

*ASSP For Video Applications*

CMOS

**8-bit 100 MSPS A/D Converter****MB40C328****DESCRIPTION**

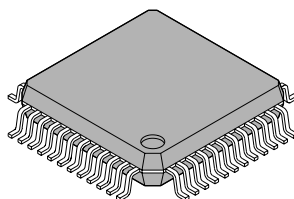
MB40C328 is a high-speed A/D converter using a fast CMOS technology.

**FEATURES**

- Resolution : 8 bit
- Linearity error :  $\pm 0.40\%$  (standard)
- Maximum conversion rate : 100 MSPS (minimum)
- Power supply voltage : 3.3 V single (standard)
- Digital input/output voltage range : CMOS level compatible
- Analog input voltage range : 0 to 3.0 V (2 V<sub>p-p</sub>)
- Analog input capacitance : 22 pF (standard)
- Power dissipation : 210 mW (standard)
- Additional features : Reference voltage generator circuit: V<sub>REFT</sub> = 3.0 V, V<sub>REFB</sub> = 1.0 V  
High impedance output, power down function  
1:2 demultiplex output enable (RESET action enable)  
1/2 deviding clock output  
Cross sampling at 50 MHz (two-phase CLK) enable (CLKA, CLKB)
- Package : LQFP48 (7 mm × 7 mm, lead pitch 0.5 mm)

**PACKAGE**

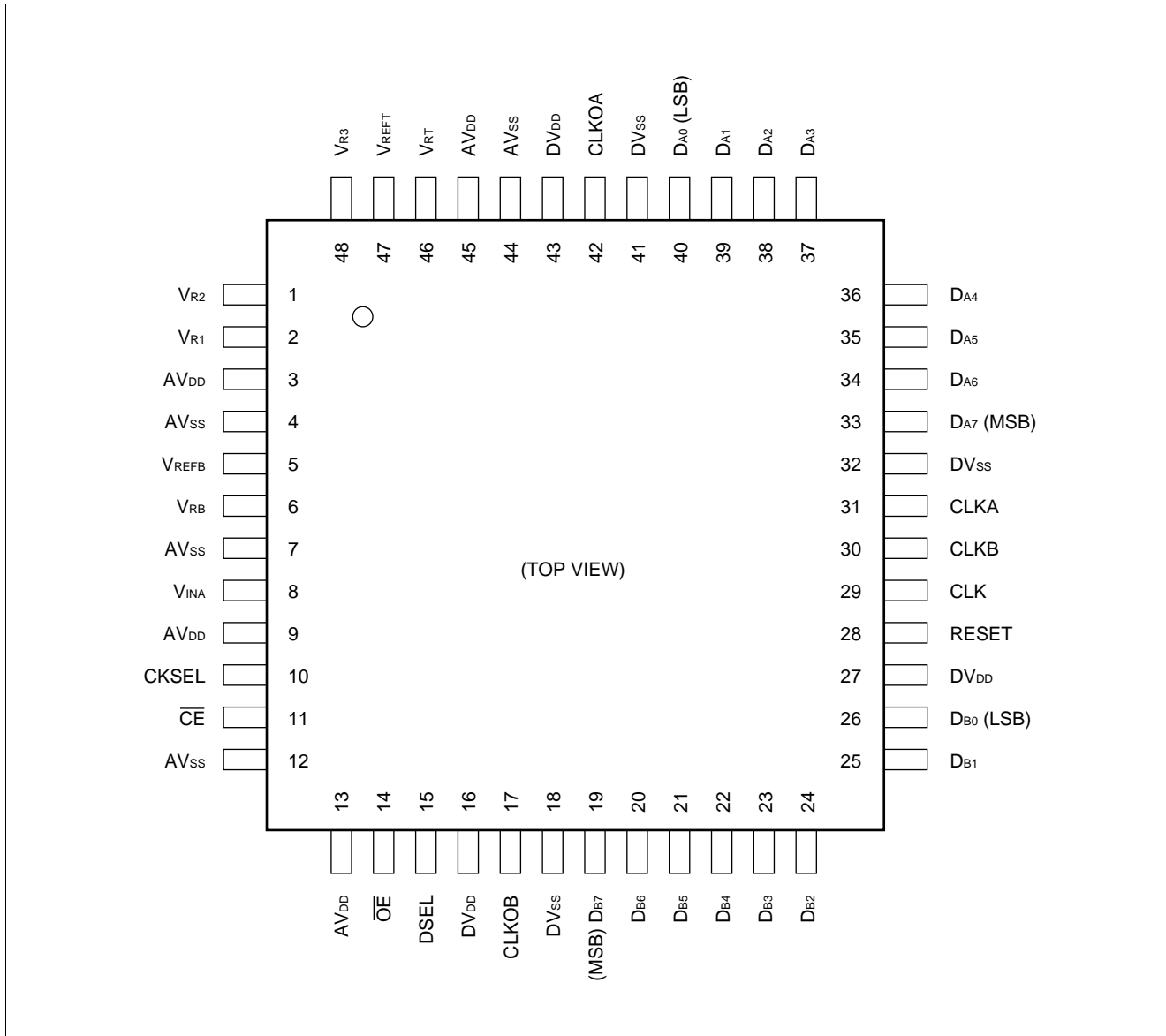
48-pin Plastic LQFP



(FPT-48P-M05)

# MB40C328

## ■ PIN ASSIGNMENT



## MB40C328

## ■ PIN DESCRIPTION

Pin No.	Symbol	Description
3, 9, 13, 45	AV <sub>DD</sub>	Analog power supply (+3.3 V)
16, 27, 43	DV <sub>DD</sub>	Digital power supply (+3.3 V)
4, 7, 12, 44	AV <sub>SS</sub>	Analog power supply ground pin (0 V)
18, 32, 41	DV <sub>SS</sub>	Digital power supply ground pin (0 V)
33 to 40	DA <sub>7</sub> to DA <sub>0</sub>	Digital output pin (Port A) DA <sub>7</sub> : MSB, DA <sub>0</sub> : LSB
19 to 26	DB <sub>7</sub> to DB <sub>0</sub>	Digital output pin (Port B) DB <sub>7</sub> : MSB, DB <sub>0</sub> : LSB
11	$\overline{\text{CE}}$	Power down at $\overline{\text{CE}}$ input "H" (internal pull-up resistor)
14	$\overline{\text{OE}}$	Digital output (Both Port A, B) and clock output (CLKOA, CLKOB) are high impedance at $\overline{\text{OE}}$ input "H".
10	CKSEL	Mode of operation setting input pin (Refer to ■ MODE SETTING)
15	DSEL	
28	RESET	Dividing circuit reset input pin (See ■ TIMING CHART 2, 3)
29	CLK	Clock input pin (max 100 MHz)
31	CLKA	A ch clock input pin (max 50 MHz)
30	CLKB	B ch clock input pin (max 50 MHz)
42	CLKOA	Clock output pin (See ■ TIMING CHART 1 to 4)
17	CLKOB	Clock output pin (See ■ TIMING CHART 1 to 4)
8	V <sub>INA</sub>	Analog input pin Input range is V <sub>RT</sub> to V <sub>RB</sub> (0 V to 3.0 V: 2 Vp-p)
2	V <sub>R1</sub>	Reference 1/4 voltage output pin (Add 0.1 $\mu$ F for AV <sub>SS</sub> ) Reference 1/2 voltage output pin (Add 0.1 $\mu$ F for AV <sub>SS</sub> ) Reference 3/4 voltage output pin (Add 0.1 $\mu$ F for AV <sub>SS</sub> )
1	V <sub>R2</sub>	
48	V <sub>R3</sub>	
46	V <sub>RT</sub>	Reference voltage input pin on top side
47	V <sub>REFT</sub>	Reference voltage output pin By connecting to V <sub>RT</sub> , $0.9 \times \text{AV}_{\text{DD}}$ ( $\cong 3$ V) is generated.
6	V <sub>RB</sub>	Reference voltage input pin on bottom side
5	V <sub>REFB</sub>	Reference voltage output pin By connecting to V <sub>RB</sub> , $0.3 \times \text{AV}_{\text{DD}}$ ( $\cong 1$ V) is generated.

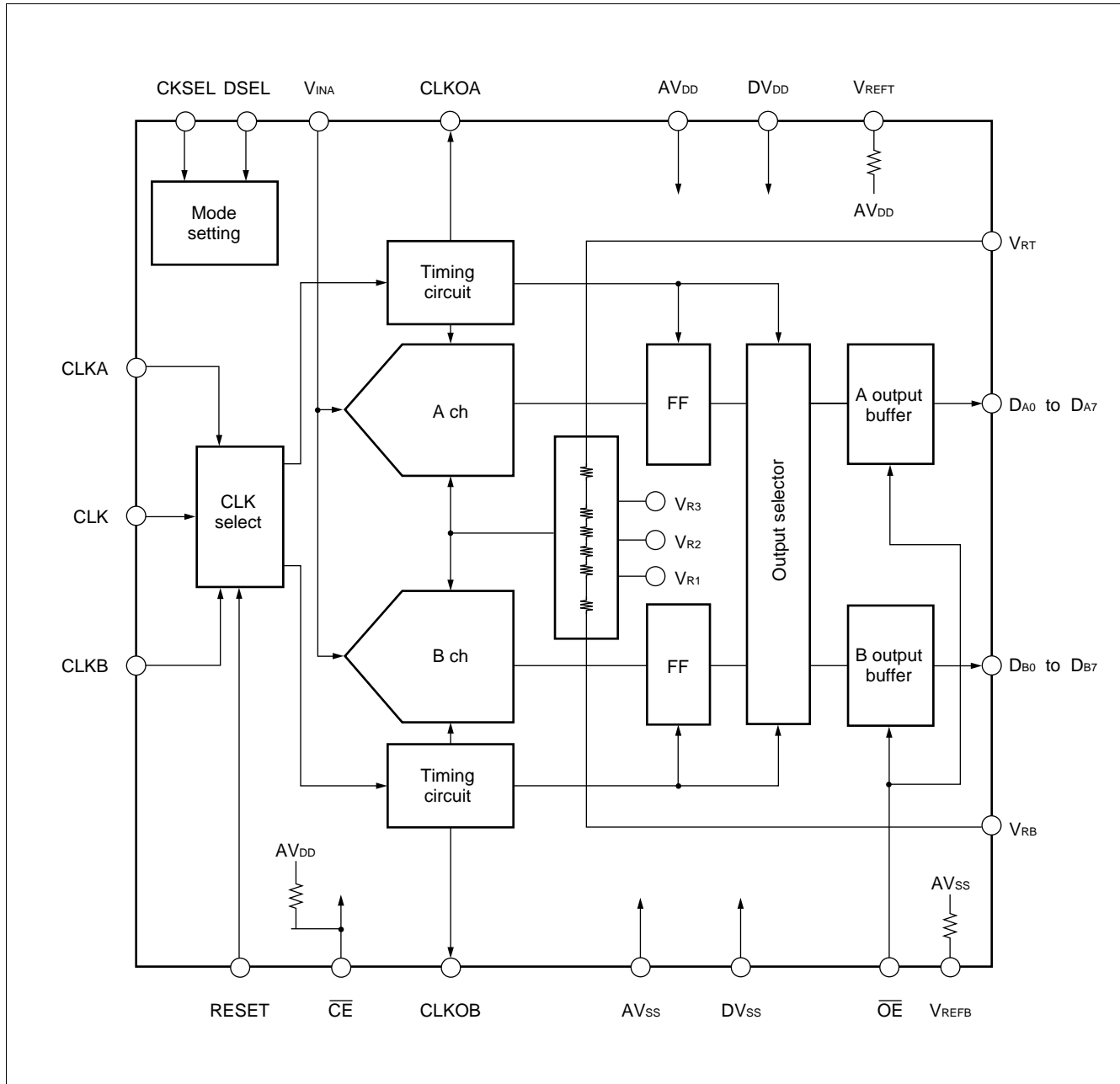
The values in parentheses are standard.

## ■ PRECAUTIONS ON USE

- Be sure to ground the pins of AV<sub>DD</sub>, DV<sub>DD</sub>, V<sub>RT</sub>, V<sub>RB</sub>, V<sub>R1</sub>, V<sub>R2</sub>, and V<sub>R3</sub> via high-frequency capacitor. Place the high-frequency capacitor as close as possible to the pin.
- To avoid generation of undesired current owing to indetermination of internal logic, set  $\overline{\text{CE}}$  to "H" at powering on and input more than five clock pulses just after operation ( $\overline{\text{CE}}$ : H  $\rightarrow$  L).

# MB40C328

## ■ BLOCK DIAGRAM



**MB40C328****■ ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	$AV_{DD}$ , $DV_{DD}$	-0.3	+4.0	V
Input/output voltage	$V_{INA}$ , $V_{RT}$ , $V_{RB}$ , $V_{REFT}$ , $V_{REFB}$ , $V_{R1}$ , $V_{R2}$ , $V_{R3}$ , $\overline{CE}$ , $CKSEL$	-0.3	$AV_{DD}+0.3^{*1}$	V
	$DA_0$ to $DA_7$ , $DB_0$ to $DB_7$ , $CLKOA$ , $CLKOB$ , $CLKA$ , $CLKB$ , $CLK$ , $DSEL$ , $\overline{OE}$ , $RESET$	-0.3	$DV_{DD}+0.3^{*1}$	V
Storage temperature	$T_{STG}$	-55	+125	°C

\*1: Do not exceed +4.0 V.

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.

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## ■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Power supply voltage	$AV_{DD}, DV_{DD}$	3.00	3.30	3.60	V
Analog input voltage	$V_{INA}$	$V_{RB}$	—	$V_{RT}$	V
Analog reference voltage: T	$V_{RT}$	—	—	3.00	V
Analog reference voltage: B	$V_{RB}$	0.00	—	—	V
Analog reference voltage range	$V_{RT} - V_{RB}$	1.90	2.00	2.10	V
Digital "H" level input voltage	$\overline{OE}, DSEL, RESET, CLK, CLKA, CLKB$	$DV_{DD} - 0.5$	—	—	V
	$CKSEL, \overline{CE}$	$AV_{DD} - 0.5$	—	—	V
Digital "L" level input voltage	$\overline{OE}, DSEL, RESET, CLK, CLKA, CLKB$	—	—	0.5	V
	$CKSEL, \overline{CE}$	—	—	0.5	V
Digital input current	$I_{ID}$	-20	—	5	$\mu A$
Single-phase clock frequency	$f_{CLK}$	0.1	—	100	MHz
Two-phase clock frequency	$f_{CLKA}, f_{CLKB}$	0.1	—	50	MHz
Minimum clock pulse width (single-phase)	$t_{WS}^+, t_{WS}^-$	4.0	5.0	—	ns
Minimum clock pulse width (two-phase)	$t_{WD}^+, t_{WD}^-$	8.0	10.0	—	ns
Clock pulse rising/falling time	$t_r, t_f$	—	2.0	—	ns
RESET signal setup time	$t_s$	3.0	—	—	ns
RESET signal hold time	$t_h$	3.0	—	—	ns
Operating temperature range	$T_a$	-20	—	70	$^{\circ}C$

**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.

**MB40C328****■ ELECTRICAL CHARACTERISTICS****• DC Characteristics in Analog Section**(AV<sub>DD</sub> = DV<sub>DD</sub> = 3.00 V to 3.60 V, Ta = -20°C to +70°C)

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Resolution	—	—	8	—	bit
Linearity error	LE	—	±0.40	±0.6	%
Differential linearity error	DLE	—	±0.20	±0.36	%
Analog input capacity	C <sub>INA</sub>	—	22	—	pF
Reference voltage: T	V <sub>REFT</sub>	0.88 × AV <sub>DD</sub>	0.91 × AV <sub>DD</sub>	0.94 × AV <sub>DD</sub>	V
Reference voltage: B	V <sub>REFB</sub>	0.27 × AV <sub>DD</sub>	0.3 × AV <sub>DD</sub>	0.33 × AV <sub>DD</sub>	V
Reference current	I <sub>RB</sub>	-15	-10	—	mA
Analog supply current	AI <sub>DD</sub>	—	42.0	85.0	mA
Digital supply current	DI <sub>DD</sub>	—	20.0	40.0	mA
Standby current	I <sub>SB</sub>	—	100	—	mA

**• DC Characteristics in Digital Section**(AV<sub>DD</sub> = DV<sub>DD</sub> = 3.00 V to 3.60 V, Ta = -20°C to +70°C)

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Digital "H" level output voltage	V <sub>OHD</sub>	DV <sub>DD</sub> - 0.4	—	DV <sub>DD</sub>	V
Digital "L" level output voltage	V <sub>OLD</sub>	—	—	0.4	V
Digital "H" level output current	I <sub>OHD</sub>	-400	—	—	μA
Digital "L" level output current	I <sub>OLD</sub>	—	—	1.6	mA

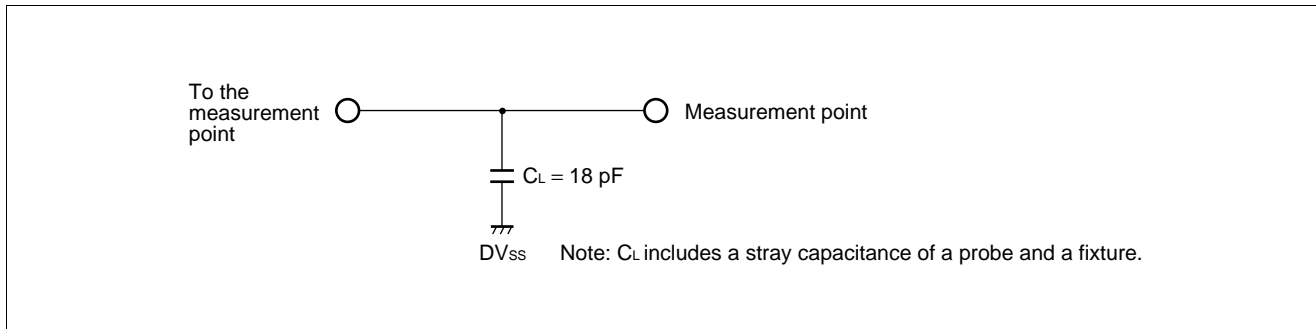
# MB40C328

## • Switching Characteristics

( $A_{V_{DD}} = DV_{DD} = 3.00\text{ V to }3.60\text{ V}$ ,  $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$ )

Parameter		Symbol	Value			Unit
			Min.	Typ.	Max.	
Maximum conversion rate		$f_s$	100	—	—	MSPS
Aperture time		$t_{AD}$	—	1.7	—	ns
Digital output delay time	Timing chart 1	$t_{pdS}$	2.5	6.0	9.0	ns
		$t_{pdSO}$	$t_{ws}^+ + 2.5$	$t_{ws}^+ + 6.0$	$t_{ws}^+ + 10$	ns
	Timing chart 2	$t_{pdM1}$	2.5	5.5	10	ns
		$t_{pdM1O}$	$T + 2.5$	$T + 5.5$	$T + 10$	ns
	Timing chart 3	$t_{pdM2}$	2.5	5.5	10	ns
		$t_{pdM2O}$	$T + 2.5$	$T + 5.5$	$T + 10$	ns
	Timing chart 4	$t_{pdD}$	2.5	6.5	11	ns
		$t_{pdDO}$	$t_{wD}^+ + 2.5$	$t_{wD}^+ + 6.5$	$t_{wD}^+ + 11$	ns

## ■ DIGITAL OUTPUT BUFFER LOAD CIRCUIT



## ■ MODE SETTING

CKCEL	DCEL	Mode	Timing Chart
H	H	CLK input-straight output mode	Timing chart 1
H	L	CLK input-demultiplex output (in-phase) mode	Timing chart 2
L	H	CLK input-demultiplex output (two-phase) mode	Timing chart 3
L	L	Two-phase CLK input mode (CLKA, CLKB)	Timing chart 4

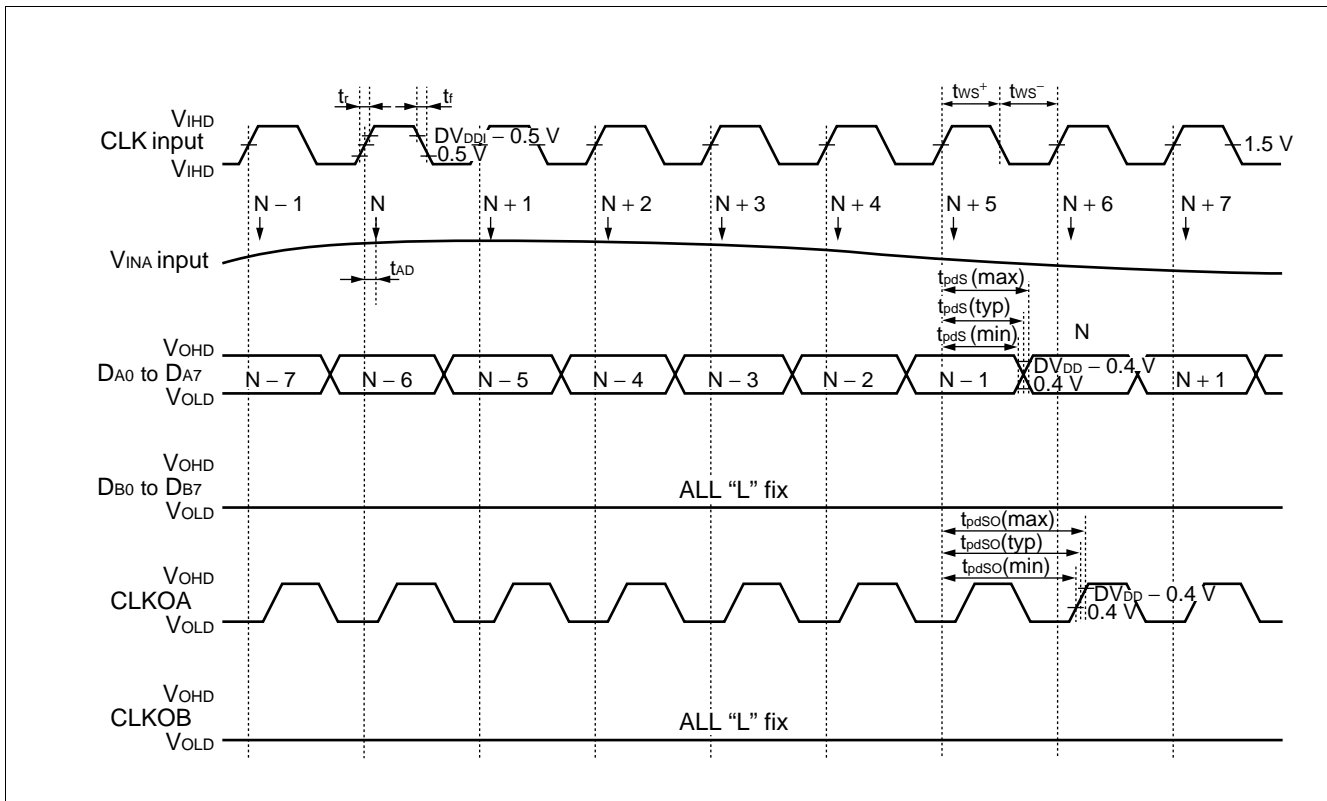


## MB40C328

## ■ TIMING CHART 1

CLK input-straight output mode

- CLK = 100 MHz (max)
- CLKA = CLKB = L (DV<sub>SS</sub>)
- CKSEL = H (AV<sub>DD</sub>)
- DSEL = H (DV<sub>DD</sub>)
- RESET = H (DV<sub>DD</sub>)
- $\overline{CE}$  = L (AV<sub>SS</sub>)
- $\overline{OE}$  = L (DV<sub>SS</sub>)



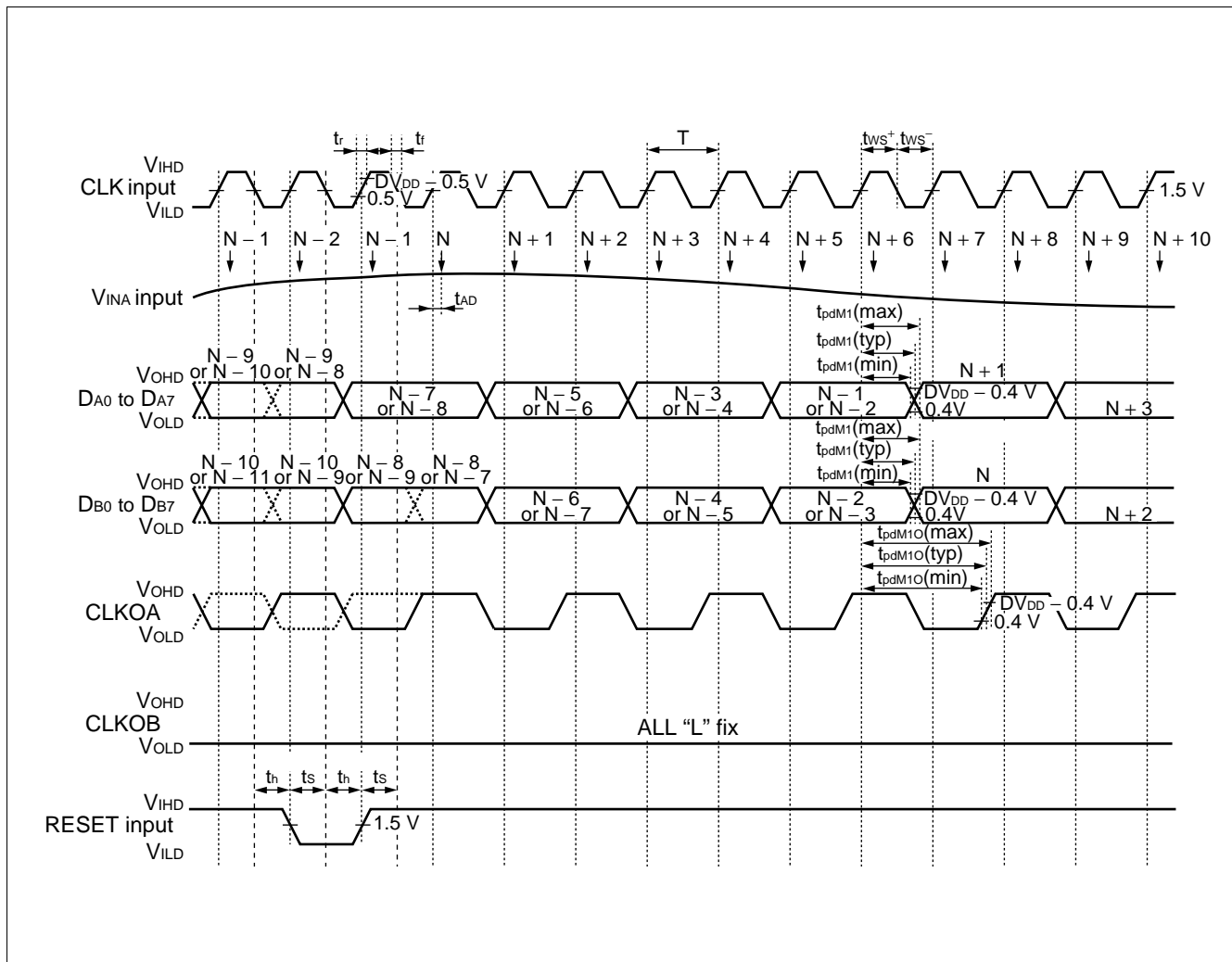
- V<sub>INA</sub> input — Sampling at CLK rising
- DA<sub>0</sub> to DA<sub>7</sub> — Output (after 5 CLK + t<sub>pds</sub> from Sampling) at CLK rising

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## ■ TIMING CHART 2

CLK input-demultiplex output (in-phase) mode

- CLK = 100 MHz (max)
- CLKA = CLKB = L (DV<sub>SS</sub>)
- CKSEL = H (AV<sub>DD</sub>)
- DSEL = L (DV<sub>SS</sub>)
- $\overline{\text{CE}} = \text{L}$  (AV<sub>SS</sub>)
- $\overline{\text{OE}} = \text{L}$  (DV<sub>SS</sub>)



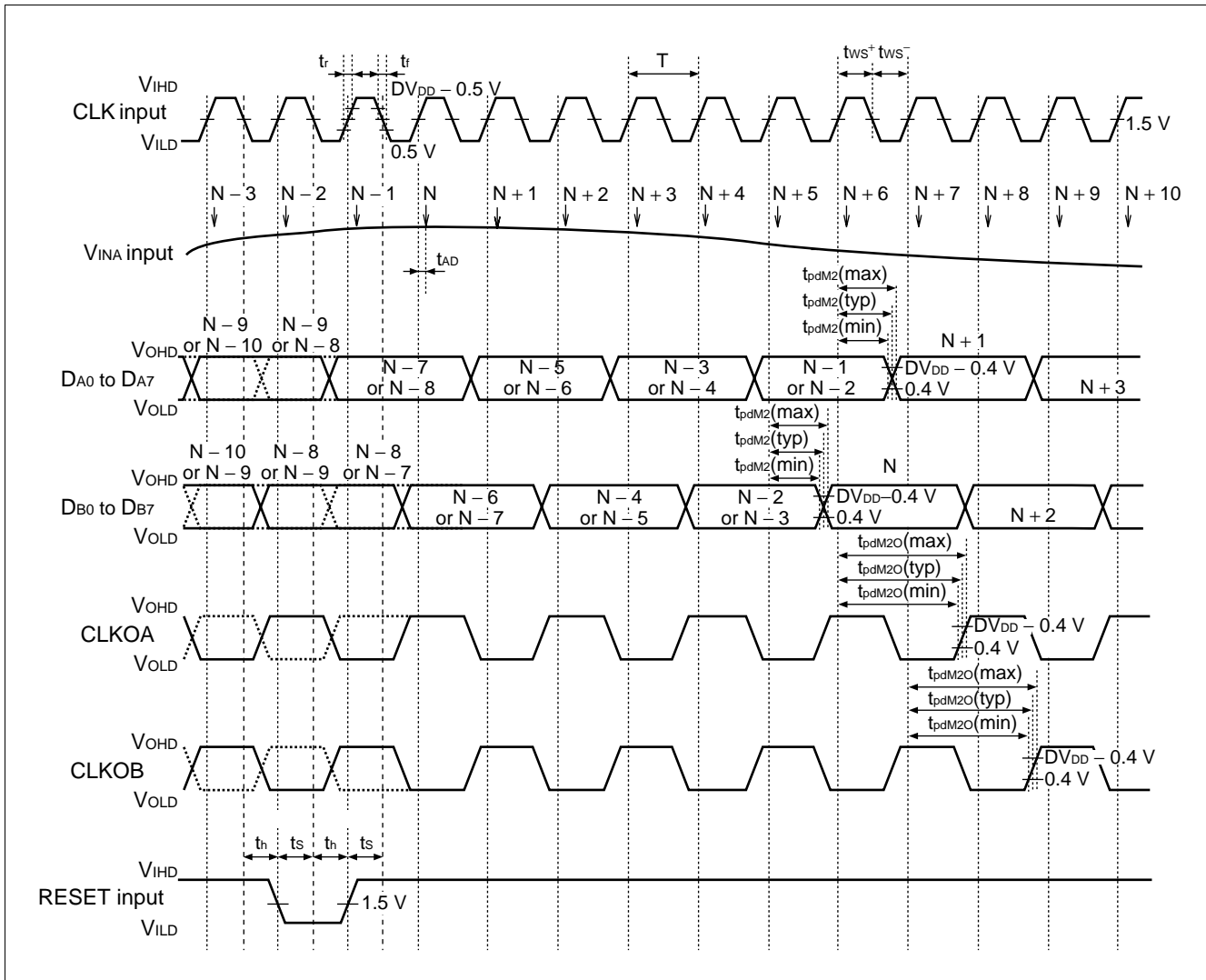
- V<sub>INA</sub> input — Sampling at CLK rising
- DA<sub>0</sub> to DA<sub>7</sub> — Output (after 5 CLK +  $t_{pdM1}$  from Sampling) at CLK rising
- DB<sub>0</sub> to DB<sub>7</sub> — Output (after 6 CLK +  $t_{pdM1}$  from Sampling) at CLK rising

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### ■ TIMING CHART 3

CLK input-demultiplex output (two-phase) mode

- CLK = 100 MHz (max)
- CLKA = CLKB = L (DV<sub>SS</sub>)
- CKSEL = L (AV<sub>SS</sub>)
- DSEL = H (DV<sub>DD</sub>)
- $\overline{\text{CE}} = \text{L (AV}_{\text{SS}})$
- $\overline{\text{OE}} = \text{L (DV}_{\text{SS}})$



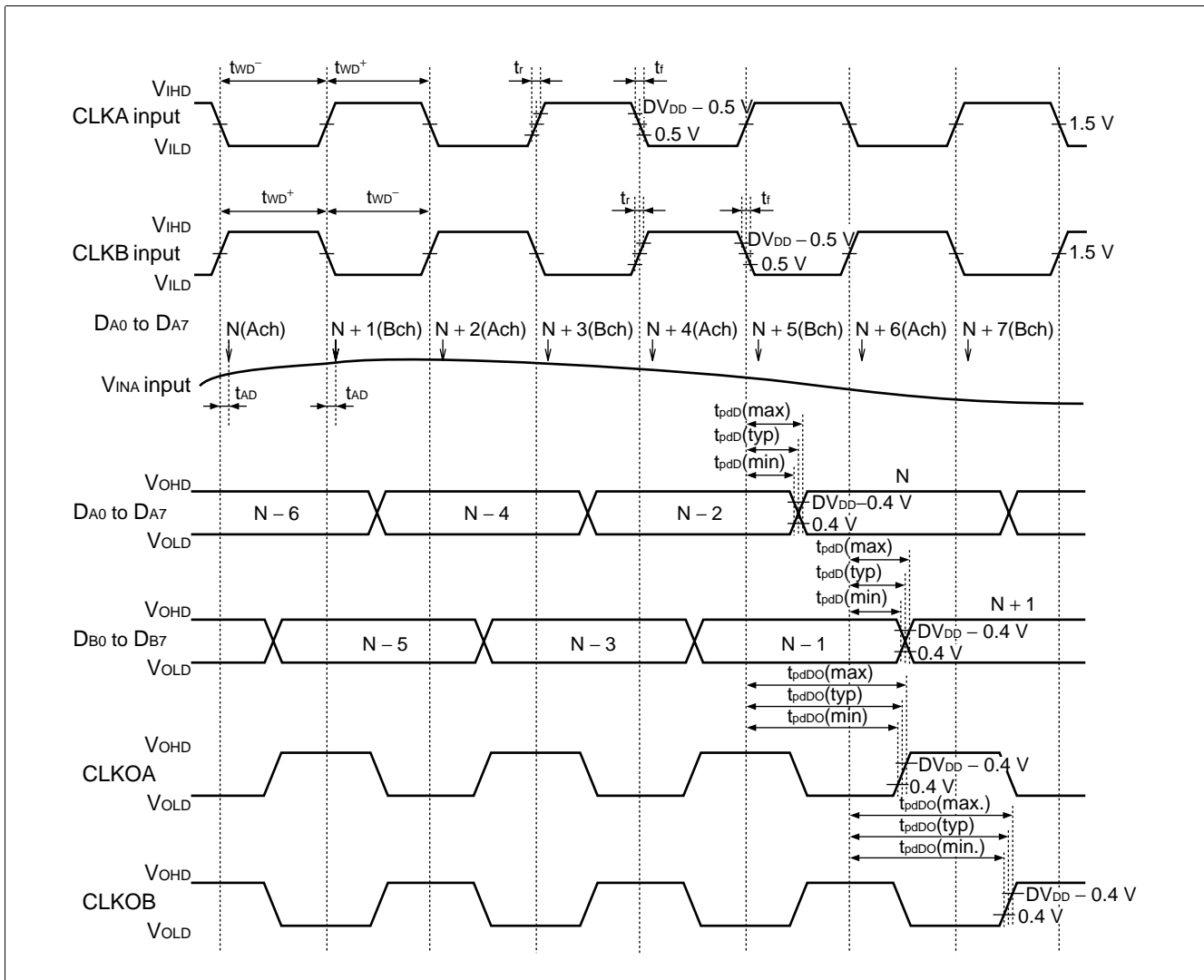
- V<sub>INA</sub> input — Sampling at CLK rising
- DA<sub>0</sub> to DA<sub>7</sub> — Output (after 5 CLK +  $t_{\text{pdM2}}$  from Sampling) at CLK rising
- DB<sub>0</sub> to DB<sub>7</sub> — Output (after 5 CLK +  $t_{\text{pdM2}}$  from Sampling) at CLK rising

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## ■ TIMING CHART 4

Two-phase CLK input mode (CLKA, CLKB)

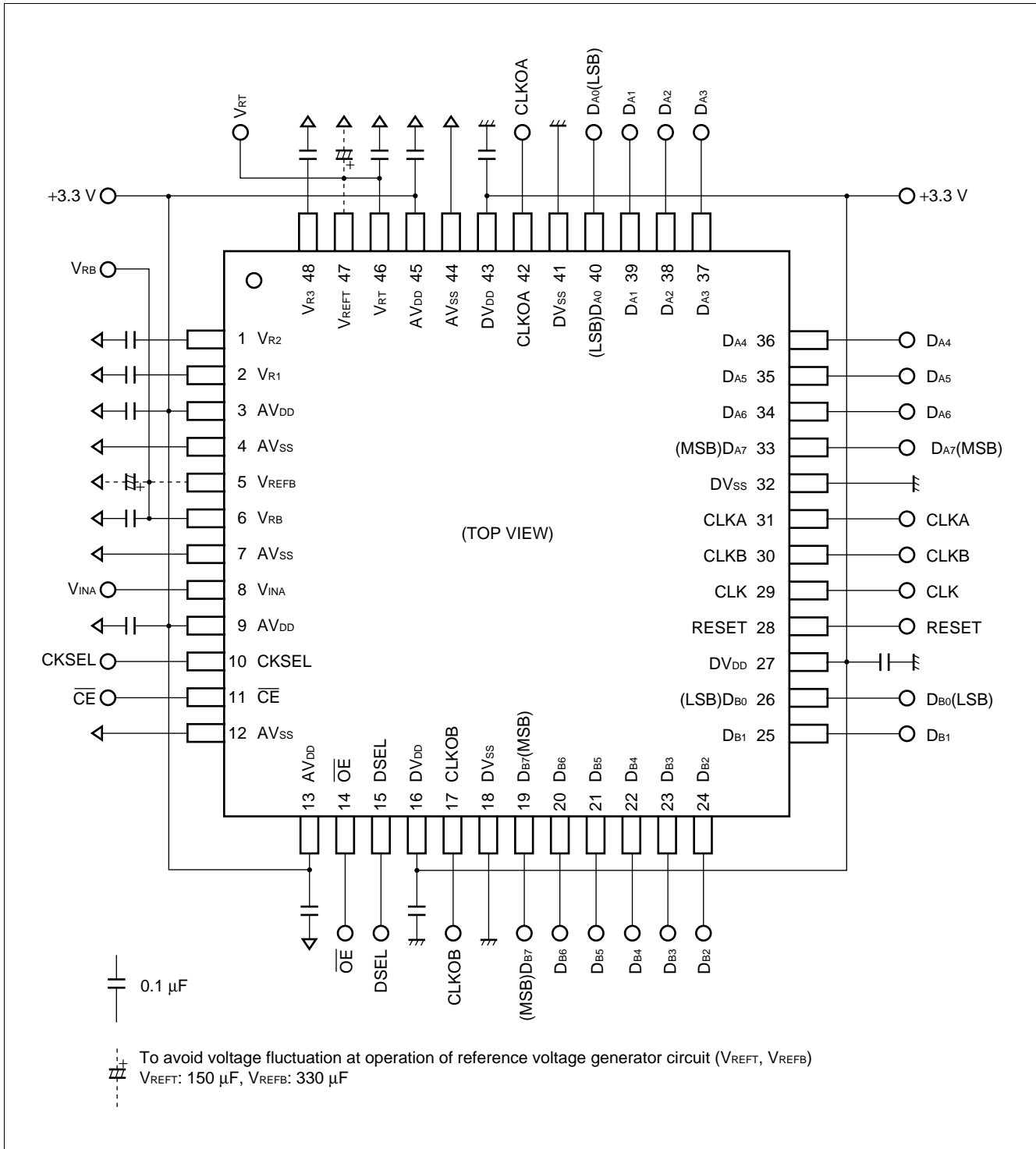
- CLK = L ( $DV_{SS}$ ) or H ( $DV_{DD}$ )
- CLKA = CLKB = 50 MHz (max)
- CKSEL = L ( $AV_{SS}$ )
- DSEL = L ( $DV_{SS}$ )
- RESET = H ( $DV_{DD}$ ) or L ( $DV_{SS}$ )
- $\overline{CE}$  = L ( $AV_{SS}$ )
- $\overline{OE}$  = L ( $DV_{SS}$ )



- $V_{INA}$  input — Sampling (A ch) at CLKA falling  
Sampling (B ch) at CLKB falling
- DA0 to DA7 — Output (after 2.5 CLK +  $t_{pdD}$  from Sampling) at CLKA rising
- DB0 to DB7 — Output (after 2.5 CLK +  $t_{pdD}$  from Sampling) at CLKB rising

# MB40C328

## TYPICAL CONNECTION EXAMPLE



# MB40C328

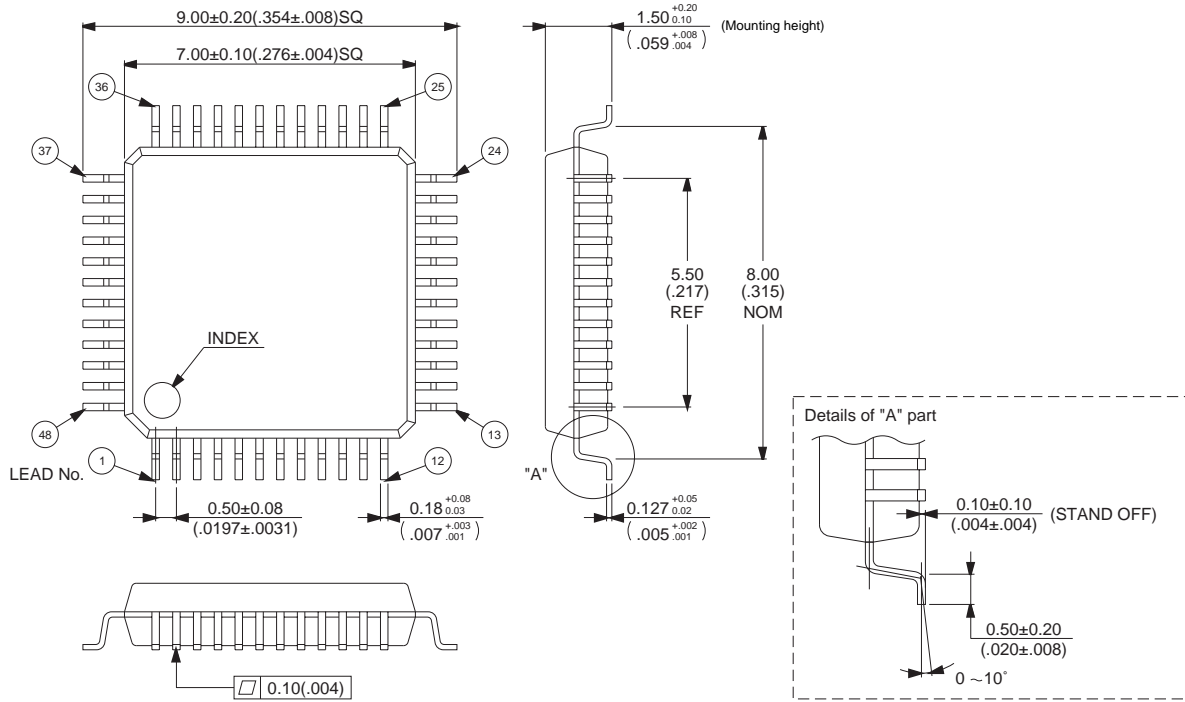
## ■ ORDERING INFORMATION

Part number	Package	Remark
MB40C328PFV	48-pin Plastic LQFP (FPT-48P-M05)	

# MB40C328

## ■ PACKAGE DIMENSION

48-pin Plastic LQFP  
(FPT-48P-M05)



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Dimensions in mm (inches).

# MB40C328

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