74HC164
8-Bit Serial-In and Parallel-Out Shift Register

GENERAL DESCRIPTION

The 74HC164 is an 8-bit serial-in and parallel-out shift register which can accept a wide supply voltage range from 2.0V to 5.5V.

This device provides gated serial inputs (DSA and DSB) and parallel data outputs (Q0 to Q7). DSA and DSB support serial data entry, where either input can allow data to enter through another input as an active-high input. CP is a clock input. When the device is on low-to-high clock transition of the CP, data can be shifted. $\overline{MR}$ is the master reset input that is separated from the other inputs. When $\overline{MR}$ is held low, it can make the register clear and all outputs must be low level. The clamp diodes of inputs allow the use of current limiting resistors to connect inputs to the voltage exceeding supply voltage.

The 74HC164 is available in Green SOIC-14 and TSSOP-14 packages. It operates over an operating temperature range of -40℃ to +125℃.

FEATURES

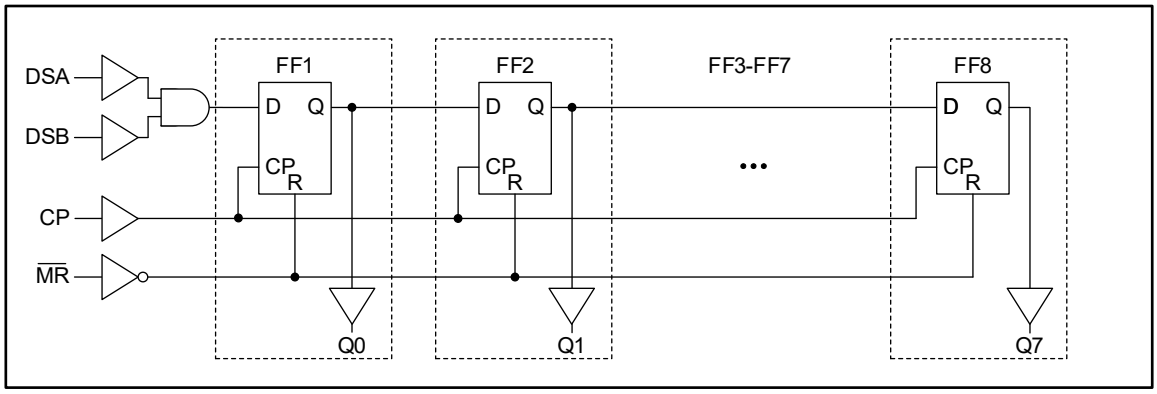
- **Wide Operating Voltage Range: 2.0V to 5.5V**
- **+5.2mA/-5.2mA Output Current**
- **CMOS Low Power Consumption**
- **Gated Serial Data Inputs**
- **Asynchronous Master Reset Input**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green SOIC-14 and TSSOP-14 Packages**

APPLICATIONS

Servers and I/O Expanders

LED Displays

LOGIC DIAGRAM

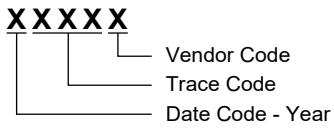


PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
74HC164	SOIC-14	-40℃ to +125℃	74HC164XS14G/TR	74HC164XS14 XXXXX	Tape and Reel, 2500
	TSSOP-14	-40℃ to +125℃	74HC164XTS14G/TR	74HC164 XTS14 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 7.0V
Input Voltage Range, V_I (2) .... -0.5V to MIN(7.0V, V_{CC} + 0.5V)
Output Voltage Range, V_O (2) -0.5V to MIN(7.0V, V_{CC} + 0.5V)
Input Clamp Current, I_{IK} (V_I < -0.5V or V_I > V_{CC} + 0.5V)
..... ±20mA
Output Clamp Current, I_{OK} (V_O < -0.5V or V_O > V_{CC} + 0.5V)
..... ±20mA
Continuous Output Current, I_O (-0.5V < V_O < V_{CC} + 0.5V)
..... ±25mA
Continuous Current through V_{CC} or GND..... ±50mA
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} .....2.0V to 5.5V
Input Voltage Range, V_I..... 0V to V_{CC}
Output Voltage Range, V_O ..... 0V to V_{CC}
Output Current, I_O ..... ±5.2mA
Input Transition Rise or Fall Rate, Δt/ΔV
V_{CC} = 2.0V..... 625ns/V (MAX)
V_{CC} = 4.5V..... 139ns/V (MAX)
V_{CC} = 5.5V..... 83ns/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

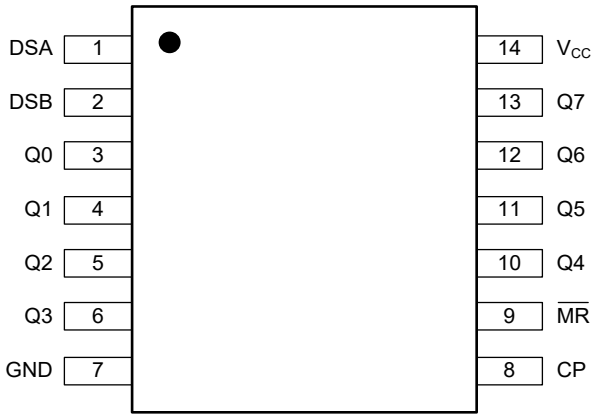
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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-14/TSSOP-14

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	DSA	Serial Data Input A.
2	DSB	Serial Data Input B.
3, 4, 5, 6, 10, 11, 12, 13	Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7	Parallel Data Outputs.
7	GND	Ground.
8	CP	Clock Input (Low-to-High Clock Transition, Edge-Triggered).
9	$\overline{MR}$	Master Reset Input (Active-Low).
14	V_{CC}	Supply Voltage.

FUNCTION TABLE

INPUT				OUTPUT	
$\overline{MR}$	CP	DSA	DSB	Q0	Q1 to Q7
L	*X*	*X*	*X*	L	L to L
H	↑	I	I	L	q0 to q6
H	↑	I	h	L	q0 to q6
H	↑	h	I	L	q0 to q6
H	↑	h	h	H	q0 to q6

H = High voltage level.

h = High voltage level one setup time before clock rising edge ↑.

L = Low voltage level.

I = Low voltage level one setup time before clock rising edge ↑.

q = The state of the referenced output one setup time before clock rising edge ↑.

↑ = Low-to-high clock transition.

X = Don't care.

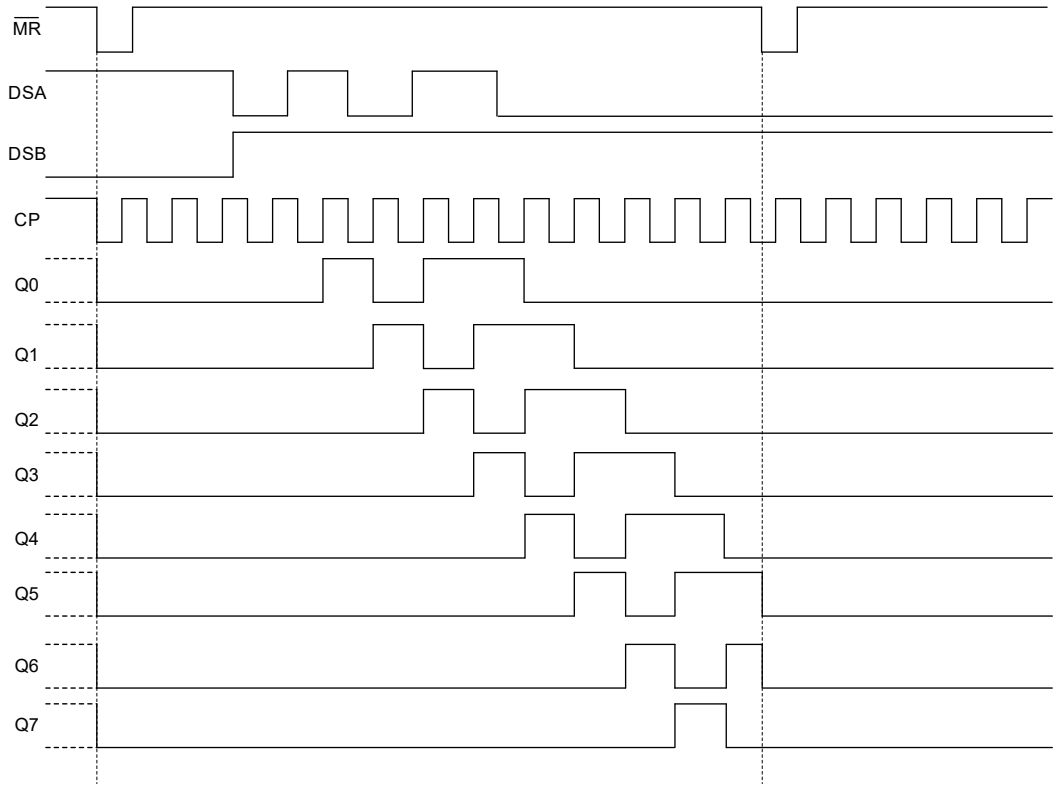


Figure 1. Timing Diagram

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} = 2.0V	Full	1.50			V
		V_{CC} = 4.5V	Full	3.15			
		V_{CC} = 5.5V	Full	3.85			
Low-Level Input Voltage	V_{IL}	V_{CC} = 2.0V	Full			0.50	V
		V_{CC} = 4.5V	Full			1.35	
		V_{CC} = 5.5V	Full			1.65	
High-Level Output Voltage	V_{OH}	V_{CC} = 2.0V, I_O = -20μA	Full	1.95	1.995		V
		V_{CC} = 4.5V, I_O = -20μA	Full	4.45	4.495		
		V_{CC} = 5.5V, I_O = -20μA	Full	5.45	5.495		
		V_{CC} = 4.5V, I_O = -4.0mA	Full	3.84	4.390		
		V_{CC} = 5.5V, I_O = -5.2mA	Full	4.84	5.380		
Low-Level Output Voltage	V_{OL}	V_{CC} = 2.0V, I_O = 20μA	Full		0.005	0.05	V
		V_{CC} = 4.5V, I_O = 20μA	Full		0.005	0.05	
		V_{CC} = 5.5V, I_O = 20μA	Full		0.005	0.05	
		V_{CC} = 4.5V, I_O = 4.0mA	Full		0.10	0.33	
		V_{CC} = 5.5V, I_O = 5.2mA	Full		0.12	0.33	
Input Leakage Current	I_I	V_{CC} = 5.5V, V_I = V_{CC} or GND	Full			±1	μA
Supply Current	I_{CC}	V_{CC} = 5.5V, V_I = V_{CC} or GND, I_O = 0A	Full			10	μA
Input Capacitance	C_I		+25℃		4		pF

DYNAMIC CHARACTERISTICS

(See Figure 2 for test circuit. Full = -40℃ to +125℃, all typical values are measured at C_L = 50pF and T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN (1)	TYP	MAX (1)	UNITS
Propagation Delay (2)	t_{PD}	CP to Qn, see Figure 3	V_{CC} = 2.0V	Full	7	30	100	ns
			V_{CC} = 4.5V	Full	4	11	30	
			V_{CC} = 5.5V	Full	3	10	25	
High-to-Low Propagation Delay	t_{PHL}	$\overline{MR}$ to Qn, see Figure 4	V_{CC} = 2.0V	Full	7	24	100	ns
			V_{CC} = 4.5V	Full	4	10	30	
			V_{CC} = 5.5V	Full	4	9	25	
Transition Time (2)	t_T	See Figure 3	V_{CC} = 2.0V	Full	1.5	17	40	ns
			V_{CC} = 4.5V	Full	0.3	6	18	
			V_{CC} = 5.5V	Full	0.3	4	15	
Pulse Width	t_W	CP high or low, see Figure 3	V_{CC} = 2.0V	Full	50			ns
			V_{CC} = 4.5V	Full	22			
			V_{CC} = 5.5V	Full	20			
		$\overline{MR}$ low, see Figure 4	V_{CC} = 2.0V	Full	50			ns
			V_{CC} = 4.5V	Full	22			
			V_{CC} = 5.5V	Full	20			
Recovery Time	t_{REC}	$\overline{MR}$ to CP, see Figure 4	V_{CC} = 2.0V	Full	30			ns
			V_{CC} = 4.5V	Full	15			
			V_{CC} = 5.5V	Full	14			
Setup Time	t_{SU}	DSA, DSB to CP, see Figure 5	V_{CC} = 2.0V	Full	30			ns
			V_{CC} = 4.5V	Full	15			
			V_{CC} = 5.5V	Full	14			
Hold Time	t_H	DSA, DSB to CP, see Figure 5	V_{CC} = 2.0V	Full	4			ns
			V_{CC} = 4.5V	Full	4			
			V_{CC} = 5.5V	Full	4			
Maximum Frequency	f_{MAX}	CP, see Figure 3	V_{CC} = 2.0V	Full	4			MHz
			V_{CC} = 4.5V	Full	20			
			V_{CC} = 5.5V	Full	24			
Power Dissipation Capacitance (3)	C_{PD}	Per package, V_I = GND to V_{CC}		+25℃		45		pF

NOTES:

1. Specified by design and characterization, not production tested.
2. t_{PD} is the same as t_{PLH} and t_{PHL}. t_T is the same as t_{THL} and t_{TLH}.
3. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

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

   where:

   f_{DS} = Input frequency in MHz.

   f_o = Output frequency in MHz.

   $f_{CP} = 2 \times f_{DS}$

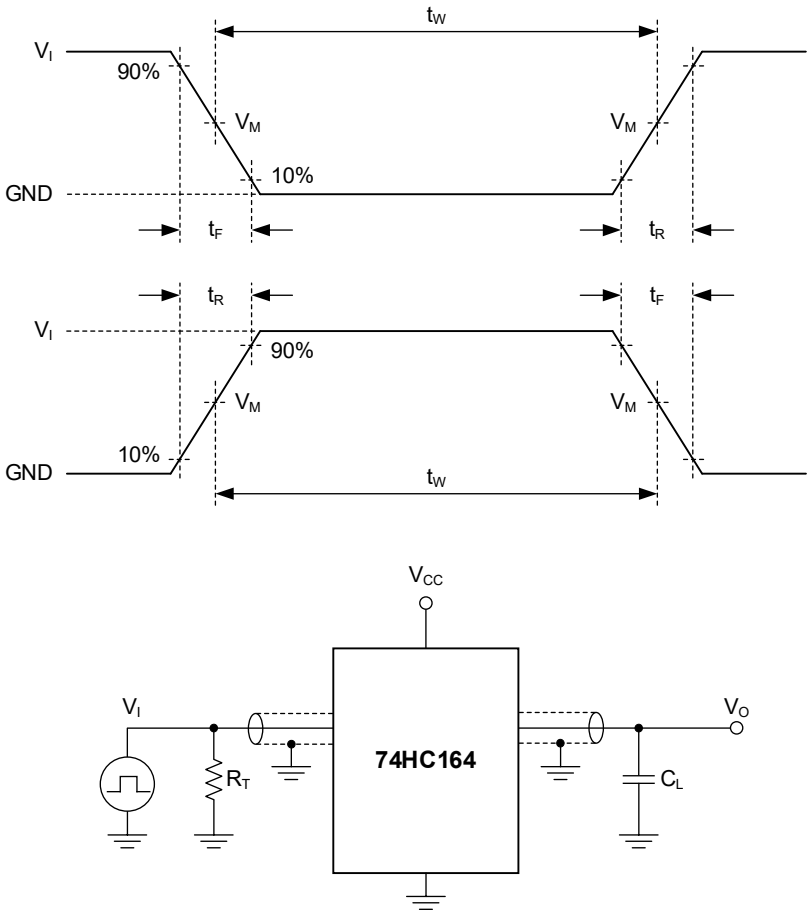
   C_L = Output load capacitance in pF.

   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:

C_L: Load capacitance (includes jig and probe).

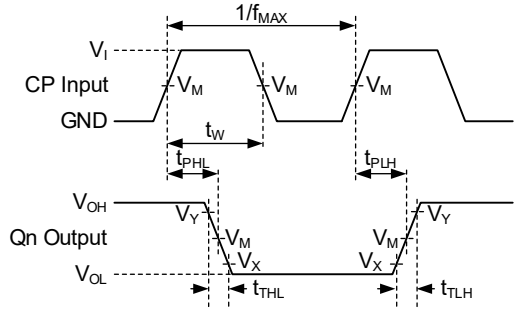
R_T: Termination resistance (equals to output impedance Z_O of the pulse generator).

Figure 2. Test Circuit for Measuring Switching Times

Table 1. Test Conditions

SUPPLY VOLTAGE	INPUT		LOAD	TEST
V_{CC}	V_I	t_R, t_F	C_L	
2.0V to 5.5V	V_{CC}	≤ 6.0ns	50pF	t_{PHL}, t_{PLH}

WAVEFORMS

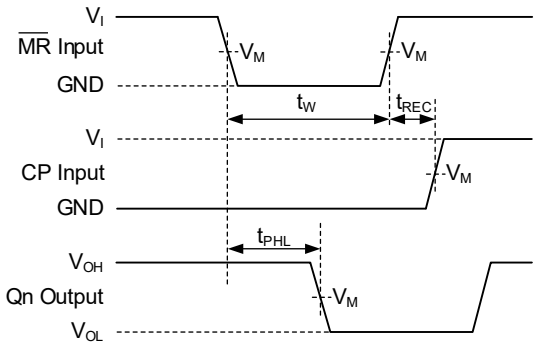


Test conditions are given in Table 1.

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 3. Clock Input to Output Propagation Delays, Clock Pulse Width, Transition Times and Maximum Frequency

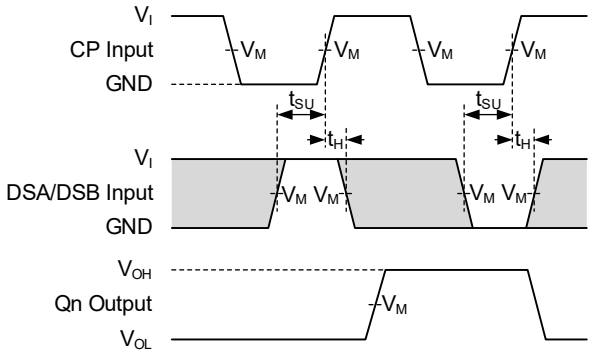


Test conditions are given in Table 1.

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 4. Master Reset Input to Output Propagation Delays, Pulse Width and Recovery Time



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.

The shaded areas refer to when the input is allowed to change for predictable output performance.

Figure 5. 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
2.0V to 5.5V	V_{CC}	0.5 × V_{CC}	0.5 × V_{CC}	0.1 × V_{CC}	0.9 × V_{CC}

NOTE:

1. The measurement points should be V_{IH} or V_{IL} when the input rising or falling time exceeds 6.0ns.

REVISION HISTORY

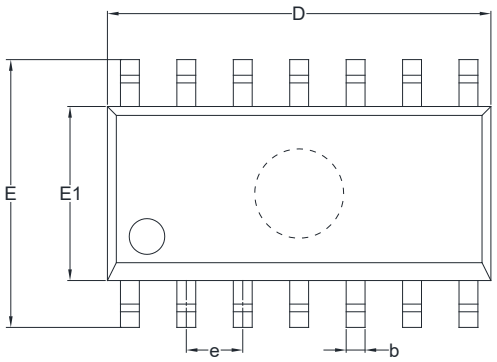
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

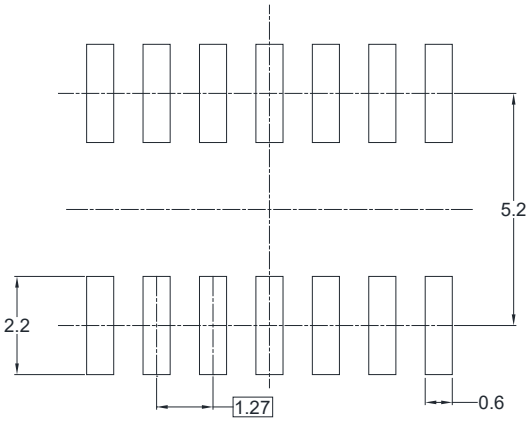
JULY 2024 – REV.A to REV.A.1	Page
Added Timing Diagram	4

Changes from Original (AUGUST 2023) to REV.A	Page
Changed from product preview to production data	All

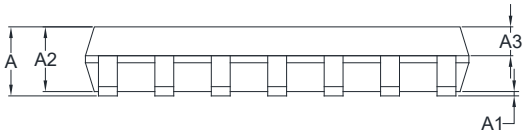
PACKAGE OUTLINE DIMENSIONS

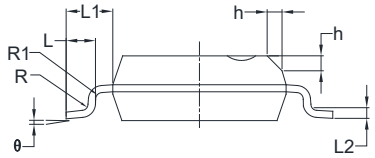
SOIC-14





RECOMMENDED LAND PATTERN (Unit: mm)



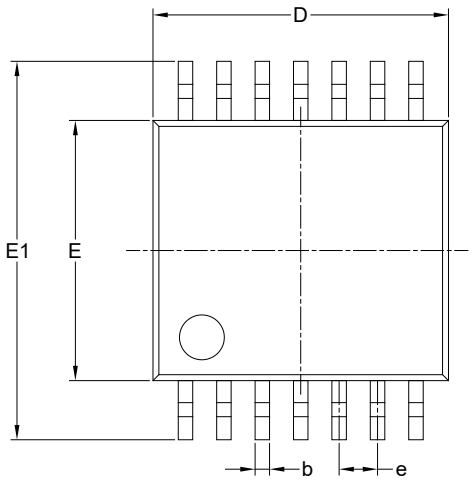


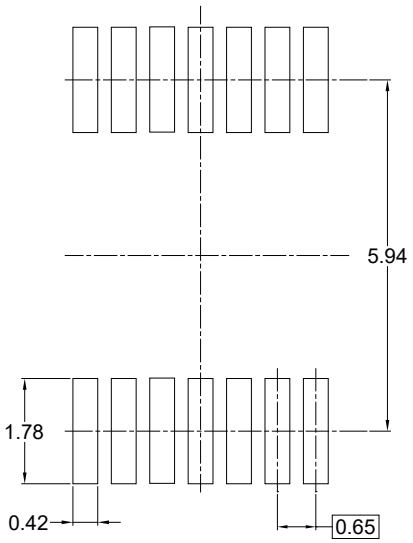
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	0.018	0.032
L1	1.04 REF		0.040 REF	
L2	0.25 BSC		0.01 BSC	
R	0.07		0.003	
R1	0.07		0.003	
h	0.30	0.50	0.012	0.020
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.

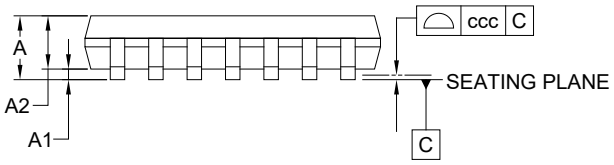
PACKAGE OUTLINE DIMENSIONS

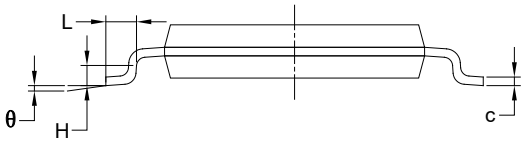
TSSOP-14





RECOMMENDED LAND PATTERN (Unit: mm)



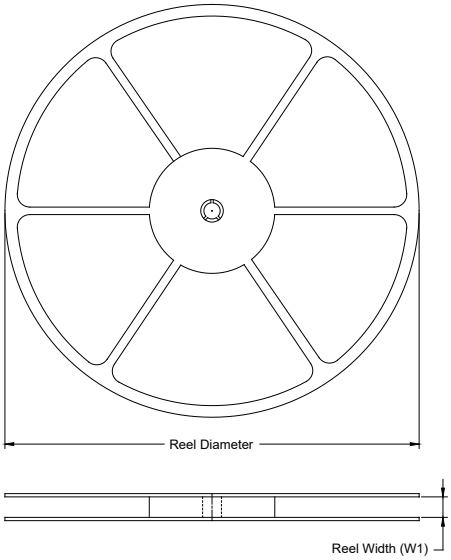


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.200
A1	0.050	-	0.150
A2	0.800	-	1.050
b	0.190	-	0.300
c	0.090	-	0.200
D	4.860	-	5.100
E	4.300	-	4.500
E1	6.200	-	6.600
e	0.650 BSC		
L	0.450	-	0.750
H	0.250 TYP		
θ	0°	-	8°
ccc	0.100		

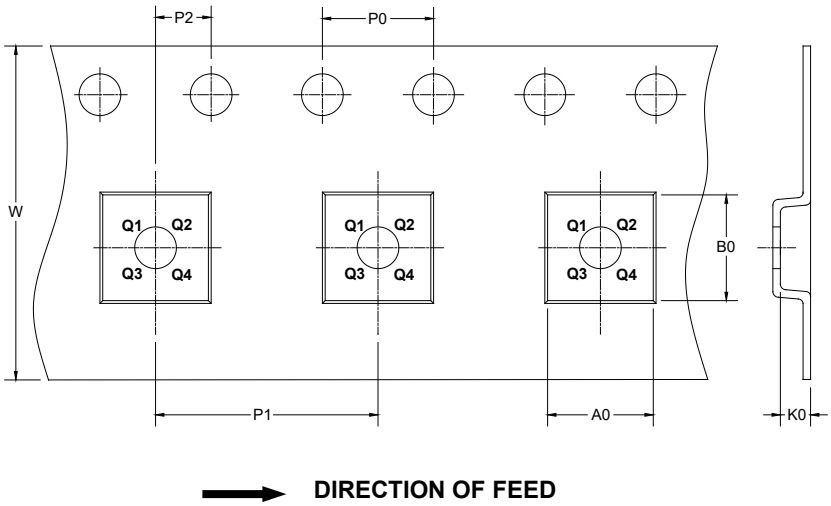
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-153.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

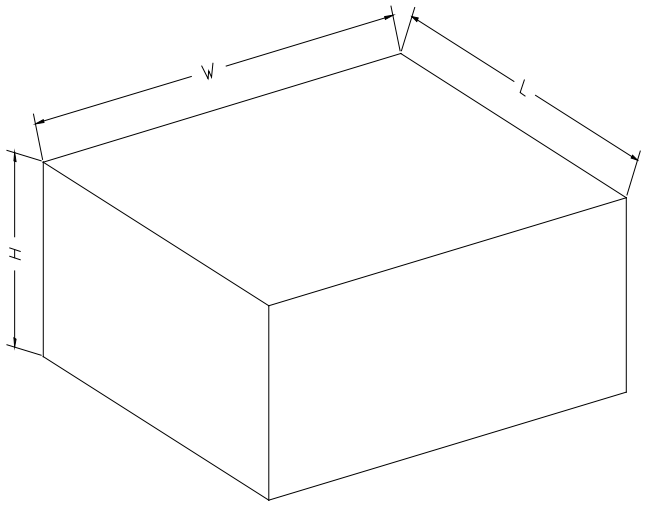
NOTE: The picture is only for reference. Please make the object as the standard.

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-14	13"	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1
TSSOP-14	13"	12.4	6.80	5.40	1.50	4.0	8.0	2.0	12.0	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