

54VHC/74VHC245 • 54VHCT/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 speed:

VHC $t_{PD} = 4.0 \text{ ns (typ) @ } V_{CC} = 5V$

VHCT $t_{PD} = 4.5 \text{ ns (typ) @ } V_{CC} = 5V$

■ High Noise Immunity:

VHC $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (Min)}$

VHCT $V_{IH} = 2.0V, V_{IL} = 0.8V$

■ Operating Voltage:

VHC $V_{CC} \text{ (opr)} = 2V \sim 5.5V$

VHCT $V_{CC} \text{ (opr)} = 4.5V \sim 5.5V$

■ Power Down Protection:

VHC Inputs Only

VHCT Inputs and Outputs

■ Low Noise:

VHC $V_{OLP} = 0.9V \text{ (typ)}$

VHCT $V_{OLP} = 1.1V \text{ (typ)}$

■ Low Power Dissipation:

$I_{CC} = 4 \mu A \text{ (Max) @ } T_a = 25^\circ C$

■ Balanced Propagation Delays: $t_{PLH} \approx t_{PHL}$

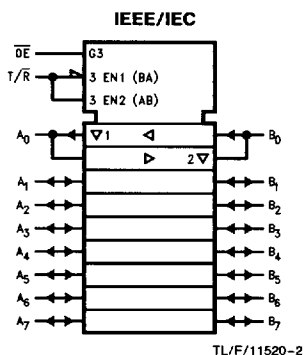
■ Pin and Function Compatible with 74HC/HCT245

NOTE: MILITARY SPECIFICATIONS ARE PRELIMINARY

Logic Symbol

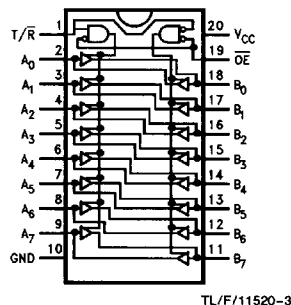
Pin Description

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



Connection Diagrams

Pin Assignment for DIP, Flatpak, SSOP, TSSOP and SOIC



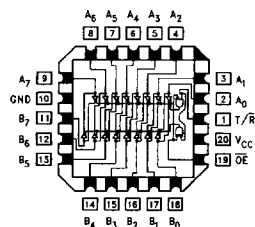
Truth Table

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

Pin Assignment for LCC



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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	-0.5V to +7.0V
DC Input Voltage (V_{IN}) ($T/\bar{R}$, $\bar{OE}$)	-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}) ($T/\bar{R}$, $\bar{OE}$)	-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)	300°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}) ($T/\bar{R}$, $\bar{OE}$)	0V to 5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	
54 VHC/VHCT	-55°C to +125°C
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			54VHC		74VHC		Units	Conditions	
			T _A = 25°C			T _A = -55°C to +125°C		T _A = -40°C to +85°C				
			Min	Typ	Max	Min	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}		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}		0.50 0.3 V _{CC}		V		
V _{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9		1.9		V	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50 μA
		3.0	2.9	3.0		2.9		2.9				
		4.5	4.4	4.5		4.4		4.4				
		4.5	2.58 3.94			3.70		2.48 3.80		V		I _{OH} = -4 mA I _{OH} = -8 mA
V _{OL}	Low Level Output Voltage	2.0		0.0	0.1		0.1		0.1	V	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA
		3.0		0.0	0.1		0.1		0.1			
		4.5		0.0	0.1		0.1		0.1			
		3.0		0.36 0.36			0.50 0.50		0.44 0.44	V		I _{OL} = 4 mA I _{OL} = 8 mA
I _{OZ}	TRI-STATE Output Off-State Current	5.5	±0.25			±10.0		±2.5		μA	V _{IN} = V _{CC} or GND V _{OUT} = V _{CC} or GND V _{IN} OE = V _{IH} or V _{IL}	
I _{IN} (T/R, OE)	Input Leakage Current	0–5.5	±0.1			±1.0		±1.0		μA	V _{IN} = 5.5V or GND	
I _{CC}	Quiescent Supply Current	5.5	4.0			160.0		40.0		μA	V _{IN} = V _{CC} or GND	

DC Characteristics for 'VHC Family Devices:

Symbol	Parameter	V _{CC} (V)	74VHC		54VHC	74VHC	Units	Conditions
			T _A = 25°C		T _A = −55°C to +125°C	T _A = −40°C to +85°C		
			Typ	Limits	Limits	Limits		
*V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	5.0	0.9	1.2			v	C _L = 50 pF
*V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	5.0	−0.9	−1.2			v	C _L = 50 pF
*V _{IHD}	Minimum High Level Dynamic Input Voltage	5.0	3.5				v	C _L = 50 pF
*V _{ILD}	Maximum Low Level Dynamic Input Voltage	5.0	1.5				v	C _L = 50 pF

*Parameter guaranteed by design.

DC Characteristics for 'VHCT Family Devices

Symbol	Parameter	V _{CC} (V)	74VHCT			54VHCT		74VHCT		Units	Conditions	
			T _A = 25°C			T _A = -55°C to +125°C		T _A = -40°C to +85°C				
			Min	Typ	Max	Min	Max	Min	Max			
V _{IH}	High Level Input Voltage	4.5 5.5	2.0					2.0 2.0		V		
V _{IL}	Low Level Input Voltage	4.5 5.5			0.8 0.8			0.8 0.8		V		
V _{OH}	High Level Output Voltage	4.5	3.15	3.65				3.15		V	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50 μA
		4.5	2.5					2.4		V		I _{OH} = -8 mA
V _{OL}	Low Level Output Voltage	4.5		0.0	0.1			0.1		V	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA
		4.5			0.36			0.44		V		I _{OL} = 8 mA
I _{OZ}	TRI-STATE Output Off-State Current	5.5			±0.25			±2.5		μA	V _{IN} = V _{CC} or GND V _{OUT} = V _{CC} or GND V _{IN} OE = V _{IH} or V _{IL}	
I _{IN} (T/R, OE)	Input Leakage Current	0-5.5			±0.1			±1.0		μA	V _{IN} = 5.5V or GND	
I _{CC}	Quiescent Supply Current	5.5			4.0			40.0		μA	V _{IN} = V _{CC} or GND	
I _{CC} T	Maximum I _{CC} /Input	5.5			1.35			1.50		mA	V _{IN} = 3.4V Other Inputs = V _{CC} or GND	
I _{OPD}	Output Leakage Current (Power Down State)	0.0			+0.5			+5.0		μA	V _{OUT} = 5.5V	

DC Characteristics for 'VHCT Family Devices:

Symbol	Parameter	V _{CC} (V)	74VHCT		54VHCT	74VHCT	Units	Conditions
			T _A = 25°C		T _A = -55°C to +125°C	T _A = -40°C to +85°C		
			Typ	Limits	Limits	Limits		
V _{OLP} *	Quiet Output Maximum Dynamic V _{OL}		1.1	1.6			V	C _L = 50 pF
V _{OLV} *	Quiet Output Minimum Dynamic V _{OL}		-1.1	-1.6			V	C _L = 50 pF
V _{IHD} *	Minimum High Level Dynamic Input Voltage		2.0				V	C _L = 50 pF
V _{ILD} *	Maximum Low Level Dynamic Input Voltage		0.8				V	C _L = 50 pF

*Parameter guaranteed by design.

AC Electrical Characteristics for 'VHC Family Devices

Symbol	Parameter	V _{CC} (V)	74VHC			54VHC		74VHC		Units	Conditions	
			T _A = 25°C			T _A = −55°C to +125°C		T _A = −40°C to +85°C				
			Min	Typ	Max	Min	Max	Min	Max			
t _{PLH} t _{PHL}	Propagation Delay Time	3.3 ± 0.3	5.8	8.4			1.0	10.0	ns	C _L = 15 pF C _L = 50 pF C _L = 15 pF C _L = 50 pF		
			8.3	11.9			1.0	13.5				
		5.0 ± 0.5	4.0	5.5			1.0	6.5	ns			
			5.5	7.5			1.0	8.5				
t _{PZL} t _{PZH}	TRI-STATE Output Enable Time	3.3 ± 0.3	8.5	13.2			1.0	15.5	ns	R _L = 1 kΩ C _L = 15 pF C _L = 50 pF C _L = 15 pF C _L = 50 pF		
			11.0	16.7			1.0	19.0				
		5.0 ± 0.5	5.8	8.5			1.0	10.0	ns			
			7.3	10.6			1.0	12.0				
t _{PLZ} t _{PHZ}	TRI-STATE Output Disable Time	3.3 ± 0.3	11.5	15.8			1.0	18.0	ns	R _L = 1 kΩ C _L = 50 pF C _L = 50 pF		
		5.0 ± 0.5	7.0	9.7			1.0	11.0				
t _{OSLH} t _{OSHL}	Output to Output Skew	3.3 ± 0.3	1.5			1.5		ns	(Note 1) C _L = 50 pF C _L = 50 pF			
		5.0 ± 0.5	1.0			1.0						
C _{IN} (T/R, OE)	Input Capacitance		4	10			10	pF	V _{CC} = Open			
C _{I/O}	Output Capacitance		8					pF	V _{CC} = 5.0V			
C _{PD}	Power Dissipation Capacitance		21					pF	(Note 2)			

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

Note 2: C_{PD} 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).

AC Electrical Characteristics for 'VHCT Family Devices

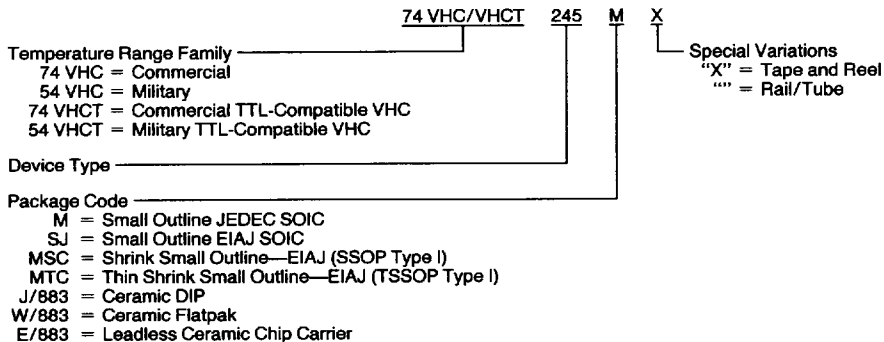
Symbol	Parameter	V _{CC} (V)	74VHCT			54VHCT		74VHCT		Units	Conditions	
			T _A = 25°C			T _A = −55°C to + 125°C		T _A = −40°C to + 85°C				
			Min	Typ	Max	Min	Max	Min	Max			
t _{PLH}	Propagation Delay Time	5.0 ± 0.5	4.5	7.7				1.0	8.5	ns		C _L = 15 pF
t _{PHL}			5.3	8.7				1.0	9.5			C _L = 50 pF
t _{PZL}	TRI-STATE Output Enable Time	5.0 ± 0.5	8.9	13.8				1.0	15.0	ns	R _L = 1 kΩ	C _L = 15 pF
t _{PZH}			9.7	14.8				1.0	16.0			C _L = 50 pF
t _{PLZ}	TRI-STATE Output Disable Time	5.0 ± 0.5	10.0	15.4				1.0	16.5	ns	R _L = 1 kΩ	C _L = 50 pF
t _{PHZ}												
t _{OSLH}	Output to Output Skew	5.0 ± 0.5	1.0					1.0		ns	(Note 1)	C _L = 50 pF
t _{OSHL}												
C _{IN}	Input Capacitance		4	10				10		pF	V _{CC} = Open	
C _{I/O}	Output Capacitance		9							pF	V _{CC} = 5.0V	
C _{PD}	Power Dissipation Capacitance		23							pF	(Note 2)	

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

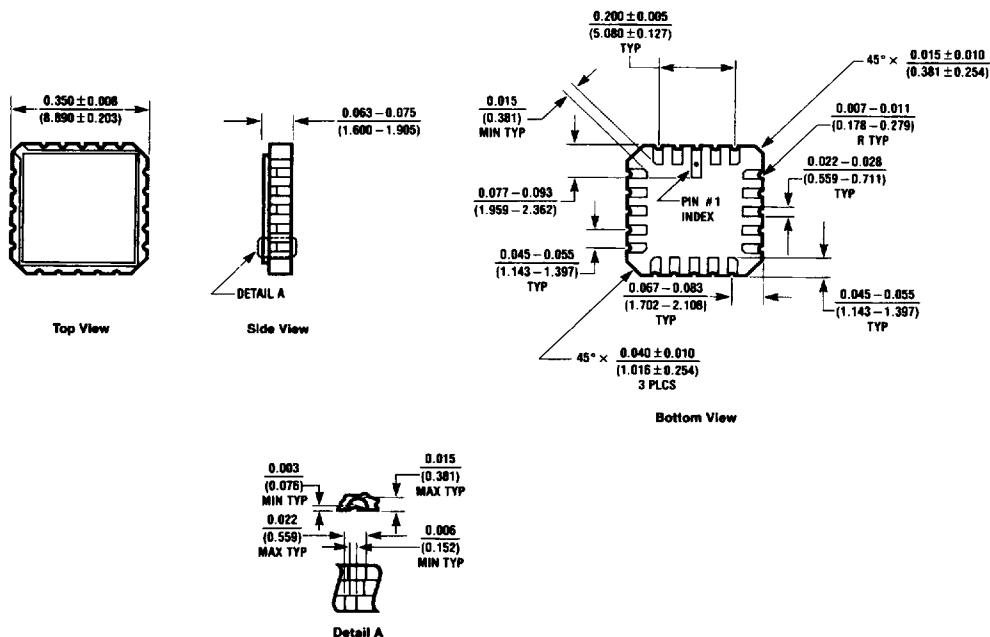
Note 2: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8$ (per Bit).

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:



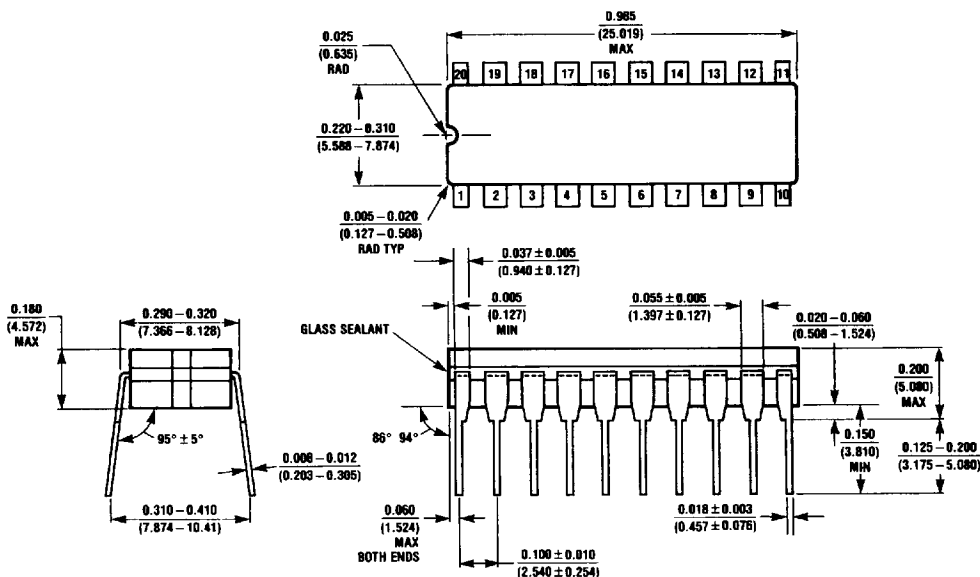
Physical Dimensions inches (millimeters)



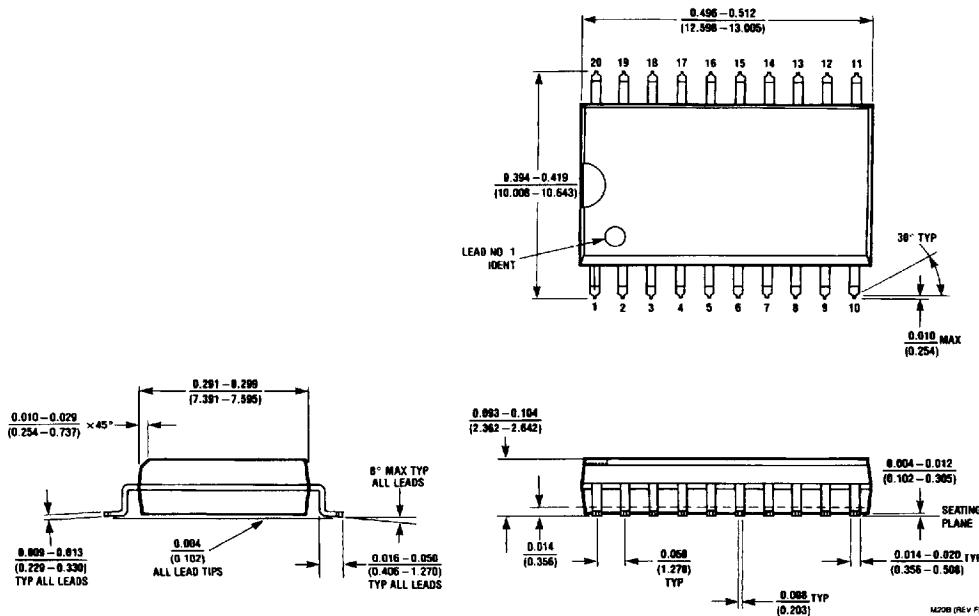
20-Lead Ceramic Leadless Chip Carrier, Type C (L)
Order Number 54VHC245E/883 or 54VHCT245E/883
NS Package Number E20A

E20A (REV D)

Physical Dimensions inches (millimeters) (Continued)

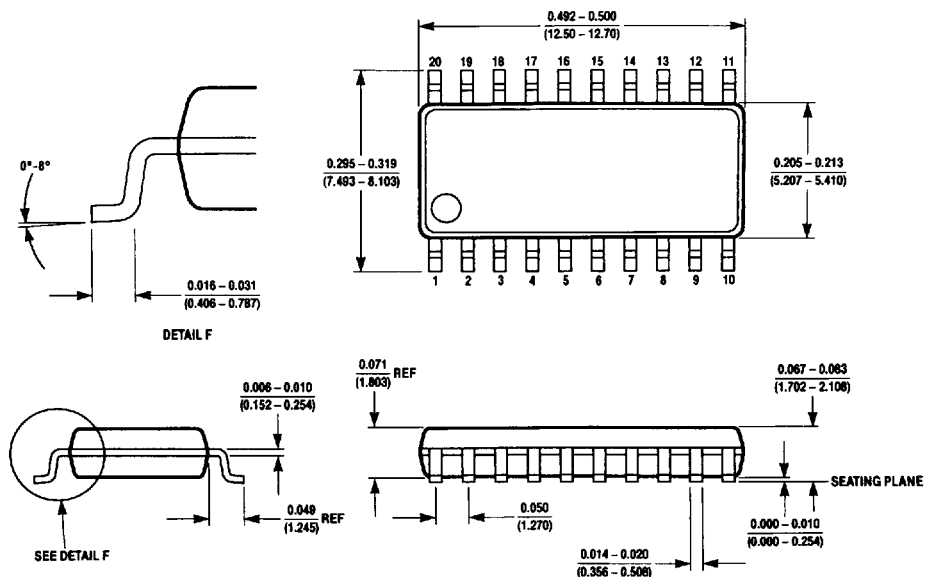


20-Lead Ceramic Dual-In-Line Package (D)
Order Number 54VHC245J/883 or 54VHCT245J/883
NS Package Number J20A

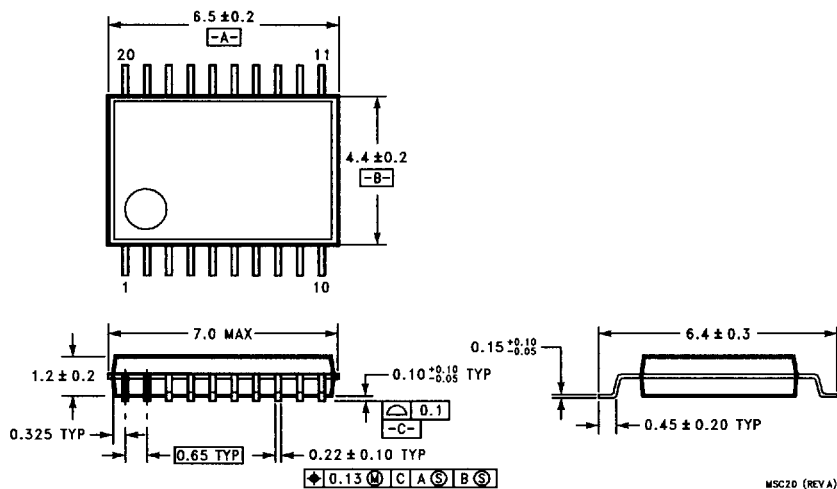


20-Lead Small Outline Integrated Circuit—JEDEC SOIC (M)
Order Number 74VHC245M, 74VHC245MX, 74VHCT245M, or 74VHCT245MX
NS Package Number M20B

Physical Dimensions inches (millimeters) (Continued)

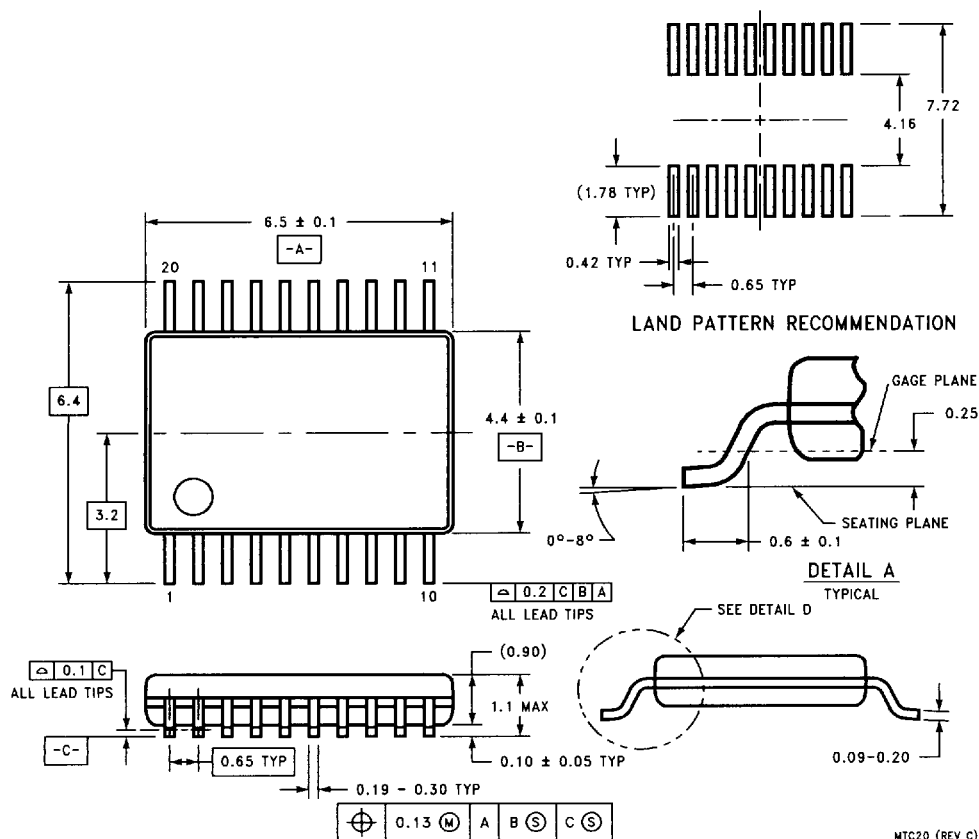


20-Lead Small Outline Package EIAJ SOIC (SJ)
Order Number 74VHC245SJ, 74VHC245SJX, 74VHCT245SJ, or 74VHCT245SJX
NS Package Number M20D



20-Lead Plastic EIAJ SSOP Type I (MSC)
Order Number 74VHC245MSCX or 74VHCT245MSCX
NS Package Number MSC20

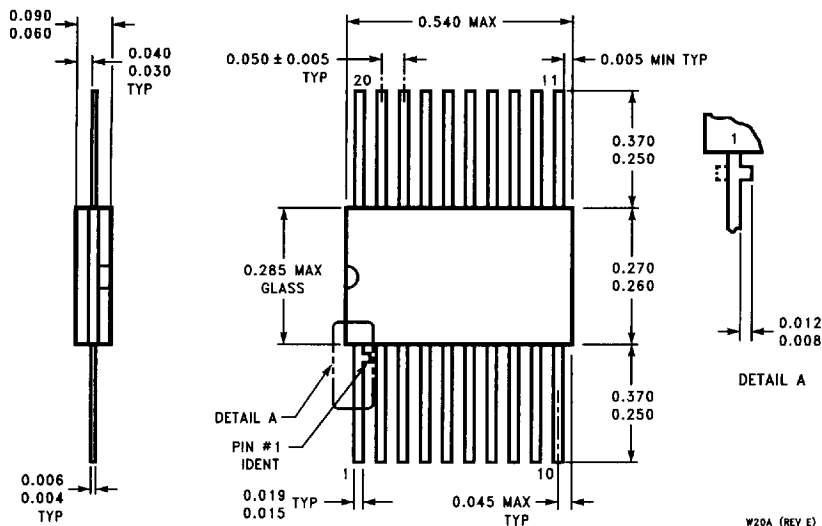
Physical Dimensions inches (millimeters) (Continued)



20-Lead Plastic EIAJ TSSOP Type I (MTC)
Order Number 74VHC245MTC, 74VHC245MTCX, 74VHCT245MTC or 74VHCT245MTCX
NS Package Number MSC20

Physical Dimensions inches (millimeters) (Continued)

Lit.# 118085-002



20-Lead Cerpak (F)
Order Number 54VHC245W/883 or 54VHCT245W/883
NS Package Number W20A

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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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