FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-28208-2E

ASSP for Image Processing

CMOS

A/D Converter
# (1-channel, 8-bit, 18MHz)

MB40C368

■ DESCRIPTION

The MB40C368 is a high-speed A/D converter using high-speed CMOS process technology.

■ FEATURES

- Resolution: 8 bits
- Linearity error: ±0.20% (Typ.)
- Maximum conversion rate: 18 MSPS (Min.)
- Power supply voltage: Analog section +3.0 V
  Digital section +3.0 V
- Digital input voltage range: TTL level
- Digital output voltage range: CMOS level compatible
- Analog input voltage range: 0.5 to 3 V (with 2 Vp-p)
- Analog input capacity: 15 pF (Typ.)
- Power consumption: 14 mW (Typical: @f_{CLK} = 18 MHz)
- Additional function: Reference voltage generator circuit: V_{REFB} = 1 V
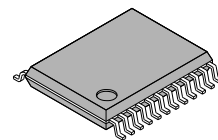- Package options: SOP24, SSOP24

■ PACKAGES

24-pin, Plastic SOP
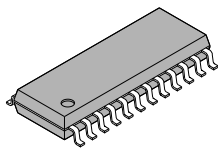
(FPT-24P-M01)

24-pin, Plastic SSOP

(FPT-24P-M03)

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.

MB40C368

■ PIN ASSIGNMENT

(TOP VIEW)

Left pin	No.		No.	Right pin
AV_{DD}	1		24	AV_{SS}
AV_{DD}	2		23	V_{RB}
AV_{SS}	3		22	V_{REFB}
(LSB) D_8	4		21	V_{INA}
D_7	5		20	N.C.
D_6	6		19	V_{RT}
D_5	7		18	AV_{DD}
D_4	8		17	AV_{SS}
D_3	9		16	AV_{DD}
D_2	10		15	AV_{SS}
(MSB) D_1	11		14	CLK
DV_{SS}	12		13	DV_{DD}

(FPT-24P-M01)
(FPT-24P-M03)

■ PIN DESCRIPTION

Pin No.	Pin name	Functions
1, 2, 16, 18	AV_{DD}	Analog power supply pins (+3 V)
13	DV_{DD}	Digital power supply pin (+3 V)
3, 15, 17, 24	AV_{SS}	Analog power ground pins (0 V)
12	DV_{SS}	Digital power ground pin (0 V)
4 to 11	D_1 to D_8	Digital output pins. D_1: MSB, D_8: LSB
14	CLK	Clock input pin
21	V_{INA}	Analog input pin. Input range: V_{RB} to V_{RT} (2 Vp-p between 0.5 to 3 V)
19	V_{RT}	Reference voltage input pin (3 V)
23	V_{RB}	Reference voltage input pin (1 V)
22	V_{REFB}	Reference voltage output pin. When connected to V_{RB}, the pin generates $0.33 \times AV_{DD}$ (1 V).
20	N. C.	No connection pin. Should be connected to AV_{DD}.

Values within ( ) are typical values.

■ NOTES ON USE

- Be sure to bypass the AV_{DD}, DV_{DD}, V_{RT} and V_{RB} pins to the ground using a high-frequency capacitor. The high-frequency capacitor should be connected as near the pin as possible.
- Provide four clocks or more immediately after the power up to prevent current dissipation due to the indeterminate internal logic.

■ ABSOLUTE MAXIMUM RATINGS (See WARNING)

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	AV_{DD}, DV_{DD}	–0.3	0.7	V
Input voltage	CLK, V_{INA} V_{RT}, V_{RB}	–0.3	AV_{DD}+0.3	V
Output voltage	D_1 to D_8	–0.3	DV_{DD}+0.3	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

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Power supply voltage	AV_{DD}, DV_{DD}	2.70	3.00	3.60	V
Analog input voltage	V_{INA}	V_{RB}	–	V_{RT}	V
Analog reference voltage: T	V_{RT}	–	–	AV_{DD}	V
Analog reference voltage: B	V_{RB}	0.50	–	–	V
Analog reference voltage range	$V_{RT}–V_{RB}$	1.90	2.00	2.10	V
Digital "H" level input voltage	V_{IHD}	2.4	–	–	V
Digital "L" level input voltage	V_{ILD}	–	–	0.8	V
Digital input current	I_{ID}	–	–	5	μA
Clock frequency	f_{CLK}	0.1	–	18	MHz
Minimum "H" level clock pulse width	tw^+	22.5	–	–	ns
Minimum "L" level clock pulse width	tw^-	22.5	–	–	ns
Operating temperature range	Ta	–20	–	70	°C

WARNING: Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. 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 representative beforehand.

MB40C368

■ ELECTRICAL CHARACTERISTICS

DC Characteristics

(1) Analog section

$(AV_{DD} = DV_{DD} = 2.70\ V\ to\ +3.60\ V,\ Ta = -20°C\ to\ +70°C)$

Parameter		Symbol	Value			Unit
			Min.	Typ.	Max.	
Resolution		–	–	8	–	bit
Linearity error	DC precision	LE	–	±0.20	±0.30	%
Differential linearity error		DLE	–	±0.12	±0.20	%
Analog input capacity		C_{INA}	–	15	–	pF
Reference voltage		V_{REFB}	–	$0.33 \times AV_{DD}$	–	V
Reference current		I_{RB}	−16.0	−8.0	−2.0	mA
Analog power supply current		AI_{DD}	–	2.2	10.0	mA
Digital power supply current		DI_{DD}	–	2.5	6.0	mA

(2) Digital section

$(AV_{DD} = DV_{DD} = 2.70\ V\ to\ +3.60\ V,\ Ta = -20°C\ to\ +70°C)$

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Digital "H" level output voltage	V_{OHD}	2.4	–	DV_{DD}	V
Digital "L" level output voltage	V_{OLD}	–	–	0.4	V
Digital "H" level output current	I_{OH}	−400	–	–	µA
Digital "L" level output current	I_{OL}	–	–	1.6	mA

(3) Switching section

$(AV_{DD} = DV_{DD} = 2.70\ V\ to\ +3.60\ V,\ Ta = -20°C\ to\ +70°C)$

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Maximum conversion rate	fs	18	–	–	MSPS
Digital output delay time	tpd	0	6	25	ns

■ EQUIVALENT CIRCUIT

• Clock input
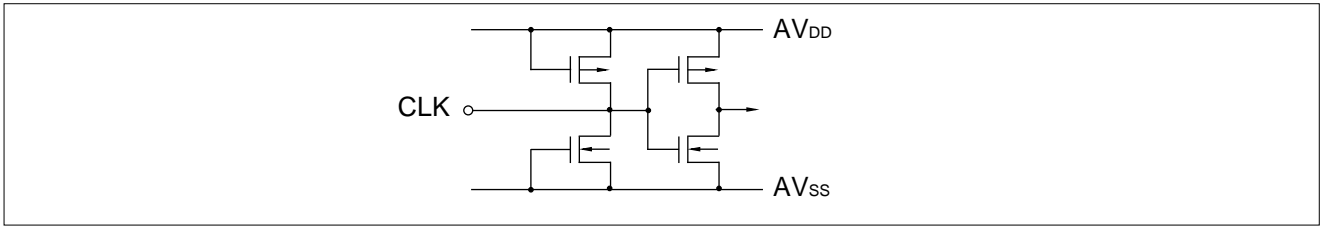
• Analog input
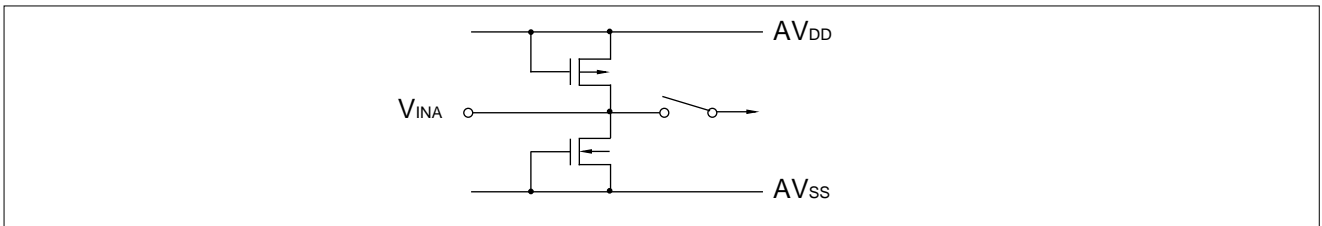
• Reference voltage input
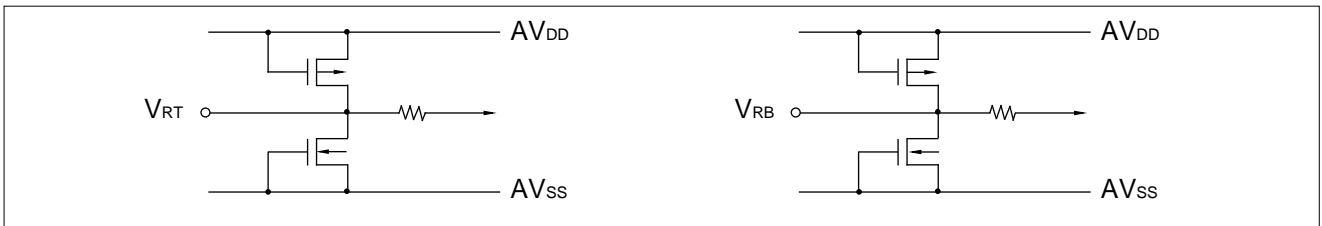
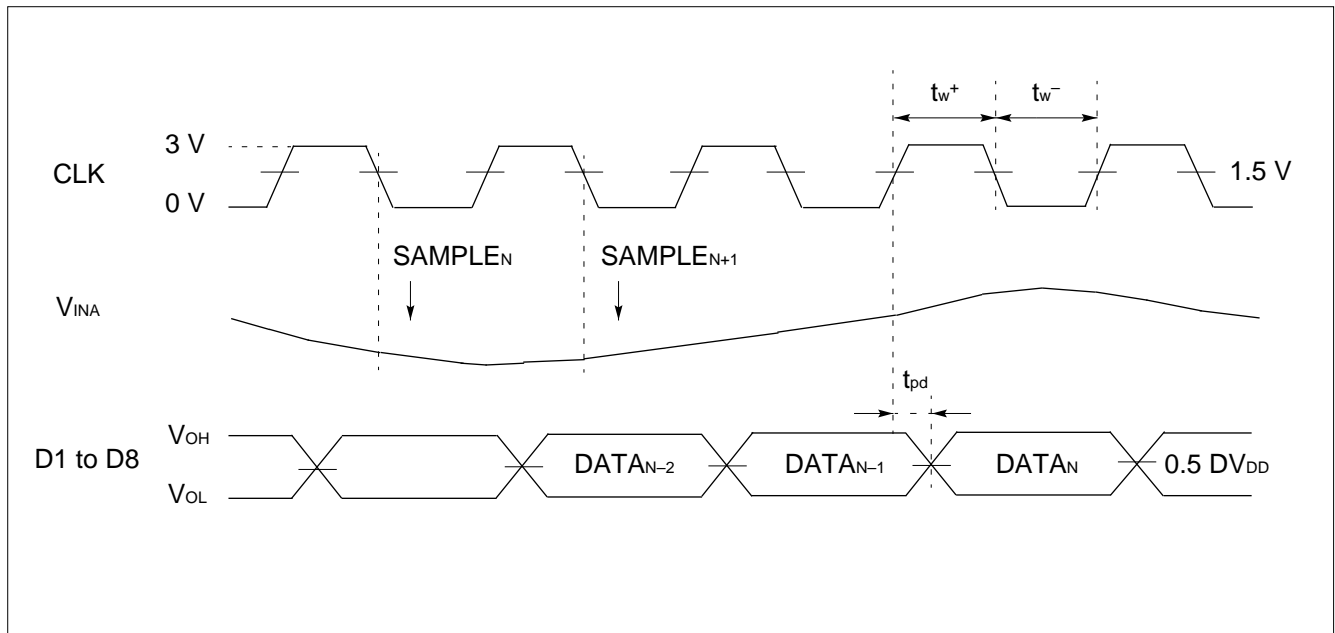### • Reference voltage output
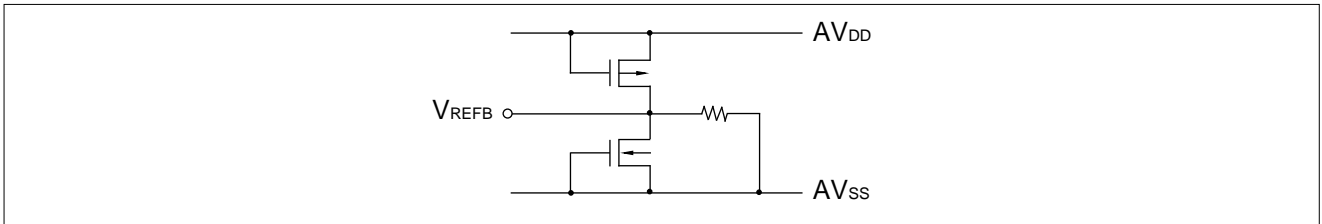
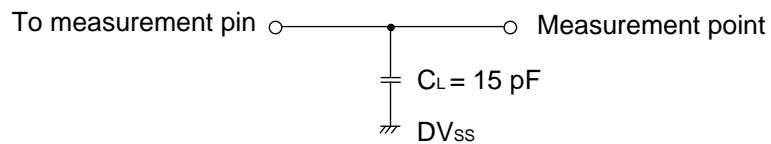### • Digital output
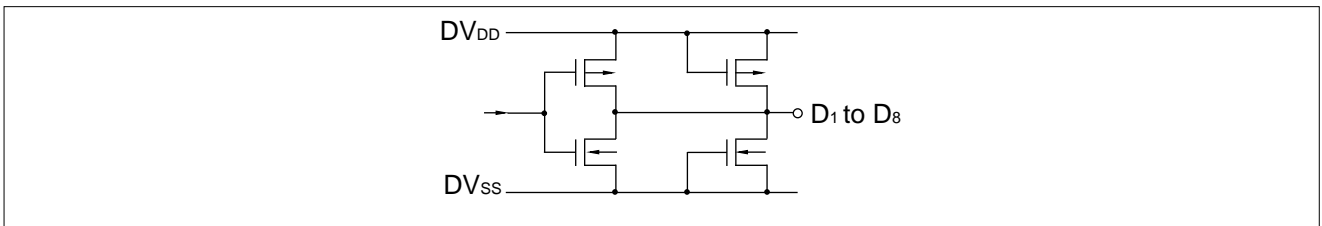
MB40C368

■ TIMING CHART

■ DIGITAL OUTPUT BUFFER LOAD CIRCUIT

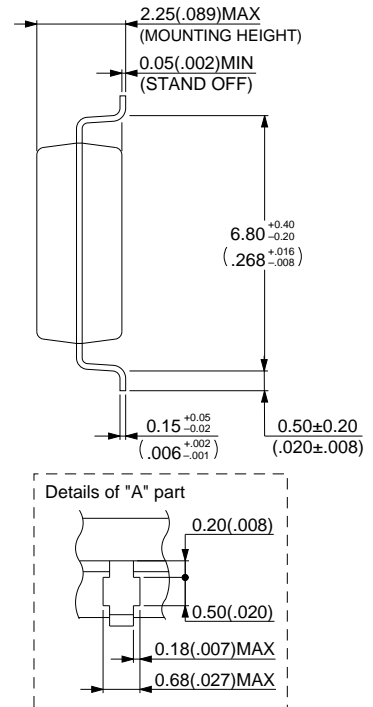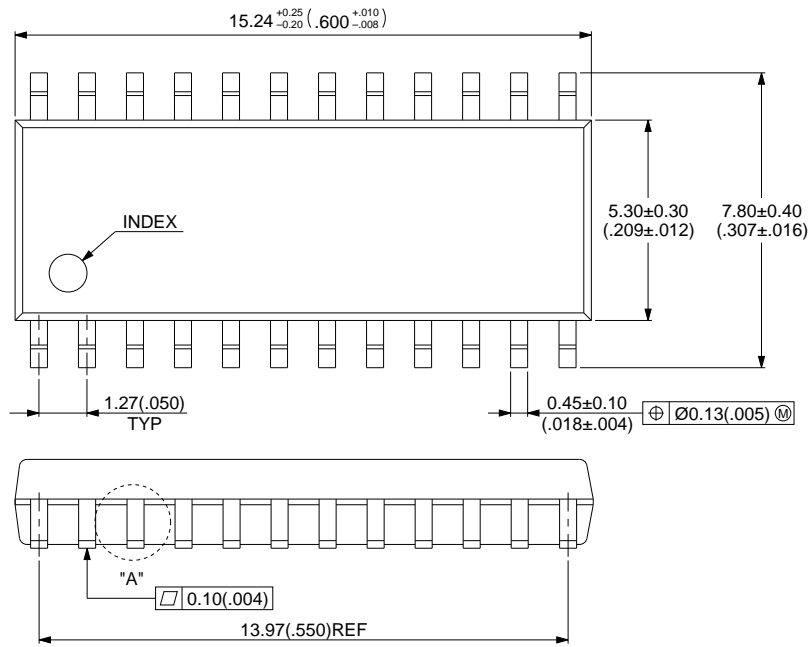(Note) C_L value includes the floating capacitance of the jig and probe.

■ ORDERING INFORMATION

Part number	Package	Remarks
MB40C368PF	24-pin, Plastic SOP (FPT-24P-M01)	
MB40C368PFV	24-pin, Plastic SSOP (FPT-24P-M03)	

MB40C368

■ PACKAGE DIMENSIONS

24-pin, Plastic SOP
(FPT-24P-M01)

15.24 $^{+0.25}_{-0.20}$ (.600 $^{+.010}_{-.008}$)

INDEX

5.30±0.30
(.209±.012)

7.80±0.40
(.307±.016)

1.27(.050)
TYP

0.45±0.10
(.018±.004)

⊕ | Ø0.13(.005) Ⓜ

"A"

▱ | 0.10(.004)

13.97(.550)REF

2.25(.089)MAX
(MOUNTING HEIGHT)

0.05(.002)MIN
(STAND OFF)

6.80 $^{+0.40}_{-0.20}$
(.268 $^{+.016}_{-.008}$)

0.15 $^{+0.05}_{-0.02}$
(.006 $^{+.002}_{-.001}$)

0.50±0.20
(.020±.008)

Details of "A" part

0.20(.008)

0.50(.020)

0.18(.007)MAX

0.68(.027)MAX

© 1994 FUJITSU LIMITED F24007S-3C-4

Dimensions in mm (inches).

(Continued)

(Continued)

24-pin, Plastic SSOP
(FPT-24P-M03)

*: These dimensions do not include resin protrusion.

*7.75±0.10(.305±.004)

INDEX

*5.60±0.10
(.220±.004)

7.60±0.20
(.299±.008)

0.65±0.12(.0256±.0047)

0.22 +0.10 −0.05
(.009 +.004 −.002)

7.15(.281)REF

1.25 +0.20 −0.10
(.049 +.008 −.004) (MOUNTING HEIGHT)

0.10(.004)

6.60(.260)
NOM

"A"

0.15 +0.05 −0.02
(.006 +.002 −.001)

Details of "A" part

0.10±0.10(.004±.004)
(STAND OFF)

0 to 10°

0.50±0.20
(.020±.008)

© 1994 FUJITSU LIMITED F24018S-2C-2

Dimensions in mm (inches).
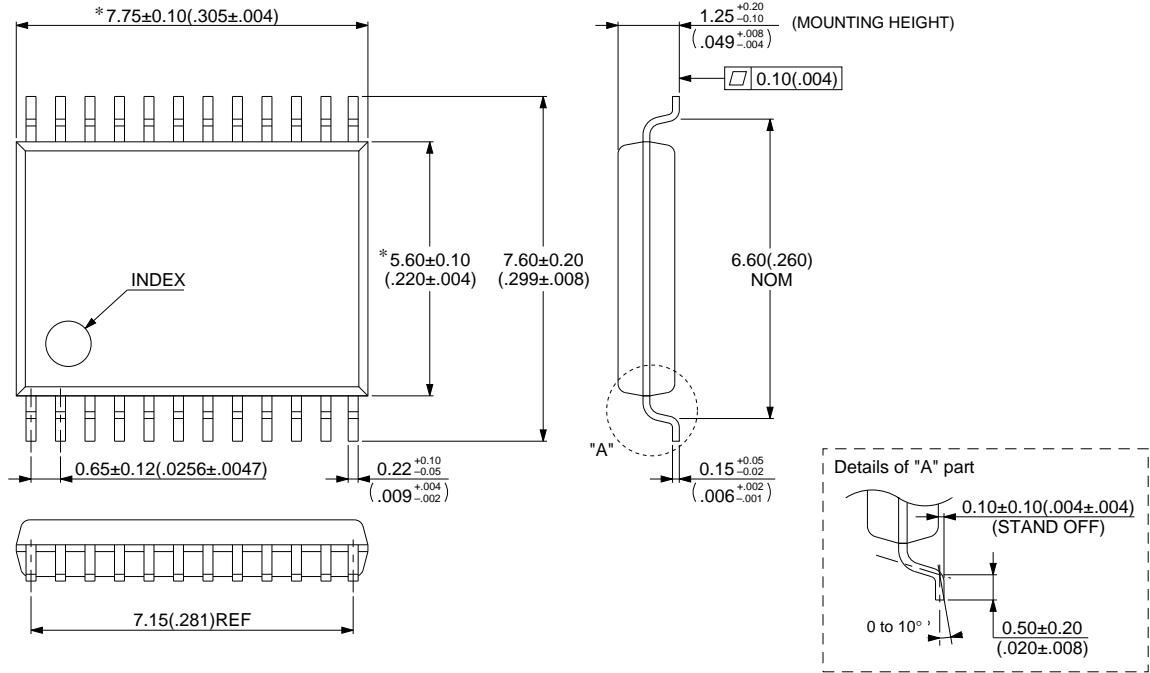
FUJITSU LIMITED

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) 754-3763
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-Buchschlag
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