74LVC374A
Octal D-Type Positive Edge-Triggered Flip-Flop with 3-State Outputs

GENERAL DESCRIPTION

The 74LVC374A is an 8-bit D-type positive edge-triggered flip-flop with 3-state outputs that is designed for 1.2V to 3.6V V_{CC} operation.

The device is provided with a clock (CP) input and an output enable ($\overline{OE}$) input. When data at the Dn inputs suffices for setup and hold time purposes, data can be moved to the Qn outputs on the low-to-high clock transition. When $\overline{OE}$ is high, all outputs are in high-impedance state. $\overline{OE}$ has no influence on the state of the flip-flops. Both 3.3V and 5V devices can drive inputs, enabling this device to operate as translator in a mixed 3.3V and 5V system environment. All inputs support Schmitt-trigger action, which can allow the circuit to tolerate slower input rise and fall times.

This device is highly suitable for partial power-down applications by using power-off leakage current (I_{OFF}) circuit. When the device is powered down, the outputs are disabled, and the current backflow can be prevented from passing through the device.

The 74LVC374A is available in Green SOIC-20 and TSSOP-20 packages. It operates over an operating temperature range of -40℃ to +125℃.

FEATURES

- **Wide Operating Voltage Range: 1.2V to 3.6V**
- **Input and Output Interface Capability to 5V System Environment**
- **+24mA/-24mA Output Current**
- **CMOS Low Power Dissipation**
- **Support Partial Power-Down Mode**
- **Outputs in High-Impedance State when V_{CC} = 0V**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green SOIC-20 and TSSOP-20 Packages**

APPLICATIONS

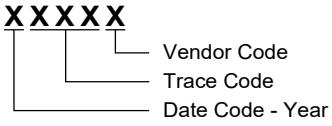
Electrical Appliances
Computing Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
74LVC374A	SOIC-20	-40℃ to +125℃	74LVC374AXS20G/TR	74LVC374AXS20 XXXXX	Tape and Reel, 1500
	TSSOP-20	-40℃ to +125℃	74LVC374AXTS20G/TR	0J9XTS20 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS (1)

Supply Voltage Range, V_{CC} ..... -0.5V to 6.5V
Input Voltage Range, V_I (2) ..... -0.5V to 6.5V
Output Voltage Range, V_O (2)
High-State or Low-State..... -0.5V to MIN(6.5V, V_{CC} + 0.5V)
High-Impedance or Power-Off State ..... -0.5V to 6.5V
Input Clamp Current, I_{IK} (V_I < 0V) .....-50mA
Output Clamp Current, I_{OK} (V_O < 0V).....-50mA
Continuous Output Current, I_O (V_O = 0V to V_{CC}).....±50mA
Continuous Current through V_{CC} or GND.....±100mA
Junction Temperature (3) .....+150℃
Storage Temperature Range .....-65℃ to +150℃
Lead Temperature (Soldering, 10s).....+260℃
ESD Susceptibility
HBM.....6000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range, V_{CC} .....1.65V to 3.6V
Function Supply Voltage Range, V_{CC}.....1.2V to 3.6V
Input Voltage Range, V_I.....0V to 5.5V
Output Voltage Range, V_O
High-State or Low-State..... 0V to V_{CC}
High-Impedance or Power-Off State .....0V to 5.5V
Output Current, I_O .....±24mA
Input Transition Rise or Fall Rate, Δt/ΔV
V_{CC} = 1.65V to 2.7V .....20ns/V (MAX)
V_{CC} = 2.7V to 3.6V .....10ns/V (MAX)
Operating Temperature Range .....-40℃ to +125℃

OVERSTRESS CAUTION

1. Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

2. The input and output voltage ratings may be exceeded if the input and output clamp current ratings are observed.

3. The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability.

ESD SENSITIVITY CAUTION

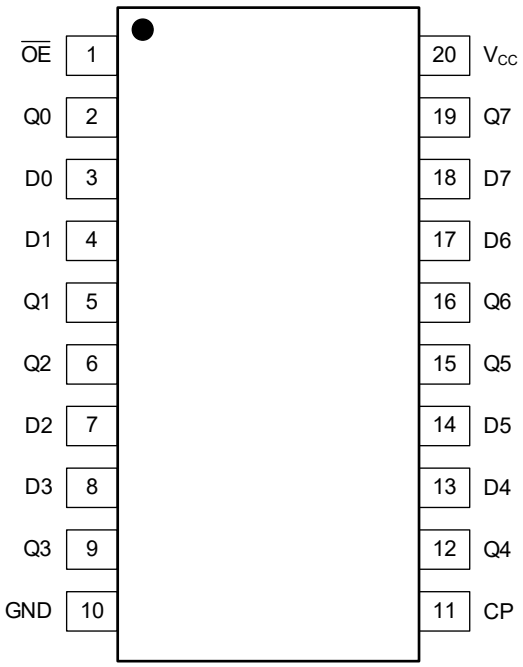
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATIONS

(TOP VIEW)

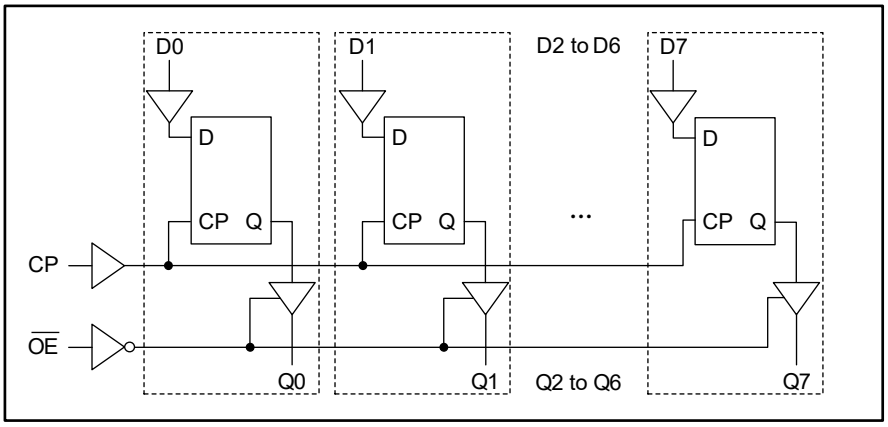


SOIC-20/TSSOP-20

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	$\overline{OE}$	Output Enable Input (Active-Low).
2, 5, 6, 9, 12, 15, 16, 19	Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7	Outputs.
3, 4, 7, 8, 13, 14, 17, 18	D0, D1, D2, D3, D4, D5, D6, D7	Data Inputs.
10	GND	Ground.
11	CP	Clock Input (Low-to-High Clock Transition, Edge-Triggered).
20	V_{CC}	Power Supply.

LOGIC DIAGRAM



FUNCTION TABLE

INPUT			INTERNAL FLIP-FLOPS	OUTPUT
$\overline{OE}$	CP	Dn		Qn
L	↑	l	L	L
L	↑	h	H	H
H	↑	l	L	Z
H	↑	h	H	Z

H = High Voltage Level

h = High Voltage Level One Setup Time before Clock Rising Edge ↑

L = Low Voltage Level

l = Low Voltage Level One Setup Time before Clock Rising Edge ↑

Z = High-Impedance State

↑ = Low-to-High Clock Transition

ELECTRICAL CHARACTERISTICS

(Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
High-Level Input Voltage	V_{IH}	V_{CC} = 1.2V	Full	1.08			V
		V_{CC} = 1.65V to 1.95V	Full	0.65 × V_{CC}			
		V_{CC} = 2.3V to 2.7V	Full	1.7			
		V_{CC} = 2.7V to 3.6V	Full	2.0			
Low-Level Input Voltage	V_{IL}	V_{CC} = 1.2V	Full			0.12	V
		V_{CC} = 1.65V to 1.95V	Full			0.35 × V_{CC}	
		V_{CC} = 2.3V to 2.7V	Full			0.7	
		V_{CC} = 2.7V to 3.6V	Full			0.8	
High-Level Output Voltage	V_{OH}	V_{CC} = 1.65V to 3.6V, I_{OH} = -100μA	Full	V_{CC} - 0.3	V_{CC} - 0.005		V
		V_{CC} = 1.65V, I_{OH} = -4mA	Full	1.05	1.50		
		V_{CC} = 2.3V, I_{OH} = -8mA	Full	1.65	2.09		
		V_{CC} = 2.7V, I_{OH} = -12mA	Full	2.05	2.42		
		V_{CC} = 3.0V, I_{OH} = -18mA	Full	2.25	2.60		
		V_{CC} = 3.0V, I_{OH} = -24mA	Full	2.00	2.45		
Low-Level Output Voltage	V_{OL}	V_{CC} = 1.65V to 3.6V, I_{OL} = 100μA	Full		0.005	0.30	V
		V_{CC} = 1.65V, I_{OL} = 4mA	Full		0.10	0.65	
		V_{CC} = 2.3V, I_{OL} = 8mA	Full		0.16	0.80	
		V_{CC} = 2.7V, I_{OL} = 12mA	Full		0.23	0.60	
		V_{CC} = 3.0V, I_{OL} = 24mA	Full		0.45	0.80	
Input Leakage Current	I_I	V_{CC} = 3.6V, V_I = 5.5V or GND	Full		±0.1	±5	μA
Off-State Output Current	I_{OZ}	V_{CC} = 3.6V, V_I = V_{IH} or V_{IL}, V_O = 5.5V or GND	Full		±0.1	±5	μA
Power-Off Leakage Current	I_{OFF}	V_{CC} = 0V, V_I or V_O = 5.5V	Full		±0.1	±5	μA
Supply Current	I_{CC}	V_{CC} = 3.6V, V_I = V_{CC} or GND, I_O = 0A	Full		0.4	20	μA
Additional Supply Current	ΔI_{CC}	Per input pin, V_{CC} = 2.7 V to 3.6V, V_I = V_{CC} - 0.6V, I_O = 0A	Full		2.0	20	μA
Input Capacitance	C_I	V_{CC} = 0V to 3.6V, V_I = GND to V_{CC}	+25℃		3.5		pF

DYNAMIC CHARACTERISTICS

(See Figure 1 for test circuit. Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃ and V_{CC} = 1.2V, 1.8V, 2.5V, 2.7V and 3.3V respectively, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN (1)	TYP	MAX (1)	UNITS
Propagation Delay (2)	t_{PD}	CP to Qn, see Figure 2	V_{CC} = 1.2V	+25℃		18.0		ns
			V_{CC} = 1.65V to 1.95V	Full	0.5	6.5	18.8	
			V_{CC} = 2.3V to 2.7V	Full	0.5	4.5	9.7	
			V_{CC} = 2.7V	Full	0.5	4.5	10.0	
			V_{CC} = 3.0V to 3.6V	Full	0.5	4.3	9.0	
Enable Time (2)	t_{EN}	$\overline{OE}$ to Qn, see Figure 3	V_{CC} = 1.2V	+25℃		30.0		ns
			V_{CC} = 1.65V to 1.95V	Full	0.5	9.0	21.0	
			V_{CC} = 2.3V to 2.7V	Full	0.5	5.8	10.8	
			V_{CC} = 2.7V	Full	0.5	5.7	11.0	
			V_{CC} = 3.0V to 3.6V	Full	0.5	5.0	9.5	
Disable Time (2)	t_{DIS}	$\overline{OE}$ to Qn, see Figure 3	V_{CC} = 1.2V	+25℃		10.0		ns
			V_{CC} = 1.65V to 1.95V	Full	0.5	4.9	12.0	
			V_{CC} = 2.3V to 2.7V	Full	0.5	2.7	7.0	
			V_{CC} = 2.7V	Full	0.5	2.8	9.0	
			V_{CC} = 3.0V to 3.6V	Full	0.5	2.8	7.5	
Pulse Width	t_W	CP high or low, see Figure 2	V_{CC} = 1.65V to 1.95V	Full	5.0			ns
			V_{CC} = 2.3V to 2.7V	Full	4.5			
			V_{CC} = 2.7V	Full	4.5			
			V_{CC} = 3.0V to 3.6V	Full	4.5			
Setup Time	t_{SU}	Dn to CP, see Figure 4	V_{CC} = 1.65V to 1.95V	Full	4.0			ns
			V_{CC} = 2.3V to 2.7V	Full	3.0			
			V_{CC} = 2.7V	Full	2.0			
			V_{CC} = 3.0V to 3.6V	Full	2.0			
Hold Time	t_H	Dn to CP, see Figure 4	V_{CC} = 1.65V to 1.95V	Full	3.0			ns
			V_{CC} = 2.3V to 2.7V	Full	2.0			
			V_{CC} = 2.7V	Full	1.5			
			V_{CC} = 3.0V to 3.6V	Full	1.5			
Power Dissipation Capacitance (3)	C_{PD}	Per flip-flop, V_I = GND to V_{CC}	V_{CC} = 1.65V to 1.95V	+25℃		18.0		pF
			V_{CC} = 2.3V to 2.7V	+25℃		18.0		
			V_{CC} = 3.0V to 3.6V	+25℃		18.0		

NOTES:

1. Specified by design and characterization, not production tested.
2. t_{PD} is the same as t_{PLH} and t_{PHL}. t_{EN} is the same as t_{PZH} and t_{PZL}. t_{DIS} is the same as t_{PLZ} and t_{PHZ}.
3. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

   $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$

   where:

   f_i = Input frequency in MHz.

   f_o = Output frequency in MHz.

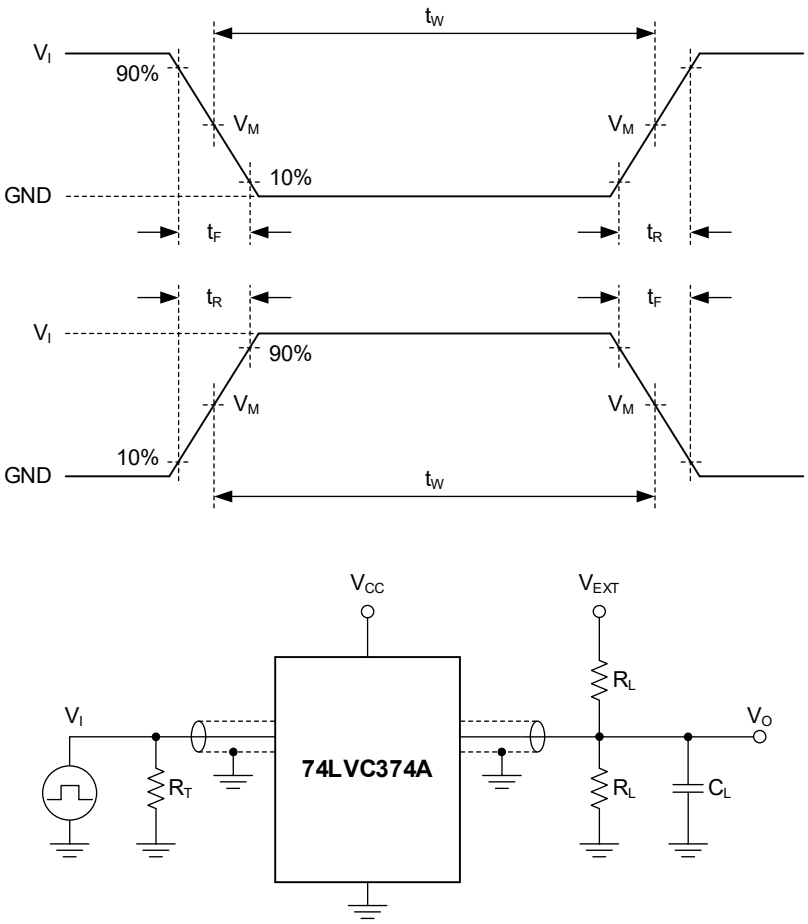
   C_L = Output load capacitance in pF.

   V_{CC} = Supply voltage in Volts.

   N = Number of inputs switching.

   $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = Sum of the outputs.

TEST CIRCUIT



Test conditions are given in Table 1.

Definitions for test circuit:

R_L: Load resistance.

C_L: Load capacitance (includes jig and probe).

R_T: Termination resistance (equals to output impedance Z_O of the pulse generator).

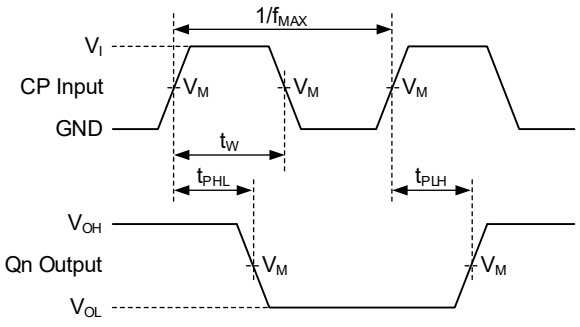
V_{EXT}: External voltage is used to measure switching time.

Figure 1. Test Circuit for Measuring Switching Times

Table 1. Test Conditions

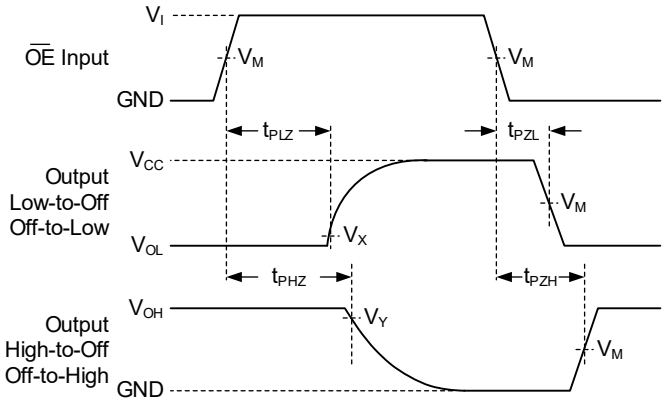
SUPPLY VOLTAGE	INPUT		LOAD		V_{EXT}		
V_{CC}	V_I	t_R, t_F	C_L	R_L	t_{PLH}, t_{PHL}	t_{PLZ}, t_{PZL}	t_{PHZ}, t_{PZH}
1.2V	V_{CC}	≤ 2.0ns	30pF	1kΩ	Open	2 × V_{CC}	GND
1.65V to 1.95V	V_{CC}	≤ 2.0ns	30pF	1kΩ	Open	2 × V_{CC}	GND
2.3V to 2.7V	V_{CC}	≤ 2.0ns	30pF	500Ω	Open	2 × V_{CC}	GND
2.7V	2.7V	≤ 2.5ns	50pF	500Ω	Open	2 × V_{CC}	GND
3.0V to 3.6V	2.7V	≤ 2.5ns	50pF	500Ω	Open	2 × V_{CC}	GND

WAVEFORMS



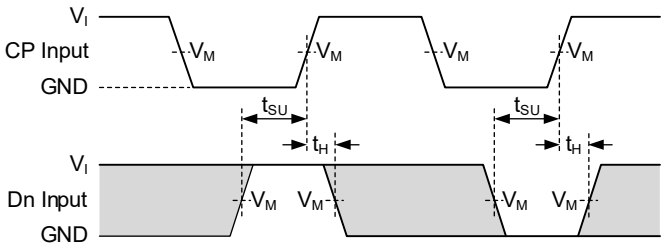
Test conditions are given in Table 1.
Measurement points are given in Table 2.
Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 2. Clock Input CP to Output Qn Propagation Delay Times and Pulse Width



Test conditions are given in Table 1.
Measurement points are given in Table 2.
Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 3. Enable and Disable Times



Test conditions are given in Table 1.
Measurement points are given in Table 2.
The shaded areas refer to when the input is allowed to change for predictable output performance.

Figure 4. Data Setup and Hold Times

WAVEFORMS (continued)

Table 2. Measurement Points

SUPPLY VOLTAGE	INPUT		OUTPUT		
V_{CC}	V_I	V_M (1)	V_M	V_X	V_Y
1.2V	V_{CC}	0.5 × V_{CC}	0.5 × V_{CC}	V_{OL} + 0.15V	V_{OH} - 0.15V
1.65V to 1.95V	V_{CC}	0.5 × V_{CC}	0.5 × V_{CC}	V_{OL} + 0.15V	V_{OH} - 0.15V
2.3V to 2.7V	V_{CC}	0.5 × V_{CC}	0.5 × V_{CC}	V_{OL} + 0.15V	V_{OH} - 0.15V
2.7V	2.7V	1.5V	1.5V	V_{OL} + 0.3V	V_{OH} - 0.3V
3.0V to 3.6V	2.7V	1.5V	1.5V	V_{OL} + 0.3V	V_{OH} - 0.3V

NOTE:

1. The measurement points should be V_{IH} or V_{IL} when the input rising or falling time exceeds 2.5ns.

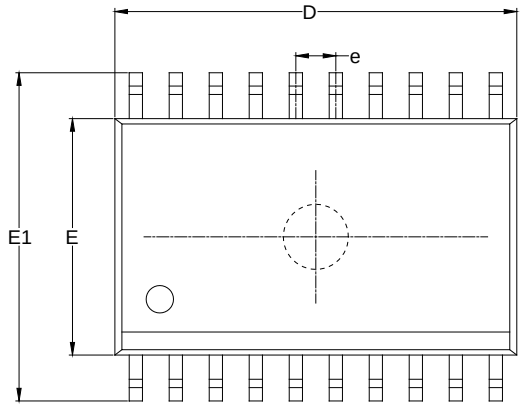
REVISION HISTORY

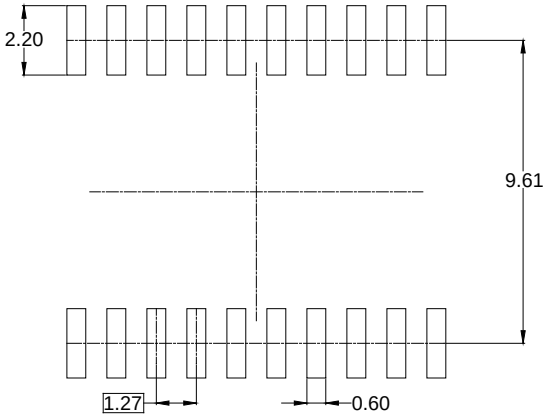
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (MARCH 2024) to REV.A	Page
Changed from product preview to production data	All

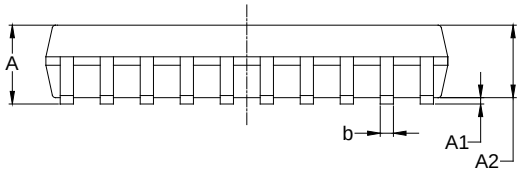
PACKAGE OUTLINE DIMENSIONS

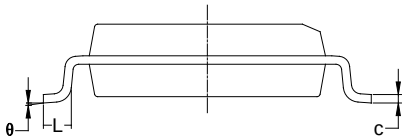
SOIC-20





RECOMMENDED LAND PATTERN (Unit: mm)



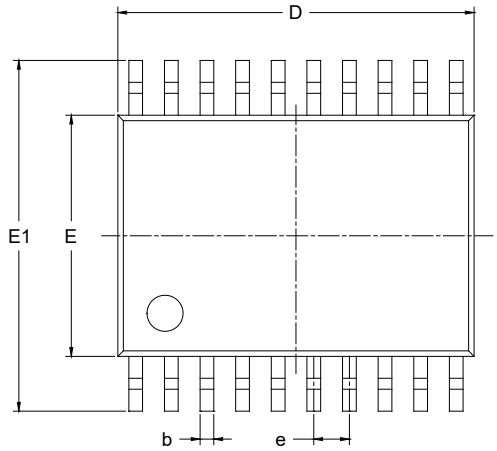


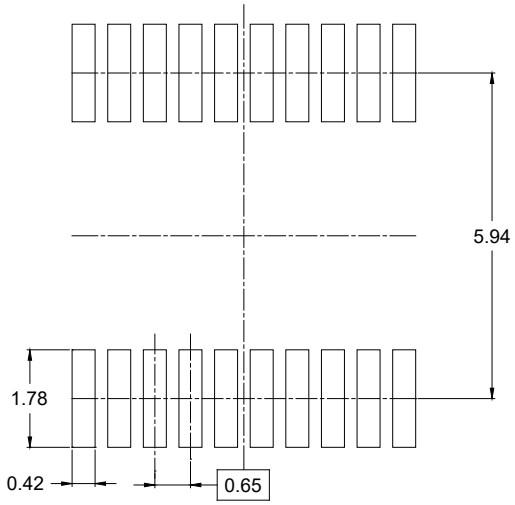
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	2.350	2.650	0.093	0.104
A1	0.100	0.300	0.004	0.012
A2	2.100	2.500	0.083	0.098
b	0.330	0.510	0.013	0.020
c	0.204	0.330	0.008	0.013
D	12.520	13.000	0.493	0.512
E	7.400	7.600	0.291	0.299
E1	10.210	10.610	0.402	0.418
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

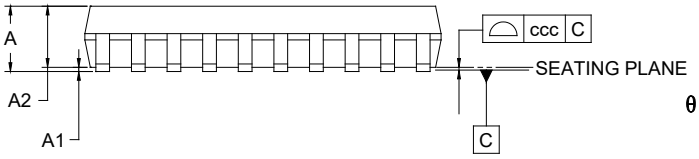
PACKAGE OUTLINE DIMENSIONS

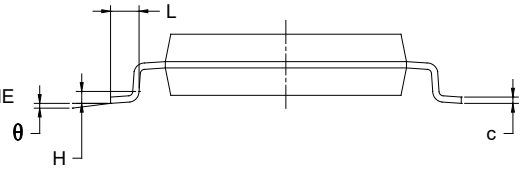
TSSOP-20





RECOMMENDED LAND PATTERN (Unit: mm)



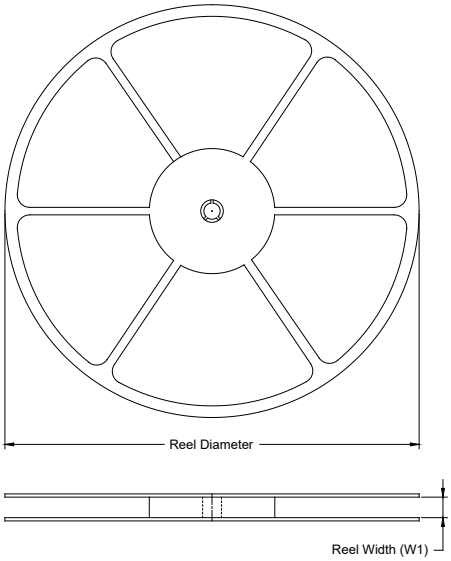


Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	-	-	1.200
A1	0.050	-	0.150
A2	0.800	-	1.050
b	0.190	-	0.300
c	0.090	-	0.200
D	6.400	-	6.600
E	4.300	-	4.500
E1	6.200	-	6.600
e	0.650 BSC		
L	0.450	-	0.750
H	0.250 TYP		
θ	0°	-	8°
ccc	0.100		

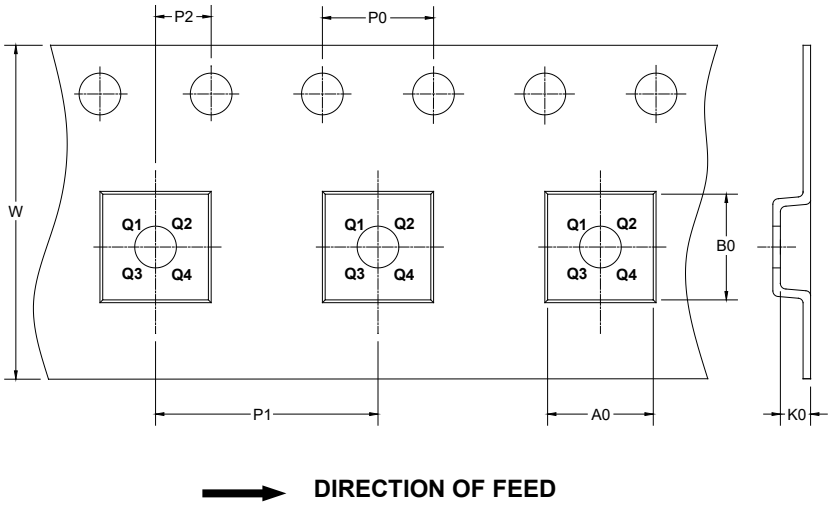
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-153.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



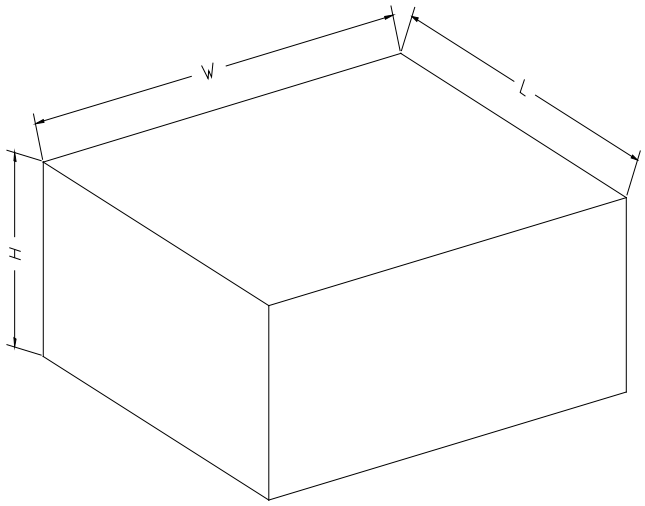
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOIC-20	13″	24.4	10.90	13.30	3.00	4.0	12.0	2.0	24.0	Q1
TSSOP-20	13″	16.4	6.80	6.90	1.50	4.0	8.0	2.0	16.0	Q1

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13″	386	280	370	5

DD0002