

SN54ALS21A, SN54AS21, SN74ALS21A, SN74AS21 DUAL 4-INPUT POSITIVE-AND GATES

SDAS085B – APRIL 1982 – REVISED DECEMBER 1994

- Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

description

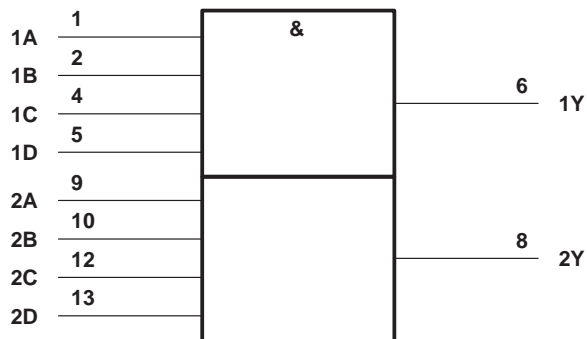
These devices contain two independent 4-input positive-AND gates. They perform the Boolean functions $Y = A \cdot B \cdot C \cdot D$ or $Y = \overline{A} + \overline{B} + \overline{C} + \overline{D}$ in positive logic.

The SN54ALS21A and SN54AS21 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ALS21A and SN74AS21 are characterized for operation from 0°C to 70°C .

FUNCTION TABLE
(each gate)

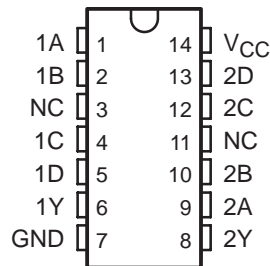
| INPUTS | | | | OUTPUT Y |
|--------|---|---|---|-------------|
| A | B | C | D | |
| H | H | H | H | H |
| L | X | X | X | L |
| X | L | X | X | L |
| X | X | L | X | L |
| X | X | X | L | L |

logic symbol†

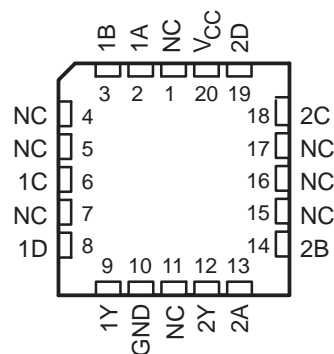


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the D, J, and N packages.

SN54ALS21A, SN54AS21 . . . J PACKAGE
SN74ALS21A, SN74AS21 . . . D OR N PACKAGE
(TOP VIEW)

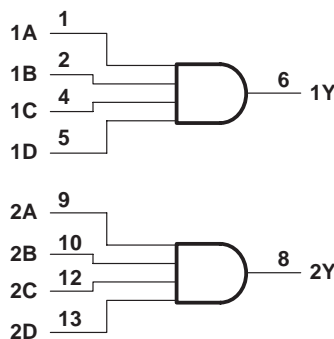


SN54ALS21A, SN54AS21 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

logic diagram (positive logic)



SN54ALS21A, SN54AS21, SN74ALS21A, SN74AS21 DUAL 4-INPUT POSITIVE-AND GATES

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

| | |
|--|----------------|
| Supply voltage, V_{CC} | 7 V |
| Input voltage, V_I | 7 V |
| Operating free-air temperature range, T_A : SN54ALS21A | -55°C to 125°C |
| SN74ALS21A | 0°C to 70°C |
| Storage temperature range | -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.

recommended operating conditions

| | SN54ALS21A | | | SN74ALS21A | | | UNIT |
|--------------------------------------|------------|-----|------|------------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.5 | 5 | 5.5 | V |
| V_{IH} High-level input voltage | 2 | | | 2 | | | V |
| V_{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I_{OH} High-level output current | | | -0.4 | | | -0.4 | mA |
| I_{OL} Low-level output current | | | 4 | | | 8 | mA |
| T_A Operating free-air temperature | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS | | SN54ALS21A | | | SN74ALS21A | | | UNIT |
|-----------|--|------------------------|--------------|------|------|--------------|------|------|------|
| | | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V_{IK} | $V_{CC} = 4.5\text{ V}$, $I_I = -18\text{ mA}$ | | | | -1.5 | | | -1.5 | V |
| V_{OH} | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$, $I_{OH} = -0.4\text{ mA}$ | | $V_{CC} - 2$ | | | $V_{CC} - 2$ | | | V |
| V_{OL} | $V_{CC} = 4.5\text{ V}$ | $I_{OL} = 4\text{ mA}$ | 0.25 | 0.4 | | 0.25 | 0.4 | | V |
| | | $I_{OL} = 8\text{ mA}$ | | | | 0.35 | 0.5 | | |
| I_I | $V_{CC} = 5.5\text{ V}$, | $V_I = 7\text{ V}$ | | 0.1 | | | 0.1 | | mA |
| I_{IH} | $V_{CC} = 5.5\text{ V}$, | $V_I = 2.7\text{ V}$ | | 20 | | | 20 | | μA |
| I_{IL} | $V_{CC} = 5.5\text{ V}$, | $V_I = 0.4\text{ V}$ | | -0.1 | | | -0.1 | | mA |
| $I_{OS}§$ | $V_{CC} = 5.5\text{ V}$, | $V_O = 2.25\text{ V}$ | -20 | | -112 | -30 | | -112 | mA |
| I_{CCH} | $V_{CC} = 5.5\text{ V}$, | $V_I = 4.5\text{ V}$ | | 0.85 | 1.4 | | 0.85 | 1.4 | mA |
| I_{CCL} | $V_{CC} = 5.5\text{ V}$, | $V_I = 0$ | | 1.4 | 2.3 | | 1.4 | 2.3 | mA |

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

§ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS} .

switching characteristics (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$, $C_L = 50\text{ pF}$, $R_L = 500\ \Omega$, $T_A = \text{MIN to MAX}^\ddagger$ | | | | UNIT |
|-----------|---------------|-------------|---|-----|------------|-----|------|
| | | | SN54ALS21A | | SN74ALS21A | | |
| | | | MIN | MAX | MIN | MAX | |
| t_{PLH} | A, B, C, or D | Y | 4 | 18 | 4 | 15 | ns |
| t_{PHL} | | | 2 | 15 | 2 | 10 | |

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



SN54ALS21A, SN54AS21, SN74ALS21A, SN74AS21 DUAL 4-INPUT POSITIVE-AND GATES

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

| | |
|--|----------------|
| Supply voltage, V_{CC} | 7 V |
| Input voltage, V_I | 7 V |
| Operating free-air temperature range, T_A : SN54AS21 | -55°C to 125°C |
| SN74AS21 | 0°C to 70°C |
| Storage temperature range | -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.

recommended operating conditions

| | | SN54AS21 | | | SN74AS21 | | | UNIT |
|----------|--------------------------------|----------|-----|-----|----------|-----|-----|------|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} | Supply voltage | 4.5 | 5 | 5.5 | 4.5 | 5 | 5.5 | V |
| V_{IH} | High-level input voltage | 2 | | | 2 | | | V |
| V_{IL} | Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I_{OH} | High-level output current | | | -2 | | | -2 | mA |
| I_{OL} | Low-level output current | | | 20 | | | 20 | mA |
| T_A | Operating free-air temperature | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS | SN54AS21 | | | SN74AS21 | | | UNIT |
|-----------|--|--------------|------|------|--------------|------|------|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V_{IK} | $V_{CC} = 4.5\text{ V}$, $I_I = -18\text{ mA}$ | | | -1.2 | | | -1.2 | V |
| V_{OH} | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$, $I_{OH} = -2\text{ mA}$ | $V_{CC} - 2$ | | | $V_{CC} - 2$ | | | V |
| V_{OL} | $V_{CC} = 4.5\text{ V}$, $I_{OL} = 20\text{ mA}$ | 0.35 | 0.5 | | 0.35 | 0.5 | | V |
| I_I | $V_{CC} = 5.5\text{ V}$, $V_I = 7\text{ V}$ | | 0.1 | | | 0.1 | | mA |
| I_{IH} | $V_{CC} = 5.5\text{ V}$, $V_I = 2.7\text{ V}$ | | 20 | | | 20 | | μA |
| I_{IL} | $V_{CC} = 5.5\text{ V}$, $V_I = 0.4\text{ V}$ | | -0.5 | | | -0.5 | | mA |
| $I_{OS}§$ | $V_{CC} = 5.5\text{ V}$, $V_O = 2.25\text{ V}$ | -30 | -112 | | -30 | -112 | | mA |
| I_{CCH} | $V_{CC} = 5.5\text{ V}$, $V_I = 4.5\text{ V}$ | | 2.9 | 4.6 | | 2.9 | 4.6 | mA |
| I_{CCL} | $V_{CC} = 5.5\text{ V}$, $V_I = 0$ | | 7.4 | 12 | | 7.4 | 12 | mA |

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

§ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS} .

switching characteristics (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$, $C_L = 50\text{ pF}$, $R_L = 500\ \Omega$, $T_A = \text{MIN to MAX}¶$ | | | | UNIT |
|-----------|---------------|-------------|---|-----|----------|-----|------|
| | | | SN54AS21 | | SN74AS21 | | |
| | | | MIN | MAX | MIN | MAX | |
| t_{PLH} | A, B, C, or D | Y | 1 | 6.5 | 1 | 6 | ns |
| t_{PHL} | | | 1 | 6.5 | 1 | 6 | |

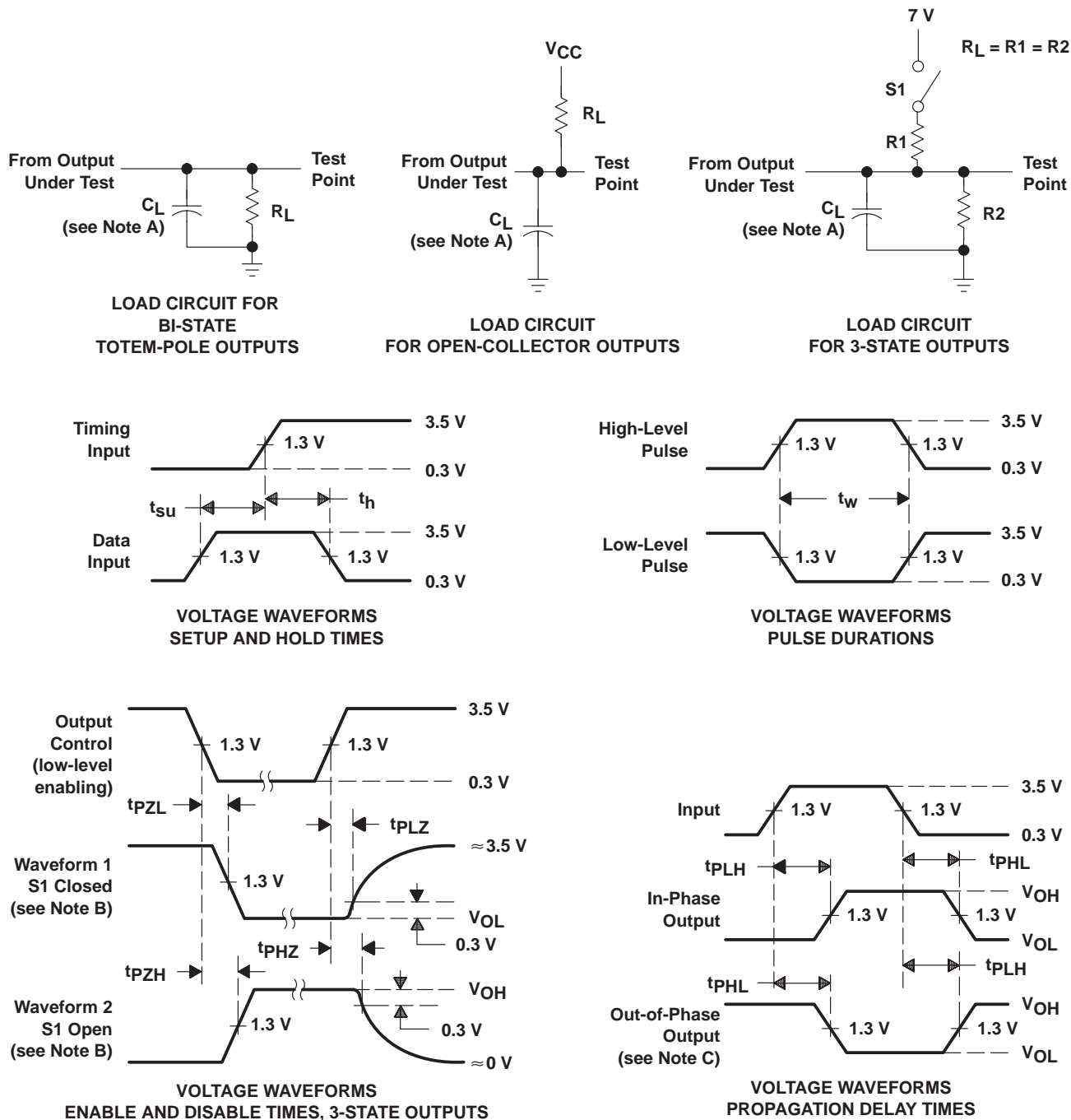
¶ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



SN54ALS21A, SN54AS21, SN74ALS21A, SN74AS21 DUAL 4-INPUT POSITIVE-AND GATES

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PARAMETER MEASUREMENT INFORMATION SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.
 D. All input pulses have the following characteristics: $PRR \leq 1$ MHz, $t_r = t_f = 2$ ns, duty cycle = 50%.
 E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms



PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|------------------|--------------------------------------|----------------------|--------------|--------------------------------|---------|
| 84143012A | ACTIVE | LCCC | FK | 20 | 55 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 84143012A SNJ54ALS 21AFK | Samples |
| 8414301CA | ACTIVE | CDIP | J | 14 | 25 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8414301CA SNJ54ALS21AJ | Samples |
| SN54ALS21AJ | ACTIVE | CDIP | J | 14 | 25 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | SN54ALS21AJ | Samples |
| SN74ALS21AD | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI | 0 to 70 | ALS21A | |
| SN74ALS21ADR | ACTIVE | SOIC | D | 14 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | ALS21A | Samples |
| SN74ALS21AN | ACTIVE | PDIP | N | 14 | 25 | RoHS & Green | NIPDAU | N / A for Pkg Type | 0 to 70 | SN74ALS21AN | Samples |
| SN74ALS21ANSR | ACTIVE | SO | NS | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | ALS21A | Samples |
| SN74AS21D | ACTIVE | SOIC | D | 14 | 50 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | AS21 | Samples |
| SN74AS21N | ACTIVE | PDIP | N | 14 | 25 | RoHS & Green | NIPDAU | N / A for Pkg Type | 0 to 70 | SN74AS21N | Samples |
| SN74AS21NS | OBSOLETE | SO | NS | 14 | | TBD | Call TI | Call TI | | 74AS21 | |
| SN74AS21NSR | ACTIVE | SO | NS | 14 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | 74AS21 | Samples |
| SNJ54ALS21AFK | ACTIVE | LCCC | FK | 20 | 55 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 84143012A SNJ54ALS 21AFK | Samples |
| SNJ54ALS21AJ | ACTIVE | CDIP | J | 14 | 25 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 8414301CA SNJ54ALS21AJ | Samples |

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF SN54ALS21A, SN74ALS21A :

- Catalog : [SN74ALS21A](#)
- Military : [SN54ALS21A](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74ALS21ADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74ALS21ANSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74AS21NSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74ALS21ADR | SOIC | D | 14 | 2500 | 356.0 | 356.0 | 35.0 |
| SN74ALS21ANSR | SO | NS | 14 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74AS21NSR | SO | NS | 14 | 2000 | 356.0 | 356.0 | 35.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|---------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 84143012A | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |
| SN74ALS21AN | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74ALS21AN | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74AS21D | D | SOIC | 14 | 50 | 506.6 | 8 | 3940 | 4.32 |
| SN74AS21N | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74AS21N | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SNJ54ALS21AFK | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |



D0014A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

EXAMPLE BOARD LAYOUT

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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.

GENERIC PACKAGE VIEW

FK 20

LCCC - 2.03 mm max height

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4229370VA\

J 14

GENERIC PACKAGE VIEW
CDIP - 5.08 mm max height
CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4040083-5/G

J0014A



PACKAGE OUTLINE

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



4214771/A 05/2017

NOTES:

1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.

EXAMPLE BOARD LAYOUT

J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE: 5X



4214771/A 05/2017

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.

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