

ASSP

CMOS

# 30 MHz 8-bit A/D Converter

## MB40C238

### ■ DESCRIPTION

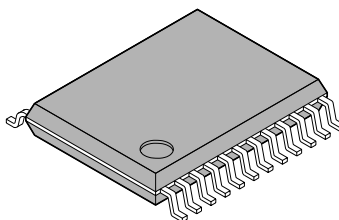
MB40C238 is a high-speed converter using a fast CMOS technology.

### ■ FEATURES

- Resolution : 8 bit
- Linearity error :  $\pm 0.2\%$  (standard)
- Differential linearity error :  $\pm 0.12\%$  (standard)
- Maximum conversion rate : 30 MSPS (minimum)
- Power supply voltage : +3.0 V (single)
- Digital input voltage range : 3 V CMOS level
- Digital output voltage range : 3 V CMOS level compatible (tristate output)
- Analog input voltage range : 0 to 2.0 V (1.2 to 1.8 V<sub>p-p</sub>)
- Analog input capacitance : 15 pF (standard)
- Power dissipation : 50 mW (standard: including reference current)
- Additional features : VRT voltage adjustment amp (VRT = 1.2 to 2.0 V)  
Power saving capacity (also reference current set to OFF: 0.5 mW or less)  
High impedance output
- Package : 24-pin SSOP

### ■ PACKAGE

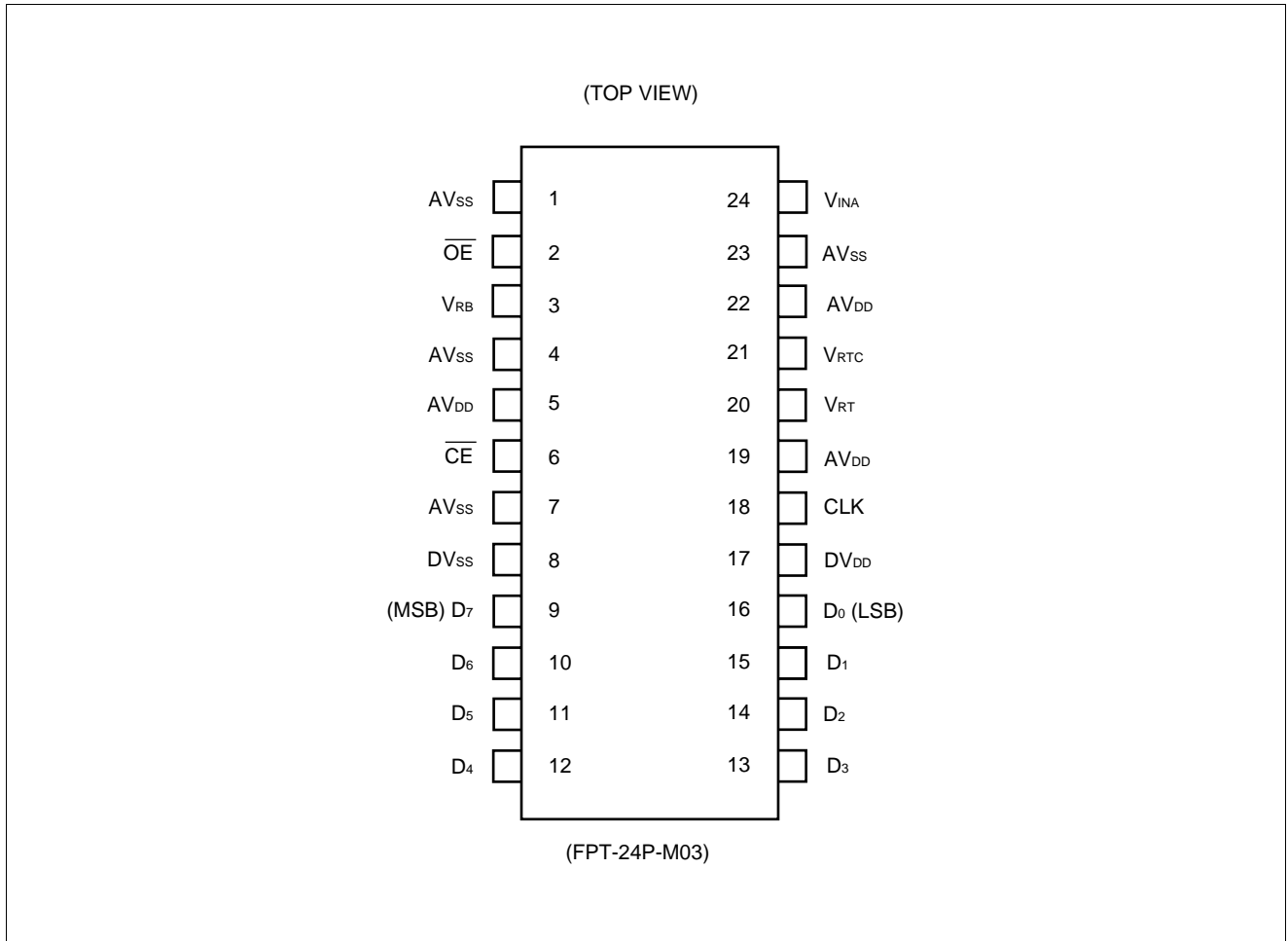
24-pin Plastic SSOP



(FPT-24P-M03)

# MB40C238

## ■ PIN ASSIGNMENT



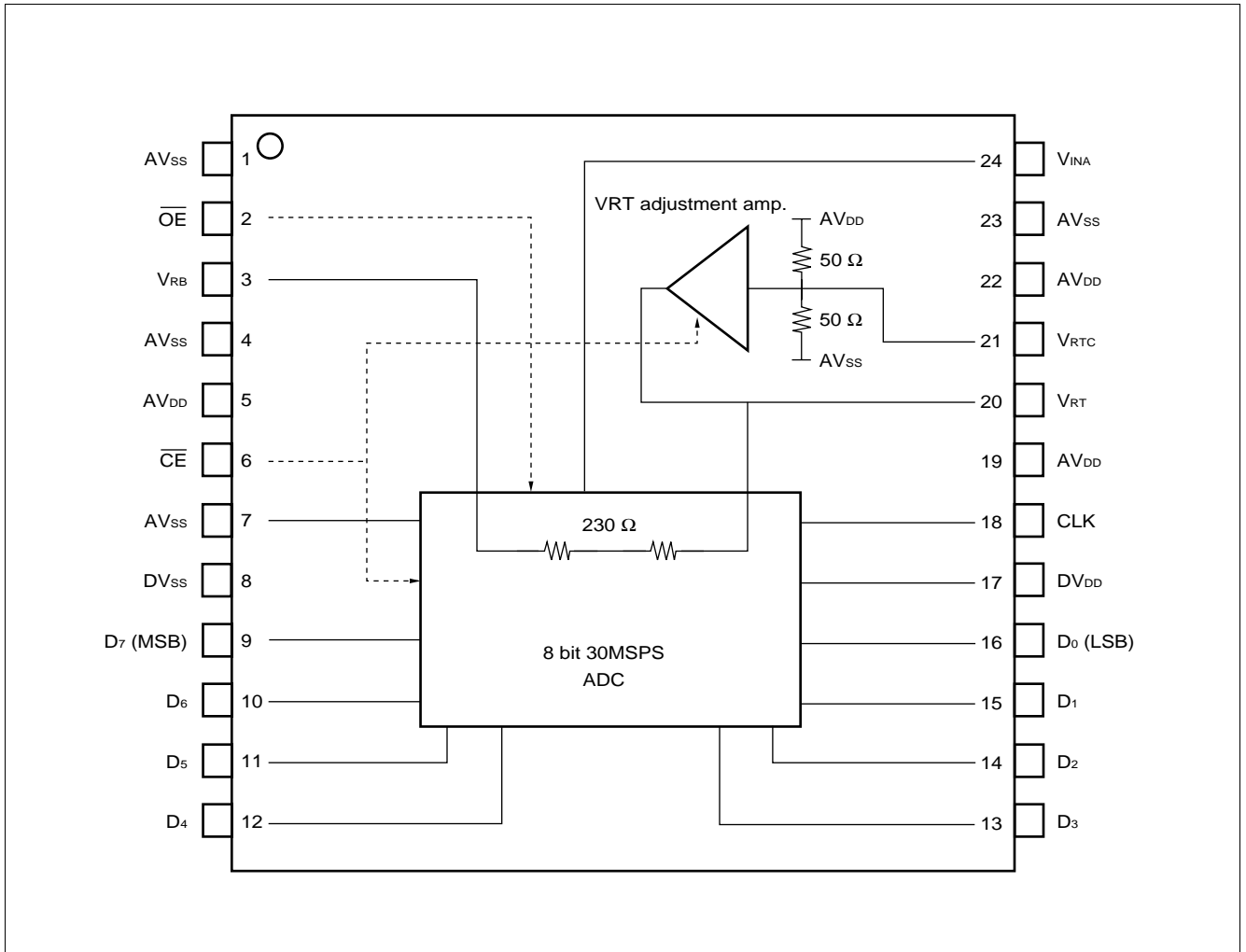
## ■ PIN DESCRIPTION

Pin No.	Symbol	Description
5, 19, 22	AV <sub>DD</sub>	Analog power supply (+3.0 V)
17	DV <sub>DD</sub>	Digital power supply (+3.0 V)
1, 4, 7, 23	AV <sub>SS</sub>	Analog power supply ground pin (0 V)
8	DV <sub>SS</sub>	Digital power supply ground pin (0 V)
9, 10, 11, 12, 13, 14, 15, 16	D <sub>7</sub> to D <sub>0</sub>	Digital output pin (D <sub>7</sub> : MSB, D <sub>0</sub> : LSB)
18	CLK	Clock input pin
24	V <sub>INA</sub>	A/D converter analog input pin Input range is V <sub>RB</sub> to V <sub>RT</sub> (0 to 1.5 V: standard)
21	V <sub>RTC</sub>	V <sub>RT</sub> voltage adjustment amp input pin (V <sub>RTC</sub> : 1.5 V is output when opened.)
20	V <sub>RT</sub>	Reference voltage output pin on top side. The voltage fed to V <sub>RTC</sub> is output. (1.5 V: standard)
3	V <sub>RB</sub>	Reference voltage input pin on bottom side (0 V: standard)
6	$\overline{\text{CE}}$	Input pin for toggling standby function. Input high signal brings the ADC and reference voltage circuit.
2	$\overline{\text{OE}}$	Input pin for toggling output high impedance function. Input high signal brings the ADC output high impedance state.

Note: The values in parentheses are standard.

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## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	$AV_{DD}, DV_{DD}$	-0.3	+7.0	V
Input voltage (analog/digital)	CLK, $V_{INA}$ , $V_{RTC}$ , $V_{RB}$	-0.3	$AV_{DD}+0.3$	V
Output voltage	D <sub>0</sub> to D <sub>7</sub>	-0.3	$DV_{DD}+0.3$	V
	$V_{RT}$	-0.3	$AV_{DD}+0.3$	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	$AV_{DD}$	2.70	3.00	3.60	V
	$DV_{DD}$	2.70	3.00	3.60	V
	$ AV_{DD} - DV_{DD} $	0.0	—	0.2	V
Analog input voltage	$V_{INA}$	$V_{RB}$	—	$V_{RT}$	V
Analog reference voltage: T	$V_{RTC}$	1.2	1.5	2.0	V
Analog reference voltage: B	$V_{RB}$	0.0	—	0.8	V
Analog reference voltage range	$V_{RT} - V_{RB}$	1.2	1.5	1.8	V
Digital “H” level input voltage	$V_{IHD}$	2.3	—	—	V
Digital “L” level input voltage	$V_{ILD}$	—	—	0.5	V
Digital input current	$I_{ID}$	—	—	5	μA
Clock frequency	$f_{CLK}$	0.5	—	30	MHz
“H” level minimum clock pulse width	$t_w^+$	16.0	—	—	ns
“L” level minimum clock pulse width	$t_w^-$	16.0	—	—	ns
Operating temperature range	$T_a$	-20	—	+75	°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.

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## ■ ELECTRICAL CHARACTERISTICS

### 1. DC Characteristics in Analog Section

( $AV_{DD} = 2.70\text{ V to }3.60\text{ V}$ ,  $DV_{DD} = 2.70\text{ V to }3.60\text{ V}$ ,  $T_a = -20^\circ\text{C to }+75^\circ\text{C}$ )

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Resolution	—	—	8	—	bit
Linearity error	Conditional DC precision $V_{RT} - V_{RB} = 1.5\text{ V}$	LE	$\pm 0.20$	$\pm 0.40$	%
Differential linearity error		DLE	$\pm 0.12$	$\pm 0.20$	%
Analog input capacity	$C_{INA}$	—	15	—	pF
Reference input voltage (Top side) ( $V_{RTC}$ opened)	$V_{RTC}$	—	$0.50 \times AV_{DD}$	—	V
Reference output voltage (Top side)	$V_{RT}$	—	$V_{RTC}$	—	V
Reference current (Bottom side)	$I_{RB}$	—	6.5	—	mA
Analog supply current	$A_{DD}$	—	14.0	34.0	mA
Digital supply current	$D_{DD}$	—	3.0	7.0	mA
Standby supply current	$I_{STBA}$	—	100	—	$\mu\text{A}$
	$I_{STBD}$	—	1	—	$\mu\text{A}$

### 2. DC Characteristics in Digital Section

( $AV_{DD} = 2.70\text{ V to }3.60\text{ V}$ ,  $DV_{DD} = 2.70\text{ V to }3.60\text{ V}$ ,  $T_a = -20^\circ\text{C to }+75^\circ\text{C}$ )

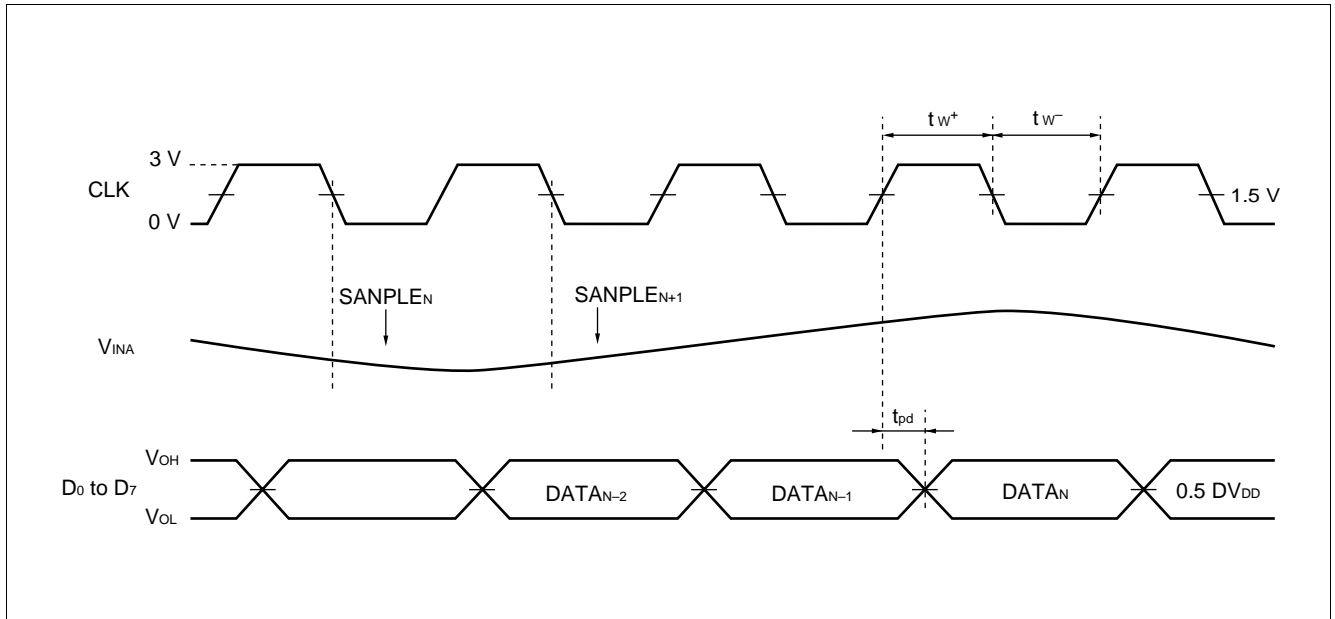
Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Digital "H" level output voltage	$V_{OHD}$	2.4	—	$DV_{DD}$	V
Digital "L" level output voltage	$V_{OLD}$	—	—	0.4	V
Digital "H" level output current	$I_{OH}$	-400	—	—	$\mu\text{A}$
Digital "L" level output current	$I_{OL}$	—	—	1.6	mA

### 3. Switching Characteristics

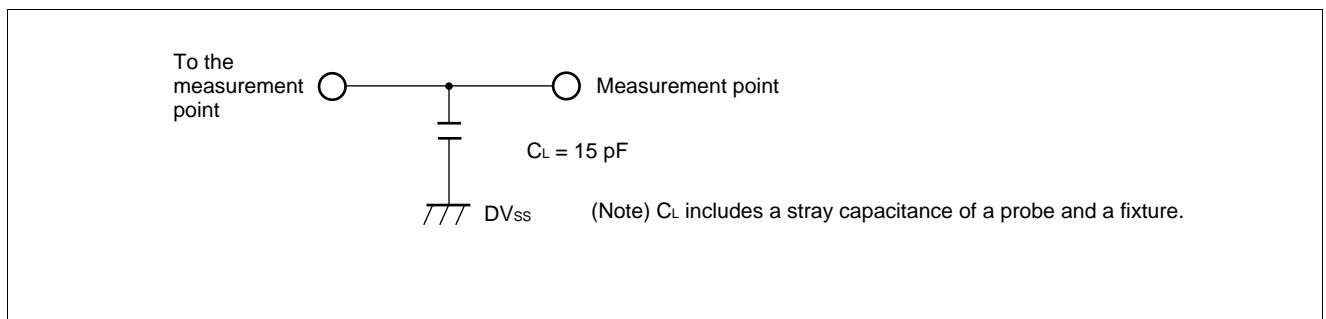
( $AV_{DD} = 2.70\text{ V to }3.60\text{ V}$ ,  $DV_{DD} = 2.70\text{ V to }3.60\text{ V}$ ,  $T_a = -20^\circ\text{C to }+75^\circ\text{C}$ )

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Maximum conversion rate	$f_s$	30	—	—	MSPS
Digital output delay time	$t_{pd}$	3	8	20	ns

## ■ DIAGRAM



## ■ DIGITAL OUTPUT BUFFER LOAD CIRCUIT



## ■ USAGE PRECAUTIONS

- Be sure to ground the pins of  $AV_{DD}$ ,  $DV_{DD}$ ,  $V_{RT}$  and  $V_{RB}$  via high-frequency capacitor. Place the high-frequency capacitor as close as possible to the pin.
- You can minimize the power supply current dissipation due to the internal logic indetermination by making the clock to 4CLK or higher.

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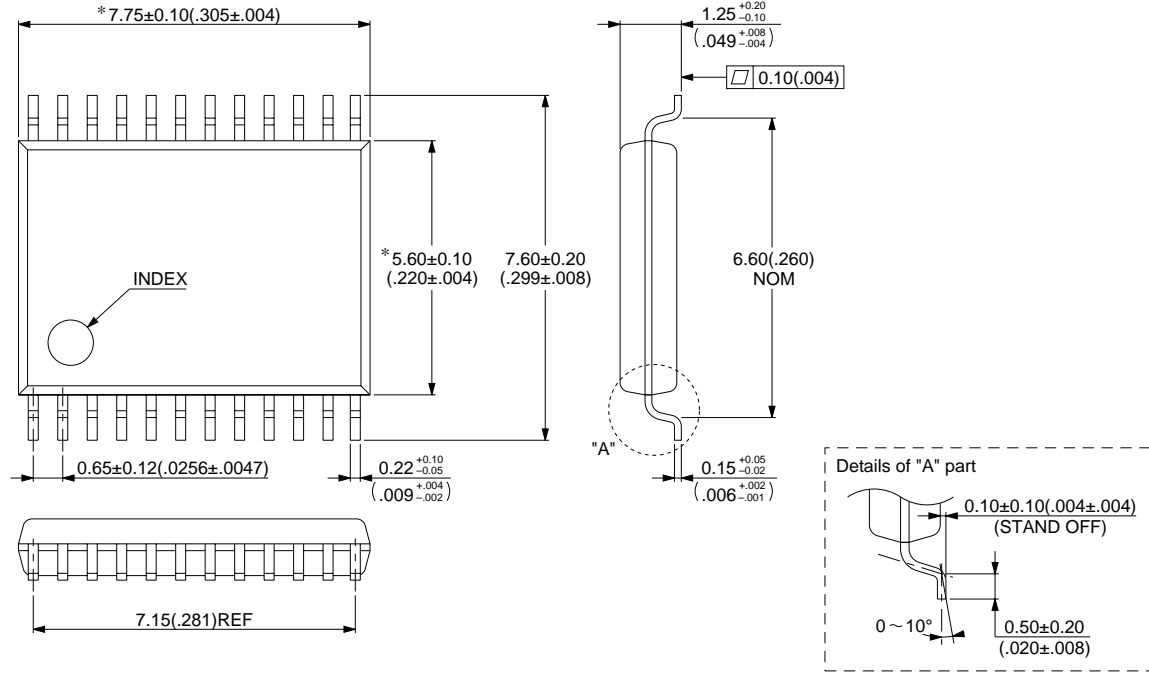
## ■ ORDERING INFORMATION

Part number	Package	Remark
MB40C238PF	24-pin Plastic SSOP (FPT-24P-M03)	



■ PACKAGE DIMENSION

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



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Dimensions in mm (inches).

# MB40C238

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