FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-28318-2E

ASSP

CMOS

85 MSPS 3ch 10-bit D/A Converter

MB40C950V

■ DESCRIPTION

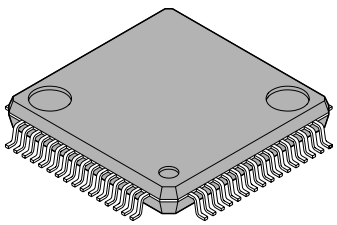
The MB40C950V is a high-speed CMOS process-based D/A converter provided with the three-channel I/O for RGB, allowing for independent control of the three channels.

■ FEATURES

- Resolution : 10 bits
- Linearity error : ±1.5 LSB (max)
- Differential linearity error : ±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 RL = 200 Ω, R_{REF} = 3.3 kΩ, V_{RIN} = 2V)
  : 1 Vp-p (0 to 1V: analog output for RL = 75 Ω, R_{REF} = 2.4 kΩ, V_{RIN} = 2V)
- Dissipation power : 240 mW (standard: analog output for RL = 200 Ω, 2 Vp-p output)
  : 310 mW (standard: analog output for RL = 75 Ω, 1 Vp-p output)
- Additional capabilities : Power saving function, independent 3-ch V_{REF}
- Package : LQFP64, QFP64

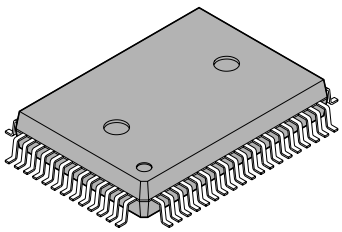
■ PACKAGES

64-pin Plastic LQFP



(FPT-64P-M03)

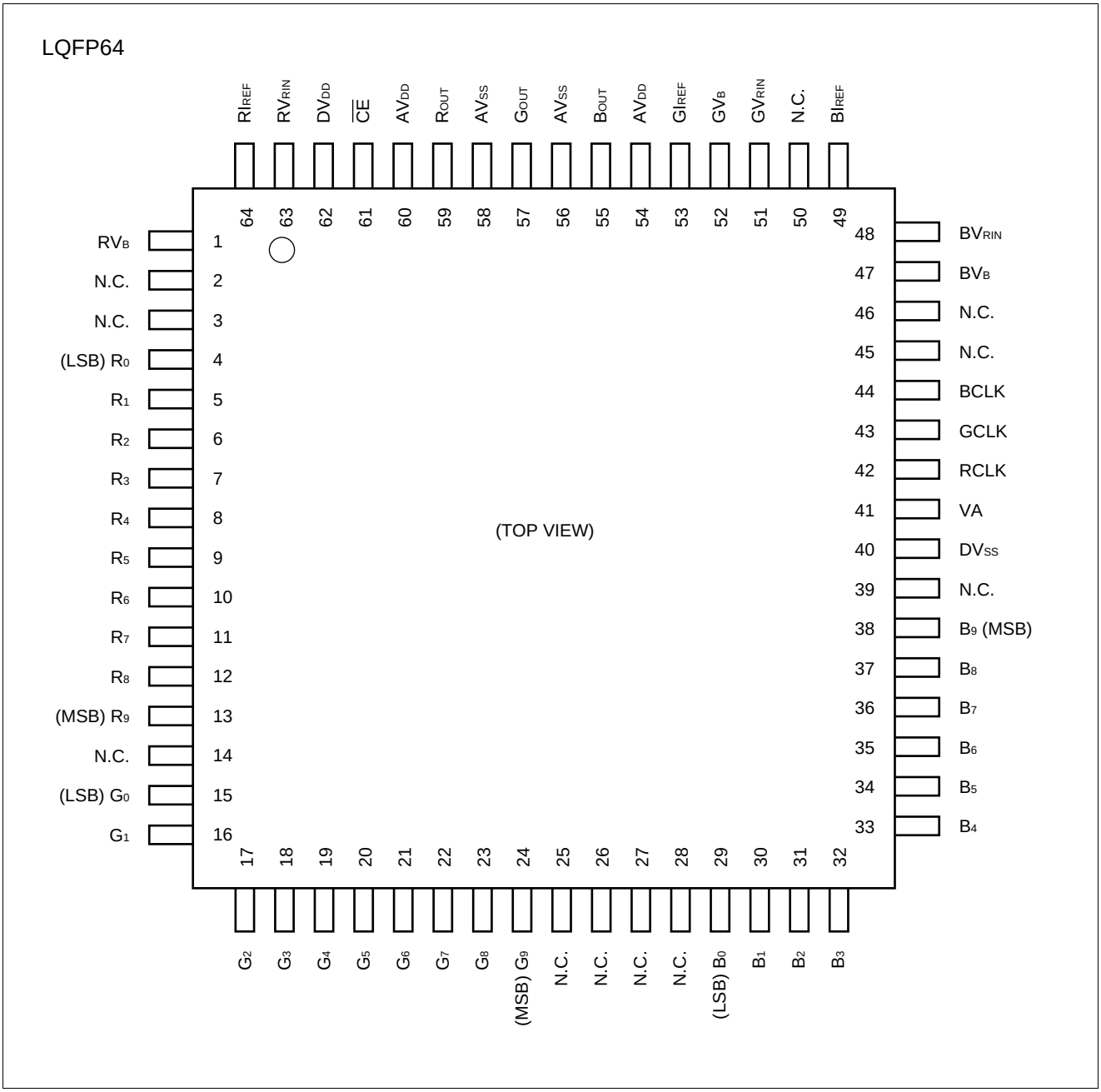
64-pin Plastic QFP



(FPT-64P-M10)

MB40C950V

■ PIN ASSIGNMENT



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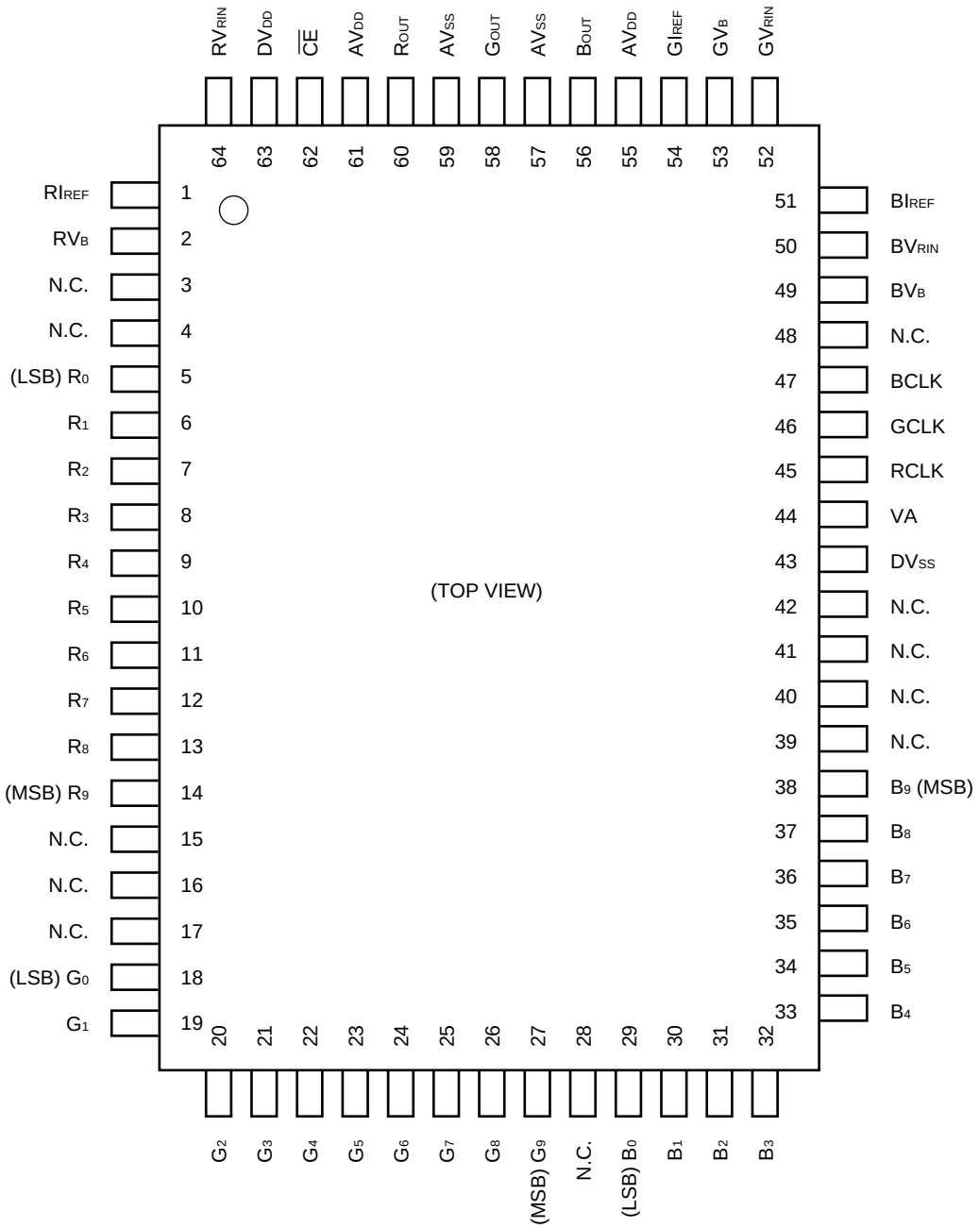
QFP64

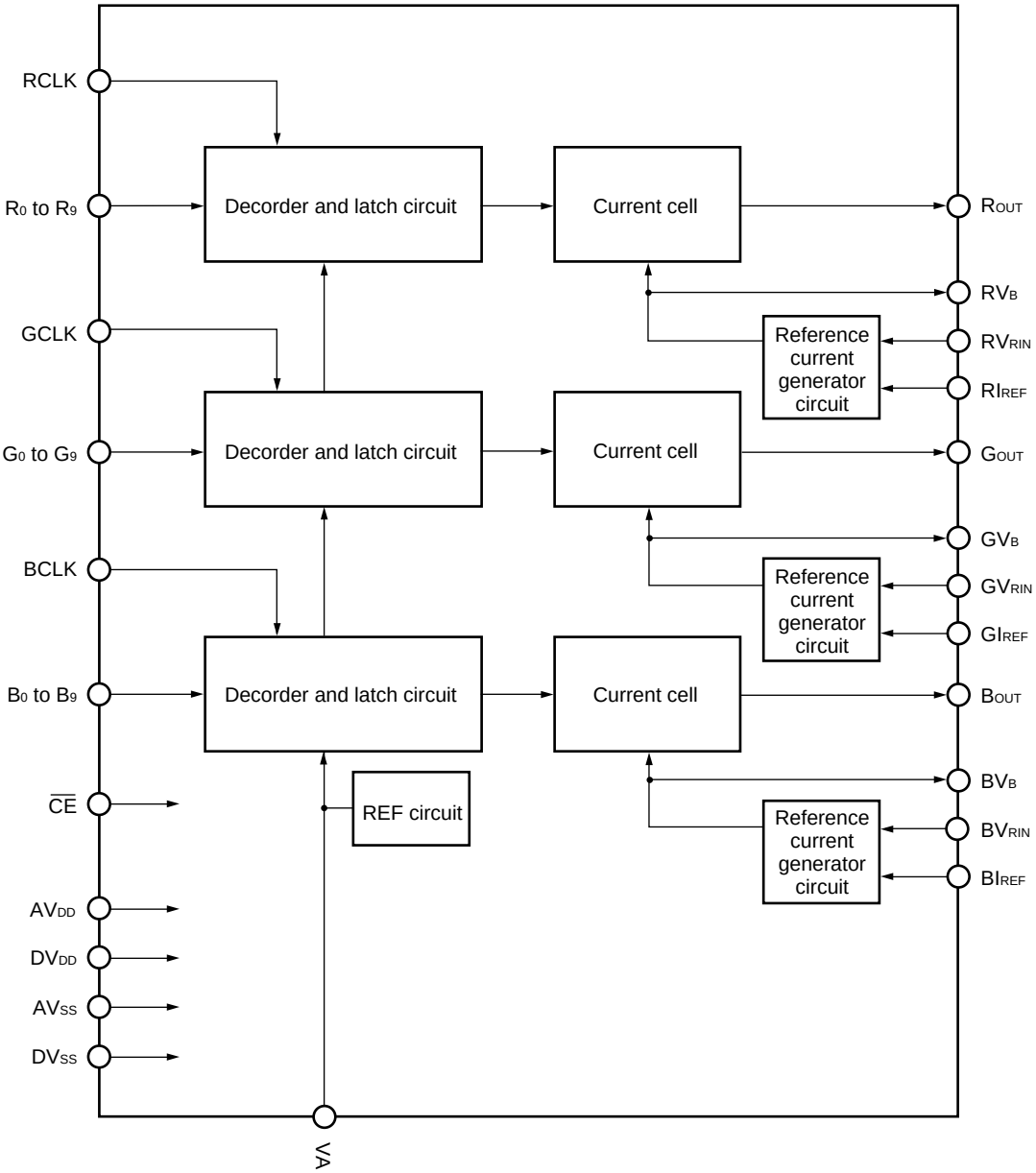


■ PIN DESCRIPTION

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_0 to R_9 G_0 to G_9 B_0 to B_9	I	Data signal incoming terminal for Rch, Gch and Bch LSB: R_0, G_0, B_0 MSB: R_9, G_9,B_9
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_{DD}	—	Digital power supply terminal
54, 60	55, 61	AV_{DD}	—	Analog power supply terminal
40	43	DV_{SS}	—	Digital ground terminal
56, 58	57, 59	AV_{SS}	—	Analog ground terminal
63 51 48	64 52 50	RV_{RIN} GV_{RIN} BV_{RIN}	I	Rererence voltage incoming terminal for Rch, Gch and Bch
64 53 49	1 54 51	RI_{REF} GI_{REF} BI_{REF}	—	Reference resistor connection terminal for Rch, Gch and Bch
41	44	VA	—	Connect >0.1 µF capacitor to the AV_{SS} terminal
1 52 47	2 53 49	RV_B GV_B BV_B	—	Connect >0.1 µF capacitor to the AV_{DD} terminal
59 57 55	60 58 56	R_{OUT} G_{OUT} B_{OUT}	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.

MB40C950V

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Power supply voltage	V_{DD}	–0.3	+7.0	V
Digital input voltage	V_{ID}	–0.3	V_{DD} + 0.3	V
Analog output voltage	V_O	–0.3	V_{DD} + 0.3	V
Analog output current: LQFP64 : QFP64	I_O	0 0	15 30	mA mA
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	Condition	Value			Unit
			Min.	Typ.	Max.	
Analog power supply voltage	AV_{DD}	—	4.75	5.00	5.25	V
Digital power supply voltage	DV_{DD}	—	4.75	5.00	5.25	V
Power supply voltage difference	$AV_{DD} – DV_{DD}$	—	–0.2	—	0.2	V
Reference input voltage	V_{RIN}	—	1.0	2.0	2.2	V
Full-scale current*1	I_{FS}	LQFP64	0	—	15	mA
		QFP64	0	—	30	mA
Full-scale output voltage*2	V_{FS}	IFS ≦ 15 mA	—	2.0	2.3	V
		15 mA < IFS ≦ 30 mA	—	1.0	1.2	V
Digital “H” level input voltage	V_{IHD}	—	2.4	—	DV_{DD}	V
Digital “L” level input voltage	V_{ILD}	—	0	—	0.5	V
Clock frequency	f_{CLK}	—	—	—	85	MHz
Setup time	t_s	—	4	—	—	ns
Hold time	t_h	—	3	—	—	ns
“H” level minimum pulse width	t_{WH}	—	5	—	—	ns
“L” level minimum pulse width	t_{WL}	—	5	—	—	ns
Operating ambient temperature	T_{op}	—	–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 Ω

(AV_{DD} = DV_{DD} = 4.75 V to 5.25 V, V_{RIN} = 2 V, R_{REF} = 3.3 kΩ, R_L = 200 Ω, Ta = –20°C to +75°C)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Resolution	—	—	—	10	—	bit
Linearity error	LE	DC Accuracy	—	—	±1.5	LSB
Differential linearity error	DLE		—	—	±1	LSB
Digital input current	I_{ID}	—	–5	—	5	µA
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	AI_{DD}	—	—	30	35	mA
Digital power supply current	DI_{DD}	—	—	17	24	mA

- R_L = 75 Ω

(AV_{DD} = DV_{DD} = 4.75 V to 5.25 V, V_{RIN} = 2 V, R_{REF} = 2.4 kΩ, R_L = 75 Ω, Ta = –20°C to +75°C)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Resolution	—	—	—	10	—	bit
Linearity error	LE	DC Accuracy	—	—	±1.5	LSB
Differential linearity error	DLE		—	—	±1	LSB
Digital input current	I_{ID}	—	–5	—	5	µA
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	AI_{DD}	—	—	45	50	mA
Digital power supply current	DI_{DD}	—	—	17	24	mA

2. AC Characteristics

- R_L = 200 Ω

  (AV_{DD} = DV_{DD} = 4.75 V to 5.25 V, V_{RIN} = 2 V, R_{REF} = 3.3 kΩ, R_L = 200 Ω, CL = 15 pF, Ta = –20°C to +75°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

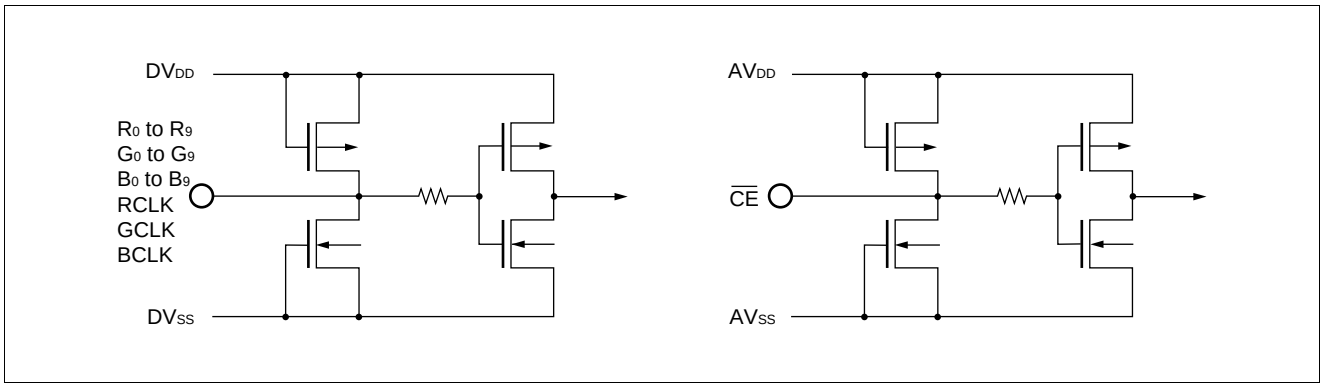
- R_L = 75 Ω

  (AV_{DD} = DV_{DD} = 4.75 V to 5.25 V, V_{RIN} = 2 V, R_{REF} = 2.4 kΩ, R_L = 75 Ω, CL = 15 pF, Ta = –20°C to +75°C)

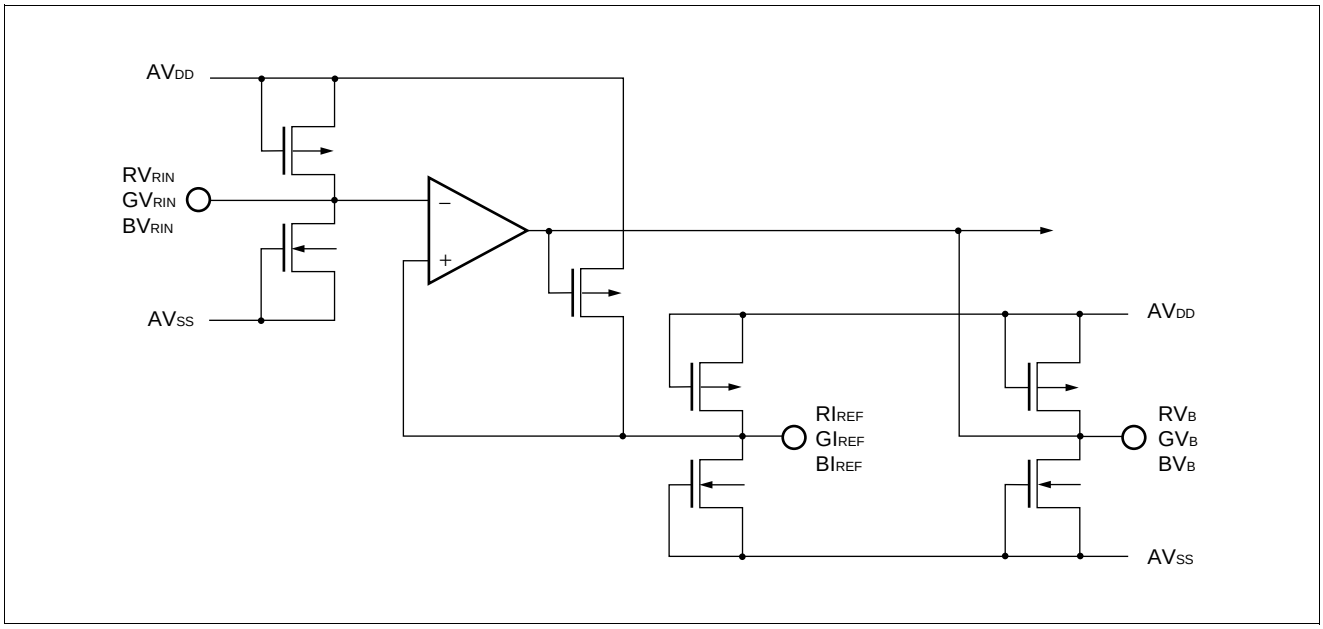
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Maximum conversion rate	f_s	—	85	—	—	MSPS
Output propagation delay time	t_{pd}		—	7	—	ns
Output rising time	t_r		—	2	—	ns
Output falling time	t_f		—	2	—	ns
Settling time	t_{set}		—	7	—	ns

■ EQUIVALENT CIRCUIT

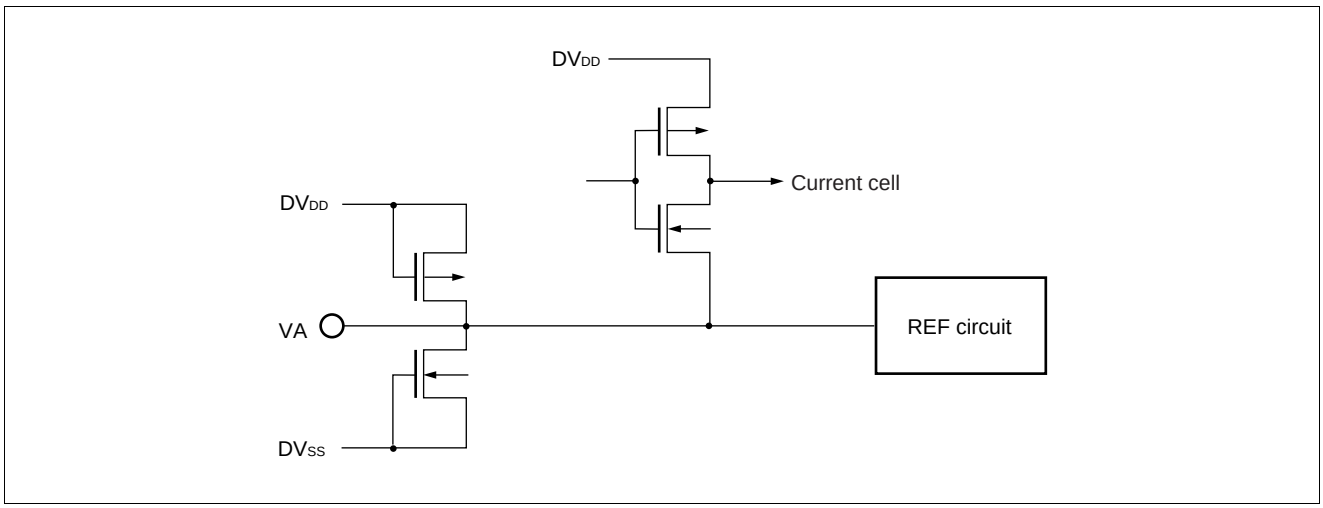
- Digital input



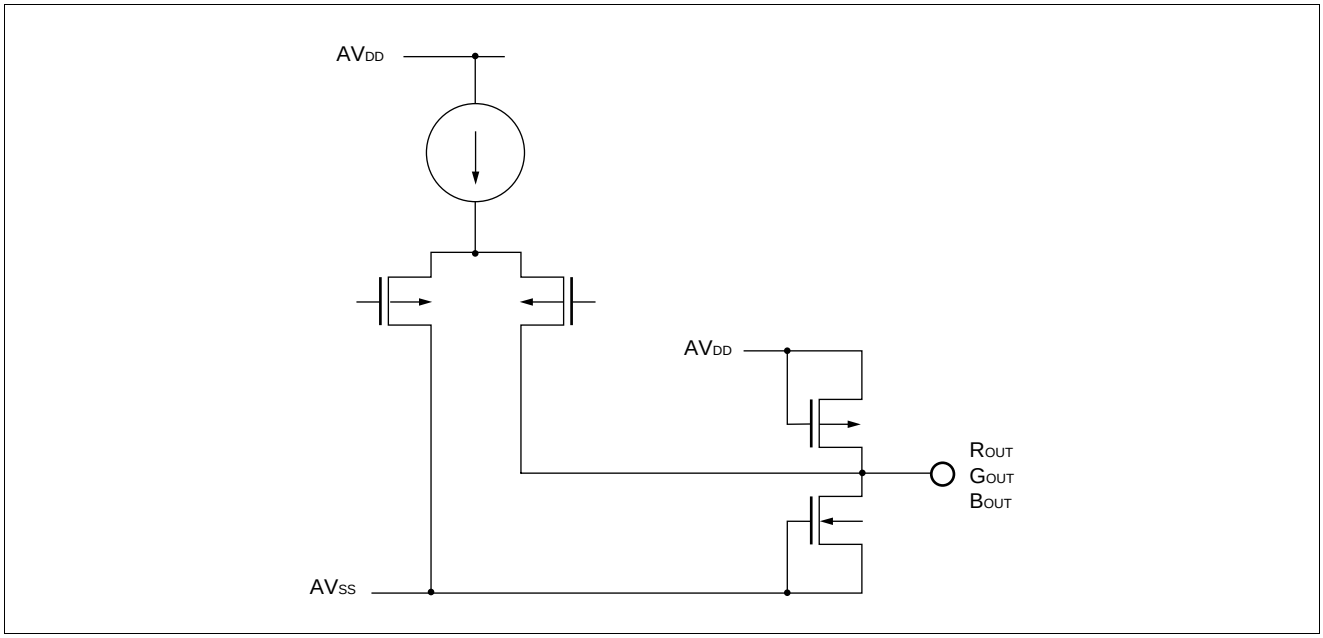
- Reference voltage input



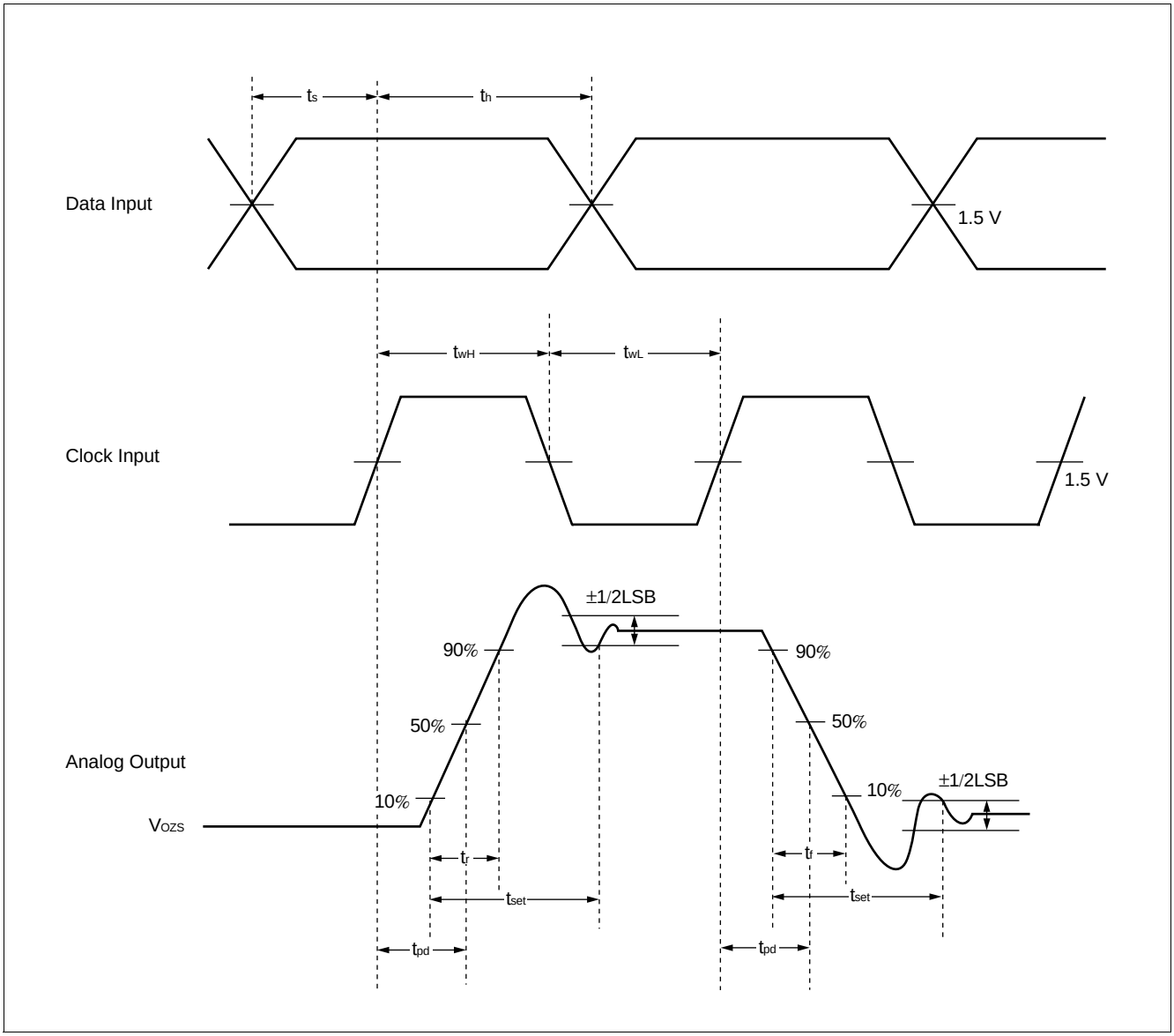
- VA pin



- Analog output

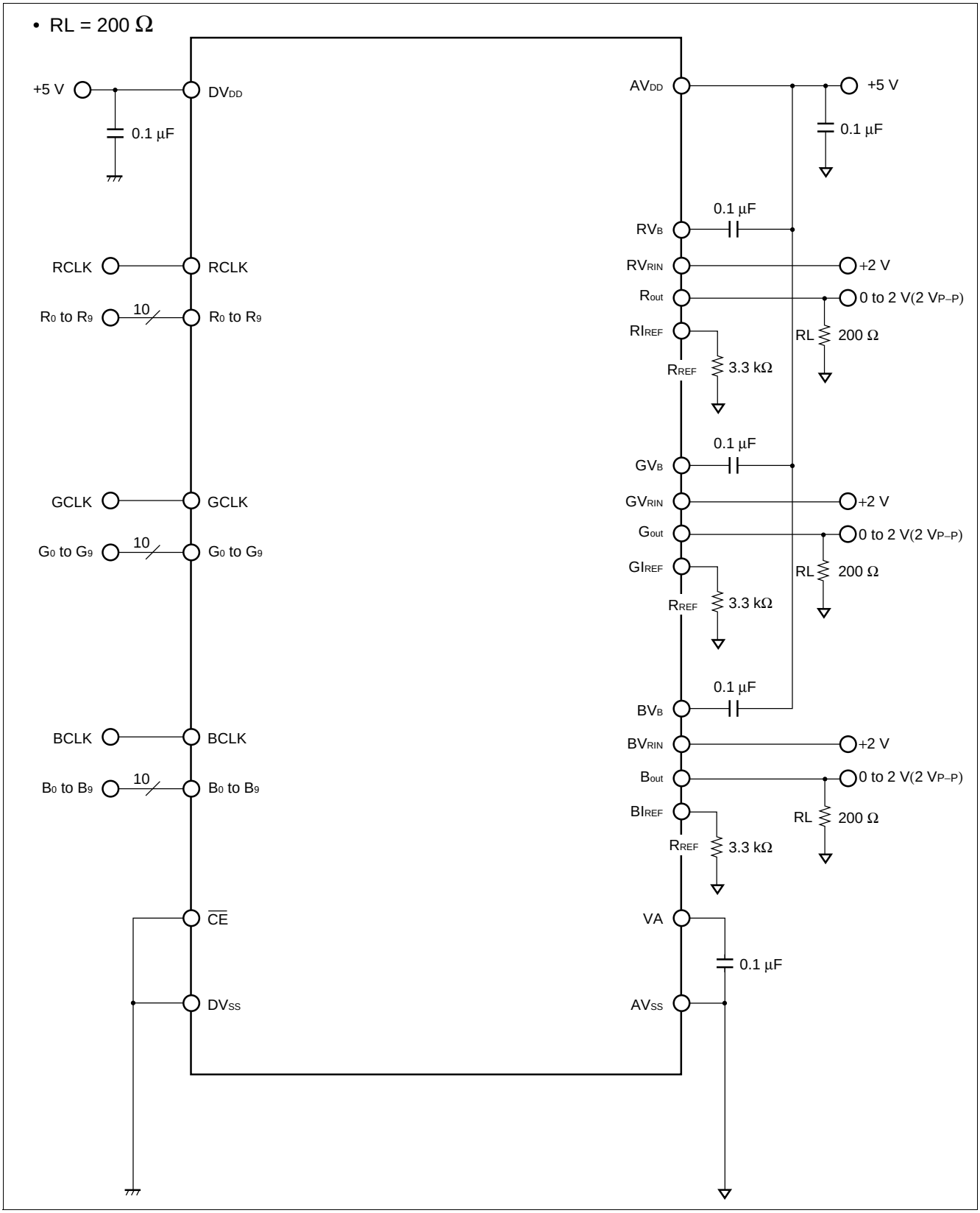


■ TIMING DIAGRAM



MB40C950V

■ TYPICAL APPLICATION



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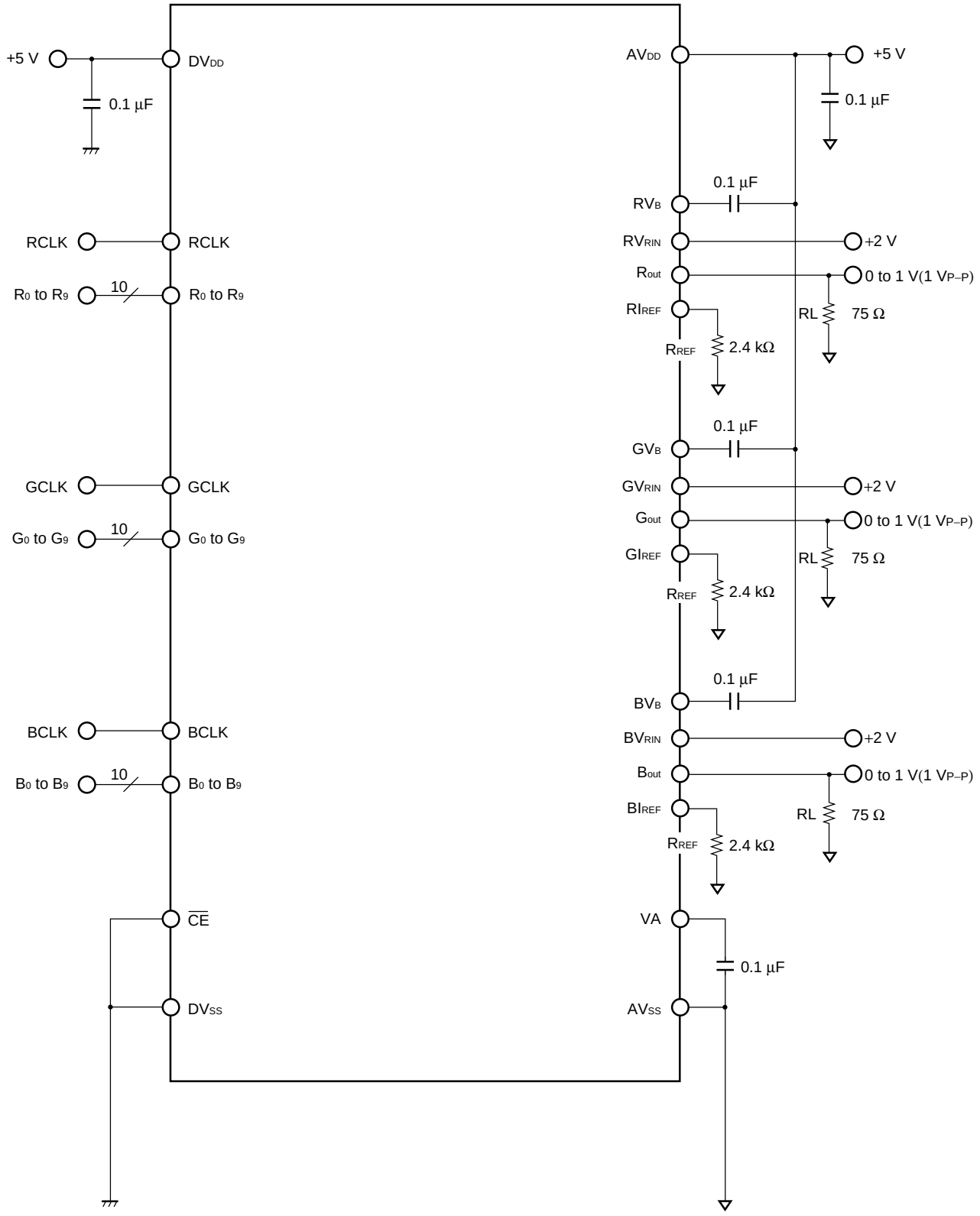
• RL = 75 Ω

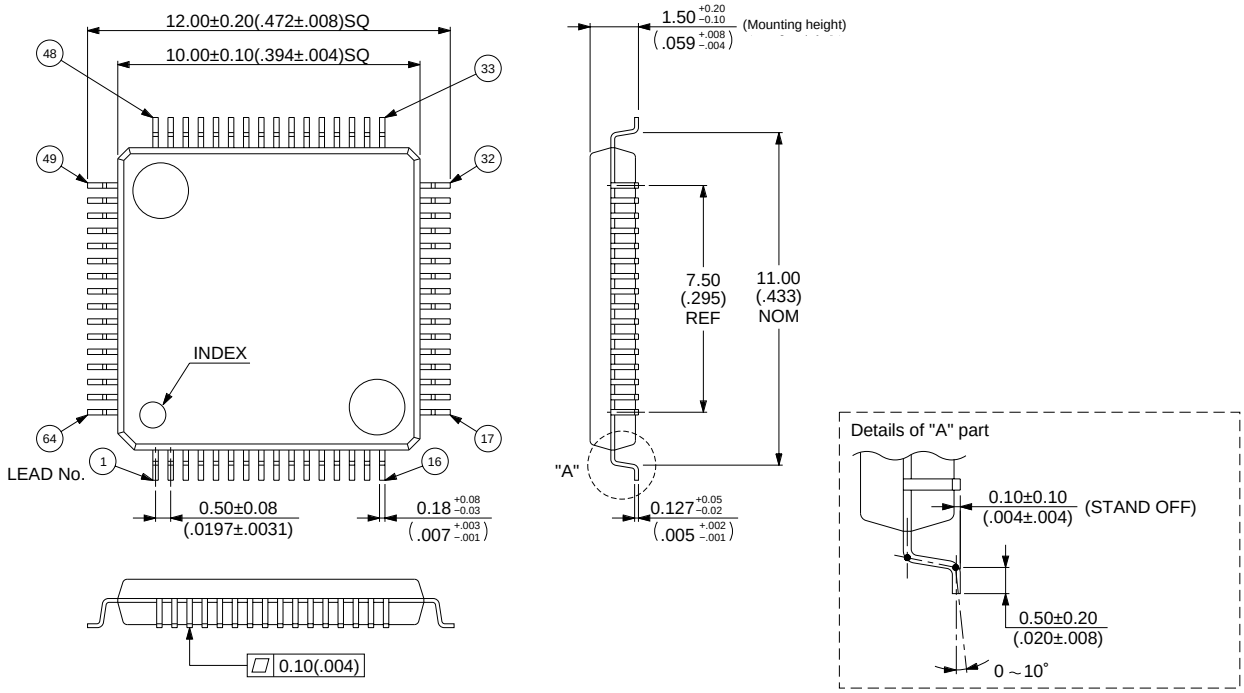


■ ORDERING INFORMATION

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)



Dimensions in mm (inches).

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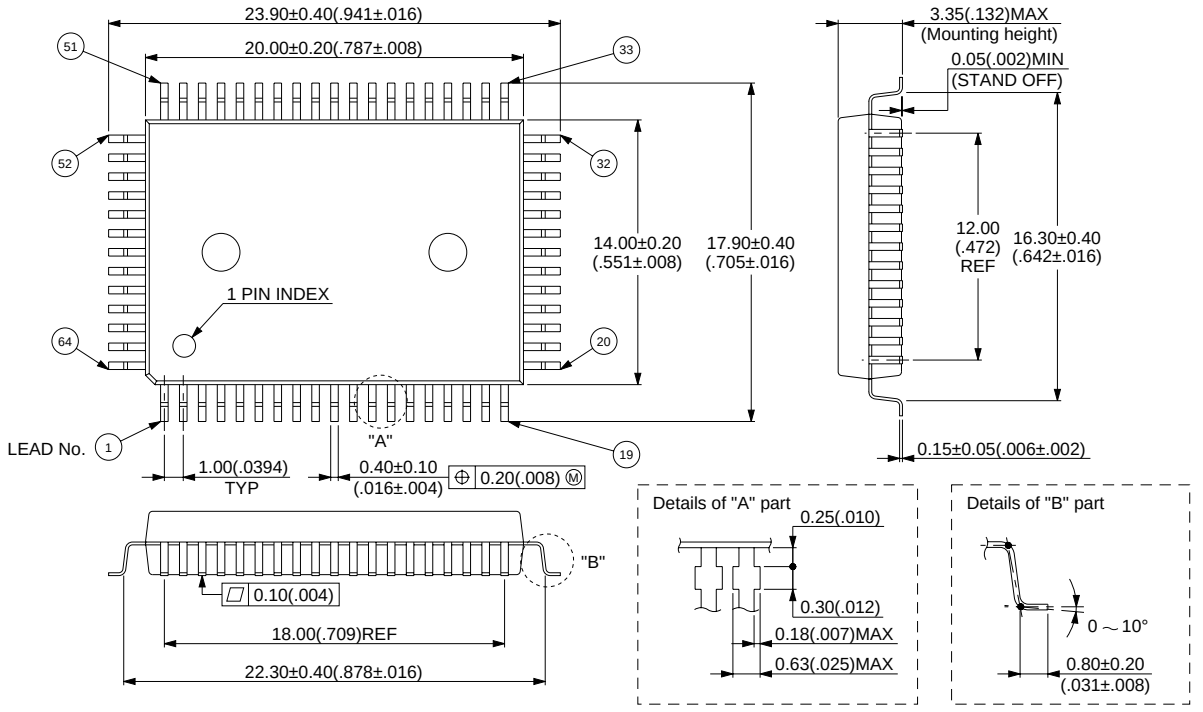
64-pin Plastic QFP
(FPT-64P-M10)



Dimensions in mm (inches)

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