

SN54AHC245, SN74AHC245 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCLS230I – OCTOBER 1995 – REVISED JULY 2003

- Operating Range 2-V to 5.5-V V_{CC}
- Latch-Up Performance Exceeds 250 mA Per JESD 17

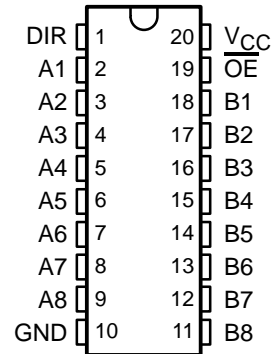
description/ordering information

The 'AHC245 octal bus transceivers are designed for asynchronous two-way communication between data buses. The control-function implementation minimizes external timing requirements.

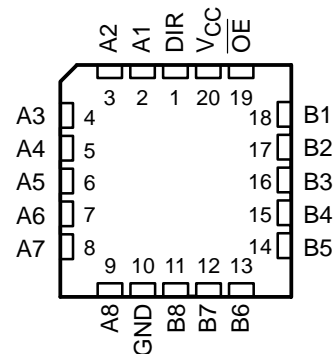
These devices allow data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable (\overline{OE}) input can be used to disable the device so that the buses are effectively isolated.

To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

SN54AHC245 . . . J OR W PACKAGE SN74AHC245 . . . DB, DGV, DW, N, OR PW PACKAGE (TOP VIEW)



SN54AHC245 . . . FK PACKAGE (TOP VIEW)



ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP – N	Tube	SN74AHC245N	SN74AHC245N
	SOIC – DW	Tube	SN74AHC245DW	AHC245
		Tape and reel	SN74AHC245DWR	
	SSOP – DB	Tape and reel	SN74AHC245DBR	HA245
	TSSOP – PW	Tube	SN74AHC245PW	HA245
		Tape and reel	SN74AHC245PWR	
	TVSOP – DGV	Tape and reel	SN74AHC245DGVR	HA245
-55°C to 125°C	CDIP – J	Tube	SNJ54AHC245J	SNJ54AHC245J
	CFP – W	Tube	SNJ54AHC245W	SNJ54AHC245W
	LCCC – FK	Tube	SNJ54AHC245FK	SNJ54AHC245FK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2003, Texas Instruments Incorporated
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

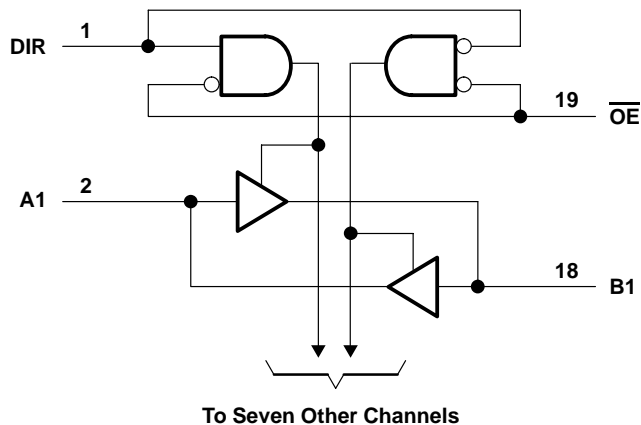
SN54AHC245, SN74AHC245 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCLS230I – OCTOBER 1995 – REVISED JULY 2003

FUNCTION TABLE
(each transceiver)

INPUTS		OPERATION
\overline{OE}	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC}	-0.5 V to 7 V
Input voltage range, V_I (see Note 1): Control inputs	-0.5 V to 7 V
I/O, Output voltage range, V_O (see Note 1)	-0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$): Control inputs	-20 mA
I/O, Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	± 20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	± 25 mA
Continuous current through V_{CC} or GND	± 75 mA
Package thermal impedance, θ_{JA} (see Note 2): DB package	70°C/W
DGV package	92°C/W
DW package	58°C/W
N package	69°C/W
PW package	83°C/W
Storage temperature range, T_{stg}	-65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

SN54AHC245, SN74AHC245 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCLS230I – OCTOBER 1995 – REVISED JULY 2003

recommended operating conditions (see Note 3)

		SN54AHC245		SN74AHC245		UNIT
		MIN	MAX	MIN	MAX	
V _{CC}	Supply voltage	2	5.5	2	5.5	V
V _{IH}	High-level input voltage	V _{CC} = 2 V		1.5		V
		V _{CC} = 3 V		2.1		
		V _{CC} = 5.5 V		3.85		
V _{IL}	Low-level input voltage	V _{CC} = 2 V		0.5		V
		V _{CC} = 3 V		0.9		
		V _{CC} = 5.5 V		1.65		
V _I	Input voltage	$\overline{\text{OE}}$ or DIR		0	5.5	V
V _O	Output voltage	A or B		0	V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 2 V		-50		μA mA
		V _{CC} = 3.3 V \pm 0.3 V		-4		
		V _{CC} = 5 V \pm 0.5 V		-8		
I _{OL}	Low-level output current	V _{CC} = 2 V		50		μA mA
		V _{CC} = 3.3 V \pm 0.3 V		4		
		V _{CC} = 5 V \pm 0.5 V		8		
$\Delta t/\Delta v$	Input transition rise or fall rate	V _{CC} = 3.3 V \pm 0.3 V		100		ns/V
		V _{CC} = 5 V \pm 0.5 V		20		
T _A	Operating free-air temperature	-55	125	-40	85	$^{\circ}\text{C}$

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25 $^{\circ}\text{C}$			SN54AHC245		SN74AHC245		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}	I _{OH} = -50 μA	2 V	1.9	2		1.9		1.9	V	
		3 V	2.9	3		2.9		2.9		
		4.5 V	4.4	4.5		4.4		4.4		
	I _{OH} = -4 mA	3 V	2.58			2.48		2.48		
	I _{OH} = -8 mA	4.5 V	3.94			3.8		3.8		
V _{OL}	I _{OL} = 50 μA	2 V				0.1		0.1	V	
		3 V				0.1		0.1		
		4.5 V				0.1		0.1		
	I _{OL} = 4 mA	3 V				0.36		0.5		
	I _{OL} = 8 mA	4.5 V				0.36		0.5		
I _I	A or B inputs	V _I = V _{CC} or GND	5.5 V					± 1	μA	
	$\overline{\text{OE}}$ or DIR		0 V to 5.5 V					$\pm 1^*$		
I _{OZ} [†]	V _O = V _{CC} or GND, V _I ($\overline{\text{OE}}$) = V _{IL} or V _{IH}	5.5 V			± 0.25			± 2.5	μA	
I _{CC}	V _I = V _{CC} or GND, I _O = 0	5.5 V			4			40	μA	
C _i	$\overline{\text{OE}}$ or DIR	V _I = V _{CC} or GND	5 V		2.5	10			10	pF
C _{io}	A or B inputs	V _I = V _{CC} or GND	5 V		4					pF

* On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.

† The parameter I_{OZ} includes the input leakage current.



SN54AHC245, SN74AHC245 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCLS230I – OCTOBER 1995 – REVISED JULY 2003

switching characteristics over recommended operating free-air temperature range, $V_{CC} = 3.3 V \pm 0.3 V$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ C$			SN54AHC245		SN74AHC245		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A or B	B or A	$C_L = 15 \text{ pF}$	5.8**	8.4**	1**	10**	1	10	ns	
t_{PHL}				5.8**	8.4**	1**	10**	1	10		
t_{PZH}	\overline{OE}	A or B	$C_L = 15 \text{ pF}$	8.5**	13.2**	1**	15.5**	1	15.5	ns	
t_{PZL}				8.5**	13.2**	1**	15.5**	1	15.5		
t_{PHZ}	\overline{OE}	A or B	$C_L = 15 \text{ pF}$	8.9**	12.5**	1**	15.5**	1	15.5	ns	
t_{PLZ}				8.9**	12.5**	1**	15.5**	1	15.5		
t_{PLH}	A or B	B or A	$C_L = 50 \text{ pF}$	8.3	11.9	1	13.5	1	13.5	ns	
t_{PHL}				8.3	11.9	1	13.5	1	13.5		
t_{PZH}	\overline{OE}	A or B	$C_L = 50 \text{ pF}$	11	16.7	1	19	1	19	ns	
t_{PZL}				11	16.7	1	19	1	19		
t_{PHZ}	\overline{OE}	A or B	$C_L = 50 \text{ pF}$	11.5	15.8	1	18	1	18	ns	
t_{PLZ}				11.5	15.8	1	18	1	18		
$t_{sk(o)}$			$C_L = 50 \text{ pF}$		1.5**				1.5	ns	

** On products compliant to MIL-PRF-38535, this parameter is not production tested.

*** On products compliant to MIL-PRF-38535, this parameter does not apply.

switching characteristics over recommended operating free-air temperature range, $V_{CC} = 5 V \pm 0.5 V$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ C$			SN54AHC245		SN74AHC245		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A or B	B or A	$C_L = 15 \text{ pF}$	4*	5.5*	1*	6.5*	1	6.5	ns	
t_{PHL}				4*	5.5*	1*	6.5*	1	6.5		
t_{PZH}	\overline{OE}	A or B	$C_L = 15 \text{ pF}$	5.8*	8.5*	1*	10*	1	10	ns	
t_{PZL}				5.8*	8.5*	1*	10*	1	10		
t_{PHZ}	\overline{OE}	A or B	$C_L = 15 \text{ pF}$	5.6*	7.8*	1*	9.2*	1	9.2	ns	
t_{PLZ}				5.6*	7.8*	1*	9.2*	1	9.2		
t_{PLH}	A or B	B or A	$C_L = 50 \text{ pF}$	5.5	7.5	1	8.5	1	8.5	ns	
t_{PHL}				5.5	7.5	1	8.5	1	8.5		
t_{PZH}	\overline{OE}	A or B	$C_L = 50 \text{ pF}$	7.3	10.6	1	12	1	12	ns	
t_{PZL}				7.3	10.6	1	12	1	12		
t_{PHZ}	\overline{OE}	A or B	$C_L = 50 \text{ pF}$	7	9.7	1	11	1	11	ns	
t_{PLZ}				7	9.7	1	11	1	11		
$t_{sk(o)}$			$C_L = 50 \text{ pF}$		1**				1	ns	

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

** On products compliant to MIL-PRF-38535, this parameter does not apply.



**SN54AHC245, SN74AHC245
OCTAL BUS TRANSCEIVERS
WITH 3-STATE OUTPUTS**

SCLS230I – OCTOBER 1995 – REVISED JULY 2003

noise characteristics, $V_{CC} = 5\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 4)

PARAMETER	SN74AHC245			UNIT
	MIN	TYP	MAX	
$V_{OL(P)}$ Quiet output, maximum dynamic V_{OL}		0.9		V
$V_{OL(V)}$ Quiet output, minimum dynamic V_{OL}		-0.9		V
$V_{OH(V)}$ Quiet output, minimum dynamic V_{OH}		4.3		V
$V_{IH(D)}$ High-level dynamic input voltage	3.5			V
$V_{IL(D)}$ Low-level dynamic input voltage			1.5	V

NOTE 4: Characteristics are for surface-mount packages only.

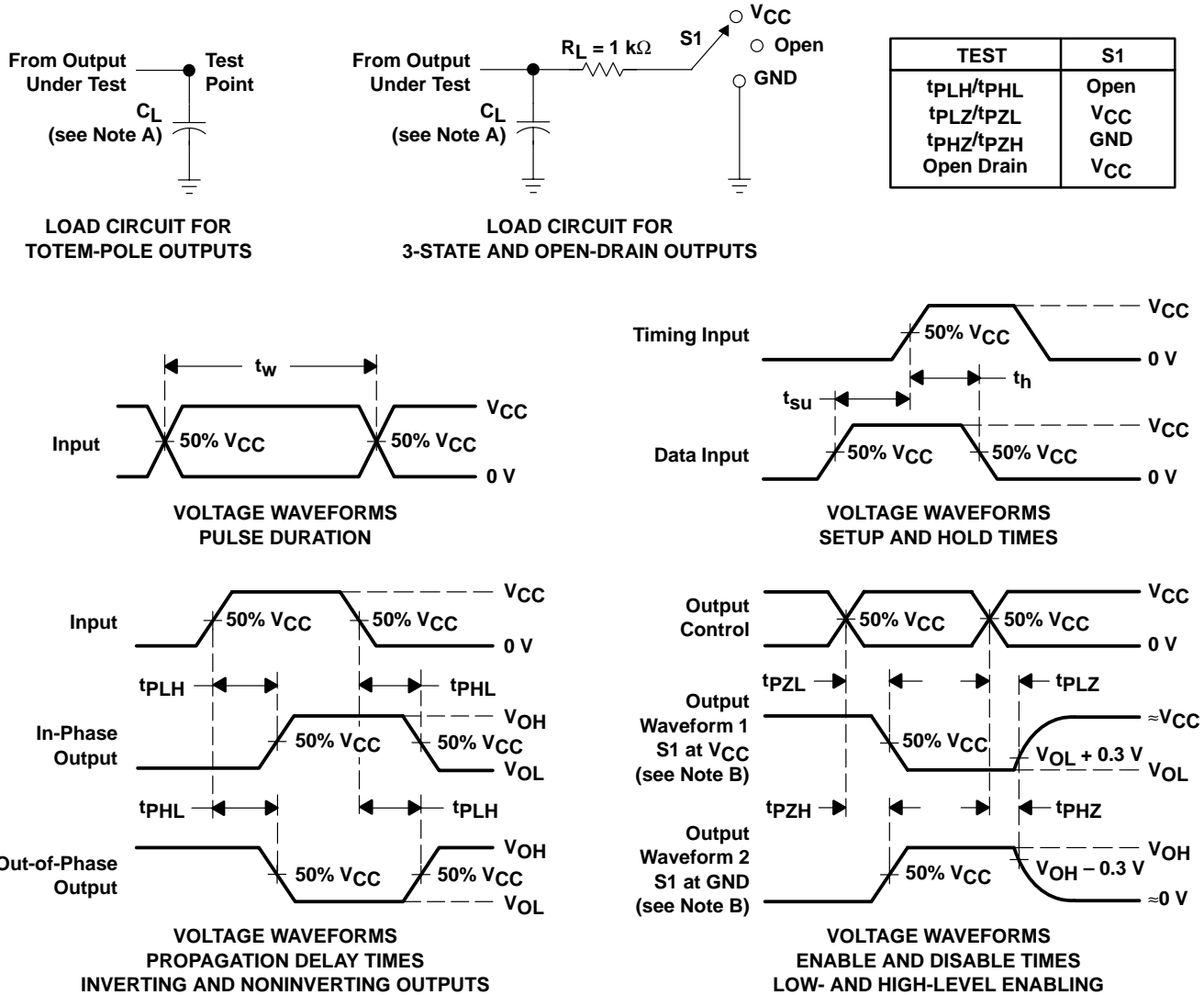
operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
C_{pd} Power dissipation capacitance	No load, $f = 1\text{ MHz}$	14	pF

SN54AHC245, SN74AHC245 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCLS230I – OCTOBER 1995 – REVISED JULY 2003

PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A. C_L includes probe and jig capacitance.
 - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 - C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 3\text{ ns}$, $t_f \leq 3\text{ ns}$.
 - D. The outputs are measured one at a time with one input transition per measurement.
 - E. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
5962-9681801Q2A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
5962-9681801QRA	ACTIVE	CDIP	J	20	1	TBD	Call TI	Level-NC-NC-NC
5962-9681801QSA	ACTIVE	CFP	W	20	1	TBD	Call TI	Level-NC-NC-NC
5962-9681801VRA	ACTIVE	CDIP	J	20	1	TBD	Call TI	Level-NC-NC-NC
5962-9681801VSA	ACTIVE	CFP	W	20	1	TBD	Call TI	Level-NC-NC-NC
SN74AHC245DBLE	OBSOLETE	SSOP	DB	20		TBD	Call TI	Call TI
SN74AHC245DBR	ACTIVE	SSOP	DB	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC245DBRE4	ACTIVE	SSOP	DB	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC245DGVR	ACTIVE	TVSOP	DGV	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC245DGVRE4	ACTIVE	TVSOP	DGV	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC245DW	ACTIVE	SOIC	DW	20	25	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC245DWE4	ACTIVE	SOIC	DW	20	25	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC245DWR	ACTIVE	SOIC	DW	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC245DWRE4	ACTIVE	SOIC	DW	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC245N	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74AHC245NE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74AHC245NSR	ACTIVE	SO	NS	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC245PW	ACTIVE	TSSOP	PW	20	70	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC245PWE4	ACTIVE	TSSOP	PW	20	70	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC245PWLE	OBSOLETE	TSSOP	PW	20		TBD	Call TI	Call TI
SN74AHC245PWR	ACTIVE	TSSOP	PW	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC245PWRE4	ACTIVE	TSSOP	PW	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC245PWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54AHC245FK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54AHC245J	ACTIVE	CDIP	J	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54AHC245W	ACTIVE	CFP	W	20	1	TBD	Call TI	Level-NC-NC-NC

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F20)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within Mil-Std 1835 GDFP2-F20

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



4040140/D 10/96

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a metal lid.
 - D. The terminals are gold plated.
 - E. Falls within JEDEC MS-004

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



4073251/E 08/00

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation AC.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265