



74LVCH244A

OCTAL BUFFER/LINE DRIVER WITH BUS HOLD / 3 STATE OUTPUTS

## Description

The 74LVCH244A 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 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.

Bus hold circuitry holds unused or un-driven inputs at a high or low logic state. The use of external pull-up or pull down resistors is not recommended.

#### Features

- Supply Voltage Range from 1.65V to 3.6V
- Sinks or Sources 24mA at V<sub>CC</sub> = 3V
- CMOS Low Power Consumption
- IOFF 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<sub>OLP</sub> (Quiet Output Ground Bounce) less than 0.8V with V<sub>CC</sub> = 3.3V and T<sub>A</sub> = +25°C
- Typical V<sub>OHV</sub> (Quiet Output Dynamic VOH) greater than 2.0V with V<sub>CC</sub> = 3.3V and T<sub>A</sub> = +25°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
- Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)
- Halogen and Antimony Free. Green" Device (Note 3)

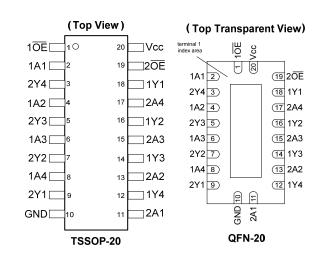
Notes:

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**

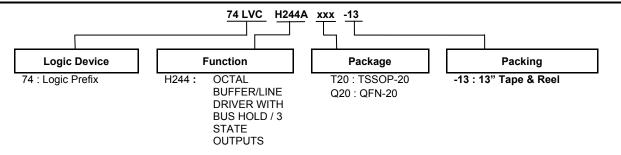


## **Applications**

- 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 Package |               | Package                                      | 13" Tape and Reel |                    |  |
|------------------|-----------------|---------------|--|-------------------|--------------------|--|
| Fart Number      | Code            | (Notes 4 & 5) | Size   | Quantity          | Part Number Suffix |  |
| 74LVCH244AT20-13 | T20             | TSSOP-20      | 6.4mm X 6.5mm X 1.2mm<br>0.65 mm lead pitch  | 2500/Tape & Reel  | -13                |  |
| 74LVCH244AQ20-13 | Q20             | V-QFN4525-20  | 2.5mm X 4.5mm X 0.95mm<br>0.50 mm lead pitch | 2500/Tape & Reel  | -13                |  |

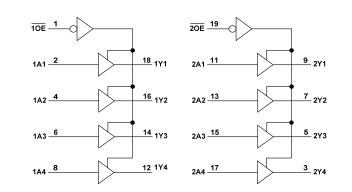
Notes: 4. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

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          | 10E             | 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         | 20E             | Output Enable 2 |
| 20         | V <sub>CC</sub> | Supply Voltage  |

# Logic Diagram



#### **Function Table**

| (Each 4-Bit Buffer) |      |        |  |  |  |  |
|---------------------|------|--------|--|--|--|--|
| INPU                | TS   | OUTPUT |  |  |  |  |
| OE                  | OE A |        |  |  |  |  |
| L                   | Н    | Н      |  |  |  |  |
| L                   | L    | L      |  |  |  |  |
| Н                   | Х    | 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 <sub>CC</sub>  | Supply Voltage Range   | -0.5 to +7.0 | V    |
| VI               | Input Voltage Range  | -0.5 to +7.0 | V    |
| I <sub>IK</sub>  | Input Clamp Current V <sub>I</sub> < 0V                                | -20          | mA   |
| I <sub>OK</sub>  | Output Clamp Current V <sub>O</sub> < 0V                               | -50          | mA   |
| lo               | Continuous Output Current -0.5V < V <sub>O</sub> V <sub>CC</sub> +0.5V | ±50          | mA   |
| Icc              | Continuous Current Through V <sub>CC</sub>                             | 100          | mA   |
| I <sub>GND</sub> | Continuous Current Through GND   | -100         | mA   |
| TJ               | Operating Junction Temperature   | -40 to +150  | °C   |
| T <sub>STG</sub> | Storage Temperature  | -65 to +150  | °C   |
| Ртот             | Total Power Dissipation  | 500          | mW   |

Notes:

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6. 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.7. 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**

| Symbol          | Parameter                          | Conditions              | Min  | Max  | Unit |
|-----------------|------------------------------------|-------------------------|------|------|------|
| N/              | Supply Voltage                     | Operating               | 1.65 | 3.6  | V    |
| V <sub>CC</sub> | Supply voltage                     | Data Retention Only     | 1.5  | —    | V    |
| VI              | Input Voltage                      | —                       | 0    | 5.5  | V    |
| Vo              | Output Voltage                     | —                       | 0    | Vcc  | V    |
|                 |                                    | V <sub>CC</sub> = 1.65V | —    | -4   |      |
|                 | High-Level Output Current          | V <sub>CC</sub> = 2.3V  | —    | -8   | ~ ^  |
| I <sub>OH</sub> |                                    | V <sub>CC</sub> = 2.7V  | —    | -12  | mA   |
|                 |                                    | V <sub>CC</sub> = 3.0V  | —    | -24  |      |
|                 |                                    | V <sub>CC</sub> = 1.65V | —    | 4    |      |
|                 |                                    | V <sub>CC</sub> = 2.3V  | —    | 8    |      |
| I <sub>OL</sub> | Low-Level Output Current           | V <sub>CC</sub> = 2.7V  | —    | 12   | mA   |
|                 |                                    | V <sub>CC</sub> = 3.0V  | —    | 24   |      |
| Δt/ΔV           | Input Transition Rise or Fall Rate |                         | —    | 10   | ns/V |
| T <sub>A</sub>  | Operating Free-Air Temperature     |                         | -40  | +125 | °C   |



# **Electrical Characteristics**

| Symbol               | Parameter                                   | Test Conditions   | N              | T <sub>A</sub> = -40°C | C to +85°C             | T <sub>A</sub> = -40°C | to +125°C              | Unit |
|----------------------|---|---|----------------|------------------------|------------------------|------------------------|------------------------|------|
| Symbol               | Parameter                                   | Test Conditions   | Vcc            | Min                    | Max                    | Min                    | Max                    | Unit |
|                      |   |   | 1.65V to 1.95V | V <sub>CC</sub> X 0.65 | —                      | V <sub>CC</sub> X 0.65 | —                      |      |
| VIH                  | High-Level Input<br>Voltage                 |   | 2.3V to 2.7V   | 1.7                    | _                      | 1.7                    | —                      | V    |
|                      | Voltage                                     |   | 3.0V to 3.6V   | 2                      | —                      | 2                      | _                      |      |
|                      |   |   | 1.65V to 1.95V | —                      | V <sub>CC</sub> X 0.35 |                        | V <sub>CC</sub> X 0.35 |      |
| VIL                  | Low-Level input<br>voltage                  |   | 2.3V to 2.7V   | —                      | 0.7                    |                        | 0.7                    | V    |
|                      | vollago                                     |   | 3.0V to 3.6V   | —                      | 0.8                    |                        | 0.8                    |      |
|                      |   | I <sub>OH</sub> = -5μA                                    | 1.65V to 5.5V  | V <sub>CC</sub> -0.2   | —                      | V <sub>CC</sub> -0.3   | —                      |      |
|                      |   | I <sub>OH</sub> = -4mA                                    | 1.65V          | 1.2                    | —                      | 1.05                   | —                      |      |
| V <sub>OH</sub>      | High-Level                                  | I <sub>OH</sub> = -8mA                                    | 2.3 V          | 1.7                    | —                      | 1.65                   | —                      |      |
| ∨он                  | Output Voltage                              | L = 10mA  | 2.7V           | 2.2                    | —                      | 2.05                   | —                      | V    |
|                      |   | I <sub>OH</sub> = -12mA                                   | 3.0V           | 2.4                    | —                      | 2.48                   | —                      | v    |
|                      |   | I <sub>OH</sub> = -24mA                                   | 3.0V           | 2.3                    | —                      | 2.0                    | —                      |      |
|                      |   | I <sub>OL</sub> = 100μA                                   | 1.65V to 5.5V  | —                      | 0.2                    | _                      | 0.3                    |      |
|                      | V <sub>OL</sub> Low-Level Output<br>Voltage | I <sub>OL</sub> = 4mA                                     | 1.65V          | —                      | 0.45                   | _                      | 0.65                   | V    |
| V <sub>OL</sub>      |   | I <sub>OL</sub> = 8mA                                     | 2.3V           | _                      | 0.60                   | _                      | 0.80                   |      |
|                      |   | I <sub>OL</sub> = 12mA                                    | 2.7V           | _                      | 0.40                   |                        | 0.60                   |      |
|                      |   | I <sub>OL</sub> = 24mA                                    | 3.0V           | —                      | 0.55                   |                        | 0.80                   |      |
| I <sub>OFF</sub>     | Power Down<br>Leakage Current               | $V_{\rm I}$ or $V_{\rm O}$ = 0 or 5.5V                    | 0              | _                      | ±10                    |                        | 20                     | μΑ   |
| I <sub>I</sub>       | Input Current<br>Control Pins               | V <sub>I</sub> = GND or 5.5V                              | 0 to 5.5V      | _                      | ±5                     | _                      | ± 20                   | μA   |
|                      |   | V <sub>I</sub> = 0.58V                                    | 4.0514         | 25                     | —                      | 15                     | —                      |      |
|                      |   | V <sub>I</sub> = 1.07                                     | 1.65V          | -25                    | _                      | -15                    | _                      |      |
|                      | Input Current                               | V <sub>I</sub> = 0.7V                                     | 0.01 <i>/</i>  | 45                     | _                      | 35                     | —                      |      |
| I <sub>I(HOLD)</sub> | Required to                                 | V <sub>1</sub> = 1.7V                                     | 2.3V           | -45                    | —                      | -35                    | —                      | μA   |
|                      | Change State                                | V <sub>1</sub> = 0.8V                                     |                | 75                     | —                      | 60                     | —                      |      |
|                      |   | V <sub>1</sub> = 2.0V                                     | 3.0V           | -75                    | —                      | -60                    | _                      |      |
|                      |   | V <sub>1</sub> = 0 or 3.6V                                | 3.6V           |                        | ±500                   |                        | ±500                   |      |
| I <sub>OZ</sub>      | Z-State Current                             | V <sub>1</sub> =GND or 5.5V<br>V <sub>O</sub> = 0 or 5.5V | 3.6V           | _                      | ±5                     | _                      | ± 20                   | uA   |
| I <sub>CC</sub>      | Supply Current                              | $V_{I} = GND \text{ or}$<br>$V_{CC, I_{O}} = 0$           | 6.0V           | _                      | 10                     | _                      | 40                     | μΑ   |
| $\Delta I_{CC}$      | Additional Supply Current                   | One input at $V_{CC} - 0.6V I_O = 0A$                     | 2.7V to 3.6V   | _                      | 500                    | _                      | 5000                   | μΑ   |
| Ci                   | Input<br>Capacitance                        | VI = GND or V <sub>CC</sub>                               | 3.3V           | 4.0 ty                 | 4.0 typical            |                        | ypical                 | pF   |
| Co                   | Output<br>Capacitance                       | $V_{O}$ = GND or $V_{CC}$                                 | 3.3V           | 5.5 ty                 | /pical                 | 5.5 typical            |                        |      |



# **Switching Characteristics**

| Symbol Parameter         |                          | Test Conditions | Vcc            | т   | <sub>A</sub> = +25° | °C   | T <sub>A</sub> = -40°C to<br>+85°C |      | T <sub>A</sub> = -40°C to<br>+125°C |      | Unit |
|--------------------------|--------------------------|-----------------|----------------|-----|---------------------|------|------------------------------------|------|-------------------------------------|------|------|
|                          |                          |                 |                | Min | Тур                 | Max  | Min                                | Max  | Min                                 | Max  |      |
|                          |                          |                 | 1.8V ± 0.15V   | 1   | 5.9                 | 12   | 1                                  | 12.2 | 1                                   | 12.4 |      |
|                          | Propagation              | Figure 1        | 2.5V ± 0.2V    | 1   | 4.2                 | 7.8  | 1                                  | 8.4  | 1                                   | 10   |      |
| t <sub>PD</sub>          | Delay $A_N$ to $Y_N$     | -               | 2.7V           | 1   | 4.2                 | 8.2  | 1                                  | 8.9  | 1                                   | 9    | ns   |
|                          |                          |                 | 3.3V ± 0.3V    | 1.5 | 3.9                 | 7.7  | 1.5                                | 8.2  | 1.5                                 | 8.3  |      |
|                          |                          |                 | 1.8V ± 0.15V   | 1   | 6.4                 | 12.1 | 1                                  | 12.6 | 1                                   | 14.1 |      |
| 4                        | Enable Time              | Figure 1        | 2.5V ± 0.2V    | 1   | 4.6                 | 9.1  | 1                                  | 9.6  | 1                                   | 11.7 |      |
| t <sub>EN</sub>          | $\overline{OE}$ to $Y_N$ |                 | 2.7V           | 1   | 5                   | 8.4  | 1                                  | 8.6  | 1                                   | 10.3 | ns   |
|                          |                          |                 | 3.3V ± 0.3V    | 1.5 | 4.5                 | 7.4  | 1.5                                | 7.6  | 1.5                                 | 9.4  |      |
|                          |                          |                 | 1.8V ± 0.15V   | 1   | 5.8                 | 11.6 | 1                                  | 12.1 | 1                                   | 13.6 |      |
| t <sub>DIS</sub>         | Disable Time             | Figure 1        | 2.5V ±<br>0.2V | 1   | 3.7                 | 7.3  | 1                                  | 7.8  | 1                                   | 9.9  | ns   |
| $\overline{OE}$ to $Y_N$ |                          | 2.7V            | 1              | 3.8 | 6.6                 | 1    | 6.8                                | 1    | 8.6                                 |      |      |
|                          |                          | 3.3V ± 0.3V     | 1.5            | 3.8 | 6.3                 | 1.5  | 6.5                                | 1.5  | 8                                   |      |      |
| t <sub>sk(0)</sub>       | Output Skew<br>Time      |                 | 3.3V ± 0.3V    | —   | _                   | 1.0  | _                                  | _    | _                                   | 1.5  | ns   |

# **Operating Characteristics**

| T <sub>A</sub> = +25°C |  |                               |                |      |      |
|------------------------|--|-------------------------------|----------------|------|------|
| Symbol                 | Parameter                              | <b>Test Conditions</b>        | Vcc            | Тур  | Unit |
|                        |  |                               | 1.8V ± 0.15V   | 9.9  |      |
| C <sub>pd</sub>        | Power dissipation capacitance per gate | F = 10 MHz<br>Outputs Enabled | 2.5V ±<br>0.2V | 10.2 | pF   |
|                        |  |                               | 3.3V ± 0.3V    | 10.6 |      |

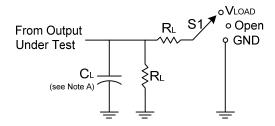
# **Package Characteristics**

| Symbol          | Parameter                                 | Package      | Test Conditions | Min | Тур | Max | Unit |
|-----------------|---|--------------|-----------------|-----|-----|-----|------|
| θ <sub>JA</sub> | Thermal Resistance<br>Junction-to-Ambient | TSSOP-20     | (Note 8)        | —   | 74  | _   | °C/W |
| θ <sub>JC</sub> | Thermal Resistance<br>Junction-to-Case    | TSSOP-20     | (Note 8)        | _   | 15  | _   | °C/W |
| $\theta_{JA}$   | Thermal Resistance<br>Junction-to-Ambient | V-QFN4525-20 | (Note 8)        | _   | 67  | _   | °C/W |
| θ <sub>JC</sub> | Thermal Resistance<br>Junction-to-Case    | V-QFN4525-20 | (Note 8)        | _   | 20  | _   | °C/W |

Note: 8. 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.

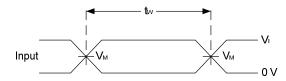


#### **Parameter Measurement Information**

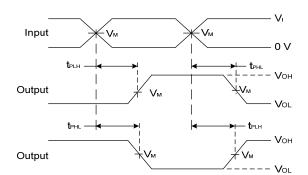


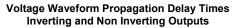
| TEST                               | S1                |
|------------------------------------|-------------------|
| t <sub>PLH</sub> /t <sub>PHL</sub> | Open              |
| t <sub>PLZ</sub> /t <sub>PZL</sub> | V <sub>LOAD</sub> |
| t <sub>PHZ</sub> /t <sub>PZH</sub> | GND               |

|              | Inputs          |                                |                    |                     |      |      |       |
|--------------|-----------------|--------------------------------|--------------------|---------------------|------|------|-------|
| Vcc          | VI              | t <sub>r</sub> /t <sub>f</sub> | VM                 | VLOAD               | C∟   | RL   | V۵    |
| 1.8V ± 0.15V | Vcc             | ≤2ns                           | V <sub>CC</sub> /2 | 2 x V <sub>CC</sub> | 30pF | 1KΩ  | 0.15V |
| 2.5V ± 0.2V  | V <sub>CC</sub> | ≤2ns                           | V <sub>CC</sub> /2 | $2 \times V_{CC}$   | 30pF | 500Ω | 0.15V |
| 2.7V         | 2.7V            | ≤2.5ns                         | 1.5V               | 6V                  | 50pF | 500Ω | 0.3V  |
| 3.3V ± 0.3V  | 2.7V            | ≤2.5ns                         | 1.5V               | 6V                  | 50pF | 500Ω | 0.3V  |



#### Voltage Waveform Pulse Duration

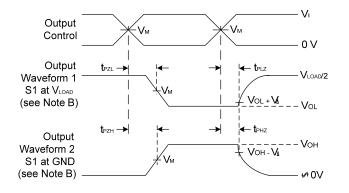




Notes:

- A. Includes test lead and test apparatus capacitance.
- B. All pulses are supplied a pulse repetition rate ≤ 10 MHz.
  C. Inputs are measured separately one transition per measurement.
- D.  $t_{\mathsf{PLZ}}$  and  $t_{\mathsf{PHZ}}$  are the same as  $t_{\mathsf{dis.}}$
- E.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{EN0}$
- F.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{PD}$ .

Figure 1 Load Circuit and Voltage Waveforms

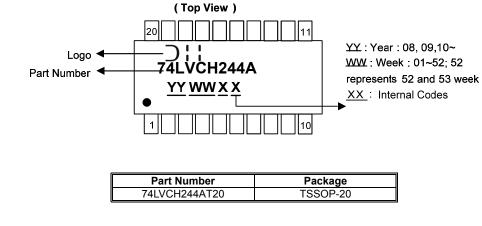


Voltage Waveform Enable and Disable Times Low and High Level Enabling

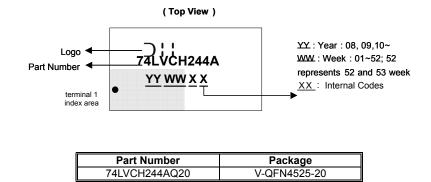


## **Marking Information**

#### (1) TSSOP20



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



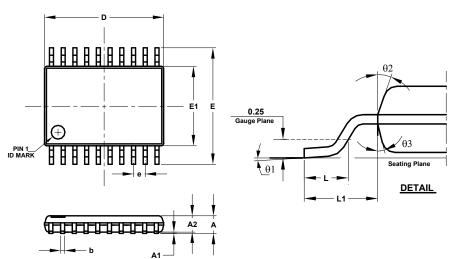
74LVCH244AQ20



## **Package Outline Dimensions**

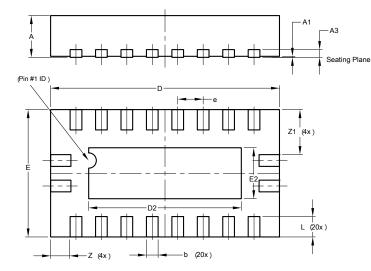
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

#### (1) TSSOP-20



|       | TSSO    | P-20     |      |
|-------|---------|----------|------|
| Dim   | Min     | Max      | Тур  |
| Α     | -       | 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 |
| Е     | 6.20    | 6.60     | 6.40 |
| E1    | 4.30    | 4.50     | 4.40 |
| е     | C       | .65 BSC  | )    |
| L     | 0.45    | 0.75     | 0.60 |
| L1    |         | 1.0 REF  |      |
| θ1    | 0°      | 8°       | -    |
| θ2    | 10°     | 14°      | 12°  |
| θ3    | 10°     | 14°      | 12°  |
| All I | Dimensi | ons in r | nm   |

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



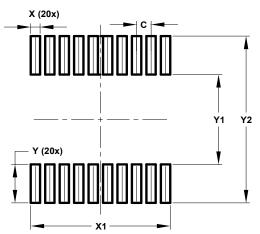
| V-QFN4525-20         |         |      |       |  |
|----------------------|---------|------|-------|--|
| Dim                  | Min     | Max  | Тур   |  |
| Α                    | 0.75    | 0.85 | 0.80  |  |
| A1                   | 0.00    | 0.05 | 0.02  |  |
| A3                   | -       | -    | 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  |  |
| е                    | 0.50BSC |      |       |  |
| L                    | 0.30    | 0.50 | 0.40  |  |
| Z                    | -       | -    | 0.385 |  |
| Z1                   | -       | -    | 0.885 |  |
| All Dimensions in mm |         |      |       |  |



## **Suggested Pad Layout**

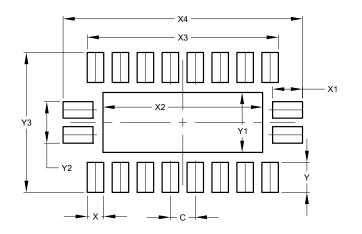
Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

#### (1) TSSOP-20



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

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



| Dimensions | Value (in mm) |  |
|------------|---------------|--|
| С          | 0.500         |  |
| Х          | 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         |  |



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