

# 74VHC245 • 74VHCT245 Octal Bidirectional Transceiver with TRI-STATE® Outputs

## General Description

The VHC/VHCT245 is an advanced high speed CMOS octal bus transceiver fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The 'VHC245 is intended for bidirectional asynchronous communication between data busses. The direction of data transmission is determined by the level of the T/R input. The enable input can be used to disable the device so that the busses are effectively isolated. All inputs are equipped with protection circuits against static discharge.

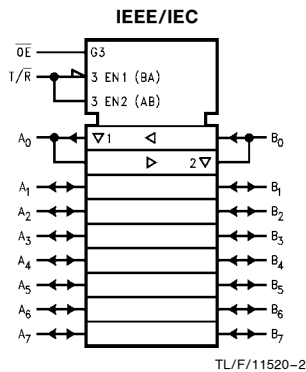
## Features

- 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  $V_{OLP} = 0.9V$  (typ)  
VHCT  $V_{OLP} = 1.1V$  (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/HCT245

Commercial	Package Number	Package Description
74VHC245M	M20B	20 Lead Molded JEDEC SOIC
74VHC245SJ	M20D	20 Lead Molded EIAJ SOIC
74VHC245MSC	MSC20	20 Lead Molded EIAJ Type 1 SSOP
74VHC245MTC	MTC20	20 Lead Molded JEDEC Type 1 TSSOP
74VHC245N	N20A	20 Lead Molded DIP
74VHCT245M	M20B	20 Lead Molded JEDEC SOIC
74VHCT245SJ	M20D	20 Lead Molded EIAJ SOIC
74VHCT245MTC	MTC20	20 Lead Molded JEDEC Type 1 TSSOP
74VHCT245N	N20A	20 Lead Molded DIP

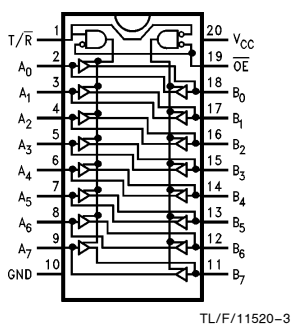
**Note:** Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.  
EIAJ Type 1 SSOP available on Tape and Reel only, order MSCX.

## Logic Symbol



## Connection Diagram

Pin Assignment for DIP, SSOP, TSSOP and SOIC



## Pin Description

Pin Names	Description
OE	Output Enable Input
T/R	Transmit/Receive Input
A <sub>0</sub> -A <sub>7</sub>	Side A Inputs or TRI-STATE Outputs
B <sub>0</sub> -B <sub>7</sub>	Side B Inputs or TRI-STATE Outputs

## Truth Table

Inputs		Outputs
OE	T/R	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	HIGH-Z State

H = HIGH Voltage Level X = Immaterial  
L = LOW Voltage Level

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## Absolute Maximum Ratings (Note 1)

Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V
DC Input Voltage ( $V_{IN}$ ) ( $T/\bar{R}$ , $\overline{OE}$ )	-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 ( $I_{IK}$ ) ( $T/\bar{R}$ , $\overline{OE}$ )	-20 mA
Output Diode Current ( $I_{OK}$ )	
(VHC)	$\pm 20$ mA
(VHCT)	-20 mA
DC Output Current ( $I_{OUT}$ )	$\pm 25$ mA
DC $V_{CC}$ /GND Current ( $I_{CC}$ )	$\pm 75$ 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 ( $V_{IN}$ ) ( $T/\bar{R}$ , $\overline{OE}$ )	0V to 5.5V
Output Voltage ( $V_{OUT}$ )	0V to $V_{CC}$
Operating Temperature ( $T_{OPR}$ )	
74 VHC/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 ~ 100 ns/V
$V_{CC} = 5.0V \pm 0.5V$	0 ~ 20 ns/V

## DC Characteristics for 'VHC Family Devices

Symbol	Parameter	$V_{CC}$ (V)	74VHC			74VHC		Units	Conditions
			$T_A = 25^\circ\text{C}$			$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$			
			Min	Typ	Max	Min	Max		
$V_{IH}$	High Level Input Voltage	2.0 3.0-5.5	1.50 0.7 $V_{CC}$		1.50 0.7 $V_{CC}$		V		
$V_{IL}$	Low Level Input Voltage	2.0 3.0-5.5		0.50 0.3 $V_{CC}$	0.50 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 $V_{IL}$ $I_{OH} = -50 \mu\text{A}$	
		4.5 4.5	2.58 3.94		2.48 3.80		V	$I_{OH} = -4 \text{ mA}$ $I_{OH} = -8 \text{ mA}$	
$V_{OL}$	Low Level Output Voltage	2.0 3.0 4.5	0.0 0.0 0.0	0.1 0.1 0.1	0.1 0.1 0.1		V	$V_{IN} = V_{IH}$ or $V_{IL}$ $I_{OL} = 50 \mu\text{A}$	
		3.0 4.5		0.36 0.36	0.44 0.44		V	$I_{OL} = 4 \text{ mA}$ $I_{OL} = 8 \text{ mA}$	
$I_{OZ}$	TRI-STATE Output Off-State Current	5.5		$\pm 0.25$	$\pm 2.5$		$\mu\text{A}$	$V_{IN} = V_{CC}$ or GND $V_{OUT} = V_{CC}$ or GND $V_{IN} \overline{OE} = V_{IH}$ or $V_{IL}$	
$I_{IN}$ ( $T/\bar{R}$ , $\overline{OE}$ )	Input Leakage Current	0-5.5		$\pm 0.1$	$\pm 1.0$		$\mu\text{A}$	$V_{IN} = 5.5V$ or GND	
$I_{CC}$	Quiescent Supply Current	5.5		4.0	40.0		$\mu\text{A}$	$V_{IN} = V_{CC}$ 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	0.9	1.2	V	C <sub>L</sub> = 50 pF
*V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	-0.9	-1.2	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 Low 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)	74VHCT			74VHCT		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	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		V	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		V	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>CC</sub> or GND V <sub>OUT</sub> = V <sub>CC</sub> or GND V <sub>IN</sub> $\overline{OE}$ = V <sub>IH</sub> or V <sub>IL</sub>	
I <sub>IN</sub> (T/ $\overline{R}$ , $\overline{OE}$ )	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>CCT</sub>	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 Current (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>		1.1	1.6	V	C <sub>L</sub> = 50 pF
V <sub>OLV</sub> *	Quiet Output Minimum Dynamic V <sub>OL</sub>		-1.1	-1.6	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 Low 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	
			8.3	11.9	1.0	13.5		C <sub>L</sub> = 50 pF	
		5.0 ± 0.5	4.0	5.5	1.0	6.5	ns	C <sub>L</sub> = 15 pF	
			5.5	7.5	1.0	8.5		C <sub>L</sub> = 50 pF	
t <sub>PZL</sub> t <sub>PZH</sub>	TRI-STATE Output Enable Time	3.3 ± 0.3	8.5	13.2	1.0	15.5	ns	R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 15 pF	
			11.0	16.7	1.0	19.0		C <sub>L</sub> = 50 pF	
		5.0 ± 0.5	5.8	8.5	1.0	10.0	ns	C <sub>L</sub> = 15 pF	
			7.3	10.6	1.0	12.0		C <sub>L</sub> = 50 pF	
t <sub>PLZ</sub> t <sub>PHZ</sub>	TRI-STATE Output Disable Time	3.3 ± 0.3	11.5	15.8	1.0	18.0	ns	R <sub>L</sub> = 1 kΩ C <sub>L</sub> = 50 pF	
		5.0 ± 0.5	7.0	9.7	1.0	11.0		C <sub>L</sub> = 50 pF	
t <sub>OSLH</sub> t <sub>OSHL</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> (T/ $\bar{R}$ , $\overline{OE}$ )	Input Capacitance		4	10		10	pF	V <sub>CC</sub> = Open	
C <sub>I/O</sub>	Output Capacitance		8				pF	V <sub>CC</sub> = 5.0V	
C <sub>PD</sub>	Power Dissipation Capacitance		21				pF	(Note 2)	

**Note 1:** Parameter guaranteed by design. t<sub>OSLH</sub> = |t<sub>PLH</sub> max - t<sub>PLH</sub> min|; t<sub>OSHL</sub> = |t<sub>PHL</sub> max - t<sub>PHL</sub> min|

**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

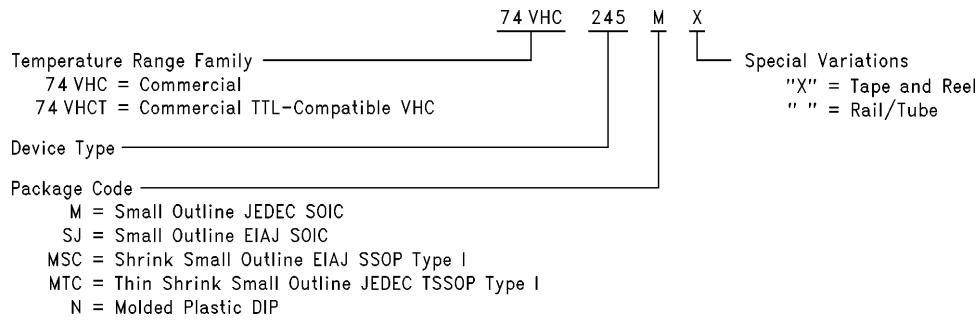
Symbol	Parameter	V <sub>CC</sub> (V)	74VHCT		74VHCT		Units	Conditions		
			T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C				
			Min	Typ	Max	Min				Max
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time	5.0 ± 0.5	4.5	7.7	1.0	8.5	ns		C <sub>L</sub> = 15 pF	
			5.3	8.7	1.0	9.5			C <sub>L</sub> = 50 pF	
t <sub>PZL</sub> t <sub>PZH</sub>	TRI-STATE Output Enable Time	5.0 ± 0.5	8.9	13.8	1.0	15.0	ns	R <sub>L</sub> = 1 kΩ	C <sub>L</sub> = 15 pF	
			9.7	14.8	1.0	16.0			C <sub>L</sub> = 50 pF	
t <sub>PLZ</sub> t <sub>PHZ</sub>	TRI-STATE Output Disable Time	5.0 ± 0.5	10.0	15.4	1.0	16.5	ns	R <sub>L</sub> = 1 kΩ	C <sub>L</sub> = 50 pF	
t <sub>OSLH</sub> t <sub>OSSL</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>I/O</sub>	Output Capacitance		9				pF	V <sub>CC</sub> = 5.0V		
C <sub>PD</sub>	Power Dissipation Capacitance		23				pF	(Note 2)		

**Note 1:** Parameter guaranteed by design.  $t_{OSLH} = |t_{PLH\ max} - t_{PLH\ min}|$ ;  $t_{OSSL} = |t_{PHL\ max} - t_{PHL\ min}|$

**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).

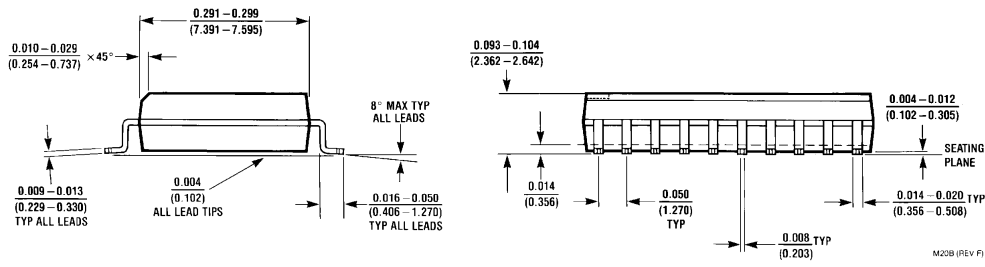
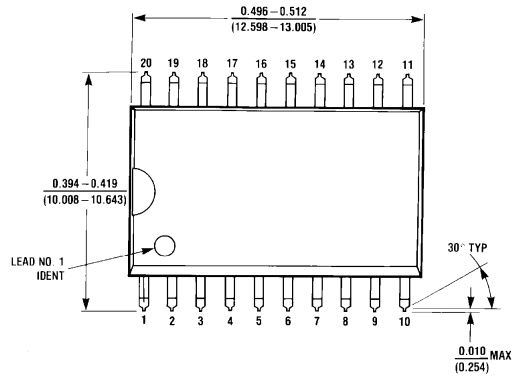
## Ordering Information

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

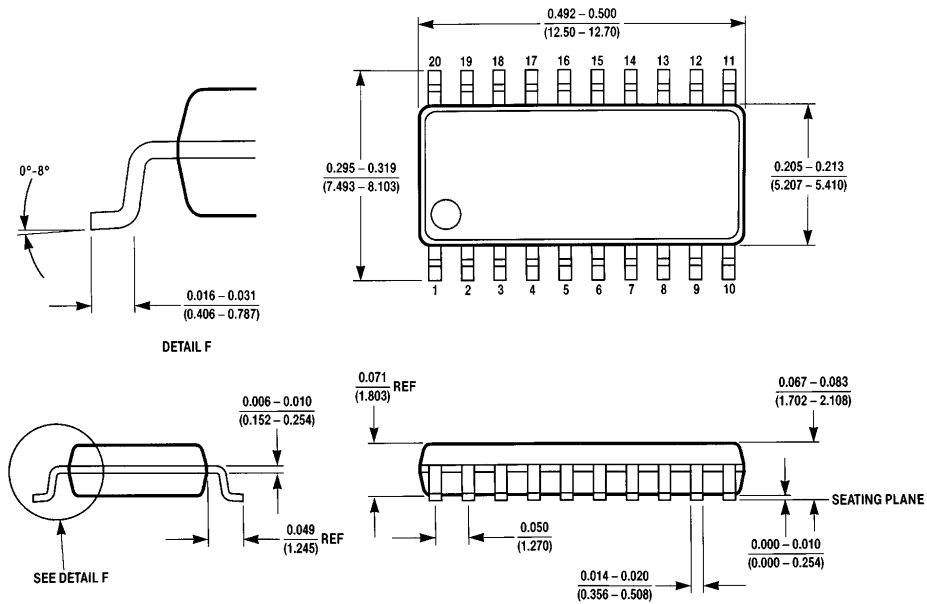


TL/F/11520-5

**Physical Dimensions** inches (millimeters)

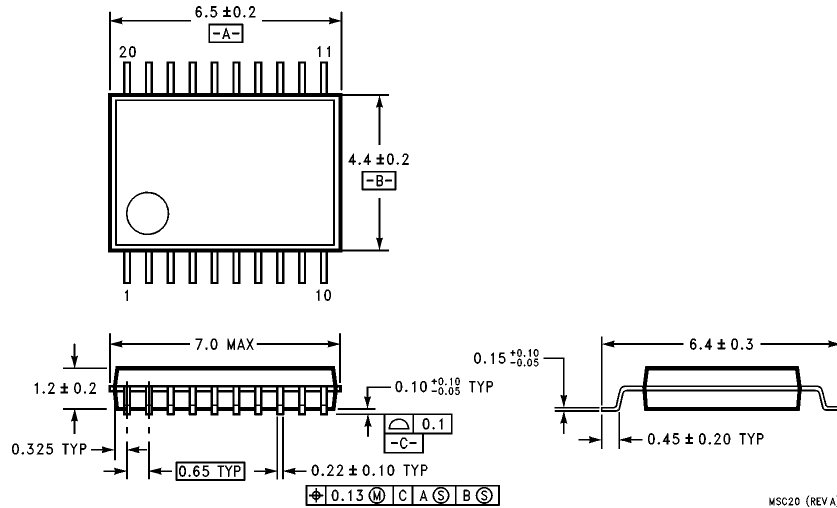


**20-Lead Small Outline Integrated Circuit—JEDEC SOIC (M)**  
**Order Number 74VHC245M, 74VHC245MX, 74VHCT245M, or 74VHCT245MX**  
**NS Package Number M20B**



**20-Lead Small Outline Package EIAJ SOIC (SJ)**  
**Order Number 74VHC245SJ, 74VHC245SJX, 74VHCT245SJ, or 74VHCT245SJX**  
**NS Package Number M20D**

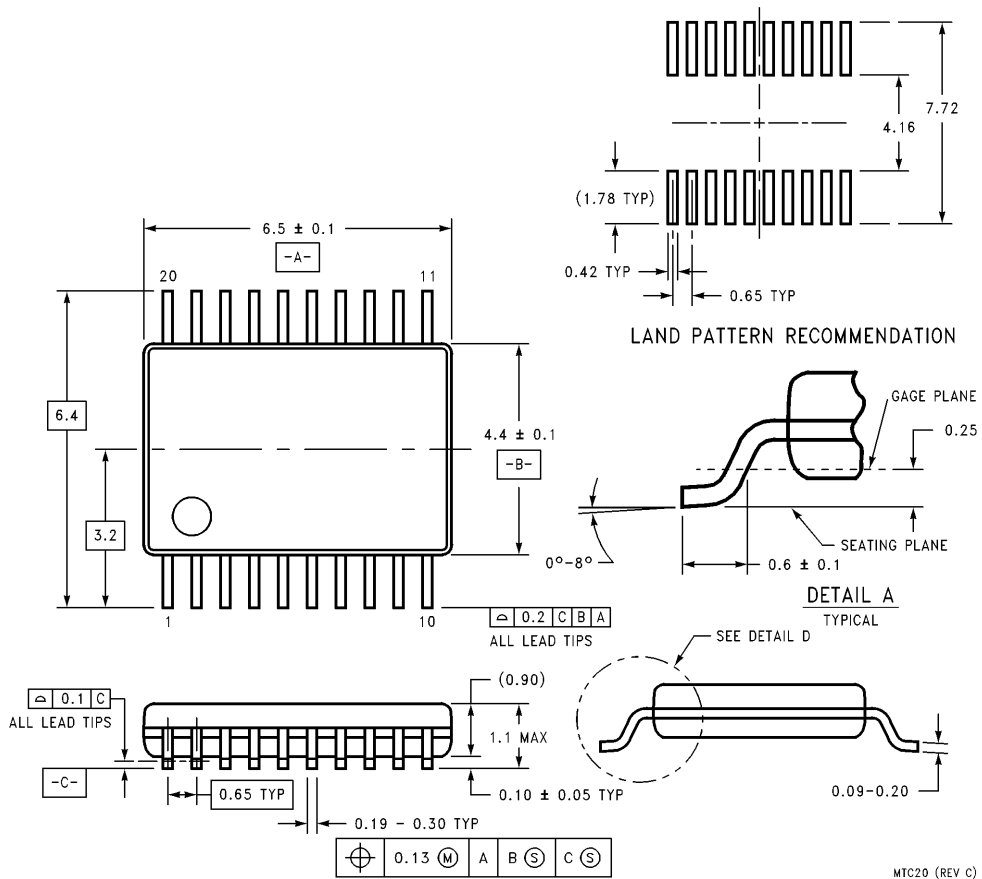
**Physical Dimensions** millimeters (Continued)



**20-Lead Plastic EIAJ SSOP Type I (MSC)**  
**Order Number 74VHC245MSCX**  
**NS Package Number MSC20**

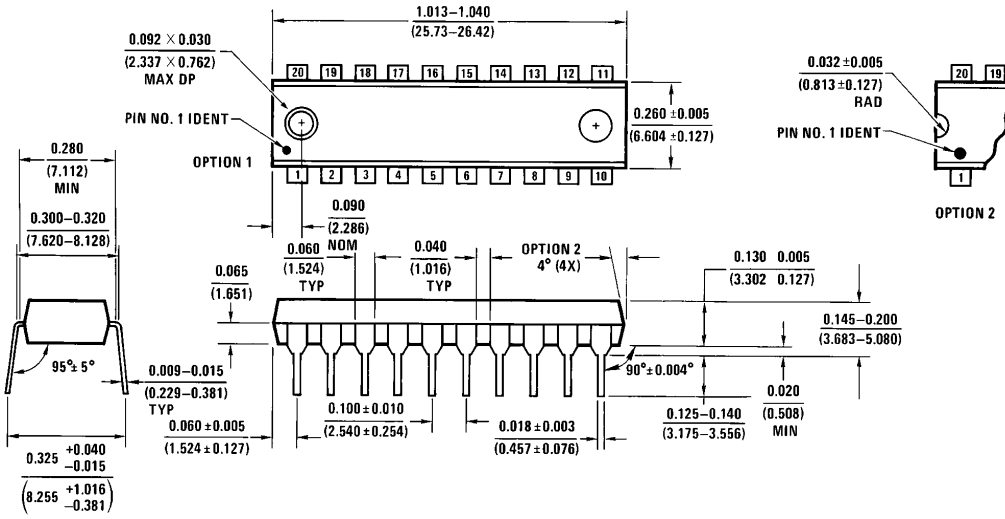
MSC20 (REV A)

**Physical Dimensions** millimeters (Continued)



74VHC245 • 74VHCT245  
Octal Bidirectional Transceiver with TRI-STATE Outputs

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



**20-Lead (0.300" Wide) Molded Dual-In-Line Package**  
Order Number 74VHCT245N  
NS Package Number N20A

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This file is the datasheet for the following electronic components:

74VHC245 - <http://www.ti.com/product/74vhc245?HQS=TI-null-null-dscatalog-df-pf-null-ww>

74VHCT245 - <http://www.ti.com/product/74vhct245?HQS=TI-null-null-dscatalog-df-pf-null-ww>



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