FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-28313-1E

ASSP Image Processing

BIPOLAR

D/A Converter (1-ch, 8-bit, 60 MSPS)

MB40768H

■ DESCRIPTION

The MB40768H is a low-power and high-speed 8-bit D/A converter.

The digital input is TTL compatible and the analog output voltage is 3 to 5 V. Maximum conversion speed is 60 MHz. The internal reference voltage provided has two types of resistor division scheme and band-gap reference scheme; the external reference voltage may also be used.

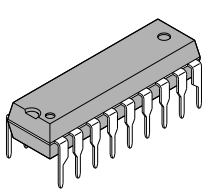
The MB40768H is suitable for high-definition TV or VCR application.

■ FEATURES

- Resolution: 8 bits
- Conversion characteristics: Maximum conversion rate: 60 MSPS [min.]
  Linearity error: ±0.2 % [max.]
- I/O: Digital input voltage: TTL level
  Analog output voltage: $2V_{P-P}$ (3 to 5 V)
- Reference voltage: V_{ROUT1}: Resistor division circuit ($0.6 \times V_{CCA}$)
  V_{ROUT2}: Band-gap reference circuit ($V_{CCA} - 2$ V)
- Power supply voltage: +5 V single power supply
- Power consumption: 160 mW [typical value for the analog output voltage of 2 V_{P-P}]
  120 mW [typical value for the analog output voltage of 1 V_{P-P}]

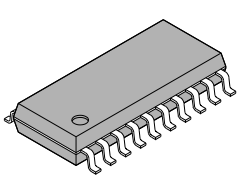
■ PACKAGES

18-pin Plastic DIP



(DIP-18P-M02)

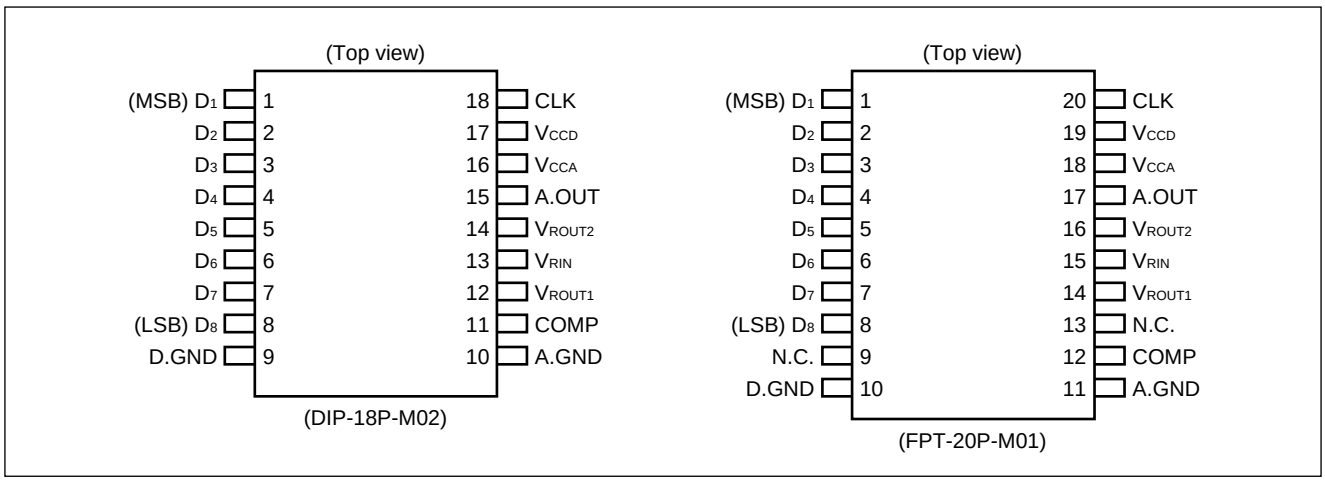
20-pin Plastic SOP



(FPT-20P-M01)

MB40768H

■ PIN ASSIGNMENTS

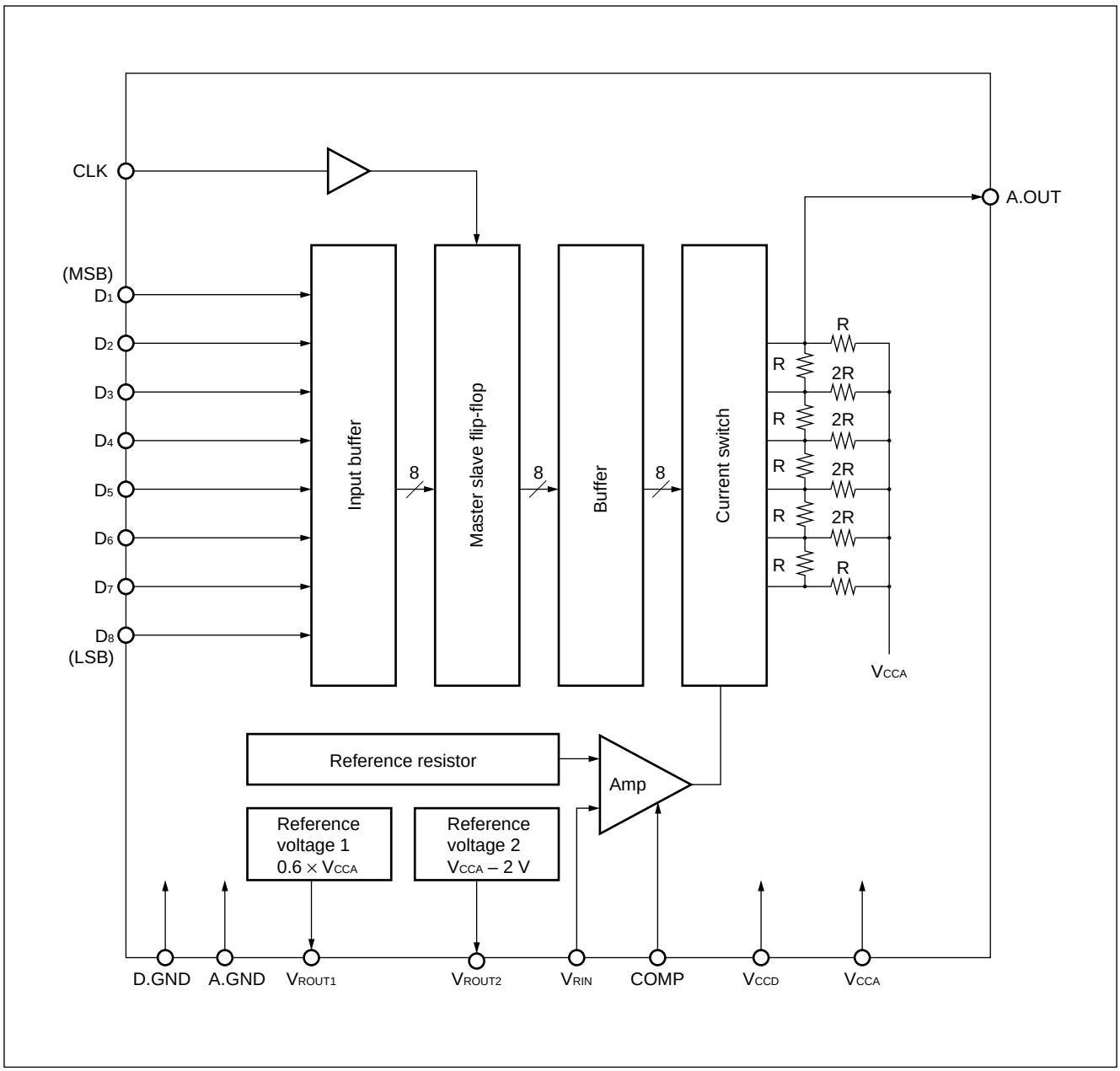


■ PIN DESCRIPTIONS

Pin No.		Pin name	I/O	Description
DIP	SOP			
1 to 8	1 to 8	D_1 to D_8	I	Input pins for data signals (D_1: MSB, D_8: LSB)
18	20	CLK	I	Input pin for clock signal
17	19	V_{CCD}	—	Digital power supply pin (+5 V)
16	18	V_{CCA}	—	Analog power supply pin (+5 V)
9	10	D.GND	—	Digital ground pin (0 V)
10	11	A.GND	—	Analog ground pin (0 V)
13	15	V_{RIN}	I	Reference voltage input pin. Used for setting dynamic range for analog output. Connect this pin with either V_{ROUT1} or V_{ROUT2} pin when using the internal reference voltage. When using the external reference voltage, use it within the range of 2.65 to 4.3 V or for the $V_{CCA} – V_{RIN}$ range of 0.7 to 2.2 V.
12	14	V_{ROUT1}	O	Reference voltage output pin 1. Resistance division reference voltage, with its output voltage set to $0.6 \times V_{CCA}$. This pin, if connected with the V_{RIN} pin, provides V_{CCA} analog output voltage at $0.6 \times V_{CCA}$.
14	16	V_{ROUT2}	O	Reference voltage output pin 2. Band-gap reference voltage, with its output voltage set to $V_{CCA} – 2$ [V]. This pin, if connected with the V_{RIN} pin, provides the V_{CCA} analog output voltage at V_{CCA} 1 – 2 [V].
11	12	COMP	—	Phase compensated capacitance pin. Insert the capacitance of 0.1 µF or more between this pin and the A.GND for the phase compensated capacitance.
15	17	A.OUT	O	Analog signal output pin
—	9, 13	N.C.	—	No connection pins

MB40768H

■ BLOCK DIAGRAM



MB40768H

■ ABSOLUTE MAXIMUM RATINGS (See WARNING)

(A.GND = D.GND = 0 V)

Parameter		Symbol	Rating	Units
Power supply voltage	Analog power supply voltage	V_{CCA}	–0.5 to +7.0	V
	Digital power supply voltage	V_{CCD}	–0.5 to +7.0	V
	Power supply voltage difference	$V_{CCD} – V_{CCA}$	1.5	V
Digital signal input voltage		V_{ID}	–0.5 to +7.0	V
Storage temperature		Tstg	–55 to +125	°C

WARNING: Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

■ RECOMMENDED OPERATING CONDITIONS

(A.GND = D.GND = 0 V)

Parameter		Symbol	Value			Units
			Min.	Typ.	Max.	
Power supply voltage	Analog power supply voltage	V_{CCA}	4.75	5.00	5.25	V
	Digital power supply voltage	V_{CCD}	4.75	5.00	5.25	V
	Power supply voltage difference	$V_{CCA} – V_{CCD}$	–0.2	—	0.2	V
Analog reference voltage		$V_{CCA} – V_{RIN}$	0.70	2.00	2.20	V
		V_{RIN}	2.65	3.00	4.30	V
Digital High level input voltage		V_{IHD}	2.0	—	—	V
Digital Low level input voltage		V_{ILD}	—	—	0.8	V
Clock frequency		f_{CLK}	—	—	60	MHz
Setup time		t_{su}	8	—	—	ns
Hold time		t_h	2	—	—	ns
High level minimum pulse width		t_{wH}	6.5	—	—	ns
Low level minimum pulse width		t_{wL}	6.5	—	—	ns
Phase compensated capacitance		C_{COMP}	0.1	—	—	µF
Operating ambient temperature		Top	–20	—	+75	°C

■ ELECTRIC CHARACTERISTICS

1. DC Characteristics

(V_{CCA} = V_{CCD} = 4.75 V to 5.25 V, A.GND = D.GND = 0 V, Ta = –20°C to +75°C)

Parameter		Symbol	Condition	Value			Units
				Min.	Typ.	Max.	
Resolution		—	—	—	—	8	bit
Linearity error		LE	DC precision	—	—	±0.2	%
Digital High level input current		I_{IHD}	V_{IHD} = 2.7 V	—	—	20	µA
Digital Low level input current		I_{ILD}	V_{ILD} = 0.4 V	–100	—	—	µA
Reference input current		I_{RIN}	V_{RIN} = 3.000 V	—	—	10	µA
Resistance division method	Reference voltage	V_{ROUT1}	V_{CCA} = 5.00 V V_{CCD} = 5.00 V	2.900	3.000	3.100	V
Band-gap reference method	Reference voltage	V_{ROUT2}	—	V_{CCA} – 2.100	V_{CCA} – 2.000	V_{CCA} – 1.900	V
	Temperature coefficient	—	—	—	100	—	ppm/°C
Full-scale output voltage		V_{OFS}	—	V_{CCA} – 20	V_{CCA}	—	mV
Zero-scale output voltage		V_{OZS}	V_{CCA} = 5.00 V V_{CCD} = 5.00 V V_{RIN} = 3.000 V	2.938	3.008	3.078	V
Output resistance		R_O	Ta = +25°C	192	240	288	Ω
Current consumption		I_{CC}	V_{CCA} = 5.25 V V_{CCD} = 5.25 V V_{RIN} = V_{ROUT1}	—	32*	56	mA

* : V_{CCA} = V_{CCD} = 5 V

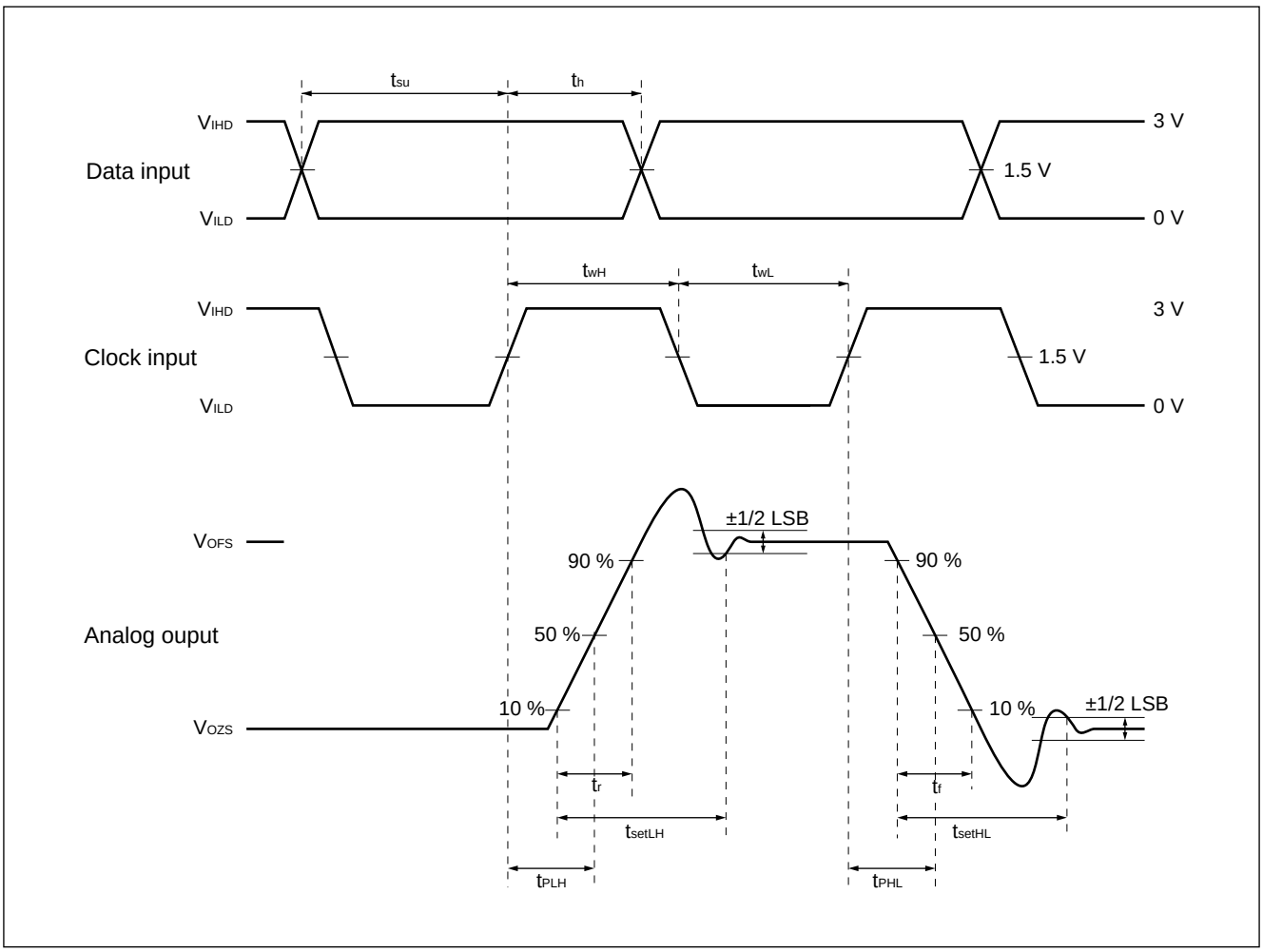
2. AC Characteristics

(V_{CCA} = V_{CCD} = 4.75 V to 5.25 V, A.GND = D.GND = 0 V, Ta = –20°C to +75°C)

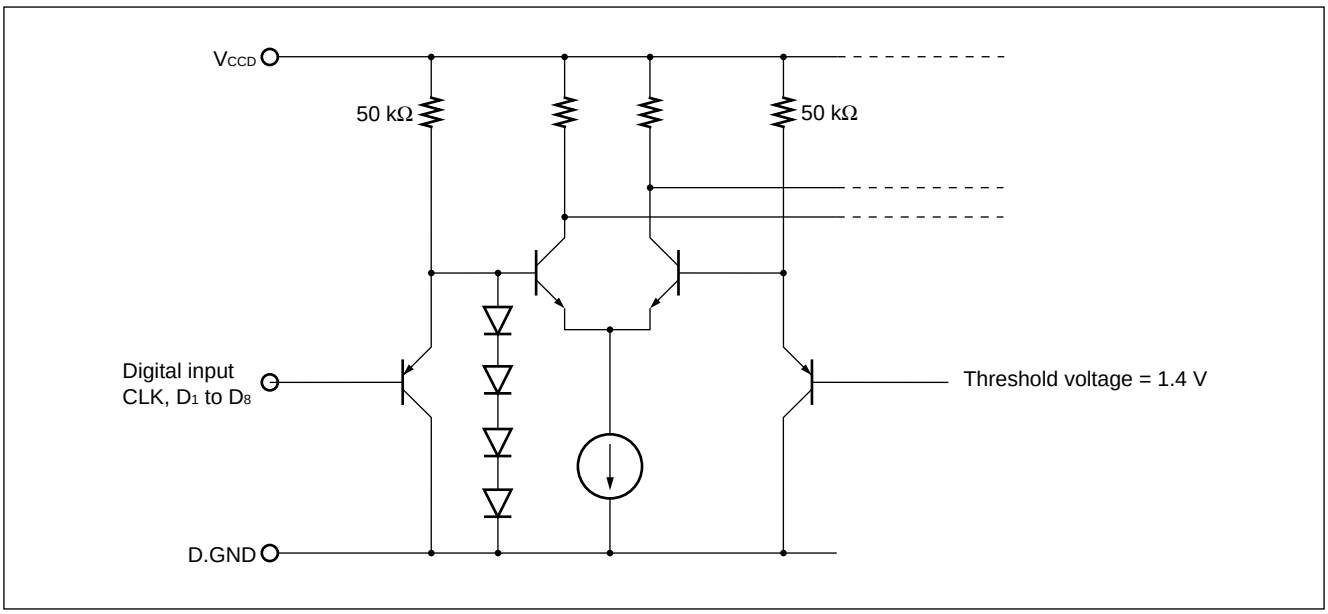
Parameter	Symbol	Condition	Value			Units
			Min.	Typ.	Max.	
Maximum conversion rate	F_s	C_L = 15 pF Terminal resistance at A.OUT pin = 240 Ω	60	—	—	MSPS
Output propagation time	t_{pd}		—	7	—	ns
Output rise time	t_r		—	5	—	ns
Output fall time	t_f		—	5	—	ns
Settling time	t_{set}		—	15	—	ns

MB40768H

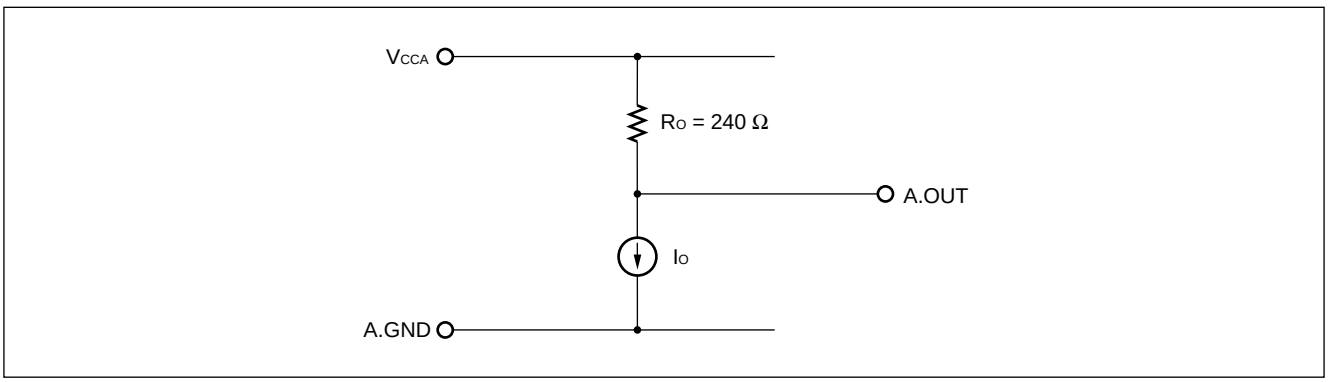
■ TIMING DIAGRAM



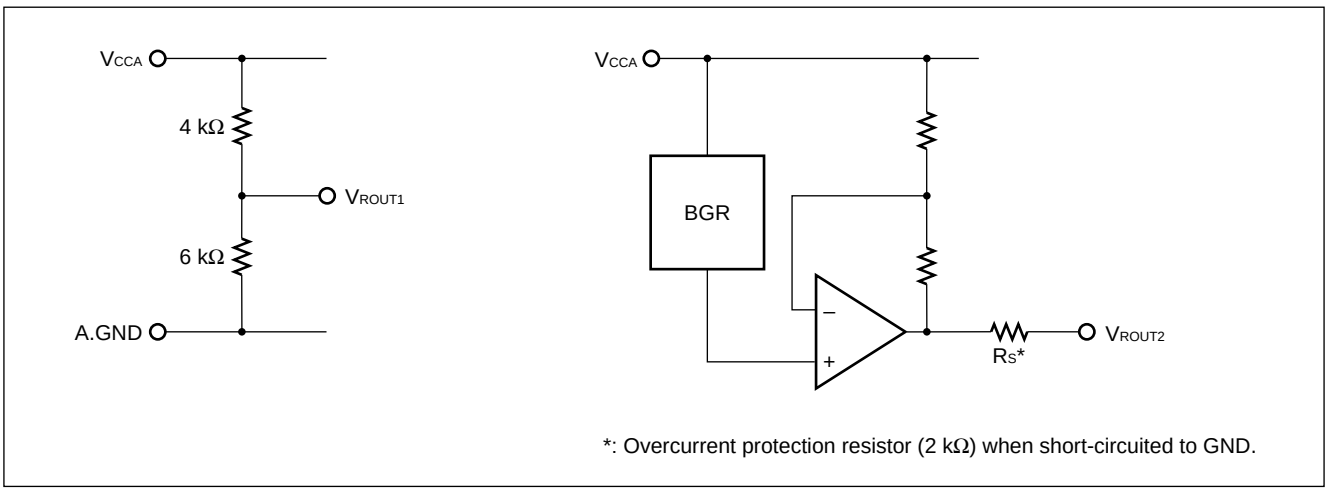
■ DIGITAL INPUT EQUIVALENT CIRCUIT



■ ANALOG OUTPUT EQUIVALENT CIRCUIT



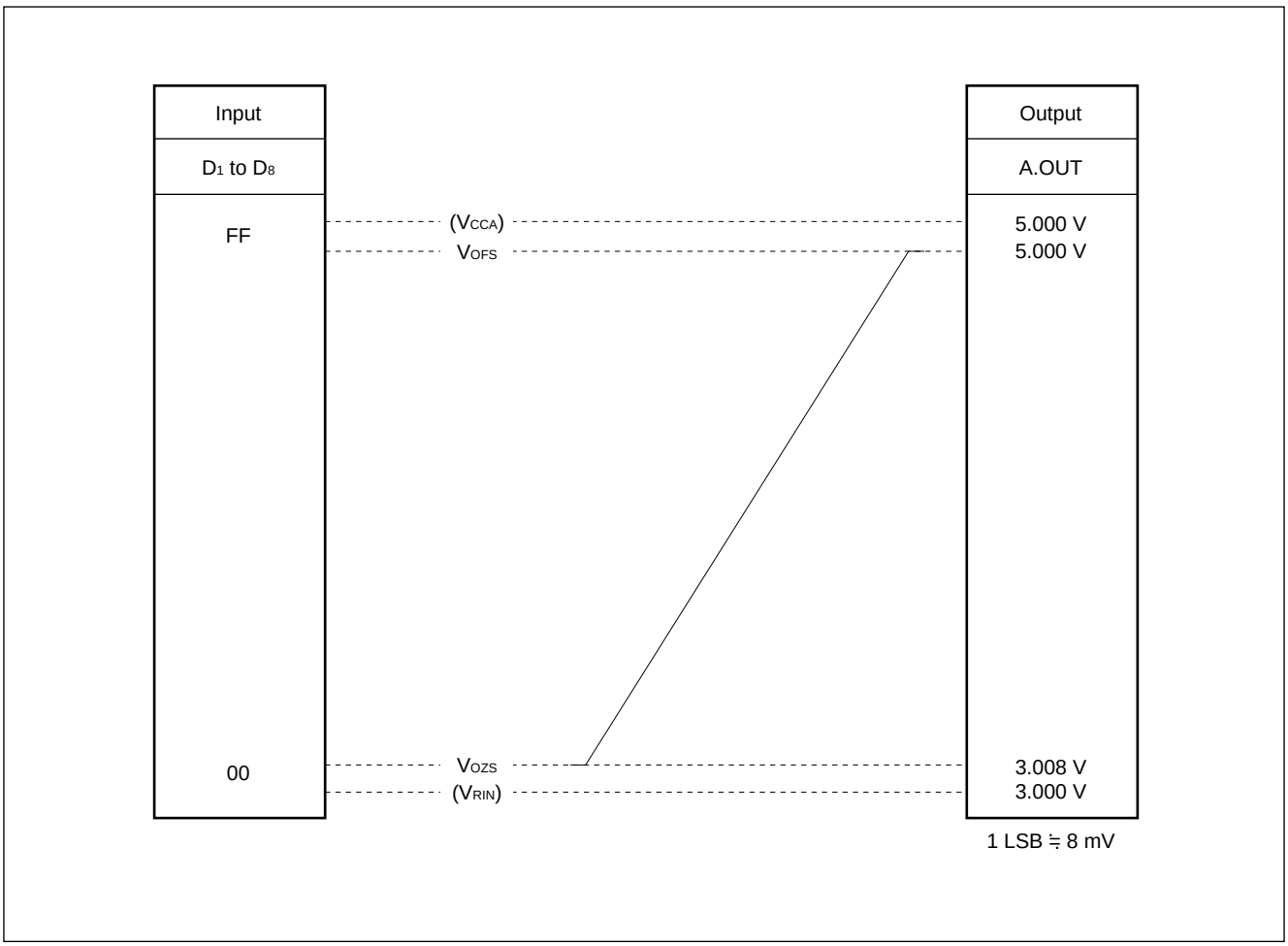
■ REFERENCE VOLTAGE OUTPUT EQUIVALENT CIRCUIT



*: Overcurrent protection resistor (2 kΩ) when short-circuited to GND.

MB40768H

■ DAC OUTPUT VOLTAGE CHARACTERISTIC



■ EQUATION FOR IDEAL DAC OUTPUT VOLTAGE

$$A.OUT = V_{CCA} - \frac{255 - N}{256} \times (V_{CCA} - V_{RIN})$$

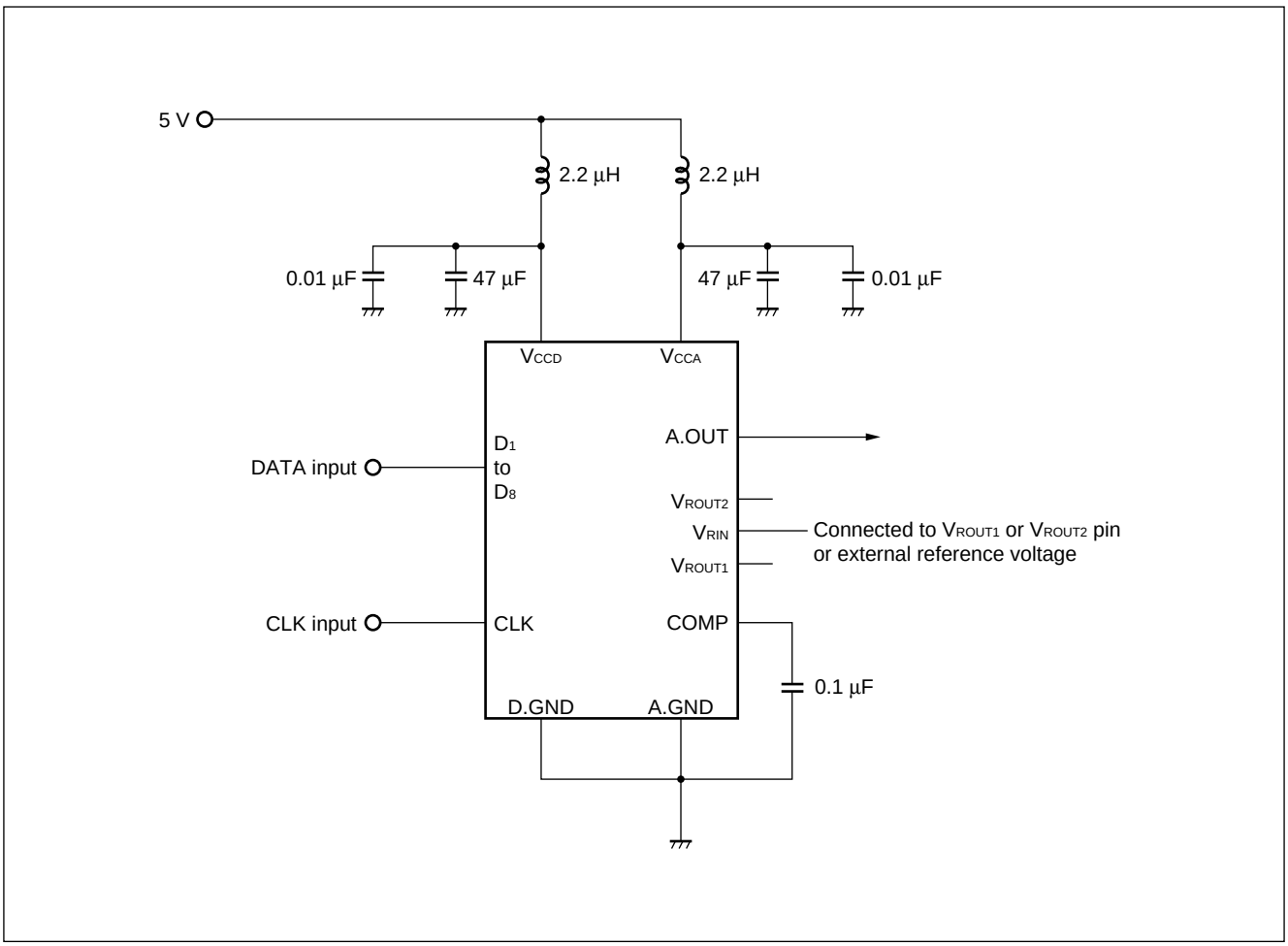
(N: digital input code for 0 to 255)

$$V_{OFS} = V_{CCA}$$

$$V_{OZS} = V_{CCA} - \frac{255}{256} \times (V_{CCA} - V_{RIN})$$

MB40768H

■ STANDARD EXAMPLE OF CONNECTION



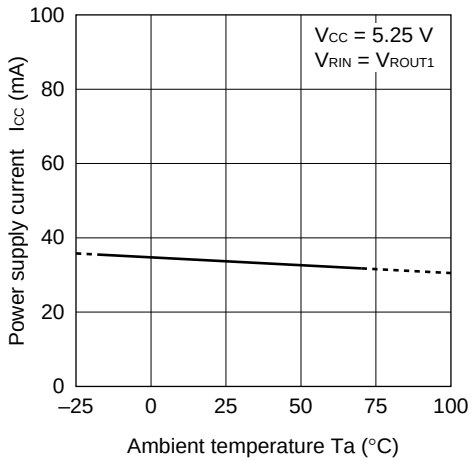
■ NOTES ON USAGE

- **Countermeasures for switching noise**
  To prevent the switching noise riding on the analog output signal to the maximum possible extent, insert the noise limiting capacitor between V_{CCA}-A.GND pins, and between V_{CCD}-D.GND pins closest as possible to the IC pins.
- **Power supply patterns**
  To reduce parasitic impedance, use the patterns as wide as possible to be connected to the V_{CCA}, V_{CCD}, A.GND and D.GND pins.

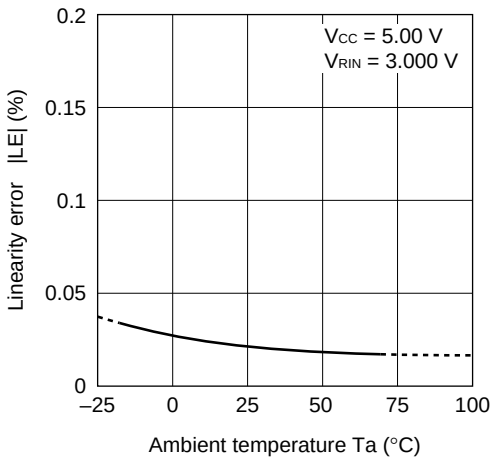
MB40768H

■ TYPICAL CHARACTERISTIC CURVES

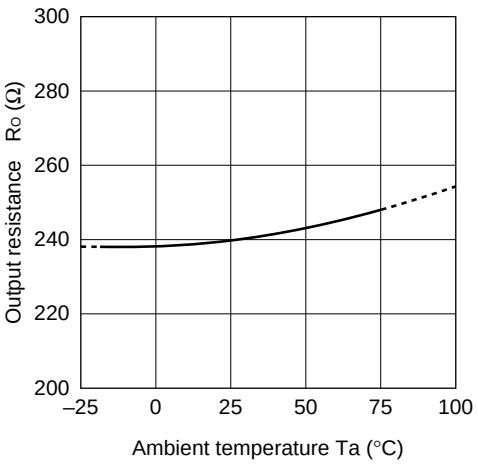
1. Power supply current vs Ambient temperature



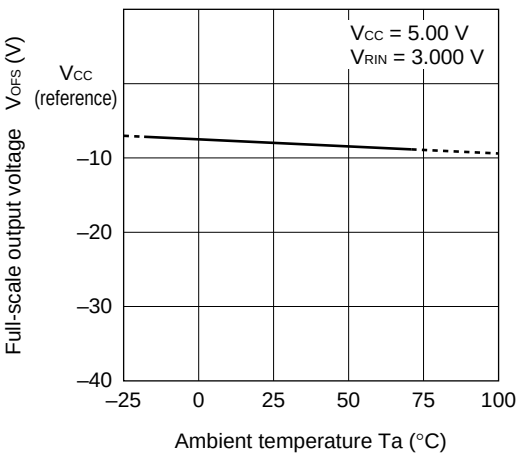
2. Linearity error vs Ambient temperature



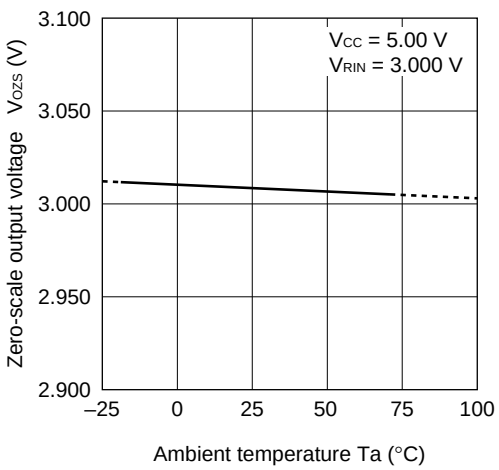
3. Output resistance vs Ambient temperature



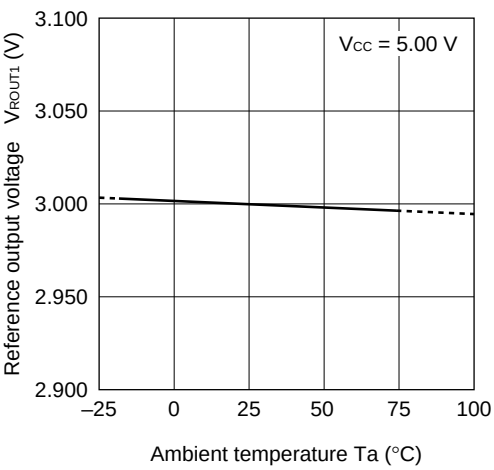
4. Full-scale output voltage vs Ambient temperature



5. Zero-scale output voltage vs Ambient temperature



6. VROUT1 reference output voltage vs Ambient temperature



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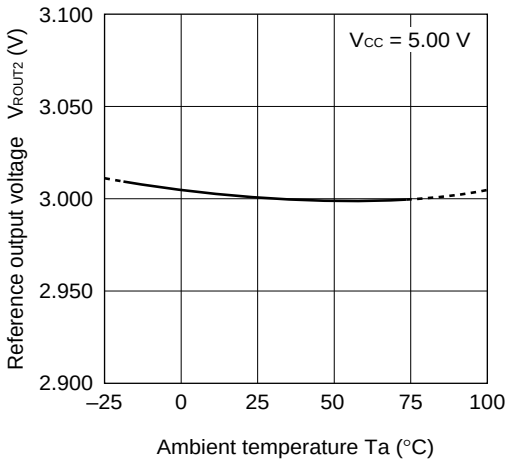
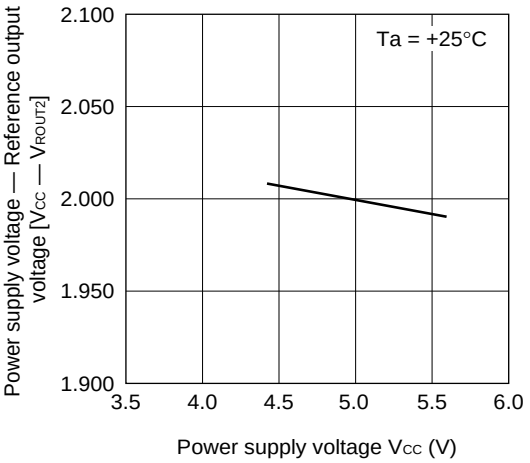
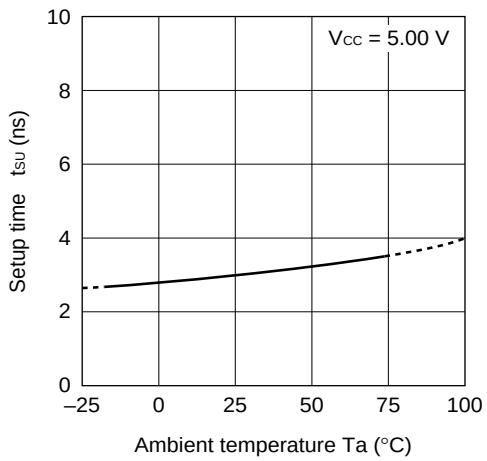
7. V_{ROUT2} reference output vs Ambient temperature



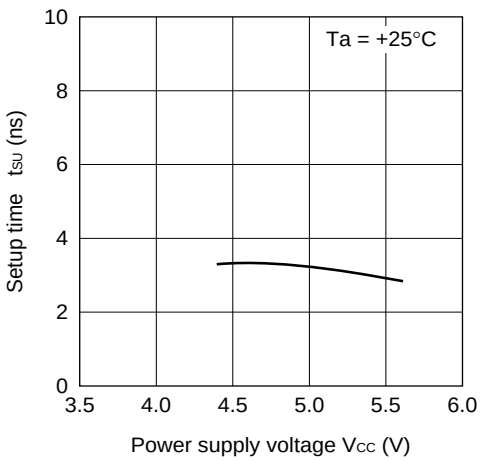
8. V_{ROUT2} reference output voltage vs Power supply voltage



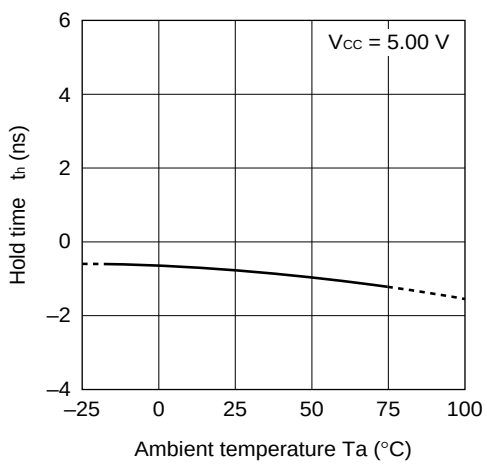
9. Setup time vs Ambient temperature



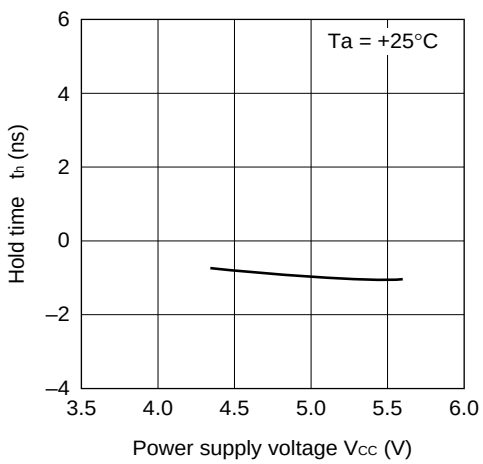
10. Setup time vs Power supply voltage



11. Hold time vs Ambient temperature



12. Hold time vs Power supply voltage



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MB40768H

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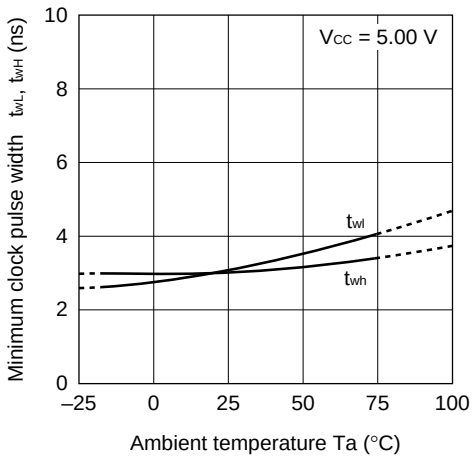
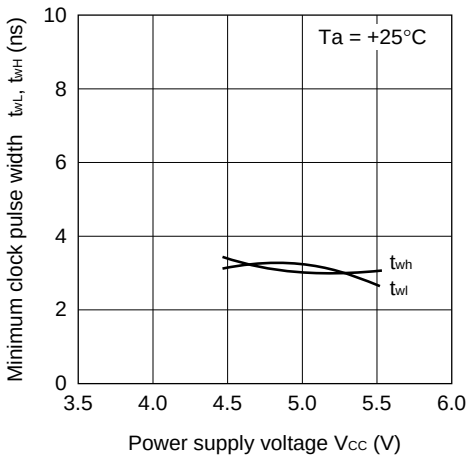
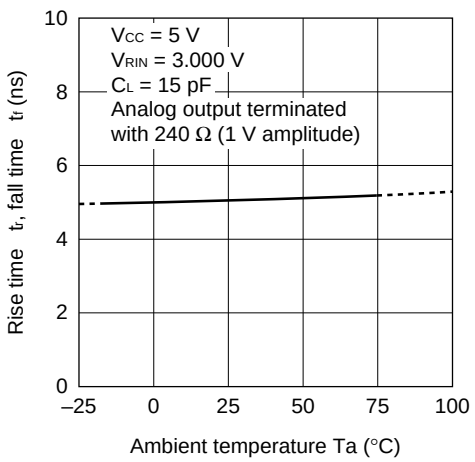
13. Minimum clock pulse width vs Ambient temperature



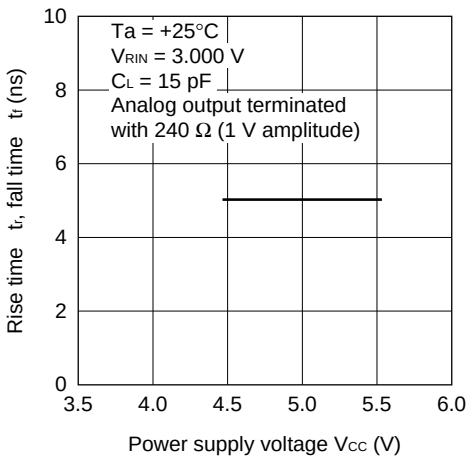
14. Minimum clock pulse width vs Power supply voltage



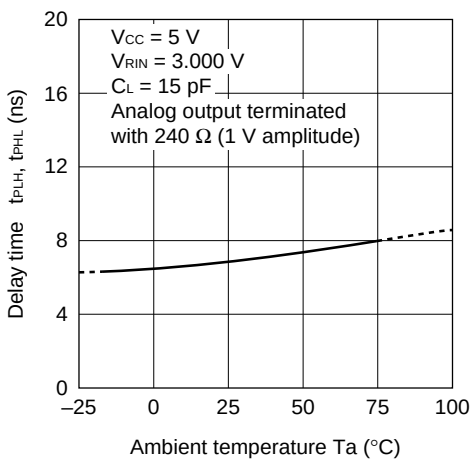
15. Rise time, Fall time vs Ambient temperature



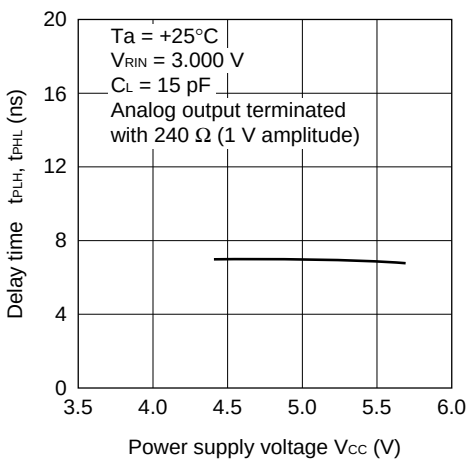
16. Rise time, Fall time vs Power supply voltage



17. Delay time vs Ambient temperature



18. Delay time vs Power supply voltage



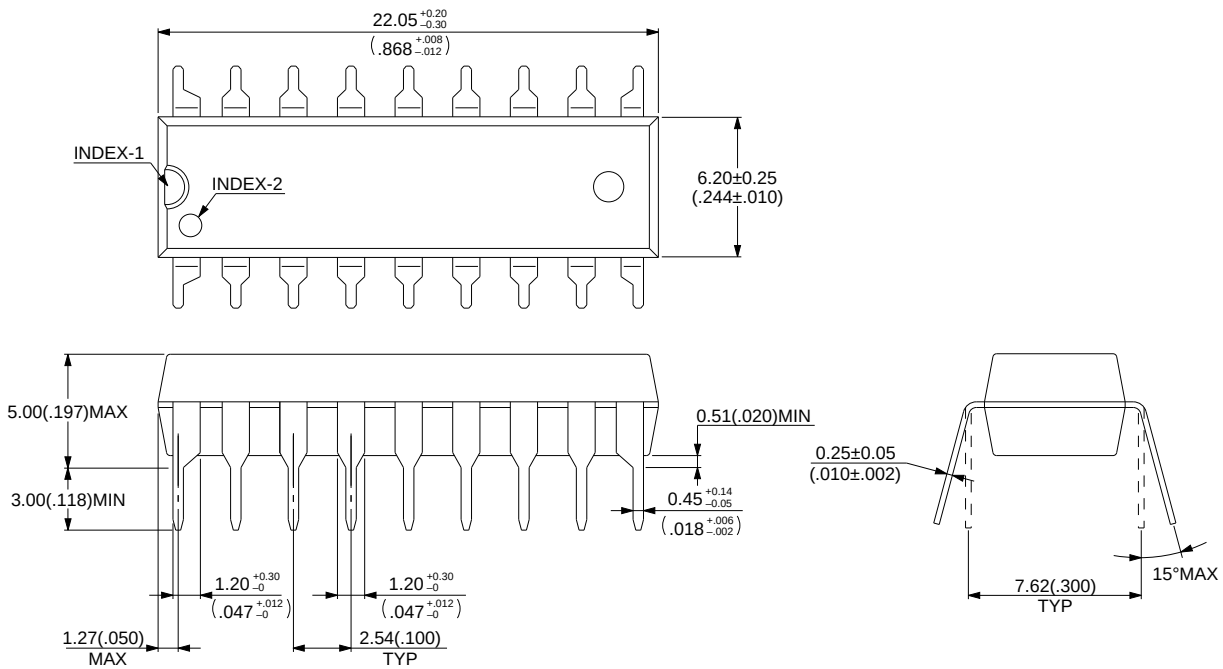
■ ORDERING INFORMATION

Part number	Package	Remarks
MB40768HP	18-pin Plastic DIP (DIP-18P-M02)	
MB40768HPF	20-pin Plastic SOP (FPT-20P-M01)	

MB40768H

■ PACKAGE DIMENSIONS

18-pin Plastic DIP
(DIP-18P-M02)



Dimensions in mm (inches)

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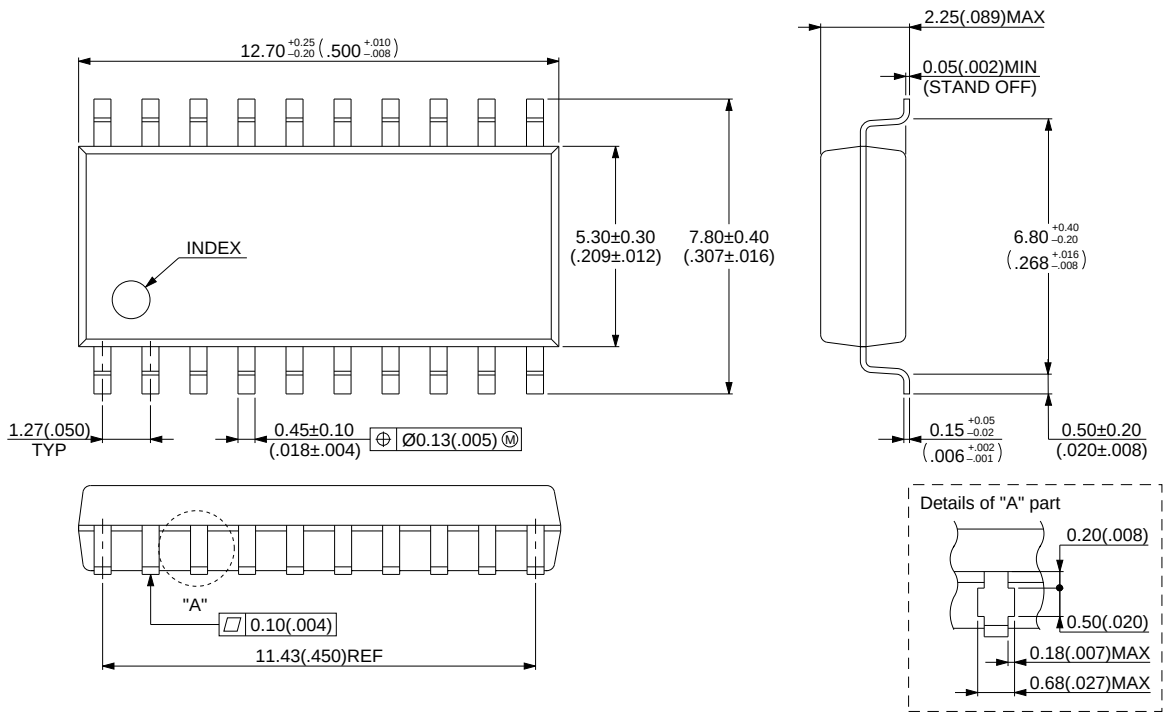
20-pin Plastic SOP
(FPT-20P-M01)



Dimensions in mm (inches)

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