

FUJITSU

8-CHANNEL 8-BIT A/D CONVERTER

MB4056

April 1988
Edition 2.0

8-CHANNEL 8-BIT A/D CONVERTER

The Fujitsu MB4056 is an analog-to-digital converter (ADC) for general purpose which features eight channels of analog inputs and 8-bit data length of digital output.

Analog input signal is converted to serial 8-bit digital data by the successive-approximation technique which provides high-speed conversion, i.e. many analog data can be converted within a short time.

Additionally, the MB4056 has dual range conversion capability, which provides sequentially one data of both range, standard and contracted modes, to chose better data between them and to delete the range change time.

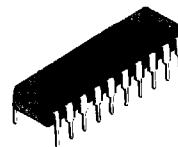
All digital I/O signals including control inputs are TTL level compatible so as to provide wide application such as in microprocessor-controlled system and so on.

- Single Power Supply: +4.75 V to +18 V
- Multiplex 8-Channel Analog Inputs: 8 bits
- Resolution: 8 bits
- Linearity Error: $\pm 0.19\%$ Max.
- Analog Input Voltage Ranges:
 - Automatic Range Change/Dual Range Conversion: 0 to 5 V
Standard mode
 - 0 to 1.25 V
Contracted mode
- Successive-Approximation Conversion: 100 μ s/ch Max. at $f_{CLK} = 100$ kHz, S/D = 1
200 μ s/ch Max. at $f_{CLK} = 100$ kHz, S/D = 0
- Ratio-metric Conversion by Reference Voltage V_{REF}
- Analog Input Bias Current: 250 nA Max.
- TTL/CMOS Compatible Digital I/O
- Power Consumption: 160 mW Typ. at $V_{CC} = 8V$
- Standard 20-pin Plastic Package: Suffix: -P
- Standard 20-Pin Ceramic Package: Suffix: -Z

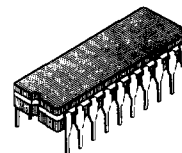
ABSOLUTE MAXIMUM RATINGS (See NOTE)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	+20	V
Digital Input Voltage	V_{IH}	+20	V
Digital Output Voltage (Off-State)	V_{OH}	+20	V
Analog Input Voltage	V_{IA}	+20	V
Storage Temperature	Ceramic	T_{STG}	-55 to +150 °C
	Plastic	T_{STG}	-40 to +125 °C

NOTE: Permanent device damage may occur if 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.



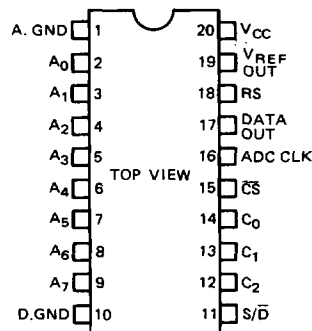
PLASTIC PACKAGE
DIP-20P-M01



PLASTIC PACKAGE
DIP-20C-C03

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PIN ASSIGNMENT



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.

Fig. 1 - MB4056 BLOCK DIAGRAM

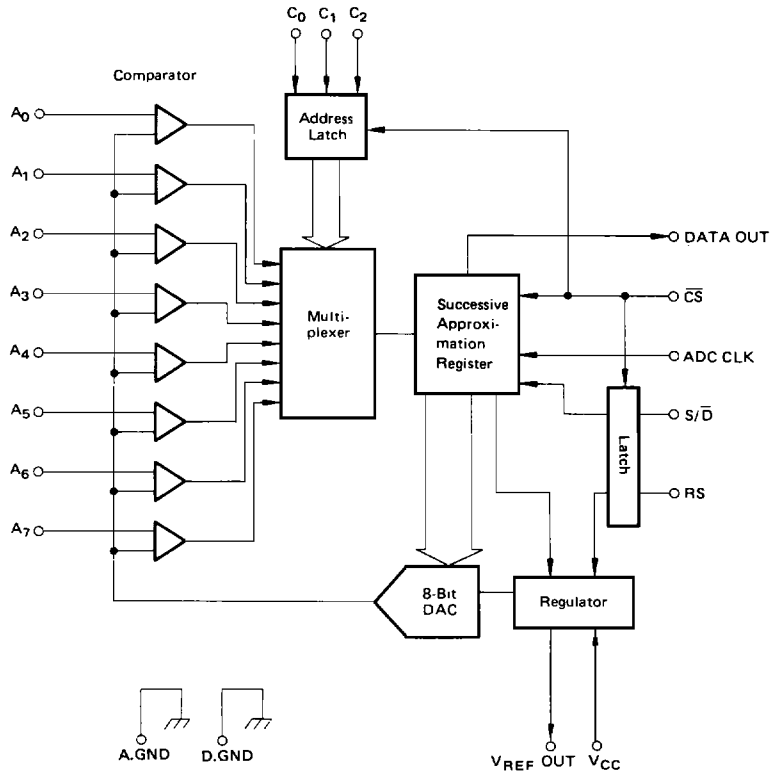


TABLE 1: CONVERSION MODES

S/D	RS	1st Conversion	2nd Conversion
L	L	Contracted Range	Standard Range
L	H	Standard Range	Contracted Range
H	L	Contracted Range	-
H	H	Standard Range	-

TABLE 2: CHANNEL SELECTIONS

C ₂	C ₁	C ₀	Channel
0	0	0	A ₀
0	0	1	A ₁
0	1	0	A ₂
0	1	1	A ₃
1	0	0	A ₄
1	0	1	A ₅
1	1	0	A ₆
1	1	1	A ₇

PIN DESCRIPTIONS

Pin Name	Pin No.	Descriptions
A ₀ to A ₇	2 to 9	Analog Inputs These inputs are provided to receive eight channels of analog inputs. One of them is selected by a combination of C ₀ to C ₂ .
S/ \overline{D}	11	Conversion Mode Select Input This control input is provided to select a conversion sequence with RS input as shown in Table 1. When low, analog input voltage is converted in both ranges, and when high, in one range only. This input is latched at the falling edge of \overline{CS} .
C ₂ to C ₀	12 to 14	Channel Select Inputs These inputs are used to select one of eight analog input as shown in Table 2. This inputs are latched at the falling edge of \overline{CS} .
\overline{CS}	15	Chip Select Input This control input is used to start analog to digital conversion and to terminate it. When \overline{CS} goes low, the A/D conversion starts and the DATA OUTPUT is enabled. When the A/D conversion is completed or termination of the conversion is required, \overline{CS} is made high.
ADC CLK	16	A/D Conversion Clock This clock signal is used for A/D conversion. The conversion speed is determined by this clock rate. But precise stability of the clock rate is no required.
DATA OUT	17	Data Outputs This output is provided to output the A/D conversion results as digital signals. The converted digital data are serially output in the order of start-bit, MSB (Most Significant Bit), 2SB (Second Significant Bit), . . . , 7SB, LSB (Least Significant Bit) and stop-bit in synchronous with the ADC CLK.
RS	18	Range Select Input This control input is provided to select an analog input voltage as shown in Table 1. This input is latched at the falling edge of \overline{CS} .
V _{REF}	19	Reference Voltage Output This output provides the regulated 5V when V _{CC} is between 8V and 18V. About 10mA current of the output is supplied externally.
A. GND D. GND	1 10	Analog Ground Digital Ground
V _{CC}	20	Power Supply Voltage, 4.75V to 18V.



RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
Power Supply Voltage	V_{CC}	4.75	12	18	V
Digital output Low Current	I_{OL}			8	mA
Ambient Operating Temperature	T_A	-40		+85	°C

ANALOG CIRCUIT CHARACTERISTICS

($V_{CC} = 4.75$ to $18V$, $T_A = -40$ to $85^\circ C$)

Parameter	Symbol	Condition	Value			Unit
			Max	Typ	Max	
Resolution					8	bit
Linearity Error					±0.5	LSB
Differential Linearity Error					±0.9	LSB
Zero Transition Voltage	V_{ZS}	Standard Conversion Mode $8V \leq V_{CC} \leq 18V$		20		mV
Full Scale Transition Voltage	V_{FS}			4980		mV
Zero Transition Voltage	V_{ZC}	Contracted Conversion Mode $4.75V \leq V_{CC} \leq 18V$		5		mV
Full Scale Transition Voltage	V_{FC}			1245		mV
Comparator Input Current	I_{COP}				-250	nA
Regulator	Output Voltage	$8V \leq V_{CC} \leq 18V$	4.5	5.0	5.5	V
	Line Regulation	$8V \leq V_{CC} \leq 18V$		4.0		mV/V
	Load Regulation	$V_{CC} = 12V$ $-10mA \leq I_{OUT} \leq 0mA$		0.5		mV/mA
	Output Voltage Change with Temperature	$V_{CC} = 12V$		50		PPm/°C
Conversion Time	t_{CYC1}	$f_{CLK} = 100kHz, S/D = "1"$			100	μs/CH
	t_{CYC0}	$f_{CLK} = 100kHz, S/D = "0"$			200	μs/CH

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DIGITAL CIRCUIT DC CHARACTERISTICS

($V_{CC} = 4.75$ to $18V$, $T_A = -40$ to $85^\circ C$)

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Input High Voltage	V_{IH}		2.0			V
Input Low Voltage	V_{IL}				0.8	V
Input Clamp Voltage	V_{IC}	$I_{IL} = -18mA$			-1.5	V
Output High Current	I_{OH}	$V_{IH} = 2V$, $V_{IL} = 0.8V$ $V_{OH} = 20V$			100	μA
Output Low Voltage	V_{OL}	$V_{IH} = 2V$ $V_{IL} = 0.8V$	$I_{OL} = 4mA$		0.4	V
			$I_{OL} = 8mA$		0.5	V
Input High Current	I_{IH}	$V_{IH} = 2.7V$			20	μA
		$V_{IH} = 20V$			100	μA
Input Low Current	I_{IL}	$V_{IL} = 0.4V$		-20	-100	μA
Power Supply Current	I_{CC}	$V_{CC} = 20V$		20	38	mA

DIGITAL CIRCUIT AC CHARACTERISTICS

($V_{CC} = 4.75$ to $18V$, $T_A = -40$ to $85^\circ C$)

Parameter	Symbol	Value			Unit
		Min	Typ	Max	
ADC CLK Cycle Time	t_{CY}	10			μs
ADC CLK H level Pulse Width	t_{WAC}^+	2.5			μs
ADC CLK L level Pulse Width	t_{WAC}^-	2.5			μs
\overline{CS} H level Pulse Width	t_{WCS}^+	1.5			μs
\overline{CS} Set-up Time	t_{SCS}	1			μs
\overline{CS} Hold Time	t_{HCS}	1			μs
Channel Set-up Time	t_{SCH}	0			μs
Channel Hold Time	t_{HCH}	1.5			μs
Propagation Delay Time	t_{PLH}		0.8	2	μs
	t_{PHL}		0.8	2	μs

Fig. 2 – AC MEASUREMENT CIRCUIT

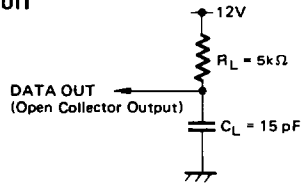
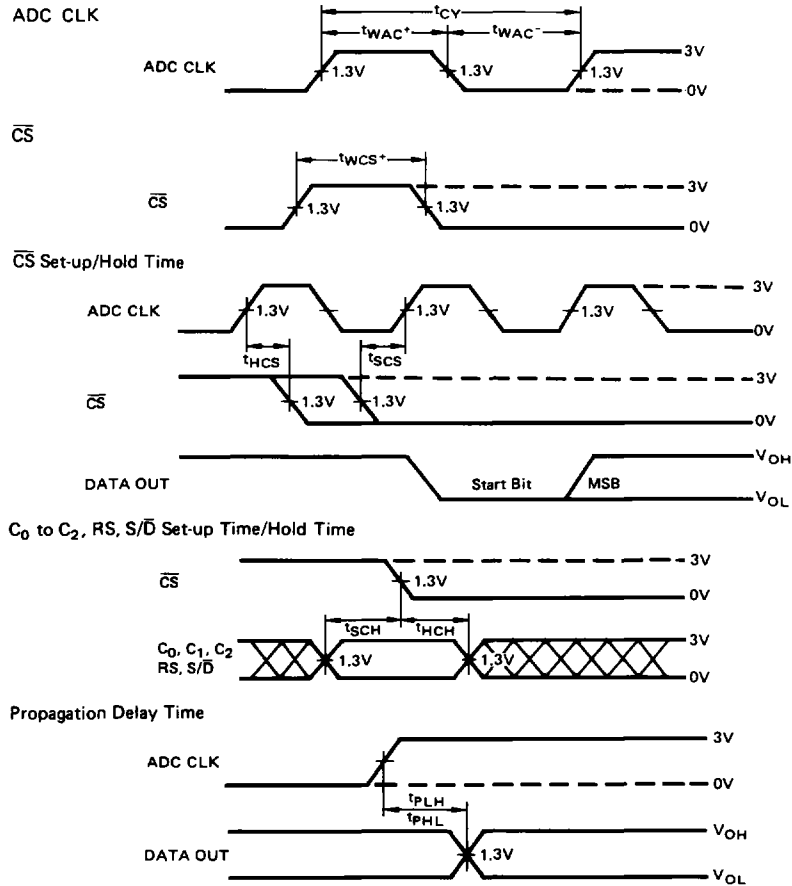
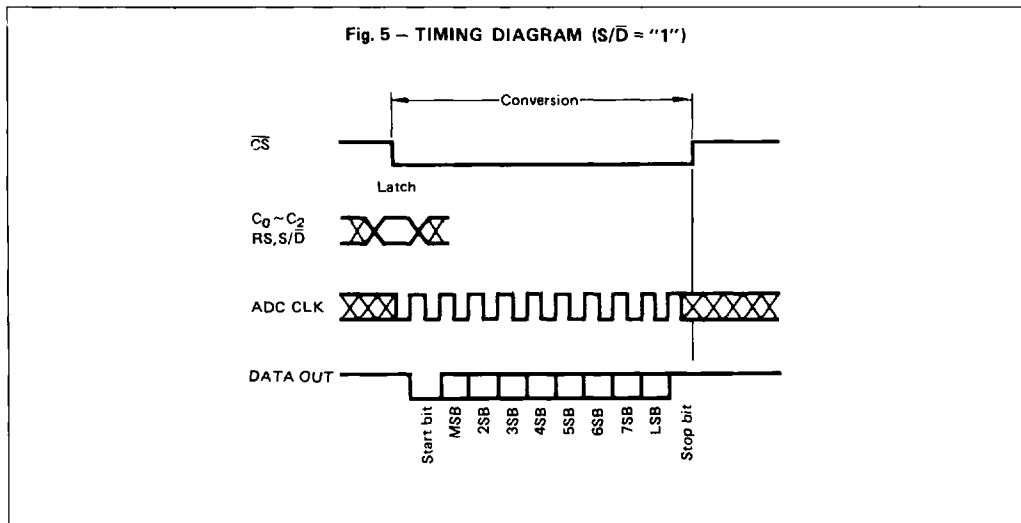
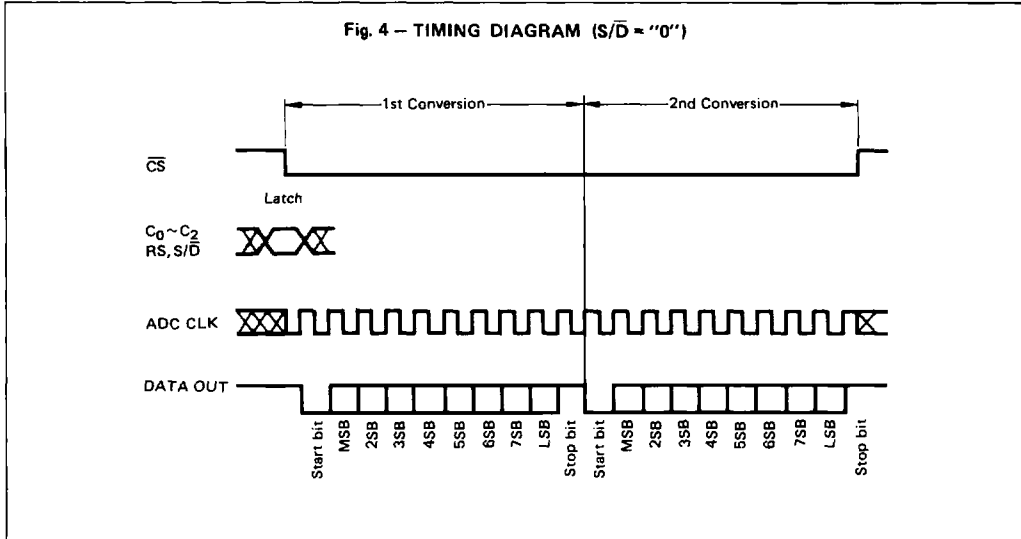


Fig. 3 – AC TIMING DIAGRAM



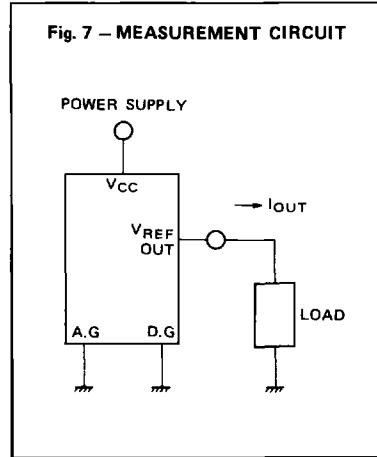
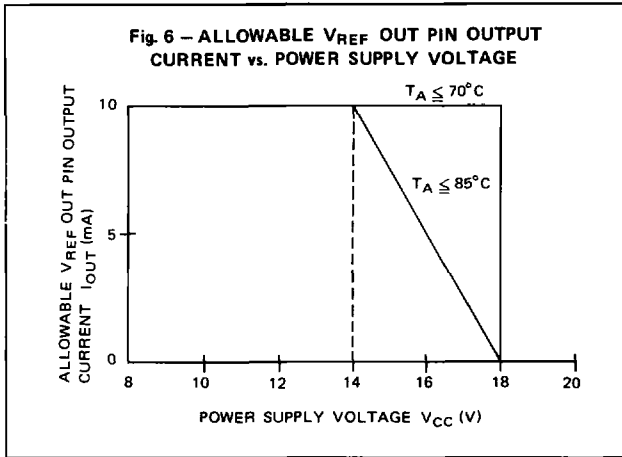
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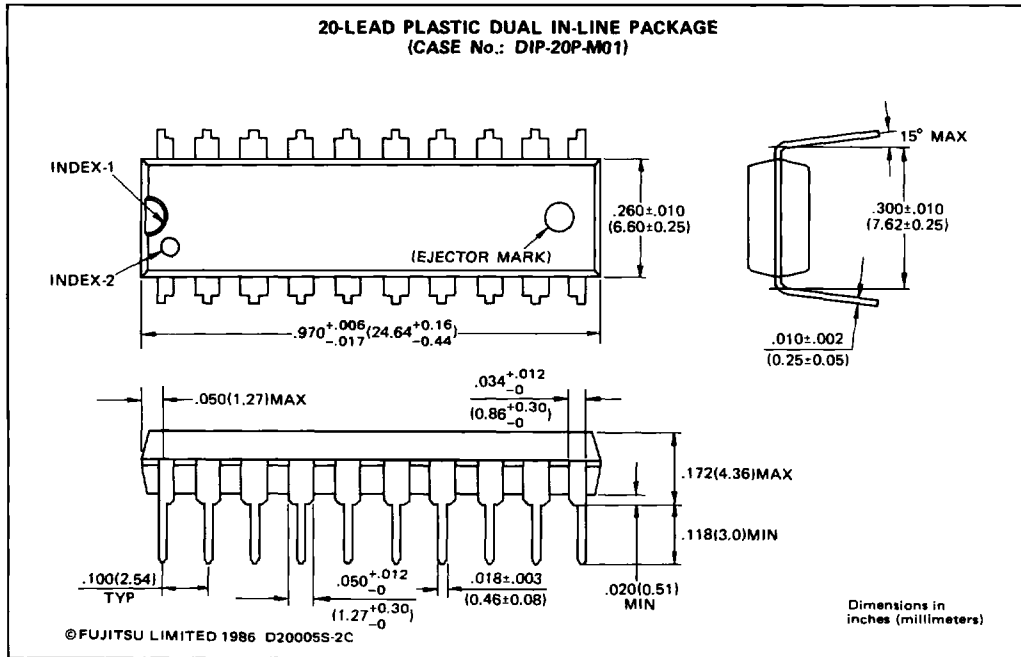
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TYPICAL CHARACTERISTICS CURVES



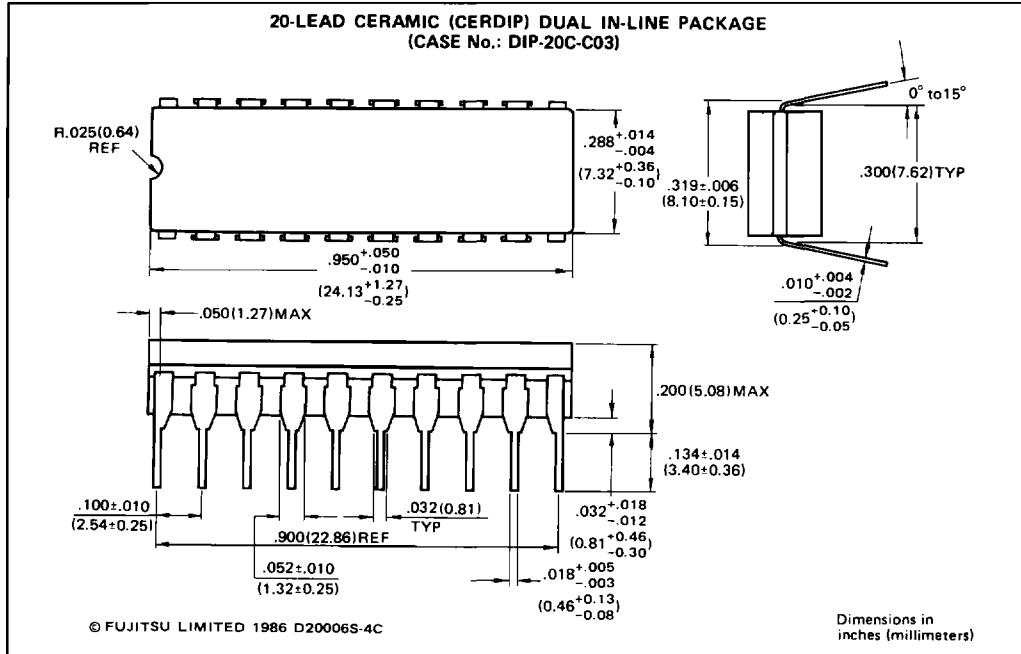
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PACKAGE DIMENSIONS



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PACKAGE DIMENSIONS (continued)



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