

ASSP

1CHANNEL 10-BIT D/A CONVERTER

MB40760

■ DESCRIPTION

MB40760 is a low-power consumption, high-speed 10-bit D/A converter.

The MB40760 is characterized by TTL compatible digital inputs, an analog output voltage from 3 to 5V, and a maximum conversion rate of 60 MHz. It provides a reference voltage from a potential divider and band-gap reference, and can also use an external reference voltage.

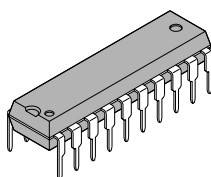
The MB40760 D/A converter is suitable for high-resolution TVs or VTRs.

■ FEATURES

- Resolution: 10 bits
- Conversion characteristics:
 - Maximum conversion rate: 60 MHz (Minimum)
 - Linearity error: $\pm 0.1\%$ (Maximum)
 - Differential linearity error: $\pm 0.1\%$ (Maximum)
- Input and output:
 - Digital input voltage: TTL levels
 - Analog output voltage: 2 V_{P-P} (3V to 5V)
- Reference voltage
 - V_{ROUT1}: Potential divider circuit (0.6 V_{CCA})
 - V_{ROUT2}: Band-gap reference circuit (V_{CCA}-2V)
- Others
 - Supply voltage: +5V single power supply
 - Power dissipation: 180 mW (Typical value at analog output voltage 2 VP-P)
 - 140 mW (Typical value at analog output voltage 1 VP-P)

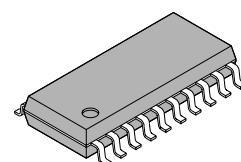
■ PACKAGES

Plastic DIP, 20 pin



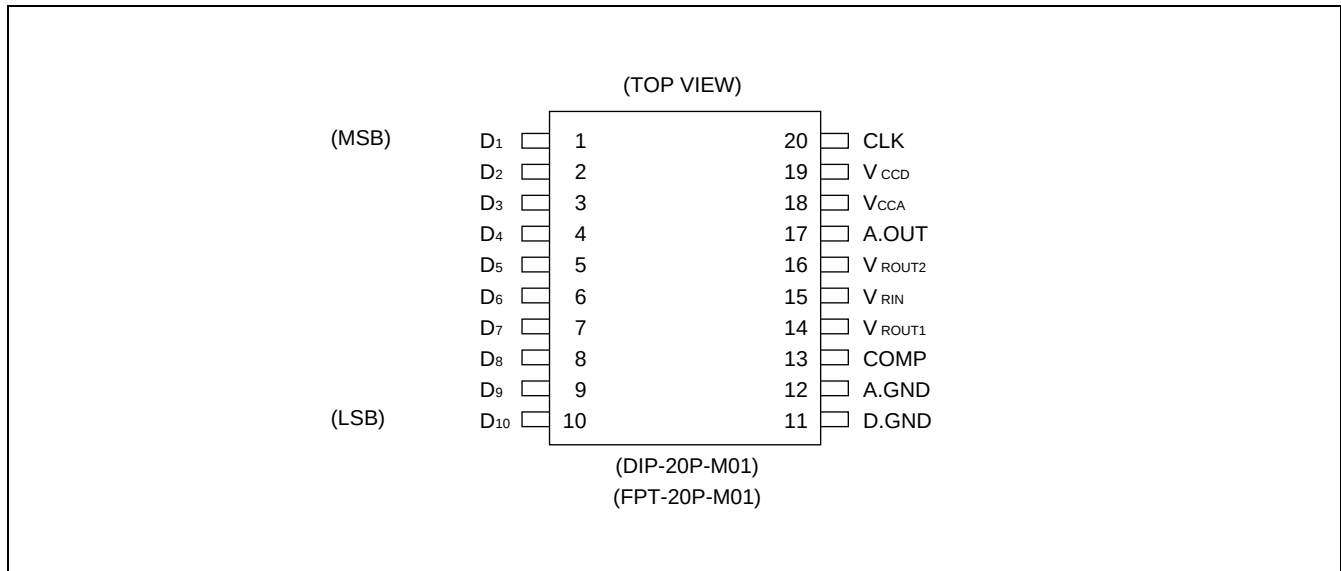
(DIP-20P-M01)

Plastic SOP, 20 pin



(FPT-20P-M01)

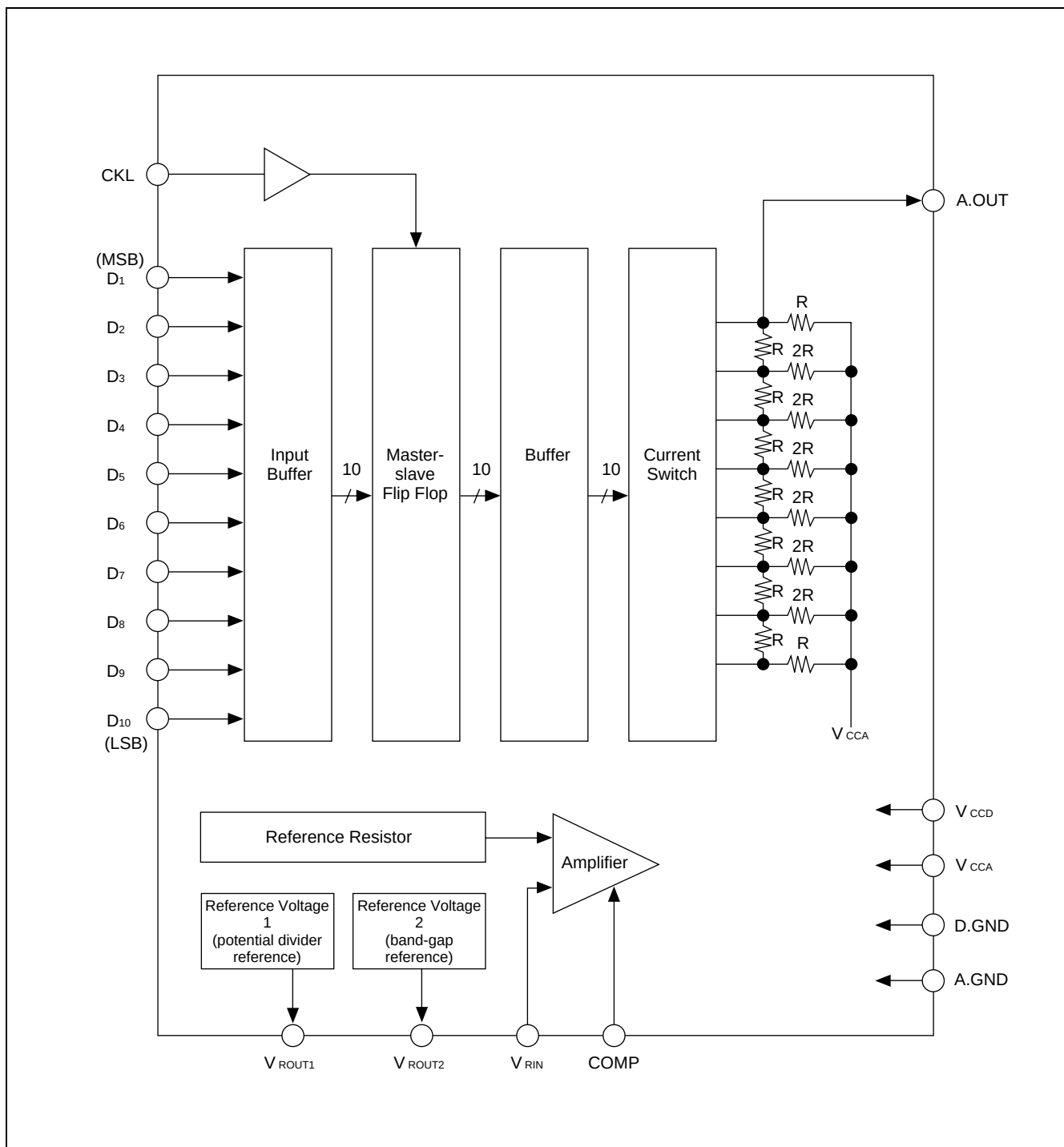
PIN ASSIGNMENT



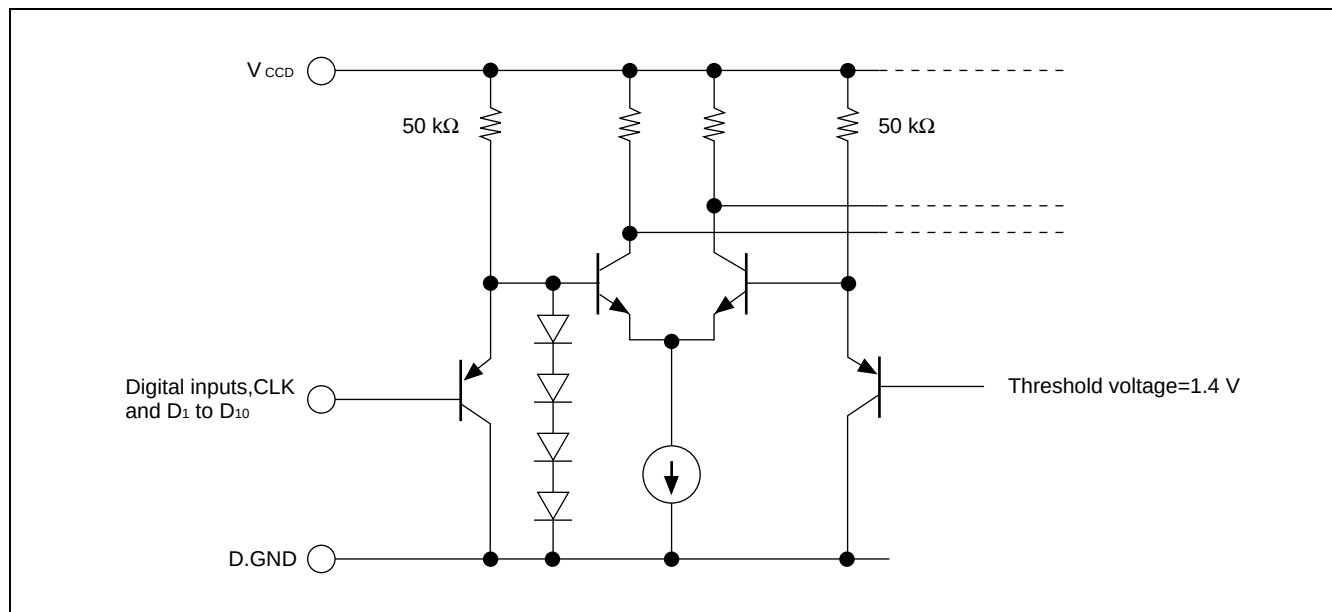
PIN DESCRIPTIONS

Pin No.	Symbol	I/O	Description
1 to 10	D ₁ to D ₁₀	I	Data signal input pin (D ₁ : MSB, D ₁₀ : LSB)
20	CLK	I	Clock signal input pin
19	V _{CCD}	—	Digital power pin (+5V)
18	V _{CCA}	—	Analog power pin (+5 V)
11	D.GND	—	Digital ground pin (0V)
12	A.GND	—	Analog ground pin (0V)
15	V _{RIN}	I	Reference voltage input pin Analog output dynamic range setup pin Connect to pin 14 or 16 to use the built-in reference voltage When using an external reference voltage, the voltage on this pin must be from 2.7V to 4.3V, and V _{CCA} -V _{RIN} must be from 0.7V to 2.2V
14	V _{ROUT1}	O	Reference voltage output pin 1 The output voltage of the potential divider reference is fixed at 0.6 V _{CCA} . When this pin is connected to pin 15, the analog output voltage ranges from 0.6 V _{CCA} to V _{CCA}
16	V _{ROUT2}	O	Reference voltage output pin 2 The output voltage of the band-gap reference is fixed at V _{CCA} -2.0(V). When the pin is connected to pin 15, the analog output voltage ranges from V _{CCA} -2.0(V) to V _{CCA}
13	COMP	—	Phase compensation capacitor pin Insert a capacitor of 0.1 μF or greater between A.GND and COMP for phase compensation
17	A.OUT	O	Analog signal output pin

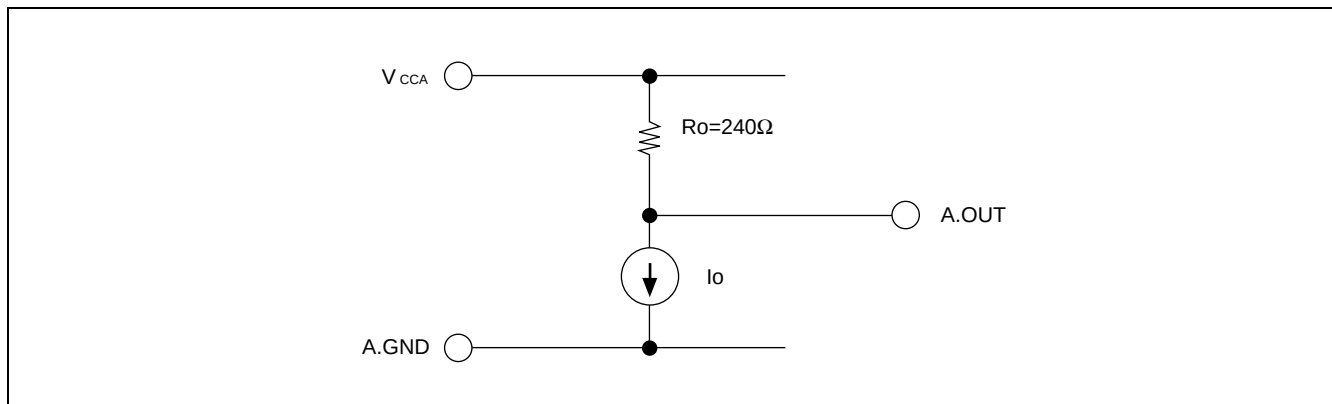
■ BLOCK DIAGRAM



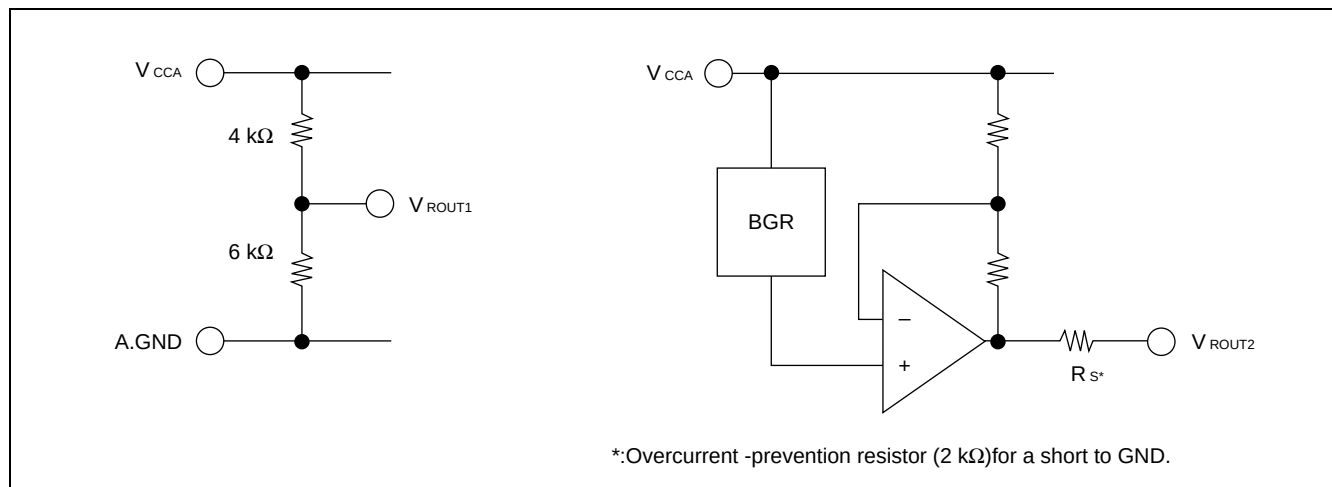
■ DIGITAL INPUT EQUIVALENT CIRCUIT



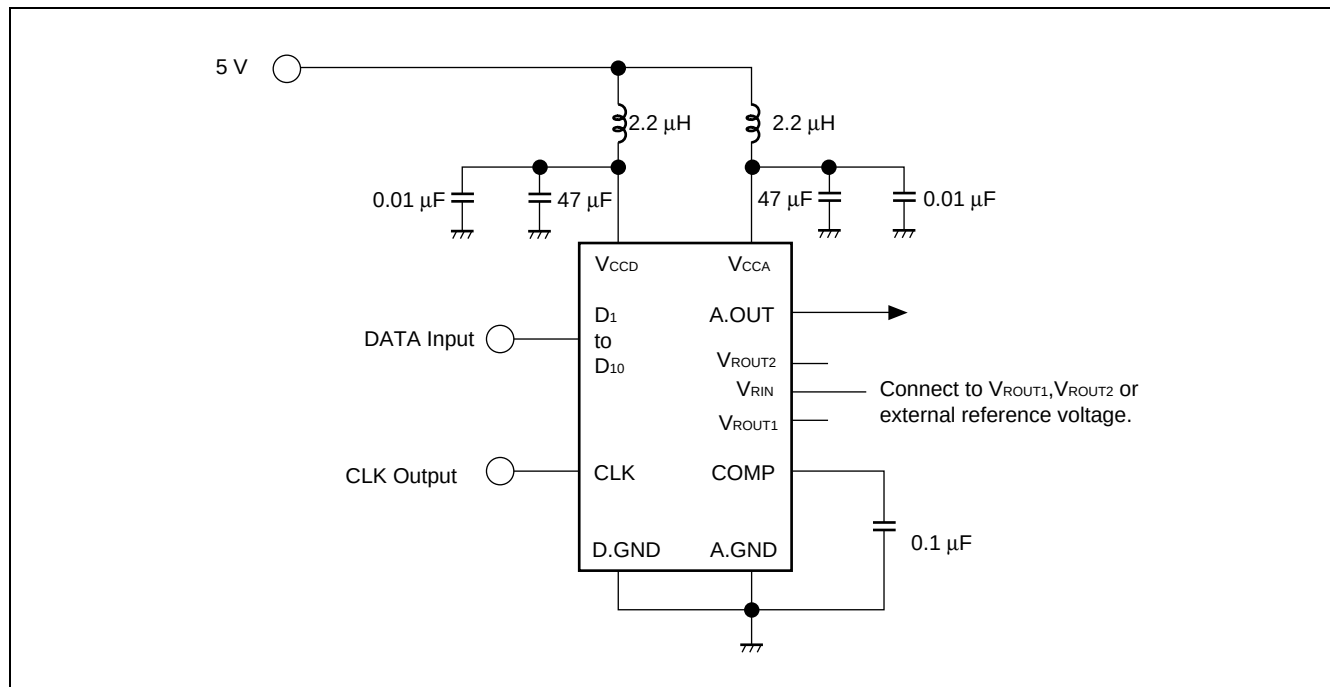
■ ANALOG OUTPUT EQUIVALENT CIRCUIT



■ REFERENCE VOLTAGE OUTPUT EQUIVALENT CIRCUIT



■ TYPICAL CONNECTION EXAMPLE



■ ABSOLUTE MAXIMUM RATINGS

(A.GND = D.GND = 0V, Ta = +25°C)

Parameter	Symbol	Value	Unit
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	T _{stg}	−55 to +125	°C

Note: Permanent device damage may occur if the above Absolute Maximum Rating 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 = 0V, Ta = −20°C to +75°C)

Parameter		Symbol	Standard values			Unit
			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 input high voltage		V _{IHD}	2.0	—	—	V
Digital input low voltage		V _{ILD}	—	—	0.8	V
Clock frequency		f _{CLK}	—	—	60	MHz
Setup time		T _{su}	8	—	—	ns
Hold time		t _h	2	—	—	ns
Clock minimum pulse width high		t _{WH}	6.5	—	—	ns
Clock minimum pulse width low		t _{WL}	6.5	—	—	ns
Phase compensation capacitor		C _{COMP}	0.1	—	—	μF
Operating temperature		T _{OP}	−20	—	75	°C

■ DC CHARACTERISTICS

($V_{CCA} = V_{CCD} = 4.75$ to $5.25V$, $A.GND = D.GND = 0V$, $T_a = -20^{\circ}C$ to $+75^{\circ}C$)

Parameter	Symbol	Conditions	Standard values			Unit
			Min.	Typ.	Max.	
Resolution	—	—	—	—	10	bit
Linearity error	LE	DC accuracy	—	—	± 0.1	%
Differential linearity error	DLE		—	—	± 0.1	%
Digital input current high	I_{IHD}	$V_{IHD} = 2.7V$	—	—	20	μA
Digital input current low	I_{ILD}	$V_{ILD} = 0.4V$	-100	—	—	μA
Reference input current	I_{RIN}	$V_{RIN} = 3.000V$	—	—	10	μA
Potential divider reference	Reference voltage	V_{ROUT1} $V_{CCA} = 5.00V$ $V_{CCD} = 5.00V$	2.900	3.000	3.100	V
Band-gap reference	Reference voltage	V_{ROUT2}	$V_{CCA} - 2.100$	$V_{CCA} - 2.000$	$V_{CCA} - 1.900$	V
	Temperature coefficient	—	—	100	—	ppm/ $^{\circ}C$
Full-scale output voltage	V_{OFS}	—	$V_{CCA} - 20$	V_{CCA}	—	mV
Zero-scale output voltage	V_{OZS}	$V_{CCA} = 5.00V$ $V_{CCD} = 5.0V$ $V_{RIN} = 3.000V$	2.932	3.002	3.072	V
Output resistance	R_o	$T_a = +25^{\circ}C$	192	240	288	Ω
Power dissipation	I_{CC}	$V_{CCA} = 5.25V$ $V_{CCD} = 5.25V$ $V_{RIN} = V_{ROUT1}$	—	36*	62	mA

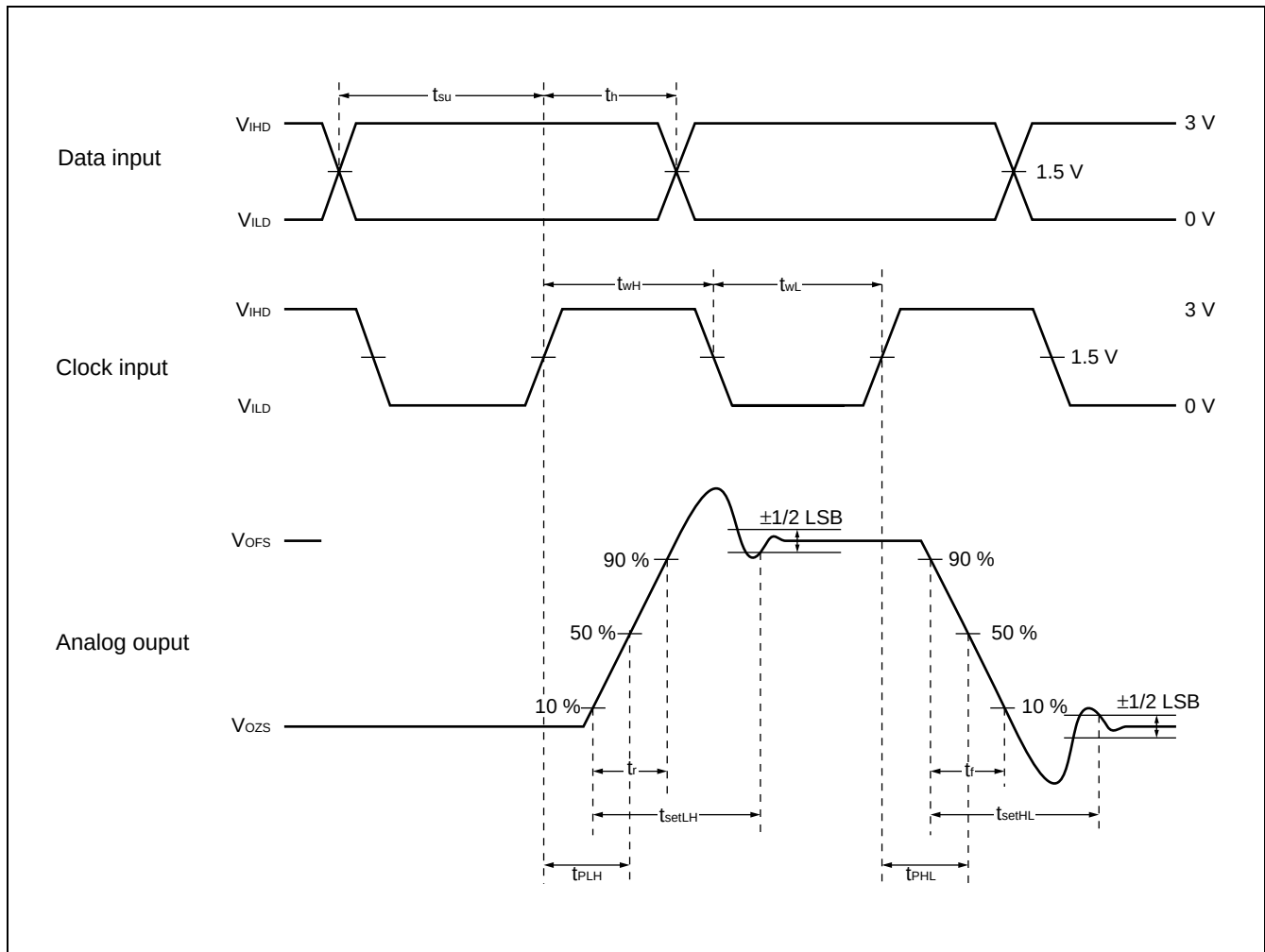
* : $V_{CCA} = V_{CCD} = 5V$

■ AC CHARACTERISTICS

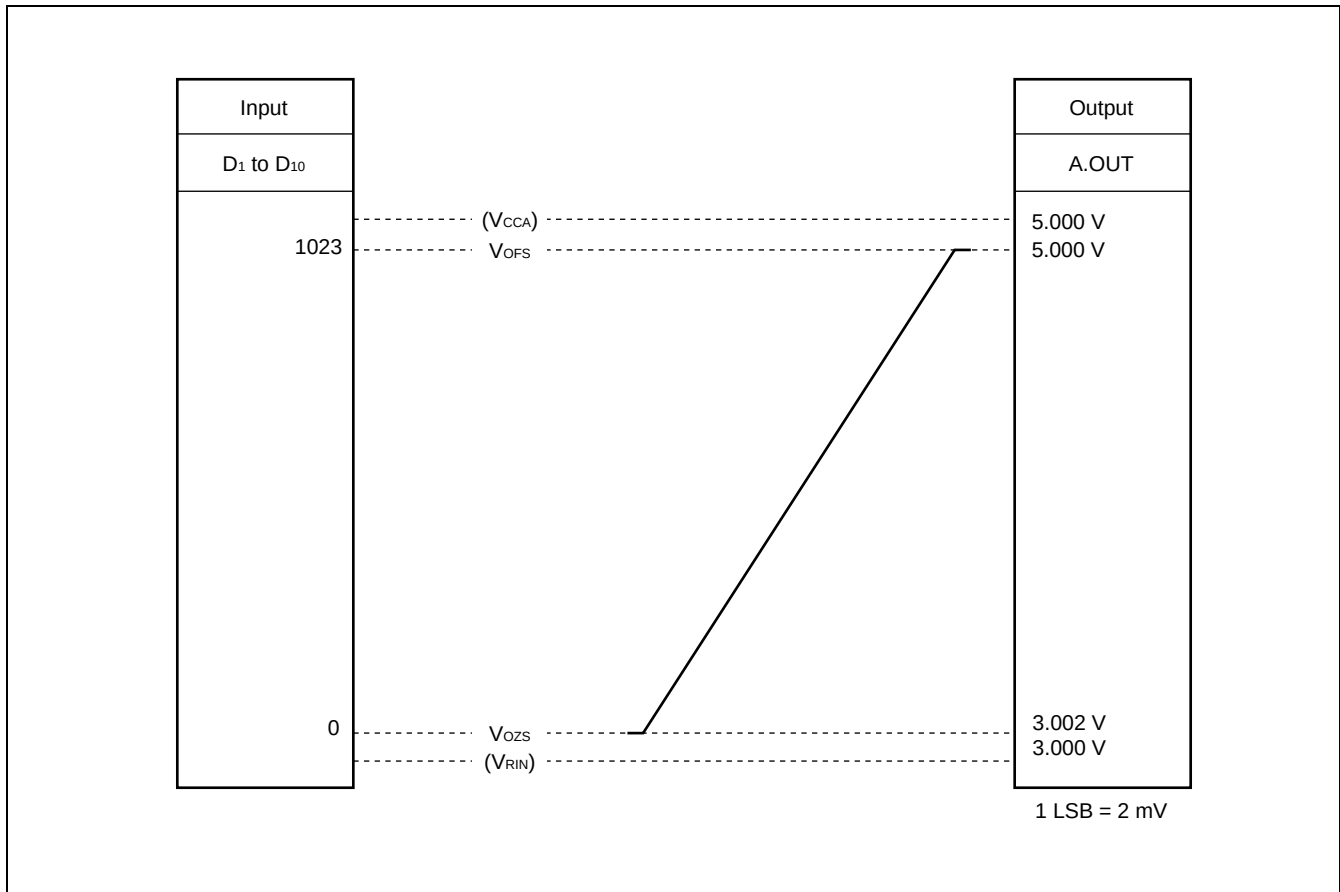
($V_{CCA} = V_{CCD} = 4.75$ to $5.25V$, $A.GND = D.GND = 0V$, $T_a = -20^{\circ}C$ to $+75^{\circ}C$)

Parameter	Symbol	Conditions	Standard values			Unit
			Min.	Typ.	Max.	
Maximum conversion rate	F_s	$C_L = 15pF$ A.OUT pin terminating resistance = 240Ω	60	—	—	MSPS
Output propagation delay time	t_{pd}		—	7	—	ns
Output rise time	t_r		—	5	—	ns
Output fall time	t_f		—	5	—	ns
Settling time	t_{set}		—	17.5	—	ns

■ TIMING CHART



■ DAC OUTPUT VOLTAGE CHARACTERISTICS



■ DAC OUTPUT VOLTAGE FORMULA IN IDEAL CONDITIONS

$$A.OUT = V_{CCA} - \frac{1023 - N}{1024} (V_{CCA} - V_{RIN})$$

(N: Digital input from 0 to 1023)

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

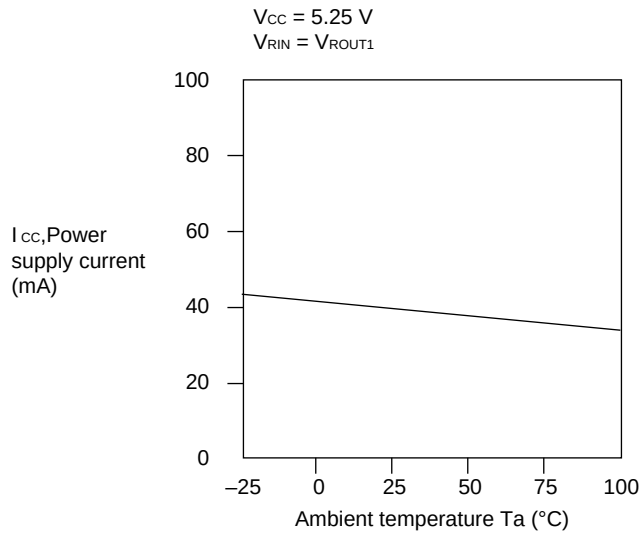
$$V_{OZS} = V_{CCA} - \frac{1023}{1024} (V_{CCA} - V_{RIN})$$

Notes:

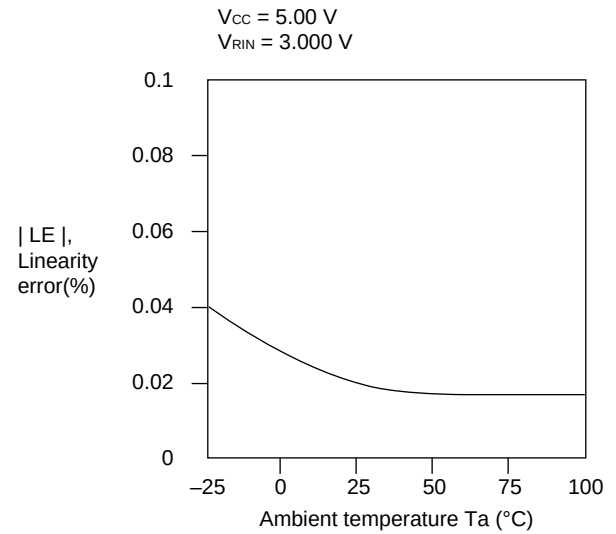
1. Preventing Switching Noise
To prevent switching noise in the analog output signal, connect noise limiting capacitors to the VCCA and VCCD pins as close to the A.GND and D.GND pins as possible.
2. Power Pattern
To reduce parasitic impedance, the PC board pattern to the VCCA, VCCD, A.GND and D.GND pins should be as wide as possible.

■ TYPICAL CHARACTERISTICS CURVES

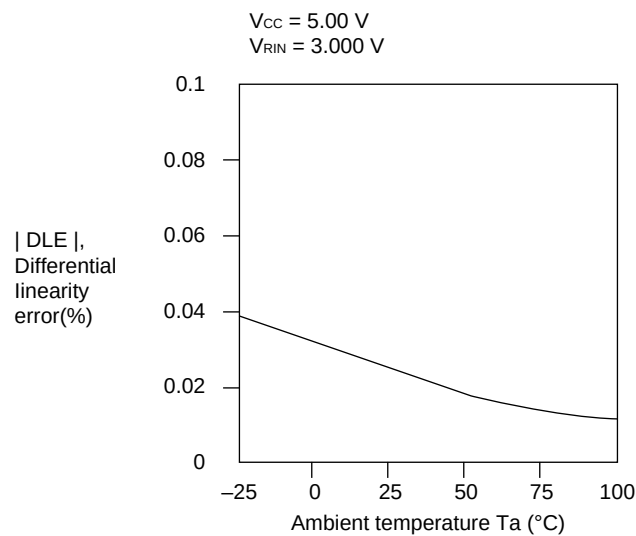
1.Power Supply Current v.s. Ambient Temperature



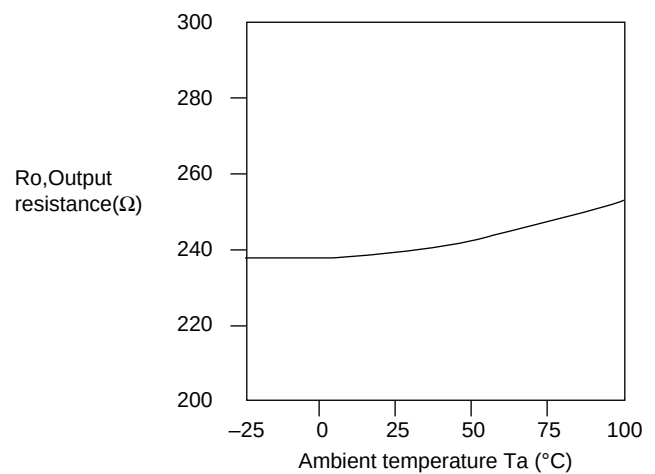
2.Linearity Error v.s. Ambient Temperature



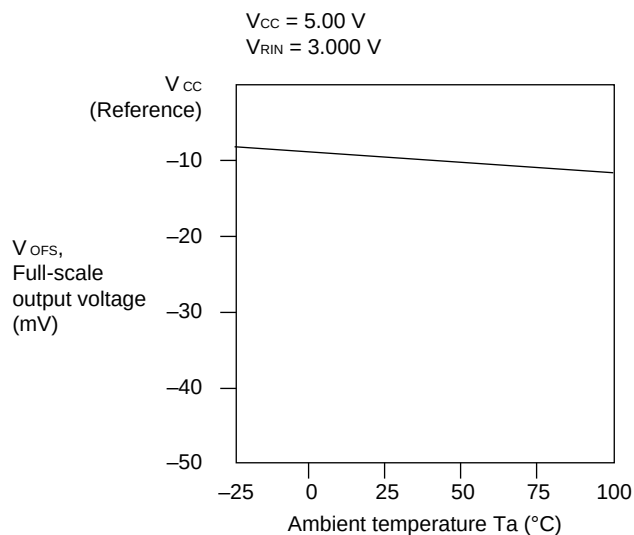
3.Differential Linearity Error v.s. Ambient Temperature



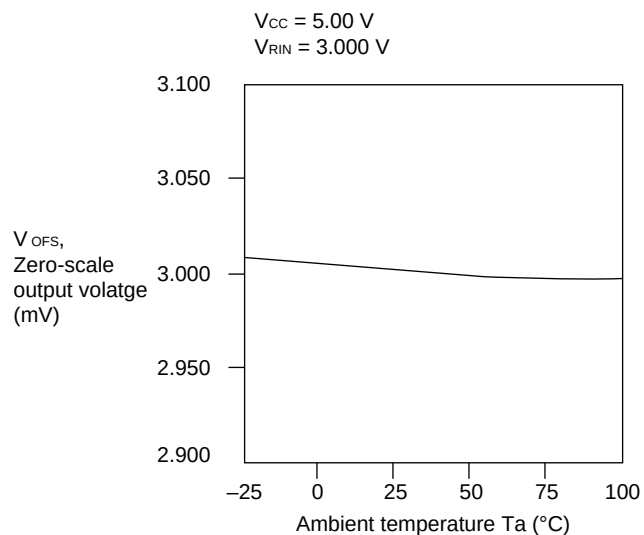
4.Output Resistance v.s. Ambient Temperature



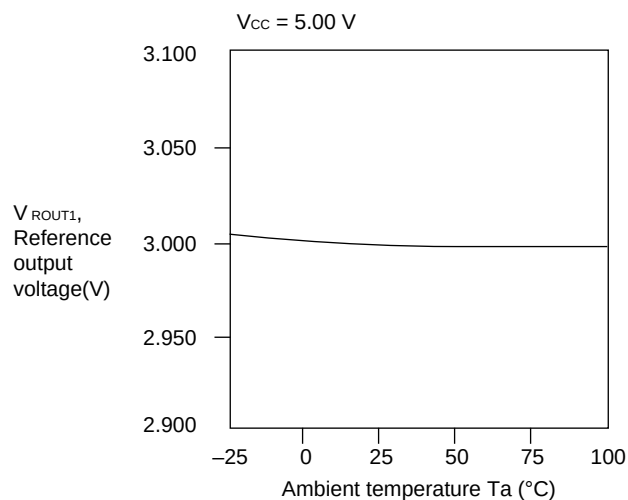
**5.Full-Scale Output Voltage
v.s. Ambient Temperature**



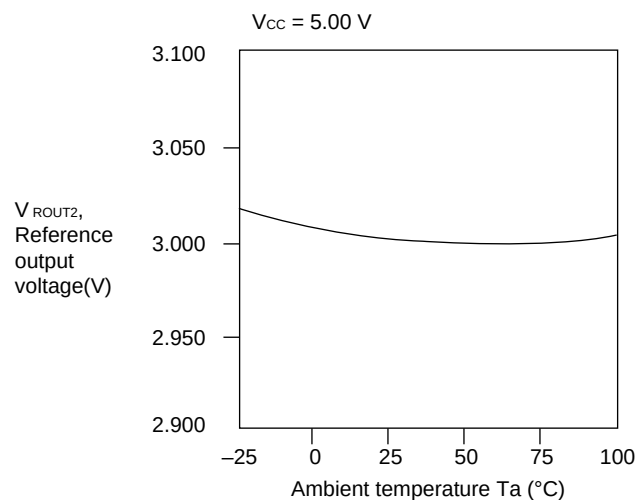
**6.Zero-Scale Output Voltage
v.s. Ambient Temperature**



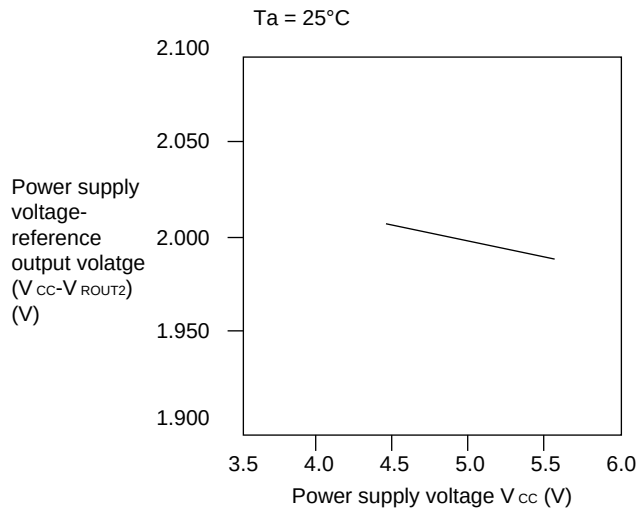
**7. V_{ROUT1} Reference Output Voltage
v.s. Ambient Temperature**



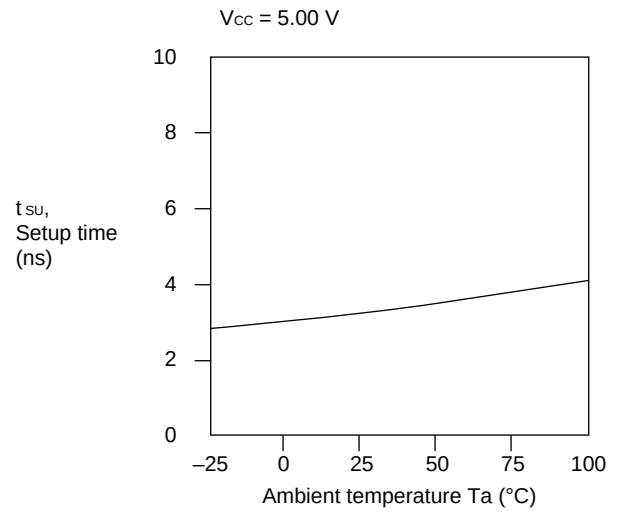
**8. V_{ROUT2} Reference Output Voltage
v.s. Ambient Temperature**



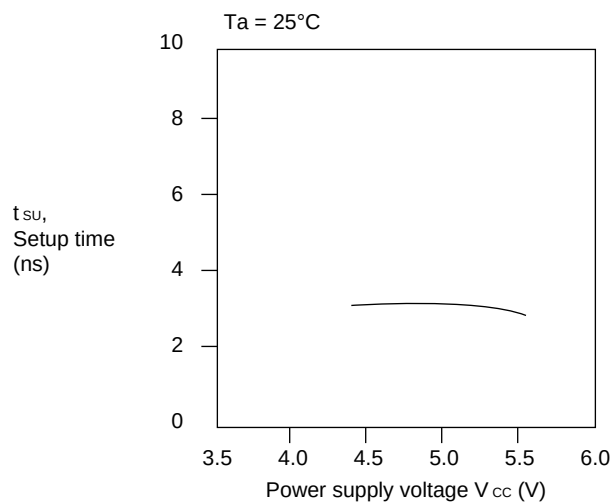
**9. V_{ROUT2} Reference Output Voltage
v.s. Power Supply Voltage**



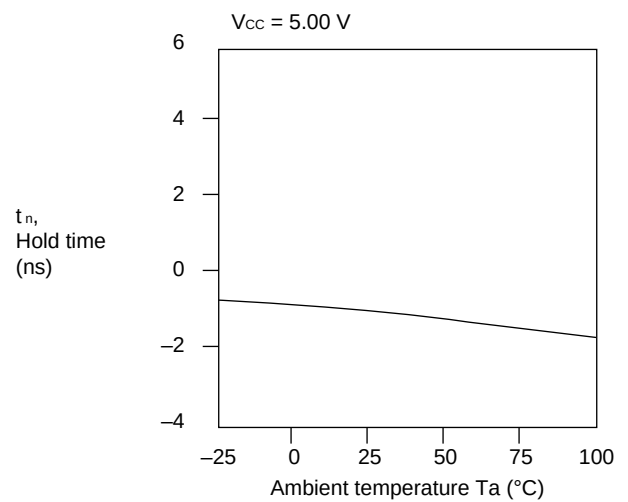
10. Setup Time v.s. Ambient Temperature



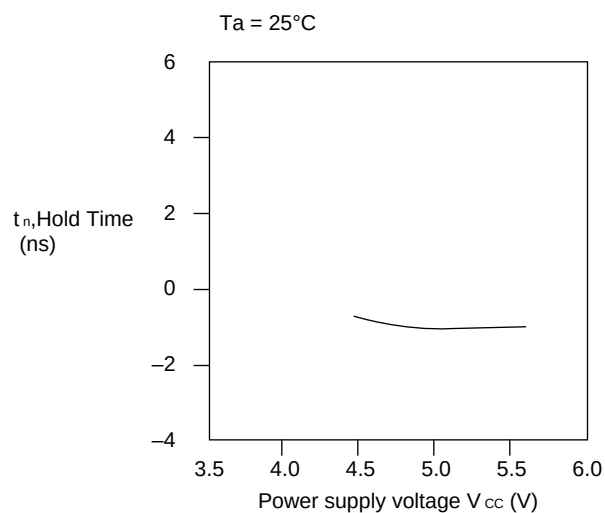
11. Setup Time v.s. Power Supply Voltage



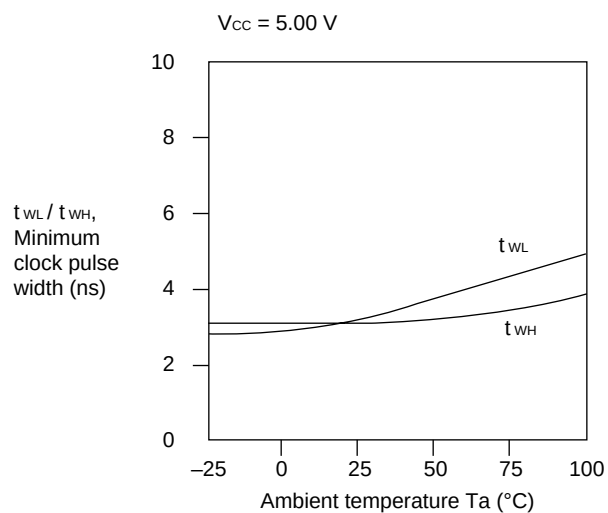
12. Hold Time v.s. Ambient Temperature



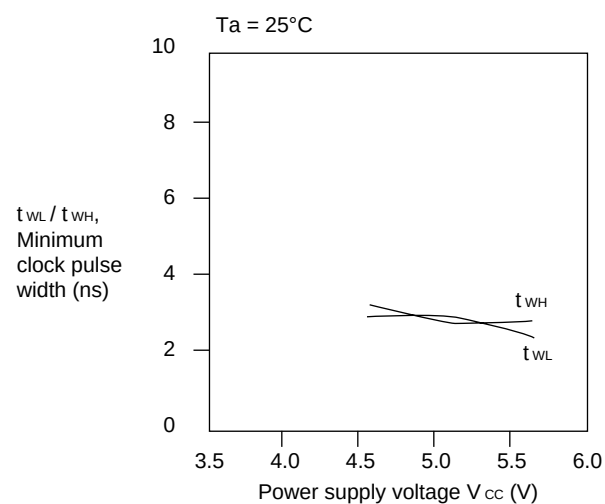
13. Hold Time v.s. Power Supply Voltage



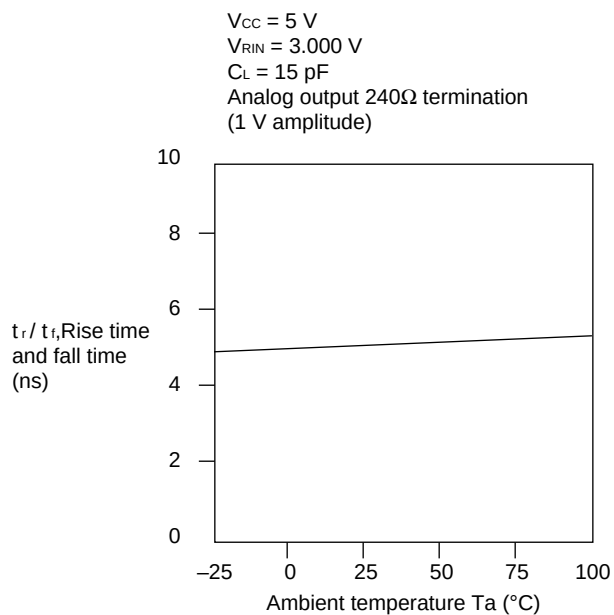
14. Minimum Clock Pulse Width v.s. Ambient Temperature



15. Minimum Clock Pulse Width v.s. Power Supply Voltage

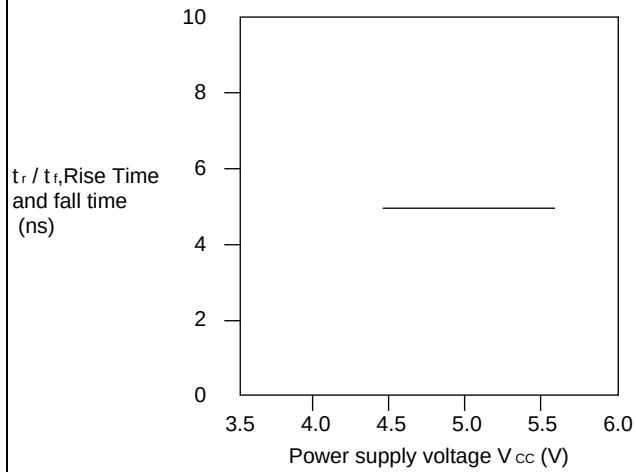


16. Rise Time / Fall Time v.s. Ambient Temperature



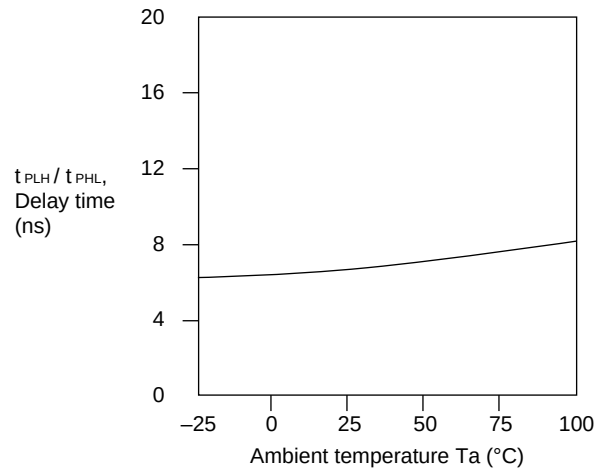
17. Rise Time / Fall Time v.s. Power Supply Voltage

$T_a = 25^\circ\text{C}$
 $V_{RIN} = 3.000\text{ V}$
 $C_L = 15\text{ pF}$
 Analog output 240Ω termination
 (1 V amplitude)



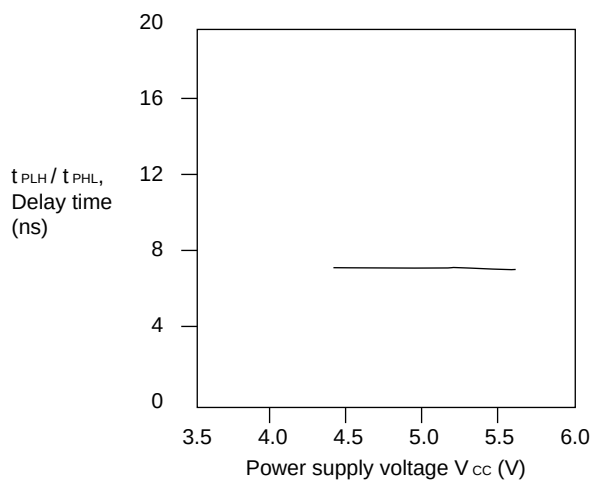
18. Delay Time v.s. Ambient Temperature

$V_{CC} = 5.00\text{ V}$
 $V_{RIN} = 3.000\text{ V}$
 $C_L = 15\text{ pF}$
 Analog output 240Ω termination
 (1 V amplitude)

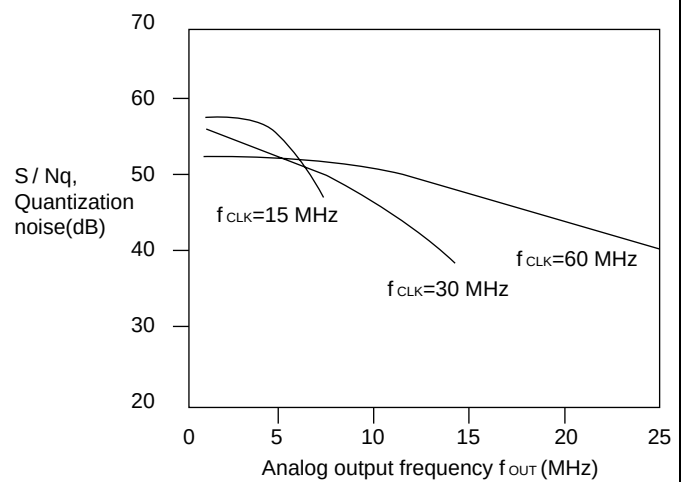


19. Delay Time v.s. Power Supply Voltage

$T_a = 25^\circ\text{C}$
 $V_{RIN} = 3.000\text{ V}$
 $C_L = 15\text{ pF}$
 Analog output 240Ω termination
 (1 V amplitude)

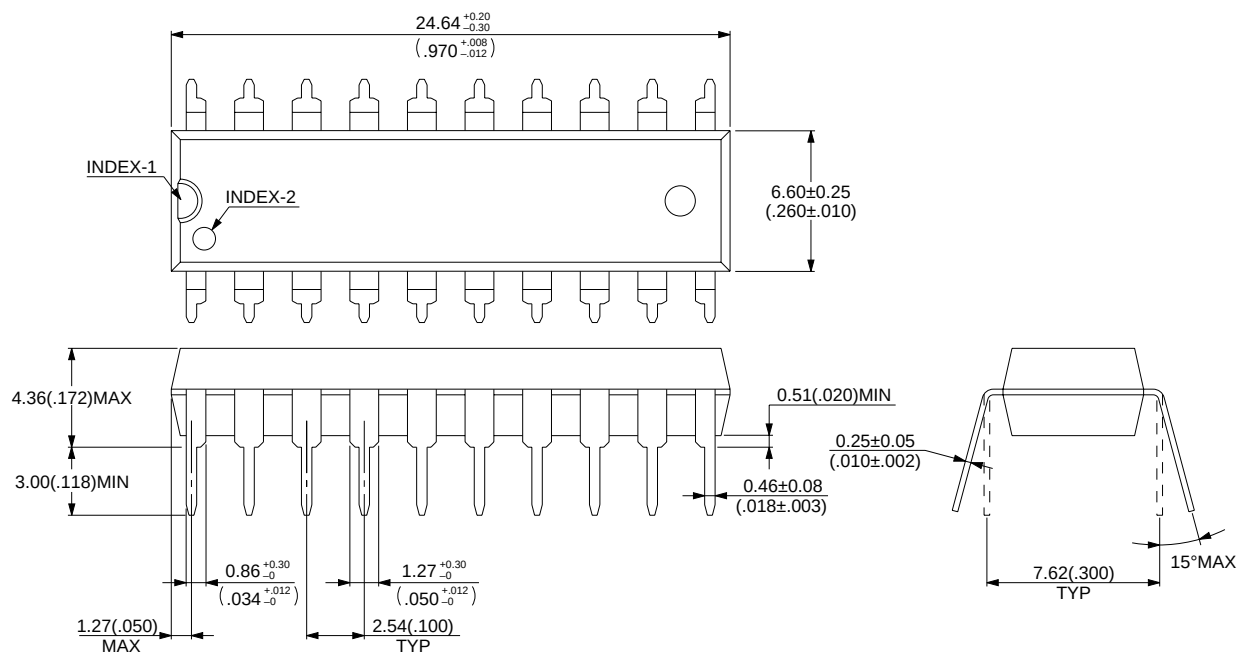


20. Quantization Noise v.s. Analog Output Frequency



■ PACKAGE DIMENSIONS

Plastic DIP, 20 pin
(DIP-20P-M01)

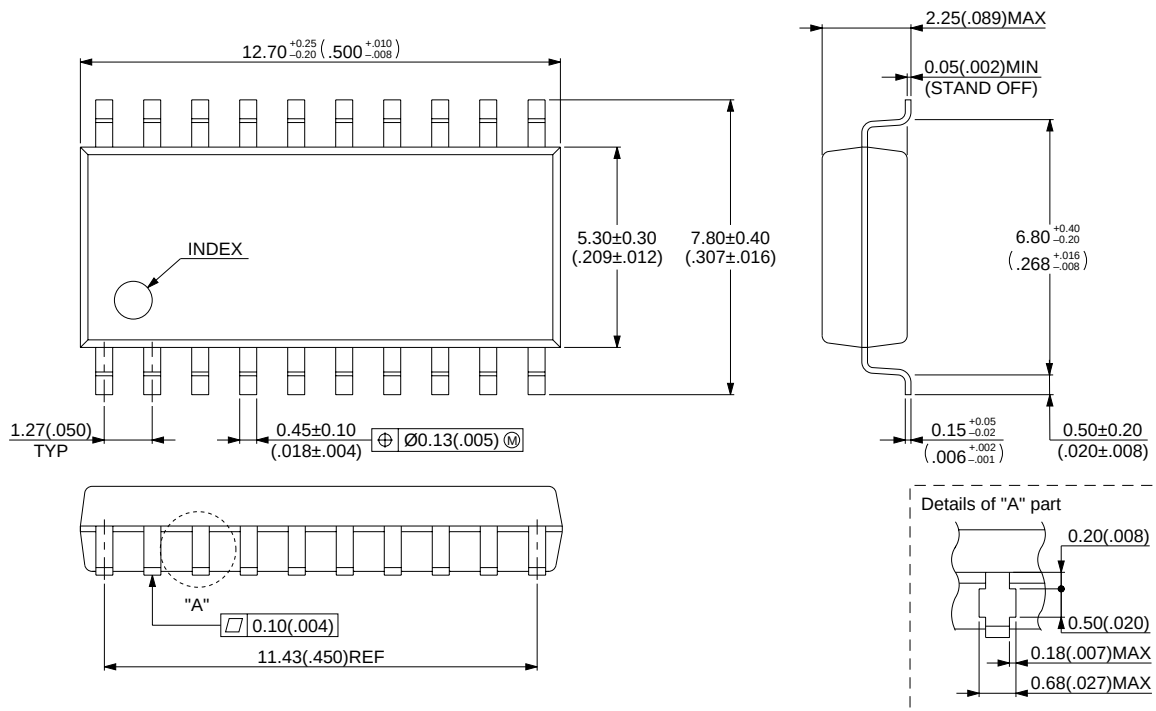


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Dimensions in mm (inch)

MB40760

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



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Dimensions in mm (inch)

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