

Description

The 74LVC244A provides two 4-bit line drivers with separate output-enable (\overline{OE}) inputs. When \overline{OE} is low, the device passes data from the A inputs to the Y outputs. When \overline{OE} is high, the outputs are in the high-impedance state.

The device is designed for operation with a power supply range of 1.65V to 3.6V.

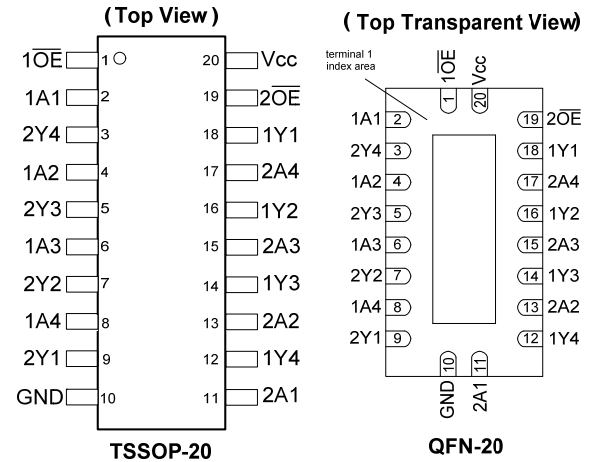
The inputs are tolerant to 5.5V allowing this device to be used in a mixed voltage environment. The device is fully specified for partial power down applications using I_{OFF} . The I_{OFF} circuitry disables the output preventing damaging current backflow when the device is powered down.

Features

- Supply Voltage Range from 1.65V to 3.6V
- Sinks or Sources 24ma at $V_{CC} = 3V$
- CMOS Low Power Consumption
- I_{OFF} Supports Partial - Power Down Operation
- Inputs or Outputs Accept up to 5.5V
- Inputs can be Driven by 3.3V or 5V Allowing for Mixed Voltage Applications
- Schmitt Trigger Action at All Inputs
- Typical V_{OLP} (Quiet Output Ground Bounce) Less than 0.8V with $V_{CC} = 3.3V$ and $T_A = +25^\circ C$
- Typical V_{OHV} (Quiet Output Dynamic VOH) Greater than 2.0V with $V_{CC} = 3.3V$ and $T_A = +25^\circ C$
- ESD Protection Tested per JESD 22
 - Exceeds 200-V Machine Model (A115)
 - Exceeds 2000-V Human Body Model (A114)
 - Exceeds 1000-V Charged Device Model (C101)
- Latch-Up Exceeds 250mA per JESD 78, Class I
- All devices are:
 - **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
 - **Halogen and Antimony Free. "Green" Device (Note 3)**

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
 2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen and Antimony free, "Green" and Lead-Free.
 3. Halogen and Antimony free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

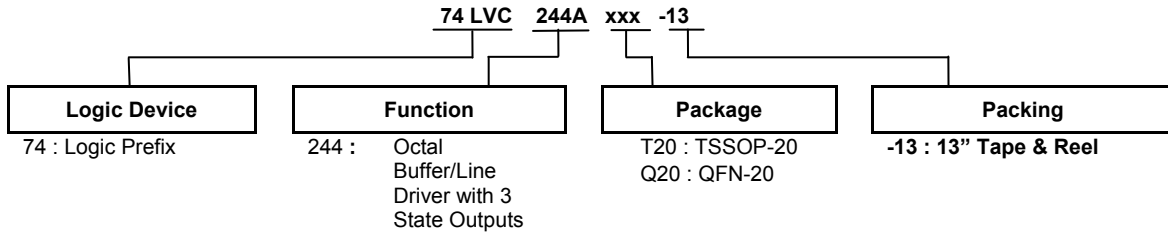
Pin Assignments



Applications

- General Purpose Logic
- Bus Driving
- Power Down Signal Isolation
- Wide array of products such as:
 - PCs, Notebooks, Netbooks, Ultrabooks
 - Networking Computer Peripherals, Hard Drives, CD/DVD ROM
 - TV, DVD, DVR, Set Top Box

Ordering Information



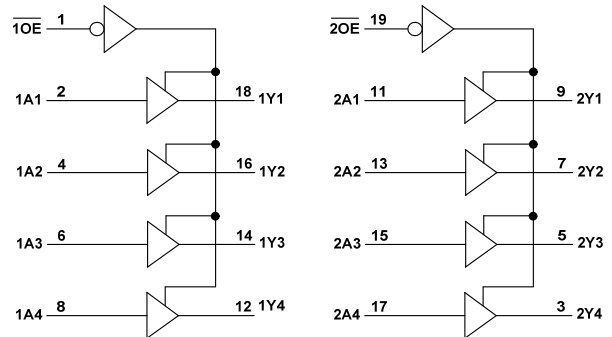
| Part Number | Package Code | Package (Note 4 & 5) | Package Size | 13" Tape and Reel | |
|-----------------|--------------|----------------------|--|-------------------|--------------------|
| | | | | Quantity | Part Number Suffix |
| 74LVC244AT20-13 | T20 | TSSOP-20 | 6.4mm X 6.5mm X 1.2mm 0.65 mm lead pitch | 2500/Tape & Reel | -13 |
| 74LVC244AQ20-13 | Q20 | V-QFN4525-20 | 2.5mm X 4.5mm X 0.95mm 0.50 mm lead pitch | 2500/Tape & Reel | -13 |

- Notes:
4. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.
 5. V-QFN4525-20 is a JEDEC recognized naming convention that specifies the package thickness category as V and the number 4525 describes the package as 4.5mm X 2.5mm.

Pin Descriptions

| Pin Number | Pin Name | Description |
|------------|------------------|-----------------|
| 1 | $\overline{1OE}$ | Output Enable 1 |
| 2 | 1A1 | Data Input |
| 3 | 2Y4 | Data Output |
| 4 | 1A2 | Data Input |
| 5 | 2Y3 | Data Output |
| 6 | 1A3 | Data Input |
| 7 | 2Y2 | Data Output |
| 8 | 1A4 | Data Input |
| 9 | 2Y1 | Data Output |
| 10 | GND | Ground |
| 11 | 2A1 | Data Input |
| 12 | 1Y4 | Data Output |
| 13 | 2A2 | Data Input |
| 14 | 1Y3 | Data Output |
| 15 | 2A3 | Data Input |
| 16 | 1Y2 | Data Output |
| 17 | 2A4 | Data Input |
| 18 | 1Y1 | Data Output |
| 19 | $\overline{2OE}$ | Output Enable 2 |
| 20 | V _{CC} | Supply Voltage |

Logic Diagram



Function Table

| (Each 4-Bit Buffer) | | |
|---------------------|---|--------|
| INPUTS | | OUTPUT |
| \overline{OE} | A | Y |
| L | H | H |
| L | L | L |
| H | X | Z |

Absolute Maximum Ratings (Notes 6 & 7)

| Symbol | Description | Rating | Unit |
|------------------|--|--------------|------|
| ESD HBM | Human Body Model ESD Protection | 2 | kV |
| ESD CDM | Charged Device Model ESD Protection | 1 | kV |
| ESD MM | Machine Model ESD Protection | 200 | V |
| V _{CC} | Supply Voltage Range | -0.5 to +7.0 | V |
| V _I | Input Voltage Range | -0.5 to +7.0 | V |
| I _{IK} | Input Clamp Current V _I < 0V | -20 | mA |
| I _{OK} | Output Clamp Current V _O < 0V | -50 | mA |
| I _O | Continuous Output Current -0.5V < V _O V _{CC} +0.5V | ±50 | mA |
| I _{CC} | Continuous Current Through V _{CC} | 100 | mA |
| I _{GND} | Continuous Current Through GND | -100 | mA |
| T _J | Operating Junction Temperature | -40 to +150 | °C |
| T _{STG} | Storage Temperature | -65 to +150 | °C |
| P _{TOT} | Total Power Dissipation | 500 | mW |

- Notes:
- Stresses beyond the absolute maximum may result in immediate failure or reduced reliability. These are stress values and device operation should be within recommend values.
 - Forcing the maximum allowed voltage could cause a condition exceeding the maximum current or conversely forcing the maximum current could cause a condition exceeding the maximum voltage. The ratings of both current and voltage must be maintained within the controlled range.

Recommended Operating Conditions (Note 8)

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------|------------------------------------|-------------------------|------|-----------------|------|
| V _{CC} | Supply Voltage | Operating | 1.65 | 3.6 | V |
| | | Data Retention Only | 1.5 | — | V |
| V _I | Input Voltage | — | 0 | 5.5 | V |
| V _O | Output Voltage | — | 0 | V _{CC} | V |
| I _{OH} | High-Level Output Current | V _{CC} = 1.65V | — | -4 | mA |
| | | V _{CC} = 2.3V | — | -8 | |
| | | V _{CC} = 2.7V | — | -12 | |
| | | V _{CC} = 3.0V | — | -24 | |
| I _{OL} | Low-Level Output Current | V _{CC} = 1.65V | — | 4 | mA |
| | | V _{CC} = 2.3V | — | 8 | |
| | | V _{CC} = 2.7V | — | 12 | |
| | | V _{CC} = 3.0V | — | 24 | |
| Δt/ΔV | Input Transition Rise or Fall Rate | — | — | 10 | ns/V |
| T _A | Operating Free-Air Temperature | — | -40 | +125 | °C |

- Note:
- Unused inputs should be held at V_{CC} or ground.

Electrical Characteristics

| Symbol | Parameter | Test Conditions | V _{CC} | T _A = -40°C to +85°C | | T _A = -40° to +125°C | | Unit | |
|------------------|--|--|---|---------------------------------|------------------------|---------------------------------|------------------------|------|----|
| | | | | Min | Max | Min | Max | | |
| V _{IH} | High-Level Input Voltage | | 1.65V to 1.95V | V _{CC} X 0.65 | — | V _{CC} X 0.65 | — | V | |
| | | | 2.3V to 2.7V | 1.7 | — | 1.7 | — | | |
| | | | 3.0V to 3.6V | 2 | — | 2 | — | | |
| V _{IL} | Low-Level input Voltage | | 1.65V to 1.95V | — | V _{CC} X 0.35 | — | V _{CC} X 0.35 | V | |
| | | | 2.3V to 2.7V | — | 0.7 | — | 0.7 | | |
| | | | 3.0V to 3.6V | — | 0.8 | — | 0.8 | | |
| V _{OH} | High-Level Output Voltage | I _{OH} = -50μA | 1.65V to 3.6V | V _{CC} -0.2 | — | V _{CC} -0.3 | — | V | |
| | | I _{OH} = -4mA | 1.65V | 1.2 | — | 1.05 | — | | |
| | | I _{OH} = -8mA | 2.3V | 1.7 | — | 1.65 | — | | |
| | | I _{OH} = -12mA | 2.7V | 2.2 | — | 2.05 | — | | |
| | | | 3.0V | 2.4 | — | 2.48 | — | | |
| | | I _{OH} = -24mA | 3.0V | 2.3 | — | 2.0 | — | | |
| V _{OL} | Low-Level Output Voltage | I _{OL} = 100μA | 1.65V to 3.6V | — | 0.2 | — | 0.3 | V | |
| | | I _{OL} = 4mA | 1.65V | — | 0.45 | — | 0.65 | | |
| | | I _{OL} = 8mA | 2.3V | — | 0.60 | — | 0.80 | | |
| | | I _{OL} = 12mA | 2.7V | — | 0.40 | — | 0.60 | | |
| | | I _{OL} = 24mA | 3.0V | — | 0.55 | — | 0.80 | | |
| I _{OFF} | Power Down Leakage Current | V _I or V _O = 0 or 5.5V | 0V | — | ±10 | — | 20 | μA | |
| I _I | Input Current Control Pins | V _I = GND or 5.5V | 0 to 3.6V | — | ±5 | — | ± 20 | μA | |
| I _{OZ} | Z-state Current including Input Current I/O Pins | V _I = GND or 5.5V V _O = 0 to 5.5V | 3.6V | — | ±5 | — | ± 20 | μA | |
| I _{CC} | Supply Current | V _I = GND or V _{CC} , I _O = 0 | 3.6V | — | 10 | — | 40 | μA | |
| ΔI _{CC} | Additional Supply Current | One input at V _{CC} -0.6V, I _O = 0A | 2.7V to 3.6V | — | 500 | — | 5000 | μA | |
| C _i | Input Capacitance | Control Pins | V _I = GND or V _{CC} | 0V to 3.6V | 4.0 typical | | 4.0 typical | | pF |
| | | I/O Pins | | | 5.5 typical | | 5.5 typical | | |

Switching Characteristics

| Symbol | Parameter | Test Conditions | V _{CC} | T _A = +25°C | | | T _A = -40° to +85°C | | T _A = -40° to +125°C | | Unit |
|--------------------|--|-----------------|-----------------|------------------------|------|------|--------------------------------|------|---------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{PD} | Propagation Delay A _N to Y _N | Figure 1 | 1.5V | 1 | 7 | 16.9 | 1 | 18.9 | 1 | 20.4 | ns |
| | | | 1.8V ± 0.15V | 1 | 6.0 | 11.4 | 1 | 11.3 | 1 | 12.4 | |
| | | | 2.5V ± 0.2V | 1 | 3.9 | 7.4 | 1 | 8.0 | 1 | 10.0 | |
| | | | 2.7V | 1 | 4.2 | 7.7 | 1 | 8.5 | 1 | 8.8 | |
| | | | 3.3V ± 0.3 | 1.5 | 3.8 | 7.3 | 1.5 | 7.7 | 1.5 | 7.9 | |
| t _{EN} | Enable Time \overline{OE} to Y _N | Figure 1 | 1.5V | 1 | 12.4 | 18.3 | 1 | 19.8 | 1 | 25.4 | ns |
| | | | 1.8V ± 0.15V | 1 | 6.4 | 12.1 | 1 | 12.6 | 1 | 14.1 | |
| | | | 2.5V ± 0.2V | 1 | 4.6 | 9.1 | 1 | 9.6 | 1 | 11.7 | |
| | | | 2.7V | 1 | 5 | 8.4 | 1 | 8.6 | 1 | 10.3 | |
| | | | 3.3V ± 0.3 | 1.5 | 4.5 | 7.4 | 1.5 | 7.6 | 1.5 | 9.4 | |
| t _{DIS} | Disable Time \overline{OE} to Y _N | Figure 1 | 1.5V | 1 | 7.2 | 15.6 | 1 | 16.1 | 1 | 17.6 | ns |
| | | | 1.8V ± 0.15V | 1 | 5.8 | 11.6 | 1 | 12.1 | 1 | 13.6 | |
| | | | 2.5V ± 0.2V | 1 | 3.7 | 7.3 | 1 | 7.8 | 1 | 9.9 | |
| | | | 2.7V | 1 | 3.8 | 6.6 | 1 | 6.8 | 1 | 8.6 | |
| | | | 3.3V ± 0.3 | 1.5 | 3.8 | 6.3 | 1.5 | 6.5 | 1.5 | 8 | |
| t _{sk(0)} | Output Skew Time | | 3.3V ± 0.3 | — | — | 1.0 | — | — | — | 1.5 | ns |

Operating Characteristics

 T_A = +25°C

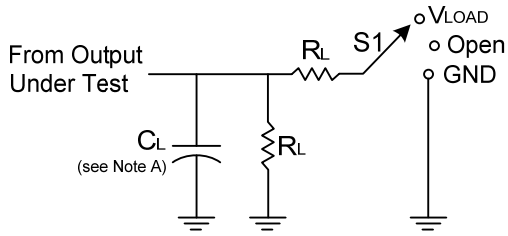
| Symbol | Parameter | Test Conditions | V _{CC} | Typ | Unit |
|-----------------|--|-------------------------------|-----------------|------|------|
| C _{pd} | Power dissipation capacitance per gate | F = 10 MHz Outputs Enabled | 1.8V ± 0.15V | 9.9 | pF |
| | | | 2.5V ± 0.2V | 10.2 | |
| | | | 3.3V ± 0.3V | 10.6 | |

Package Characteristics

| Symbol | Parameter | Package | Test Conditions | Min | Typ | Max | Unit |
|-----------------|--|--------------|-----------------|-----|-----|-----|------|
| θ _{JA} | Thermal Resistance Junction-to-Ambient | TSSOP-20 | (Note 9) | — | 74 | — | °C/W |
| θ _{JC} | Thermal Resistance Junction-to-Case | TSSOP-20 | (Note 9) | — | 15 | — | °C/W |
| θ _{JA} | Thermal Resistance Junction-to-Ambient | V-QFN4525-20 | (Note 9) | — | 67 | — | °C/W |
| θ _{JC} | Thermal Resistance Junction-to-Case | V-QFN4525-20 | (Note 9) | — | 20 | — | °C/W |

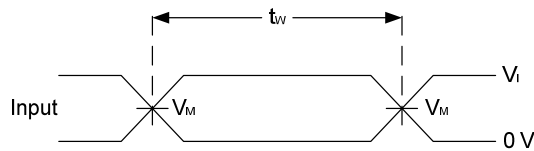
Note: 9. Test conditions for TSSOP-20 and V-QFN4525-20: Devices mounted on 4 layer FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout per JESD 51-7.

Parameter Measurement Information

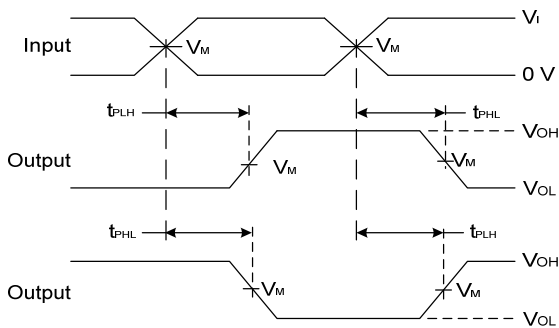


| TEST | S1 |
|-------------------|------------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | V_{LOAD} |
| t_{PHZ}/t_{PZH} | GND |

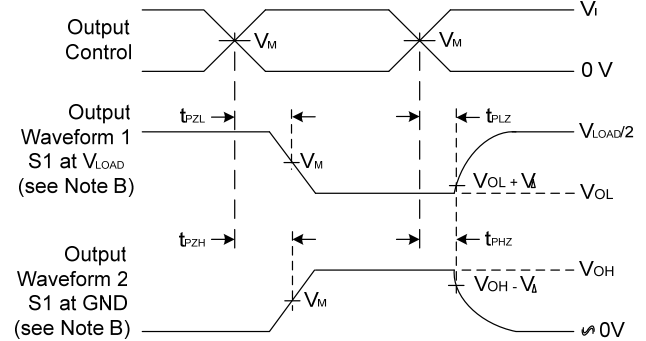
| V_{CC} | Inputs | | V_M | V_{LOAD} | C_L | R_L | V_{Δ} |
|------------------|----------|--------------|------------|-------------------|-------|--------------|--------------|
| | V_I | t_r/t_f | | | | | |
| $1.8V \pm 0.15V$ | V_{CC} | $\leq 2ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF | 1K Ω | 0.15V |
| $2.5V \pm 0.2V$ | V_{CC} | $\leq 2ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF | 500 Ω | 0.15V |
| 2.7V | 2.7V | $\leq 2.5ns$ | 1.5V | 6V | 50pF | 500 Ω | 0.3V |
| $3.3V \pm 0.3V$ | 2.7V | $\leq 2.5ns$ | 1.5V | 6V | 50pF | 500 Ω | 0.3V |



Voltage Waveform Pulse Duration



**Voltage Waveform Propagation Delay Times
Inverting and Non Inverting Outputs**



**Voltage Waveform Enable and Disable Times
Low and High Level Enabling**

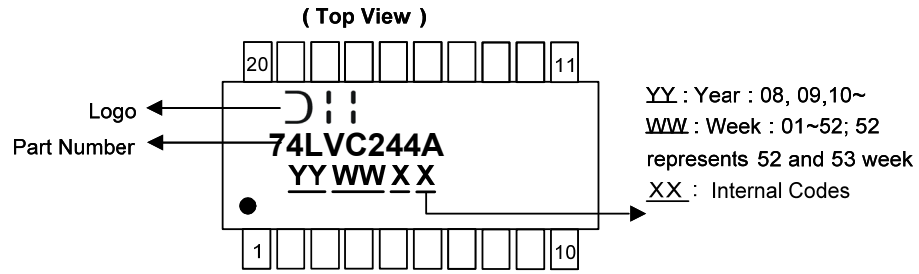
- Notes:
- A. Includes test lead and test apparatus capacitance.
 - B. All pulses are supplied at pulse repetition rate ≤ 10 MHz.
 - C. Inputs are measured separately one transition per measurement.
 - D. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - E. t_{PZL} and t_{PZH} are the same as t_{ENO} .
 - F. t_{PLH} and t_{PHL} are the same as t_{PD} .

Figure 1 Load Circuit and Voltage Waveforms

NEW PRODUCT

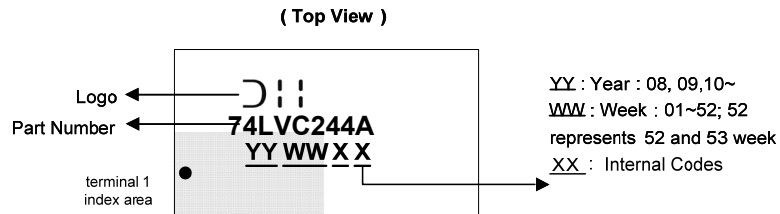
Marking Information

(1) TSSOP20



| Part Number | Package |
|--------------|----------|
| 74LVC244AT20 | TSSOP-20 |

(2) QFN-20 (V-QFN4525-20)



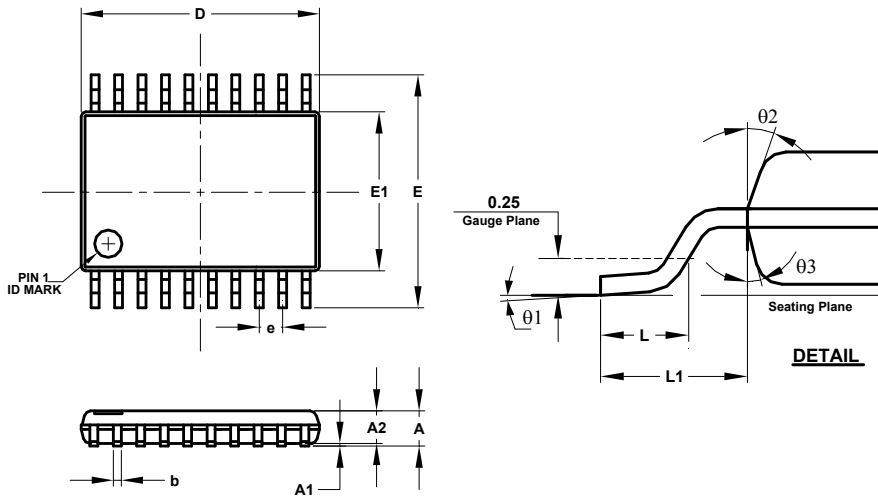
| Part Number | Package |
|--------------|--------------|
| 74LVC244AQ20 | V-QFN4525-20 |

NEW PRODUCT

Package Outline Dimensions (All Dimensions in mm)

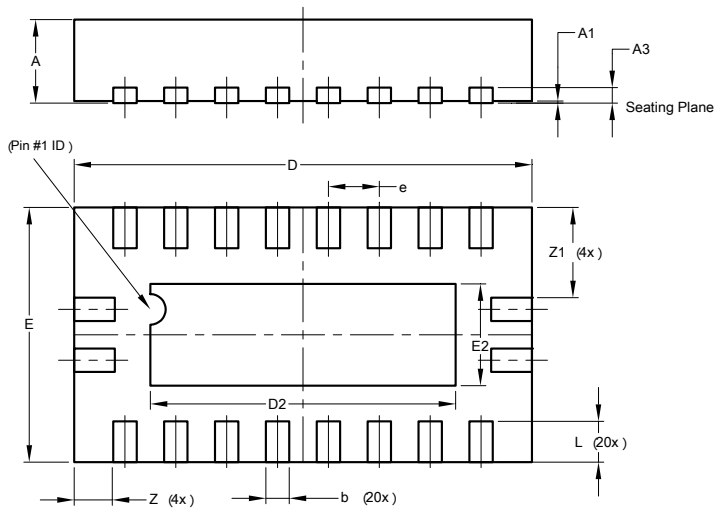
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

(1) TSSOP-20



| TSSOP-20 | | | |
|----------------------|----------|------|------|
| Dim | Min | Max | Typ |
| A | - | 1.20 | - |
| A1 | 0.05 | 0.15 | - |
| A2 | 0.80 | 1.05 | - |
| b | 0.19 | 0.30 | - |
| c | 0.09 | 0.20 | - |
| D | 6.40 | 6.60 | 6.50 |
| E | 6.20 | 6.60 | 6.40 |
| E1 | 4.30 | 4.50 | 4.40 |
| e | 0.65 BSC | | |
| L | 0.45 | 0.75 | 0.60 |
| L1 | 1.0 REF | | |
| theta1 | 0° | 8° | - |
| theta2 | 10° | 14° | 12° |
| theta3 | 10° | 14° | 12° |
| All Dimensions in mm | | | |

(2) QFN-20 (V-QFN4525-20)



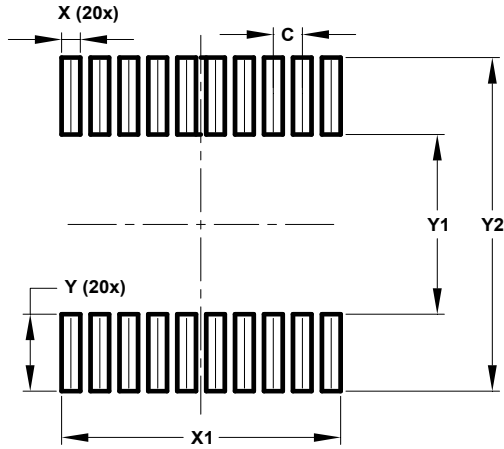
| V-QFN4525-20 | | | |
|----------------------|---------|------|-------|
| Dim | Min | Max | Typ |
| A | 0.75 | 0.85 | 0.80 |
| A1 | 0.00 | 0.05 | 0.02 |
| A3 | - | - | 0.15 |
| b | 0.18 | 0.30 | 0.23 |
| D | 4.45 | 4.55 | 4.50 |
| D2 | 2.85 | 3.15 | 3.00 |
| E | 2.45 | 2.55 | 2.50 |
| E2 | 0.85 | 1.15 | 1.00 |
| e | 0.50BSC | | |
| L | 0.30 | 0.50 | 0.40 |
| Z | - | - | 0.385 |
| Z1 | - | - | 0.885 |
| All Dimensions in mm | | | |

NEW PRODUCT

Suggested Pad Layout

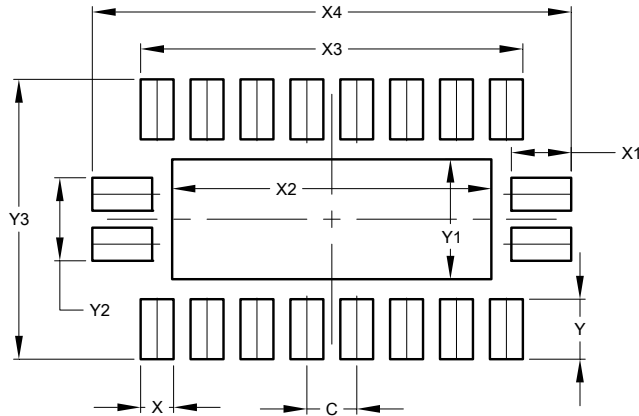
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

(1) TSSOP-20



| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.650 |
| X | 0.420 |
| X1 | 6.270 |
| Y | 1.789 |
| Y1 | 4.160 |
| Y2 | 7.720 |

(2) QFN-20 (V-QFN4525-20)



| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.500 |
| X | 0.330 |
| X1 | 0.600 |
| X2 | 3.200 |
| X3 | 3.830 |
| X4 | 4.800 |
| Y | 0.600 |
| Y1 | 1.200 |
| Y2 | 0.830 |
| Y3 | 2.800 |

NEW PRODUCT

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