

# ASSP CMOS 85 MSPS 3ch 10-bit D/A Converter

## MB40C950V

### DESCRIPTION

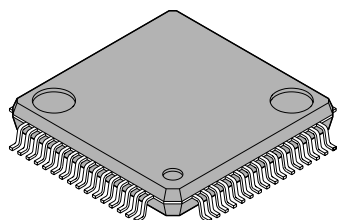
The MB40C950V is a high-speed CMOS process-based D/A converter provided with the three-channel I/O for RGB, allowing for independent control of the three channels.

### FEATURES

- Resolution : 10 bits
- Linearity error :  $\pm 1.5$  LSB (max)
- Differential linearity error :  $\pm 1.0$  LSB (max)
- Maximum conversion rate : 85 MSPS (min)
- Supply voltage : single +5 V
- Digital input voltage range : TTL level
- Analog output voltage range : 2 Vp-p (0 to 2V: analog output for  $R_L = 200 \Omega$ ,  $R_{REF} = 3.3 \text{ k}\Omega$ ,  $V_{RIN} = 2\text{V}$ )  
: 1 Vp-p (0 to 1V: analog output for  $R_L = 75 \Omega$ ,  $R_{REF} = 2.4 \text{ k}\Omega$ ,  $V_{RIN} = 2\text{V}$ )
- Dissipation power : 240 mW (standard: analog output for  $R_L = 200 \Omega$ , 2 Vp-p output)  
: 310 mW (standard: analog output for  $R_L = 75 \Omega$ , 1 Vp-p output)
- Additional capabilities : Power saving function, independent 3-ch  $V_{REF}$
- Package : LQFP64, QFP64

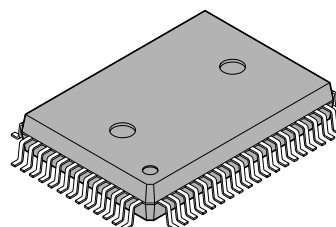
### PACKAGES

64-pin Plastic LQFP



(FPT-64P-M03)

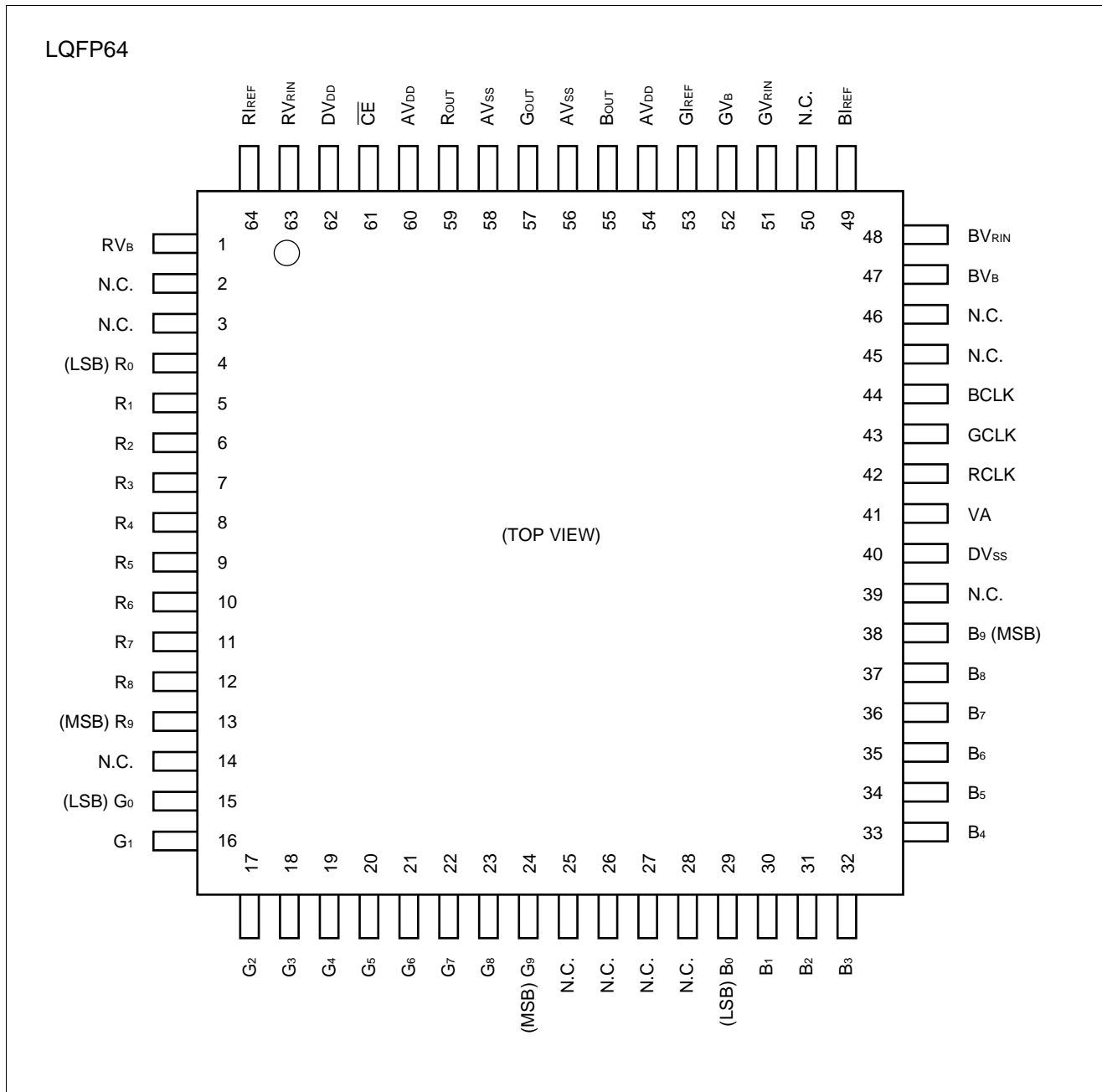
64-pin Plastic QFP



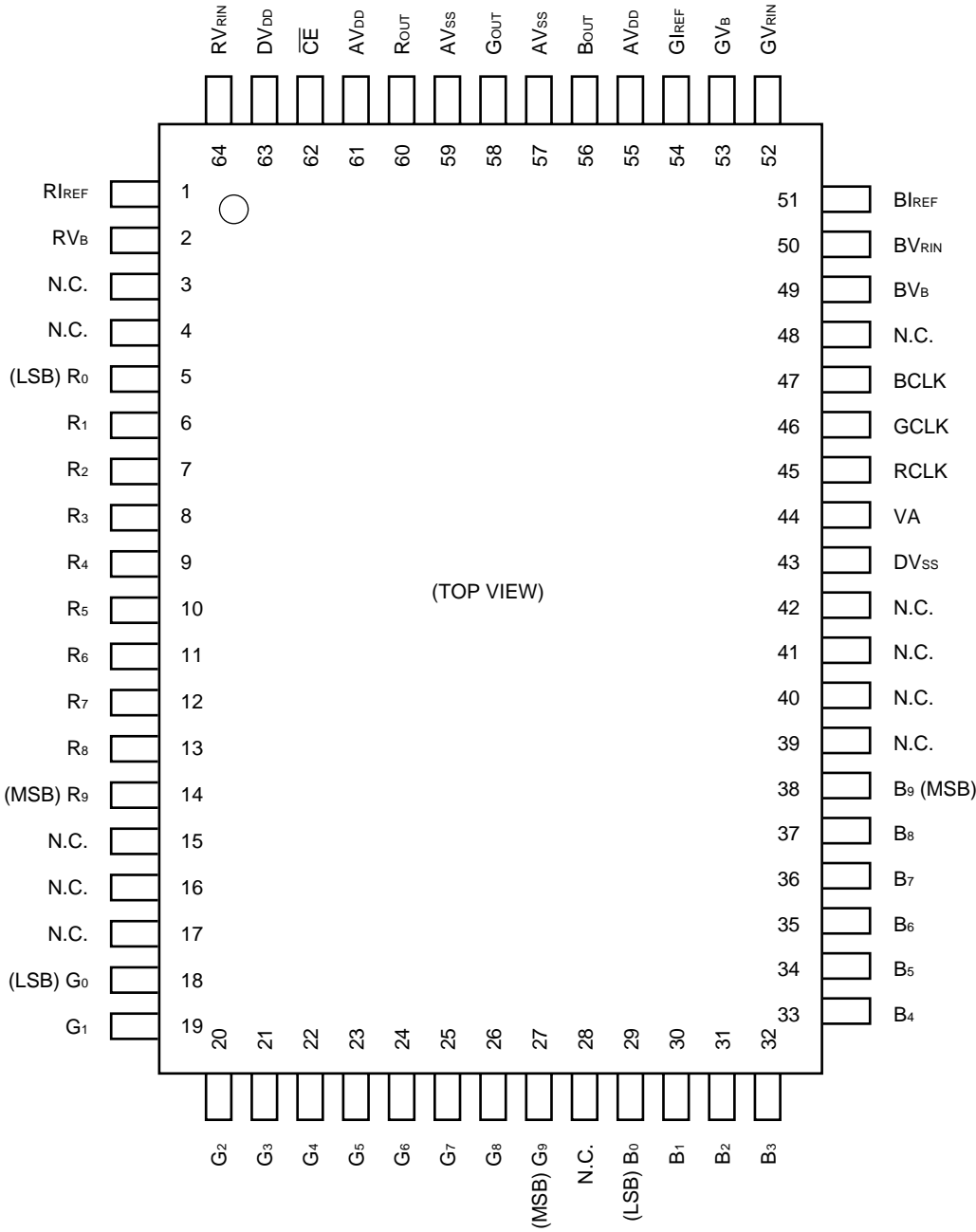
(FPT-64P-M10)

# MB40C950V

## ■ PIN ASSIGNMENT



QFP64

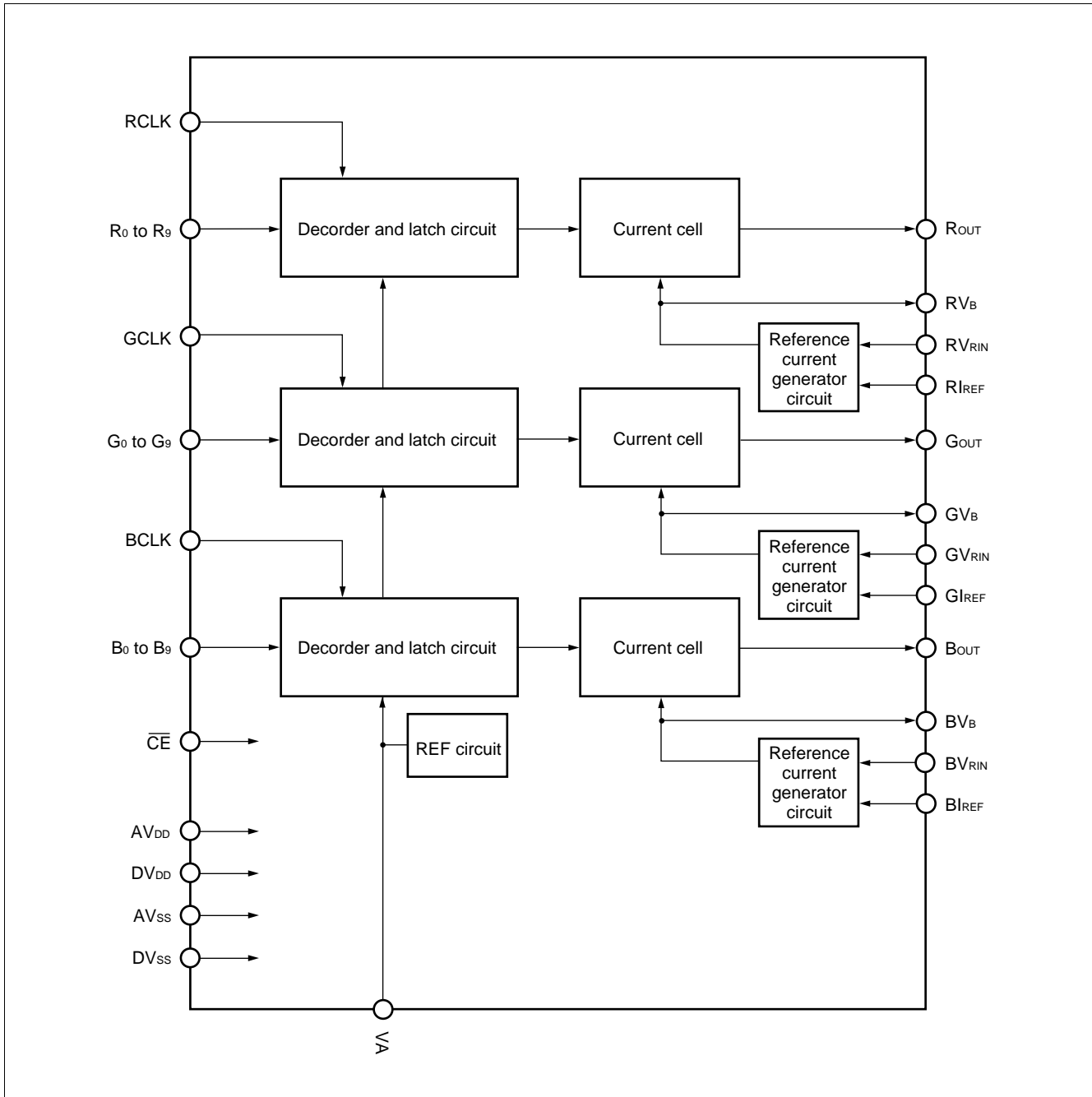


# MB40C950V

## ■ PIN DESCRIPTION

Pin No.		Symbol	I/O	Description
LQFP64	QFP64			
4 to 13 15 to 24 29 to 38	5 to 14 18 to 27 29 to 38	R <sub>0</sub> to R <sub>9</sub> G <sub>0</sub> to G <sub>9</sub> B <sub>0</sub> to B <sub>9</sub>	I	Data signal incoming terminal for Rch, Gch and Bch LSB: R <sub>0</sub> , G <sub>0</sub> , B <sub>0</sub> MSB: R <sub>9</sub> , G <sub>9</sub> , B <sub>9</sub>
42 43 44	45 46 47	RCLK GCLK BCLK	I	Clock signal incoming terminal for Rch, Gch and Bch
61	62	$\overline{CE}$	I	Power saving signal incoming terminal. Power saving enabled for High
62	63	DV <sub>DD</sub>	—	Digital power supply terminal
54, 60	55, 61	AV <sub>DD</sub>	—	Analog power supply terminal
40	43	DV <sub>SS</sub>	—	Digital ground terminal
56, 58	57, 59	AV <sub>SS</sub>	—	Analog ground terminal
63 51 48	64 52 50	RV <sub>RIN</sub> GV <sub>RIN</sub> BV <sub>RIN</sub>	I	Reference voltage incoming terminal for Rch, Gch and Bch
64 53 49	1 54 51	RI <sub>REF</sub> GI <sub>REF</sub> BI <sub>REF</sub>	—	Reference resistor connection terminal for Rch, Gch and Bch
41	44	VA	—	Connect >0.1 $\mu$ F capacitor to the AV <sub>SS</sub> terminal
1 52 47	2 53 49	RV <sub>B</sub> GV <sub>B</sub> BV <sub>B</sub>	—	Connect >0.1 $\mu$ F capacitor to the AV <sub>DD</sub> terminal
59 57 55	60 58 56	R <sub>OUT</sub> G <sub>OUT</sub> B <sub>OUT</sub>	O	Analog signal output terminals for Rch, Gch and Bch
2 to 3 14 25 to 28 39, 45 46, 50	3 to 4 15 to 17 28 39 to 42 48	N.C.	—	Not connected. To be left open.

## ■ BLOCK DIAGRAM



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## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	V <sub>DD</sub>	-0.3	+7.0	V
Digital input voltage	V <sub>ID</sub>	-0.3	V <sub>DD</sub> + 0.3	V
Analog output voltage	V <sub>O</sub>	-0.3	V <sub>DD</sub> + 0.3	V
Analog output current: LQFP64 : QFP64	I <sub>O</sub>	0 0	15 30	mA mA
Storage temperature	T <sub>stg</sub>	-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	Condition	Value			Unit
			Min.	Typ.	Max.	
Analog power supply voltage	AV <sub>DD</sub>	—	4.75	5.00	5.25	V
Digital power supply voltage	DV <sub>DD</sub>	—	4.75	5.00	5.25	V
Power supply voltage difference	AV <sub>DD</sub> – DV <sub>DD</sub>	—	-0.2	—	0.2	V
Reference input voltage	V <sub>RIN</sub>	—	1.0	2.0	2.2	V
Full-scale current*1	I <sub>FS</sub>	LQFP64	0	—	15	mA
		QFP64	0	—	30	mA
Full-scale output voltage*2	V <sub>FS</sub>	I <sub>FS</sub> ≤ 15 mA	—	2.0	2.3	V
		15 mA < I <sub>FS</sub> ≤ 30 mA	—	1.0	1.2	V
Digital “H” level input voltage	V <sub>IHD</sub>	—	2.4	—	DV <sub>DD</sub>	V
Digital “L” level input voltage	V <sub>ILD</sub>	—	0	—	0.5	V
Clock frequency	f <sub>CLK</sub>	—	—	—	85	MHz
Setup time	t <sub>s</sub>	—	4	—	—	ns
Hold time	t <sub>h</sub>	—	3	—	—	ns
“H” level minimum pulse width	t <sub>WH</sub>	—	5	—	—	ns
“L” level minimum pulse width	t <sub>WL</sub>	—	5	—	—	ns
Operating ambient temperature	T <sub>op</sub>	—	-20	—	+75	°C

\*1:  $I_{FS} = V_{RIN}/R_{REF} \times 16$

\*2:  $V_{FS} = I_{FS} \times R_L$

**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 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 representatives beforehand.

## ■ ELECTRICAL CHARACTERISTICS

### 1. DC Characteristics

- $R_L = 200 \Omega$

( $V_{DD} = DV_{DD} = 4.75 \text{ V to } 5.25 \text{ V}$ ,  $V_{RIN} = 2 \text{ V}$ ,  $R_{REF} = 3.3 \text{ k}\Omega$ ,  $R_L = 200 \Omega$ ,  $T_a = -20^\circ\text{C to } +75^\circ\text{C}$ )

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Resolution	—	—	—	10	—	bit
Linearity error	LE	DC Accuracy	—	—	$\pm 1.5$	LSB
Differential linearity error	DLE		—	—	$\pm 1$	LSB
Digital input current	$I_{ID}$	—	-5	—	5	$\mu\text{A}$
Full-scale output voltage	$V_{OFS}$	—	1.85	1.94	2.03	V
Zero-scale output voltage	$V_{OZS}$	—	0	—	10	mV
Analog power supply current	$A_{DD}$	—	—	30	35	mA
Digital power supply current	$D_{DD}$	—	—	17	24	mA

- $R_L = 75 \Omega$

( $V_{DD} = DV_{DD} = 4.75 \text{ V to } 5.25 \text{ V}$ ,  $V_{RIN} = 2 \text{ V}$ ,  $R_{REF} = 2.4 \text{ k}\Omega$ ,  $R_L = 75 \Omega$ ,  $T_a = -20^\circ\text{C to } +75^\circ\text{C}$ )

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Resolution	—	—	—	10	—	bit
Linearity error	LE	DC Accuracy	—	—	$\pm 1.5$	LSB
Differential linearity error	DLE		—	—	$\pm 1$	LSB
Digital input current	$I_{ID}$	—	-5	—	5	$\mu\text{A}$
Full-scale output voltage	$V_{OFS}$	—	0.94	1.0	1.06	V
Zero-scale output voltage	$V_{OZS}$	—	0	—	10	mV
Analog power supply current	$A_{DD}$	—	—	45	50	mA
Digital power supply current	$D_{DD}$	—	—	17	24	mA

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## 2. AC Characteristics

- $R_L = 200 \Omega$

( $A_{VDD} = DV_{DD} = 4.75 \text{ V to } 5.25 \text{ V}$ ,  $V_{RIN} = 2 \text{ V}$ ,  $R_{REF} = 3.3 \text{ k}\Omega$ ,  $R_L = 200 \Omega$ ,  $C_L = 15 \text{ pF}$ ,  $T_a = -20^\circ\text{C to } +75^\circ\text{C}$ )

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Maximum conversion rate	$f_s$	—	85	—	—	MSPS
Output propagation delay time	$t_{pd}$		—	10	—	ns
Output rising time	$t_r$		—	8	—	ns
Output falling time	$t_f$		—	8	—	ns
Settling time	$t_{set}$		—	27	—	ns

- $R_L = 75 \Omega$

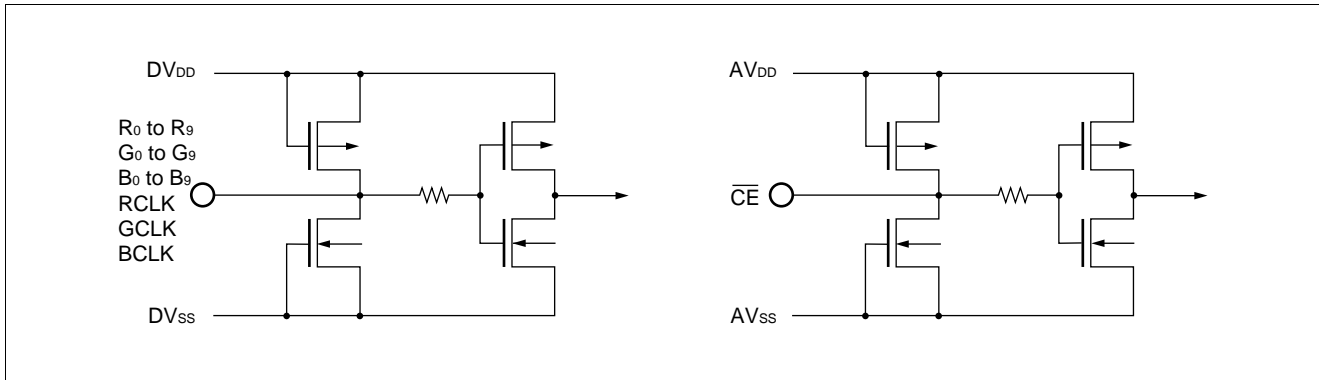
( $A_{VDD} = DV_{DD} = 4.75 \text{ V to } 5.25 \text{ V}$ ,  $V_{RIN} = 2 \text{ V}$ ,  $R_{REF} = 2.4 \text{ k}\Omega$ ,  $R_L = 75 \Omega$ ,  $C_L = 15 \text{ pF}$ ,  $T_a = -20^\circ\text{C to } +75^\circ\text{C}$ )

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Maximum conversion rate	$f_s$	—	85	—	—	MSPS
Output propagation delay time	$t_{pd}$		—	7	—	ns
Output rising time	$t_r$		—	2	—	ns
Output falling time	$t_f$		—	2	—	ns
Settling time	$t_{set}$		—	7	—	ns

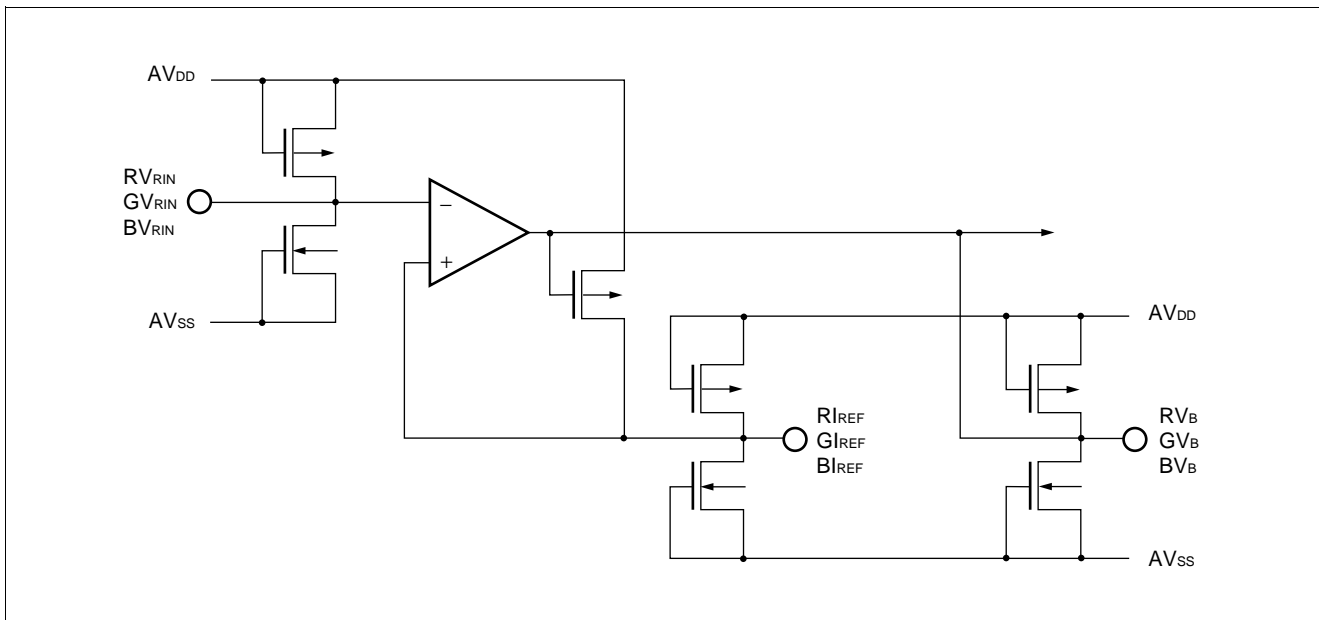


## ■ EQUIVALENT CIRCUIT

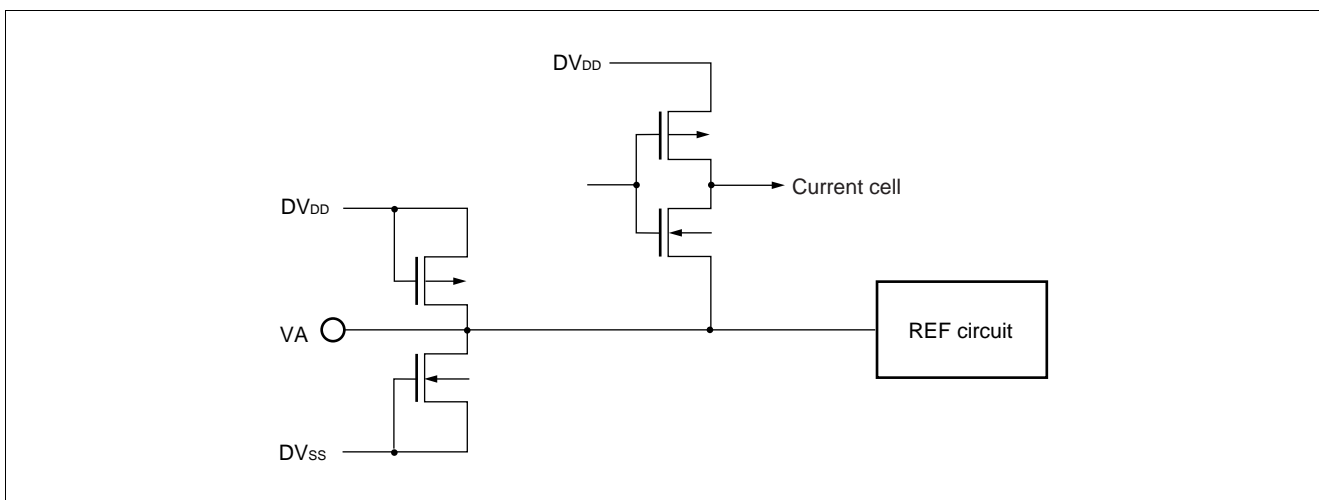
- Digital input



- Reference voltage input

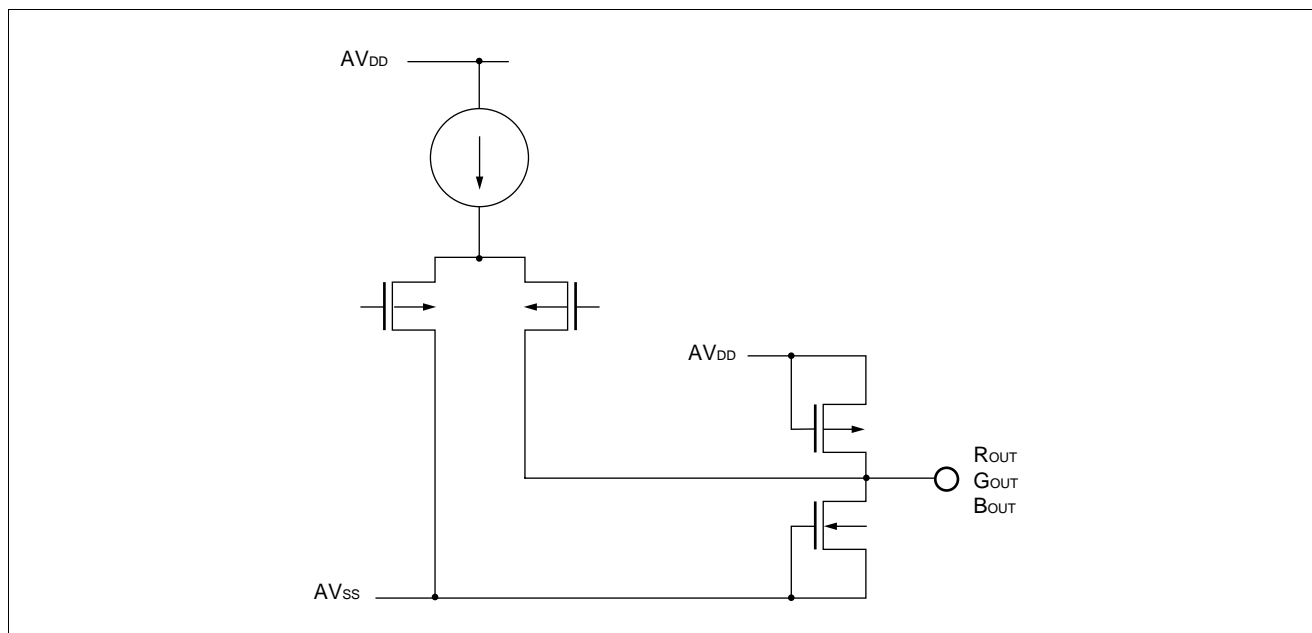


- VA pin

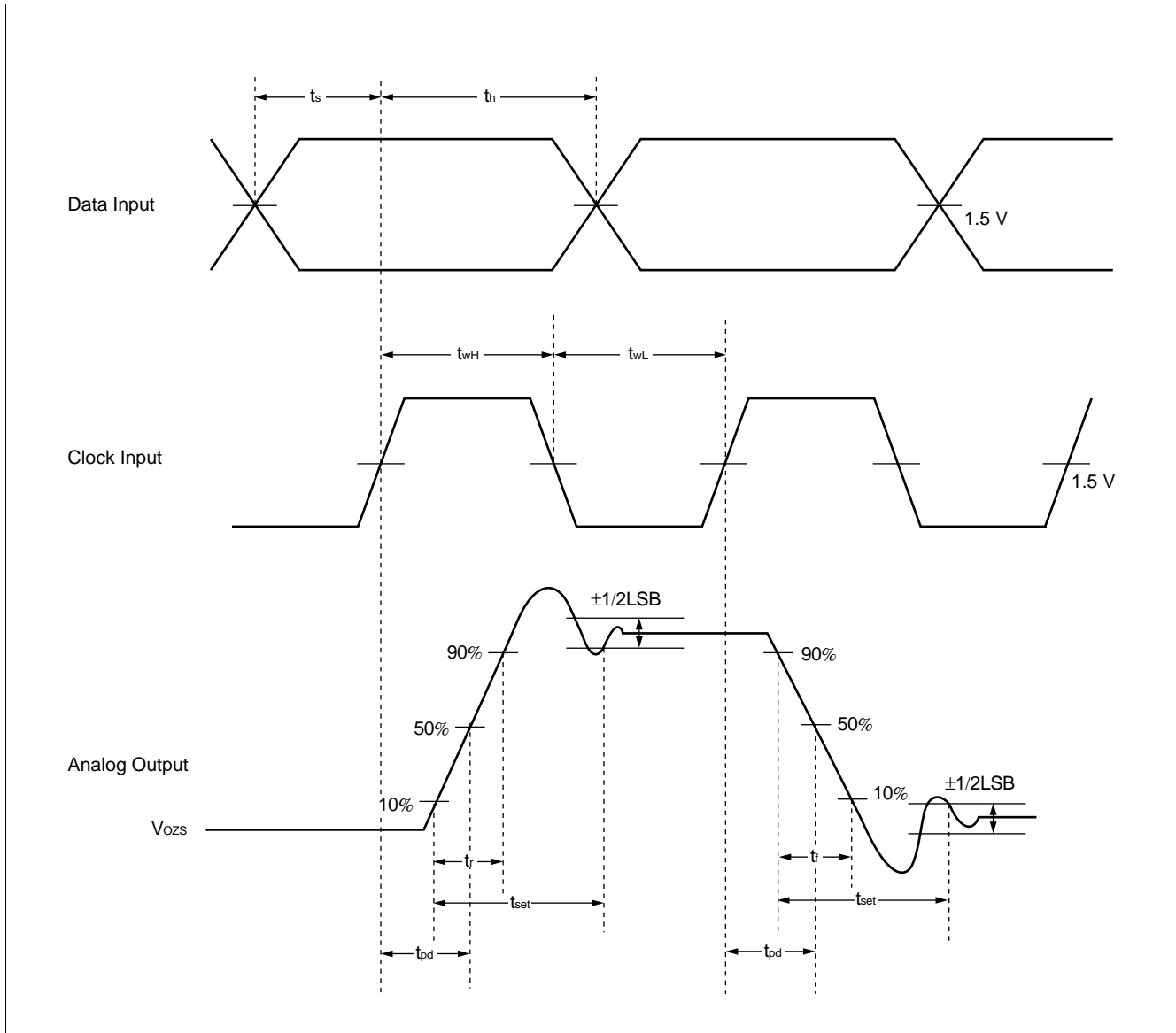


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- Analog output

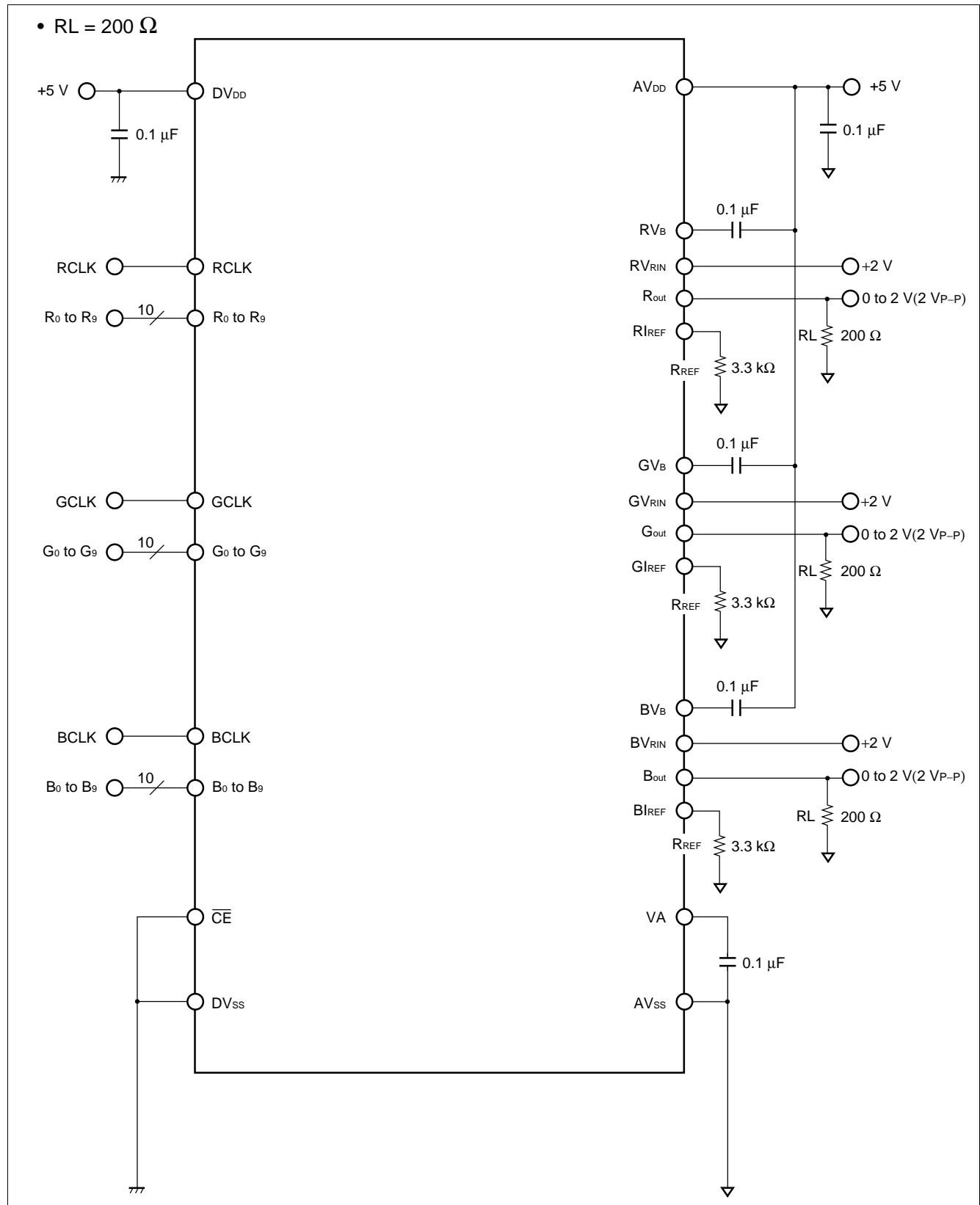


## ■ TIMING DIAGRAM



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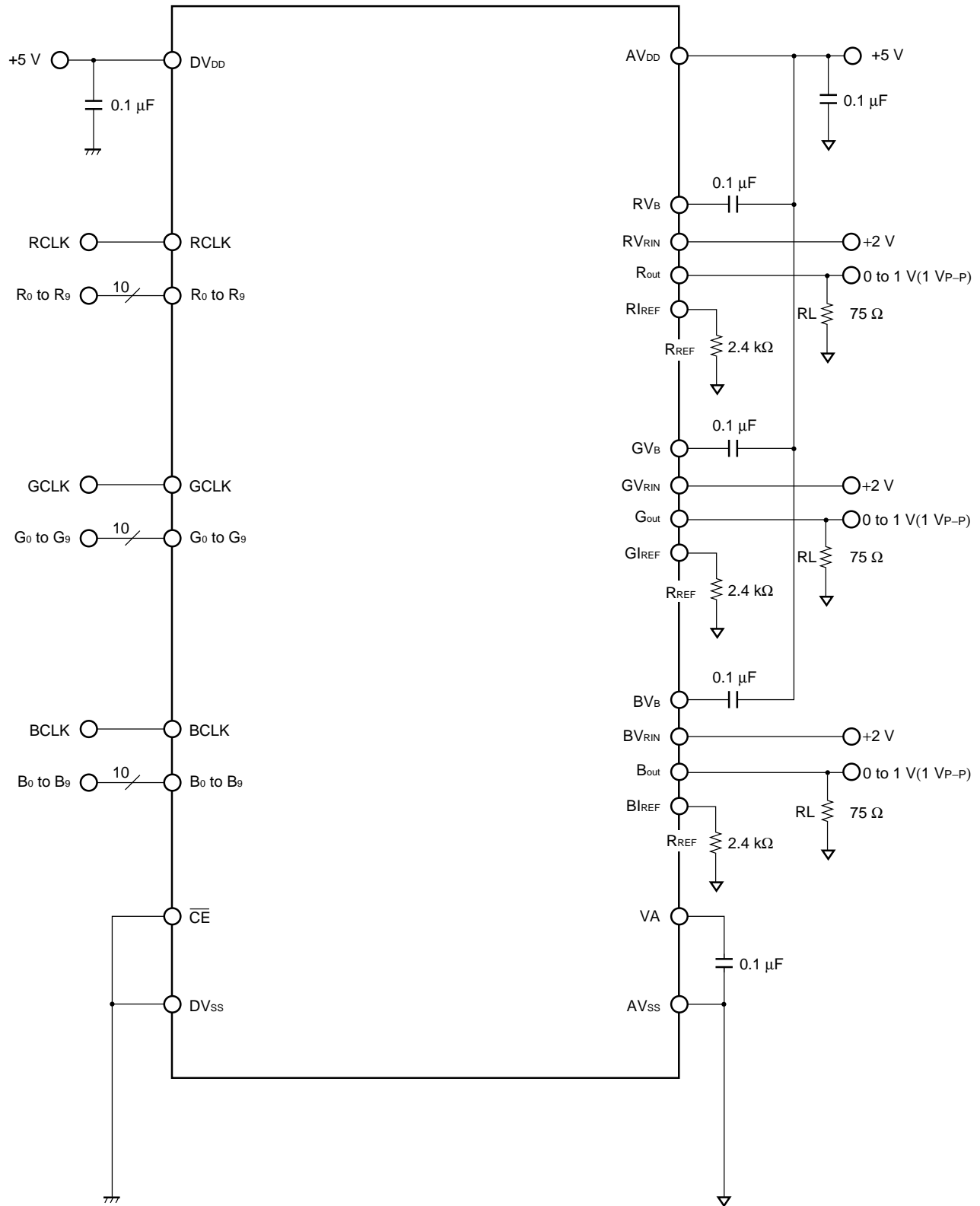
## ■ TYPICAL APPLICATION



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•  $R_L = 75 \Omega$



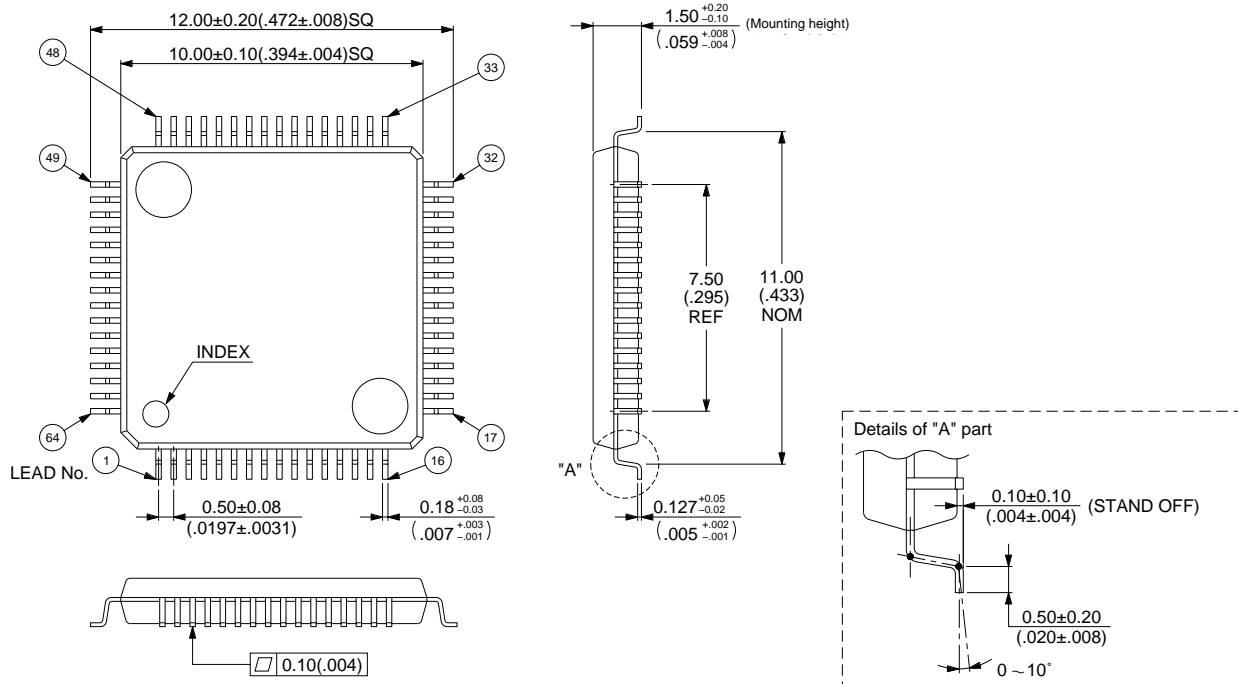
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## ■ ORDERING INFORMATION

Part number	Package	Remarks
MB40C950VPFV	64-pin Plastic LQFP (FPT-64P-M03)	
MB40C950VPFQ	64-pin Plastic QFP (FPT-64P-M10)	

## ■ PACKAGE DIMENSIONS

64-pin Plastic LQFP  
(FPT-64P-M03)



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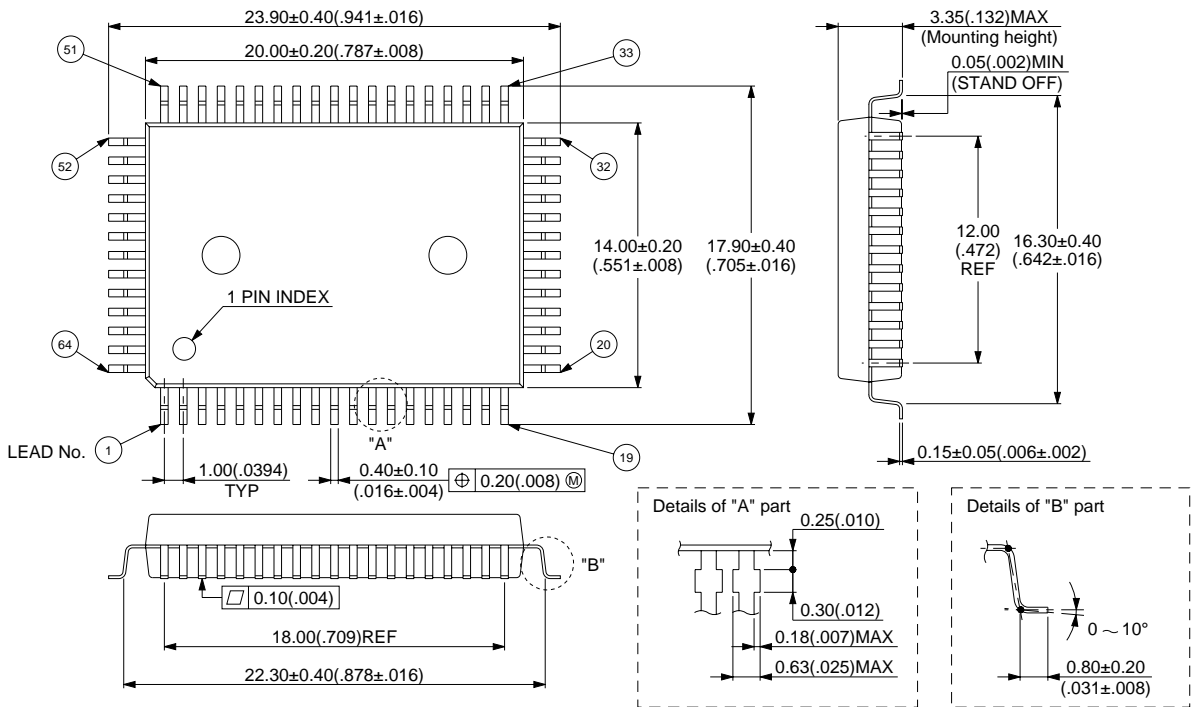
Dimensions in mm (inches).

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## 64-pin Plastic QFP (FPT-64P-M10)



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Dimensions in mm (inches)



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