DS04-13504-6E

FUJITSU

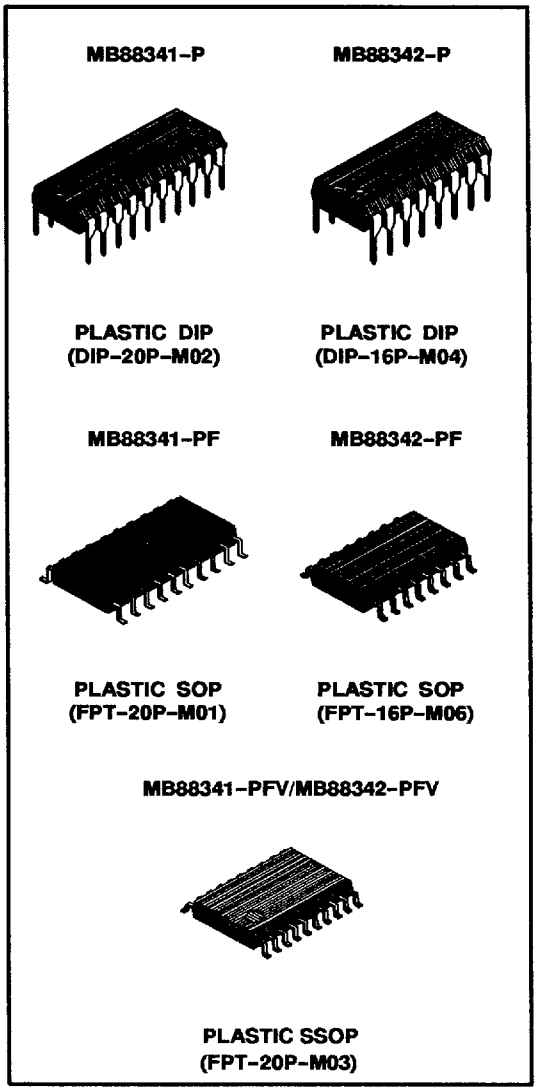
DATA SHEET

LINEAR IC
R-2R TYPE 8-BIT D/A CONVERTER
MB88341/MB88342

DESCRIPTION

The Fujitsu MB88341 and MB88342 are R-2R type 8-bit resolution digital-to-analog converters (DAC), designed for interface with a wide range of general 4-bit and 8-bit microcomputers including Fujitsu's MB8840/50 series and MB88400/500 series 4-bit single-chip microcomputers.

The MB88341 has an 8-bit x 12-channel D/A converter and the MB88342 has an 8-bit x 8-channel D/A converter. Digital data are input serially by individual channel units. The loaded digital data are convertered into analog DC voltages by the D/A converter in 60 µs settling time. The MB88341 and MB88342 are suitable for electronic volumes and replacement for potentiometers for adjustment, in addition to normal D/A converter applications.

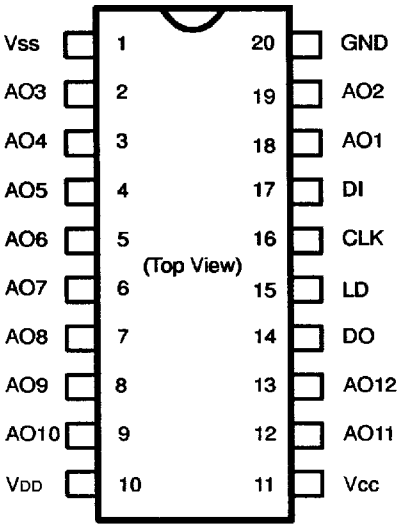


FEATURES

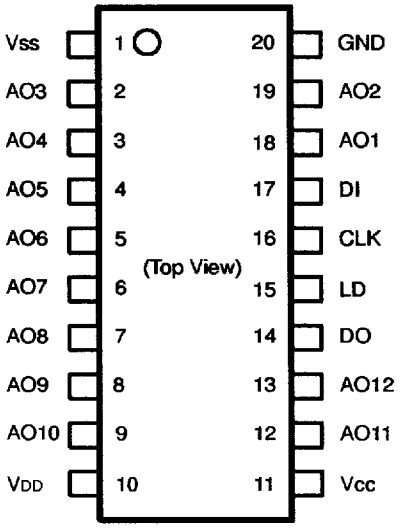
- Conversion method : R-2R resistor ladder
- MB88341 : 8-bit x 12-channel D/A converter
- MB88342 : 8-bit x 8-channel D/A converter
- Serial data input
- Serial data output for cascade connection
- 60 µs DAC output settling time
- Two separate power supply/ground lines for digital and analog blocks.
- Single +5V power supply
- Wide operating temperature range: -40°C to +85°C
- Silicon-gate CMOS process
- Three package options :
  - -MB88341: 20-pin plastic DIP (Suffix : -P), 20-pin plastic SOP (Suffix : -PF), 20-pin plastic SSOP (Suffix : -PFV)
  - -MB88342: 16-pin plastic DIP (Suffix : -P), 16-pin plastic SOP (Suffix : -PF), 20-pin plastic SSOP (Suffix : -PFV)

PIN ASSIGNMENT

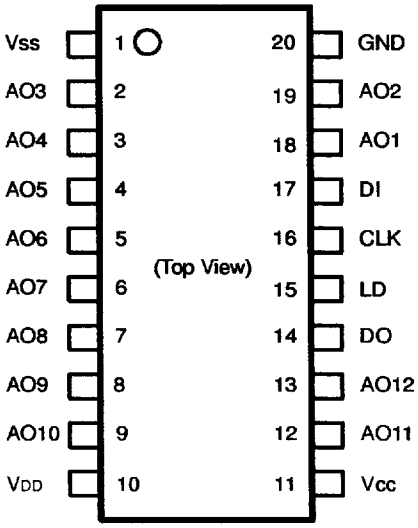
MB88341-P



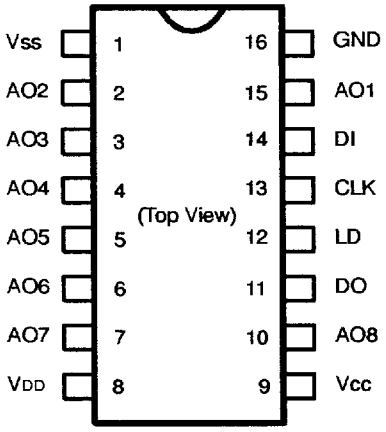
MB88341-PF



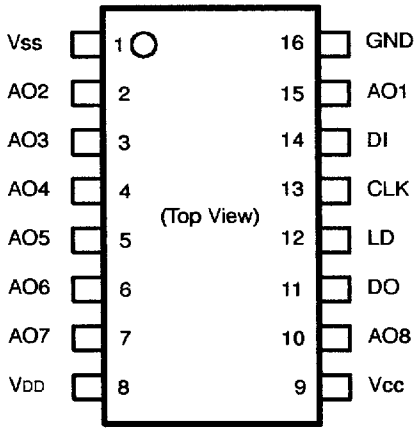
MB88341-PFV



MB88342-P



MB88342-PF



MB88342-PFV

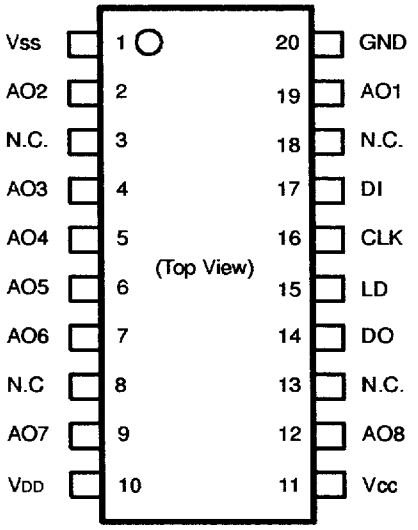


Figure 1 Logic Symbol

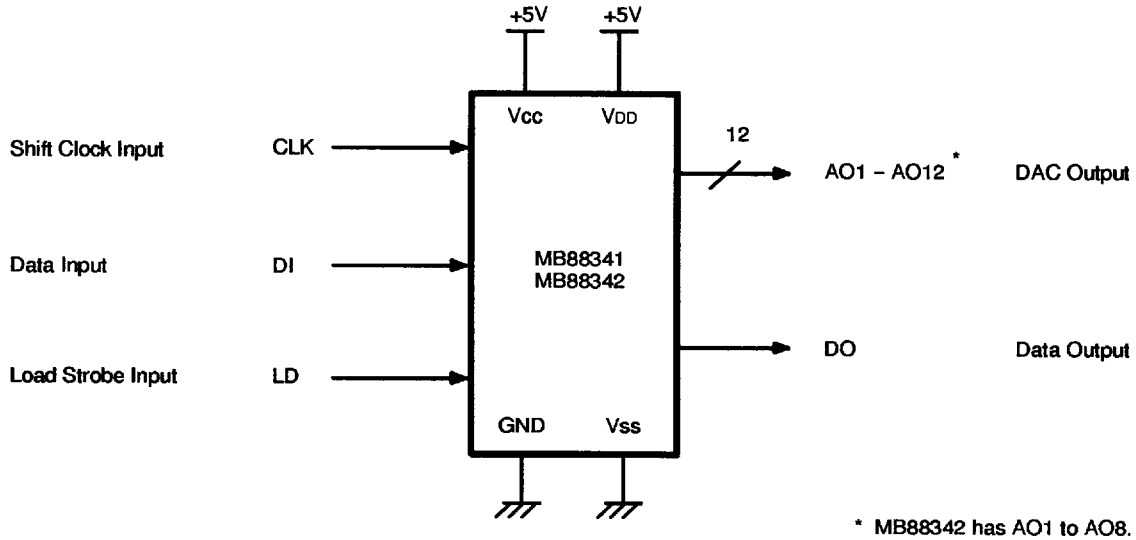
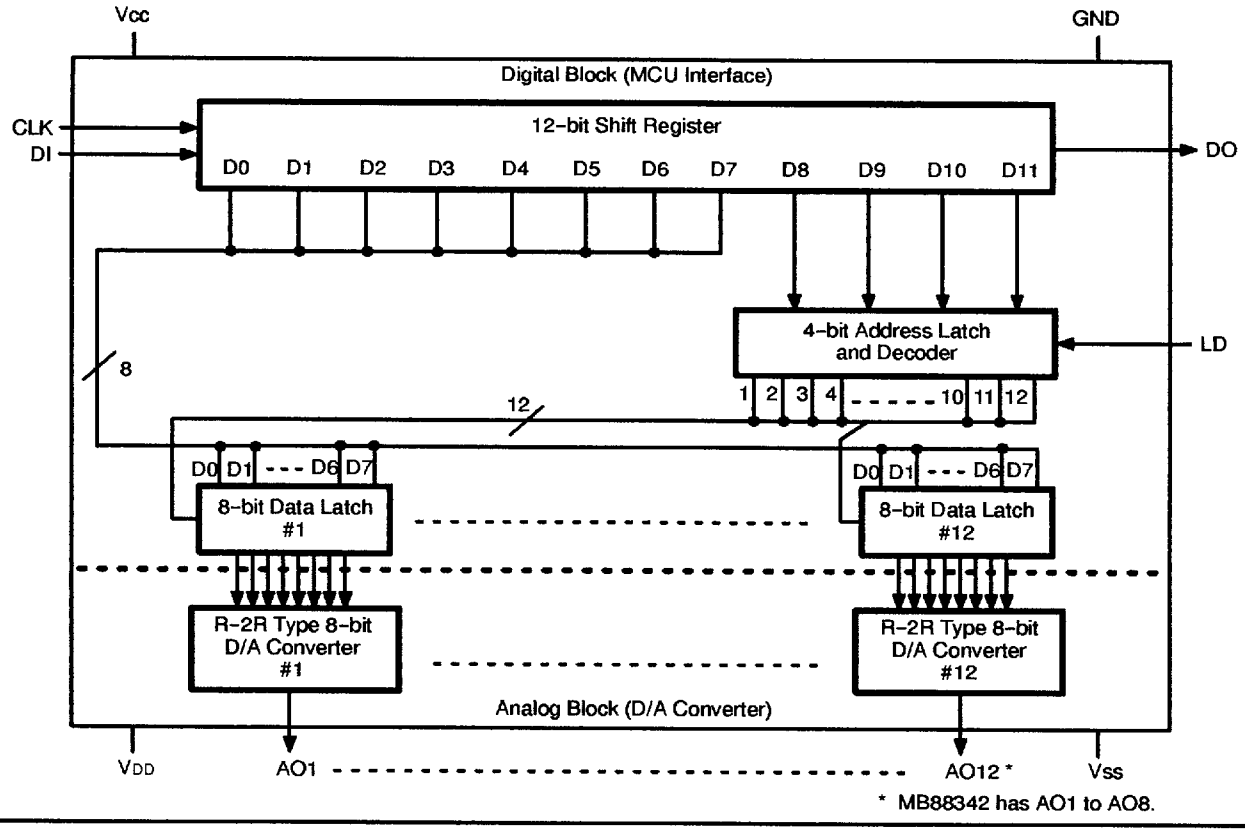


Figure 2 Block Diagram



PIN DESCRIPTION

PIN ASSIGNMENT and Table 1 show the pin assignment and pin description of the MB88341 and MB88342.

Table 1 Pin Description

Symbol	Pin No. MB88341	Pin No. MB88342	Type	Name & Function
Power Supply				
Vcc	11	9 (11)	–	+5V DC power supply pin for the digital block (MCU interface).
GND	20	16 (20)	–	Ground pin for the digital block (MCU interface).
VDD	10	8 (10)	–	+5V DC power supply pin for the analog block (D/A converter).
Vss	1	1 (1)	–	Ground pin for the analog block (D/A converter).
Control Input				
CLK	16	13 (16)	I	Shift clock input to the internal 12-bit shift register: At the rising edge of CLK data on the DI pin is shifted into the LSB of the shift register and contents of the shift register are shifted right (to the MSB).
LD	15	12 (15)	I	Load strobe input for a 12-bit address/data : A high level on the LD pin latches a 4-bit address (upper 4 bits: D11 to D8) of the internal 12-bit shift register into the internal address latch/decoder, and writes 8-bit data (lower 8 bits: D7 to D0) of the shift register into an internal data latch selected by the latched address.
Data Input/Output				
DI	17	14 (17)	I	Serial address/data input to the internal 12-bit shift register: The address/data format is that upper 4 bits (D11 to D8) indicate an address and lower 8 bits (D7 to D0) indicate data. The D11 (MSB) is the first-in bit and D0 (LSB) is the last-in bit.
DO	14	11 (14)	O	Serial address/data output from the internal 12-bit shift register: This is an output pin of the MSB bit data of the 12-bit shift register. This pin allows a cascade connection of the device.
DAC Output				
AO1	18	15 (19)	O	8-bit resolution D/A converter outputs : MB88341: 12 channels (AO1 to AO12) MB88342: 8 channels (AO1 to AO8)
AO2	19	2 (2)		
AO3	2	3 (4)		
AO4	3	4 (5)		
AO5	4	5 (6)		
AO6	5	6 (7)		
AO7	6	7 (9)		
AO8	7	10 (12)		
AO9	8	– (–)		
AO10	9	– (–)		
AO11	12	– (–)		
AO12	13	– (–)		

Note : Pin numbers in parentheses are applied to MB88342-PFV.

FUNCTIONAL DESCRIPTION

OVERVIEW

The MB88341 and MB88342 are R-2R resistor ladder type, 8-bit resolution digital-to-analog converter (DAC) devices. The MB88341 has 12 channels, and MB88342 has 8 channels of D/A converters. 8-bit digital data are loaded into internal data latches by individual DAC channel units. The loaded digital data are converted into analog DC voltages through the internal D/A converter in 60 µs settling time. For cascade connection, a serial data output is provided.

DEVICE CONFIGURATION

As illustrated in Figure 2 block diagram, the MB88341 (MB88342) device is composed by the digital block (MCU interface) and analog block (D/A converter). The digital block consists of a 12-bit shift register, a 4-bit address latch/decoder, and 12 (8) 8-bit data latches. The analog block includes 12 (8) 8-bit D/A converters connecting to the data latches. For electrically stable operation the power supply and ground lines are separate between the digital block (for MCU interface) and analog block (for D/A converter).

DEVICE OPERATION

Figure 3 shows the input/output timing. A 12-bit address/data is serially input into the shift register through the DI pin synchronously with the rising edge of CLK. The format of the shift register is shown in Figure 4. The lower 8 bits (D7 to D0) are data bits to be converted, and the upper 4 bits are address bits (D11 to D8) to select a data latch to be written. A high level on the LD pin loads the address latch/decoder with the 4-bit address to select a data latch, and writes the 8-bit data into a selected data latch. Figure 5 shows the data latch address map, and Table 2, address decoding. 8-bit data written into individual data latches are converted into analog DC voltages, dividing the supply voltage |V_{DD}-Vss| through R-2R resistor ladders of D/A converters. Figure 6 shows the R-2R resistor ladder D/A converter configuration, and Table 3 analog DC voltages corresponding to each digital data.

Figure 3 Input/Output Timing

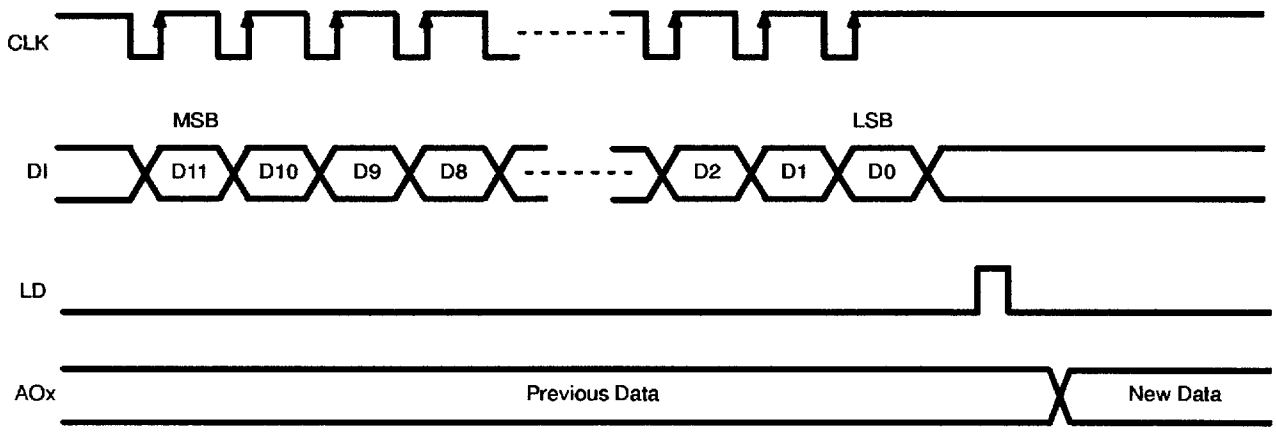


Figure 4 Shift Register Format

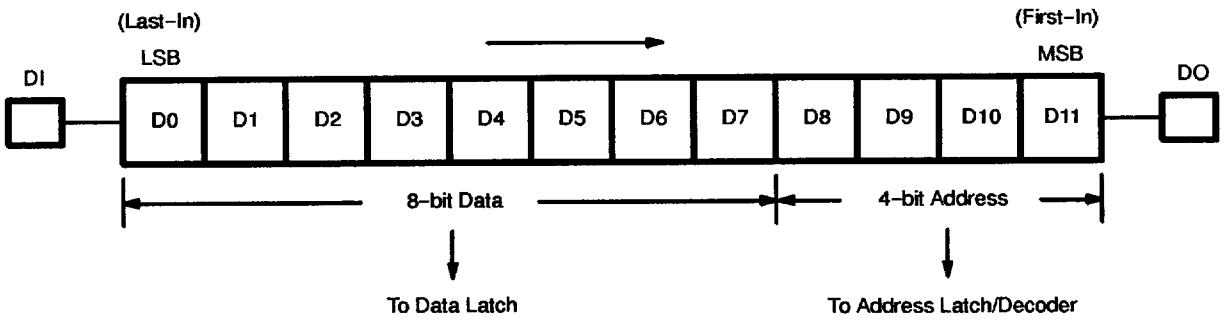
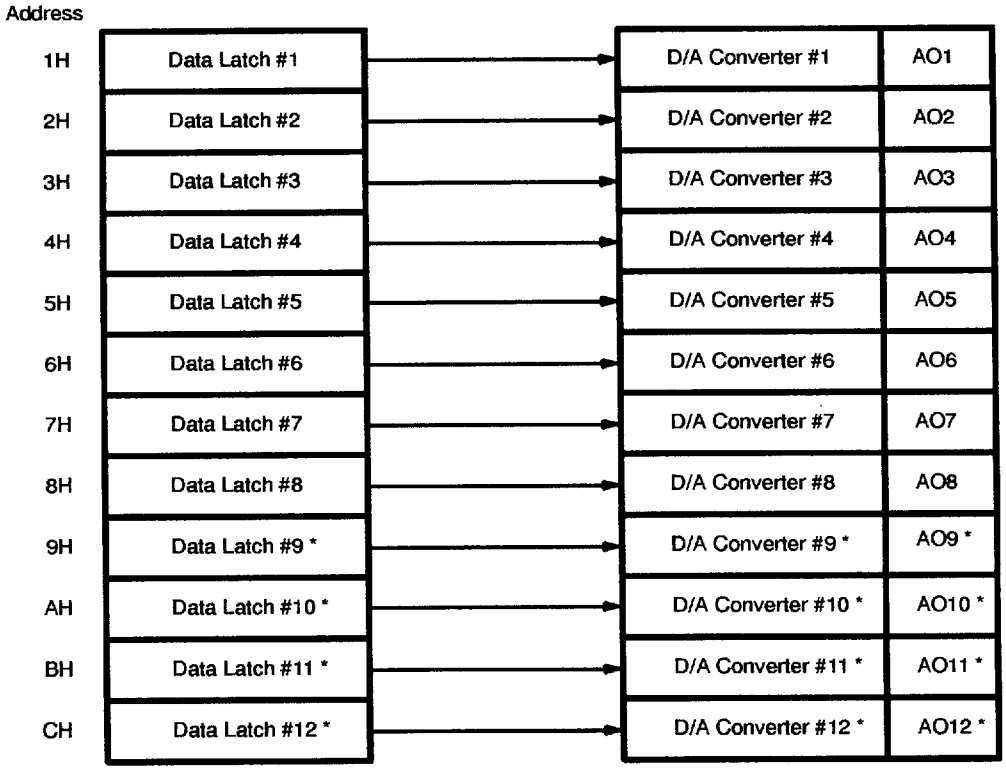


Figure 5 Data Latch Address Map



* : Available on MB88341 only

Figure 6 R–2R Resistor Ladder D/A Converter Configuration

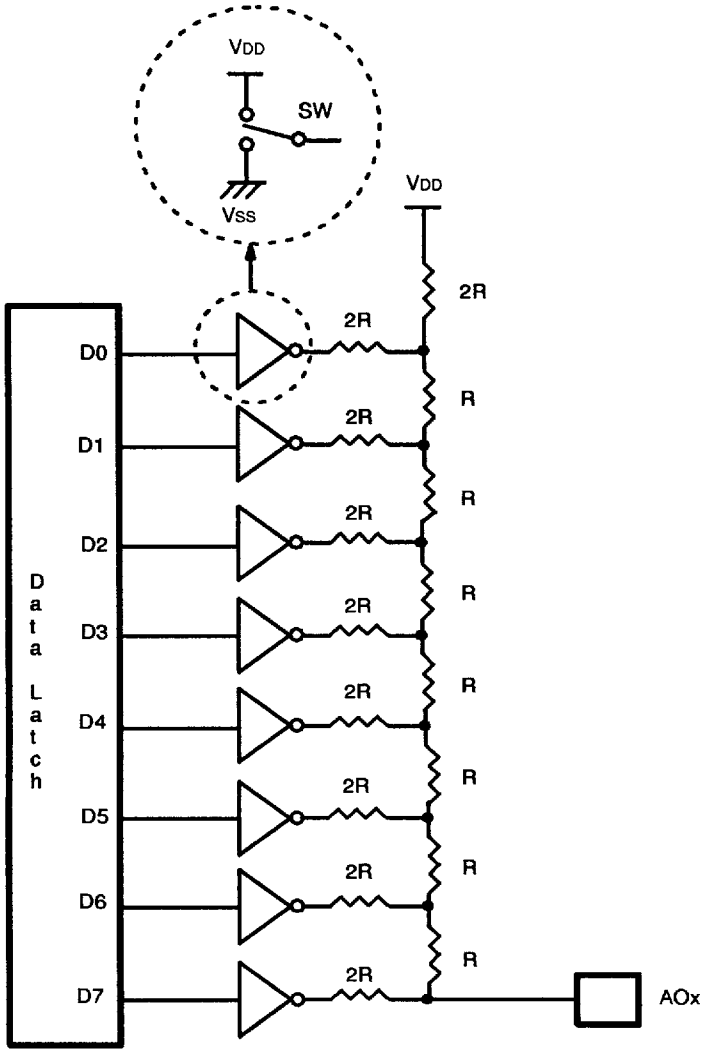


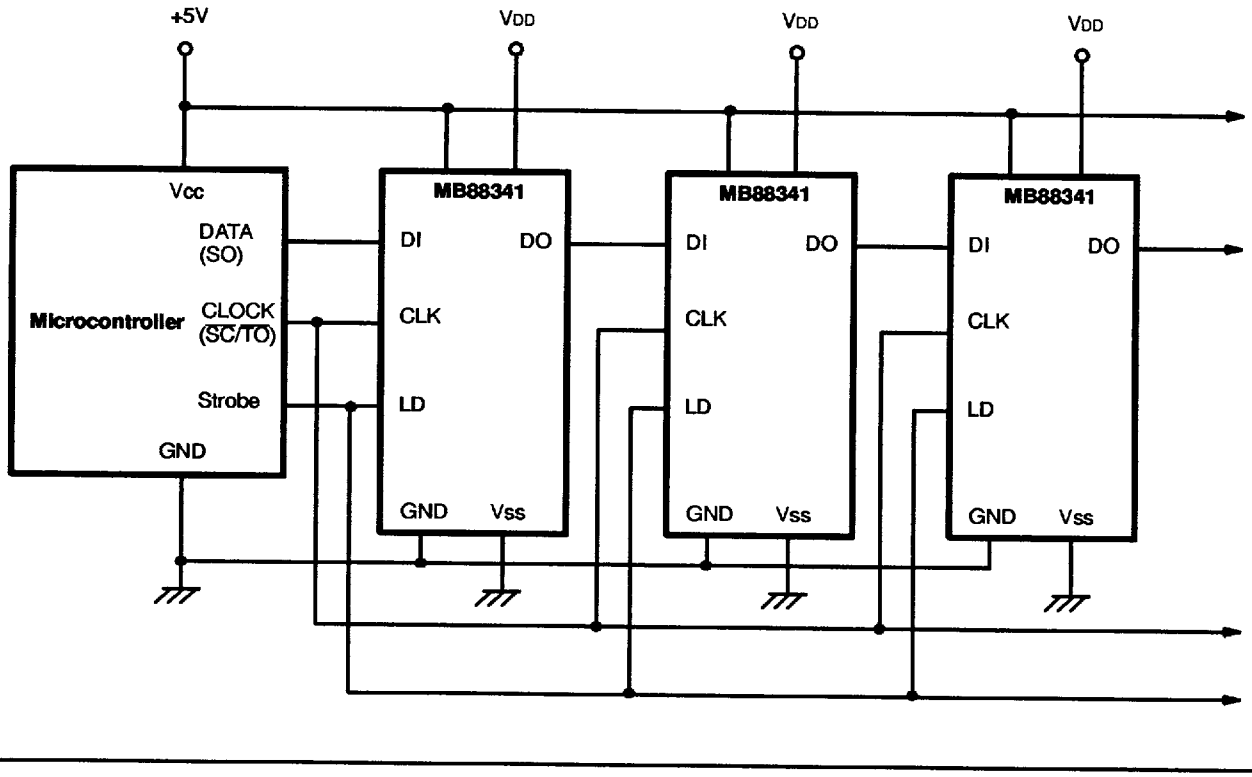
Table 2 Address Decoding

Address				Data Latch Selected	
D8	D9	D10	D11	MB88341	MB88342
0	0	0	0	Deselected	
0	0	0	1	Data Latch #1	
0	0	1	0	Data Latch #2	
0	0	1	1	Data Latch #3	
0	1	0	0	Data Latch #4	
0	1	0	1	Data Latch #5	
0	1	1	0	Data Latch #6	
0	1	1	1	Data Latch #7	
1	0	0	0	Data Latch #8	
1	0	0	1	Data Latch #9	Deselected
1	0	1	0	Data Latch #10	Deselected
1	0	1	1	Data Latch #11	Deselected
1	1	0	0	Data Latch #12	Deselected
1	1	0	1	Deselected	
1	1	1	0	Deselected	
1	1	1	1	Deselected	

Table 3 Data Conversion

Data								DAC Output Level
D7	D6	D5	D4	D3	D2	D1	D0	AOx
0	0	0	0	0	0	0	0	$\approx \lvert V_{DD} - V_{SS} \rvert \times 1/256$
0	0	0	0	0	0	0	1	$\approx \lvert V_{DD} - V_{SS} \rvert \times 2/256$
0	0	0	0	0	0	1	0	$\approx \lvert V_{DD} - V_{SS} \rvert \times 3/256$
0	0	0	0	0	0	1	1	$\approx \lvert V_{DD} - V_{SS} \rvert \times 4/256$
1	1	1	1	1	1	1	0	$\approx \lvert V_{DD} - V_{SS} \rvert \times 255/256$
1	1	1	1	1	1	1	1	$\approx \lvert V_{DD} - V_{SS} \rvert$

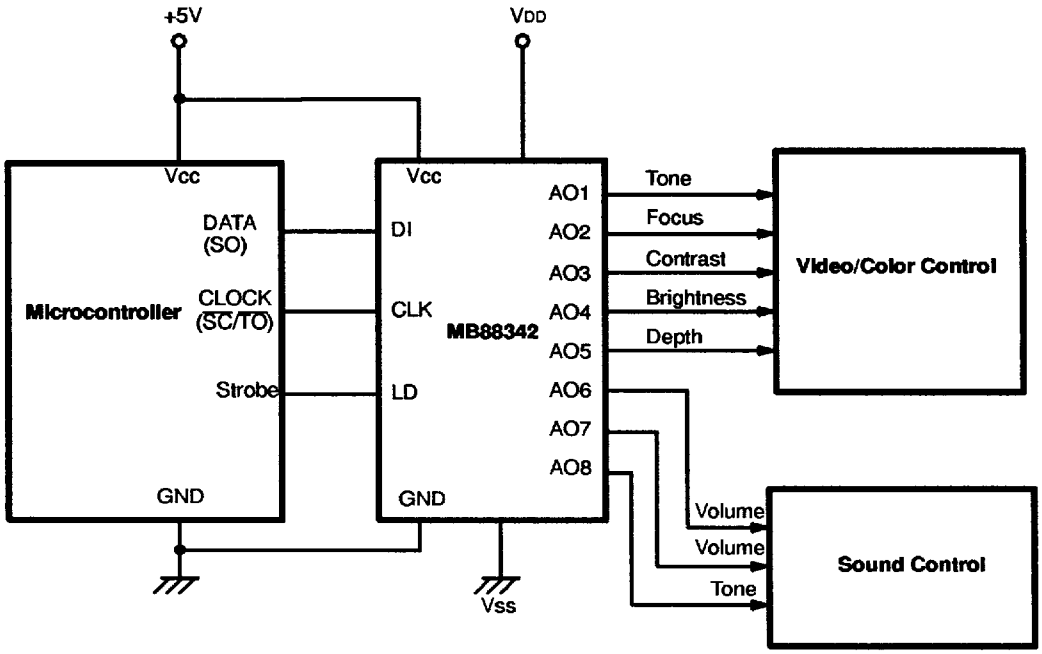
Figure 7 Cascade Connection Example



APPLICATION DESCRIPTION

The MB88341 and MB88342 are suitable for electronic volumes and replacement for adjustment potentiometers, in addition to normal D/A converter applications. Figure 7 illustrates an application example for TV set.

Figure 8 Application Example (for TV Set)



ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating			Unit	Condition
		Min	Typ	Max		
Supply Voltage	Vcc	−0.3	−	7.0	V	Ta = 25°C GND = 0 V
	V_{DD}	−0.3	−	7.0	V	
Input Voltage	V_{IN}	−0.3	−	7.0	V	Ta = 25°C GND = 0 V Should not exceed Vcc + 0.3V
Output Voltage	V_{OUT}	−0.3	−	7.0	V	
Power Dissipation	P_D	−	−	250	mW	
Operating Ambient Temperature	Ta	−40	−	+85	°C	
Storage Temperature	T_{STG}	−55	−	+150	°C	

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

Parameter	Symbol	Value			Unit	Condition
		Min	Typ	Max		
Supply Voltage (for Digital Block)	Vcc	4.5 (2.7)*1	5.0	5.5	V	
	GND	−	0	−	V	
Supply Voltage (for Analog Block)	V_{DD}	2.0	−	Vcc	V	$V_{DD} \leq Vcc$, $V_{DD}-V_{SS} \geq 2$ V Monotonicity, No load
	Vss	0	−	Vcc−2.0	V	
Operating Ambient Temperature	Ta	−40	−	+85	°C	

*1 AC Characteristics are changed when using by low voltage (3 V ±10%).

DC CHARACTERISTICS

(Recommended operating conditions unless otherwise noted.)

Digital Block (MCU Interface)

Parameter	Symbol	Value			Unit	Condition
		Min	Typ.	Max		
Active Supply Current	Icc	–	–	1.0	mA	CLK = 1MHz
Standby Supply Current	Iccs	–	–	10	µA	All inputs (including CLK) fixed at Vcc or GND. All outputs open.
Input Leakage Current	IILK	−10	–	10	µA	VIN = 0 to Vcc
Input Low Voltage	VIL	–	–	0.2•Vcc	V	
Input High Voltage	VIH	0.5•Vcc (0.8•Vcc)*2	–	–	V	*2 Using low voltage (Vcc < 4.5 V)
Output Low Voltage	VOL	–	–	0.4	V	IOL = 2.5 mA
Output High Voltage	VOH	Vcc−0.4	–	–	V	IOH = −400 µA

Analog Block (D/A Converter)

Parameter	Symbol	Value			Unit	Condition	
		Min	Typ	Max			
Supply Current	IDD	–	1.5	3.0	mA	MB88341	No load
		–	1.2	2.5	mA	MB88342	
Resolution		8	–	–	bit	Monotonicity, IOUT = −0.01 µA	
Variation of Linearity among Channels		–	–	±3	LSB	Monotonicity, No load	
Analog Output Impedance	ZAO	25	50	75	kΩ		

AC CHARACTERISTICS

(Recommended operating conditions unless otherwise noted.)

Parameter	Symbol	Value		Unit	Condition
		Min	Max		
Clock Low Time	t_{CKL}	200 (1000)	–	ns	
Clock High Time	t_{CKH}	200 (1000)	–	ns	
Clock Rise Time	t_{Cr}	–	200 (1000)	ns	
Clock Fall Time	t_{Cf}	–	200 (1000)	ns	
Data Setup Time	t_{DCH}	30 (150)	–	ns	
Data Hold Time	t_{CHD}	60 (300)	–	ns	
Load Strobe High Time	t_{LDH}	100 (500)	–	ns	
Load Strobe Setup Time	t_{CHL}	200 (1000)	–	ns	
Load Strobe Hold Time	t_{LDC}	100 (500)	–	ns	
DAC Output Settling Time	t_{LDD}	–	60 (300)	µs	No load
Data Output Delay Time	t_{DO}	70	350 (1750)	ns	*C_L = 20 pF (Min.), 100 pF (Max.)

Please use the value (corresponding CLK frequency = 0.5 MHz) in parantheses when using by low voltage (3 V ± 10%).

Figure 9 AC Test Conditions

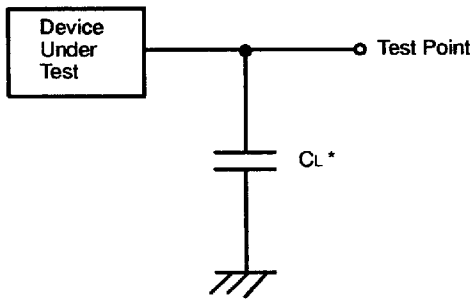
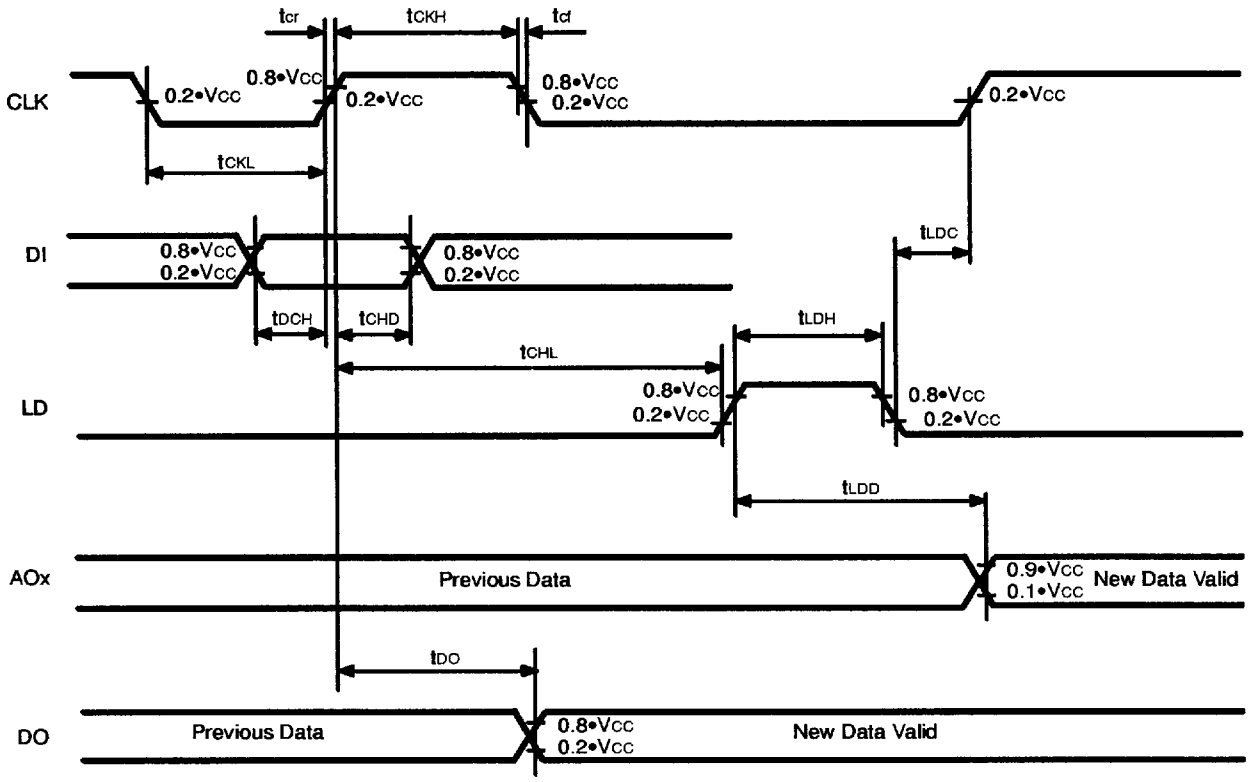


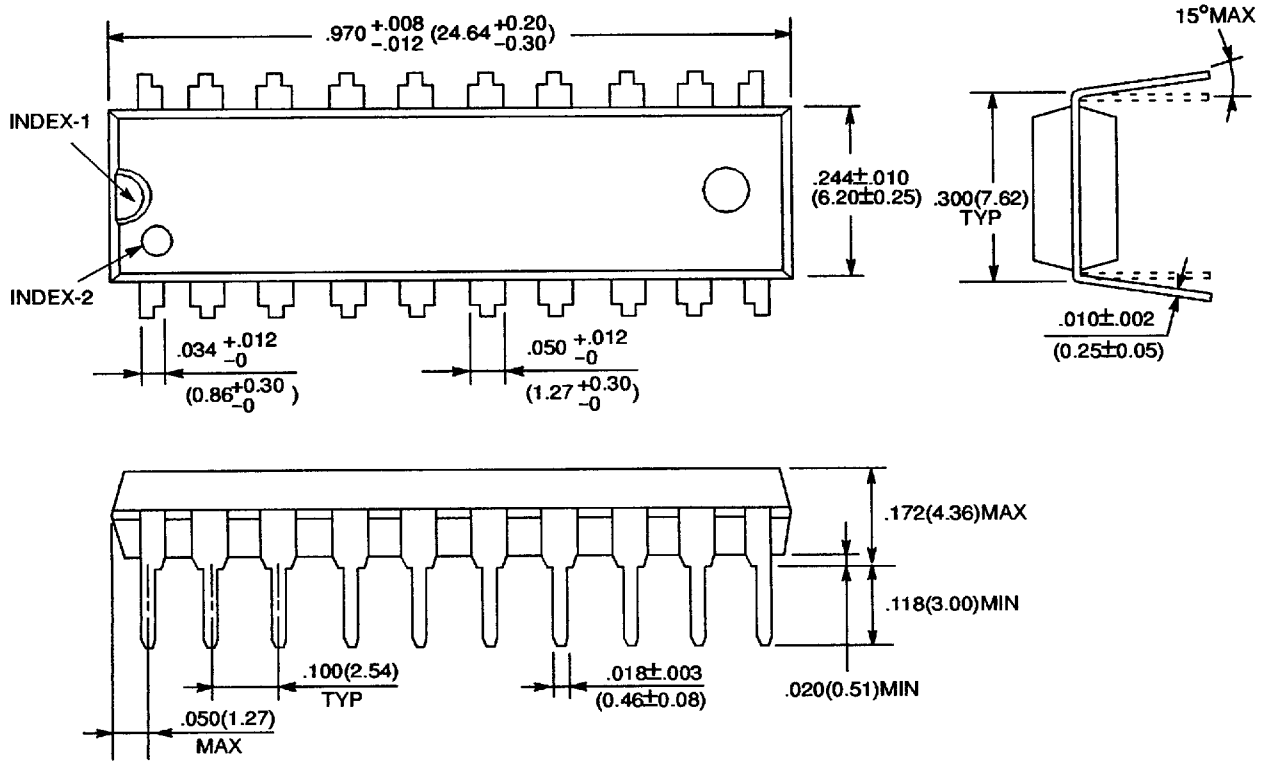
Figure 10 Input/Output Timing



PACKAGE DIMENSIONS

MB88341-P

20-LEAD PLASTIC DUAL IN-LINE PACKAGE
(CASE No.: DIP-20P-M02)

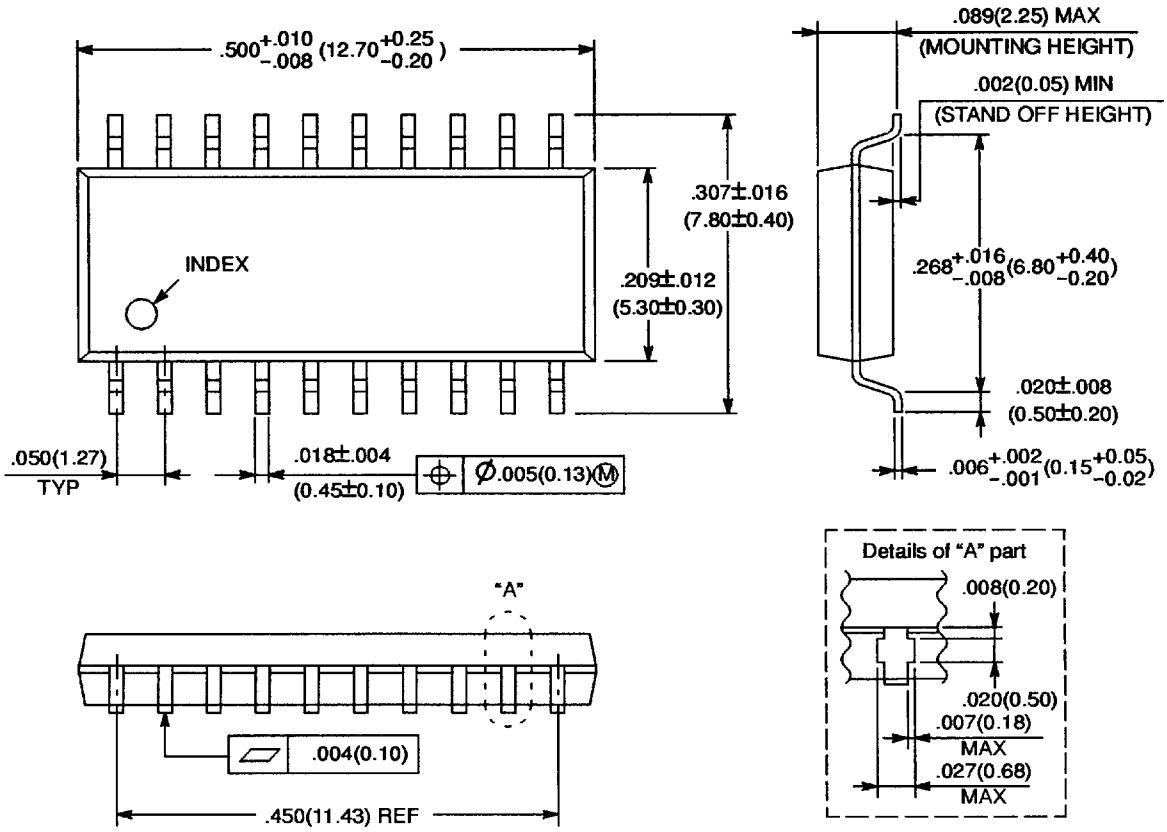


Dimensions in
inches (millimeters)

PACKAGE DIMENSIONS (Continued)

MB88341-PF

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

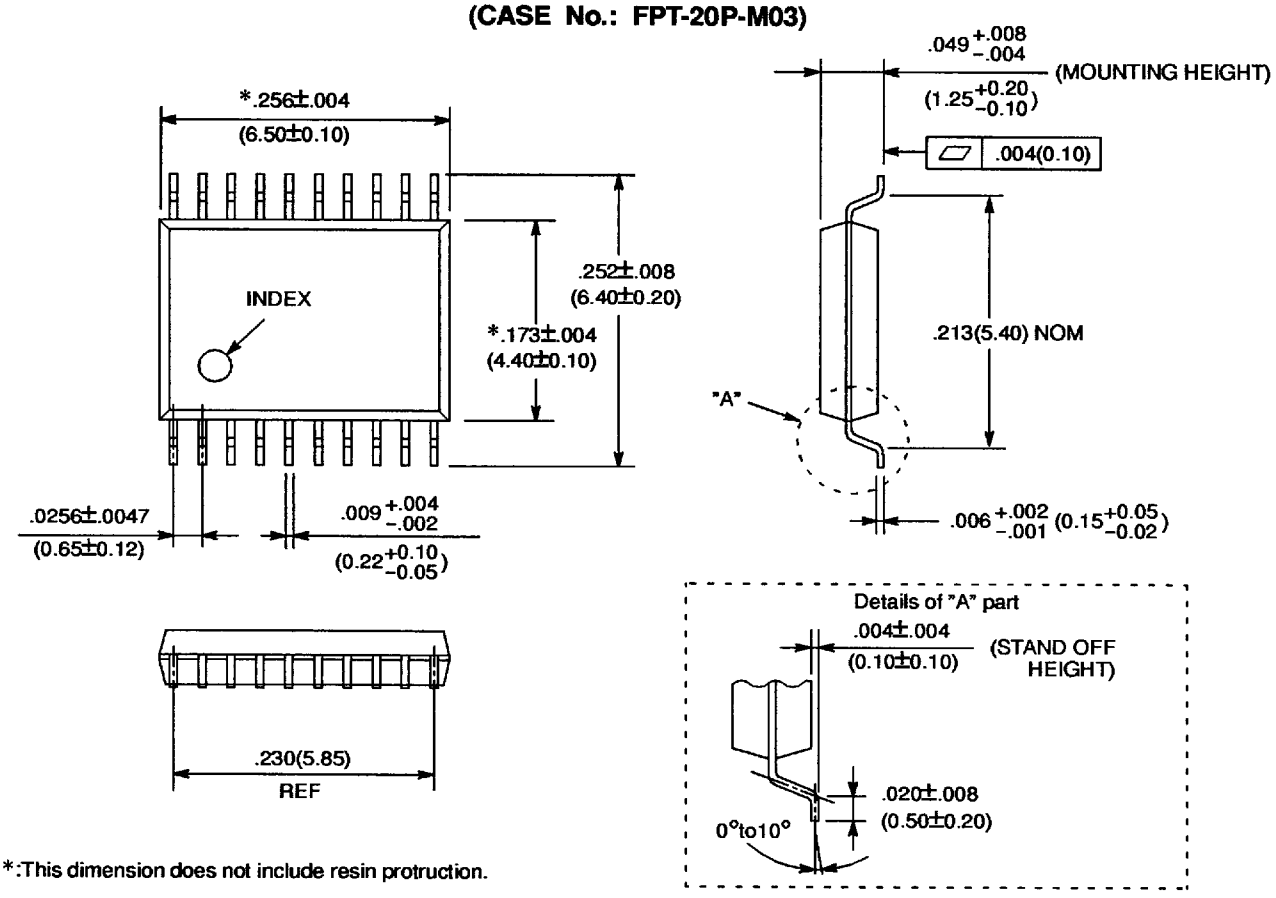


Dimensions in
inches (millimeters)

PACKAGE DIMENSIONS (Continued)

MB88341–PFV

20-LEAD PLASTIC FLAT PACKAGE
(CASE No.: FPT-20P-M03)



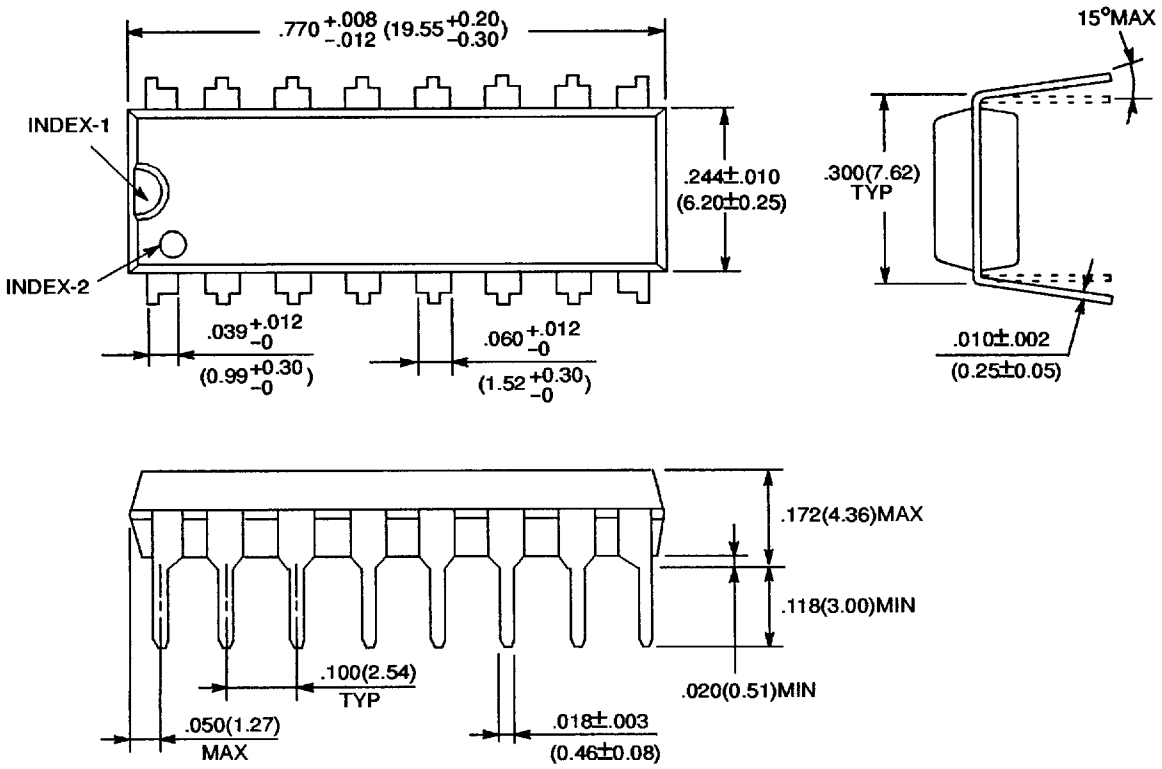
*:This dimension does not include resin protruction.

Dimensions in inches (millimeters)

PACKAGE DIMENSIONS (Continued)

MB88342–P

16-LEAD PLASTIC DUAL IN-LINE PACKAGE
(CASE No.: DIP-16P-M04)

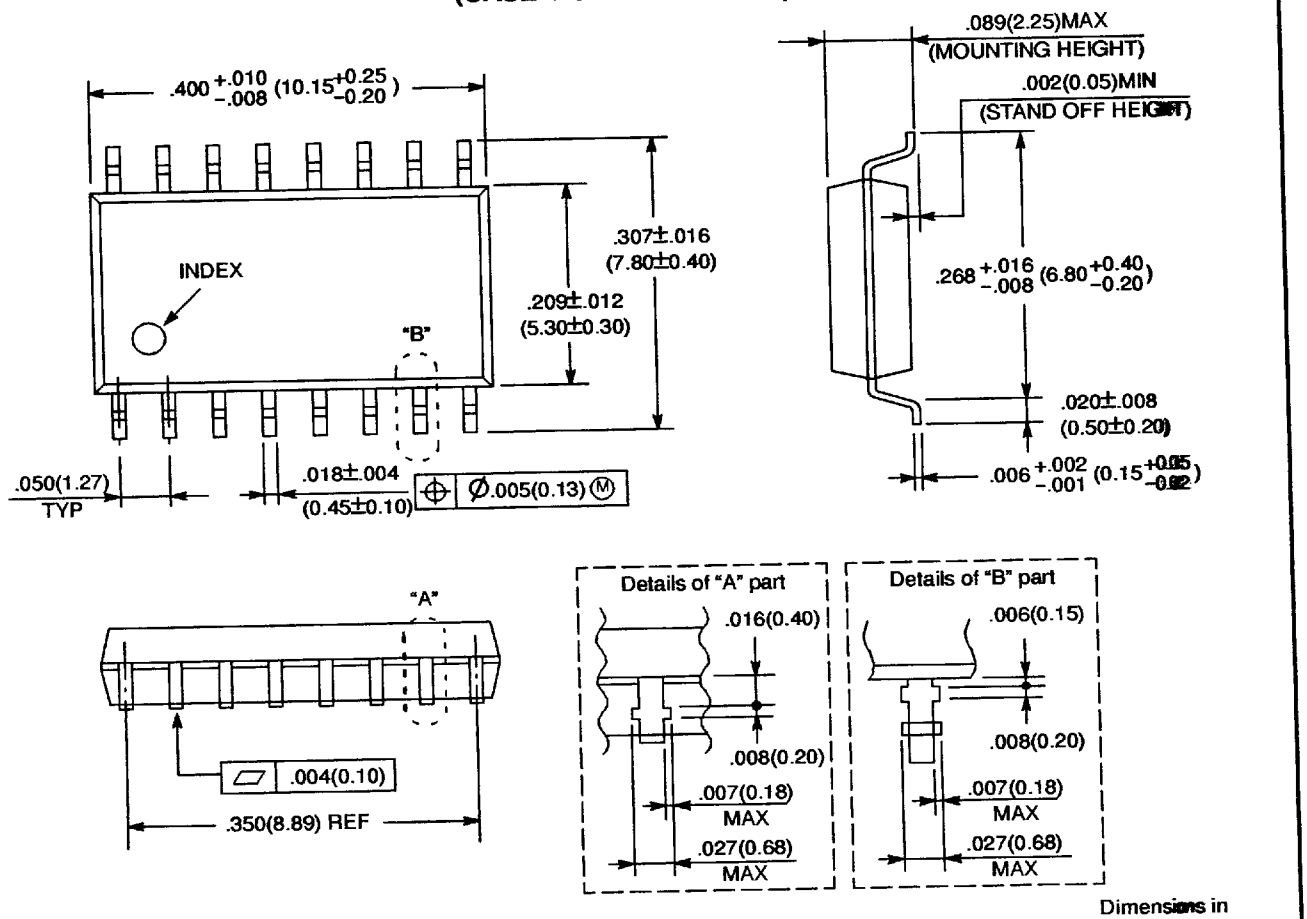


Dimensions in
inches (millimeters)

PACKAGE DIMENSIONS (Continued)

MB88342-PF

16-LEAD PLASTIC FLAT PACKAGE
(CASE No.: FPT-16P-M06)

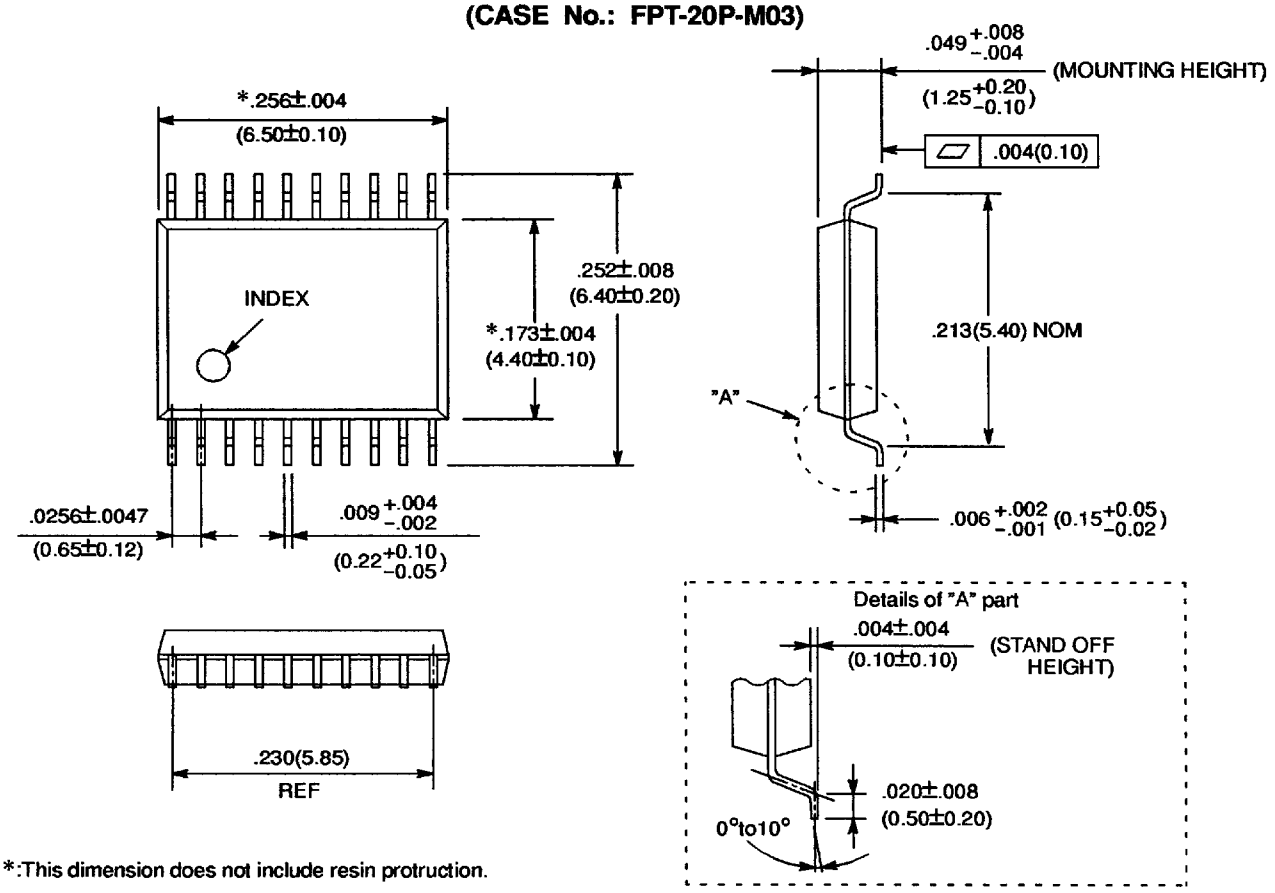


Dimensions in inches (millimeters)

PACKAGE DIMENSIONS (Continued)

MB88342–PFV

20-LEAD PLASTIC FLAT PACKAGE
(CASE No.: FPT-20P-M03)



*:This dimension does not include resin protruction.

Dimensions in inches (millimeters)