FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-28310-2E

ASSP

1 CHANNEL 10-BIT D/A CONVERTER

MB40730

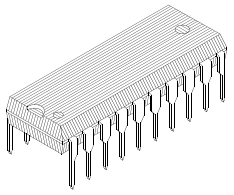
MB40730 is a low-power consumption, high-speed 10-bit D/A converter.

The MB40730 is characterized by ECL (10 kH) compatible digital inputs, an analog output voltage from -2 to 0 V, 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 MB40730 D/A converter is suitable for high-resolution TVs or VTRs.

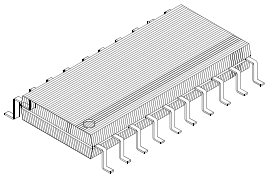
- Resolution: 10 bits
- Conversion characteristics:
  -Maximum conversion rate: 60 MHz (Minimum)
  -Linearity error: ±0.1 % (Maximum)
  -Differential linearity error: ±0.1 % (Maximum)
- Input and output:
  -Digital input voltage: ECL (10 kH) levels
  -Analog output voltage: 2 Vp-p (-2 V to 0 V)
- Reference voltage:
  -V_{ROUT1}: Potential divider circuit (V_{EEA} 2/5.2)
  -V_{ROUT2}: Band-gap reference circuit (-2 V)
- Others:
  - Supply voltage: -5.2 V 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)

20-PIN PLASTIC DIP



(DIP-20P-M01)

20-PIN PLASTIC SOP



(FPT-20P-M01)

ABSOLUTE MAXIMUM RATINGS (See NOTE)

(V_{CCA}=V_{CCD}=0 V, T_a=+25°C)

Parameter	Symbol	Value	Unit
Analog power supply voltage	V_{EEA}	-7.0 to 0	V
Digital power supply voltage	V_{EED}	-7.0 to 0	V
Power supply voltage difference	V_{EED}-V_{EEA}	1.0	V
Digital signal input voltage	V_{ID}	0 to V_{EE}	V
Storage Temperature	T_{stg}	-55 to +125	°C

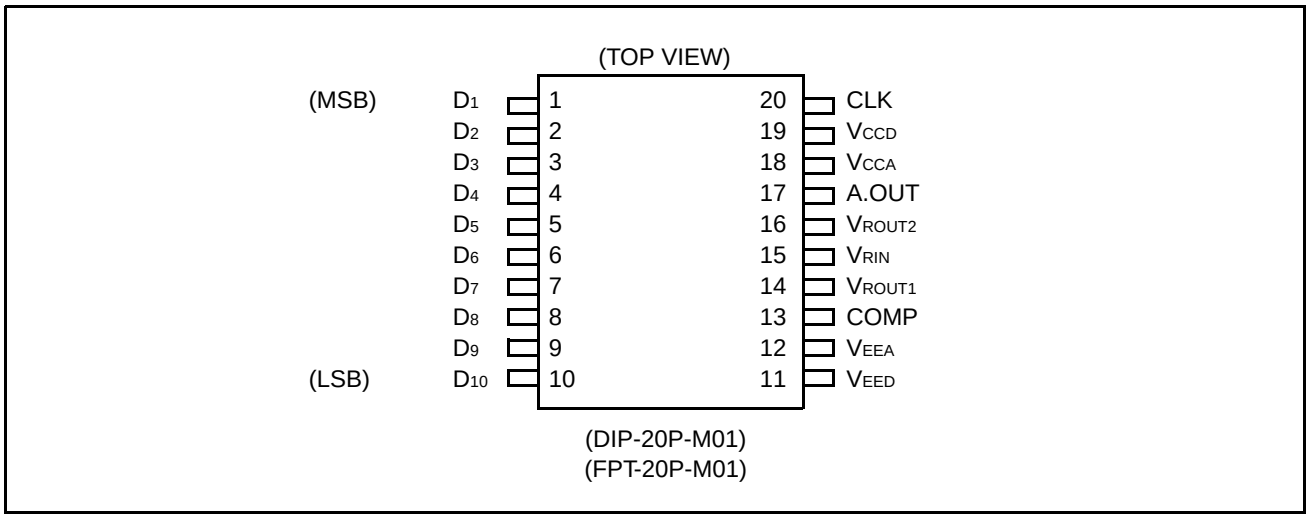
NOTE: Permanent device damage may occur if the above **Absolute Maximum Rating** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device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

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

DataSheet4U.com
www.DataSheet4U.com

DataSheet4U.com
DataSheet4U.com

■ PIN ASSIGNMENT



et4U.com

■ PIN DESCRIPTIONS

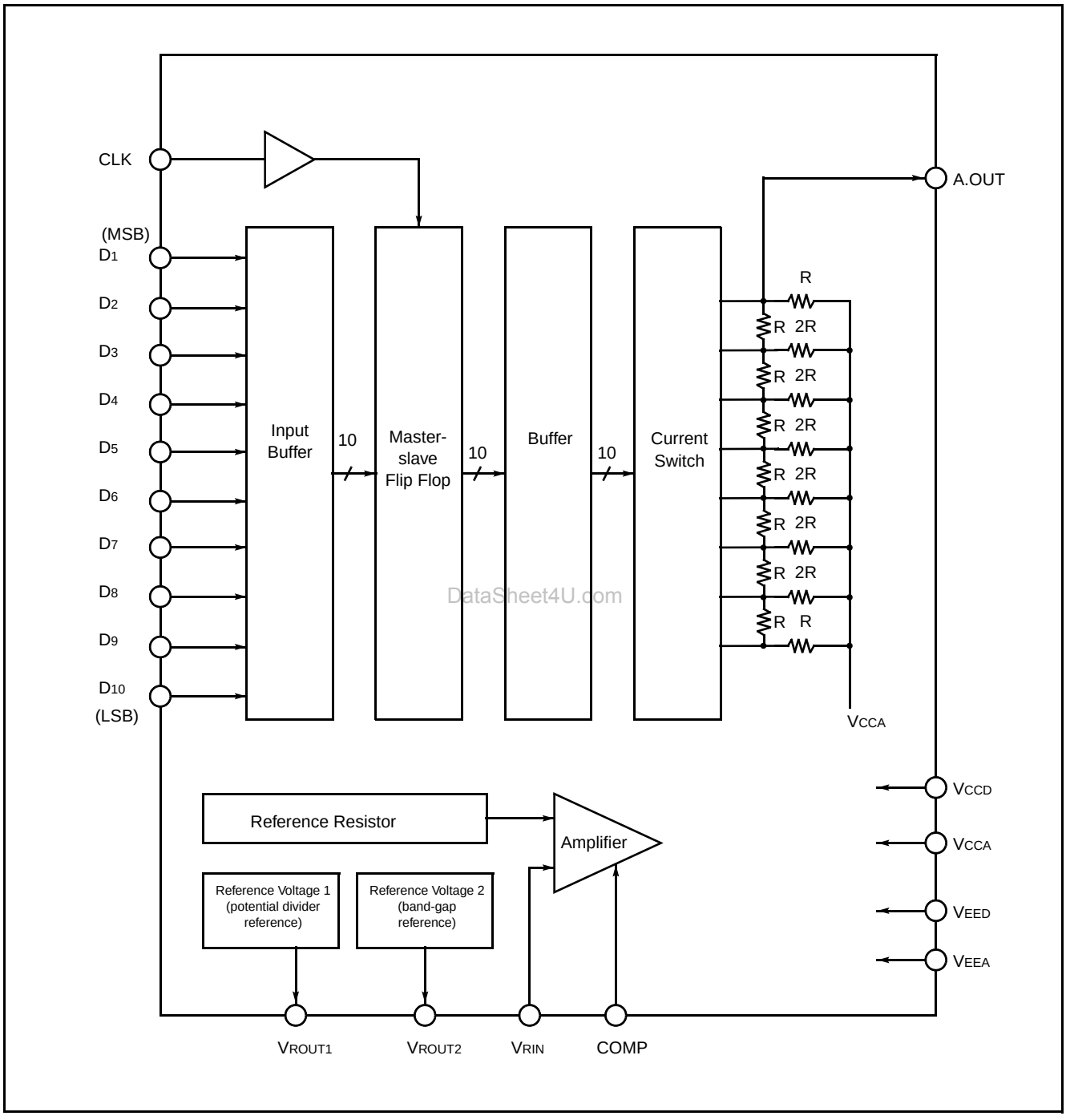
DataShee

Pin No.	Symbol	I/O	Description
1 to 10	D_1 to D_{10}	I	Data signal input pin (D1: MSB, D10: LSB)
20	CLK	I	Clock signal input pin
19	V_{CCD}	-	Digital ground pin (0 V)
18	V_{CCA}	-	Analog ground pin (0 V)
11	V_{EED}	-	Digital power pin (-5.2 V)
12	V_{EEA}	-	Analog ground pin (-5.2 V)
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 -2.20 V to -0.70 V
14	V_{ROUT1}	O	Reference voltage output pin 1 The output voltage of the potential divider reference is fixed at V_{EEA} 2/5.2. When this pin is connected to pin 15, the analog output voltage ranges from V_{EEA} 2/5.2 to 0 V
16	VROUT2	O	Reference voltage output pin 2 The output voltage of the band-gap reference is fixed at -2.0 V. When the pin is connected to pin 15, the analog output voltage ranges from -2 V to 0 V
13	COMP	-	Phase compensation capacitor pin Insert a capacitor of 0.1 µF or greater between V_{EEA} and COMP for phase compensation
17	A. OUT	O	Analog signal output pin

DataSheet4U.com
www.DataSheet4U.com

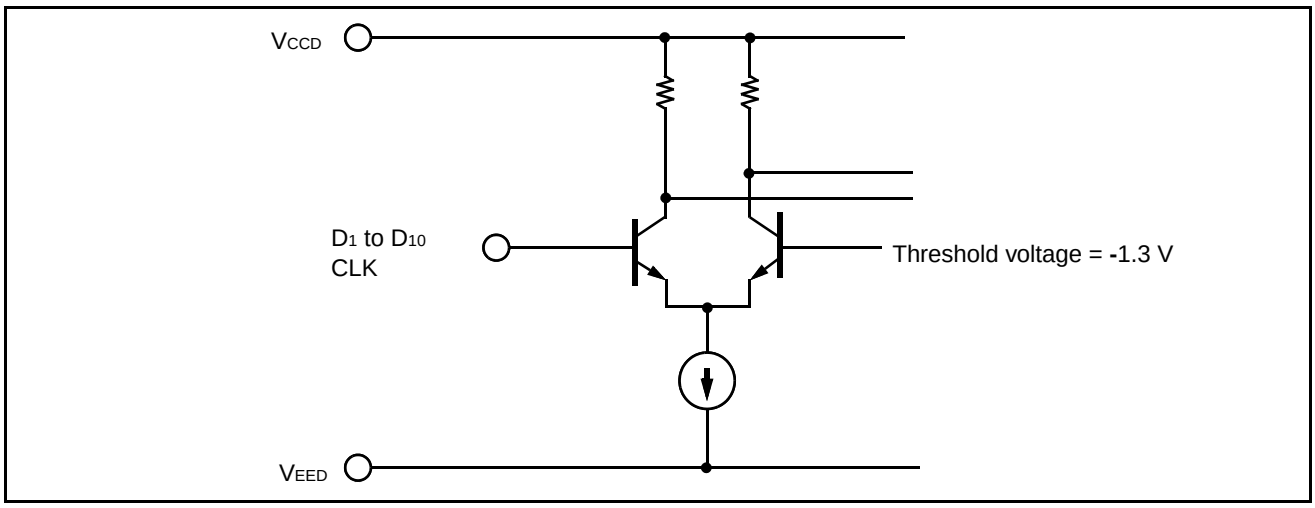
DataSheet4U.com
DataSheet4U.com

■ BLOCK DIAGRAM

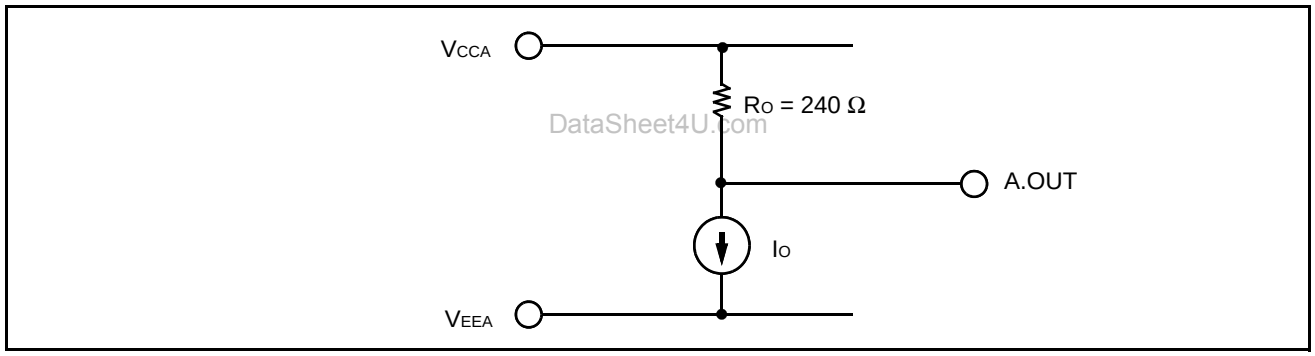


DataSheet4U.com
www.DataSheet4U.com

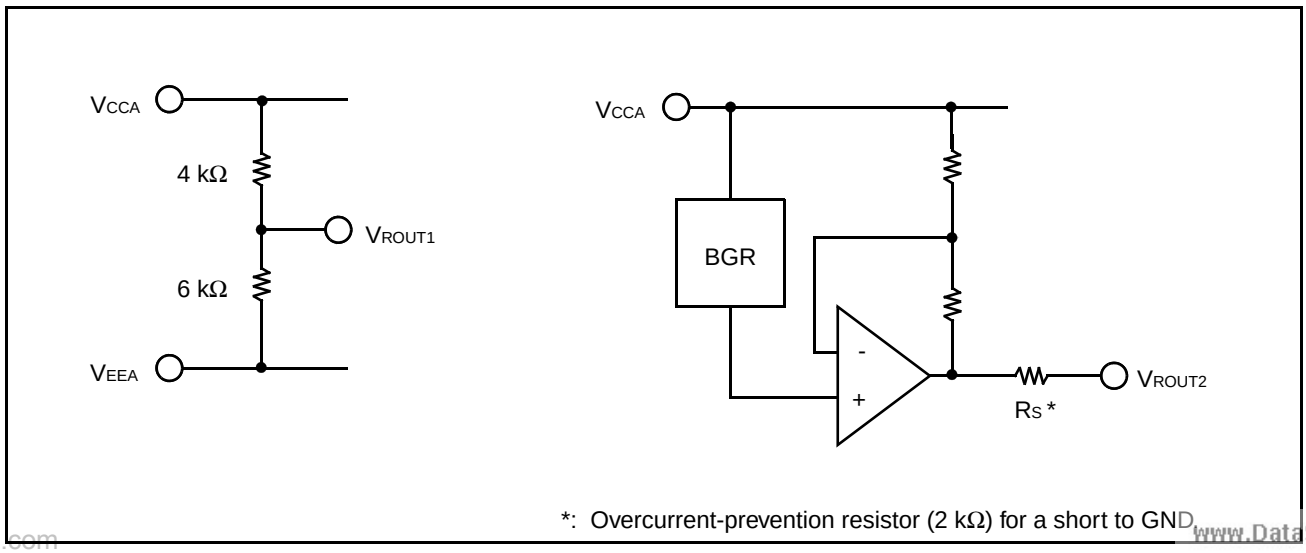
■ DIGITAL INPUT EQUIVALENT CIRCUIT



■ ANALOG OUTPUT EQUIVALENT CIRCUIT



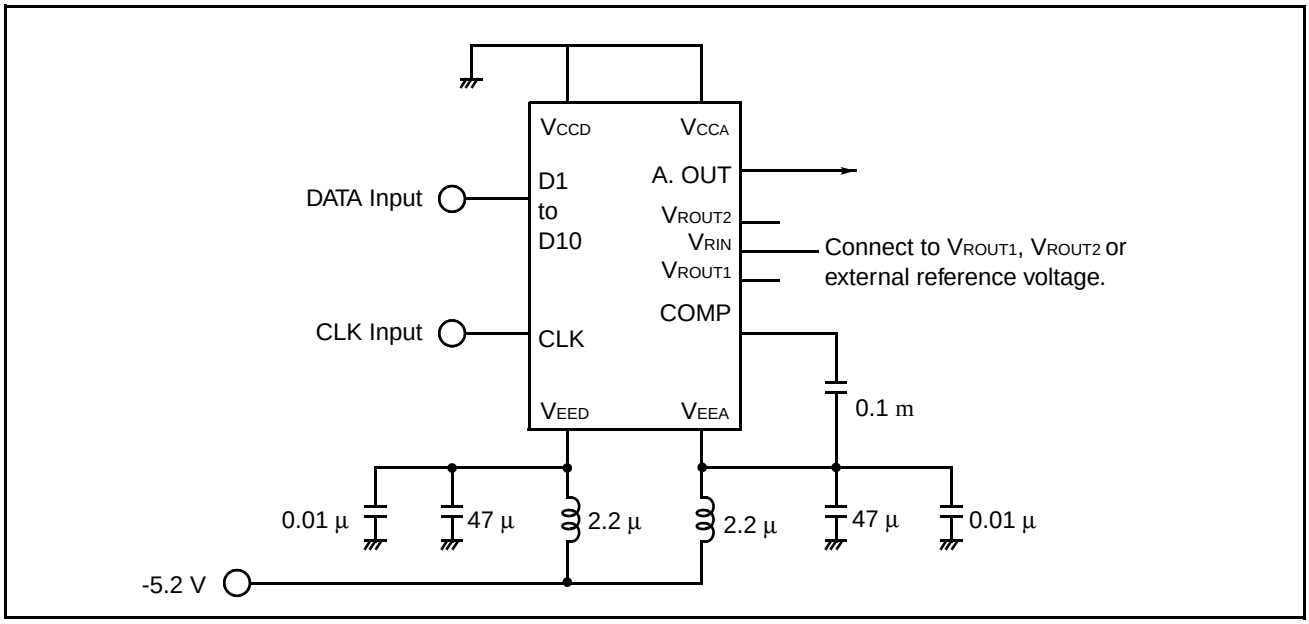
■ REFERENCE VOLTAGE OUTPUT EQUIVALENT CIRCUIT



*: Overcurrent-prevention resistor (2 kΩ) for a short to GND

DataSheet4U.com
www.DataSheet4U.com

■ TYPICAL CONNECTION EXAMPLE



et4U.com DataShee

■ RECOMMENDED OPERATING CONDITIONS

DataSheet4U.com

(V_{CCA}=V_{CCD}=0 V, T_a=-20°C to +75°C)

Parameter		Symbol		Standard value			Unit
				Min.	Typ.	Max.	
Power supply voltage	Analog power supply voltage	V_{EEA}		-5.46	-5.20	-4.94	V
	Digital power supply voltage	V_{EED}		-5.46	-5.20	-4.94	V
	Power supply voltage difference	V_{EEA}-V_{EED}		-0.2	-	0.2	V
Analog reference voltage		V_{RIN}		-2.20	-2.00	-0.70	V
Digital input high voltage		V_{IHD}	-20°C	-	-	-0.88	V
			25°C	-1.13	-	-0.81	V
			75°C	-	-	-0.735	V
Digital input low voltage		V_{ILD}	-20°C	-1.95	-	-	V
			25°C	-1.95	-	-1.48	V
			75°C	-1.95	-	-	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

DataSheet4U.com www.DataSheet4U.com

DataSheet4U.com DataSheet4U.com

■ DC CHARACTERISTICS

(V_{EEA}=V_{EED}=-5.46 to -4.94 V, T_a=-20°C to +75°C)

Parameter		Symbol	Condition	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}	-	-	-	5	µA
Digital input current low		I_{ILD}	-	-0.1	-	-	µA
Reference input current		I_{RIN}	V_{RIN}=-2.000V	-	-	10	µA
Potential divider reference	Reference voltage	V_{ROUT1}	V_{EEA} = -5.20 V V_{EED} = -5.20 V	-2.100	-2.000	-1.900	V
Band-gap reference	Reference voltage	V_{ROUT2}	-	-2.100	-2.000	-1.900	V
	Temperature coefficient	-	-	-	100	-	ppm/°C
Full-scale output voltage		V_{OFS}	-	-20	0	-	mV
Zero-scale output voltage		V_{OZS}	V_{EEA} = -5.20 V V_{EED} = -5.20 V V_{RIN} = -2.000 V	-2.068	-1.998	-1.928	V
Output resistance		R_O	Ta=+25°C	192	240	288	Ω
Power dissipation		I_{EE}	V_{EEA} = -5.46 V V_{EED} = -5.46 V V_{RIN} = V_{ROUT}	-59	-34*	-	mA

* : V_{EEA} = V_{EED} = -5.20 V

■ AC CHARACTERISTICS

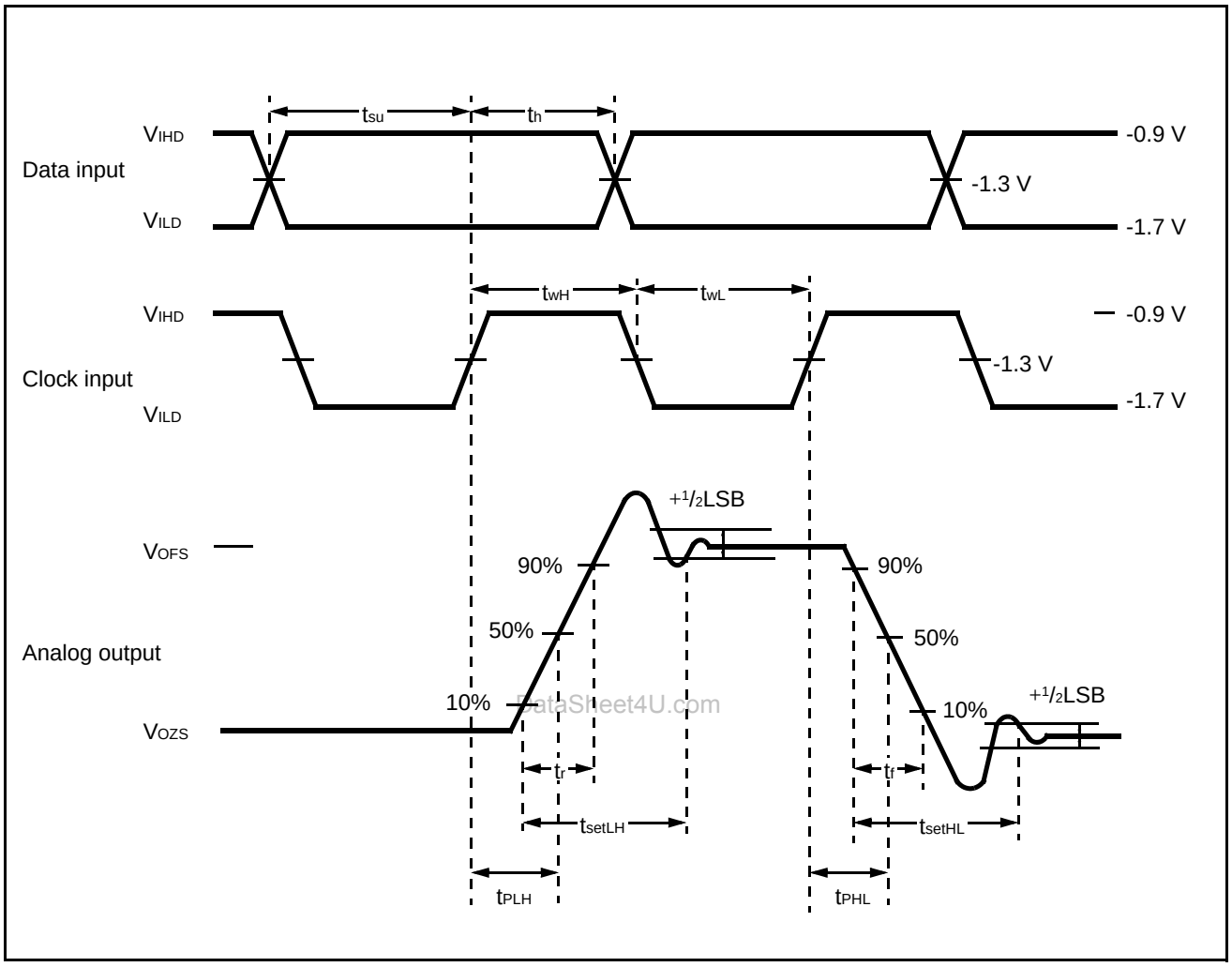
(V_{EEA}= V_{EED}=-5.46 to -4.94 V, T_a=-20°C to +75°C)

Parameter	Symbol	Conditions	Standard values			Unit
			Min.	Typ.	Max.	
Maximum conversion rate	F_S	CL = 15 pF A.OUT pin terminating resistance = 240 Ω	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

DataSheet4U.com
www.DataSheet4U.com

DataSheet4U.com
DataSheet4U.com

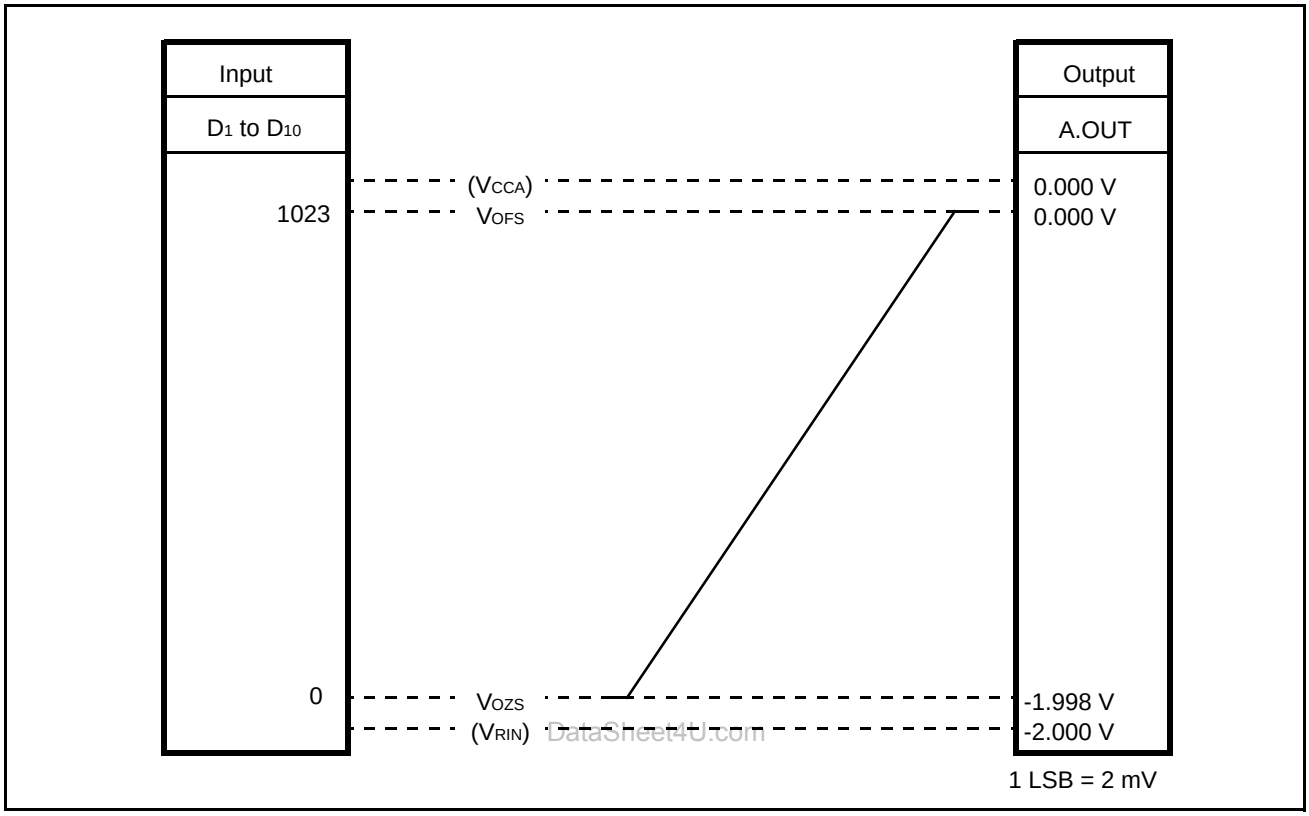
■ TIMING CHART



DataSheet4U.com
www.DataSheet4U.com

DataSheet4U.com
DataSheet4U.com

■ 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 code from 0 to 1023)

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

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

NOTES

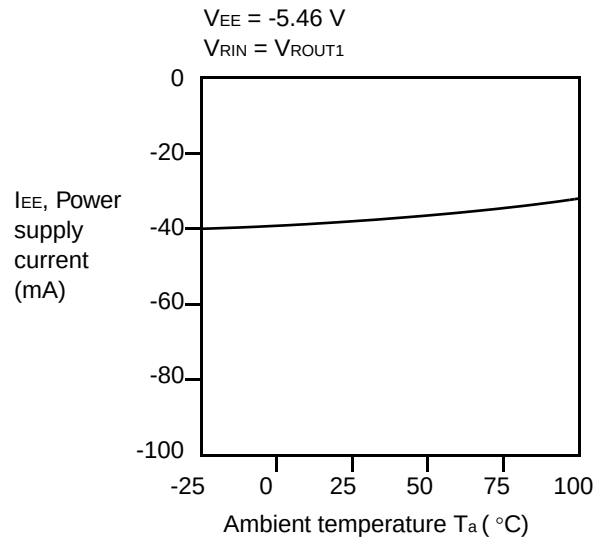
1. **Preventing Switching Noise**
   To prevent switching noise in the analog output signal, connect noise limiting capacitors to the V_{EEA} and V_{EED} pins as close to the V_{CCA} and V_{CCD} pins as possible.
2. **Power Pattern**
   To reduce parasitic impedance, the PC board pattern to the V_{CCA}, V_{CCD}, V_{EEA} and V_{EED} pins should be as wide as possible.

DataSheet4U.com
www.DataSheet4U.com

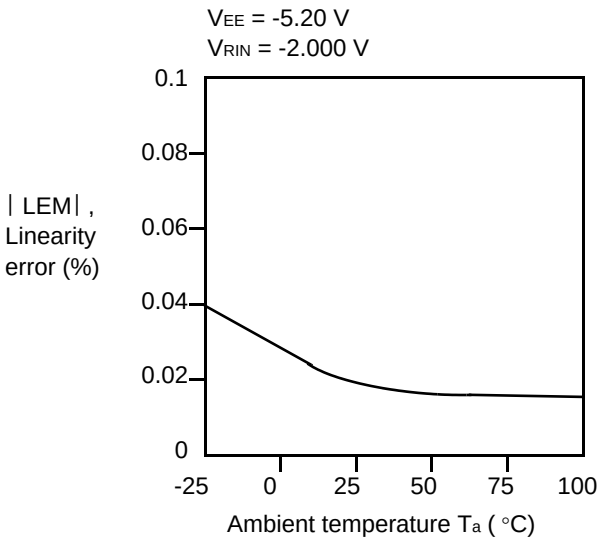
DataSheet4U.com
DataSheet4U.com

■ TYPICAL CHARACTERISTICS CURVES

1. Power Supply Current v.s. Ambient Temperature

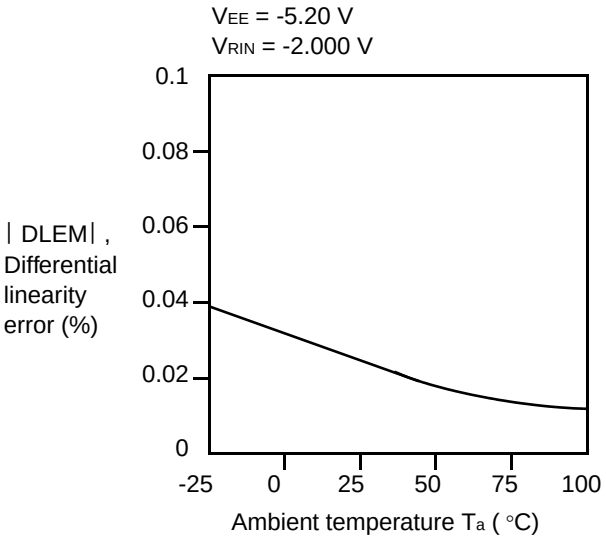


2. Linearity Error v.s. Ambient Temperature

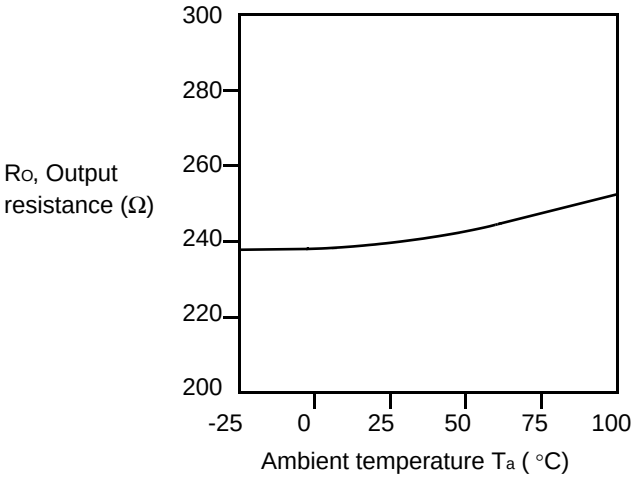


DataSheet4U.com

3. Differential Linearity Error v.s. Ambient Temperature



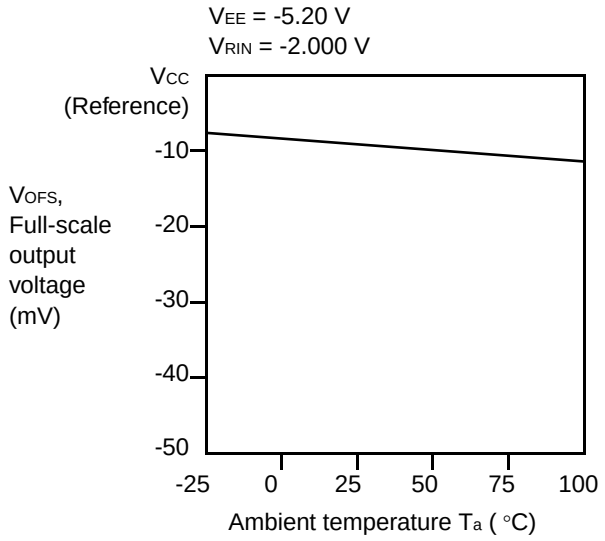
4. Output Resistance v.s. Ambient Temperature



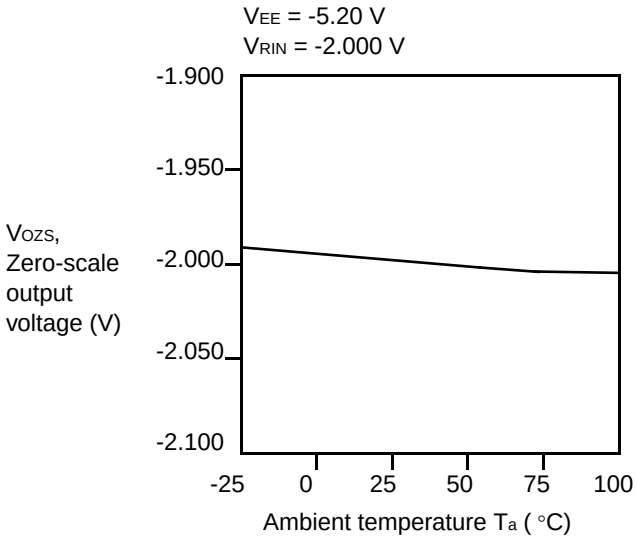
DataSheet4U.com
www.DataSheet4U.com

DataSheet4U.com
DataSheet4U.com

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

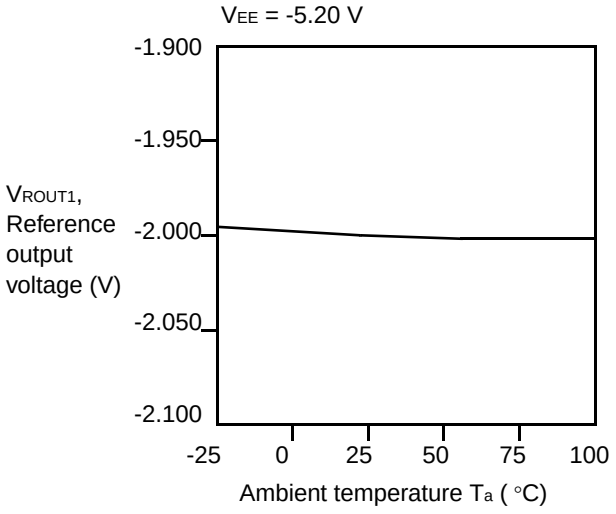


6. Zero-Scale Output Voltage v.s. Ambient Temperature

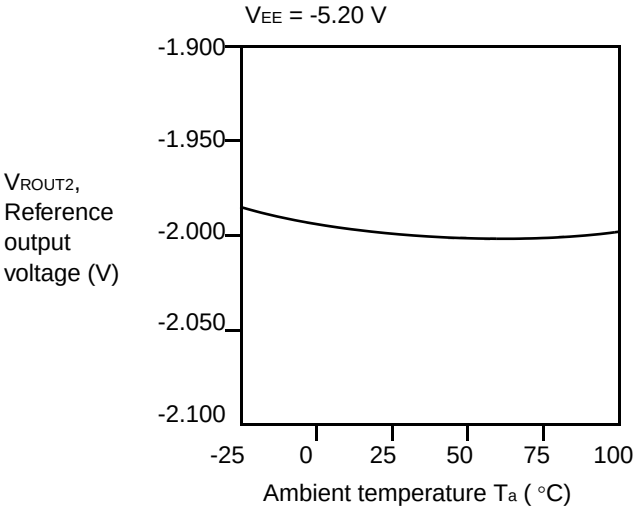


et4U.com
DataShee
DataSheet4U.com

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



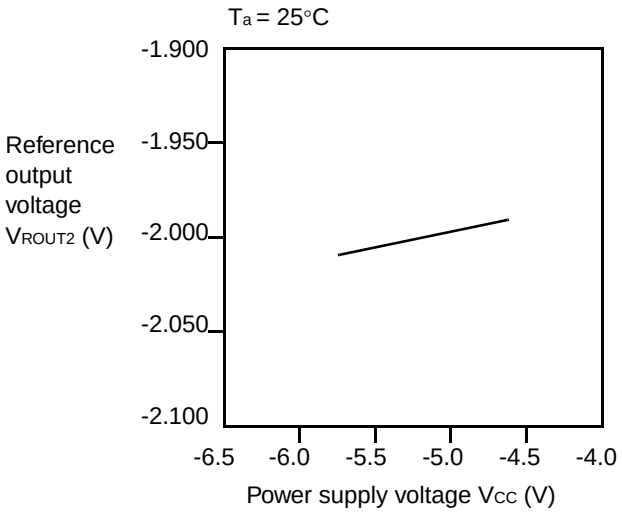
8. V_{ROUT2} Reference Output Voltage v.s. Ambient Temperature



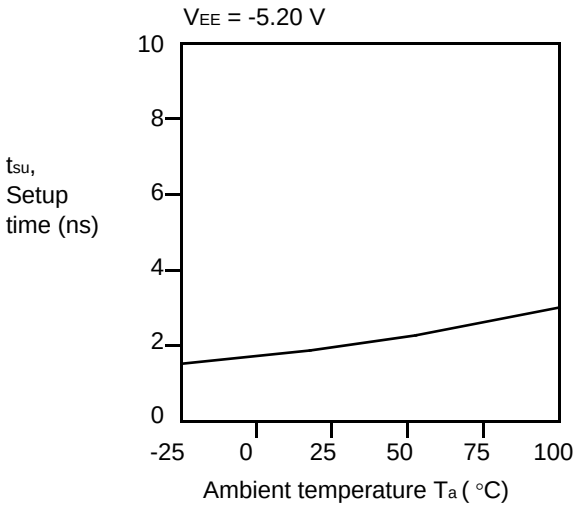
DataSheet4U.com
www.DataSheet4U.com

DataSheet4U.com
DataSheet4U.com

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

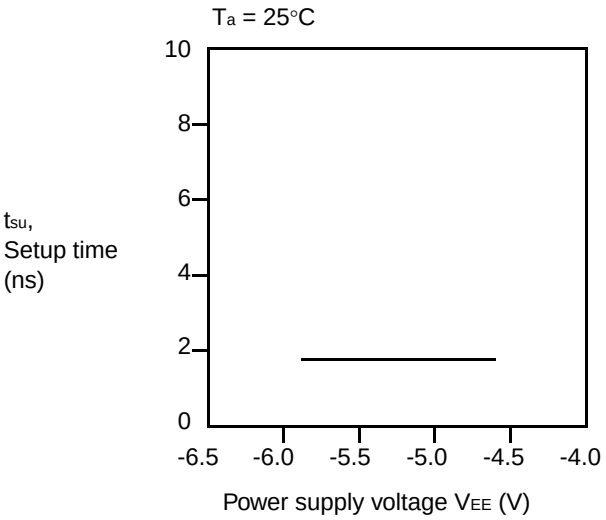


10. Setup Time v.s. Ambient Temperature

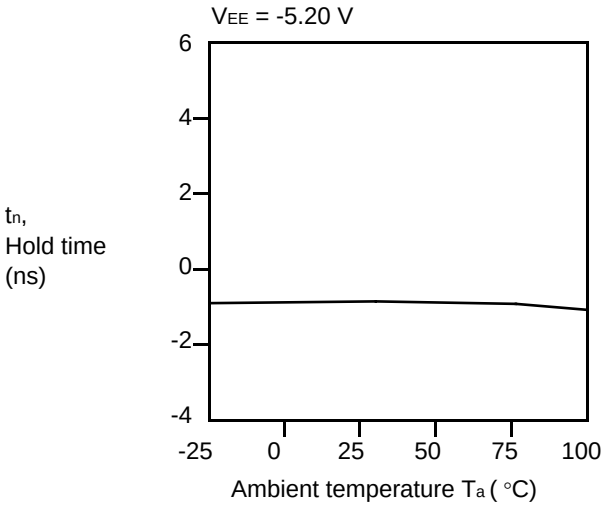


DataSheet4U.com

11. Setup Time v.s. Power Supply Voltage



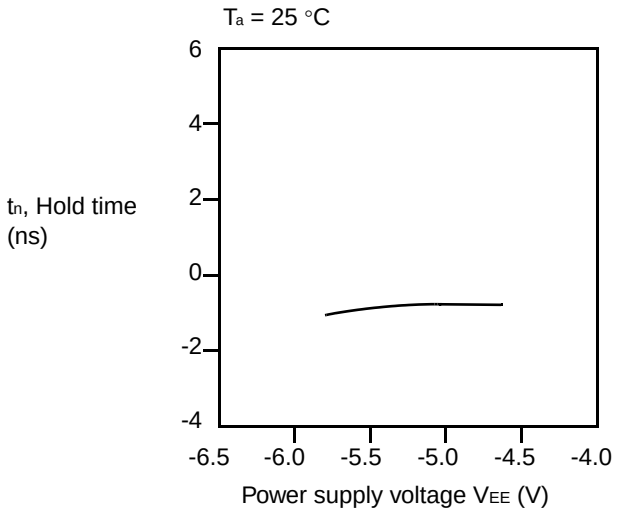
12. Hold Time v.s. Ambient Temperature



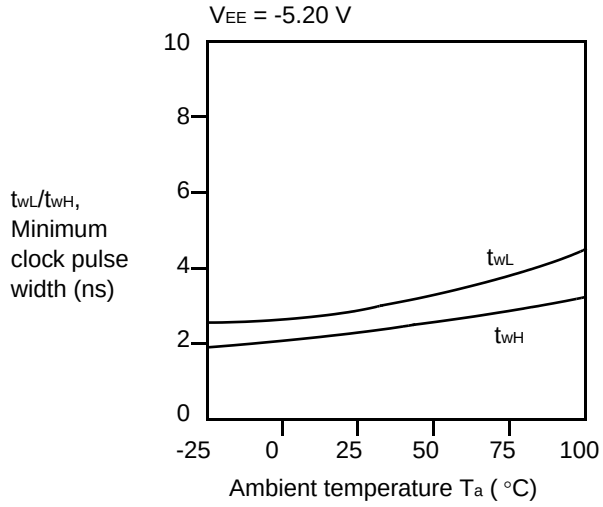
DataSheet4U.com
www.DataSheet4U.com

DataSheet4U.com
DataSheet4U.com

13. Hold Time v.s. Power Supply Voltage

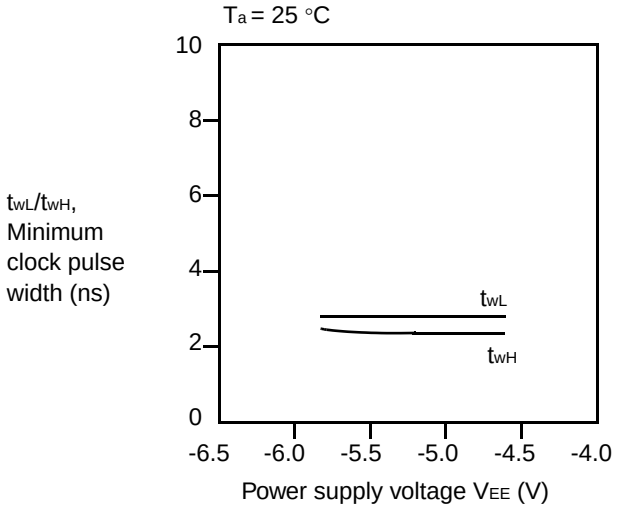


14. Minimum Clock Pulse Width v.s. Ambient Temperature



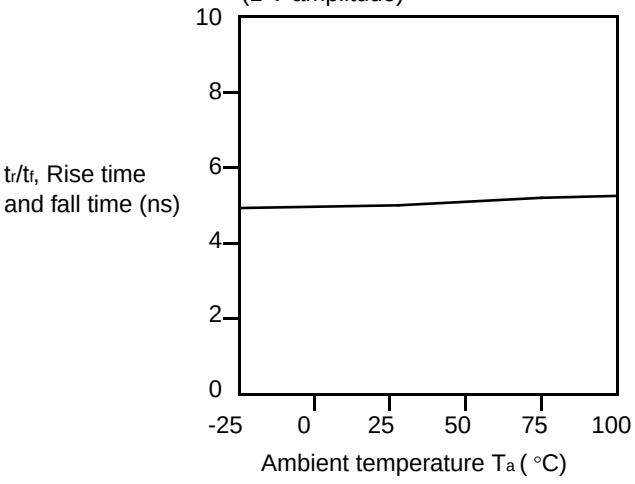
DataSheet4U.com

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



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

VEE = -5.20 V
VRIN = -2.000 V
CL = 15 pF
Analog output 240 Ω termination
(1 V amplitude)

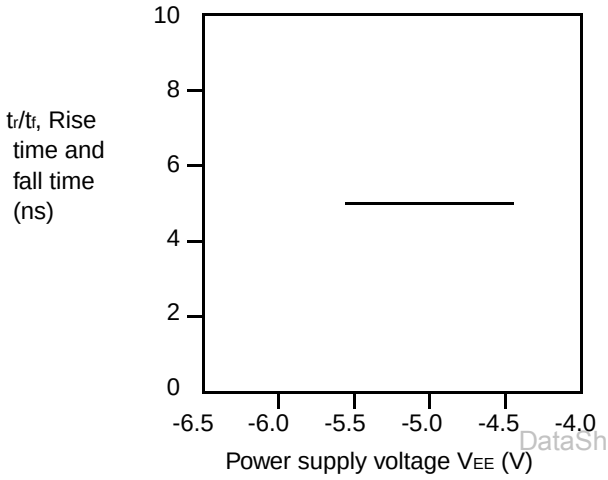


DataSheet4U.com
www.DataSheet4U.com

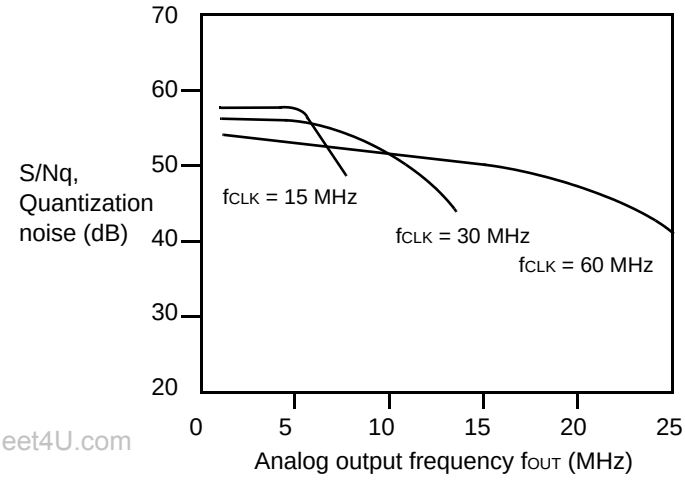
DataSheet4U.com
DataSheet4U.com

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

T_a = 25 °C
V_{RIN} = -2.000 V
C_L = 15 pF
Analog output 240 Ω termination
(1 V amplitude)



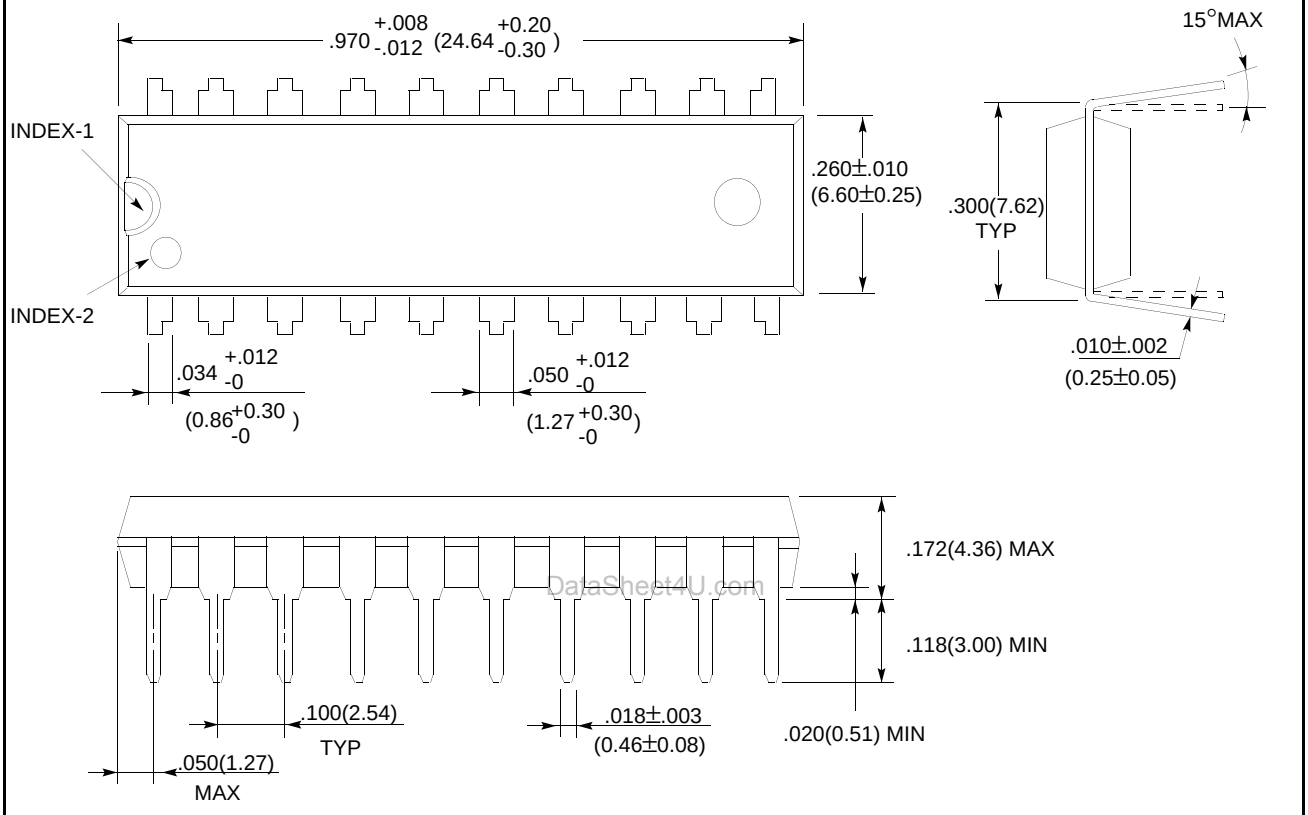
18. Quantization Noise v.s. Analog Output Frequency



DataSheet4U.com
www.DataSheet4U.com

■ PACKAGE DIMENSIONS

20-LEAD PLASTIC DUAL IN-LINE PACKAGE
(CASE No.: DIP-20P-M01)



Dimensions in
inches (millimeters)

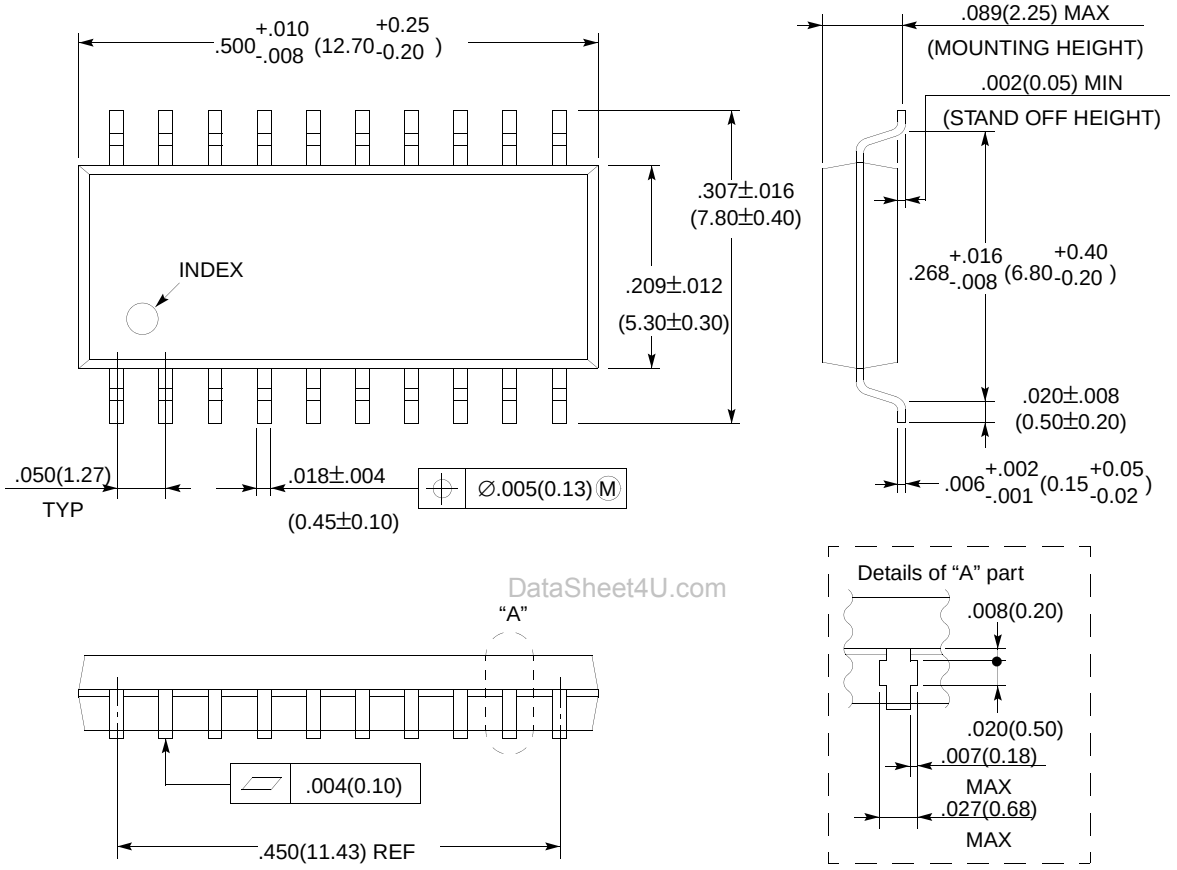
©1991 FUJITSU LIMITED D20005S-3C

DataSheet4U.com
www.DataSheet4U.com

DataSheet4U.com
DataSheet4U.com

■ PACKAGE DIMENSIONS (Continued)

20-LEAD PLASTIC FLAT PACKAGE
(CASE No.: FPT-20P-M01)



©1991 FUJITSU LIMITED F20003S-5C

Dimensions in
inches (millimeters)

DataSheet4U.com
www.DataSheet4U.com

FUJITSU LIMITED

For further information please contact:

Japan
FUJITSU LIMITED
Corporate Global Business Support Division
Electronic Devices
KAWASAKI PLANT, 1015, Kamikodanaka
Nakahara-ku, Kawasaki-shi
Kanagawa 211, Japan
Tel: (044) 754-3753
Fax: (044) 754-3329

North and South America
FUJITSU MICROELECTRONICS, INC.
Semiconductor Division
3545 North First Street
San Jose, CA 95134-1804, U.S.A.
Tel: (408) 922-9000
Fax: (408) 432-9044/9045

Europe
FUJITSU MIKROELEKTRONIK GmbH
Am Siebenstein 6-10
63303 Dreieich-Buchschlag
Germany
Tel: (06103) 690-0
Fax: (06103) 690-122

Asia Pacific
FUJITSU MICROELECTRONICS ASIA PTE. LIMITED
No. 51 Bras Basah Road,
Plaza By The Park,
#06-04 to #06-07
Singapore 189554
Tel: 336-1600
Fax: 336-1609

F9601
© FUJITSU LIMITED Printed in Japan

All Rights Reserved.

Circuit diagrams utilizing Fujitsu products are included as a means of illustrating typical semiconductor applications. Complete information sufficient for construction purposes is not necessarily given.

The information contained in this document has been carefully checked and is believed to be reliable. However, Fujitsu assumes no responsibility for inaccuracies.

The information contained in this document does not convey any license under the copyrights, patent rights or trademarks claimed and owned by Fujitsu.

Fujitsu reserves the right to change products or specifications without notice.

No part of this publication may be copied or reproduced in any form or by any means, or transferred to any third party without prior written consent of Fujitsu.

The information contained in this document are not intended for use with equipments which require extremely high reliability such as aerospace equipments, undersea repeaters, nuclear control systems or medical equipments for life support.

DataSheet4U.com
www.DataSheet4U.com
DataSheet4U.com
DataSheet4U.com