

# 74VHC244 • 74VHCT244

## Octal Buffer/Line Driver with TRI-STATE® Outputs

### General Description

The <sup>®</sup>VHC/<sup>®</sup>VHCT244 is an advanced high speed CMOS octal bus buffer fabricated with silicon gate C<sup>2</sup>MOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The <sup>®</sup>VHC/<sup>®</sup>VHCT244 is a non-inverting TRI-STATE buffer having two active-low output enables. These devices are designed to be used as TRI-STATE memory address drivers, clock drivers, and bus oriented transmitter/receivers.

An input protection circuit ensures that 0V–7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

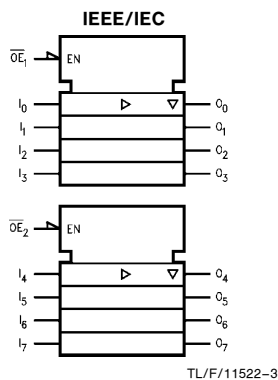
### Features

- High noise immunity:  
VHC  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)  
VHCT  $V_{IH} = 2.0V, V_{IL} = 0.8V$
  - Power down protection:  
VHC inputs only  
VHCT inputs and outputs
  - Low noise:  
VHC  $V_{OLP} = 0.6V$  (typ)  
VHCT  $V_{OLP} = 0.7V$  (typ)
  - Low power dissipation:  
 $I_{CC} = 4 \mu A$  (max) @  $T_A = 25^\circ C$
  - Balanced propagation delays:  $t_{PLH} \cong t_{PHL}$
  - Pin and function compatible with 74HC/HCT244
- NOTE: ADD EXTERNAL PULL UP RESISTOR TO VHCT OUTPUTS TO DRIVE CMOS INPUTS**

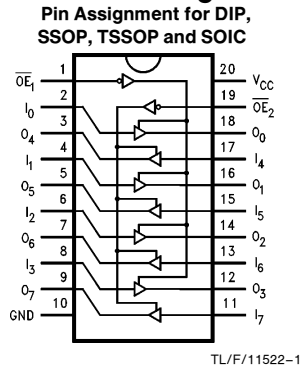
Commercial	Package Number	Package Description
74VHC244M	M20B	20-Lead Molded JEDEC SOIC
74VHC244SJ	M20D	20-Lead Molded EIAJ SOIC
74VHC244MSC	MSC20	20-Lead Molded EIAJ Type 1 SSOP
74VHC244MTC	MTC20	20-Lead Molded JEDEC Type 1 TSSOP
74VHC244N	N20A	20-Lead Molded DIP
74VHCT244M	M20B	20-Lead Molded JEDEC SOIC
74VHCT244SJ	M20D	20-Lead Molded EIAJ SOIC
74VHCT244MTC	MTC20	20-Lead Molded JEDEC Type 1 TSSOP
74VHCT244N	N20A	20-Lead Molded DIP

**Note:** Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code. EIAJ Type 1 SSOP available on Tape and Reel only, order MSCX.

### Logic Symbol



### Connection Diagram



### Truth Tables

Inputs		Outputs
$\overline{OE}_1$	$I_n$	(Pins 12, 14, 16, 18)
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$\overline{OE}_2$	$I_n$	(Pins 3, 5, 7, 9)
L	L	L
L	H	H
H	X	Z

H = HIGH Voltage Level    I = Immaterial  
L = LOW Voltage Level    Z = High Impedance

Pin Names	Description
$\overline{OE}_1, \overline{OE}_2$	TRI-STATE Output Enable Inputs
$I_0-I_7$	Inputs
$O_0-O_7$	TRI-STATE Outputs

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## Absolute Maximum Ratings (Note 1)

Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V
DC Input Voltage ( $V_{IN}$ )	-0.5V to +7.0V
DC Output Voltage ( $V_{OUT}$ )	
VHC	-0.5V to $V_{CC} + 0.5V$
VHCT*	-0.5V to 7.0V
Input Diode Current ( $I_{IK}$ )	-20 mA
Output Diode Current ( $I_{OK}$ )	
VHC	±20 mA
VHCT	-20 mA
DC Output Current ( $I_{OUT}$ )	±25 mA
DC $V_{CC}$ /GND Current ( $I_{CC}$ )	±75 mA
Storage Temperature ( $T_{STG}$ )	-65°C to +150°C
Lead Temperature ( $T_L$ )	
(Soldering, 10 seconds)	260°C

\* $V_{OUT} > V_{CC}$  only if output is in H or Z state.

Note 1: *Absolute Maximum Ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation outside databook specifications.*

## Recommended Operating Conditions

Supply Voltage ( $V_{CC}$ )	
VHC	2.0V to 5.5V
VHCT	4.5V to 5.5V
Input Voltage ( $V_{IN}$ )	0V to +5.5V
Output Voltage ( $V_{OUT}$ )	0V to $V_{CC}$
Operating Temperature ( $T_{OPR}$ )	
74VHC/VHCT	-40°C to +85°C
Input Rise and Fall Time ( $t_r, t_f$ )	
$V_{CC} = 3.3V \pm 0.3V$ (VHC Only)	0 ns/V ~ 100 ns/V
$V_{CC} = 5.0V \pm 0.5V$	0 ns/V ~ 20 ns/V

## DC Characteristics for 'VHC Family Devices

Symbol	Parameter	$V_{CC}$ (V)	74VHC			74VHC		Units	Conditions
			$T_A = 25^\circ C$			$T_A = -40^\circ C$ to $+85^\circ C$			
			Min	Typ	Max	Min	Max		
$V_{IH}$	High Level Input Voltage	2.0 3.0-5.5	1.5 $0.7 V_{CC}$		1.5 $0.7 V_{CC}$		V		
$V_{IL}$	Low Level Input Voltage	2.0 3.0-5.5		0.5 $0.3 V_{CC}$		0.5 $0.3 V_{CC}$	V		
$V_{OH}$	High Level Output Voltage	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	1.9 2.9 4.4		V	$V_{IN} = V_{IH}$ or $V_{IL}$ $I_{OH} = -50 \mu A$	
		3.0 4.5	2.58 3.94		2.48 3.80		V	$I_{OH} = -4 mA$ $I_{OH} = -8 mA$	
$V_{OL}$	Low Level Output Voltage	2.0 3.0 4.5		0.0 0.0 0.1		0.1 0.1 0.1	V	$V_{IN} = V_{IH}$ or $V_{IL}$ $I_{OL} = 50 \mu A$	
		3.0 4.5			0.36 0.36		0.44 0.44	V	$I_{OL} = 4 mA$ $I_{OL} = 8 mA$

### DC Characteristics for 'VHC Family Devices (Continued)

Symbol	Parameter	V <sub>CC</sub> (V)	74VHC		74VHC		Units	Conditions	
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C			
			Min	Typ	Max	Min			Max
I <sub>OZ</sub>	TRI-STATE Output Off-State Current	5.5	±0.25			±2.5		μA	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND
I <sub>IN</sub>	Input Leakage Current	0-5.5	±0.1			±1.0		μA	V <sub>IN</sub> = 5.5V or GND
I <sub>CC</sub>	Quiescent Supply Current	5.5	4.0			40.0		μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

### DC Characteristics for 'VHC Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74VHC		Units	Conditions
			T <sub>A</sub> = 25°C			
			Typ	Limits		
V <sub>OLP</sub> **	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	0.6	0.9	V	C <sub>L</sub> = 50 pF
V <sub>OLV</sub> **	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	-0.6	-0.9	V	C <sub>L</sub> = 50 pF
V <sub>IHD</sub> **	Minimum High Level Dynamic Input Voltage	5.0		3.5	V	C <sub>L</sub> = 50 pF
V <sub>ILD</sub> **	Maximum High Level Dynamic Input Voltage	5.0		1.5	V	C <sub>L</sub> = 50 pF

\*\*Parameter guaranteed by design.

### DC Characteristics for 'VHCT Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74VHC			74VHC		Units	Conditions
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C			
			Min	Typ	Max	Min	Max		
V <sub>IH</sub>	High Level Input Voltage	4.5 5.5	2.0 2.0			2.0 2.0	V		
V <sub>IL</sub>	Low Level Input Voltage	4.5 5.5			0.8 0.8	0.8 0.8	V		
V <sub>OH</sub>	High Level Output Voltage	4.5	3.15	3.65		3.15	V	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA
		4.5	2.5			2.4			I <sub>OH</sub> = -8 mA
V <sub>OL</sub>	Low Level Output Voltage	4.5		0.0	0.1	0.1	V	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA
		4.5			0.36	0.44			I <sub>OL</sub> = 8 mA
I <sub>OZ</sub>	TRI-STATE Output Off-State Current	5.5			±0.25	±2.5	μA	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND	
I <sub>IN</sub>	Input Leakage Current	0-5.5			±0.1	±1.0	μA	V <sub>IN</sub> = 5.5V or GND	
I <sub>CC</sub>	Quiescent Supply Current	5.5			4.0	40.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND	
I <sub>CC</sub> T	Maximum I <sub>CC</sub> /Input	5.5			1.35	1.50	mA	V <sub>IN</sub> = 3.4V, Other Inputs = V <sub>CC</sub> or GND	
I <sub>OPD</sub>	Output Leakage (Power Down State)	0.0			+0.5	+5.0	μA	V <sub>OUT</sub> = 5.5V	

### DC Characteristics for 'VHCT Family Devices:

Symbol	Parameter	V <sub>CC</sub> (V)	74VHCT		Units	Conditions
			T <sub>A</sub> = 25°C			
			Typ	Limits		
V <sub>OLP</sub> **	Quiet Output Maximum Dynamic V <sub>OL</sub>		0.7	1.0	V	C <sub>L</sub> = 50 pF
V <sub>OLV</sub> **	Quiet Output Minimum Dynamic V <sub>OL</sub>		-0.7	-1.0	V	C <sub>L</sub> = 50 pF
V <sub>IHD</sub> **	Minimum High Level Dynamic Input Voltage			2.0	V	C <sub>L</sub> = 50 pF
V <sub>ILD</sub> **	Maximum High Level Dynamic Input Voltage			0.8	V	C <sub>L</sub> = 50 pF

\*\*Parameter guaranteed by design.

## AC Electrical Characteristics for 'VHC Family Devices:

Symbol	Parameter	V <sub>CC</sub> (V)	74VHC			74VHC		Units	Conditions	
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C				
			Min	Typ	Max	Min	Max			
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay Time	3.3 ± 0.3	5.8	8.4	1.0	10.0	ns	C <sub>L</sub> = 15 pF	C <sub>L</sub> = 50 pF	
			8.3	11.9	1.0	13.5				
		5.0 ± 0.5	3.9	5.5	1.0	6.5	ns			
			5.4	7.5	1.0	8.5				
t <sub>PZL</sub> , t <sub>PZH</sub>	TRI-STATE Output Enable Time	3.3 ± 0.3	6.6	10.6	1.0	12.5	ns	R <sub>L</sub> = 1 kΩ	C <sub>L</sub> = 15 pF	
			9.1	14.1	1.0	16.0				
		5.0 ± 0.5	4.7	7.3	1.0	8.5	ns			
			6.2	9.3	1.0	10.5				
t <sub>PLZ</sub> , t <sub>PHZ</sub>	TRI-STATE Output Disable Time	3.3 ± 0.3	10.3	14.0	1.0	16.0	ns	R <sub>L</sub> = 1 kΩ	C <sub>L</sub> = 50 pF	
		5.0 ± 0.5	6.7	9.2	1.0	10.5			C <sub>L</sub> = 50 pF	
t <sub>OSLH</sub> , t <sub>OSSL</sub>	Output to Output Skew	3.3 ± 0.3	1.5		1.5		ns	(Note 1)	C <sub>L</sub> = 50 pF	
		5.0 ± 0.5	1.0		1.0				C <sub>L</sub> = 50 pF	
C <sub>IN</sub>	Input Capacitance		4	10	10		pF	V <sub>CC</sub> = Open		
C <sub>OUT</sub>	Output Capacitance		6				pF	V <sub>CC</sub> = 5.0V		
C <sub>PD</sub>	Power Dissipation Capacitance		19				pF	(Note 2)		

**Note 1:** Parameter guaranteed by design. t<sub>OSLH</sub> = |t<sub>PLHmax</sub> - t<sub>PLHmin</sub>|; t<sub>OSSL</sub> = |t<sub>PHLmax</sub> - t<sub>PHLmin</sub>|.

**Note 2:** C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I<sub>CC</sub> (OPR.) = C<sub>PD</sub> \* V<sub>CC</sub> \* f<sub>IN</sub> + I<sub>CC</sub>/8 (per bit).

## AC Electrical Characteristics for 'VHCT Family Devices

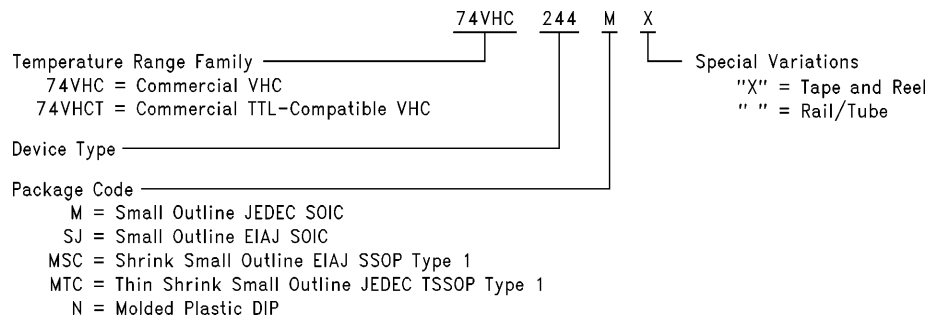
Symbol	Parameter	V <sub>CC</sub> (V)	74VHCT			74VHCT		Units	Conditions	
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C				
			Min	Typ	Max	Min	Max			
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay Time	5.0 ± 0.5	5.4	7.4	1.0	8.5	ns		C <sub>L</sub> = 15 pF	
			5.9	8.4	1.0	9.5			C <sub>L</sub> = 50 pF	
t <sub>PZL</sub> , t <sub>PZH</sub>	TRI-STATE Output Enable Time	5.0 ± 0.5	7.7	10.4	1.0	12.0	ns	R <sub>L</sub> = 1 kΩ	C <sub>L</sub> = 15 pF	
			8.2	11.4	1.0	13.0			C <sub>L</sub> = 50 pF	
t <sub>PLZ</sub> , t <sub>PHZ</sub>	TRI-STATE Output Disable Time	5.0 ± 0.5	8.8	11.4	1.0	13.0	ns	R <sub>L</sub> = 1 kΩ	C <sub>L</sub> = 50 pF	
t <sub>OSLH</sub> , t <sub>OSHL</sub>	Output to Output Skew	5.0 ± 0.5		1.0		1.0	ns	(Note 1)	C <sub>L</sub> = 50 pF	
C <sub>IN</sub>	Input Capacitance		4	10		10	pF	V <sub>CC</sub> = Open		
C <sub>OUT</sub>	Output Capacitance		9				pF	V <sub>CC</sub> = 5.0V		
C <sub>PD</sub>	Power Dissipation Capacitance		18				pF	(Note 2)		

**Note 1:** Parameter guaranteed by design.  $t_{OSLH} = |t_{PLHmax} - t_{PLHmin}|$ ;  $t_{OSHL} = |t_{PHLmax} - t_{PHLmin}|$ .

**Note 2:** C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation:  $I_{CC} (OPR.) = C_{PD} * V_{CC} * f_{IN} + I_{CC}/8$  (per bit).

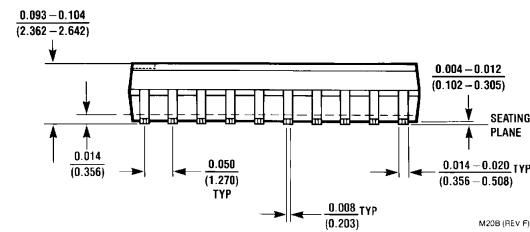
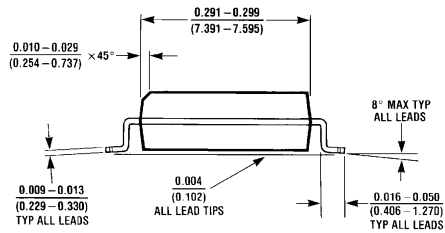
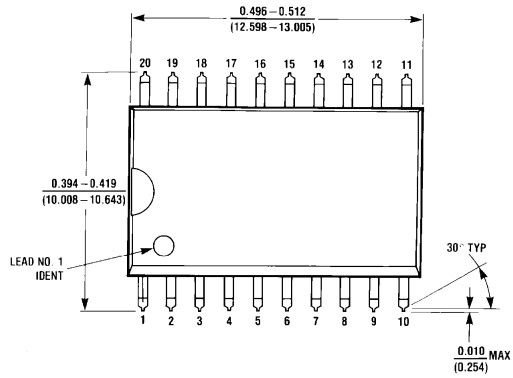
## Ordering Information

The device number is used to form part of a simplified purchasing code, where the package type and temperature range are defined as follows:

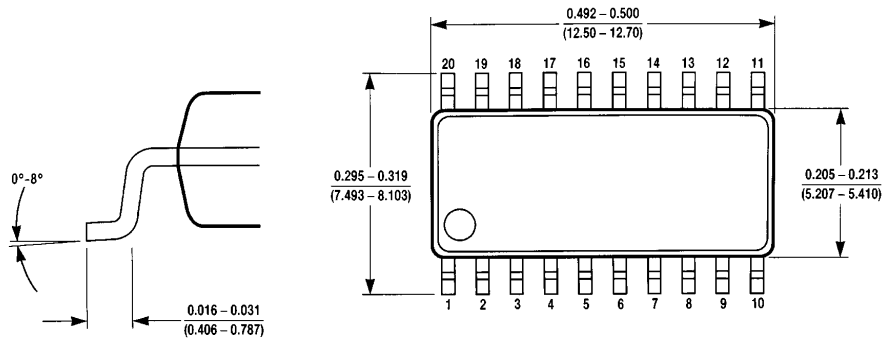


TL/F/11522-4

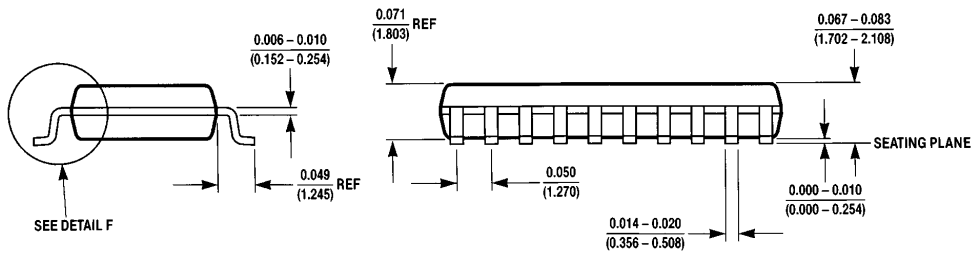
**Physical Dimensions** inches (millimeters)



**20-Lead Small Outline Integrated Circuit JEDEC SOIC (M)**  
**Order Number 74VHC244M, 74VHC244MX, 74VHCT244M or 74VHCT244MX**  
**NS Package Number M20B**



**DETAIL F**

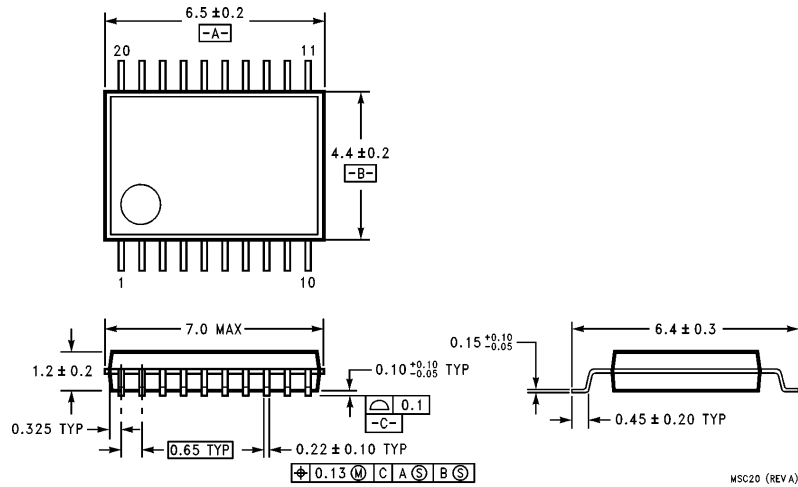


**SEE DETAIL F**

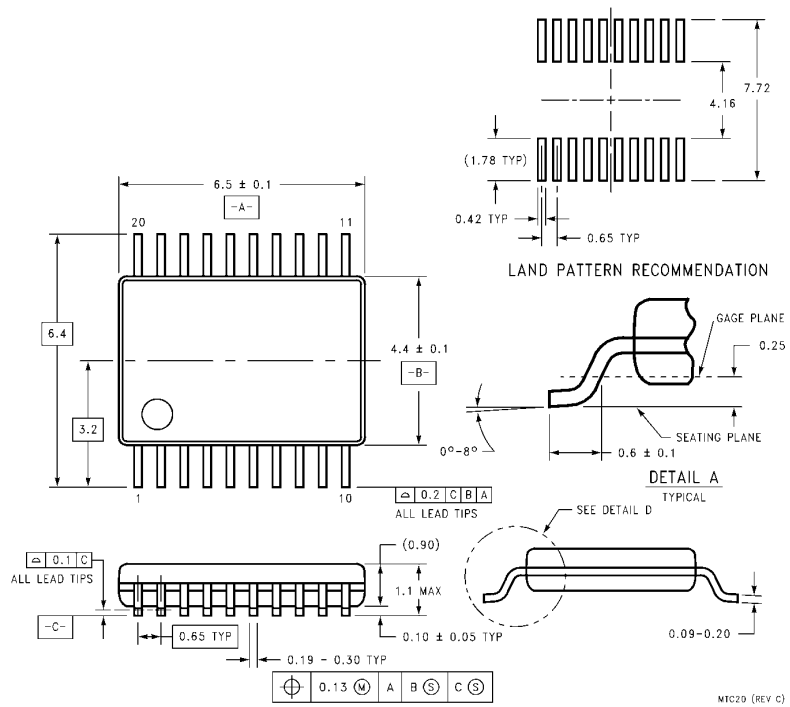
**20-Lead Small Outline Integrated Circuit-EIAJ SOIC (SJ)**  
**Order Number 74VHC244SJ, 74VHC244SJX, 74VHCT244SJ or 74VHCT244SJX**  
**NS Package Number M20D**



**Physical Dimensions** millimeters

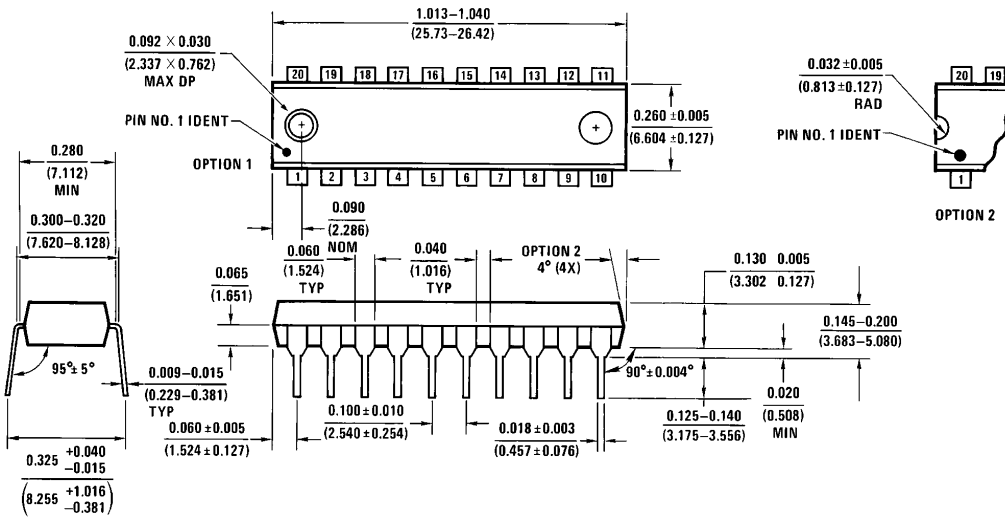


**20-Lead Plastic EIAJ SSOP Type I (MSC)**  
**Order Number 74VHC244MSCX**  
**NS Package Number MSC20**



**20-Lead Plastic JEDEC TSSOP Type I (MTC)**  
**Order Number 74VHC244MTC, 74VHC244MTCX, 74VHCT244MTC or 74VHCT244MTCX**  
**NS Package Number MTC20**

**Physical Dimensions** (millimeters) (Continued)



**20-Lead Molded DIP**  
**Order Number 74VHC244N or 74VHCT244N**  
**NS Package Number N20A**

N20A (REV G)

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



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