

ASSP

CMOS

# 20 MSPS 3ch 8-bit D/A Converter

## MB40C938V

### ■ DESCRIPTION

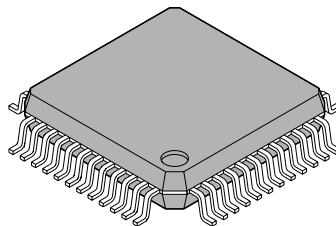
The MB40C938V is a high-speed CMOS process-based D/A converter provided with the three-channel I/O for RGB, allowing for independent control of the three channels.

### ■ FEATURES

- Resolution : 8 bits
- Linearity error :  $\pm 0.5$  LSB (max)
- Differential linearity error :  $\pm 1.0$  LSB (max)
- Maximum conversion rate : 20 MSPS (min)
- Supply voltage : single +3 V
- Digital input voltage range : 3 V CMOS level
- Analog output voltage range : 1 Vp-p (0 to 1V)
- Dissipation power : 40 mW (standard: analog output for  $R_L = 390 \Omega$ , 1 Vp-p output)
- Additional capabilities : Reference voltage generator, power saving function, independent 3-ch  $V_{REF}$
- Package : LQFP48

### ■ PACKAGE

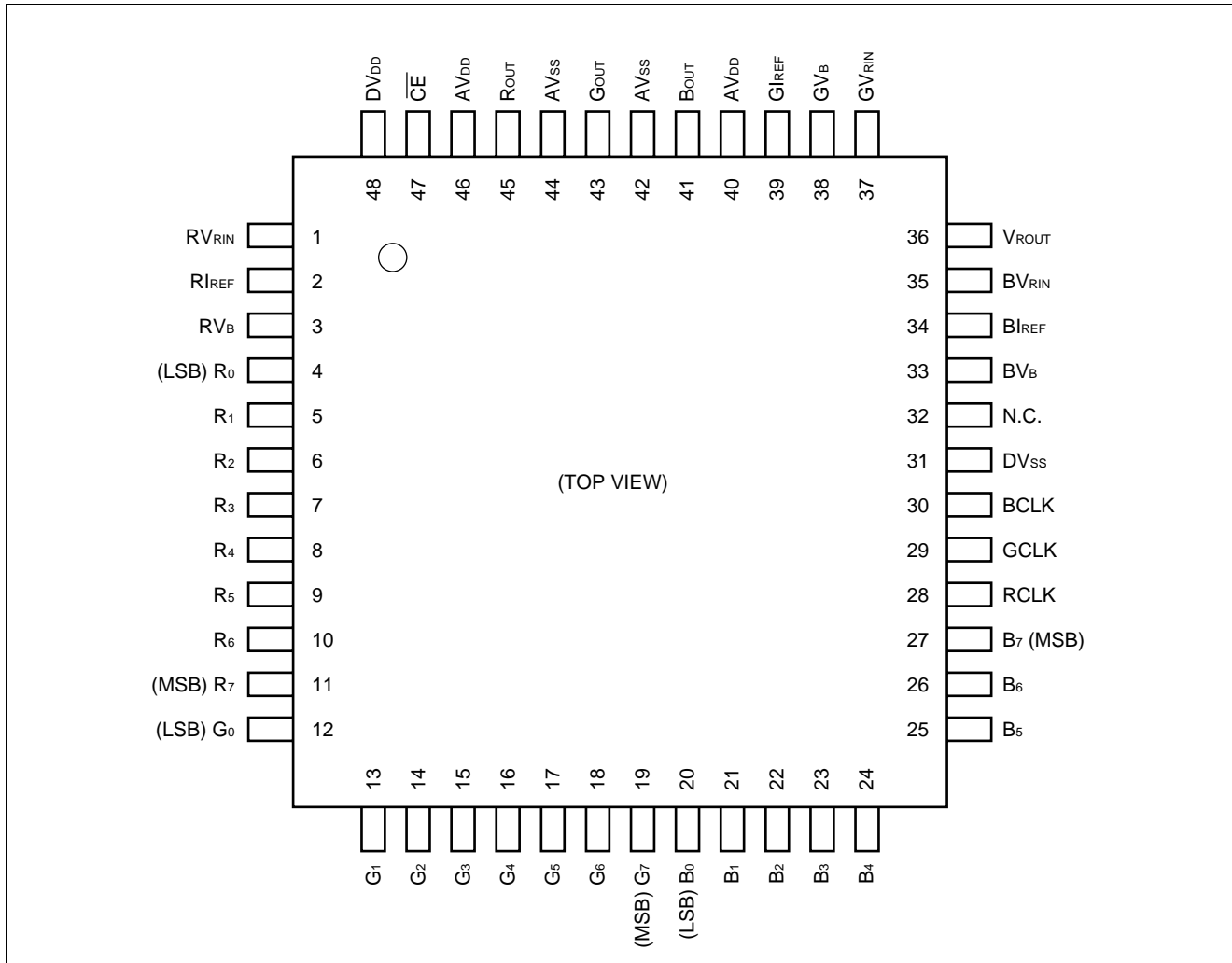
48-pin Plastic LQFP



(FPT-48P-M05)

# MB40C938V

## ■ PIN ASSIGNMENT

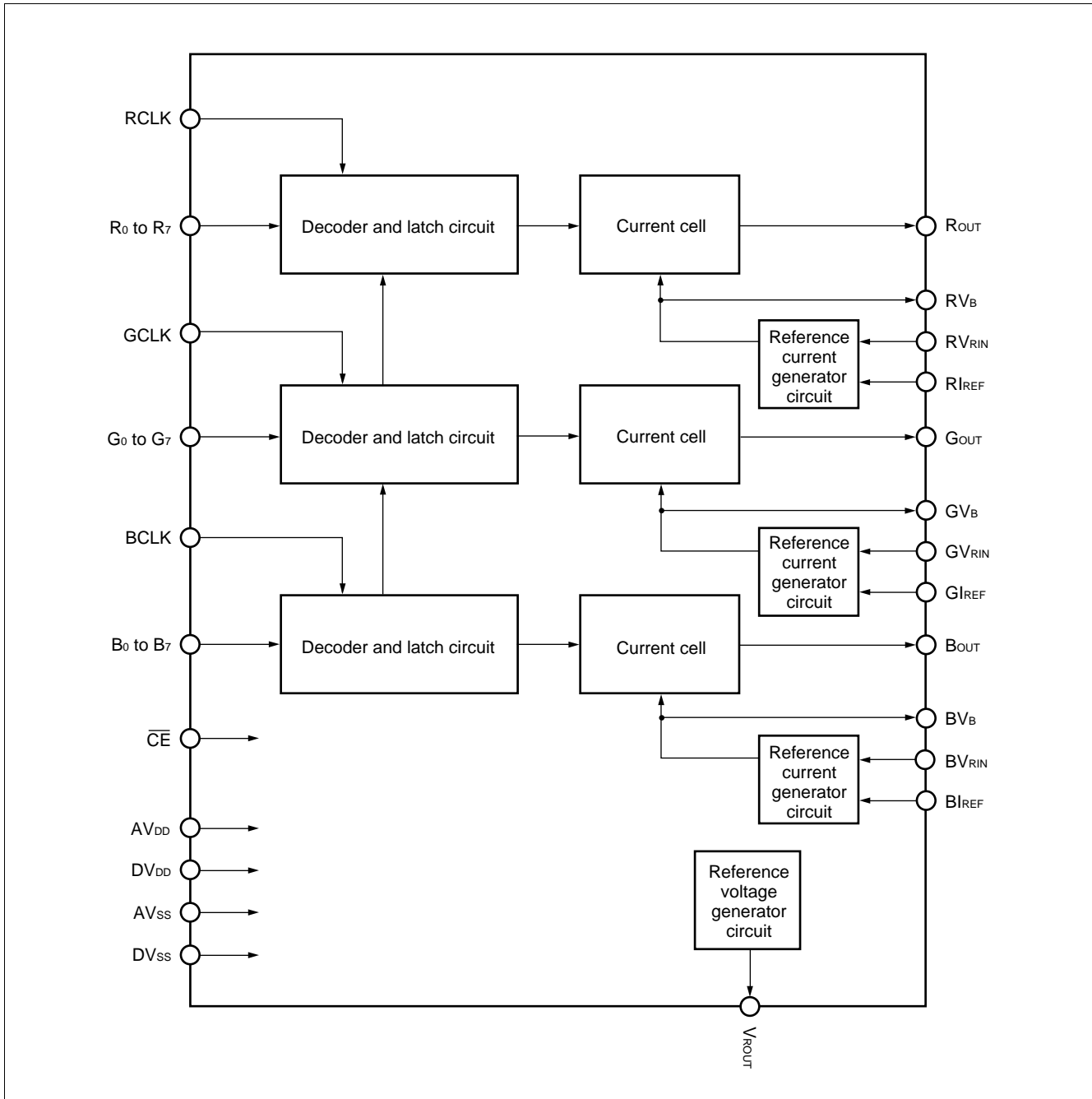


**MB40C938V****■ PIN DESCRIPTION**

Pin No.	Symbol	I/O	Description
4 to 11 12 to 19 20 to 27	R <sub>0</sub> to R <sub>7</sub> G <sub>0</sub> to G <sub>7</sub> B <sub>0</sub> to B <sub>7</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>7</sub> , G <sub>7</sub> , B <sub>7</sub>
28 29 30	RCLK GCLK BCLK	I	Clock signal incoming terminal for Rch, Gch and Bch (3 V CMOS)
47	CE	I	Power saving signal incoming terminal. Power saving enabled for High
48	DV <sub>DD</sub>	—	Digital power supply terminal (standard 3 V)
40, 46	AV <sub>DD</sub>	—	Analog power supply terminal (standard 3 V)
31	DV <sub>SS</sub>	—	Digital ground terminal
42, 44	AV <sub>SS</sub>	—	Analog ground terminal
36	V <sub>ROUT</sub>	O	Reference voltage output terminal (standard: 1.2 V)
1 37 35	RV <sub>RIN</sub> GV <sub>RIN</sub> BV <sub>RIN</sub>	I	Reference voltage incoming terminal for Rch, Gch and Bch (standard: 1.2 V)
2 39 34	RI <sub>REF</sub> GI <sub>REF</sub> BI <sub>REF</sub>	—	Reference resistor connection terminal for Rch, Gch and Bch
3 38 33	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
45 43 41	R <sub>OUT</sub> G <sub>OUT</sub> B <sub>OUT</sub>	O	Analog signal output terminals for Rch, Gch and Bch
32	N.C.	—	Not connected. To be left open.

# MB40C938V

## ■ BLOCK DIAGRAM



# MB40C938V

## ■ 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	I <sub>O</sub>	0	12	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	Value			Unit
		Min.	Typ.	Max.	
Analog power supply voltage	AV <sub>DD</sub>	2.7	3.0	3.6	V
Digital power supply voltage	DV <sub>DD</sub>	2.7	3.0	3.6	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	1.2	1.5	V
Full-scale current*1	I <sub>FS</sub>	0	—	12	mA
Full-scale output voltage*2	V <sub>FS</sub>	—	1.0	1.3	V
Digital “H” level input voltage	V <sub>IHD</sub>	DV <sub>DD</sub> -0.4	—	DV <sub>DD</sub>	V
Digital “L” level input voltage	V <sub>ILD</sub>	0	—	0.5	V
Clock frequency	f <sub>CLK</sub>	—	—	20	MHz
Setup time	t <sub>s</sub>	10	—	—	ns
Hold time	t <sub>h</sub>	5	—	—	ns
“H” level minimum pulse width	t <sub>WH</sub>	20	—	—	ns
“L” level minimum pulse width	t <sub>WL</sub>	20	—	—	ns
Operating ambient temperature	T <sub>op</sub>	-20	—	85	°C

\*1:  $I_{FS} = V_{RIN}/R_{REF} \times 15.9$

\*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.

# MB40C938V

## ■ ELECTRICAL CHARACTERISTICS

### 1. DC Characteristics

( $A_{VDD} = DV_{DD} = 2.7\text{ V to }3.3\text{ V}$ ,  $V_{RIN} = 1.2\text{ V}$ ,  $R_{REF} = 7.5\text{ k}\Omega$ ,  $R_L = 390\ \Omega$ ,  $T_a = -20^\circ\text{C to }+85^\circ\text{C}$ )

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Resolution	—	—	—	8	—	bit
Linearity error	LE	DC Accuracy	—	—	$\pm 0.5$	LSB
Differential linearity error	DLE		—	—	$\pm 0.1$	LSB
Digital input current	$I_{ID}$	—	-5	—	5	$\mu\text{A}$
Reference output voltage	$V_{ROUT}$	$A_{VDD} = DV_{DD} = 3.0\text{ V}$	1.15	1.20	1.25	V
Full-scale output voltage	$V_{OFS}$	—	0.925	0.995	1.065	V
Zero-scale output voltage	$V_{OZS}$	—	0	—	15	mV
Analog power supply current	$I_{DD}$	—	—	9	12	mA
Digital power supply current	$I_{DD}$	—	—	4	8	mA

### 2. AC Characteristics

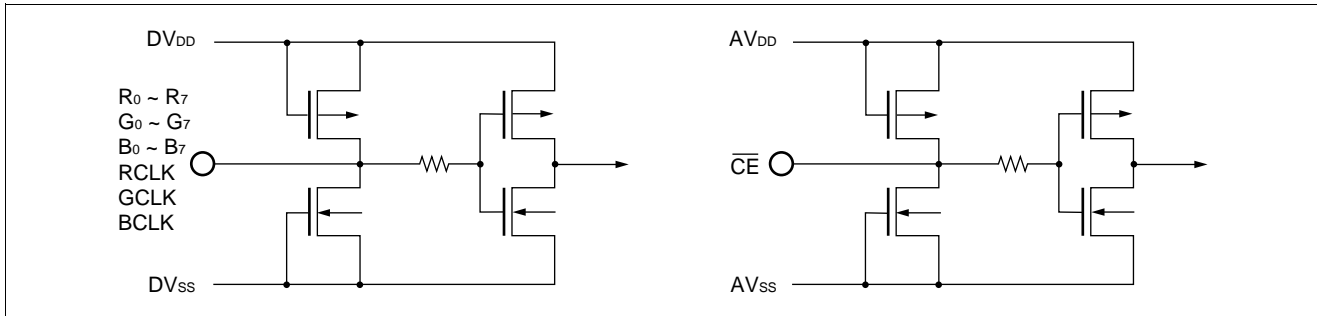
( $A_{VDD} = DV_{DD} = 2.7\text{ V to }3.3\text{ V}$ ,  $V_{RIN} = 1.2\text{ V}$ ,  $R_{REF} = 7.5\text{ k}\Omega$ ,  $R_L = 390\ \Omega$ ,  $C_L = 15\text{ pF}$ ,  $T_a = -20^\circ\text{C to }+85^\circ\text{C}$ )

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Maximum conversion rate	$f_s$	—	20	—	—	MSPS
Output propagation delay time	$t_{pd}$		—	15	—	ns
Output rising time	$t_r$		—	24	—	ns
Output falling time	$t_f$		—	24	—	ns

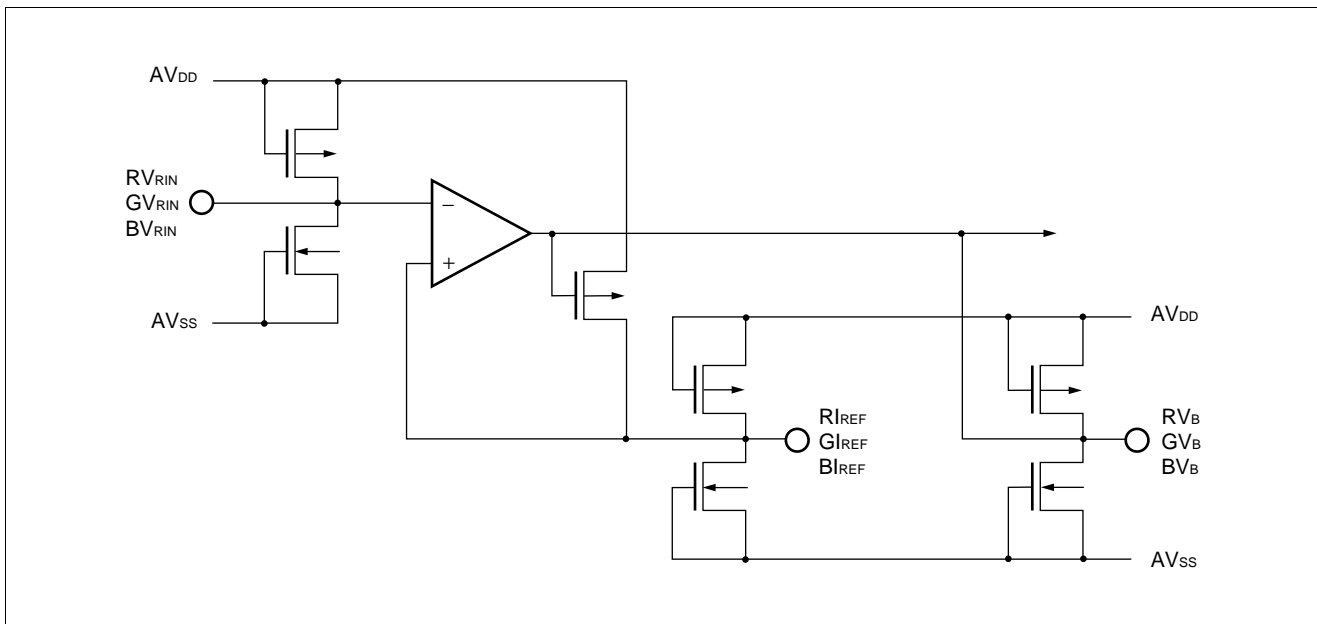
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## ■ EQUIVALENT CIRCUIT

- Digital input

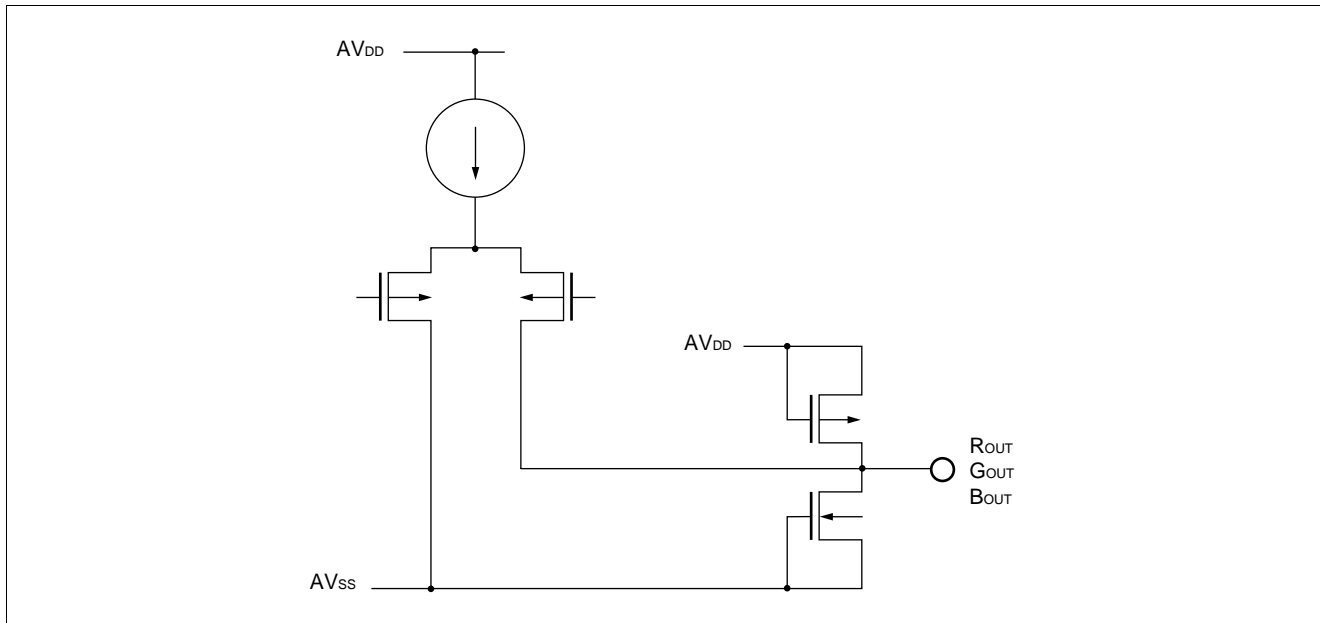


- Reference voltage input

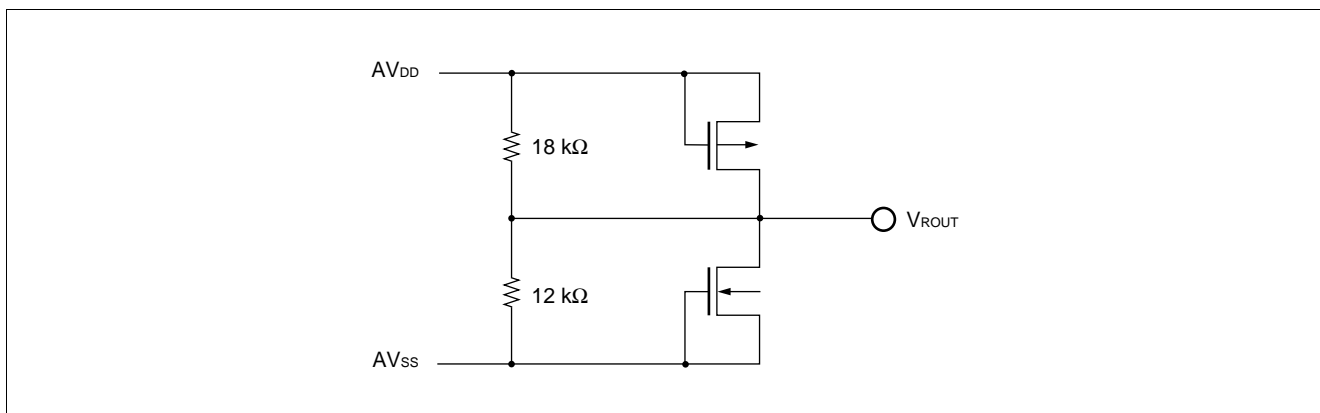


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- Analog output



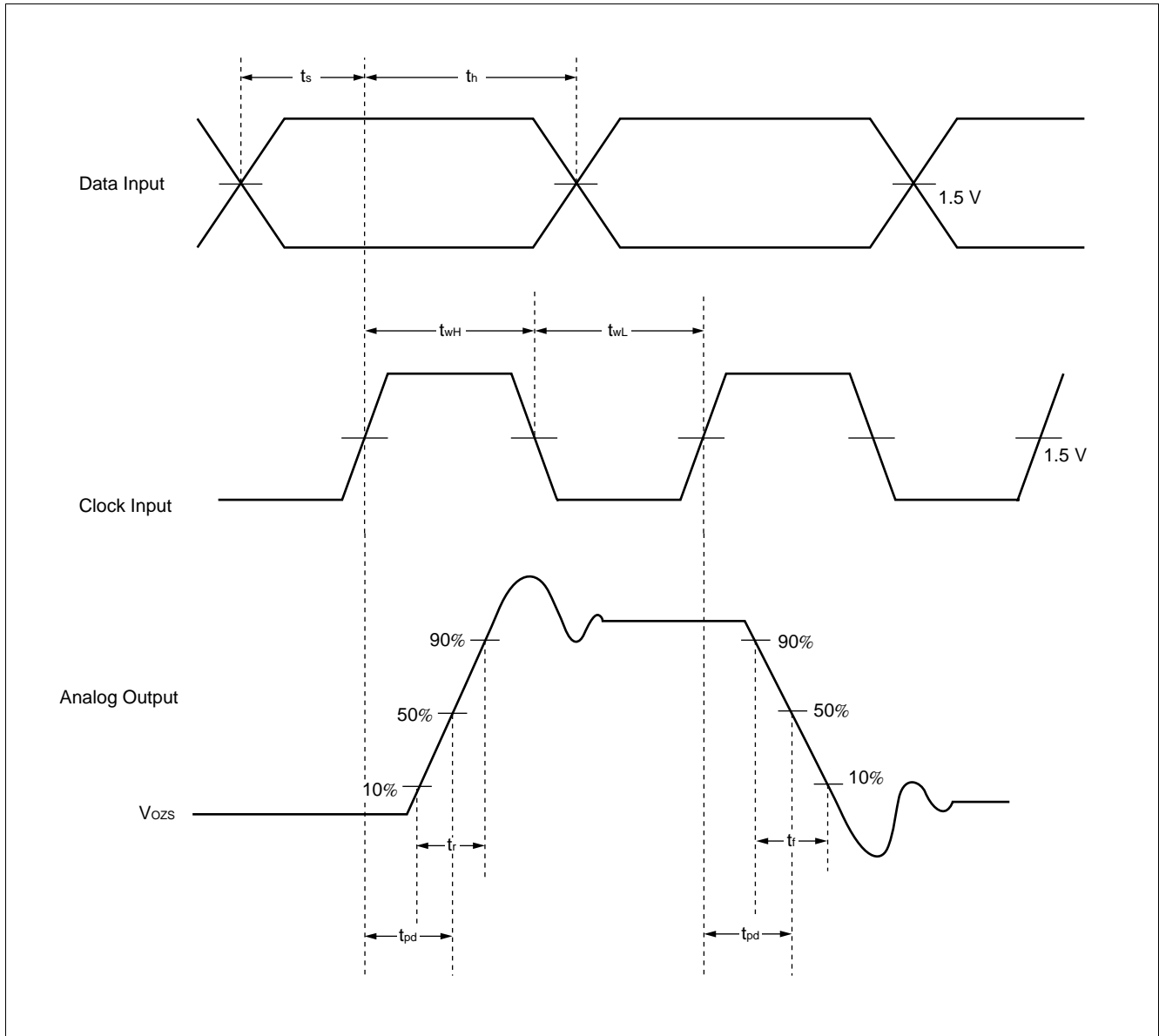
- Reference voltage output





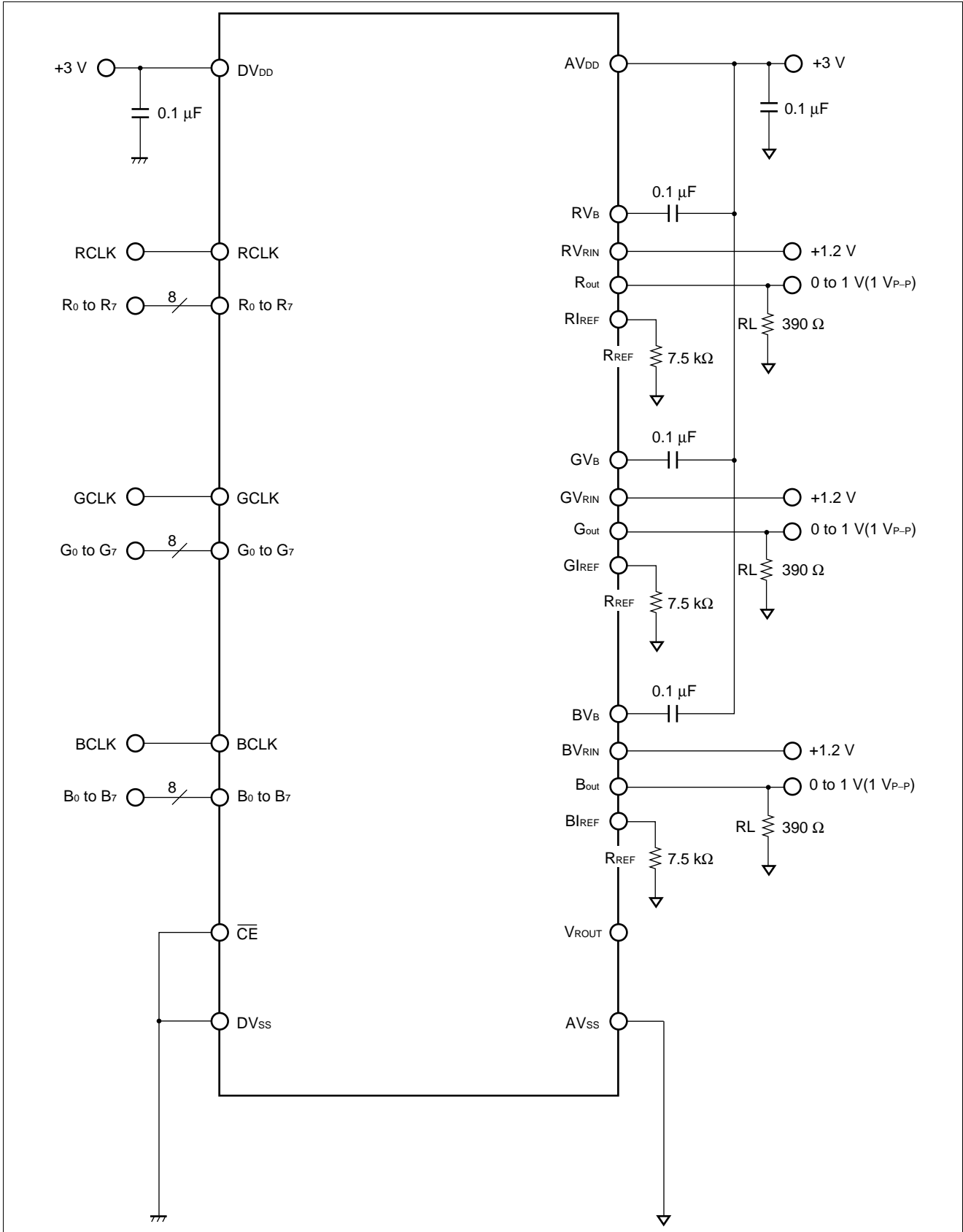
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## ■ TIMING DIAGRAM



# MB40C938V

## ■ TYPICAL APPLICATION



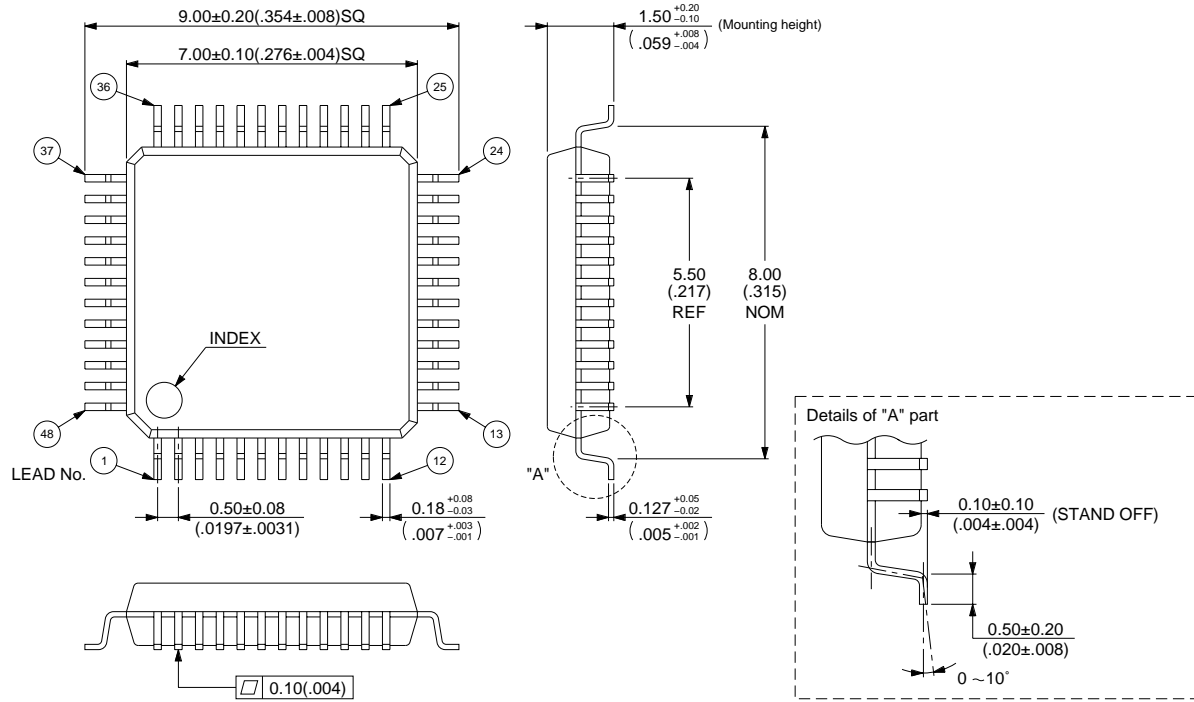
**MB40C938V****■ ORDERING INFORMATION**

Part number	Package	Remarks
MB40C938VPFV	48-pin Plastic LQFP (FPT-48P-M05)	

# MB40C938V

## ■ PACKAGE DIMENSION

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



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Dimensions in mm (inches).

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