

# ASSP For Video Applications

## CMOS

# 8-bit 140 MSPS A/D Converter

# MB40C318V

## ■ DESCRIPTION

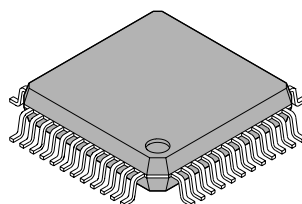
MB40C318V is a high-speed A/D converter using a fast CMOS technology.

## ■ FEATURES

- Resolution : 8 bit
- Linearity error :  $\pm 0.40\%$  (standard)
- Maximum conversion rate : 140 MSPS (minimum)
- Power supply voltage : 5 V (standard: digital input)  
3.3 V (standard: A/D converter)
- Clock input voltage range : PECL level (140 MHz max differential input CLKEP, CLKEN)  
TTL level (70 MHz max two-phase input CLKA, CLKB)
- Digital input voltage range : TTL level (RESET)  
3.3 V CMOS level ( $\overline{CE}$ ,  $\overline{OE}$ , CKSEL, DSEL)
- Digital output voltage range : 3.3 V 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 : 300 mW (standard)
- Additional features : Reference voltage generator circuit:  $V_{REFT} = 3.0$  V,  $V_{REFB} = 1.0$  V  
High impedance output, power down function  
1:2 demultiplex output enable (RESET action enable)  
1/2 devider clock output  
Cross sampling at 70 MHz (two-phase CLK) enable (CLKA, CLKB)
- Package : LQFP48 (7 mm  $\times$  7 mm, lead pitch 0.5 mm)

## ■ PACKAGE

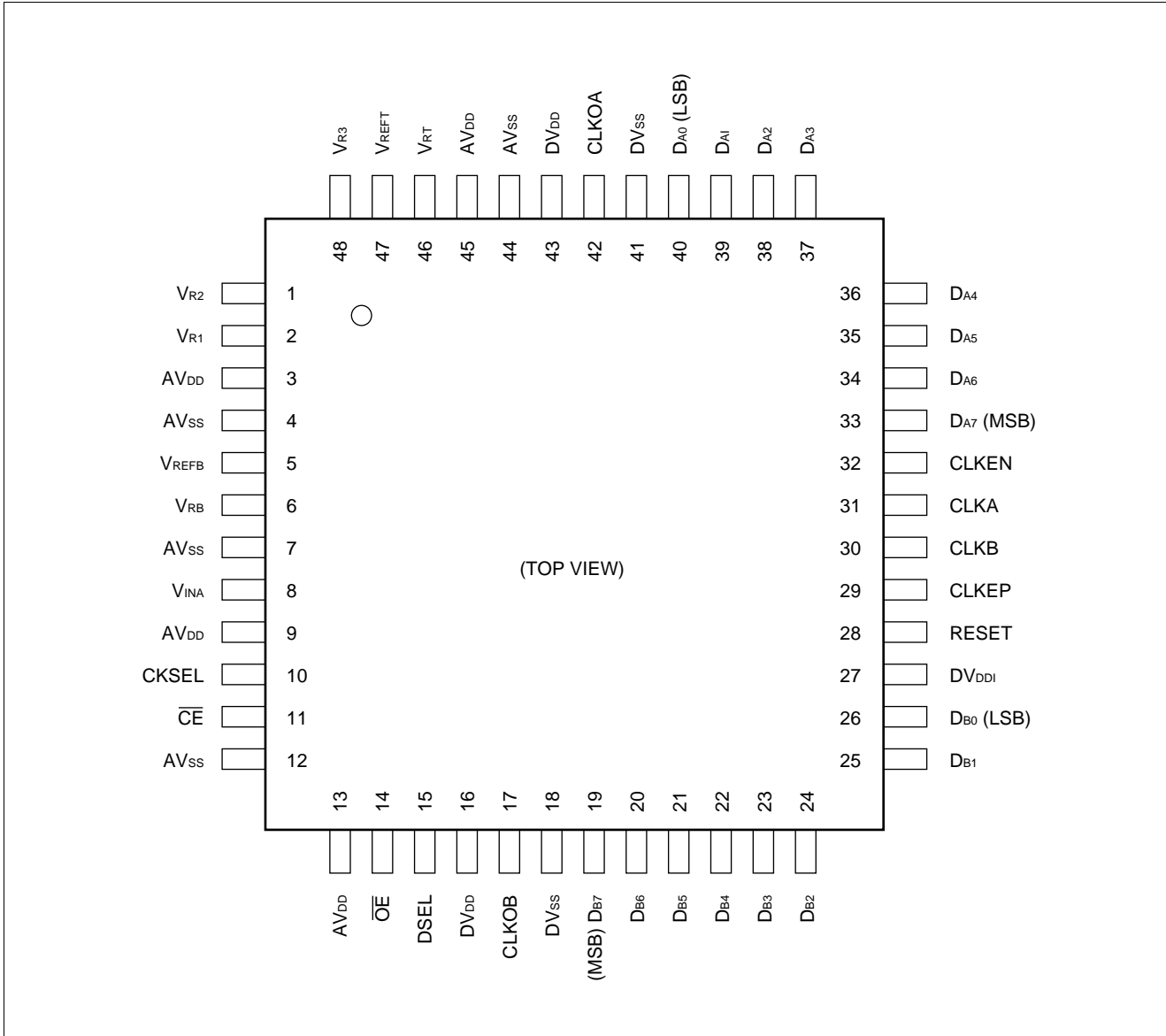
48-pin plastic LQFP



(FPT-48P-M05)

# MB40C318V

## ■ PIN ASSIGNMENT



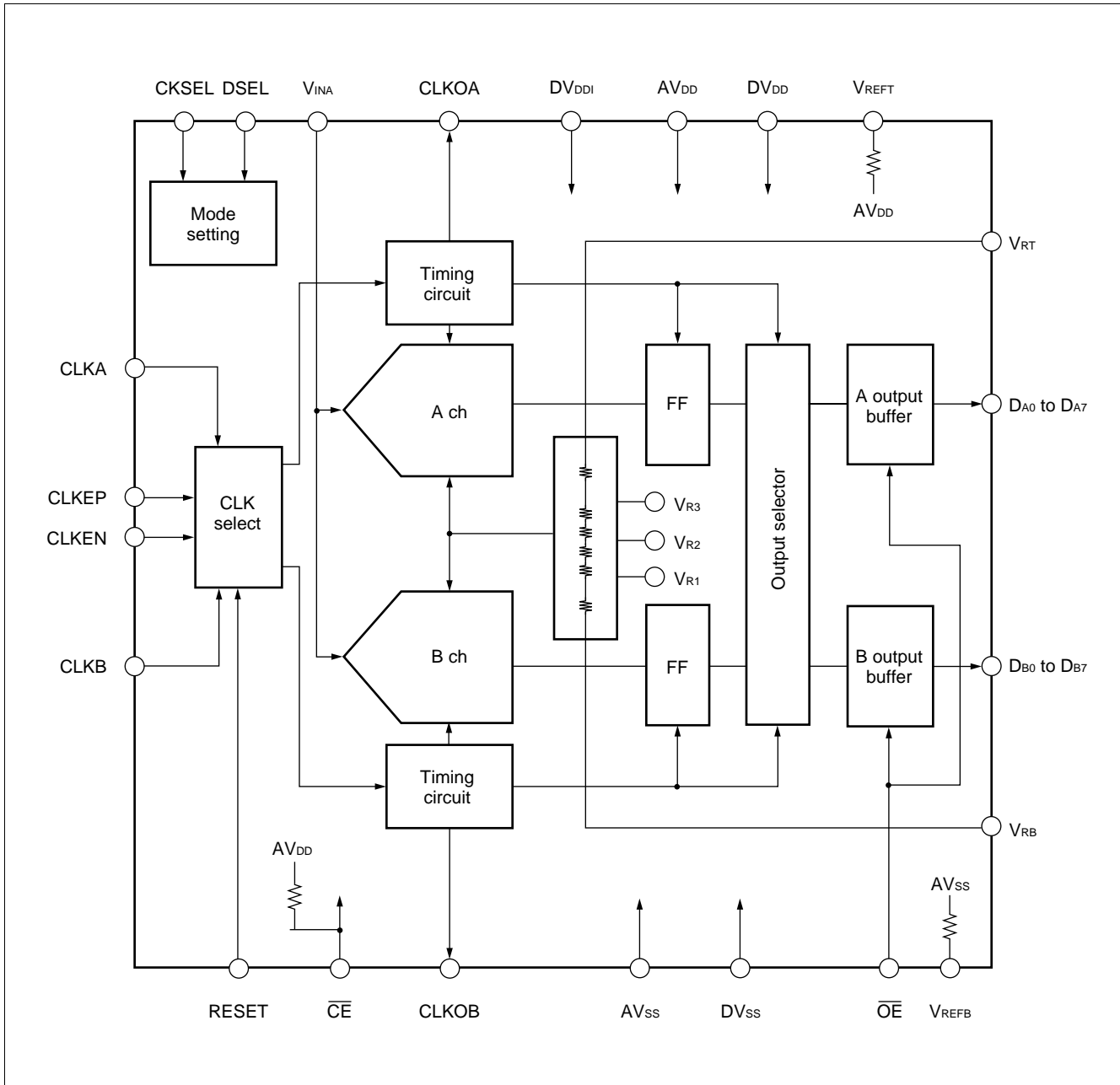
## ■ PIN DESCRIPTION

Pin No.	Symbol	Description
3, 9, 13, 45	AV <sub>DD</sub>	Analog power supply (+3.3 V)
16, 43	DV <sub>DD</sub>	Digital power supply (+3.3 V)
27	DV <sub>DDI</sub>	Digital power supply for digital input (+5.0 V)
4, 7, 12, 44	AV <sub>SS</sub>	Analog power supply ground pin (0 V)
18, 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	$\overline{CE}$	Power down at $\overline{CE}$ input "H" (internal pull-up resistor)
14	$\overline{OE}$	Digital output (Both Port A, B) and clock output (CLKOA, CLKOB) are high impedance at $\overline{OE}$ 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 DIAGRAM] 2, 3)
29	CLKEP	Differential clock (positive-phase) input pin (max 140 MHz)
32	CLKEN	Differential clock (negative-phase) input pin (max 140 MHz)
31	CLKA	Two-phase clock (A ch) input pin (max 70 MHz)
30	CLKB	Two-phase clock (B ch) input pin (max 70 MHz)
42	CLKOA	Clock output pin (See [■ TIMING DIAGRAM] 1 to 4)
17	CLKOB	Clock output pin (See [■ TIMING DIAGRAM] 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 V <sub>p-p</sub> )
2	V <sub>R1</sub>	Reference 1/4 voltage output pin (Add 0.1 μF for AV <sub>SS</sub> )
1	V <sub>R2</sub>	Reference 1/2 voltage output pin (Add 0.1 μF for AV <sub>SS</sub> )
48	V <sub>R3</sub>	Reference 3/4 voltage output pin (Add 0.1 μF for AV <sub>SS</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 × AV <sub>DD</sub> (≒ 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 × AV <sub>DD</sub> (≒ 1 V) is generated.

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 <sub>DD</sub> , DV <sub>DD</sub>	-0.3	+4.0	V
	DV <sub>DDI</sub>	-0.3	+7.0	V
Input/output voltage	V <sub>INA</sub> , V <sub>RT</sub> , V <sub>RB</sub> , V <sub>REFT</sub> , V <sub>REFB</sub> , V <sub>R1</sub> , V <sub>R2</sub> , V <sub>R3</sub> , $\overline{CE}$ , CKSEL	-0.3	AV <sub>DD</sub> +0.3*1	V
	D <sub>A0</sub> to D <sub>A7</sub> , D <sub>B0</sub> to D <sub>B7</sub> , CLKOA, CLKOB, DSEL, $\overline{OE}$ ,	-0.3	DV <sub>DD</sub> +0.3*1	V
	CLKEP, CLKEN, CLKA, CLKB, RESET	-0.3	DV <sub>DDI</sub> +0.3*2	V
Storage temperature	T <sub>STG</sub>	-55	+125	°C

\*1: Do not exceed +4.0 V.

\*2: Do not exceed +7.0 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
		$DV_{DDI}$	4.75	5.00	5.25	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	CKSEL, $\overline{CE}$	$V_{IHD}$	$AV_{DD} - 0.5$	—	—	V
	$\overline{OE}$ , DSEL		$DV_{DD} - 0.5$	—	—	V
	CLKA, CLKB, RESET		2.6	—	—	V
	CLKEP, CLKEN		$DV_{DDI} - 1.1$	—	$DV_{DDI} - 0.6$	V
Digital “L” level input voltage	CKSEL, $\overline{CE}$	$V_{ILD}$	—	—	0.5	V
	$\overline{OE}$ , DSEL		—	—	0.5	V
	CLKA, CLKB, RESET		—	—	0.5	V
	CLKEP, CLKEN		$DV_{DDI} - 2.0$	—	$DV_{DDI} - 1.45$	V
Digital input voltage range	CLKEP, CLKEN	$V_{IHD} - V_{ILD}$	0.4	0.8	—	V
Digital input current		$I_{ID}$	−20	—	5	μA
Differential clock frequency		$f_{CLKEP}, f_{CLKEN}$	0.1	—	140	MHz
Two-phase clock frequency		$f_{CLKA}, f_{CLKB}$	0.1	—	70	MHz
Minimum clock pulse width (differential)		$t_{WS}^+, t_{WS}^-$	3.0	3.5	—	ns
Minimum clock pulse width (two-phase)		$t_{WD}^+, t_{WD}^-$	6.0	7.0	—	ns
Clock pulse rising/falling time		$t_r, t_f$	—	2.0	—	ns
RESET signal setup time		$t_s$	1.5	—	—	ns
RESET signal hold time		$t_h$	1.5	—	—	ns
Operating temperature range		$T_a$	−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

### • DC Characteristics in Analog Section

( $AV_{DD} = DV_{DD} = 3.00\text{ V to }3.60\text{ V}$ ,  $DV_{DDI} = 4.75\text{ V to }5.25\text{ V}$ ,  $T_a = -20^\circ\text{C to }+70^\circ\text{C}$ )

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Resolution	—	—	8	—	bit
Linearity error	LE	—	$\pm 0.40$	$\pm 0.6$	%
Differential linearity error	DLE	—	$\pm 0.20$	$\pm 0.36$	%
Analog input capacity	$C_{INA}$	—	22	—	pF
Reference voltage: T	$V_{REFT}$	$0.88 \times AV_{DD}$	$0.91 \times AV_{DD}$	$0.94 \times AV_{DD}$	V
Reference voltage: B	$V_{REFB}$	$0.27 \times AV_{DD}$	$0.3 \times AV_{DD}$	$0.33 \times AV_{DD}$	V
Reference current	$I_{RB}$	-15	-10	—	mA
Analog supply current	$I_{DD}$	—	60.0	100	mA
Digital supply current	$I_{DD}$	—	30.0	45	mA
	$I_{DDI}$	—	1	3	mA
Standby current	$I_{SB}$	—	1	—	mA

### • DC Characteristics in Digital Section

( $AV_{DD} = DV_{DD} = 3.00\text{ V to }3.60\text{ V}$ ,  $DV_{DDI} = 4.75\text{ V to }5.25\text{ V}$ ,  $T_a = -20^\circ\text{C to }+70^\circ\text{C}$ )

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

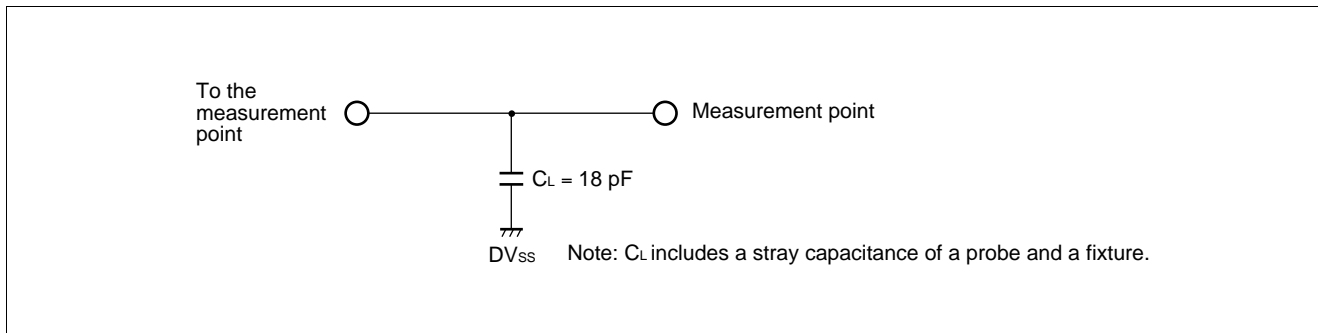
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## • Switching Characteristics

( $AV_{DD} = DV_{DD} = 3.00\text{ V to }3.60\text{ V}$ ,  $DV_{DDI} = 4.75\text{ V to }5.25\text{ V}$ ,  $T_a = -20^{\circ}\text{C to }+70^{\circ}\text{C}$ )

Parameter		Symbol	Value			Unit
			Min.	Typ.	Max.	
Maximum conversion rate		$f_s$	140	—	—	MSPS
Aperture time	Timing diagram 1 to 3	$t_{AD}$	—	3.5	—	ns
	Timing diagram 4		—	2.0	—	ns
Digital output delay time	Timing diagram 1	$t_{pdS}$	4	8	11.5	ns
		$t_{pdSO}$	$t_{ws}^+ + 4$	$t_{ws}^+ + 8$	$t_{ws}^+ + 11$	ns
	Timing diagram 2	$t_{pdM1}$	4	7	11.5	ns
		$t_{pdM1O}$	$T + 4$	$T + 7$	$T + 11$	ns
	Timing diagram 3	$t_{pdM2}$	4	7	11.5	ns
		$t_{pdM2O}$	$T + 4$	$T + 7$	$T + 11$	ns
	Timing diagram 4	$t_{pdD}$	3	6	10.5	ns
		$t_{pdDO}$	$t_{wD}^+ + 2$	$t_{wD}^+ + 6$	$t_{wD}^+ + 10$	ns

## ■ DIGITAL OUTPUT BUFFER LOAD CIRCUIT



## ■ MODE SETTING

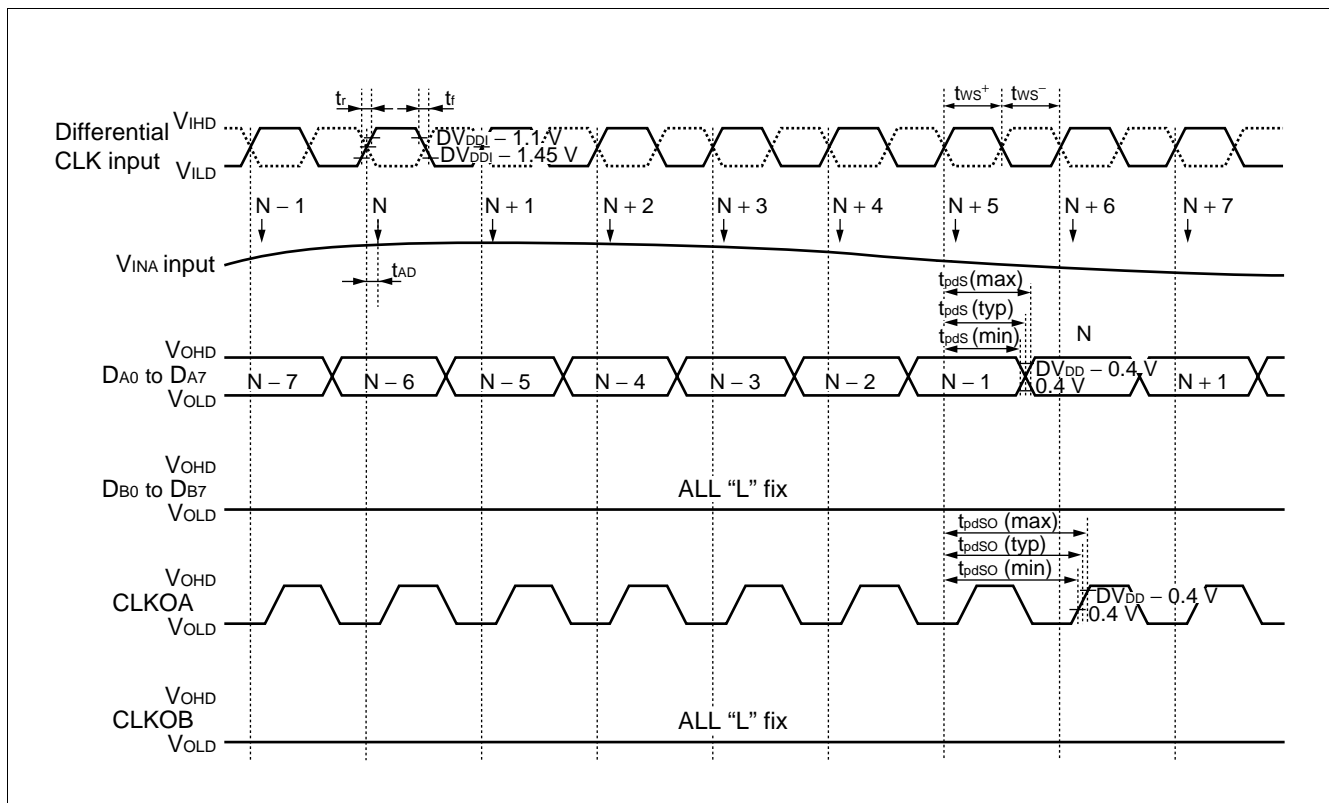
CKSEL	DSEL	Mode	Timing Diagram
H	H	Differential CLK input-straight output mode	Timing diagram 1
H	L	Differential CLK input-demultiplex output (in-phase) mode	Timing diagram 2
L	H	Differential CLK input-demultiplex output (two-phase) mode	Timing diagram 3
L	L	Two-phase CLK input mode (CLKA, CLKB)	Timing diagram 4



## ■ TIMING DIAGRAM 1

Differential CLK input-straight output mode

- CLKEP = CLKEN = 140 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>DDI</sub>)
- $\overline{CE}$  = "L" (AV<sub>SS</sub>)
- $\overline{OE}$  = "L" (DV<sub>SS</sub>)



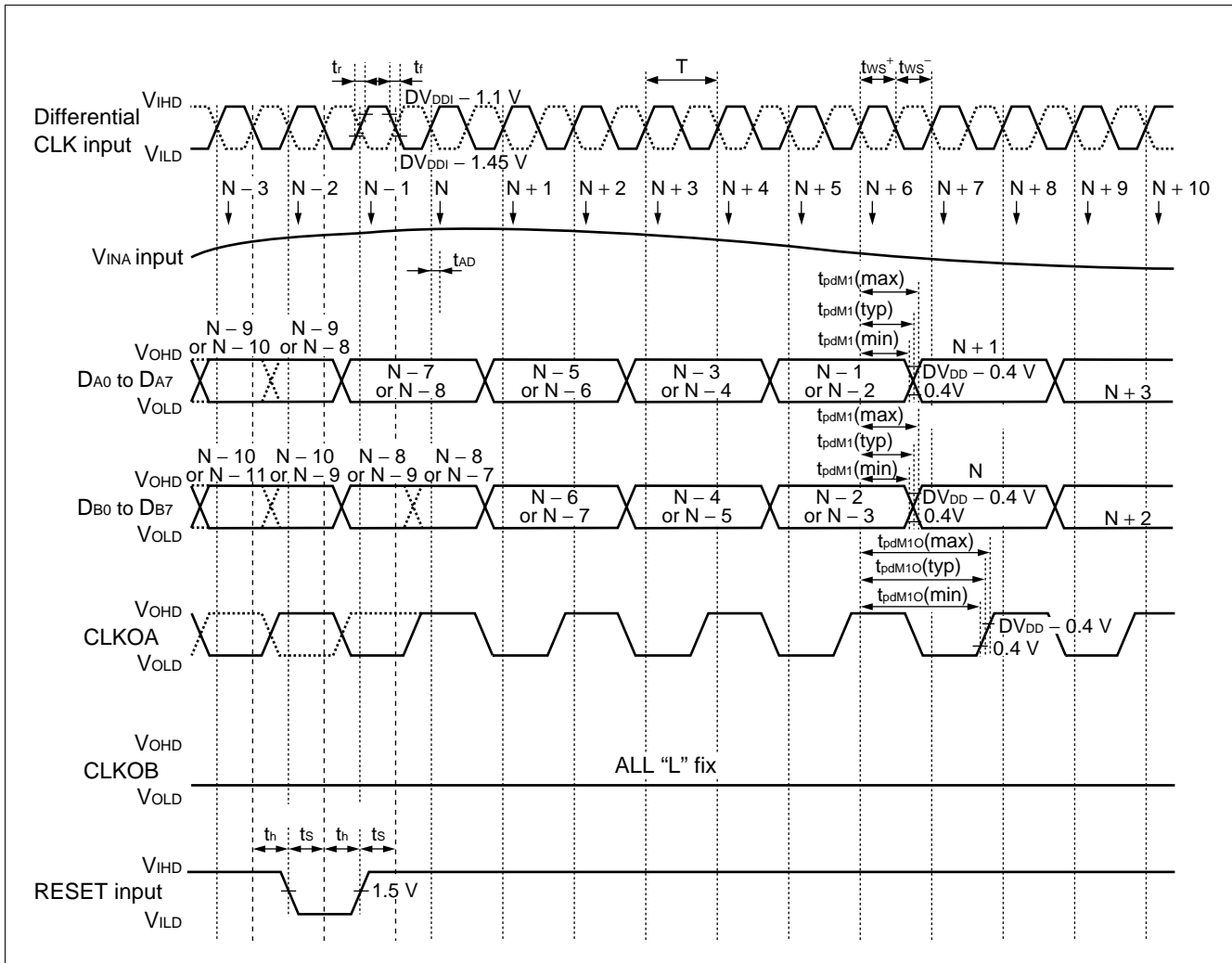
- Differential CLK input — Solid line: CLKEP, Dotted line: CLKEN
- V<sub>INA</sub> input — Sampling at CLKEP rising (CLKEN falling)
- DA<sub>0</sub> to DA<sub>7</sub> — Output (after 5 CLK + t<sub>pds</sub> from Sampling) at CLKEP rising (CLKEN falling)

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## ■ TIMING DIAGRAM 2

Differential CLK input-demultiplex output (in-phase) mode

- CLKEP = CLKEN = 140 MHz (max)
- CLKA = CLKB = "L" (DV<sub>SS</sub>)
- CKSEL = "H" (AV<sub>DD</sub>)
- DSEL = "L" (DV<sub>SS</sub>)
- $\overline{CE}$  = "L" (AV<sub>SS</sub>)
- $\overline{OE}$  = "L" (DV<sub>SS</sub>)

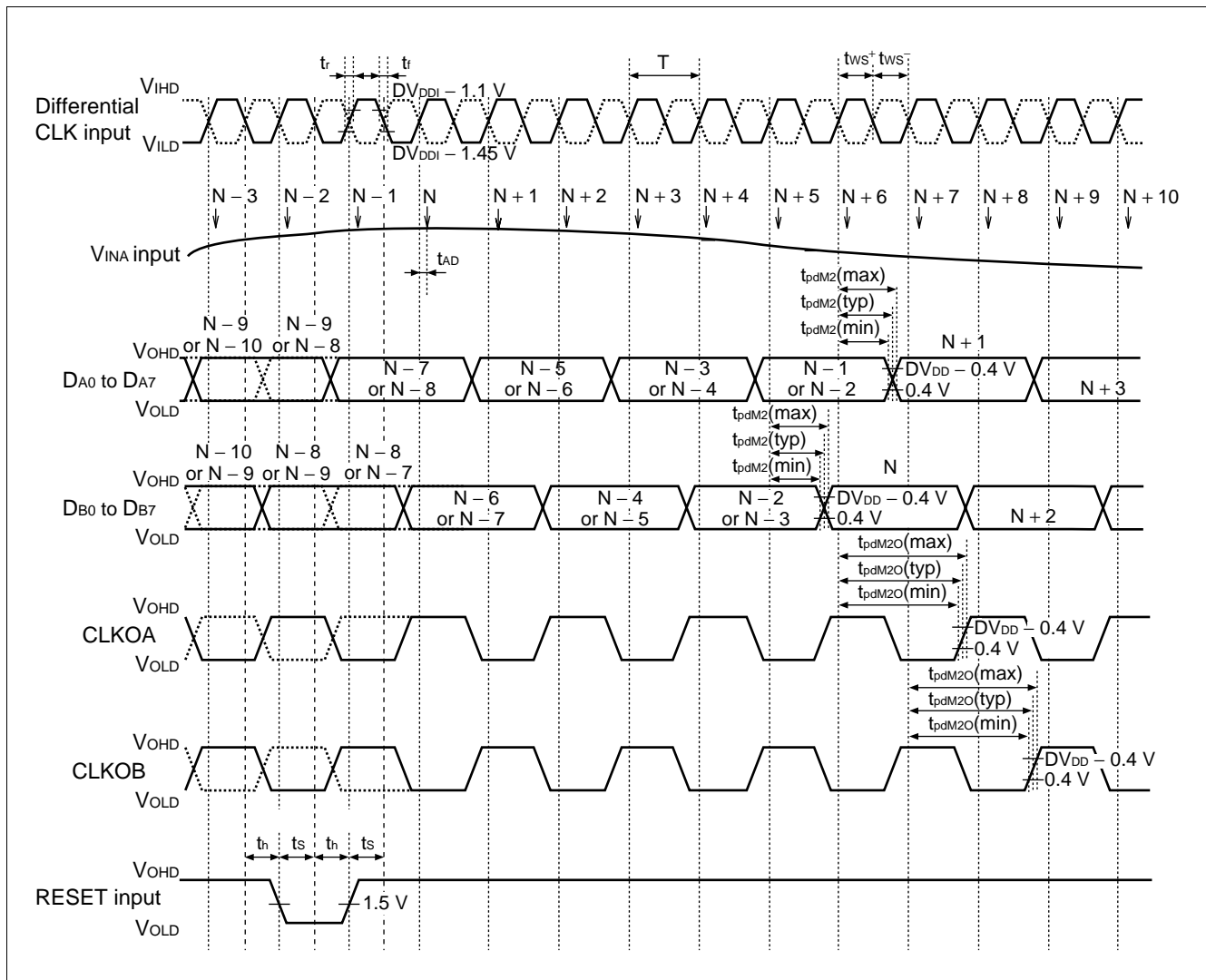


- Differential CLK input — Solid line: CLKEP, Dotted line: CLKEN
- V<sub>INA</sub> input — Sampling at CLKEP rising (CLKEN falling)
- DA<sub>0</sub> to DA<sub>7</sub> — Output (after 5 CLK +  $t_{pdM1}$  from Sampling) at CLKEP rising (CLKEN falling)
- DB<sub>0</sub> to DB<sub>7</sub> — Output (after 6 CLK +  $t_{pdM1}$  from Sampling) at CLKEP rising (CLKEN falling)

## ■ TIMING DIAGRAM 3

Differential CLK input-demultiplex output (two-phase) mode

- CLKEP = CLKEN = 140 MHz (max)
- CLKA = CLKB = "L" (DV<sub>SS</sub>)
- CKSEL = "L" (AV<sub>SS</sub>)
- DSEL = "H" (DV<sub>DD</sub>)
- $\overline{CE}$  = "L" (AV<sub>SS</sub>)
- $\overline{OE}$  = "L" (DV<sub>SS</sub>)



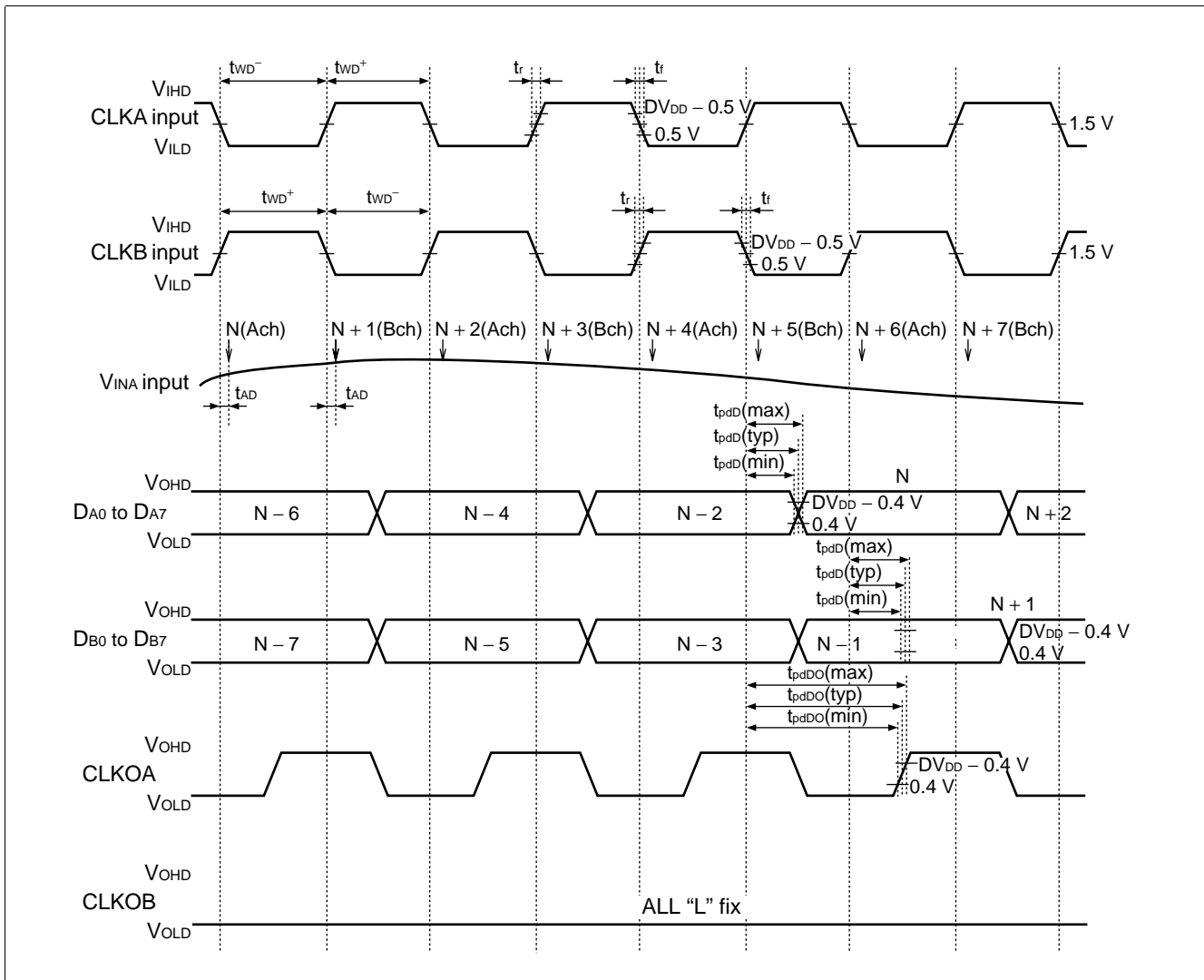
- Differential CLK input — Solid line: CLKEP, Dotted line: CLKEN
- V<sub>INA</sub> input — Sampling at CLKEP rising (CLKEN falling)
- DA<sub>0</sub> to DA<sub>7</sub> — Output (after 5 CLK +  $t_{pdM2}$  from Sampling) at CLKEP rising (CLKEN falling)
- DB<sub>0</sub> to DB<sub>7</sub> — Output (after 5 CLK +  $t_{pdM2}$  from Sampling) at CLKEP rising (CLKEN falling)

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## ■ TIMING DIAGRAM 4

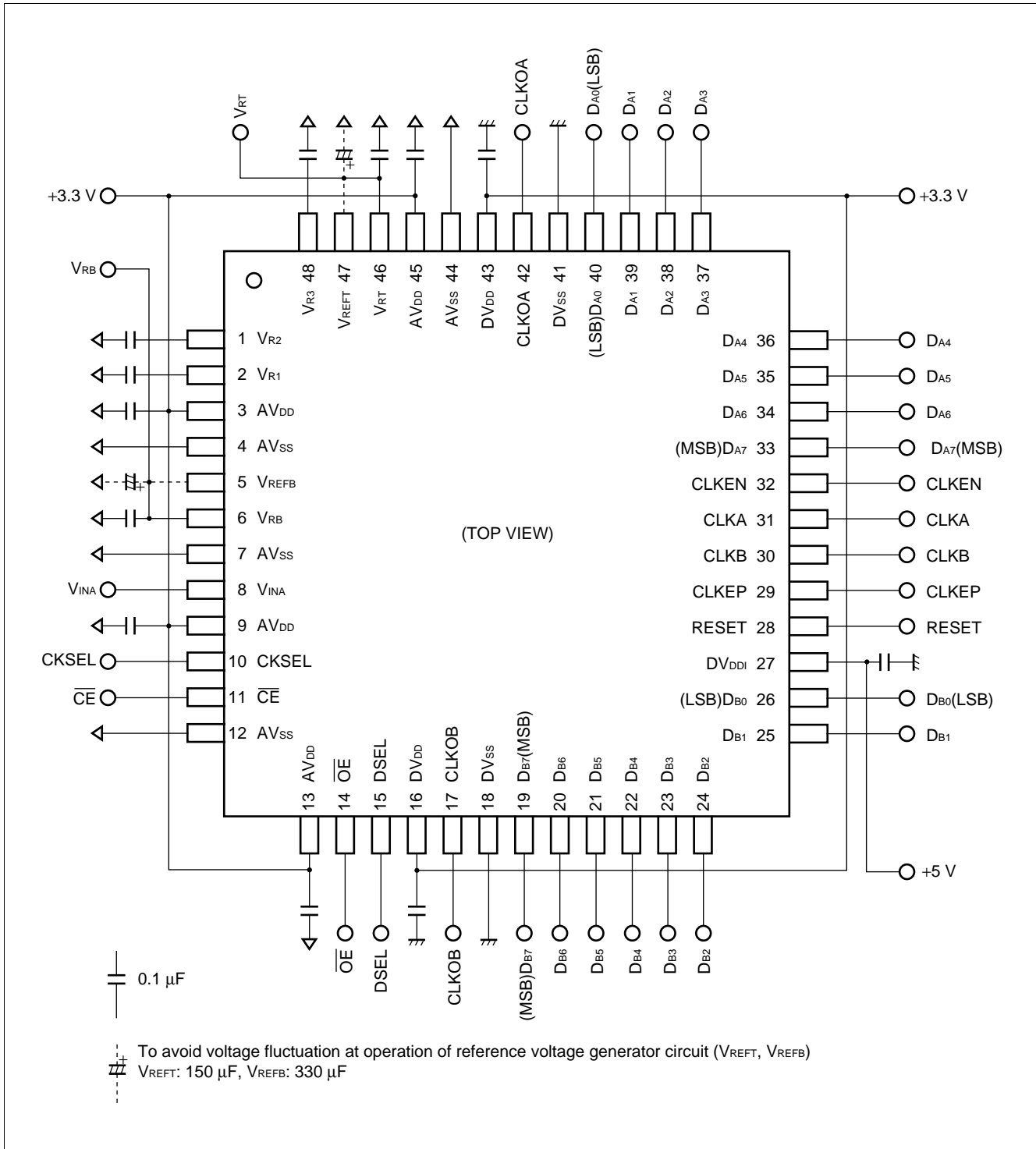
Two-phase CLK input mode (CLKA, CLKB)

- CLKEP = "L" (DV<sub>SS</sub>), CLKEN = "H" (DV<sub>DDI</sub>) or CLKEP = "H" (DV<sub>DDI</sub>), CLKEN = "L" (DV<sub>SS</sub>)
- CLKA = CLKB = 70 MHz (max)
- CKSEL = "L" (AV<sub>SS</sub>)
- DSEL = "L" (DV<sub>SS</sub>)
- RESET = "H" (DV<sub>DDI</sub>) or RESET = "L" (DV<sub>SS</sub>)
- $\overline{CE}$  = "L" (AV<sub>SS</sub>)
- $\overline{OE}$  = "L" (DV<sub>SS</sub>)



- V<sub>INA</sub> input — Sampling (A ch) at CLKA falling  
Sampling (B ch) at CLKB falling
- DA<sub>0</sub> to DA<sub>7</sub> — Output (after 2.5 CLK + t<sub>pdD</sub> from Sampling) at CLKA rising
- DB<sub>0</sub> to DB<sub>7</sub> — Output (after 3 CLK + t<sub>pdD</sub> from Sampling) at CLKB falling

## TYPICAL APPLICATION



# MB40C318V

## ■ USAGE PRECAUTIONS

- Be sure to ground the pins of  $AV_{DD}$ ,  $DV_{DD}$ ,  $DV_{DDI}$ ,  $V_{RT}$ ,  $V_{RB}$ ,  $V_{R1}$ ,  $V_{R2}$ , and  $V_{R3}$  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  $\overline{CE}$  to "H" at powering on and input more than five clock pulses just after operation ( $\overline{CE}$ : H  $\rightarrow$  L).

## ■ ORDERING INFORMATION

Part number	Package	Remark
MB40C318VPFV	48-pin Plastic LQFP (FPT-48P-M05)	



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