Four Channel Differential Line Driver

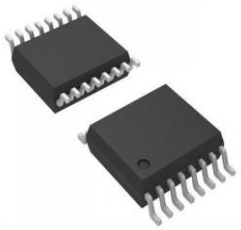
PRODUCT DESCRIPTION

The MS2374 series is a four-channel complementary line driver, which meets the demands of ANSI TIA/EIA-422-B and ITU (original CCITT) suggestion V.11. Tri-state outputs could provide high current for driving equalization lines, such as twisted-pair or parallel transmission line. In addition, it's at high-impedance state in power-down condition.

Each of the four drivers all has enable function, which offers two optional input modes: active high-level and active low-level enable (G, GN). The low-power Schottky circuit could reduce dissipation without sacrificing speed.

SOP16

TSSOP16



SSOP16

DIP16

FEATURES

- Meet or Exceed the Demands of ANSI TIA/EIA-422-B and ITU
- 5V Single Power Supply
- Compatible with TTL
- Complementary Outputs
- High Output Impedance in Power-down Condition
- Complementary Output Enable Input

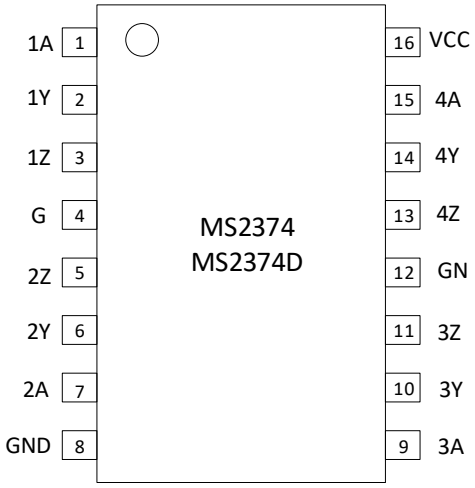
APPLICATIONS

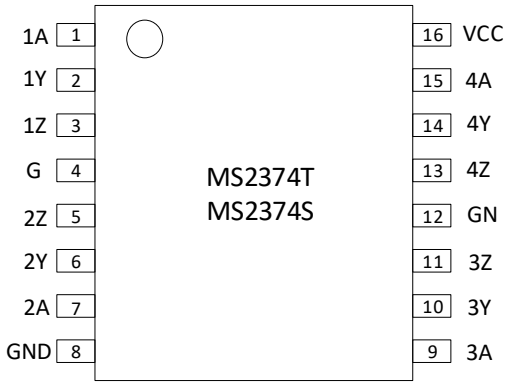
- Motor Encoder
- Field Transmitter: Pressure Senor and Temperature Senor
- Military and Avionic Electronic Imaging
- Temperature Senor or Controller with Modbus

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS2374	SOP16	MS2374
MS2374T	TSSOP16	MS2374T
MS2374S	SSOP16	MS2374S
MS2374D	DIP16	MS2374D

PIN CONFIGURATION

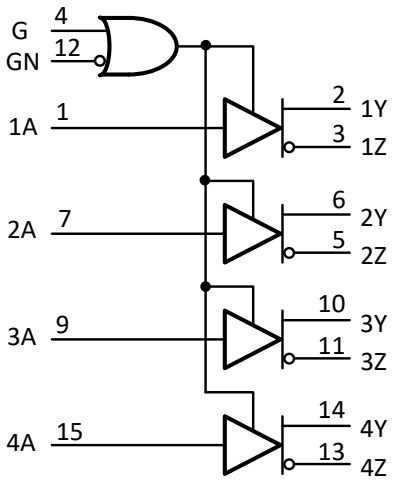




PIN DESCRIPTION

Pin	Name	Type	Description
1	1A	I	Data Input for RS422 Driver 1
2	1Y	O	Non-inverting Output for Driver 1
3	1Z	O	Inverting Output for Driver 1
7	2A	I	Data Input for RS422 Driver 2
6	2Y	O	Non-inverting Output for Driver 2
5	2Z	O	Inverting Output for Driver 2
9	3A	I	Data Input for RS422 Driver 3
10	3Y	O	Non-inverting Output for Driver 3
11	3Z	O	Inverting Output for Driver 3
15	4A	I	Data Input for RS422 Driver 4
14	4Y	O	Non-inverting Output for Driver 4
13	4Z	O	Inverting Output for Driver 4
4	G	I	Driver Enable (Active High)
12	GN	I	Driver Enable (Active Low)
16	VCC	-	Power Supply
8	GND	-	Ground

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Symbol	Range	Unit
Power Supply	V_{CC}	4.5 ~ 7	V
Maximum Input Voltage	V_{INMAX}	7	V
Maximum Shutdown(Hi-Z) Output	V_{OZMAX}	5.5	V
Soldering Temperature(10s)	$T_{SOLDERING}$	260	°C
Storage Temperature	T_{STG}	-65 ~ +150	°C
ESD(HBM), ANSI/ESDA/JEDEC JS-001 Standard	V_{ESD}	±2000	V

Note :

1. Except differential output voltage, all voltage values are relative to ground.
2. JEP155, JEDEC document shows that HBM500V meets safety production condition under standard ESD test process.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply	V_{CC}	4.5	5	5.5	V
High-level Input Voltage	V_{IH}	2			V
Low-level Input Voltage	V_{IL}			0.8	V
Operating Temperature	T_A	-40		125	°C

ELECTRICAL CHARACTERISTICS

DC Electrical Characteristics

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Input Clamp Voltage	V_{IK}	I_I=-18mA		-0.5	-0.8	-1.5	V
High-Level Output Voltage	V_{OH}	I_{OH}=-20mA		2.5			V
Low-Level Output Voltage	V_{OL}	I_{OL}=20mA				0.5	V
Off-state(High-Impedance) Output Current	I_{OZ}	V_{CC}=5V	V_O=0.5V			20	μA
			V_O=2.5V				
Input Current at Maximum Input Voltage	I_I	V_I=7V				100	μA
High-Level Input Current	I_{IH}	V_I=2.7V				20	μA
Low-Level Input Current	I_{IL}	V_I=0.4V				-100	μA
Short-circuit Output Current	I_{OS}			30		80	mA
Power Supply Current	I_{CC}	All outputs NC			25	35	mA

1. All typical values operate at V_{CC}=5V,T_A=25°C.

2. Only one output terminal is short circuit at most, and the duration doesn't exceed one second.

Switch Characteristics

Parameter	Symbol	Condition		Typ	Unit
Propagation Delay Time, Low to High Level Output	t_{PLH}	C_L=30pF,Open S1, S2		12	ns
Propagation Delay Time, High to Low Level Output	t_{PHL}			15	
Output Enable Time to High Level	t_{PZH}	C_L=30pF	R_L=75Ω	20	ns
Output Enable Time to Low Level	t_{PZL}		R_L=180Ω	20	
Output Disable Time from High Level	t_{PHZ}	C_L=10pF, Close S1,S2		12	ns
Output Disable Time from Low Level	t_{PLZ}			35	
Output-to-Output Skew	t_{SKEW}	C_L=30pF, Open S1,S2		2	ns

1. Test conditions are at V_{CC}=5V, T_A=25°C.

2. Unless otherwise noted, the off-state of each output terminal is high impedance.

3. Test circuit is shown in figure 1. C_L includes parasitic capacitance of prod and socket. Input signal is from waveform generator, and it meets the following demands : PRR≤1MHz, Z_O≈50Ω, t_r≤15ns, t_f≤6ns; Each enable terminal is tested alone.

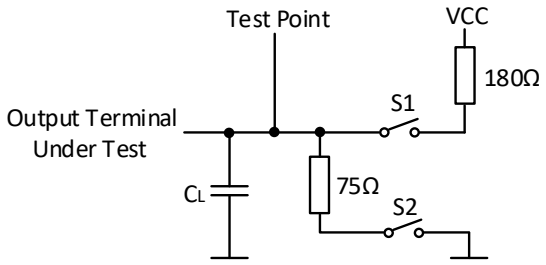


Figure 1. Switch Characteristic Test Circuit

4. Test propagation delay time and skew. It needs to open S1 and S2. The corresponding test waveform is shown in figure 2.

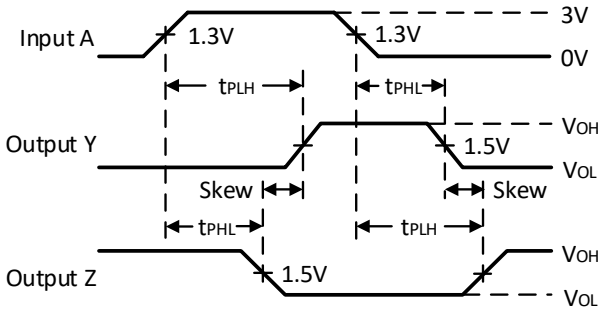


Figure 2. Propagation Delay Time and Skew

5. Test output enable time and disable time. Note S1 and S2 states are different. Please refer to above table and figure 3 to adjust switch state and test respectively. Waveform 1 represents that driver maintains low-level by input and enable signals (Unless enable terminal controls driver into high-impedance state). Waveform 2 represents that driver maintains high-level by input and enable signals (Unless enable terminal controls driver into high-impedance state).

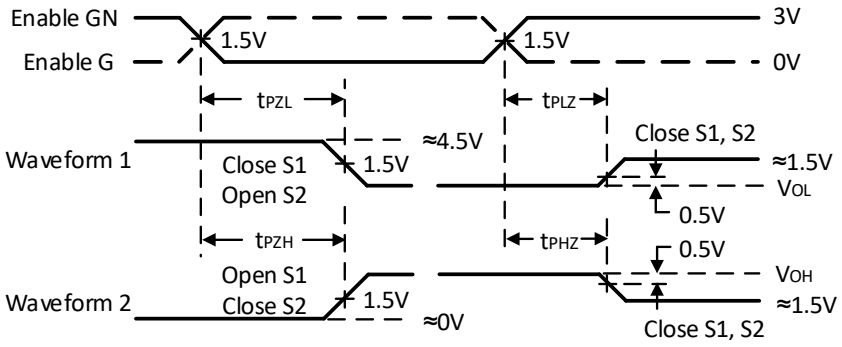


Figure 3. Enable and Disable Time Waveforms

APPLICATION INFORMATION

Chip Overview

The MS2374 is a bus transmission chip, which provides single chip solution for application of one-way communication transmission line. The chip is used in interface circuit of equalization transmission line, which meets ANSI EIA/TIA-422-B standard.

The MS2374 includes four tri-state differential line drivers, only needing 5V single power supply. In addition, in order to be accurate enable control, the MS2374 also integrates enable logic mode (active-high and active-low). Each driver could drive load network that needs ±30mA current.

What's more, it also integrates positive and negative current limit function, which prevents chip from damaging when bus transmission errors occur.

Function Overview

The MS2374 sets driver into different operation states by two enable inputs (G, GN). If set G to high level or set GN to low level, the output terminals of four drivers open, transmitting signal normally. If set G to low level or set GN to high level, the output terminals of four drivers enter into off-state (high-impedance state).The following function table is for reference.

The MS2374 is just half of a pair of line transmission devices, needing complementary receiver MS2375. In order to ensure best transmission performance, suggest using these two chips as driver and receiver at the same time. Use other proper receivers meeting the demands of RS-422 communication protocol and transmission level.

Function Table

Input	Enable		Output	
A	G	GN	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

H=High Level, L=Low Level, X=Irrelevant State, Z=High-impedance State(Off-state)

Transmission Line Application Information

When designing a system which includes driver, receiver and transceiver, and meets RS-422, RS485 standard, an appropriate terminal resistor must be paralleled in cable terminal, so as to attenuate transmission line reflection, accordingly improve the reliability of application scheme. Because RS-422 bus only supports one driver, a terminal resistor is placed near the last receiver. In general, RS-485 bus could connect many drivers and receivers, so two terminals of cable all need to place terminal resistors.

Power Supply Precaution

Placing a 0.1μF capacitor near supply pin could reduce power coupled noise and decrease source resistance.

PCB Layout Guide

When design PCB of interface circuit, need to consider much. Careful layout design could improve performance.

1. In analog circuit, the noise often enters into circuit interior through supply pin. Hence, place a bypass capacitor near supply pin to reduce coupled noise. The concrete measure is that a 0.1μF ceramic capacitor of low ESR is connected between supply pin and ground. And the capacitor is placed as close to chip pin as possible. Single bypass capacitor is suitable for application scheme with single power supply.

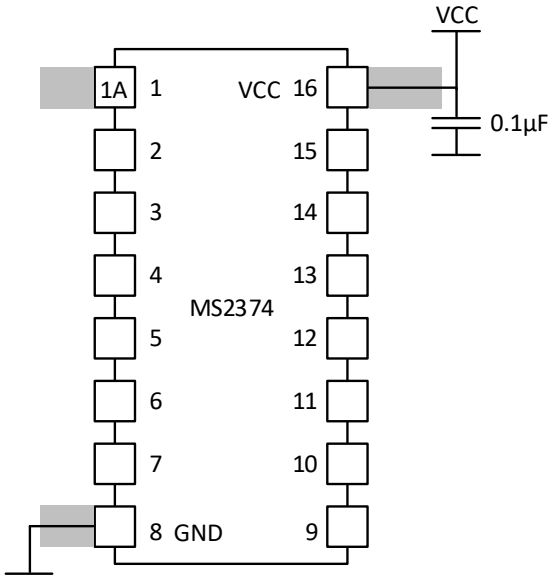
2. The layout, that analog and digital ground wires are separate, is the most simple but effective noise-suppression scheme. In single layer or multi-layers PCB, there are many ground pads, which help system to dissipate heat and reduce EMI noise pickup. Please ensure that analog and digital ground are separate in physical layer and especially note the current direction in ground wire.

3. In order to reduce parasitic coupling, input traces should keep away with supply pin and output traces as far as possible. If actual condition isn't permitted, take measures to cross noise trace vertically, instead of parallel trace.

4. Place external components as close to chip as possible. Gain resistance RF and feedback resistance RG are placed as close to inverted input terminal as possible, in order to reduce parasitic capacitance.

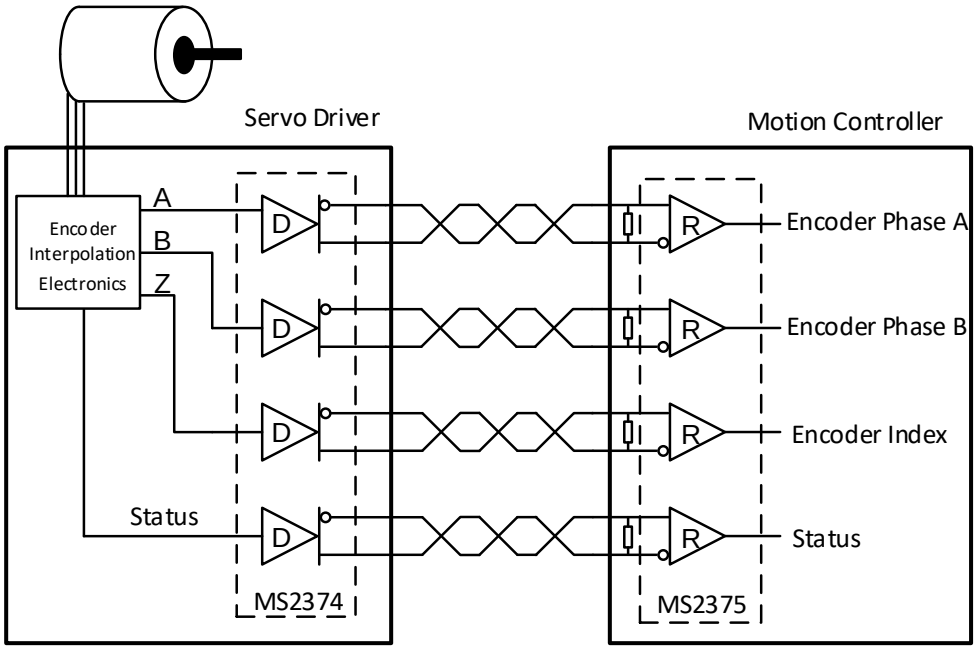
5. Input traces are as short as possible. Focus on input traces, because they are the most sensitive part in system.

6. The following diagram is a recommended PCB layout.



TYPICAL APPLICATION CIRCUIT

The following diagram shows an encoder circuit for servo system.

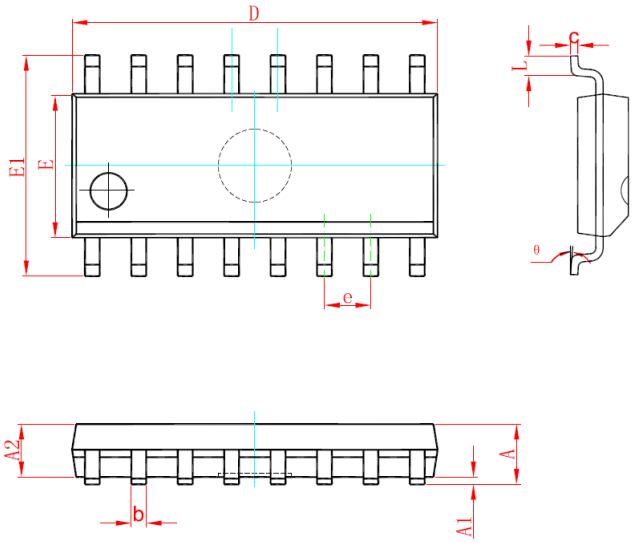


1. The circuit needs 5V power supply. The operation frequency of RS422 bus is 10MHz or less. Ensure that the corresponding pins of transmitter and receiver are correct connections.

2. Place chip as close to interface as possible, which reduces line resistance to reduce bus signal reflection. If driver is at high-impedance state, 200mV bias voltage could be increased on the A-B port for fail-safety.

PACKAGE OUTLINE DIMENSIONS

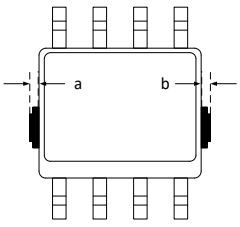
SOP16



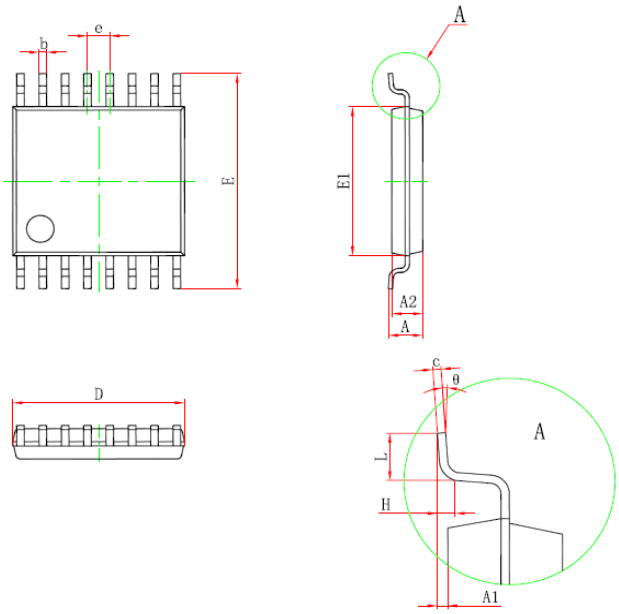
Symbol	Dimension in Millimeters		Dimension in Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	9.800	10.200	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Note: In addition to the package size, a and b are allowed to have the maximum size of 0.15mm for waste glue simultaneously.

The diagram is as follows: taking SOP8 package as an example.



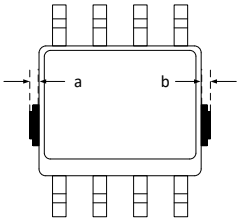
TSSOP16



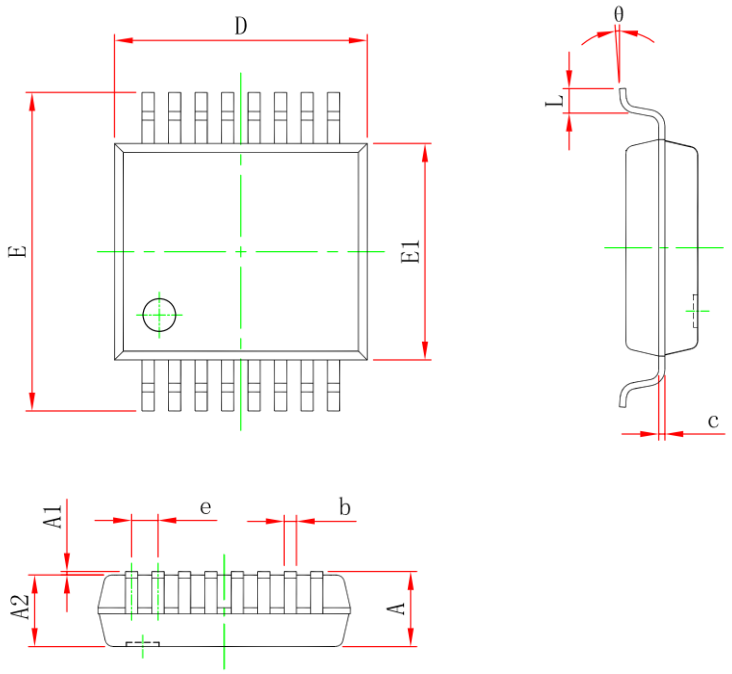
Symbol	Dimension in Millimeters		Dimension in Inches	
	Min	Max	Min	Max
D	4.900	5.100	0.193	0.201
E	6.250	6.550	0.246	0.258
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	4.300	4.500	0.169	0.177
A		1.200		0.047
A2	0.800	1.000	0.031	0.039
A1	0.050	0.150	0.002	0.006
e	0.65(BSC)		0.026(BSC)	
L	0.400	1.270	0.016	0.050
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

Note: In addition to the package size, a and b are allowed to have the maximum size of 0.15mm for waste glue simultaneously.

The diagram is as follows: taking SOP8 package as an example.



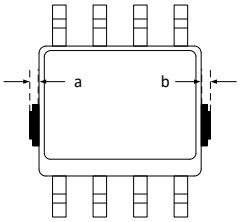
SSOP16



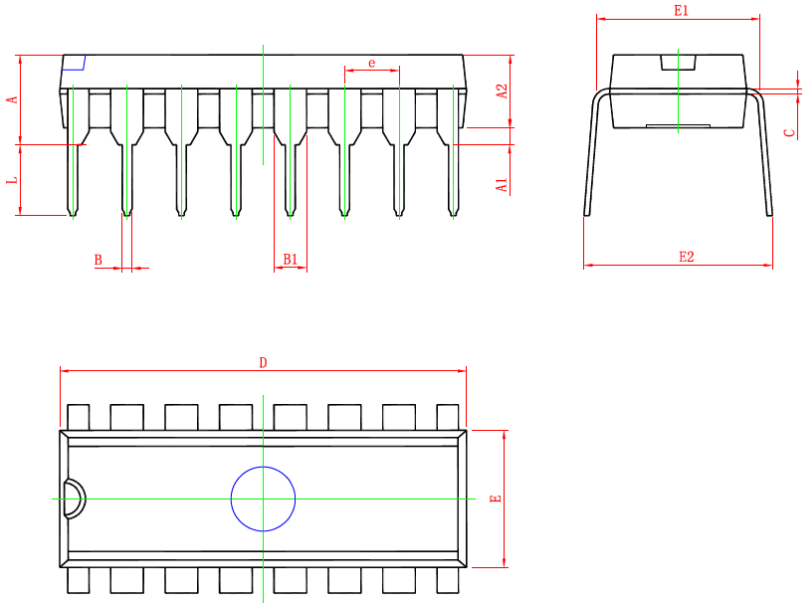
Symbol	Dimension in Millimeters		Dimension in Inches	
	Min	Max	Min	Max
A	--	2.000	--	0.079
A1	0.050	--	0.002	--
A2	1.650	1.850	0.065	0.073
b	0.220	0.380	0.009	0.015
c	0.090	0.250	0.004	0.010
D	5.900	6.500	0.232	0.256
E	7.400	8.200	0.291	0.323
E1	5.000	5.600	0.197	0.220
e	0.650(BSC)		0.026(BSC)	
L	0.550	0.950	0.022	0.037
θ	1°	8°	1°	8°

Note: In addition to the package size, a and b are allowed to have the maximum size of 0.15mm for waste glue simultaneously.

The diagram is as follows: taking SOP8 package as an example.



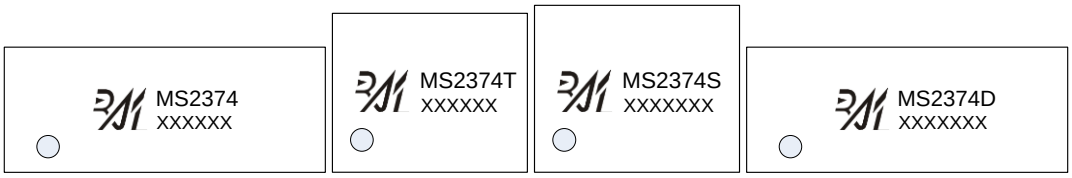
DIP16



Symbol	Dimension in Millimeters	
	Min	Max
A	3.710	4.310
A1	0.510	-
B	0.38	0.51
B1	1.524 (BSC)	
C	0.204	0.360
D	18.800	19.200
E	6.200	6.600
E1	7.320	7.974
e	2.540 (BSC)	
L	3.000	3.600
E2	8.400	9.000

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description



Product Name : MS2374, MS2374T, MS2374S, MS2374D

Product Code : XXXXXX, XXXXXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging Specification

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS2374	SOP16	4000	1	4000	8	32000
MS2374T	TSSOP16	3000	1	3000	8	24000
MS2374S	SSOP16	2500	1	2500	8	20000

Device	Package	Piece/Tube	Tube/Box	Piece/Box	Box/Carton	Piece/Carton
MS2374D	DIP16	25	40	1000	10	10000

STATEMENT

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- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.

MOS CIRCUIT OPERATION PRECAUTIONS

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1. The operator shall ground through the anti-static wristband.
2. The equipment shell must be grounded.
3. The tools used in the assembly process must be grounded.
4. Must use conductor packaging or anti-static materials packaging or transportation.

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