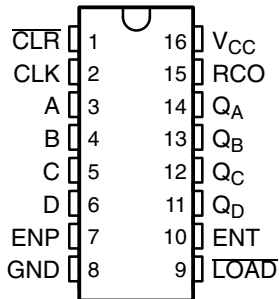


SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

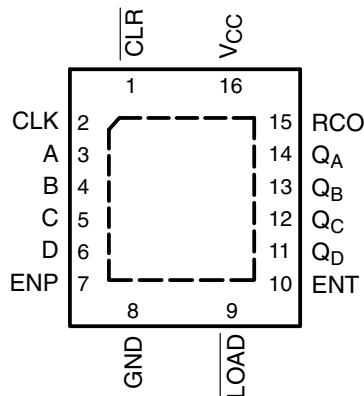
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- 2-V to 5.5-V V_{CC} Operation
- Max t_{pd} of 9.5 ns at 5 V
- Typical V_{OLP} (Output Ground Bounce) < 0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot) > 2.3 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Support Mixed-Mode Voltage Operation on All Ports
- Internal Look Ahead for Fast Counting
- Carry Output for n-Bit Cascading
- Synchronous Counting
- Synchronously Programmable
- I_{off} Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

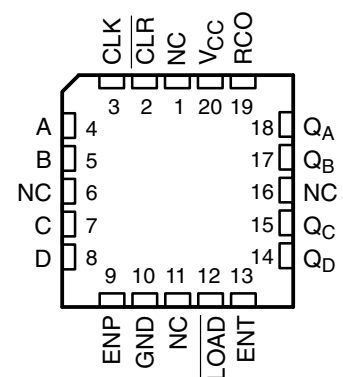
SN54LV163A . . . J OR W PACKAGE
SN74LV163A . . . D, DB, DGV, NS,
OR PW PACKAGE
(TOP VIEW)



SN74LV163A . . . RGY PACKAGE
(TOP VIEW)



SN54LV163A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

ORDERING INFORMATION

| T_A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|--------------|----------------|-----------------------|------------------|
| –40°C to 85°C | QFN – RGY | Reel of 1000 | SN74LV163ARGYR | LV163A |
| | SOIC – D | Tube of 40 | SN74LV163AD | LV163A |
| | | Reel of 2500 | SN74LV163ADR | |
| | SOP – NS | Reel of 2000 | SN74LV163ANSR | 74LV163A |
| | SSOP – DB | Reel of 2000 | SN74LV163ADBR | LV163A |
| | TSSOP – PW | Tube of 90 | SN74LV163APW | LV163A |
| | | Reel of 2000 | SN74LV163APWR | |
| Reel of 250 | | SN74LV163APWT | | |
| TVSOP – DGV | Reel of 2000 | SN74LV163ADGVR | LV163A | |
| –55°C to 125°C | CDIP – J | Tube of 25 | SNJ54LV163AJ | SNJ54LV163AJ |
| | CFP – W | Tube of 150 | SNJ54LV163AW | SNJ54LV163AW |
| | LCCC – FK | Tube of 55 | SNJ54LV163AFK | SNJ54LV163AFK |

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



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 **TEXAS
INSTRUMENTS**

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SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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description/ordering information (continued)

The 'LV163A devices are 4-bit synchronous binary counters designed for 2-V to 5.5-V V_{CC} operation.

These synchronous, presettable counters feature an internal carry look ahead for application in high-speed counting designs. The 'LV163A devices are 4-bit binary counters. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when instructed by the count-enable (ENP, ENT) inputs and internal gating. This mode of operation eliminates the output counting spikes normally associated with synchronous (ripple-clock) counters. A buffered clock (CLK) input triggers the four flip-flops on the rising (positive-going) edge of the clock waveform.

These counters are fully programmable; that is, they can be preset to any number between 0 and 9 or 15. As presetting is synchronous, setting up a low level at the load input disables the counter and causes the outputs to agree with the setup data after the next clock pulse, regardless of the levels of the enable inputs.

The clear function for the 'LV163A devices is synchronous. A low level at the clear (\overline{CLR}) input sets all four of the flip-flop outputs low after the next low-to-high transition of CLK, regardless of the levels of the enable inputs. This synchronous clear allows the count length to be modified easily by decoding the Q outputs for the maximum count desired. The active-low output of the gate used for decoding is connected to \overline{CLR} to synchronously clear the counter to 0000 (LLLL).

The carry look-ahead circuitry provides for cascading counters for n-bit synchronous applications without additional gating. ENP, ENT, and a ripple-carry output (RCO) are instrumental in accomplishing this function. Both ENP and ENT must be high to count, and ENT is fed forward to enable RCO. Enabling RCO produces a high-level pulse while the count is maximum (9 or 15 with Q_A high). This high-level overflow ripple-carry pulse can be used to enable successive cascaded stages. Transitions at ENP or ENT are allowed, regardless of the level of CLK.

These counters feature a fully independent clock circuit. Changes at control inputs (ENP, ENT, or \overline{LOAD}) that modify the operating mode have no effect on the contents of the counter until clocking occurs. The function of the counter (whether enabled, disabled, loading, or counting) is dictated solely by the conditions meeting the stable setup and hold times.

These devices are fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down.

FUNCTION TABLE

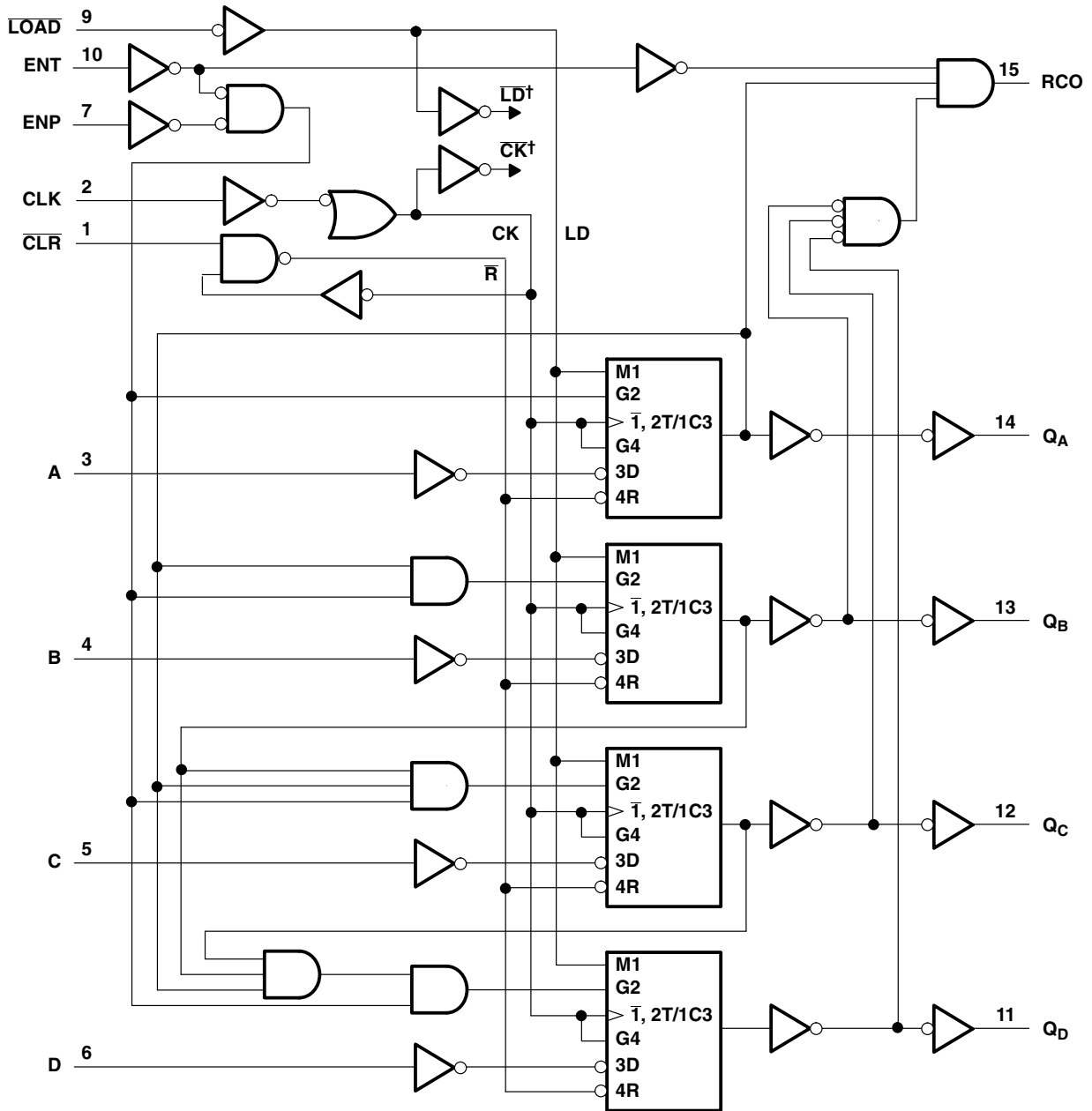
| INPUTS | | | | | OUTPUTS | | | | FUNCTION |
|------------------|-------------------|-----|-----|-----|-----------------|----|----|----|--------------|
| \overline{CLR} | \overline{LOAD} | ENP | ENT | CLK | \overline{QA} | QB | QC | QD | |
| L | X | X | X | X | L | L | L | L | Reset to "0" |
| H | L | X | X | | A | B | C | D | Preset data |
| H | H | X | L | | No change | | | | No count |
| H | H | L | X | | No change | | | | No count |
| H | H | H | H | | Count up | | | | Count |
| H | X | X | X | | No change | | | | No count |



SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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logic diagram (positive logic)



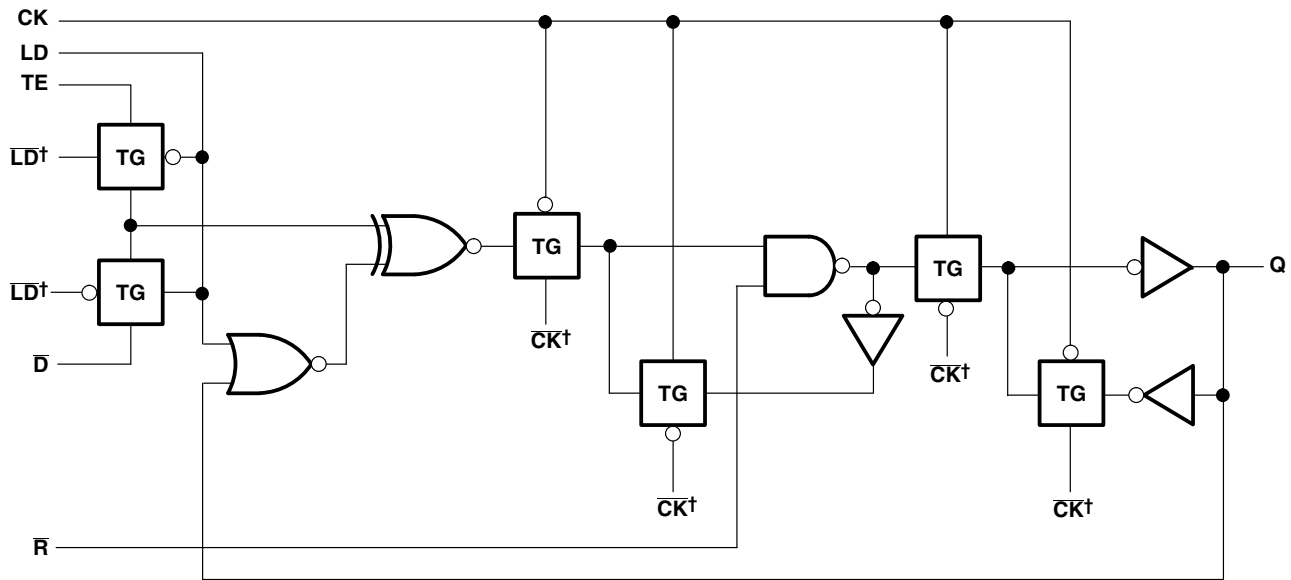
[†] For simplicity, routing of complementary signals \overline{LD} and \overline{CK} is not shown on this overall logic diagram. The uses of these signals are shown on the logic diagram of the D/T flip-flops.

Pin numbers shown are for the D, DB, DGV, J, NS, PW, RGY, and W packages.

SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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logic diagram, each D/T flip-flop (positive logic)

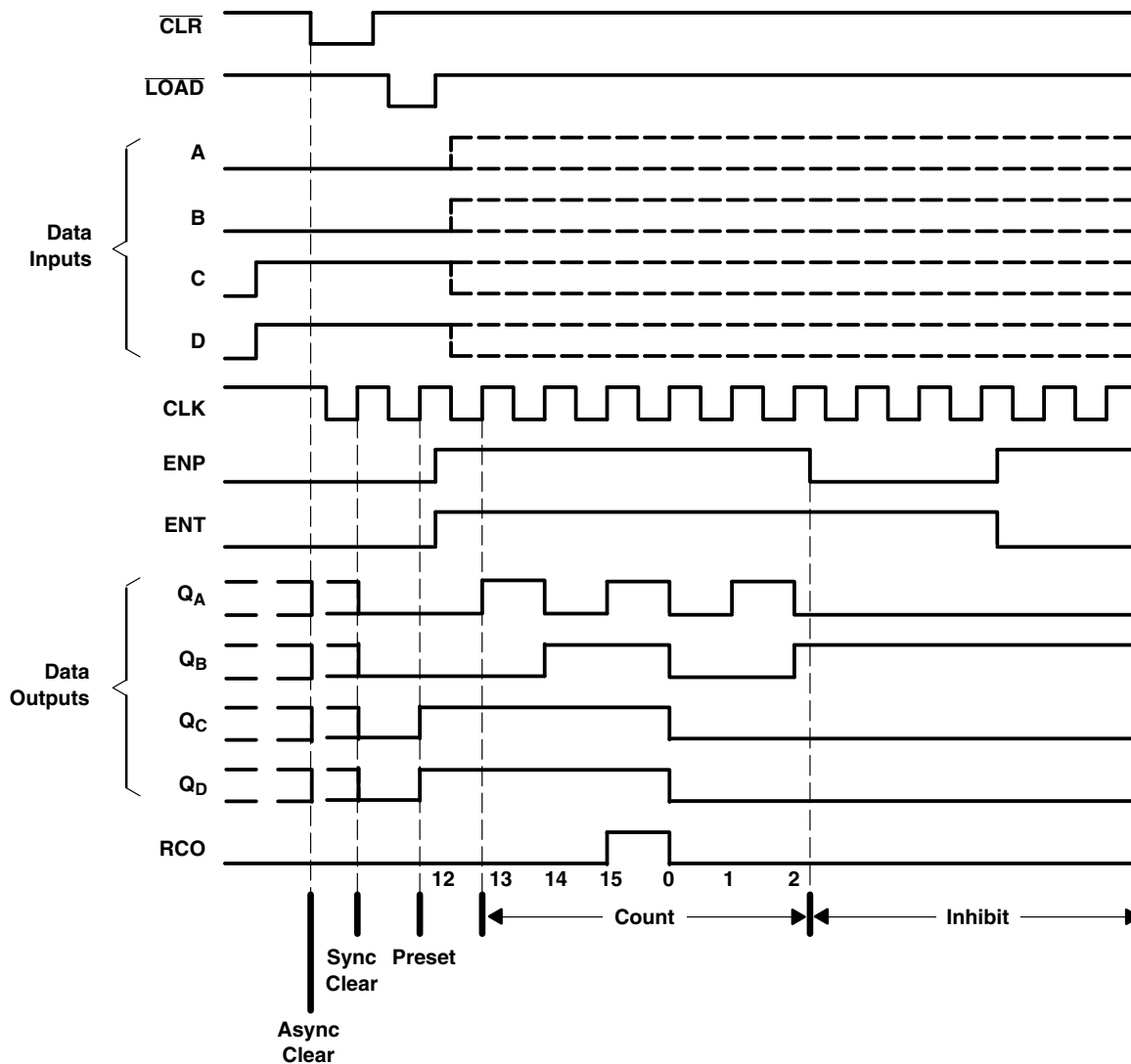


† The origins of \overline{LD} and \overline{CK} are shown in the overall logic diagram of the device.

typical clear, preset, count, and inhibit sequence

The following sequence is illustrated below:

1. Clear outputs to zero (synchronous)
2. Preset to binary 12
3. Count to 13, 14, 15, 0, 1, and 2
4. Inhibit



SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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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) | -0.5 V to 7 V |
| Output voltage range applied in high or low state, V_O (see Notes 1 and 2) | -0.5 V to $V_{CC} + 0.5$ V |
| Voltage range applied to any output in the power-off state, V_O (see Note 1) | -0.5 V to 7 V |
| Input clamp current, I_{IK} ($V_I < 0$) | -20 mA |
| Output clamp current, I_{OK} ($V_O < 0$) | -50 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ± 25 mA |
| Continuous current through V_{CC} or GND | ± 50 mA |
| Package thermal impedance, θ_{JA} (see Note 3): D package | 73°C/W |
| (see Note 3): DB package | 82°C/W |
| (see Note 3): DGV package | 120°C/W |
| (see Note 3): NS package | 64°C/W |
| (see Note 3): PW package | 108°C/W |
| (see Note 4): RGY package | 39°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 negative-voltage ratings may be exceeded if the input and output current ratings are observed.
 2. This value is limited to 5.5 V maximum.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.
 4. The package thermal impedance is calculated in accordance with JESD 51-5.



SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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recommended operating conditions (see Note 5)

| | | SN54LV163A | | SN74LV163A | | UNIT |
|---------------------|------------------------------------|---|---------------------|---------------------|---------------------|--------------------|
| | | MIN | MAX | MIN | MAX | |
| V_{CC} | Supply voltage | 2 | 5.5 | 2 | 5.5 | V |
| V_{IH} | High-level input voltage | $V_{CC} = 2\text{ V}$ | 1.5 | 1.5 | | V |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | $V_{CC} \times 0.7$ | $V_{CC} \times 0.7$ | | |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | $V_{CC} \times 0.7$ | $V_{CC} \times 0.7$ | | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | $V_{CC} \times 0.7$ | $V_{CC} \times 0.7$ | | |
| V_{IL} | Low-level input voltage | $V_{CC} = 2\text{ V}$ | | 0.5 | 0.5 | V |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | | $V_{CC} \times 0.3$ | $V_{CC} \times 0.3$ | |
| V_I | Input voltage | 0 | 5.5 | 0 | 5.5 | V |
| V_O | Output voltage | 0 | V_{CC} | 0 | V_{CC} | V |
| I_{OH} | High-level output current | $V_{CC} = 2\text{ V}$ | | -50 | -50 | μA |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | | -2 | -2 | mA |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | | -6 | -6 | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | | -12 | -12 | |
| I_{OL} | Low-level output current | $V_{CC} = 2\text{ V}$ | | 50 | 50 | μA |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | | 2 | 2 | mA |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | | 6 | 6 | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | | 12 | 12 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | | 200 | 200 | ns/V |
| | | $V_{CC} = 3\text{ V to }3.6\text{ V}$ | | 100 | 100 | |
| | | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | | 20 | 20 | |
| T_A | Operating free-air temperature | -55 | 125 | -40 | 85 | $^{\circ}\text{C}$ |

NOTE 5: 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} | SN54LV163A | | | SN74LV163A | | | UNIT |
|-----------|--|--------------|--------------|-----|---------|--------------|-----|---------|---------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{OH} | $I_{OH} = -50\ \mu\text{A}$ | 2 V to 5.5 V | $V_{CC}-0.1$ | | | $V_{CC}-0.1$ | | | V |
| | $I_{OH} = -2\ \text{mA}$ | 2.3 V | 2 | | | 2 | | | |
| | $I_{OH} = -6\ \text{mA}$ | 3 V | 2.48 | | | 2.48 | | | |
| | $I_{OH} = -12\ \text{mA}$ | 4.5 V | 3.8 | | | 3.8 | | | |
| V_{OL} | $I_{OL} = 50\ \mu\text{A}$ | 2 V to 5.5 V | | | 0.1 | | | 0.1 | V |
| | $I_{OL} = 2\ \text{mA}$ | 2.3 V | | | 0.4 | | | 0.4 | |
| | $I_{OL} = 6\ \text{mA}$ | 3 V | | | 0.44 | | | 0.44 | |
| | $I_{OL} = 12\ \text{mA}$ | 4.5 V | | | 0.55 | | | 0.55 | |
| I_I | $V_I = 5.5\text{ V or GND}$ | 0 to 5.5 V | | | ± 1 | | | ± 1 | μA |
| I_{CC} | $V_I = V_{CC}\text{ or GND, } I_O = 0$ | 5.5 V | | | 20 | | | 20 | μA |
| I_{off} | $V_I\text{ or }V_O = 0\text{ to }5.5\text{ V}$ | 0 | | | 5 | | | 5 | μA |
| C_i | $V_I = V_{CC}\text{ or GND}$ | 3.3 V | | 1.8 | | | 1.8 | | pF |

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SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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timing requirements over recommended operating free-air temperature range, $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see Figure 1)

| | | $T_A = 25^\circ\text{C}$ | | SN54LV163A | | SN74LV163A | | UNIT |
|----------|--|------------------------------|-----|------------|-----|------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w | Pulse duration, CLK high or low | 7 | | 7 | | 7 | | ns |
| t_{su} | Setup time before CLK \uparrow | $\overline{\text{CLR}}$ | 6 | 6 | | 6 | | ns |
| | | Data (A, B, C, and D) | 7.5 | 8.5 | | 8.5 | | |
| | | ENP, ENT | 9.5 | 11 | | 11 | | |
| | | $\overline{\text{LOAD}}$ low | 10 | 11.5 | | 11.5 | | |
| t_h | Hold time, all synchronous inputs after CLK \uparrow | 1.5 | | 1.5 | | 1.5 | | ns |

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

| | | $T_A = 25^\circ\text{C}$ | | SN54LV163A | | SN74LV163A | | UNIT |
|----------|--|------------------------------|-----|------------|-----|------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w | Pulse duration, CLK high or low | 5 | | 5 | | 5 | | ns |
| t_{su} | Setup time before CLK \uparrow | $\overline{\text{CLR}}$ | 4 | 4 | | 4 | | ns |
| | | Data (A, B, C, and D) | 5.5 | 6.5 | | 6.5 | | |
| | | ENP, ENT | 7.5 | 9 | | 9 | | |
| | | $\overline{\text{LOAD}}$ low | 8 | 9.5 | | 9.5 | | |
| t_h | Hold time, all synchronous inputs after CLK \uparrow | 1 | | 1 | | 1 | | ns |

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

| | | $T_A = 25^\circ\text{C}$ | | SN54LV163A | | SN74LV163A | | UNIT |
|----------|--|------------------------------|-----|------------|-----|------------|-----|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_w | Pulse duration, CLK high or low | 5 | | 5 | | 5 | | ns |
| t_{su} | Setup time before CLK \uparrow | $\overline{\text{CLR}}$ | 3.5 | 3.5 | | 3.5 | | ns |
| | | Data (A, B, C, and D) | 4.5 | 4.5 | | 4.5 | | |
| | | ENP, ENT | 5 | 6 | | 6 | | |
| | | $\overline{\text{LOAD}}$ low | 5 | 6 | | 6 | | |
| t_h | Hold time, all synchronous inputs after CLK \uparrow | 1 | | 1 | | 1 | | ns |

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SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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switching characteristics over recommended operating free-air temperature range, $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A = 25^\circ\text{C}$ | | | SN54LV163A | | SN74LV163A | | UNIT |
|------------|--------------|-------------------|----------------------|--------------------------|-------|-----|------------|-------|------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| f_{\max} | | | $C_L = 15\text{ pF}$ | 50* | 115* | | 40* | | 40 | | MHz |
| | | | $C_L = 50\text{ pF}$ | 30 | 90 | | 25 | | 25 | | |
| t_{pd} | CLK | Q | $C_L = 15\text{ pF}$ | 8.5* | 16.2* | | 1* | 19.5* | 1 | 19.5 | ns |
| | | RCO (count mode) | | 9.1* | 17* | | 1* | 20.5* | 1 | 20.5 | |
| | | RCO (preset mode) | | 12.1* | 20.6* | | 1* | 24.5* | 1 | 24.5 | |
| | ENT | RCO | | 8.7* | 15.7* | | 1* | 19* | 1 | 19 | |
| t_{pd} | CLK | Q | $C_L = 50\text{ pF}$ | 11 | 19.2 | | 1 | 22.5 | 1 | 22.5 | ns |
| | | RCO (count mode) | | 11.9 | 20 | | 1 | 23.5 | 1 | 23.5 | |
| | | RCO (preset mode) | | 14.6 | 23.6 | | 1 | 27.5 | 1 | 27.5 | |
| | ENT | RCO | | 11.7 | 18.7 | | 1 | 22 | 1 | 22 | |

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

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A = 25^\circ\text{C}$ | | | SN54LV163A | | SN74LV163A | | UNIT |
|------------|--------------|-------------------|----------------------|--------------------------|-------|-----|------------|-------|------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| f_{\max} | | | $C_L = 15\text{ pF}$ | 80* | 160* | | 70* | | 70 | | MHz |
| | | | $C_L = 50\text{ pF}$ | 55 | 125 | | 50 | | 50 | | |
| t_{pd} | CLK | Q | $C_L = 15\text{ pF}$ | 6.2* | 12.8* | | 1* | 15* | 1 | 15 | ns |
| | | RCO (count mode) | | 6.8* | 13.6* | | 1* | 16* | 1 | 16 | |
| | | RCO (preset mode) | | 8.8* | 17.2* | | 1* | 20* | 1 | 20 | |
| | ENT | RCO | | 6.5* | 12.3* | | 1* | 14.5* | 1 | 14.5 | |
| t_{pd} | CLK | Q | $C_L = 50\text{ pF}$ | 8 | 16.3 | | 1 | 18.5 | 1 | 18.5 | ns |
| | | RCO (count mode) | | 8.8 | 17.1 | | 1 | 19.5 | 1 | 19.5 | |
| | | RCO (preset mode) | | 10.7 | 20.7 | | 1 | 23.5 | 1 | 23.5 | |
| | ENT | RCO | | 8.2 | 15.8 | | 1 | 18 | 1 | 18 | |

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

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SN54LV163A, SN74LV163A 4-BIT SYNCHRONOUS BINARY COUNTERS

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A = 25^\circ\text{C}$ | | | SN54LV163A | | SN74LV163A | | UNIT |
|------------|--------------|-------------------|----------------------|--------------------------|-------|-----|------------|------|------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| f_{\max} | | | $C_L = 15\text{ pF}$ | 135* | 210* | | 115* | | 115 | | MHz |
| | | | $C_L = 50\text{ pF}$ | 95 | 160 | | 85 | | 85 | | |
| t_{pd} | CLK | Q | $C_L = 15\text{ pF}$ | 4.7* | 8.1* | | 1* | 9.5* | 1 | 9.5 | ns |
| | | RCO (count mode) | | 5.2* | 8.1* | | 1* | 9.5* | 1 | 9.5 | |
| | | RCO (preset mode) | | 6.4* | 10.3* | | 1* | 12* | 1 | 12 | |
| | ENT | RCO | | 4.9* | 8.1* | | 1* | 9.5* | 1 | 9.5 | |
| t_{pd} | CLK | Q | $C_L = 50\text{ pF}$ | 6.1 | 10.1 | | 1 | 11.5 | 1 | 11.5 | ns |
| | | RCO (count mode) | | 6.6 | 10.1 | | 1 | 11.5 | 1 | 11.5 | |
| | | RCO (preset mode) | | 7.8 | 12.3 | | 1 | 14 | 1 | 14 | |
| | ENT | RCO | | 6.3 | 10.1 | | 1 | 11.5 | 1 | 11.5 | |

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

noise characteristics, $V_{CC} = 3.3\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 6)

| PARAMETER | | SN74LV163A | | | UNIT |
|-------------|--|------------|------|------|------|
| | | MIN | TYP | MAX | |
| $V_{OL(P)}$ | Quiet output, maximum dynamic V_{OL} | | 0.3 | 0.8 | V |
| $V_{OL(V)}$ | Quiet output, minimum dynamic V_{OL} | | -0.2 | -0.8 | V |
| $V_{OH(V)}$ | Quiet output, minimum dynamic V_{OH} | | 3 | | V |
| $V_{IH(D)}$ | High-level dynamic input voltage | 2.31 | | | V |
| $V_{IL(D)}$ | Low-level dynamic input voltage | | 0.99 | | V |

NOTE 6: Characteristics are for surface-mount packages only.

operating characteristics, $T_A = 25^\circ\text{C}$

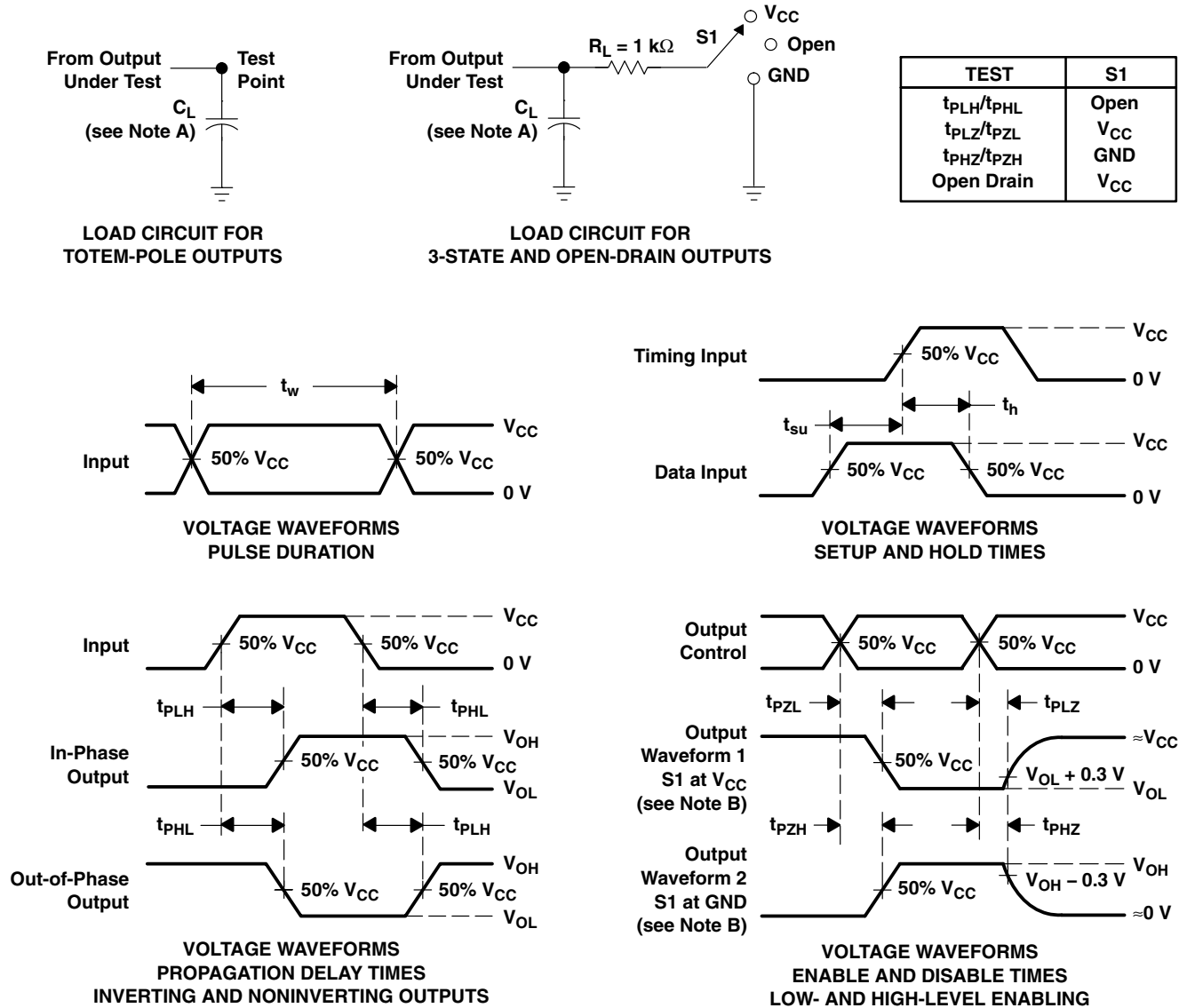
| PARAMETER | | TEST CONDITIONS | V_{CC} | TYP | UNIT |
|-----------|-------------------------------|--|----------|------|------|
| C_{pd} | Power dissipation capacitance | $C_L = 50\text{ pF}$, $f = 10\text{ MHz}$ | 3.3 V | 23.8 | pF |
| | | | 5 V | 26 | |

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



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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. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} .
 - G. t_{PHL} and t_{PLH} are the same as t_{pd} .
 - H. 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 finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LV163AD | ACTIVE | SOIC | D | 16 | 40 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163ADBR | ACTIVE | SSOP | DB | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163ADGVR | ACTIVE | TVSOP | DGV | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163ADR | ACTIVE | SOIC | D | 16 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163ANSR | ACTIVE | SO | NS | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 74LV163A | Samples |
| SN74LV163APW | ACTIVE | TSSOP | PW | 16 | 90 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163APWR | ACTIVE | TSSOP | PW | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163APWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163APWT | ACTIVE | TSSOP | PW | 16 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV163A | Samples |
| SN74LV163ARGYR | ACTIVE | VQFN | RGY | 16 | 3000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | LV163A | 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.

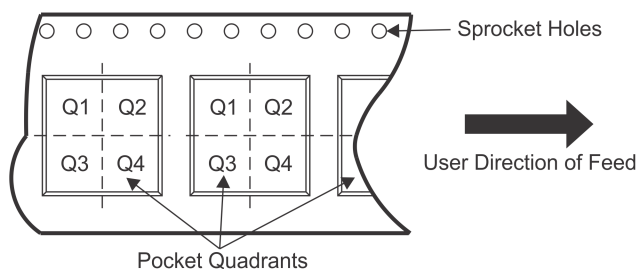
⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽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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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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LV163ADBR | SSOP | DB | 16 | 2000 | 330.0 | 16.4 | 8.35 | 6.6 | 2.4 | 12.0 | 16.0 | Q1 |
| SN74LV163ADGVR | TVSOP | DGV | 16 | 2000 | 330.0 | 12.4 | 6.8 | 4.0 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV163ADR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LV163ANSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74LV163APWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV163APWT | TSSOP | PW | 16 | 250 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV163ARGYR | VQFN | RGY | 16 | 3000 | 330.0 | 12.4 | 3.8 | 4.3 | 1.5 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV163ADBR | SSOP | DB | 16 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74LV163ADGVR | TVSOP | DGV | 16 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74LV163ADR | SOIC | D | 16 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74LV163ANSR | SO | NS | 16 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74LV163APWR | TSSOP | PW | 16 | 2000 | 853.0 | 449.0 | 35.0 |
| SN74LV163APWT | TSSOP | PW | 16 | 250 | 853.0 | 449.0 | 35.0 |
| SN74LV163ARGYR | VQFN | RGY | 16 | 3000 | 853.0 | 449.0 | 35.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|--------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN74LV163AD | D | SOIC | 16 | 40 | 507 | 8 | 3940 | 4.32 |
| SN74LV163APW | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |



PACKAGE OUTLINE

NS0016A

SOP - 2.00 mm max height

SOP



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 0.25 mm, per side.

EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:7X

4220735/A 12/2021

NOTES: (continued)

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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4211283-4/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



4220204/A 02/2017

NOTES:

1. All linear dimensions are in millimeters. Any 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 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

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

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/A 02/2017

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.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 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 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

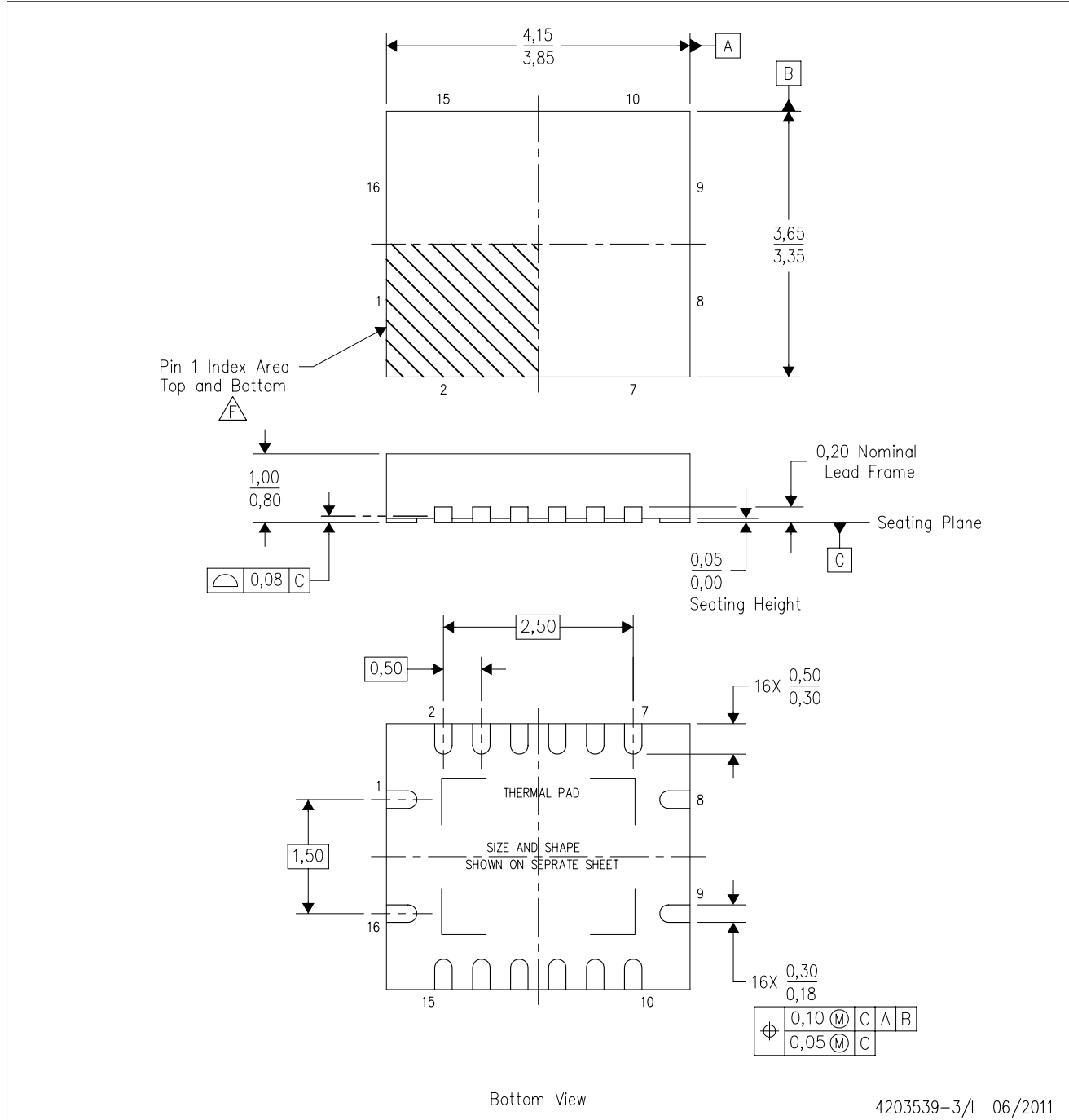
28 PINS SHOWN



- 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

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - F. Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - G. Package complies to JEDEC MO-241 variation BA.

RGY (R-PVQFN-N16)

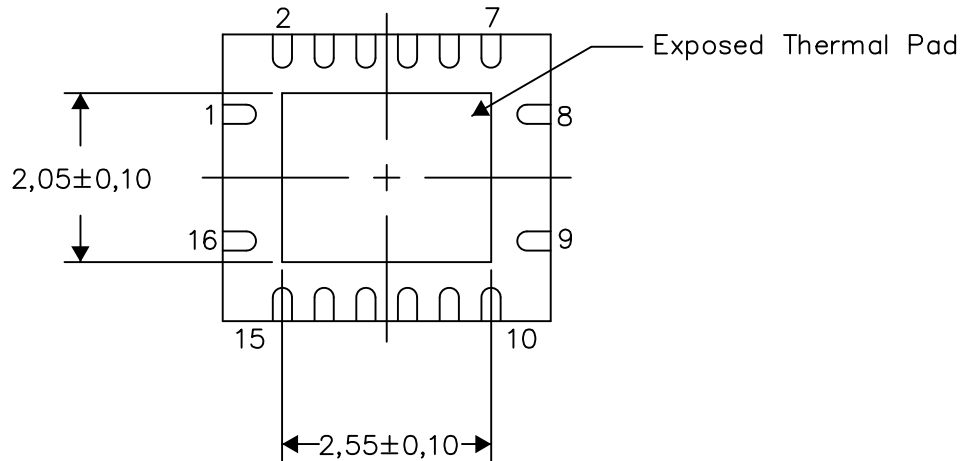
PLASTIC QUAD FLATPACK NO-LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

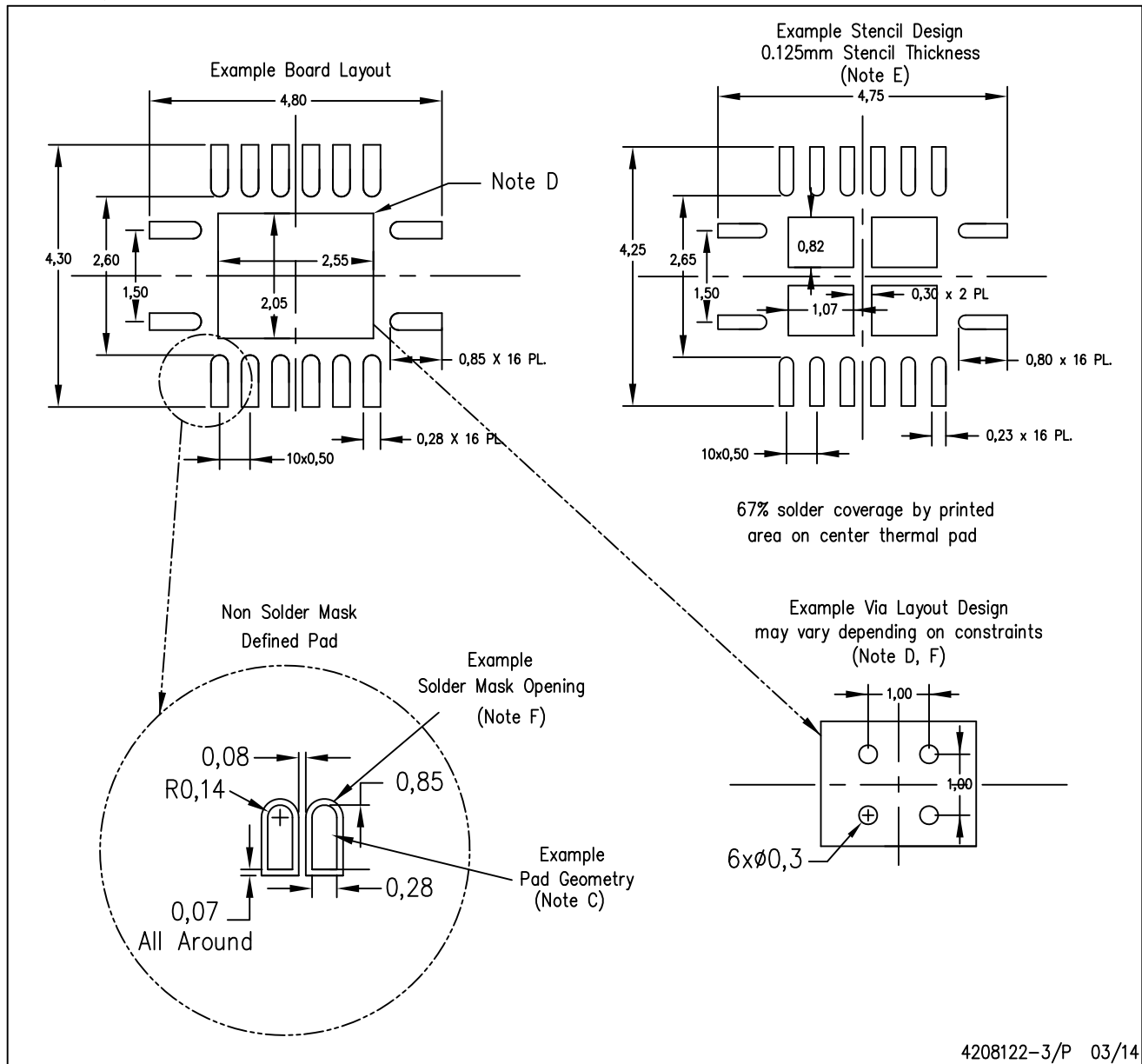
Exposed Thermal Pad Dimensions

4206353-3/P 03/14

NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4208122-3/P 03/14

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <<http://www.ti.com>>.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
 - F. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

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