, personal use, and household use, but are not designed, developed and manufactured as contemplated (1) for use accompanying fatal risks or dangers that, unless extremely high safety is secured, could have a serious effect to the public, and could lead directly to death, personal injury, severe physical damage or other loss (i.e., nuclear reaction control in nuclear facility, aircraft flight control, air traffic control, mass transport control, medical life support system, missile launch control in weapon system), or (2) for use requiring extremely high reliability (i.e., submersible repeater and artificial satellite).

Please note that Fujitsu will not be liable against you and/or any third party for any claims or damages arising in connection with above-mentioned uses of the products.

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.