

SN54LS640 THRU SN54LS642, SN54LS644, SN54LS645 SN74LS640 THRU SN74LS642, SN74LS644, SN74LS645 OCTAL BUS TRANSCEIVERS

SDLS189 – APRIL 1979 – REVISED MARCH 1988

- SN74LS64X-1 Versions Rated at I_{OL} of 48 mA
- Bi-directional Bus Transceivers in High-Density 20-Pin Packages
- Hysteresis at Bus Inputs Improves Noise Margins
- Choice of True or Inverting Logic
- Choice of 3-State or Open-Collector Outputs

| DEVICE | OUTPUT | LOGIC |
|--------|----------------|--------------------|
| 'LS640 | 3-State | Inverting |
| 'LS641 | Open-Collector | True |
| 'LS642 | Open-Collector | Inverting |
| 'LS644 | Open-Collector | True and inverting |
| 'LS645 | 3-State | True |

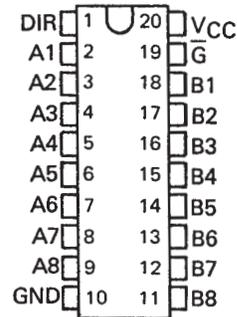
description

These octal bus transceivers are designed for asynchronous two-way communication between data buses. The devices transmit data from the A bus to the B bus or from the B bus to the A bus depending upon the level at the direction control (DIR) input. The enable input (\bar{G}) can be used to disable the device so the buses are effectively isolated.

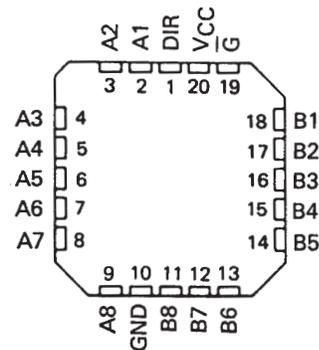
The -1 versions of the SN74LS640 thru SN74LS642, SN74LS644, and SN74LS645 are identical to the standard versions except that the recommended maximum I_{OL} is increased to 48 milliamperes. There are no -1 versions of the SN54LS640 thru SN54LS642, SN54LS644, and SN54LS645.

The SN54LS640 thru SN54LS642, SN54LS644, and SN54LS645 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LS640 thru SN74LS642, SN74LS644, and SN74LS645 are characterized for operation from 0°C to 70°C .

SN54LS' . . . J PACKAGE
SN74LS' . . . DW OR N PACKAGE
(TOP VIEW)



SN54LS' . . . FK PACKAGE
(TOP VIEW)



FUNCTION TABLE

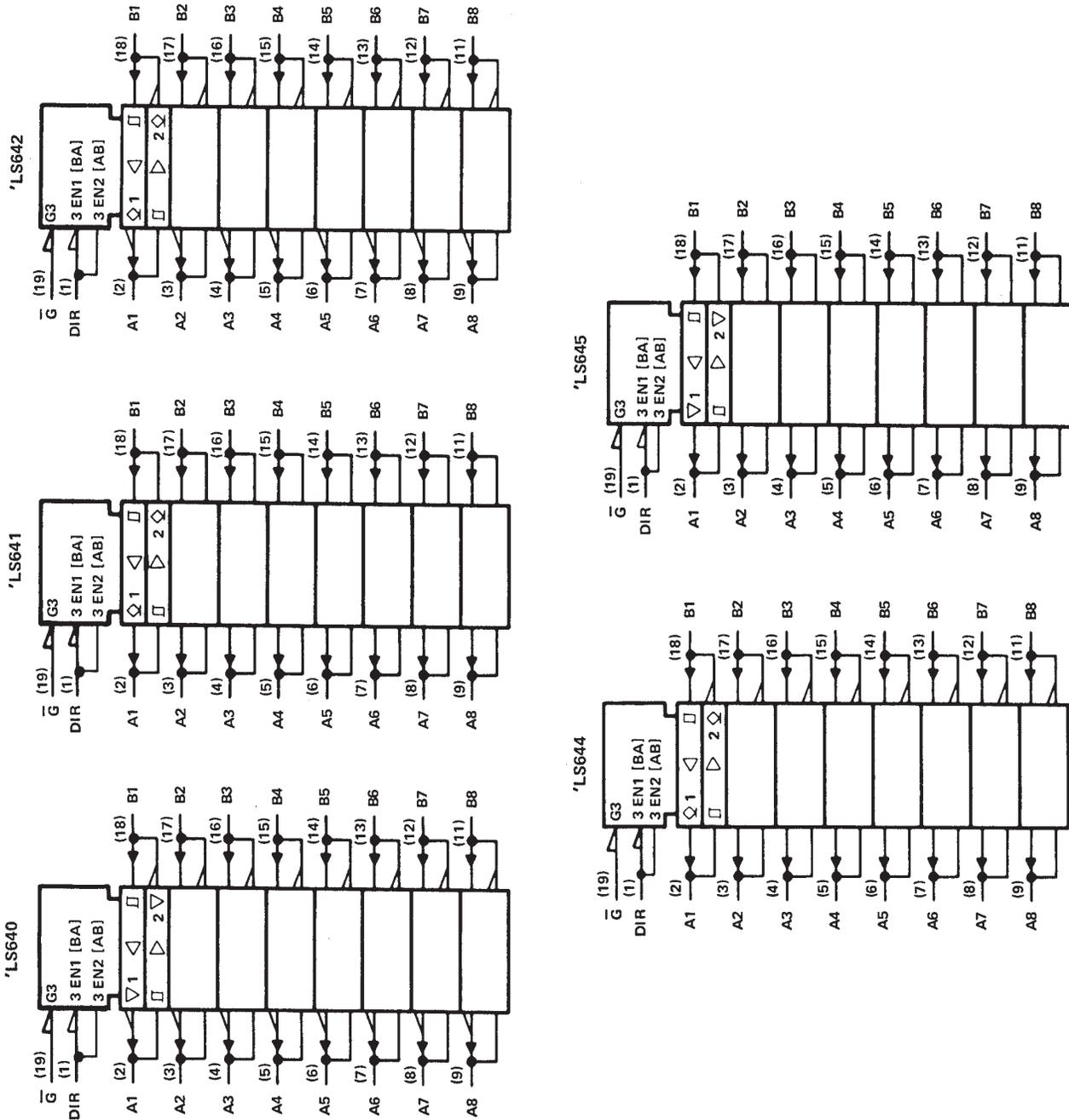
| CONTROL INPUTS | | OPERATION | | |
|----------------|-----|------------------|------------------|-------------------------|
| \bar{G} | DIR | 'LS640 'LS642 | 'LS641 'LS645 | 'LS644 |
| L | L | B data to A bus | B data to A bus | B data to A bus |
| L | H | A data to B bus | A data to B bus | \bar{A} data to B bus |
| H | X | Isolation | Isolation | Isolation |

H = high level, L = low level, X = irrelevant

SN54LS640 THRU SN54LS642, SN54LS644, SN54LS645 SN74LS640 THRU SN74LS642, SN74LS644, SN74LS645 OCTAL BUS TRANSCEIVERS

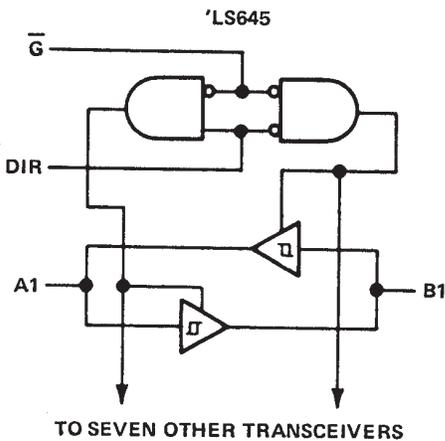
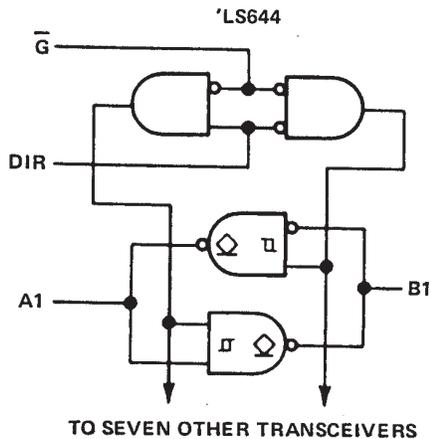
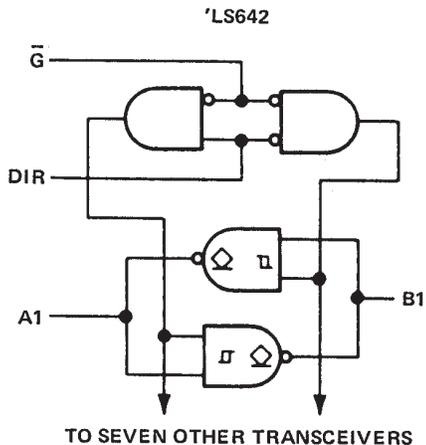
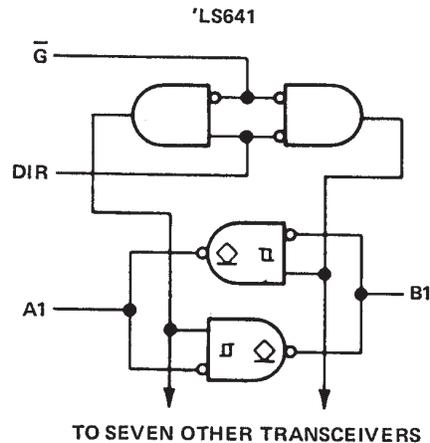
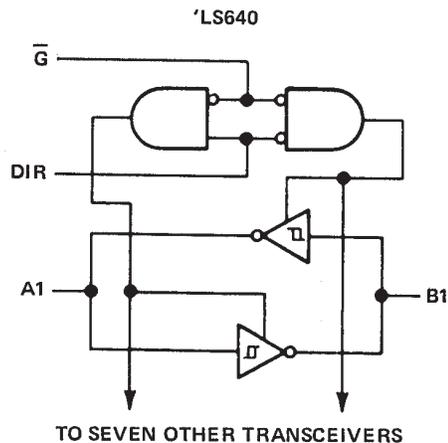
SDLS189 – APRIL 1979 – REVISED MARCH 1988

logic symbols†



† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for DW, J, and N packages.

logic diagrams (positive logic)



SN54LS640, SN54LS645
SN74LS640, SN74LS645
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SDLS189 – APRIL 1979 – REVISED MARCH 1988

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

| | |
|--|----------------|
| Supply voltage, V_{CC} (see Note 1) | 7 V |
| Input voltage: All inputs | 7 V |
| I/O ports | 5.5 V |
| Operating free-air temperature range: SN54LS640, SN54LS645 | -55°C to 125°C |
| SN74LS640, SN74LS645 | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

| PARAMETER | SN54LS640 SN54LS645 | | | SN74LS640 SN74LS645 | | | UNIT |
|--------------------------------------|------------------------|-----|-----|------------------------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V_{IH} High-level input voltage | 2 | | | 2 | | | V |
| V_{IL} Low-level input voltage | | | 0.5 | | | 0.6 | V |
| I_{OH} High-level output current | | | -12 | | | -15 | mA |
| I_{OL} Low-level output current | | | 12 | | | 24 | mA |
| | | | | | | 48† | |
| T_A Operating free-air temperature | -55 | | 125 | 0 | | 70 | °C |

†The 48-mA limit applies for the SN74LS640-1 and SN74LS645-1 only.

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

| PARAMETER | TEST CONDITIONS† | SN54LS640 SN54LS645 | | | SN74LS640 SN74LS645 | | | UNIT | |
|-------------------------------------|---|-----------------------------|-----------------------|------|------------------------|------|------|------|----|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | | |
| V_{IK} | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$ | | | -1.5 | | | -1.5 | V | |
| Hysteresis ($V_{T+} - V_{T-}$) | $V_{CC} = \text{MIN},$ A or B input | 0.1 | 0.4 | | 0.2 | 0.4 | | V | |
| V_{OH} | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = \text{MAX}$ | $I_{OH} = -3 \text{ mA}$ | 2.4 | 3.4 | 2.4 | 3.4 | | | |
| | | $I_{OH} = \text{MAX}$ | 2 | | 2 | | | | |
| V_{OL} | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = \text{MAX}$ | $I_{OL} = 12 \text{ mA}$ | 0.25 | 0.4 | 0.25 | 0.4 | | V | |
| | | $I_{OL} = 24 \text{ mA}$ | | | 0.35 | 0.5 | | | |
| | | $I_{OL} = 48 \text{ mA}^\#$ | | | 0.4 | 0.5 | | | |
| I_{OZH} | $V_{CC} = \text{MAX}, \bar{G} \text{ at } 2 \text{ V}, V_O = 2.7 \text{ V}$ | | | 20 | | | 20 | µA | |
| I_{OZL} | $V_{CC} = \text{MAX}, \bar{G} \text{ at } 2 \text{ V}, V_O = 0.4 \text{ V}$ | | | -0.4 | | | -0.4 | mA | |
| I_I | A or B DIR or \bar{G} | $V_{CC} = \text{MAX}$ | $V_I = 5.5 \text{ V}$ | | | 0.1 | | 0.1 | mA |
| | | | $V_I = 7 \text{ V}$ | | | 0.1 | | 0.1 | |
| I_{IH} | $V_{CC} = \text{MAX}, V_{IH} = 2.7 \text{ V}$ | | | 20 | | | 20 | µA | |
| I_{IL} | $V_{CC} = \text{MAX}, V_{IL} = 0.4 \text{ V}$ | | | -0.4 | | | -0.4 | mA | |
| I_{OS}^\ddagger | $V_{CC} = \text{MAX}$ | -40 | | -225 | -40 | | -225 | mA | |
| I_{CC} | Outputs high | | 48 | 70 | | 48 | 70 | mA | |
| | Outputs low | | 62 | 90 | | 62 | 90 | | |
| | Outputs at Hi-Z | | 64 | 95 | | 64 | 95 | | |

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

¶Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

#The 48-mA condition applies for the SN74LS640-1 and SN74LS645-1 only.



SN54LS640, SN54LS645
SN74LS640, SN74LS645
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

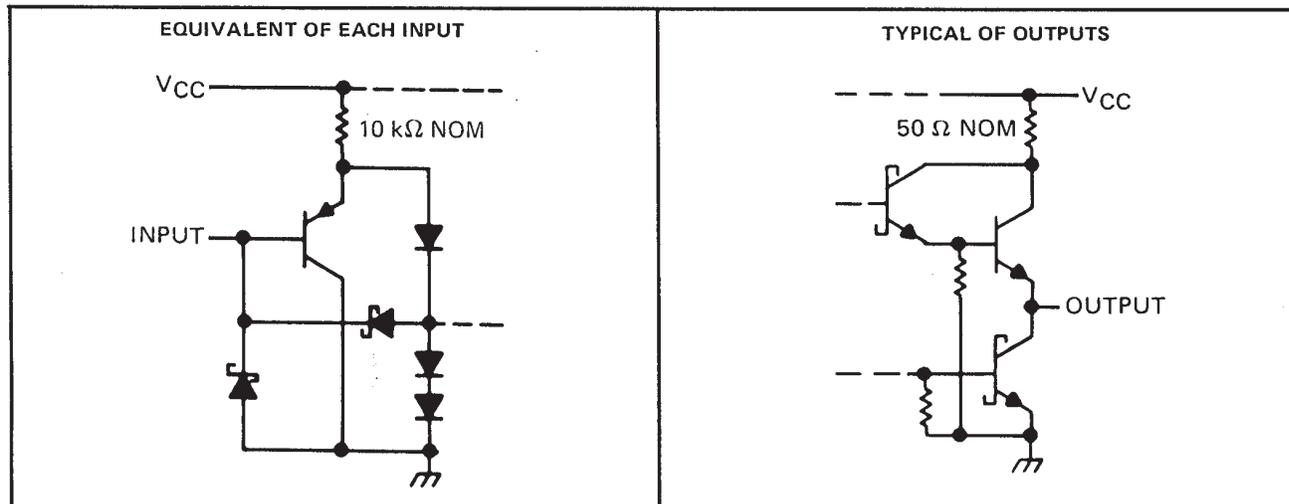
SDLS189 – APRIL 1979 – REVISED MARCH 1988

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | 'LS640, 'LS640-1 | | | 'LS645, 'LS645-1 | | | UNIT |
|--|----------------|-------------|---|------------------|-----|-----|------------------|-----|-----|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PLH} Propagation delay time, low-to-high-level output | A | B | $C_L = 45 \text{ pF}$, $R_L = 667 \Omega$, See Note 2 | | 6 | 10 | | 8 | 15 | ns |
| | B | A | | | 6 | 10 | | 8 | 15 | |
| t_{PHL} Propagation delay time, high-to-low-level output | A | B | | | 8 | 15 | | 11 | 15 | ns |
| | B | A | | | 8 | 15 | | 11 | 15 | |
| t_{PZL} Output enable time to low level | \overline{G} | A | | | 31 | 40 | | 31 | 40 | ns |
| | \overline{G} | B | | | 31 | 40 | | 31 | 40 | |
| t_{PZH} Output enable time to high level | \overline{G} | A | | | 23 | 40 | | 26 | 40 | ns |
| | \overline{G} | B | | | 23 | 40 | | 26 | 40 | |
| t_{PLZ} Output disable time from low level | \overline{G} | A | $C_L = 5 \text{ pF}$, $R_L = 667 \Omega$, See Note 2 | | 15 | 25 | | 15 | 25 | ns |
| | \overline{G} | B | | | 15 | 25 | | 15 | 25 | |
| t_{PHZ} Output disable time from high level | \overline{G} | A | | | 15 | 25 | | 15 | 25 | ns |
| | \overline{G} | B | | | 15 | 25 | | 15 | 25 | |

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs



SN54LS640, SN54LS645
SN74LS640, SN74LS645
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SDLS189 – APRIL 1979 – REVISED MARCH 1988

TYPICAL CHARACTERISTICS

SN54LS'
INVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

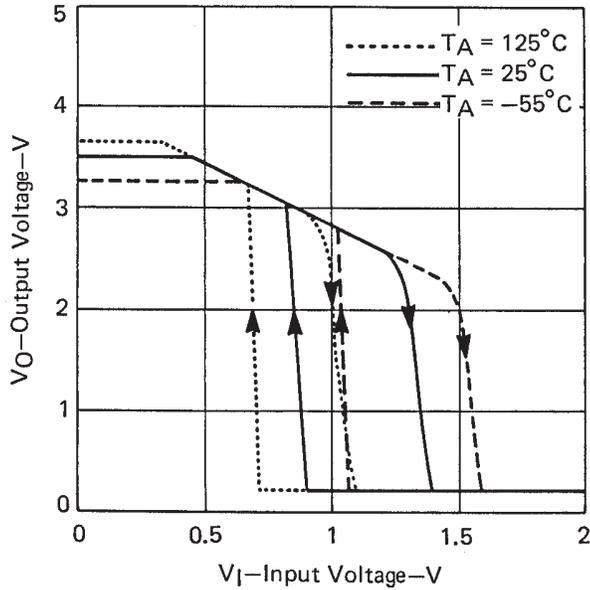


FIGURE 1

SN74LS'
INVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

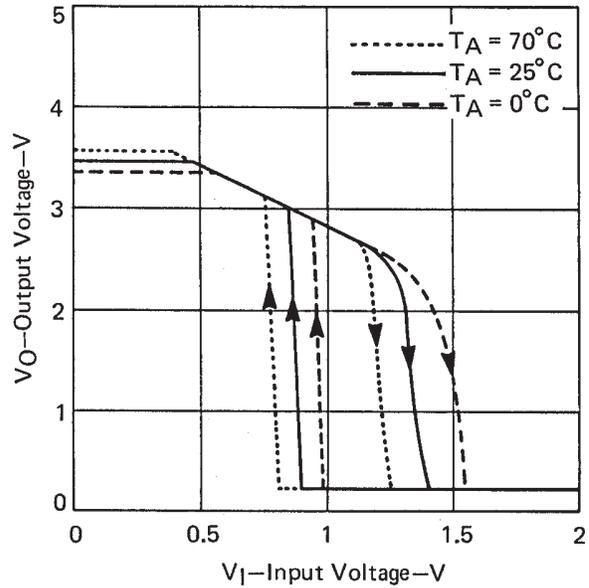


FIGURE 2

SN54LS'
NONINVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

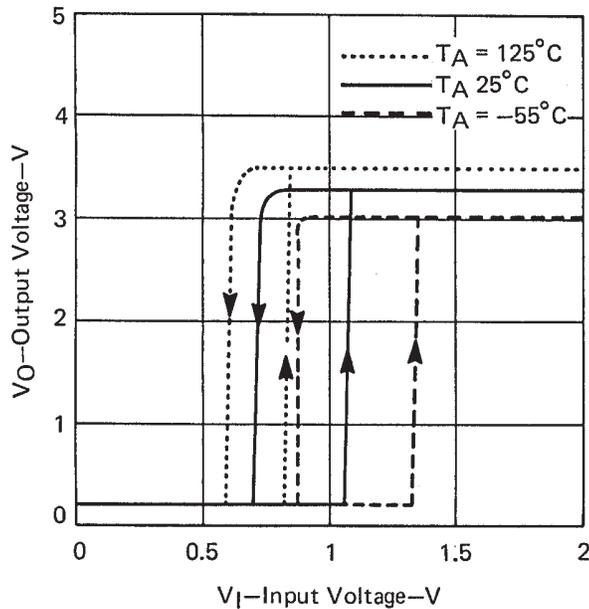


FIGURE 3

SN74LS'
NONINVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

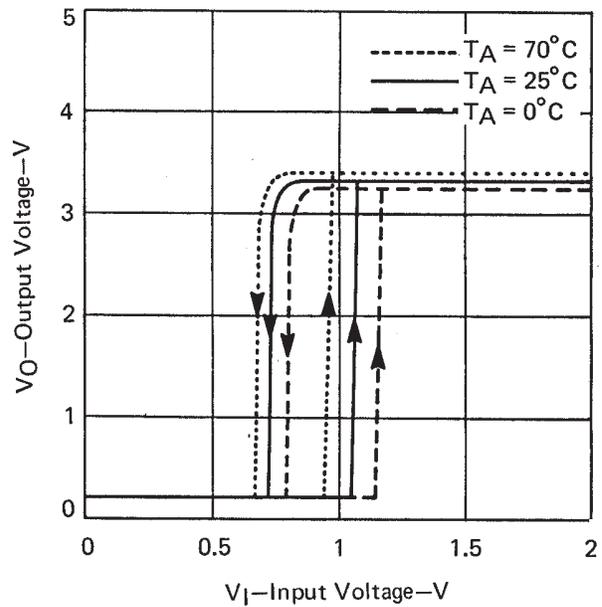


FIGURE 4



SN54LS641, SN54LS642, SN54LS644
SN74LS641, SN74LS642, SN74LS644
OCTAL BUS TRANSCEIVERS WITH OPEN-COLLECTOR OUTPUTS

SDLS189 – APRIL 1979 – REVISED MARCH 1988

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

| | |
|---|-------------------|
| Supply voltage, V_{CC} (see Note 1) | 7 V |
| Input voltage: All inputs and I/O ports | 7 V |
| Operating free-air temperature range: SN54LS641, SN54LS642, SN54LS644 | – 55° C to 125° C |
| SN74LS641, SN74LS642, SN74LS644 | 0° C to 70° C |
| Storage temperature range | – 65° C to 150° C |

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

| PARAMETER | SN54LS641 SN54LS642 SN54LS644 | | | SN74LS641 SN74LS642 SN74LS644 | | | UNIT | | |
|--------------------------------------|-------------------------------------|-----|-----|-------------------------------------|------|-----|------|------|----|
| | MIN | NOM | MAX | MIN | NOM | MAX | | | |
| | V_{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | | 5.25 | V |
| V_{IH} High-level input voltage | 2 | | | 2 | | | V | | |
| V_{IL} Low-level input voltage | 0.5 | | | 0.6 | | | V | | |
| V_{OH} High-level output voltage | 5.5 | | | 5.5 | | | V | | |
| I_{OL} Low-level output current | 12 | | | 24 | | | mA | | |
| | | | | 48 § | | | | | |
| T_A Operating free-air temperature | – 55 | | | 125 | | | 0 | 70 | °C |

§ The 48 mA limit applies for the SN74LS641-1, SN74LS642-1, and SN74LS644-1 only.

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

| PARAMETER | TEST CONDITIONS † | SN54LS641 SN54LS642 SN54LS644 | | | SN74LS641 SN74LS642 SN74LS644 | | | UNIT |
|-------------------------------------|--|--|---|-------|-------------------------------------|-------|-------|---------------|
| | | MIN | TYP ‡ | MAX | MIN | TYP ‡ | MAX | |
| | | V_{IK} | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$ | – 1.5 | | | – 1.5 | |
| Hysteresis ($V_{T+} - V_{T-}$) | $V_{CC} = \text{MIN}, A \text{ or } B \text{ input}$ | 0.1 | 0.4 | | 0.2 | 0.4 | | V |
| I_{OH} | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}, V_{OH} = 5.5 \text{ V}$ | 0.1 | | | 0.1 | | | mA |
| V_{OL} | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}$ | $I_{OL} = 12 \text{ mA}$ | 0.25 | 0.4 | 0.25 | 0.4 | V | |
| | | $I_{OL} = 24 \text{ mA}$ | | | | 0.35 | | 0.5 |
| | | $I_{OL} = 48 \text{ mA} §$ | | | | 0.4 | | 0.5 |
| I_I | A or B | $V_{CC} = \text{MAX}$ | $V_I = 5.5 \text{ V}$ | 0.1 | | | 0.1 | mA |
| | DIR or \bar{G} | | $V_I = 7 \text{ V}$ | 0.1 | | | 0.1 | |
| I_{IH} | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ | 20 | | | 20 | | | μA |
| I_{IL} | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ | – 0.4 | | | – 0.4 | | | mA |
| I_{CC} | Outputs high | $V_{CC} = \text{MAX},$ Outputs open | 48 | 70 | 48 | 70 | mA | |
| | Outputs low | | 62 | 90 | 62 | 90 | | |
| | Outputs at Hi-Z | | 64 | 95 | 64 | 95 | | |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ \text{C}$.

§ The 48 mA condition applies for the SN74LS641-1, SN74LS642-1, and SN74LS644-1 only.



SN54LS641, SN54LS642, SN54LS644
 SN74LS641, SN74LS642, SN74LS644
 OCTAL BUS TRANSCEIVERS WITH OPEN-COLLECTOR OUTPUTS

SDLS189 - APRIL 1979 - REVISED MARCH 1988

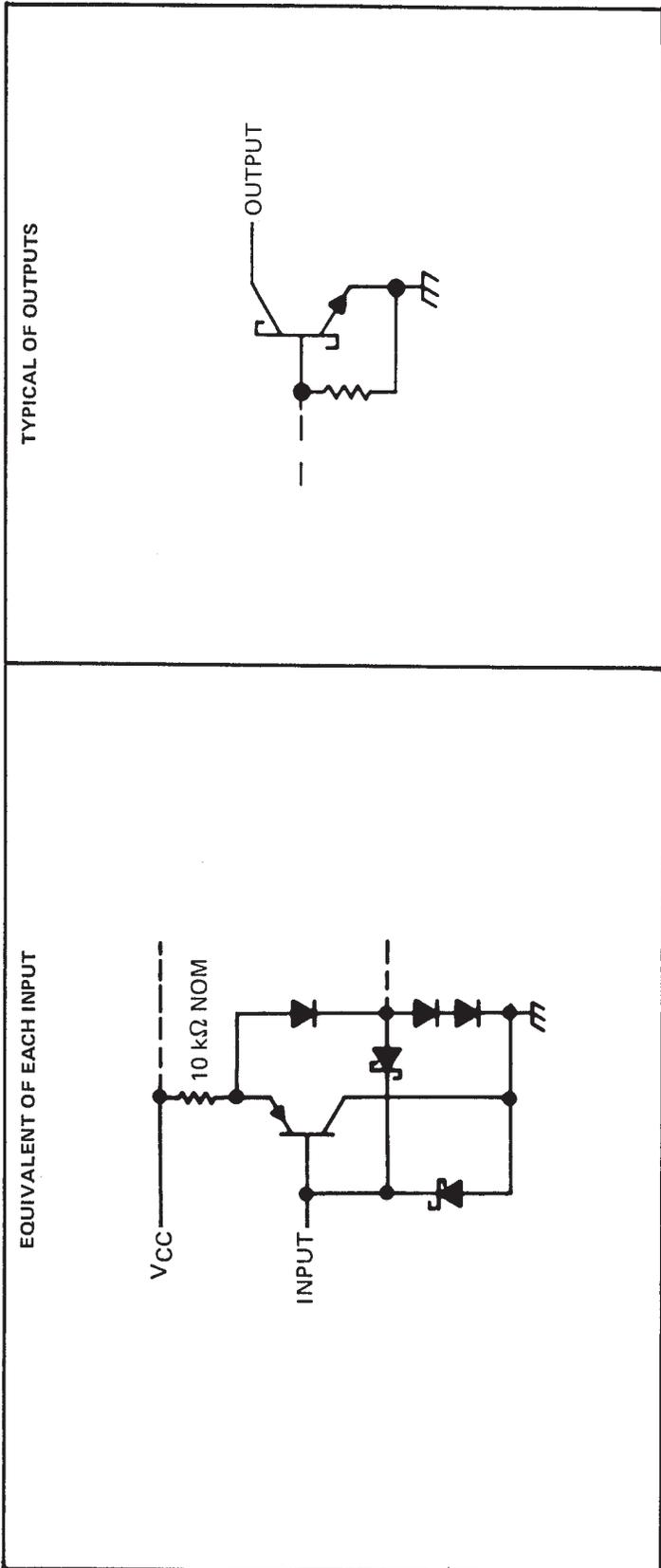
switching characteristics at $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | 'LS641, 'LS641-1 | | 'LS642, 'LS642-1 | | 'LS644, 'LS644-1 | | UNIT |
|---|-----------------|-------------|------------------|-----|------------------|-----|------------------|-----|------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t _{PLH} Propagation delay time, low-to-high-level output | A | B | 17 | 25 | 19 | 25 | 17 | 25 | ns |
| | B | A | 17 | 25 | 19 | 25 | 19 | 25 | |
| t _{PHL} Propagation delay time, high-to-low-level output | A | B | 16 | 25 | 14 | 25 | 14 | 25 | ns |
| | B | A | 16 | 25 | 14 | 25 | 16 | 25 | |
| t _{PLH} Output disable time from low level | \bar{G} , DIR | A | 23 | 40 | 26 | 40 | 26 | 40 | ns |
| | \bar{G} , DIR | B | 25 | 40 | 28 | 40 | 25 | 40 | |
| t _{PHL} Output enable time from high level | \bar{G} , DIR | A | 34 | 50 | 43 | 60 | 43 | 60 | ns |
| | \bar{G} , DIR | B | 37 | 50 | 39 | 60 | 37 | 50 | |

TEST CONDITIONS
 $C_L = 45\text{ pF}$,
 $R_L = 667\ \Omega$,
 See Note 2

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs



PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-8416101VRA | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 5962-8416101VSA | ACTIVE | CFP | W | 20 | 1 | TBD | A42 | N / A for Pkg Type |
| 5962-8416101VSA | ACTIVE | CFP | W | 20 | 1 | TBD | A42 | N / A for Pkg Type |
| 84161012A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 84161012A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 8416101RA | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 8416101RA | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| 8416101SA | ACTIVE | CFP | W | 20 | 1 | TBD | A42 | N / A for Pkg Type |
| 8416101SA | ACTIVE | CFP | W | 20 | 1 | TBD | A42 | N / A for Pkg Type |
| SN54LS640J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| SN54LS640J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| SN54LS645J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| SN54LS645J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| SN74LS640-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640-1DWR | OBSOLETE | SOIC | DW | 20 | | TBD | Call TI | Call TI |
| SN74LS640-1DWR | OBSOLETE | SOIC | DW | 20 | | TBD | Call TI | Call TI |
| SN74LS640-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640-1NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640-1NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640-1NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640-1NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74LS640DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS640N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS640NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS640NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS640NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS641-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS641-1N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS641-1N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS641-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS641-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free | CU NIPDAU | N / A for Pkg Type |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| (RoHS) | | | | | | | | |
| SN74LS641DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS641N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS641N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS641N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS641NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS641NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS641NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS641NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS642-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS642-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS642-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74LS642DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS642N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS642NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS642NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS642NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS642NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS644-1N | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS644-1N | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS644N | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS644N | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS645-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1DWR | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1DWRE4 | ACTIVE | SOIC | DW | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645-1N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645-1N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS645-1N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74LS645-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645-1NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645-1NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645-1NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645DW | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645DWE4 | ACTIVE | SOIC | DW | 20 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645DWR | OBSOLETE | SOIC | DW | 20 | | TBD | Call TI | Call TI |
| SN74LS645DWR | OBSOLETE | SOIC | DW | 20 | | TBD | Call TI | Call TI |
| SN74LS645N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645N | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS645N3 | OBSOLETE | PDIP | N | 20 | | TBD | Call TI | Call TI |
| SN74LS645NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645NE4 | ACTIVE | PDIP | N | 20 | 20 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS645NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645NSR | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS645NSRE4 | ACTIVE | SO | NS | 20 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SNJ54LS640FK | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| SNJ54LS640FK | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| SNJ54LS640J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| SNJ54LS640J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| SNJ54LS640W | ACTIVE | CFP | W | 20 | 1 | TBD | A42 | N / A for Pkg Type |
| SNJ54LS640W | ACTIVE | CFP | W | 20 | 1 | TBD | A42 | N / A for Pkg Type |
| SNJ54LS645FK | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| SNJ54LS645FK | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| SNJ54LS645J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SNJ54LS645J | ACTIVE | CDIP | J | 20 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| SNJ54LS645W | OBSOLETE | CFP | W | 20 | | TBD | Call TI | Call TI |
| SNJ54LS645W | OBSOLETE | CFP | W | 20 | | TBD | Call TI | Call TI |

⁽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), Pb-Free (RoHS Exempt), 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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

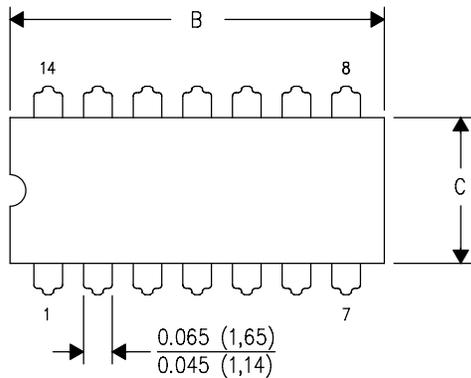
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. 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.

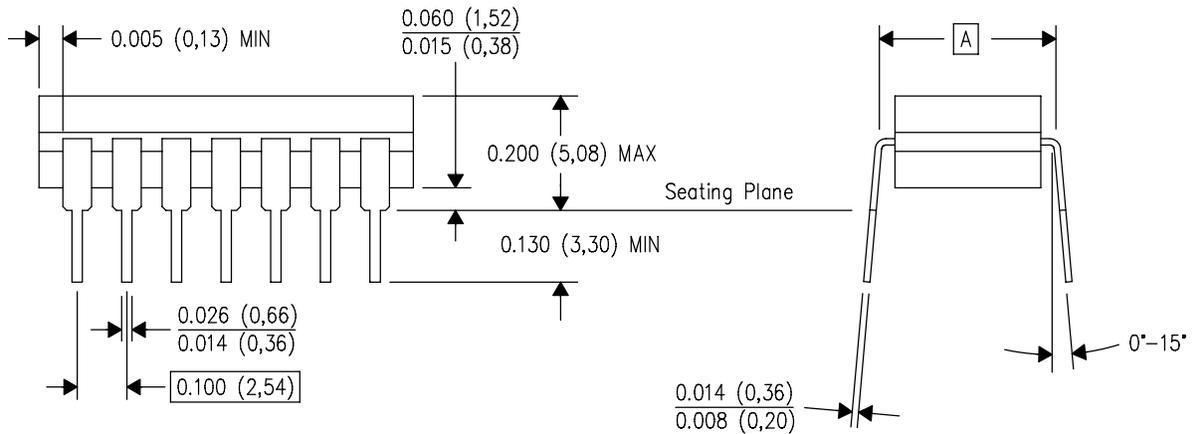
J (R-GDIP-T**)

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) |

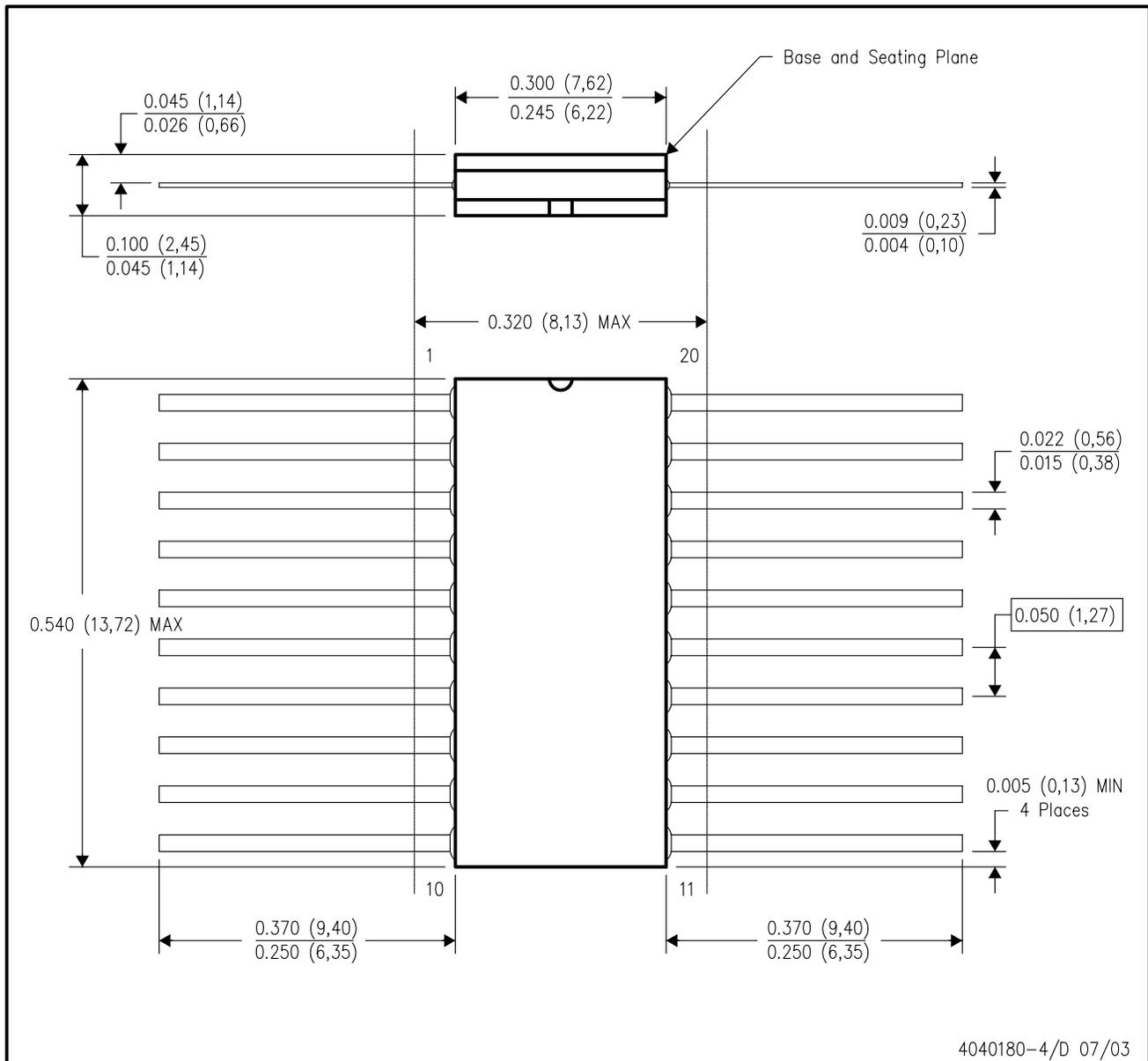


4040083/F 03/03

- 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

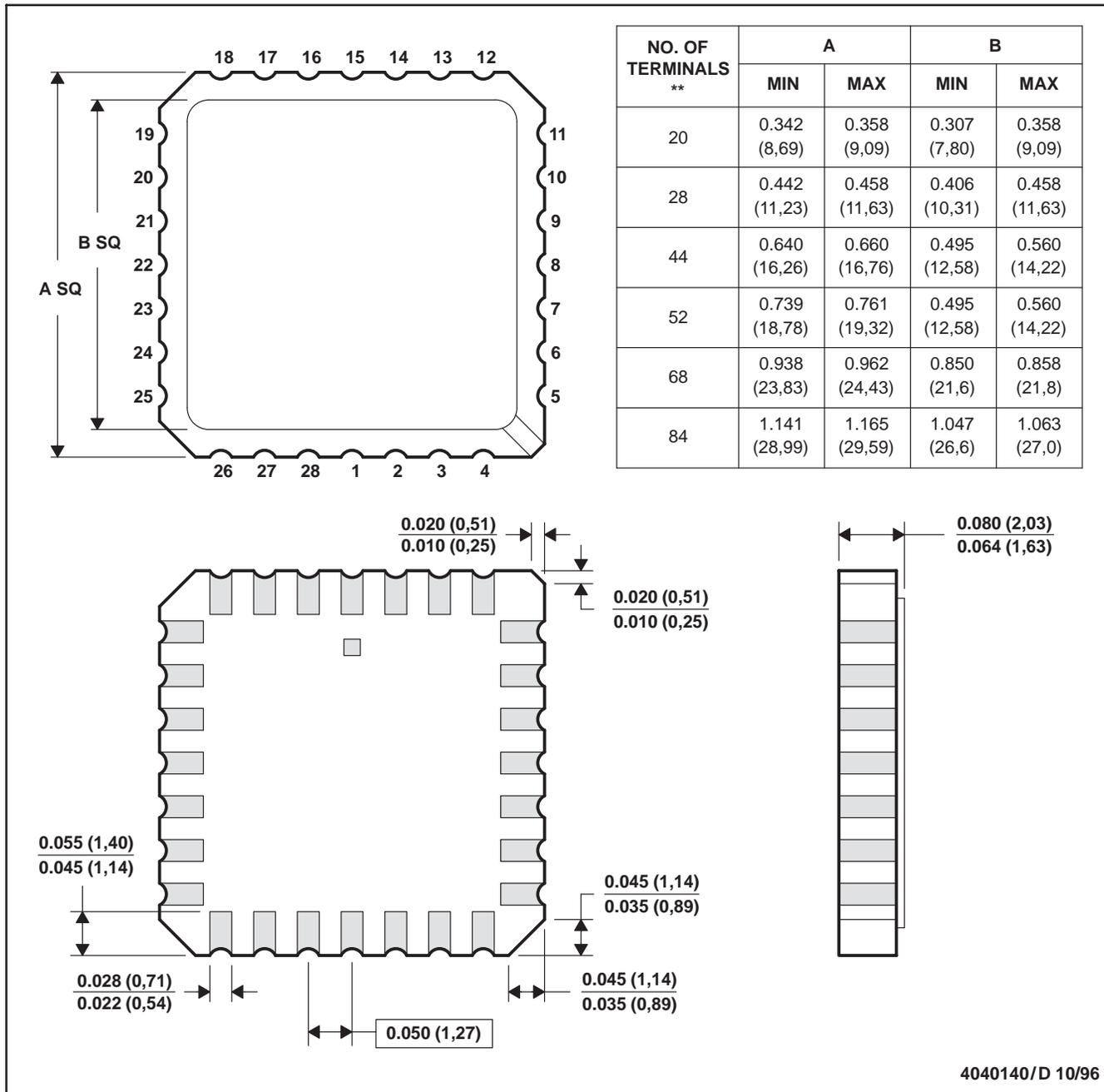


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within Mil-Std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

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN

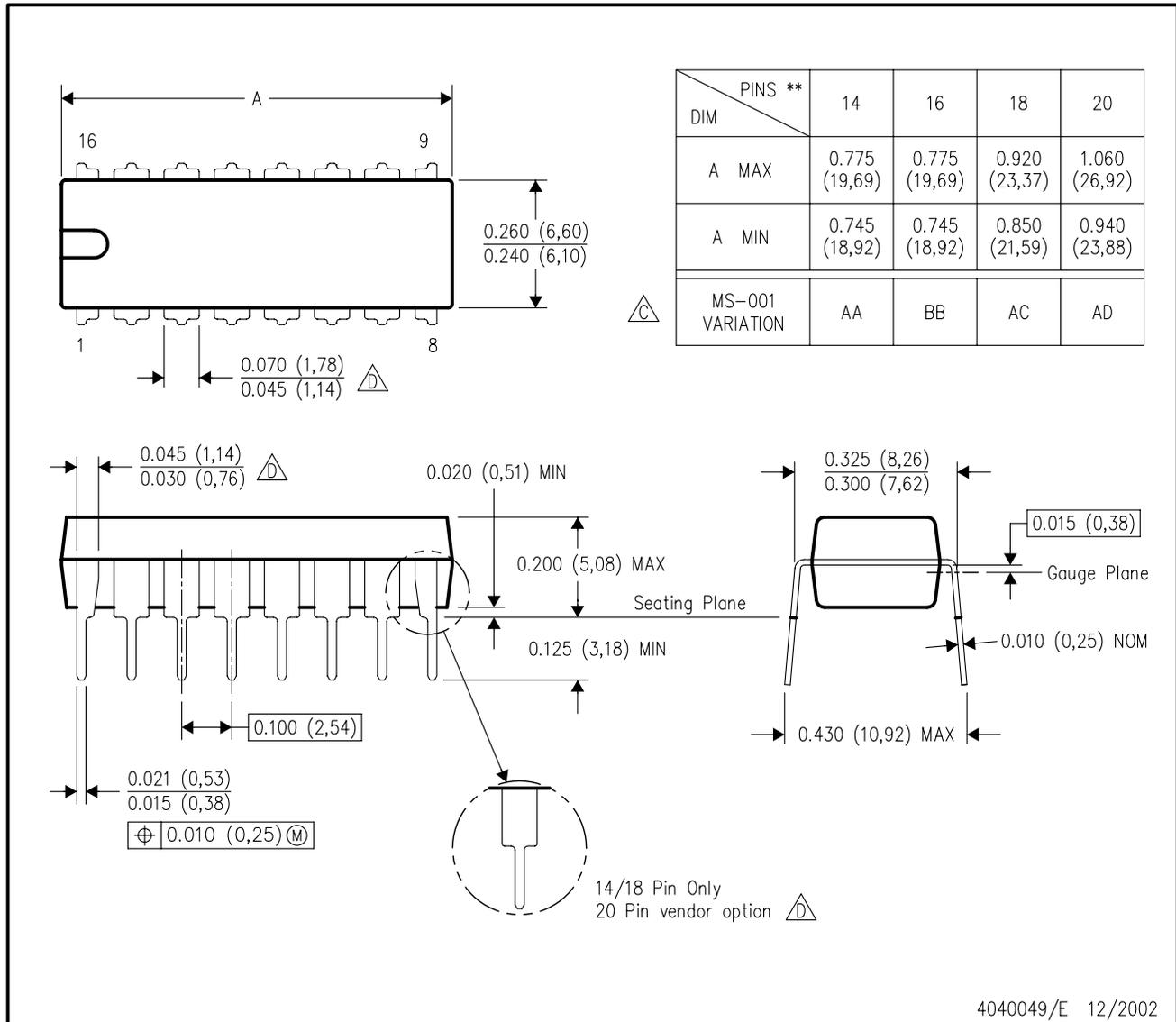


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a metal lid.
 - D. The terminals are gold plated.
 - E. Falls within JEDEC MS-004

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

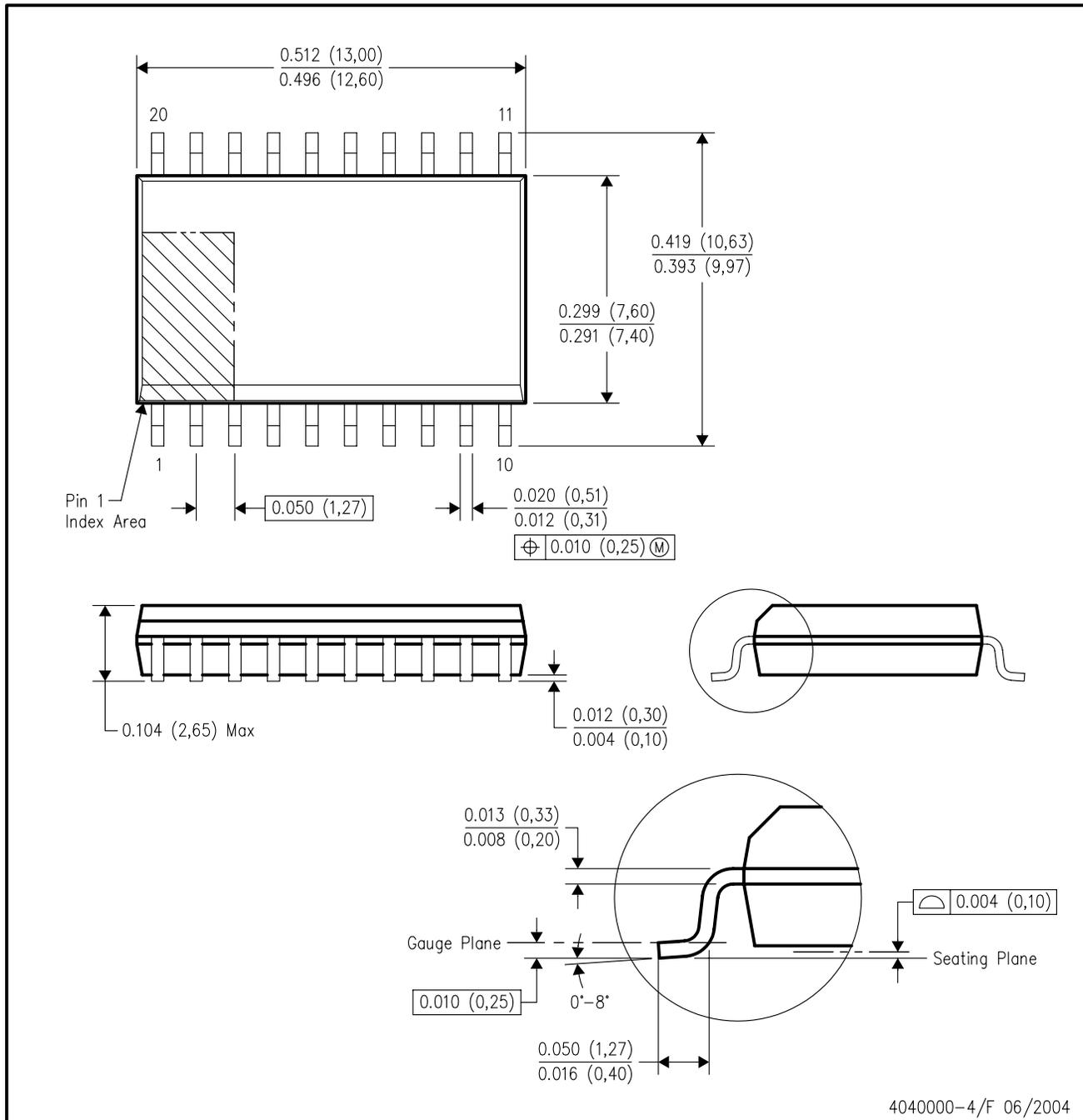
16 PINS SHOWN



- 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.

DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE



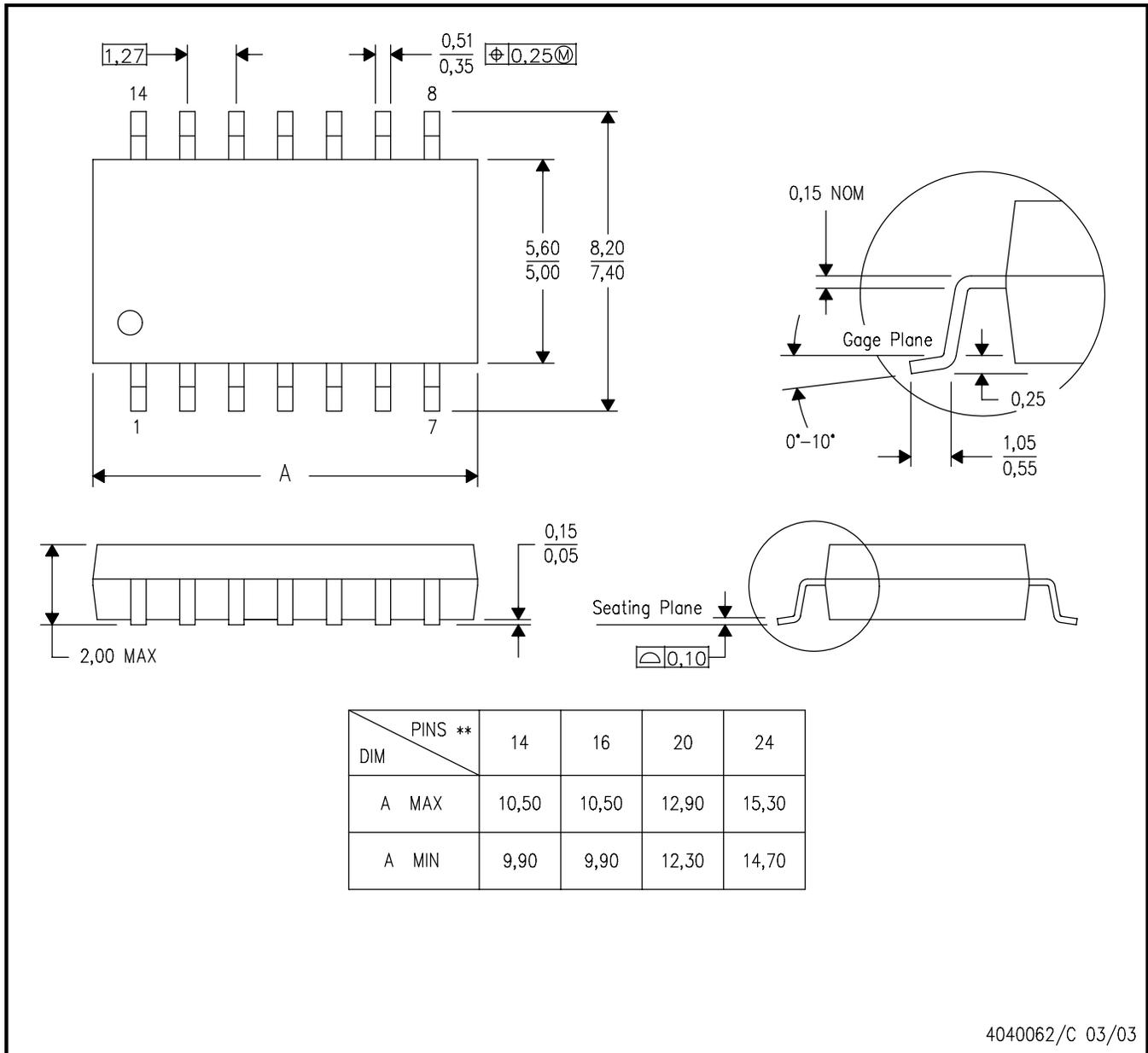
- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation AC.

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.

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 |
| Low Power Wireless | www.ti.com/lpw | 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