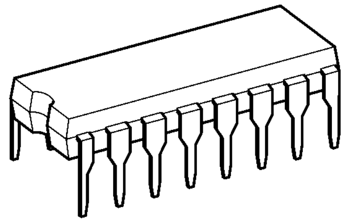
TOSHIBA BiCD Integrated Circuit Silicon Monolithic

TBD62003APG, TBD62003AFG, TBD62003AFNG, TBD62003AFWG
TBD62004APG, TBD62004AFG, TBD62004AFNG, TBD62004AFWG

7channel sink type DMOS transistor array

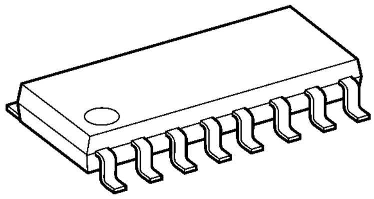
TBD62003A series and TBD62004A series are DMOS transistor array with 7 circuits. It has a clamp diode for switching inductive loads built-in in each output. Please be careful about thermal conditions during use.

TBD62003APG,TBD62004APG



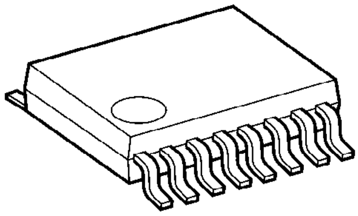
DIP16-P-300-2.54A

TBD62003AFG,TBD62004AFG



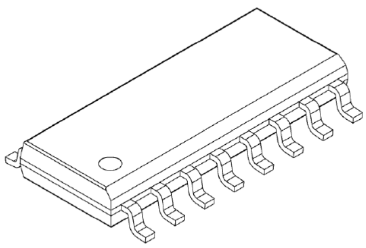
SOP16-P-225-1.27

TBD62003AFNG,TBD62004AFNG



SSOP16-P-225-0.65B

TBD62003AFWG,TBD62004AFWG



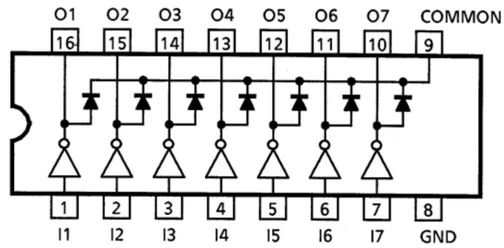
P-SOP16-0410-1.27-002

Weight
DIP16-P-300-2.54A : 1.11 g (Typ.)
SOP16-P-225-1.27 : 0.16 g (Typ.)
SSOP16-P-225-0.65B : 0.07 g (Typ.)
P-SOP16-0410-1.27-002 : 0.15 g (Typ.)

Features

- 7 circuits built-in
- High voltage : V_{OUT} = 50 V (MAX)
- High current : I_{OUT} = 500 mA/ch (MAX)
- Input voltage(output on) : TBD62003A series 2.5 V (MIN)
  TBD62004A series 7.0 V (MIN)
- Input voltage(output off) : TBD62003A series 0.6 V (MAX)
  TBD62004A series 1.0 V (MAX)
- Package : PG type DIP16-P-300-2.54A
  FG type SOP16-P-225-1.27
  FNG type SSOP16-P-225-0.65B
  FWG type P-SOP16-0410-1.27-002

Pin connection (top view)

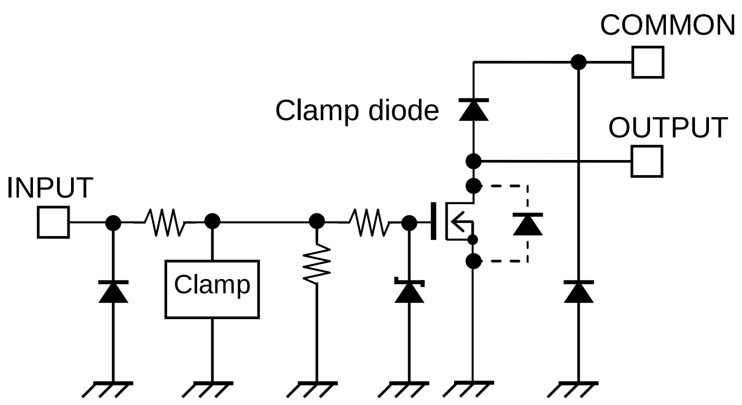


Pin connection may be simplified for explanatory purpose.

Pin explanations

Pin No.	Pin name	Function
1	I1	Input pin
2	I2	Input pin
3	I3	Input pin
4	I4	Input pin
5	I5	Input pin
6	I6	Input pin
7	I7	Input pin
8	GND	GND pin
9	COMMON	Common pin
10	O7	Output pin
11	O6	Output pin
12	O5	Output pin
13	O4	Output pin
14	O3	Output pin
15	O2	Output pin
16	O1	Output pin

Equivalent circuit (each driver)



Equivalent circuit may be simplified for explanatory purpose.

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Output voltage		V_{OUT}	50	V
COMMON pin voltage		V_{COM}	−0.5 to 50	V
Output current		I_{OUT}	500	mA/ch
Input voltage		V_{IN}	−0.5 to 30	V
Clamp diode reverse voltage		V_R	50	V
Clamp diode forward current		I_F	500	mA
Power dissipation	PG (Note 1)	P_D	1.47	W
	FG (Note 2)		0.625	
	FNG (Note 3)		0.78	
	FWG (Note 4)		1.25	
Operating temperature		T_{opr}	−40 to 85	°C
Storage temperature		T_{stg}	−55 to 150	°C

Note 1: Device alone. When Ta exceeds 25°C, it is necessary to do the derating with 11.8 mW/°C.
Note 2: On PCB (Size: 30 mm × 30 mm × 1.6 mm, Cu area: 50%, single-side glass epoxy).
When Ta exceeds 25°C, it is necessary to do the derating with 5 mW/°C.
Note 3: On PCB (Size: 50 mm × 50 mm × 1.6 mm, Cu area: 40%, single-side glass epoxy).
When Ta exceeds 25°C, it is necessary to do the derating with 6.24 mW/°C.
Note 4: On PCB (JEDEC 2s2p).
When Ta exceeds 25°C, it is necessary to do the derating with 10 mW/°C.

Operating Ranges (Ta = −40 to 85°C)

Characteristics		Symbol	Condition		Min	Typ.	Max	Unit
Output voltage		V_{OUT}	—		—	—	50	V
COMMON pin voltage		V_{COM}	—		0	—	50	V
Output current	PG(Note 1)	I_{OUT}	1 circuits ON, Ta = 25°C		0	—	400	mA/ch
			t_{pw} = 25 ms 7 circuits ON Ta = 85°C T_j = 120°C	Duty = 10%	0	—	400	
				Duty = 50%	0	—	190	
	FG(Note 2)		1 circuits ON, Ta = 25°C		0	—	400	
			t_{pw} = 25 ms 7 circuits ON Ta = 85°C T_j = 120°C	Duty = 10%	0	—	270	
				Duty = 50%	0	—	120	
	FNG(Note 3)		1 circuits ON, Ta = 25°C		0	—	400	
			t_{pw} = 25 ms 7 circuits ON Ta = 85°C T_j = 120°C	Duty = 10%	0	—	300	
				Duty = 50%	0	—	130	
	FWG(Note 4)		1 circuits ON, Ta = 25°C		0	—	400	
			t_{pw} = 25 ms 7 circuits ON Ta = 85°C T_j = 120°C	Duty = 10%	0	—	390	
				Duty = 50%	0	—	170	
Input voltage (Output on)	TBD62003A series	V_{IN} (ON)	I_{OUT} = 100 mA or upper, V_{OUT} = 2 V		2.5	—	25	V
	TBD62004A series		I_{OUT} = 100 mA or upper, V_{OUT} = 2 V		7.0	—	25	
Input voltage (Output off)	TBD62003A series	V_{IN} (OFF)	I_{OUT} = 100 μA or less, V_{OUT} = 2 V		0	—	0.6	V
	TBD62004A series		I_{OUT} = 100 μA or less, V_{OUT} = 2 V		0	—	1.0	
Clamp diode forward current		I_F	—		—	—	400	mA

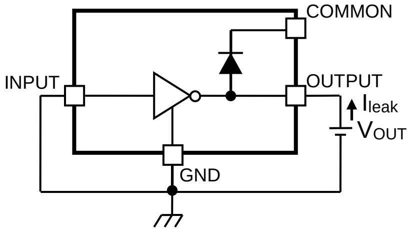
Note 1: Device alone.
Note 2: On PCB (Size: 30 mm × 30 mm × 1.6 mm, Cu area: 50%, single-side glass epoxy).
Note 3: On PCB (Size: 50 mm × 50 mm × 1.6 mm, Cu area: 40%, single-side glass epoxy).
Note 4: On PCB (JEDEC 2s2p).

Electrical Characteristics (Ta = 25°C unless otherwise noted)

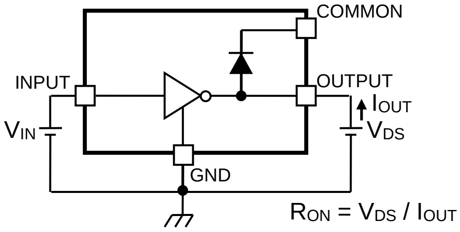
Characteristics		Symbol	Test Circuit	Condition	Min	Typ.	Max	Unit
Output leakage current		I_{leak}	1	V_{OUT} = 50V, Ta = 85 °C V_{IN} = 0 V	—	—	1.0	μA
Output voltage (Output ON-resistance)	TBD62003A series	V_{DS} (R_{ON})	2	I_{OUT} = 350 mA, V_{IN} =5.0V	—	0.7 (2.0)	1.14 (3.25)	V (Ω)
				I_{OUT} = 200 mA, V_{IN} =5.0V	—	0.4 (2.0)	0.65 (3.25)	
				I_{OUT} = 100 mA, V_{IN} =5.0V	—	0.2 (2.0)	0.325 (3.25)	
	TBD62004A series			I_{OUT} = 350 mA, V_{IN} =7.0V	—	0.7 (2.0)	1.14 (3.25)	
				I_{OUT} = 200 mA, V_{IN} =7.0V	—	0.4 (2.0)	0.65 (3.25)	
				I_{OUT} = 100 mA, V_{IN} =7.0V	—	0.2 (2.0)	0.325 (3.25)	
Input current (Output on)	TBD62003A series	$I_{IN\ (ON)}$	3	V_{IN} = 2.5 V	—	—	0.1	mA
	TBD62004A series			V_{IN} = 7.0 V	—	—	0.5	
Input current(Output off)		$I_{IN\ (OFF)}$	4	V_{IN} = 0 V, Ta = 85°C	—	—	1.0	μA
Input voltage (Output on)	TBD62003A series	$V_{IN\ (ON)}$	5	I_{OUT} = 100 mA, V_{OUT} = 2 V	—	—	2.5	V
	TBD62004A series				—	—	7.0	
Clamp diode reverse current		I_R	6	V_R = 50 V, Ta = 85°C	—	—	1.0	μA
Clamp diode forward voltage		V_F	7	I_F = 350 mA	—	—	2.0	V
Turn−on delay		t_{ON}	8	V_{OUT} = 50 V R_L = 125 Ω C_L = 15 pF	—	0.4	—	μs
Turn−off delay		t_{OFF}			—	0.8	—	

Test circuit

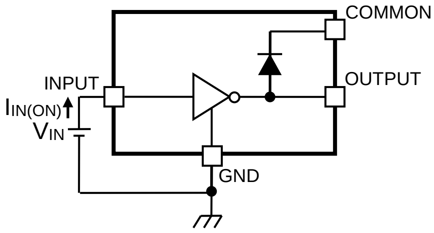
1. I_{leak}



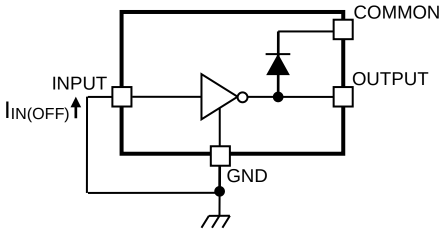
2. V_{DS} (R_{ON})



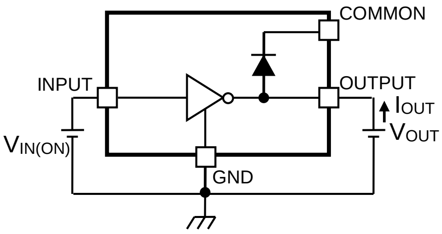
3. $I_{IN\ (ON)}$



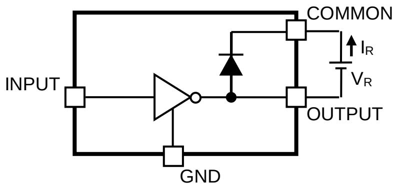
4. $I_{IN\ (OFF)}$



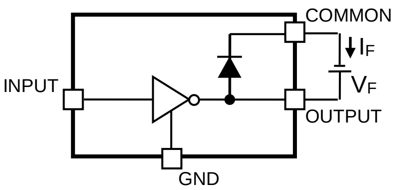
5. $V_{IN\ (ON)}$



6. I_R

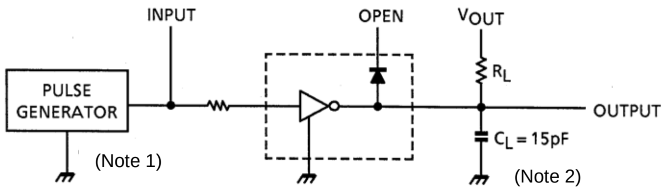


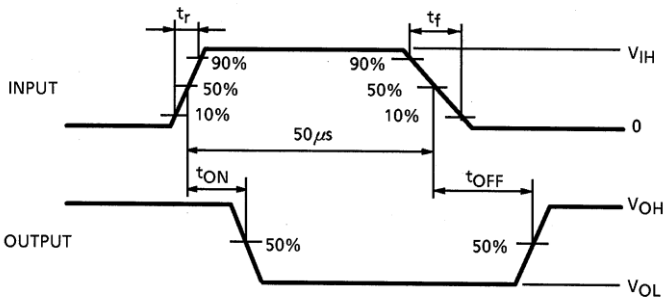
7. V_F



Test circuit may be simplified for explanatory purpose.

8. t_{ON}, t_{OFF}





Note 1: Pulse width 50 μs, Duty cycle 10%

Output impedance 50 Ω, $t_r \leq 5$ ns, $t_f \leq 10$ ns

Please refer to the following table for the V_{IH} condition.

Product	V_{IH}
TBD62003A series	5.0 V
TBD62004A serise	7.0 V

Note 2: C_L includes the probe and the test board capacitance.

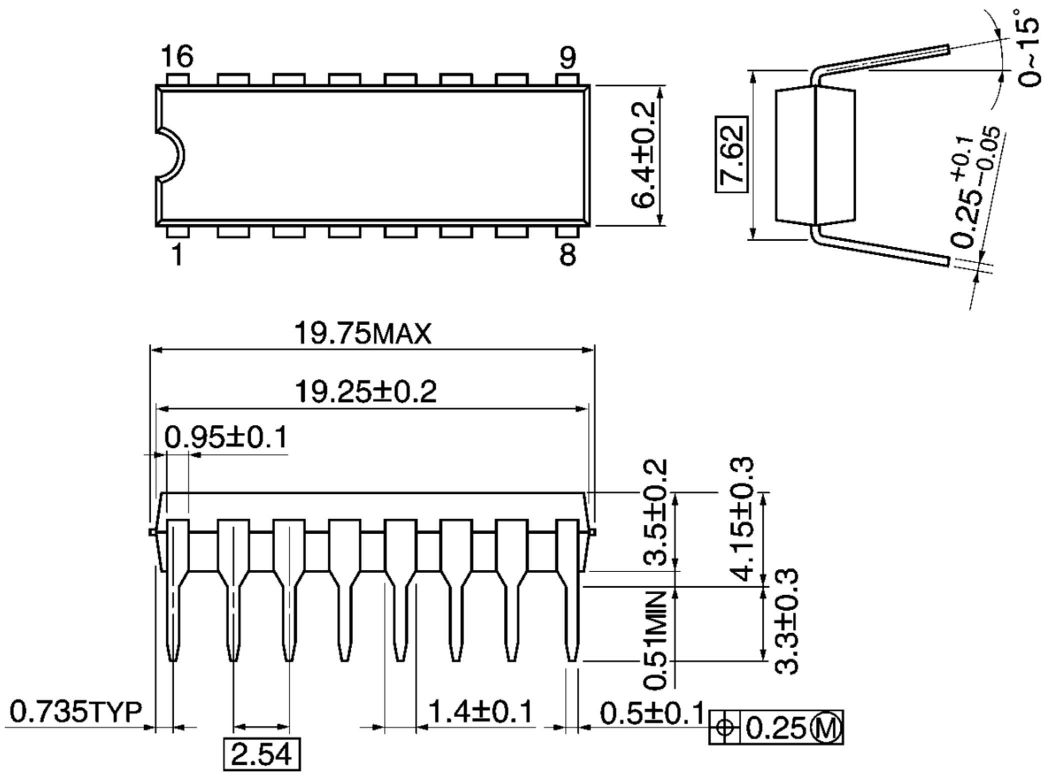
Test circuit and timing chart may be simplified for explanatory purpose.

Precautions for Using

This IC does not include built-in protection circuits for excess current or overvoltage.
If this IC is subjected to excess current or overvoltage, it may be destroyed.
Hence, the utmost care must be taken when systems which incorporate this IC are designed.
Utmost care is necessary in the design of the output line, COMMON and GND line since IC may be destroyed due to short−circuit between outputs, air contamination fault, or fault by improper grounding.

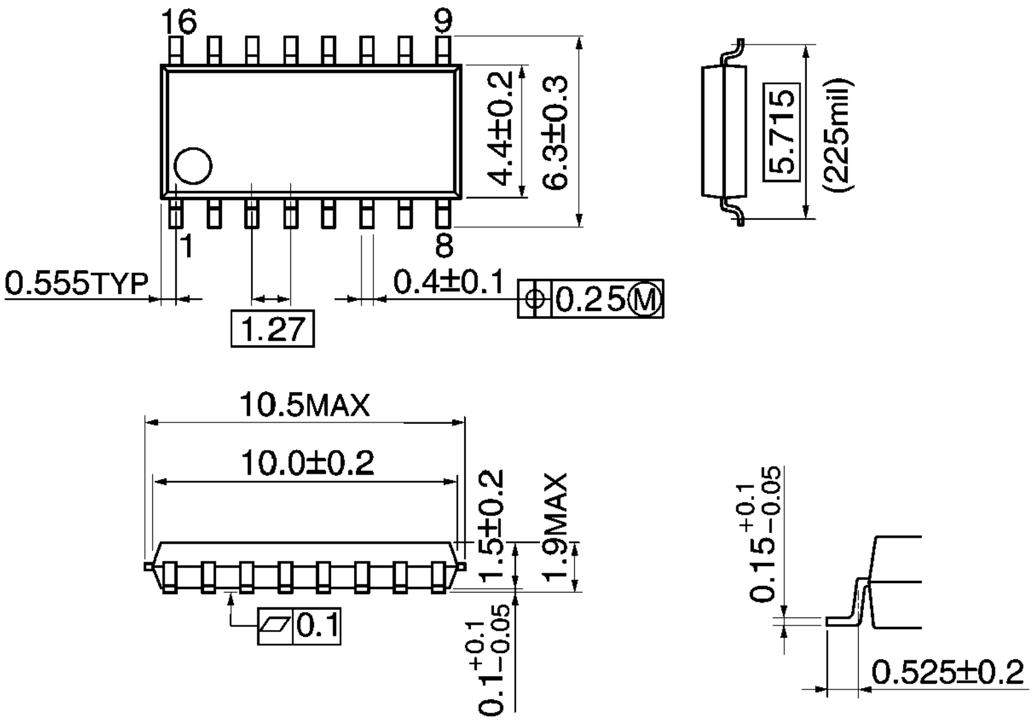
Package Dimensions

DIP16-P-300-2.54A Unit: mm



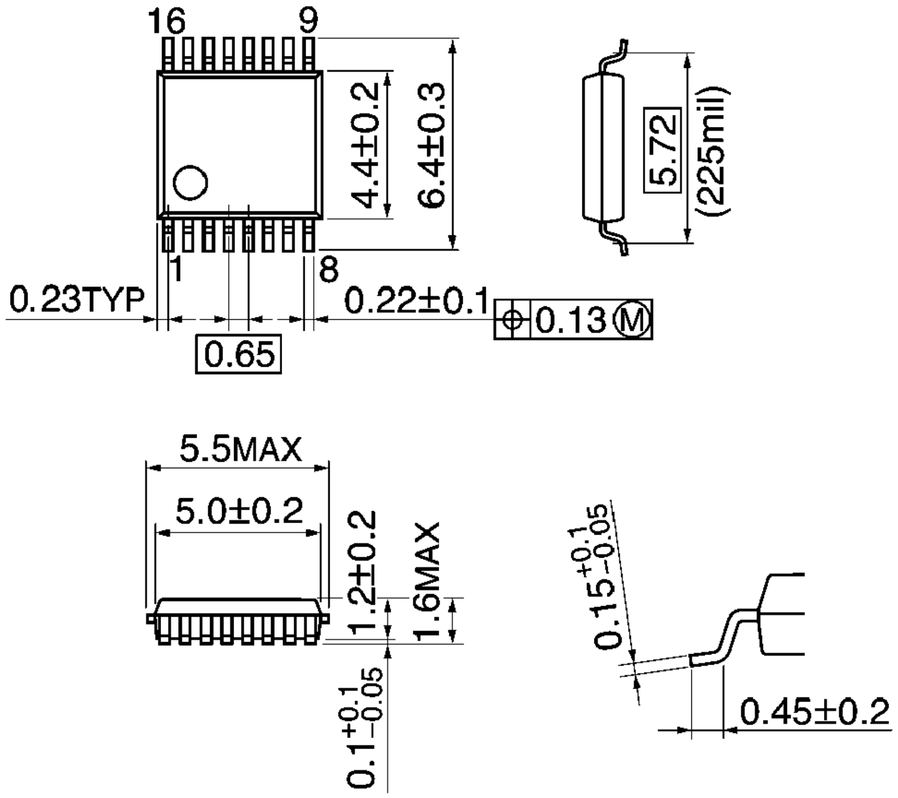
Weight: 1.11 g (Typ.)

SOP16-P-225-1.27 Unit: mm



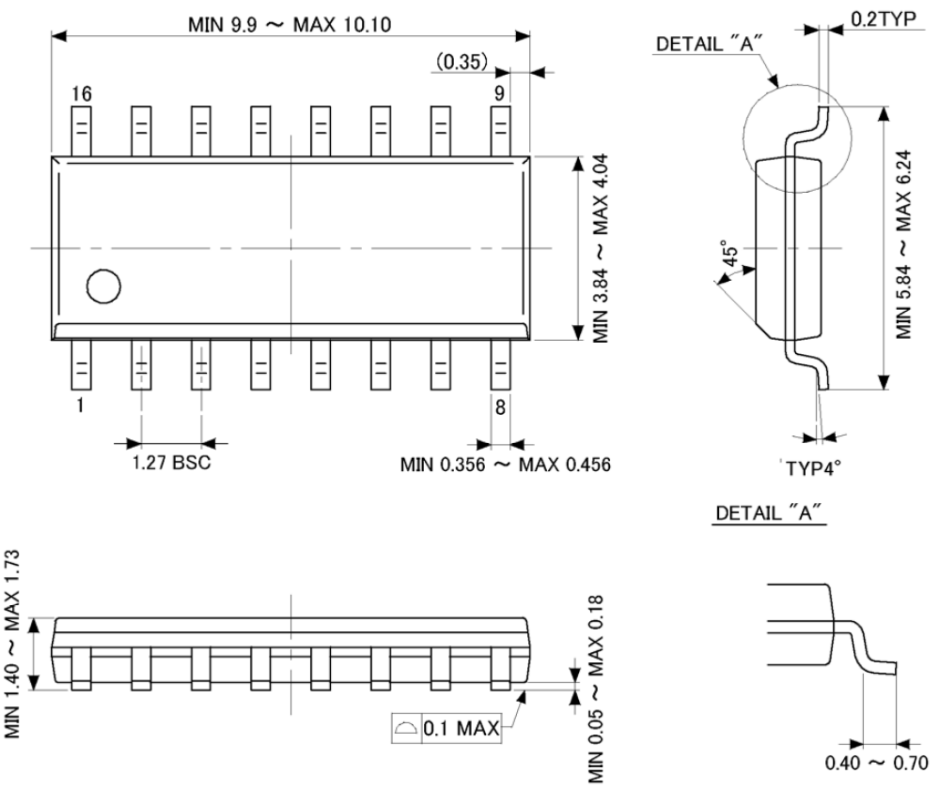
Weight: 0.16 g (Typ.)

SSOP16-P-225-0.65B Unit: mm



Weight: 0.07 g (Typ.)

P-SOP16-0410-1.27-002 Unit: mm



Weight: 0.15 g (Typ.)

Notes on Contents

1. **Pin connection**
   Pin connection may be simplified for explanatory purpose.
2. **Equivalent Circuits**
   Equivalent circuit may be simplified for explanatory purpose.
3. **Test circuit**
   Test circuit may be simplified for explanatory purpose.
4. **Timing chart**
   Timing charts may be simplified for explanatory purposes.

IC Usage Considerations

Notes on handling of ICs

(1) The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.Exceeding the rating(s) may cause device breakdown, damage or deterioration, and may result in injury by explosion or combustion.

(2) Do not insert devices in the wrong orientation or incorrectly.Make sure that the positive and negative terminals of power supplies are connected properly.Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause device breakdown, damage or deterioration, and may result in injury by explosion or combustion.In addition, do not use any device inserted in the wrong orientation or incorrectly to which current is applied even just once.

(3) Use an appropriate power supply fuse to ensure that a large current does not continuously flow in the case of overcurrent and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead to smoke or ignition. To minimize the effects of the flow of a large current in the case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

(4) If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

(5) Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.If there is a large amount of leakage current such as from input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure may cause smoke or ignition. (The overcurrent may cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection-type IC that inputs output DC voltage to a speaker directly.

Points to remember on handling of ICs

Heat Radiation Design

When using an IC with large current flow such as power amp, regulator or driver, design the device so that heat is appropriately radiated, in order not to exceed the specified junction temperature (TJ) at any time or under any condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, when designing the device, take into consideration the effect of IC heat radiation with peripheral components.

Back-EMF

When a motor rotates in the reverse direction, stops or slows abruptly, current flows back to the motor’s power supply owing to the effect of back-EMF. If the current sink capability of the power supply is small, the device’s motor power supply and output pins might be exposed to conditions beyond the absolute maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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