

# **Excalibur Low-Noise High-Speed Precision Operational Amplifiers**

## **1 Features**

- Low noise
  - 10Hz . . . 15nV/ $\sqrt{\text{Hz}}$
  - 1kHz . . . 10.5nV/ $\sqrt{\text{Hz}}$
- Load capability: 10000pF
- Short-circuit output current: 20mA (minimum)
- Slew rate: 27V/ $\mu\text{s}$  (minimum)
- High gain-bandwidth product: 5.9MHz
- Low  $V_{\text{IO}}$ : 500 $\mu\text{V}$  maximum at 25°C
- Single or split supply: 4V to 44V
- Fast settling time:
  - 340ns to 0.1%
  - 400ns to 0.01%
- Saturation recovery: 150ns
- Large output swing:
  - $V_{\text{CC-}} + 0.1\text{V}$  to  $V_{\text{CC+}} - 1\text{V}$

## **2 Applications**

- [EV charging infrastructure](#)
- [Industrial AC-DC](#)
- [Fire alarm control panel \(FACP\)](#)
- [String inverter](#)

## **3 Description**

The TLE214x and TLE214xA devices are high-performance, internally compensated operational amplifiers built using Texas Instruments complementary bipolar Excalibur process. The TLE214xA is a tighter offset voltage grade of the TLE214x. Both are pin-compatible upgrades to standard industry products.

The design incorporates an input stage that simultaneously achieves low audio-band noise of 10.5nV/ $\sqrt{\text{Hz}}$  with a 10Hz 1/f corner and symmetrical 40V/ $\mu\text{s}$  slew rate typically with loads up to 800pF. The resulting low distortion and high power bandwidth are important in high-fidelity audio applications. A fast settling time of 430ns to 0.1% of a 10V step with a 2k $\Omega$ /100pF load is useful in fast actuator/positioning drivers. Under similar test conditions, settling time to 0.01% is 640ns.

Both versions can also be used as comparators. Differential inputs of  $V_{\text{CC}\pm}$  can be maintained without damage to the device. Open-loop propagation delay with TTL supply levels is typically 200ns. This gives a good indication as to output stage saturation recovery when the device is driven beyond the limits of recommended output swing.

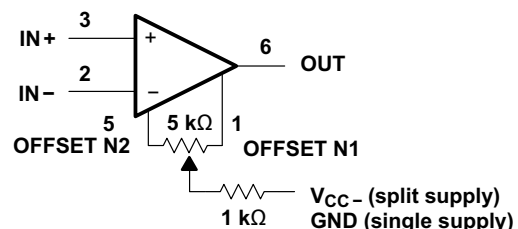
Both the TLE214x and TLE214xA are available in a wide variety of packages, including both the industry-standard 8-pin small-outline version and chip form for high-density system applications. The C-suffix devices are characterized for operation from 0°C to 70°C, I-suffix devices from –40°C to 105°C, and M-suffix devices over the full military temperature range of –55°C to 125°C.

### **Package Information**

| PART NUMBER         | PACKAGE <sup>(1)</sup> | PACKAGE SIZE <sup>(2)</sup> |
|---------------------|------------------------|-----------------------------|
| TLE2141, TLE2141A   | P (PDIP, 8)            | 9.81mm × 9.43mm             |
|                     | D (SOIC, 8)            | 4.9mm × 6mm                 |
| TLE2142             | P (PDIP, 8)            | 9.81mm × 9.43mm             |
|                     | D (SOIC, 8)            | 4.9mm × 6mm                 |
|                     | PW (TSSOP, 16)         | 5mm × 6.4mm                 |
| TLE2142A            | D (SOIC, 8)            | 4.9mm × 6mm                 |
| TLE2142AM           | JG (CDIP, 8)           | 9.6mm × 6.67mm              |
|                     | U (CFP, 10)            | 21.44mm × 6.5mm             |
|                     | FK (LCCC, 20)          | 8.89mm × 8.89mm             |
| TLE2142AM-D         | D (SOIC, 8)            | 4.9mm × 6mm                 |
| TLE2142M            | JG (CDIP, 8)           | 9.6mm × 6.67mm              |
|                     | U (CFP, 10)            | 21.44mm × 6.5mm             |
|                     | FK (LCCC, 20)          | 8.89mm × 8.89mm             |
| TLE2142M-D          | D (SOIC, 8)            | 4.9mm × 6mm                 |
| TLE2144             | N (PDIP, 14)           | 19.3mm × 9.4mm              |
|                     | DW (SOIC, 16)          | 10.3mm × 10.3mm             |
| TLE2144A            | N (PDIP, 14)           | 19.3mm × 9.4mm              |
| TLE2144AM, TLE2144M | J (CDIP, 14)           | 19.56mm × 6.67mm            |
|                     | FK (LCCC, 20)          | 8.89mm × 8.89mm             |
| TLE2144M-D          | DW (SOIC, 16)          | 10.3mm × 10.3mm             |

(1) For all available packages, see [Section 9](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



**Input Offset Voltage Null Circuit**

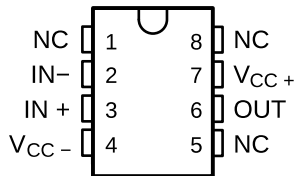


## Table of Contents

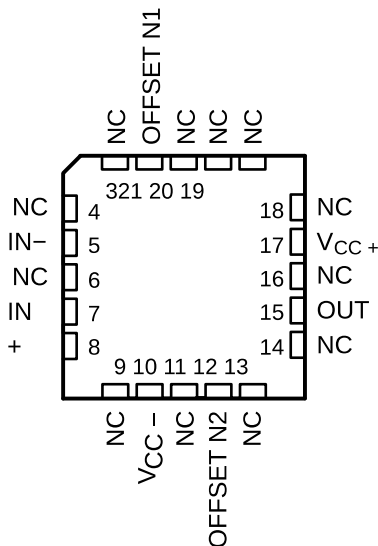
|                                                                                                       |          |                                                                                                       |           |
|-------------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------|-----------|
| <b>1 Features</b>                                                                                     | <b>1</b> | 5.23 TLE2144I Electrical Characteristics                                                              | <b>25</b> |
| <b>2 Applications</b>                                                                                 | <b>1</b> | 5.24 TLE2144C Operating Characteristics, $V_{CC} =$<br>5V, $T_A = 25^\circ\text{C}$                   | <b>26</b> |
| <b>3 Description</b>                                                                                  | <b>1</b> | 5.25 TLE2144I Electrical Characteristics                                                              | <b>27</b> |
| <b>4 Pin Configuration and Functions</b>                                                              | <b>3</b> | 5.26 TLE2144I Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$ | <b>28</b> |
| <b>5 Specifications</b>                                                                               | <b>4</b> | 5.27 TLE2144I Electrical Characteristics                                                              | <b>29</b> |
| 5.1 Absolute Maximum Ratings                                                                          | 4        | 5.28 TLE2141M Operating Characteristics, $V_{CC} =$<br>5V, $T_A = 25^\circ\text{C}$                   | <b>30</b> |
| 5.2 Recommended Operating Conditions                                                                  | 4        | 5.29 TLE2141M Electrical Characteristics                                                              | <b>31</b> |
| 5.3 TLE2141C Electrical Characteristics                                                               | 5        | 5.30 TLE2141M Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$ | <b>32</b> |
| 5.4 TLE2141C Operating Characteristics, $V_{CC} = 5\text{V}$ ,<br>$T_A = 25^\circ\text{C}$            | 6        | 5.31 TLE2142M Electrical Characteristics                                                              | <b>33</b> |
| 5.5 TLE2141C Electrical Characteristics                                                               | 7        | 5.32 TLE2142M Operating Characteristics, $V_{CC} =$<br>5V, $T_A = 25^\circ\text{C}$                   | <b>34</b> |
| 5.6 TLE2141C Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$  | 8        | 5.33 TLE2142M Electrical Characteristics                                                              | <b>35</b> |
| 5.7 TLE2142C Electrical Characteristics                                                               | 9        | 5.34 TLE2142M Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$ | <b>36</b> |
| 5.8 TLE2142C Operating Characteristics, $V_{CC} = 5\text{V}$ ,<br>$T_A = 25^\circ\text{C}$            | 10       | 5.35 TLE2144M Electrical Characteristics                                                              | <b>37</b> |
| 5.9 TLE2142C Electrical Characteristics                                                               | 11       | 5.36 TLE2144M Operating Characteristics                                                               | <b>38</b> |
| 5.10 TLE2142C Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$ | 12       | 5.37 TLE2144M Electrical Characteristics                                                              | <b>39</b> |
| 5.11 TLE2144C Electrical Characteristics                                                              | 13       | 5.38 TLE2144M Operating Characteristics                                                               | <b>40</b> |
| 5.12 TLE2144C Operating Characteristics, $V_{CC} =$<br>5V, $T_A = 25^\circ\text{C}$                   | 14       | 5.39 TLE2141Y Electrical Characteristics                                                              | <b>41</b> |
| 5.13 TLE2144C Electrical Characteristics                                                              | 15       | 5.40 TLE2142Y Electrical Characteristics                                                              | <b>42</b> |
| 5.14 TLE2144C Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$ | 16       | 5.41 TLE2144Y Electrical Characteristics                                                              | <b>43</b> |
| 5.15 TLE2141I Electrical Characteristics                                                              | 17       | 5.42 Typical Characteristics                                                                          | <b>44</b> |
| 5.16 TLE2141I Operating Characteristics, $V_{CC} =$<br>5V, $T_A = 25^\circ\text{C}$                   | 18       | <b>6 Detailed Description</b>                                                                         | <b>54</b> |
| 5.17 TLE2141I Electrical Characteristics                                                              | 19       | 6.1 Overview                                                                                          | 54        |
| 5.18 TLE2141I Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$ | 20       | <b>7 Device and Documentation Support</b>                                                             | <b>55</b> |
| 5.19 TLE2142I Electrical Characteristics                                                              | 21       | 7.1 Receiving Notification of Documentation Updates                                                   | 55        |
| 5.20 TLE2142I Operating Characteristics, $V_{CC} =$<br>5V, $T_A = 25^\circ\text{C}$                   | 22       | 7.2 Support Resources                                                                                 | 55        |
| 5.21 TLE2142I Electrical Characteristics                                                              | 23       | 7.3 Trademarks                                                                                        | 55        |
| 5.22 TLE2142I Operating Characteristics, $V_{CC\pm} =$<br>$\pm 15\text{V}$ , $T_A = 25^\circ\text{C}$ | 24       | 7.4 Electrostatic Discharge Caution                                                                   | 55        |
|                                                                                                       |          | 7.5 Glossary                                                                                          | 55        |
|                                                                                                       |          | <b>8 Revision History</b>                                                                             | <b>55</b> |
|                                                                                                       |          | <b>9 Mechanical, Packaging, and Orderable Information</b>                                             | <b>55</b> |

## 4 Pin Configuration and Functions

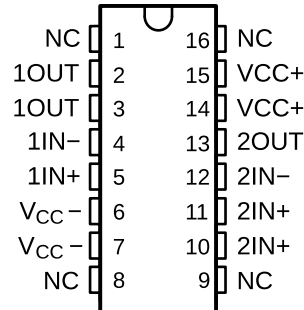
**TLE2141**  
**D, JG, OR P PACKAGE**  
**(TOP VIEW)**



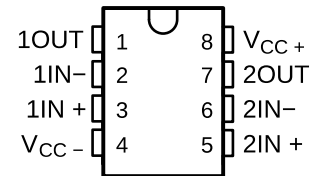
**TLE2141**  
**FK PACKAGE**  
**(TOP VIEW)**



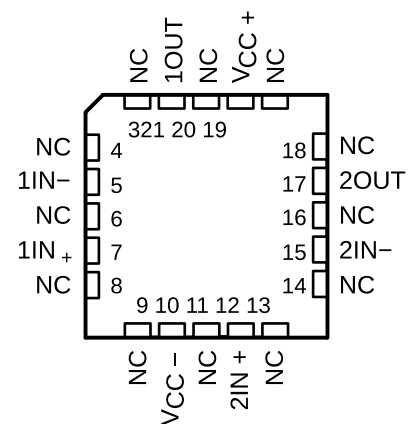
**TLE2142**  
**PW PACKAGE**  
**(TOP VIEW)**



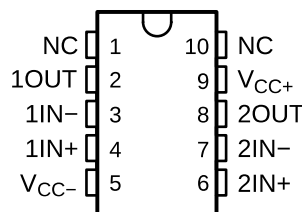
**TLE2142**  
**D, JG, OR P PACKAGE**  
**(TOP VIEW)**



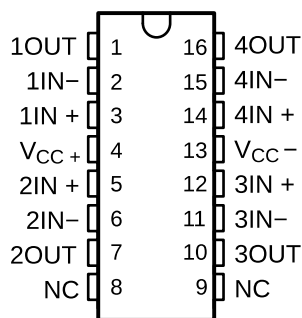
**TLE2142**  
**FK PACKAGE**  
**(TOP VIEW)**



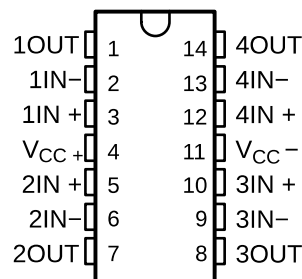
**TLE2142**  
**U PACKAGE**  
**(TOP VIEW)**



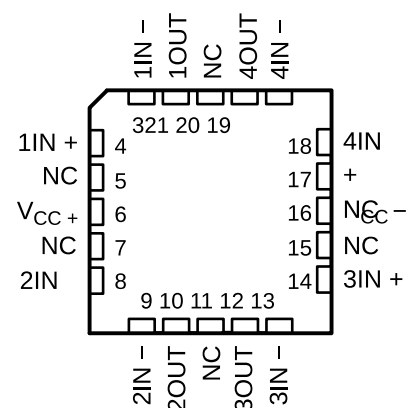
**TLE2144**  
**DW PACKAGE**  
**(TOP VIEW)**



**TLE2144**  
**J OR N PACKAGE**  
**(TOP VIEW)**



**TLE2144**  
**FK PACKAGE**  
**(TOP VIEW)**



NC – No internal connection

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                                                                          |                                              | VALUE                                     | UNIT       |      |
|------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------|------------|------|
| V <sub>CC+</sub>                                                                         | Supply voltage <sup>(2)</sup>                | 22                                        | V          |      |
| V <sub>CC-</sub>                                                                         | Supply voltage                               | –22                                       | V          |      |
| V <sub>ID</sub>                                                                          | Differential input voltage <sup>(3)</sup>    | ±44                                       | V          |      |
| V <sub>I</sub>                                                                           | Input voltage range, (any input)             | V <sub>CC+</sub> to V <sub>CC-</sub> –0.3 | V          |      |
| I <sub>I</sub>                                                                           | Input current (each input)                   | ± 1                                       | mA         |      |
| I <sub>O</sub>                                                                           | Output current                               | ± 80                                      | mA         |      |
| Total current into V <sub>CC+</sub>                                                      |                                              | 80                                        | mA         |      |
| Total current out of V <sub>CC-</sub>                                                    |                                              | 80                                        | mA         |      |
| Duration of short-circuit current at (or below) 25°C <sup>(4)</sup>                      |                                              | Unlimited                                 |            |      |
| θ <sub>JA</sub>                                                                          | Package thermal impedance <sup>(5) (6)</sup> | D package                                 | 97.1       | °C/W |
|                                                                                          |                                              | DW package                                | 57.3       |      |
|                                                                                          |                                              | N package                                 | 79.7       |      |
|                                                                                          |                                              | P package                                 | 84.6       |      |
|                                                                                          |                                              | PW package                                | 108.4      |      |
| θ <sub>JC</sub>                                                                          | Package thermal impedance <sup>(5) (6)</sup> | FK package                                | 5.6        | °C/W |
|                                                                                          |                                              | J package                                 | 15.1       |      |
|                                                                                          |                                              | JG package                                | 14.5       |      |
|                                                                                          |                                              | U package                                 | 14.7       |      |
| T <sub>A</sub>                                                                           | Operating free-air temperature range         | C suffix                                  | 0 to 70    | °C   |
|                                                                                          |                                              | I suffix                                  | –40 TO 105 | °C   |
|                                                                                          |                                              | M suffix                                  | –55 TO 125 | °C   |
| Storage temperature range                                                                |                                              | –65 TO 150                                | °C         |      |
| Case temperature for 60 seconds: FK package                                              |                                              | 260                                       | °C         |      |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, DW, N, P, or PW package |                                              | 260                                       | °C         |      |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J or JG package            |                                              | 300                                       | °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.
- All voltage values, except differential voltages, are with respect to the midpoint between V<sub>CC+</sub> and V<sub>CC-</sub>.
- Differential voltages are at IN+ with respect to IN–. Excessive current flows, if input, are brought below V<sub>CC-</sub> –0.3V.
- The output may be shorted to either supply. Temperature and /or supply voltages must be limited to make sure that the maximum dissipation rating is not exceeded.
- Maximum power dissipation is a function of T<sub>J(max)</sub>, θ<sub>JA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is P<sub>D</sub> = (T<sub>J(max)</sub> – T<sub>A</sub>)/θ<sub>JA</sub>. Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.
- The package thermal impedance is calculated in accordance with JEDEC 51-7 (plastic) or MIL-STD-883 Method 1012 (ceramic).

### 5.2 Recommended Operating Conditions

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

|                  |                                |                          | C SUFFIX |      | I SUFFIX |      | M SUFFIX |      | UNIT |
|------------------|--------------------------------|--------------------------|----------|------|----------|------|----------|------|------|
|                  |                                |                          | MIN      | MAX  | MIN      | MAX  | MIN      | MAX  |      |
| V <sub>CC±</sub> | Supply voltage                 |                          | ±2       | ±22  | ±2       | ±22  | ±2       | ±22  | V    |
| V <sub>IC</sub>  | Common-mode input voltage      | V <sub>CC</sub> = 5V     | 0        | 2.9  | 0        | 2.7  | 0        | 2.7  | V    |
|                  |                                | V <sub>CC±</sub> = ± 15V | –15      | 12.9 | –15      | 12.7 | –15      | 12.7 |      |
| T <sub>A</sub>   | Operating free-air temperature |                          | 0        | 70   | –40      | 105  | –55      | 125  | °C   |

### 5.3 TLE2141C Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                                                 | T <sub>A</sub> <sup>(1)</sup> | TLE2141C |             |          | TLE2141AC   |       |     | UNIT |
|------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------|----------|-------------|----------|-------------|-------|-----|------|
|                  |                                                                       |                                                                                 |                               | MIN      | TYP         | MAX      | MIN         | TYP   | MAX |      |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>O</sub> = 2.5V , R <sub>S</sub> = 50Ω,<br>V <sub>IC</sub> = 2.5V         | 25°C                          | 225      | 1400        | 200      | 1000        | μV    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 1700     |             |          | 1300        |       |     |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                                                 | Full range                    | 1.7      |             |          | 1.7         | μV/°C |     |      |
| I <sub>IO</sub>  | Input offset current                                                  |                                                                                 | 25°C                          | 8        | 100         | 8        | 100         | nA    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 150      |             |          | 150         |       |     |      |
| I <sub>IB</sub>  | Input bias current                                                    |                                                                                 | 25°C                          | −0.8     | −2          | −0.8     | −2          | μA    |     |      |
|                  |                                                                       | Full range                                                                      | −2.1                          |          |             | −2.1     |             |       |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                                            | 25°C                          | 0 to 3   | −0.3 to 3.2 | 0 to 3   | −0.3 to 3.2 | V     |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 0 to 2.9 |             | 0 to 2.9 |             | V     |     |      |
| V <sub>OH</sub>  | High-level output voltage                                             | I <sub>OH</sub> = −150μA                                                        | 25°C                          | 3.9      | 4.1         | 3.9      | 4.1         | V     |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 3.8      |             |          | 3.8         |       |     |      |
|                  |                                                                       | I <sub>OH</sub> = −1.5mA                                                        | 25°C                          | 3.8      | 4           | 3.8      | 4           | V     |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 3.7      |             |          | 3.7         |       |     |      |
|                  |                                                                       | I <sub>OH</sub> = −15mA                                                         | 25°C                          | 3.2      | 3.7         | 3.2      | 3.7         | V     |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 3.2      |             |          | 3.2         |       |     |      |
| V <sub>OL</sub>  | Low-level output voltage                                              | I <sub>OL</sub> = 150μA                                                         | 25°C                          | 75       | 125         | 75       | 125         | mV    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 150      |             |          | 150         |       |     |      |
|                  |                                                                       | I <sub>OL</sub> = 1.5mA                                                         | 25°C                          | 150      | 225         | 150      | 225         | mV    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 250      |             |          | 250         |       |     |      |
|                  |                                                                       | I <sub>OL</sub> = 15mA                                                          | 25°C                          | 1.2      | 1.5         | 1.2      | 1.5         | V     |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 1.7      |             |          | 1.7         |       |     |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>CC</sub> = ±2.5V , R <sub>L</sub> = 2kΩ,<br>V <sub>O</sub> = 1V to −1.5V | 25°C                          | 50       | 220         | 50       | 220         | V/mV  |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 25       |             |          | 25          |       |     |      |
| r <sub>i</sub>   | Input resistance                                                      |                                                                                 | 25°C                          | 70       |             |          | 70          | MΩ    |     |      |
| c <sub>i</sub>   | Input capacitance                                                     |                                                                                 | 25°C                          | 2.5      |             |          | 2.5         | pF    |     |      |
| z <sub>o</sub>   | Open-loop output impedance                                            | f = 1MHz                                                                        | 25°C                          | 30       |             |          | 30          | Ω     |     |      |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω                    | 25°C                          | 85       | 118         | 85       | 118         | dB    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 80       |             |          | 80          |       |     |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω                      | 25°C                          | 90       | 106         | 90       | 106         | dB    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 85       |             |          | 85          |       |     |      |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 2.5V , No load, V <sub>IC</sub> = 2.5V                         | 25°C                          | 3.4      | 4.4         | 3.4      | 4.4         | mA    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 4.6      |             |          | 4.6         |       |     |      |

(1) Full range is 0°C to 70°C.

## 5.4 TLE2141C Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER   |                                               | TEST CONDITIONS                                                                                     |          | TLE2141C |     |     | TLE2141AC |     |     | UNIT            |
|-------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|-----------------|
|             |                                               |                                                                                                     |          | MIN      | TYP | MAX | MIN       | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$C_L = 500pF$ <sup>(1)</sup>                   |          | 45       |     |     | 45        |     |     | V/ $\mu s$      |
| SR–         | Negative slew rate                            |                                                                                                     |          | 42       |     |     | 42        |     |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1$ , 2.5V step                                                                           | To 0.1%  | 0.66     |     |     | 0.66      |     |     | $\mu s$         |
|             |                                               |                                                                                                     | To 0.01% | 0.99     |     |     | 0.99      |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 10Hz$                                                                       |          | 15       |     |     | 15        |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega$ , $f = 1kHz$                                                                       |          | 10.5     |     |     | 10.5      |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to $1Hz$                                                                                |          | 0.48     |     |     | 0.48      |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to $10Hz$                                                                               |          | 0.51     |     |     | 0.51      |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                                                          |          | 1.92     |     |     | 1.92      |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                                                          |          | 0.5      |     |     | 0.5       |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_O = 1V$ to $3V$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 2$ , $f = 10kHz$                |          | 0.0052%  |     |     | 0.0052%   |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$ <sup>(1)</sup>                                      |          | 5.9      |     |     | 5.9       |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$ , <sup>(1)</sup><br>$f = 100kHz$                    |          | 5.8      |     |     | 5.8       |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 1$ , $C_L = 100pF$ <sup>(1)</sup> |          | 380      |     |     | 380       |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$ <sup>(1)</sup>                                      |          | 57°      |     |     | 57°       |     |     |                 |

(1)  $R_L$  and  $C_L$  terminated to 2.5V.

(2) Measured at -0.1dB.

## 5.5 TLE2141C Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                                    |                      | T <sub>A</sub> <sup>(1)</sup> | TLE2141C              |             |               | TLE2141AC |     |       | UNIT |
|------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------|----------------------|-------------------------------|-----------------------|-------------|---------------|-----------|-----|-------|------|
|                  |                                                                       |                                                                    |                      |                               | MIN                   | TYP         | MAX           | MIN       | TYP | MAX   |      |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>IC</sub> = 0V, R <sub>S</sub> = 50Ω,<br>V <sub>O</sub> = 0V |                      | 25°C                          | 200                   | 900         | 175           | 500       | μV  |       |      |
|                  | Full range                                                            |                                                                    |                      | 1300                          |                       |             | 800           |           |     |       |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                                    |                      | Full range                    | 1.7                   |             |               | 1.7       |     | μV/°C |      |
| I <sub>IO</sub>  | Input offset current                                                  |                                                                    |                      | 25°C                          | 7                     | 100         | 7             | 100       | nA  |       |      |
|                  |                                                                       |                                                                    |                      | Full range                    | 150                   |             |               | 150       |     |       |      |
| I <sub>IB</sub>  | Input bias current                                                    |                                                                    |                      | 25°C                          | −0.7                  | −1.5        | −0.7          | −1.5      | μA  |       |      |
|                  |                                                                       | Full range                                                         | −1.6                 |                               |                       | −1.6        |               |           |     |       |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                               | 25°C                 | −15 to 13                     | −15.3 to 13.2         | −15 to 13   | −15.3 to 13.2 | V         |     |       |      |
|                  |                                                                       |                                                                    | Full range           | −15 to 12.9                   | 15.3 to 13.1          | −15 to 12.9 | −15.3 to 13.1 |           |     |       |      |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                            | I <sub>O</sub> = −150μA                                            | 25°C                 | 13.8                          | 14.1                  | 13.8        | 14.1          | V         |     |       |      |
|                  |                                                                       |                                                                    | Full range           | 13.7                          | 13.7                  |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = −1.5mA                                            | 25°C                 | 13.7                          | 14                    | 13.7        | 14            |           |     |       |      |
|                  |                                                                       |                                                                    | Full range           | 13.6                          | 13.6                  |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = −15mA                                             | 25°C                 | 13.1                          | 13.7                  | 13.1        | 13.7          |           |     |       |      |
|                  |                                                                       |                                                                    | Full range           | 13                            | 13                    |             |               |           |     |       |      |
| V <sub>OM−</sub> | Maximum negative peak output voltage swing                            | I <sub>O</sub> = 150μA                                             | 25°C                 | −14.7                         | −14.9                 | −14.7       | −14.9         | V         |     |       |      |
|                  |                                                                       |                                                                    | Full range           | −14.6                         | −14.6                 |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 1.5mA                                             | 25°C                 | −14.5                         | −14.8                 | −14.5       | −14.8         |           |     |       |      |
|                  |                                                                       |                                                                    | Full range           | −14.4                         | −14.4                 |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 15mA                                              | 25°C                 | −13.4                         | −13.8                 | −13.4       | −13.8         | V         |     |       |      |
|                  |                                                                       |                                                                    | Full range           | −13.3                         | −13.3                 |             |               |           |     |       |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>O</sub> = ±10V                                              | 25°C                 | 100                           | 450                   | 100         | 450           | V/mV      |     |       |      |
|                  |                                                                       |                                                                    | Full range           | 75                            | 75                    |             |               |           |     |       |      |
| r <sub>i</sub>   | Input resistance                                                      | R <sub>L</sub> = 2kΩ                                               |                      | 25°C                          | 65                    |             | 65            |           | MΩ  |       |      |
| c <sub>i</sub>   | Input capacitance                                                     |                                                                    |                      | 25°C                          | 2.5                   |             | 2.5           |           | pF  |       |      |
| Z <sub>o</sub>   | Open-loop output impedance                                            | f = 1MHz                                                           |                      | 25°C                          | 30                    |             | 30            |           | Ω   |       |      |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω       |                      | 25°C                          | 85                    | 108         | 85            | 108       | dB  |       |      |
|                  |                                                                       |                                                                    |                      | Full range                    | 80                    | 80          |               |           |     |       |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω         |                      | 25°C                          | 90                    | 106         | 90            | 106       | dB  |       |      |
|                  |                                                                       |                                                                    |                      | Full range                    | 85                    | 85          |               |           |     |       |      |
| I <sub>OS</sub>  | Short circuit output current                                          | V <sub>O</sub> = 0                                                 | V <sub>ID</sub> = 1V | 25°C                          | −25                   | −50         | −25           | −50       | mA  |       |      |
|                  |                                                                       |                                                                    |                      |                               | V <sub>ID</sub> = −1V | 20          | 31            | 20        |     | 31    |      |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 0V, No load                                       |                      | 25°C                          | 3.5                   | 4.5         | 3.5           | 4.5       | mA  |       |      |
|                  |                                                                       |                                                                    |                      | Full range                    | 4.7                   |             | 4.7           |           |     |       |      |

(1) Full range is 0°C to 70°C.

## 5.6 TLE2141C Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                                               |          | TLE2141C          |     |     | TLE2141AC         |     |     | UNIT    |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------|-------------------|-----|-----|-------------------|-----|-----|---------|
|                    |                                               |                                                                                                               |          | MIN               | TYP | MAX | MIN               | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = - 1, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 500pF                                           |          | 27 <sup>(2)</sup> | 45  |     | 27 <sup>(2)</sup> | 45  |     | V/μs    |
| SR-                | Negative slew rate                            |                                                                                                               |          | 27 <sup>(2)</sup> | 42  |     | 27 <sup>(2)</sup> | 42  |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = -1, 10V step                                                                                | To 0.1%  | 0.43              |     |     | 0.43              |     |     | μs      |
|                    |                                               |                                                                                                               | To 0.01% | 0.64              |     |     | 0.64              |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                                                |          | 15                |     |     | 15                |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                                                |          | 10.5              |     |     | 10.5              |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                                              |          | 0.48              |     |     | 0.48              |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                                             |          | 0.51              |     |     | 0.51              |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                                      |          | 1.89              |     |     | 1.89              |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                                      |          | 0.47              |     |     | 0.47              |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, <sup>(1)</sup><br>A <sub>VD</sub> = 10, f = 10 kHz            |          | 0.06%             |     |     | 0.06%             |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF <sup>(1)</sup>                                                   |          | 6                 |     |     | 6                 |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF, <sup>(1)</sup><br>f = 100kHz                                    |          | 5.9               |     |     | 5.9               |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(3)</sup> | V <sub>O(PP)</sub> = 2V , R <sub>L</sub> = 2kΩ,<br>A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF <sup>(1)</sup> |          | 668               |     |     | 668               |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF <sup>(1)</sup>                                                   |          | 58°               |     |     | 58°               |     |     |         |

(1)  $R_L$  and  $C_L$  terminated to 2.5V .

(2) Specified by characterization.

(3) Measured at -0.1dB.



## 5.7 TLE2142C Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER        |                                                                          | TEST CONDITIONS                                                                 | T <sub>A</sub> <sup>(1)</sup> | TLE2142C |             |          | TLE2142AC   |       |     | UNIT |
|------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------|----------|-------------|----------|-------------|-------|-----|------|
|                  |                                                                          |                                                                                 |                               | MIN      | TYP         | MAX      | MIN         | TYP   | MAX |      |
| V <sub>IO</sub>  | Input offset voltage                                                     | V <sub>O</sub> = 2.5V , R <sub>S</sub> = 50Ω,<br>V <sub>IC</sub> = 2.5V         | 25°C                          | 220      | 1900        | 200      | 1500        | μV    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 2200     |             |          | 1800        |       |     |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                          |                                                                                 | Full range                    | 1.7      |             |          | 1.7         | μV/°C |     |      |
| I <sub>IO</sub>  | Input offset current                                                     |                                                                                 | 25°C                          | 8        | 100         | 8        | 100         | nA    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 150      |             |          | 150         |       |     |      |
| I <sub>IB</sub>  | Input bias current                                                       |                                                                                 | 25°C                          | -0.8     | -2          | -0.8     | -2          | μA    |     |      |
|                  |                                                                          | Full range                                                                      | -2.1                          |          |             | -2.1     |             |       |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                          | R <sub>S</sub> = 50Ω                                                            | 25°C                          | 0 to 3   | -0.3 to 3.2 | 0 to 3   | -0.3 to 3.2 | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 0 to 2.9 |             | 0 to 2.9 |             | V     |     |      |
| V <sub>OH</sub>  | High-level output voltage                                                | I <sub>OH</sub> = -150μA                                                        | 25°C                          | 3.9      | 4.1         | 3.9      | 4.1         | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 3.8      |             |          | 3.8         |       |     |      |
|                  |                                                                          | I <sub>OH</sub> = -1.5mA                                                        | 25°C                          | 3.8      | 4           | 3.8      | 4           | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 3.7      |             |          | 3.7         |       |     |      |
|                  |                                                                          | I <sub>OH</sub> = -15mA                                                         | 25°C                          | 3.4      | 3.7         | 3.4      | 3.7         | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 3.4      |             |          | 3.4         |       |     |      |
| V <sub>OL</sub>  | Low-level output voltage                                                 | I <sub>OL</sub> = 150μA                                                         | 25°C                          | 75       | 125         | 75       | 125         | mV    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 150      |             |          | 150         |       |     |      |
|                  |                                                                          | I <sub>OL</sub> = 1.5mA                                                         | 25°C                          | 150      | 225         | 150      | 225         |       |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 250      |             |          | 250         |       |     |      |
|                  |                                                                          | I <sub>OL</sub> = 15mA                                                          | 25°C                          | 1.2      | 1.4         | 1.2      | 1.4         | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 1.5      |             |          | 1.5         |       |     |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                          | V <sub>CC</sub> = ±2.5V , R <sub>L</sub> = 2kΩ,<br>V <sub>O</sub> = 1V to -1.5V | 25°C                          | 50       | 220         | 50       | 220         | V/mV  |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 25       |             |          | 25          |       |     |      |
| r <sub>i</sub>   | Input resistance                                                         |                                                                                 | 25°C                          | 70       |             |          | 70          | MΩ    |     |      |
| c <sub>i</sub>   | Input capacitance                                                        |                                                                                 | 25°C                          | 2.5      |             |          | 2.5         | pF    |     |      |
| Z <sub>O</sub>   | Open-loop output impedance                                               | f = 1MHz                                                                        | 25°C                          | 30       |             |          | 30          | Ω     |     |      |
| CMRR             | Common-mode rejection ratio                                              | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω                    | 25°C                          | 85       | 118         | 85       | 118         | dB    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 80       |             |          | 80          |       |     |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio<br>(ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω                      | 25°C                          | 90       | 106         | 90       | 106         | dB    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 85       |             |          | 85          |       |     |      |
| I <sub>CC</sub>  | Supply current                                                           | V <sub>O</sub> = 2.5V , No load, V <sub>IC</sub> = 2.5V                         | 25°C                          | 6.6      | 8.8         | 6.6      | 8.8         | mA    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 9.2      |             |          | 9.2         |       |     |      |

(1) Full range is 0°C to 70°C.

## 5.8 TLE2142C Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER   |                                               | TEST CONDITIONS                                                                      |          | TLE2142C |     |     | TLE2142AC |     |     | UNIT            |
|-------------|-----------------------------------------------|--------------------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|-----------------|
|             |                                               |                                                                                      |          | MIN      | TYP | MAX | MIN       | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$C_L = 500pF$                   |          | 45       |     |     | 45        |     |     | V/ $\mu s$      |
| SR-         | Negative slew rate                            |                                                                                      |          | 42       |     |     | 42        |     |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1$ , 2.5V step                                                            | To 0.1%  | 0.66     |     |     | 0.66      |     |     | $\mu s$         |
|             |                                               |                                                                                      | To 0.01% | 0.99     |     |     | 0.99      |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 10Hz$                                                        |          | 15       |     |     | 15        |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega$ , $f = 1kHz$                                                        |          | 10.5     |     |     | 10.5      |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to $1Hz$                                                                 |          | 0.48     |     |     | 0.48      |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to $10Hz$                                                                |          | 0.51     |     |     | 0.51      |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                                           |          | 1.92     |     |     | 1.92      |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                                           |          | 0.5      |     |     | 0.5       |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_O = 1V$ to $3V$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 2$ , $f = 10kHz$ |          | 0.0052%  |     |     | 0.0052%   |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$                                      |          | 5.9      |     |     | 5.9       |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$ ,<br>$f = 100kHz$                    |          | 5.8      |     |     | 5.8       |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 1$ , $C_L = 100pF$ |          | 380      |     |     | 380       |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$                                      |          | 57°      |     |     | 57°       |     |     |                 |

(1)  $R_L$  terminated to 2.5V.

(2) Measured at -0.1dB.

## 5.9 TLE2142C Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                                    |                      | T <sub>A</sub> <sup>(1)</sup> | TLE2142C              |             |               | TLE2142AC |     |     | UNIT  |
|------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------|----------------------|-------------------------------|-----------------------|-------------|---------------|-----------|-----|-----|-------|
|                  |                                                                       |                                                                    |                      |                               | MIN                   | TYP         | MAX           | MIN       | TYP | MAX |       |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>IC</sub> = 0V, R <sub>S</sub> = 50Ω,<br>V <sub>O</sub> = 0V |                      | 25°C                          | 290                   | 1200        | 275           | 750       | μV  |     |       |
|                  | Full range                                                            |                                                                    |                      | 1600                          |                       |             | 1200          |           |     |     |       |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                                    |                      | Full range                    | 1.7                   |             |               | 1.7       |     |     | μV/°C |
| I <sub>IO</sub>  | Input offset current                                                  |                                                                    |                      | 25°C                          | 7                     | 100         | 7             | 100       | nA  |     |       |
|                  |                                                                       |                                                                    |                      | Full range                    | 150                   |             |               | 150       |     |     |       |
| I <sub>IB</sub>  | Input bias current                                                    |                                                                    |                      | 25°C                          | −0.7                  | −1.5        | −0.7          | −1.5      | μA  |     |       |
|                  |                                                                       | Full range                                                         | −1.6                 |                               |                       | −1.6        |               |           |     |     |       |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                               | 25°C                 | −15 to 13                     | −15.3 to 13.2         | −15 to 13   | −15.3 to 13.2 | V         |     |     |       |
|                  |                                                                       |                                                                    | Full range           | −15 to 12.9                   | 15.3 to 13.1          | −15 to 12.9 | −15.3 to 13.1 | V         |     |     |       |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                            | I <sub>O</sub> = −150μA                                            | 25°C                 | 13.8                          | 14.1                  | 13.8        | 14.1          | V         |     |     |       |
|                  |                                                                       |                                                                    | Full range           | 13.7                          |                       |             |               |           |     |     |       |
|                  |                                                                       | I <sub>O</sub> = −1.5mA                                            | 25°C                 | 13.7                          | 14                    | 13.7        | 14            |           |     |     |       |
|                  |                                                                       |                                                                    | Full range           | 13.6                          |                       |             |               |           |     |     |       |
|                  |                                                                       | I <sub>O</sub> = −15mA                                             | 25°C                 | 13.3                          | 13.7                  | 13.2        | 13.7          |           |     |     |       |
|                  |                                                                       |                                                                    | Full range           | 13.2                          |                       |             |               |           |     |     |       |
| V <sub>OM−</sub> | Maximum negative peak output voltage swing                            | I <sub>O</sub> = 150μA                                             | 25°C                 | −14.7                         | −14.9                 | −14.7       | −14.9         | V         |     |     |       |
|                  |                                                                       |                                                                    | Full range           | −14.6                         |                       |             |               |           |     |     |       |
|                  |                                                                       | I <sub>O</sub> = 1.5mA                                             | 25°C                 | −14.5                         | −14.8                 | −14.5       | −14.8         |           |     |     |       |
|                  |                                                                       |                                                                    | Full range           | −14.4                         |                       |             |               |           |     |     |       |
|                  |                                                                       | I <sub>O</sub> = 15mA                                              | 25°C                 | −13.4                         | −13.8                 | −13.4       | −13.8         | V         |     |     |       |
|                  |                                                                       |                                                                    | Full range           | −13.3                         |                       |             |               |           |     |     |       |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>O</sub> = ±10V                                              | 25°C                 | 100                           | 450                   | 100         | 450           | V/mV      |     |     |       |
|                  |                                                                       |                                                                    | Full range           | 75                            |                       |             |               |           |     |     |       |
| r <sub>i</sub>   | Input resistance                                                      | R <sub>L</sub> = 2kΩ                                               | 25°C                 | 65                            |                       |             | 65            | MΩ        |     |     |       |
| c <sub>i</sub>   | Input capacitance                                                     |                                                                    | 25°C                 | 2.5                           |                       |             | 2.5           | pF        |     |     |       |
| Z <sub>o</sub>   | Open-loop output impedance                                            | f = 1MHz                                                           | 25°C                 | 30                            |                       |             | 30            | Ω         |     |     |       |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω       |                      | 25°C                          | 85                    | 108         | 85            | 108       | dB  |     |       |
|                  |                                                                       |                                                                    |                      | Full range                    | 80                    |             |               |           |     |     |       |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω         |                      | 25°C                          | 90                    | 106         | 90            | 106       | dB  |     |       |
|                  |                                                                       |                                                                    |                      | Full range                    | 85                    |             |               |           |     |     |       |
| I <sub>OS</sub>  | Short circuit output current                                          | V <sub>O</sub> = 0                                                 | V <sub>ID</sub> = 1V | 25°C                          | −25                   | −50         | −25           | −50       | mA  |     |       |
|                  |                                                                       |                                                                    |                      |                               | V <sub>ID</sub> = −1V | 20          | 31            | 20        |     | 31  |       |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 0V, No load                                       |                      | 25°C                          |                       | 6.9         | 9             | 6.9       | 9   | mA  |       |
|                  |                                                                       |                                                                    |                      | Full range                    | 9.4                   |             |               |           |     |     |       |

(1) Full range is 0°C to 70°C.

## 5.10 TLE2142C Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                                               |          | TLE2142C          |     |       | TLE2142AC         |     |     | UNIT    |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------|-------------------|-----|-------|-------------------|-----|-----|---------|
|                    |                                               |                                                                                                               |          | MIN               | TYP | MAX   | MIN               | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = - 1, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 500pF                                           |          | 27 <sup>(2)</sup> | 45  |       | 27 <sup>(2)</sup> | 45  |     | V/μs    |
| SR–                | Negative slew rate                            |                                                                                                               |          | 27 <sup>(2)</sup> | 42  |       | 27 <sup>(2)</sup> | 42  |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = -1, 10V step                                                                                | To 0.1%  | 0.43              |     | 0.43  |                   |     |     | μs      |
|                    |                                               |                                                                                                               | To 0.01% | 0.64              |     | 0.64  |                   |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                                                |          | 15                |     | 15    |                   |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                                                |          | 10.5              |     | 10.5  |                   |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                                              |          | 0.48              |     | 0.48  |                   |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                                             |          | 0.51              |     | 0.51  |                   |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                                      |          | 1.89              |     | 1.89  |                   |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                                      |          | 0.47              |     | 0.47  |                   |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, <sup>(1)</sup><br>A <sub>VD</sub> = 10, f = 10kHz             |          | 0.06%             |     | 0.06% |                   |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF <sup>(1)</sup>                                                   |          | 6                 |     | 6     |                   |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF, <sup>(1)</sup><br>f = 100kHz                                    |          | 5.9               |     | 5.9   |                   |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(1)</sup> | V <sub>O(PP)</sub> = 2V , R <sub>L</sub> = 2kΩ,<br>A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF <sup>(1)</sup> |          | 668               |     | 668   |                   |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF <sup>(1)</sup>                                                   |          | 58°               |     | 58°   |                   |     |     |         |

(1) Measured at -0.1dB.

## 5.11 TLE2144C Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER        |                                                                          | TEST CONDITIONS                                                                 | T <sub>A</sub> <sup>(1)</sup> | TLE2144C   |             |            | TLE2144AC   |       |     | UNIT |
|------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------|------------|-------------|------------|-------------|-------|-----|------|
|                  |                                                                          |                                                                                 |                               | MIN        | TYP         | MAX        | MIN         | TYP   | MAX |      |
| V <sub>IO</sub>  | Input offset voltage                                                     | V <sub>O</sub> = 2.5V , R <sub>S</sub> = 50Ω,<br>V <sub>IC</sub> = 2.5V         | 25°C                          | 0.5    3.8 |             | 0.5    3   |             | mV    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 4.4        |             | 3.6        |             |       |     |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                          |                                                                                 | Full range                    | 1.7        |             | 1.7        |             | μV/°C |     |      |
| I <sub>IO</sub>  | Input offset current                                                     |                                                                                 | 25°C                          | 8    100   |             | 8    100   |             | nA    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 150        |             | 150        |             |       |     |      |
| I <sub>IB</sub>  | Input bias current                                                       |                                                                                 | 25°C                          | −0.8    −2 |             | −0.8    −2 |             | μA    |     |      |
|                  |                                                                          | Full range                                                                      | −2.1                          |            | −2.1        |            |             |       |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                          | R <sub>S</sub> = 50Ω                                                            | 25°C                          | 0 to 3     | −0.3 to 3.2 | 0 to 3     | −0.3 to 3.2 | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 0 to 2.9   |             | 0 to 2.9   |             | V     |     |      |
| V <sub>OH</sub>  | High-level output voltage                                                | I <sub>OH</sub> = −150μA                                                        | 25°C                          | 3.9        | 4.1         | 3.9        | 4.1         | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 3.8        |             | 3.8        |             |       |     |      |
|                  |                                                                          | I <sub>OH</sub> = −1.5mA                                                        | 25°C                          | 3.8        | 4           | 3.8        | 4           | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 3.7        |             | 3.7        |             |       |     |      |
|                  |                                                                          | I <sub>OH</sub> = −15mA                                                         | 25°C                          | 3.4        | 3.7         | 3.4        | 3.7         | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 3.4        |             | 3.4        |             |       |     |      |
| V <sub>OL</sub>  | Low-level output voltage                                                 | I <sub>OL</sub> = 150μA                                                         | 25°C                          | 75         | 125         | 75         | 125         | mV    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 150        |             | 150        |             |       |     |      |
|                  |                                                                          | I <sub>OL</sub> = 1.5mA                                                         | 25°C                          | 150        | 225         | 150        | 225         | mV    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 250        |             | 250        |             |       |     |      |
|                  |                                                                          | I <sub>OL</sub> = 15mA                                                          | 25°C                          | 1.2        | 1.6         | 1.2        | 1.6         | V     |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 1.7        |             | 1.7        |             |       |     |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                          | V <sub>CC</sub> = ±2.5V , R <sub>L</sub> = 2kΩ,<br>V <sub>O</sub> = 1V to −1.5V | 25°C                          | 50         | 95          | 50         | 95          | V/mV  |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 25         |             | 25         |             |       |     |      |
| r <sub>i</sub>   | Input resistance                                                         |                                                                                 | 25°C                          | 70         |             | 70         |             | MΩ    |     |      |
| c <sub>i</sub>   | Input capacitance                                                        |                                                                                 | 25°C                          | 2.5        |             | 2.5        |             | pF    |     |      |
| Z <sub>O</sub>   | Open-loop output impedance                                               | f = 1MHz                                                                        | 25°C                          | 30         |             | 30         |             | Ω     |     |      |
| CMRR             | Common-mode rejection ratio                                              | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω                    | 25°C                          | 85         | 118         | 85         | 118         | dB    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 80         |             | 80         |             |       |     |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio<br>(ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω                      | 25°C                          | 90         | 106         | 90         | 106         | dB    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 85         |             | 85         |             |       |     |      |
| I <sub>CC</sub>  | Supply current                                                           | V <sub>O</sub> = 2.5V , No load, V <sub>IC</sub> = 2.5V                         | 25°C                          | 13.2       | 17.6        | 13.2       | 17.6        | mA    |     |      |
|                  |                                                                          |                                                                                 | Full range                    | 18.5       |             | 18.5       |             |       |     |      |

(1) Full range is 0°C to 70°C.

## 5.12 TLE2144C Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER   |                                               | TEST CONDITIONS                                                                      |          | TLE2144C |     |     | TLE2144AC |     |     | UNIT            |
|-------------|-----------------------------------------------|--------------------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|-----------------|
|             |                                               |                                                                                      |          | MIN      | TYP | MAX | MIN       | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega^{(1)}$ ,<br>$C_L = 500pF$                            |          | 45       |     |     | 45        |     |     | V/ $\mu s$      |
| SR–         | Negative slew rate                            |                                                                                      |          | 42       |     |     | 42        |     |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1$ , 2.5V step                                                            | To 0.1%  | 0.66     |     |     | 0.66      |     |     | $\mu s$         |
|             |                                               |                                                                                      | To 0.01% | 0.99     |     |     | 0.99      |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 10Hz$                                                        |          | 15       |     |     | 15        |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega$ , $f = 1kHz$                                                        |          | 10.5     |     |     | 10.5      |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to 1Hz                                                                   |          | 0.48     |     |     | 0.48      |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to 10Hz                                                                  |          | 0.51     |     |     | 0.51      |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                                           |          | 1.92     |     |     | 1.92      |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                                           |          | 0.5      |     |     | 0.5       |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_O = 1V$ to 3V , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 2$ , $f = 10kHz$   |          | 0.0052%  |     |     | 0.0052%   |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$                                               |          | 5.9      |     |     | 5.9       |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$ ,<br>$f = 100kHz$                             |          | 5.8      |     |     | 5.8       |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 1$ , $C_L = 100pF$ |          | 380      |     |     | 380       |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$                                               |          | 57°      |     |     | 57°       |     |     |                 |

(1)  $R_L$  terminated to 2.5V.

(2) Measured at -0.1dB.

## 5.13 TLE2144C Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER                                                                       | TEST CONDITIONS                                           | $T_A$ <sup>(1)</sup> | TLE2144C          |                     |      | TLE2144AC         |                     |      | UNIT             |
|---------------------------------------------------------------------------------|-----------------------------------------------------------|----------------------|-------------------|---------------------|------|-------------------|---------------------|------|------------------|
|                                                                                 |                                                           |                      | MIN               | TYP                 | MAX  | MIN               | TYP                 | MAX  |                  |
| $V_{IO}$ Input offset voltage                                                   | $V_{IC} = 0$ , $R_S = 50\Omega$ ,<br>$V_O = 0$            | 25°C                 |                   | 0.6                 | 2.4  |                   | 0.5                 | 1.5  | $\mu V$          |
|                                                                                 |                                                           | Full range           |                   |                     | 3.2  |                   |                     | 2.4  |                  |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage                  |                                                           | Full range           |                   | 1.7                 |      |                   | 1.7                 |      | $\mu V/^\circ C$ |
| $I_{IO}$ Input offset current                                                   |                                                           | 25°C                 |                   | 7                   | 100  |                   | 7                   | 100  | nA               |
|                                                                                 |                                                           | Full range           |                   |                     | 150  |                   |                     | 150  |                  |
| $I_{IB}$ Input bias current                                                     |                                                           | 25°C                 |                   | –0.7                | –1.5 |                   | –0.7                | –1.5 | $\mu A$          |
|                                                                                 |                                                           | Full range           |                   |                     | –1.6 |                   |                     | –1.6 |                  |
| $V_{ICR}$ Common-mode input voltage range                                       | $R_S = 50\Omega$                                          | 25°C                 | –15<br>to<br>13   | –15.3<br>to<br>13.2 |      | –15<br>to<br>13   | –15.3<br>to<br>13.2 |      | V                |
|                                                                                 |                                                           | Full range           | –15<br>to<br>12.9 | 15.3<br>to<br>13.1  |      | –15<br>to<br>12.9 | –15.3<br>to<br>13.1 |      | V                |
| $V_{OM+}$ Maximum positive peak output voltage swing                            | $I_O = -150\mu A$                                         | 25°C                 | 13.8              | 14.1                |      | 13.8              | 14.1                |      | V                |
|                                                                                 |                                                           | Full range           | 13.7              |                     |      | 13.7              |                     |      |                  |
|                                                                                 | $I_O = -1.5mA$                                            | 25°C                 | 13.7              | 14                  |      | 13.7              | 14                  |      |                  |
|                                                                                 |                                                           | Full range           | 13.6              |                     |      | 13.6              |                     |      |                  |
|                                                                                 | $I_O = -15mA$                                             | 25°C                 | 13.1              | 13.7                |      | 13.1              | 13.7                |      |                  |
|                                                                                 |                                                           | Full range           | 13                |                     |      | 13                |                     |      |                  |
| $V_{OM-}$ Maximum negative peak output voltage swing                            | $I_O = 150\mu A$                                          | 25°C                 | –14.7             | –14.9               |      | –14.7             | –14.9               |      | V                |
|                                                                                 |                                                           | Full range           | –14.6             |                     |      | –14.6             |                     |      |                  |
|                                                                                 | $I_O = 1.5mA$                                             | 25°C                 | –14.5             | –14.8               |      | –14.5             | –14.8               |      |                  |
|                                                                                 |                                                           | Full range           | –14.4             |                     |      | –14.4             |                     |      |                  |
|                                                                                 | $I_O = 15mA$                                              | 25°C                 | –13.4             | –13.8               |      | –13.4             | –13.8               |      | V                |
|                                                                                 |                                                           | Full range           | –13.3             |                     |      | –13.3             |                     |      |                  |
| $A_{VD}$ Large-signal differential voltage amplification                        | $V_O = \pm 10V$ , $R_L = 2k\Omega$                        | 25°C                 | 100               | 170                 |      | 100               | 170                 |      | V/mV             |
|                                                                                 |                                                           | Full range           | 75                |                     |      | 75                |                     |      |                  |
| $r_i$ Input resistance                                                          |                                                           | 25°C                 |                   | 65                  |      |                   | 65                  |      | M $\Omega$       |
| $c_i$ Input capacitance                                                         |                                                           | 25°C                 |                   | 2.5                 |      |                   | 2.5                 |      | pF               |
| $z_o$ Open-loop output impedance                                                | $f = 1MHz$                                                | 25°C                 |                   | 30                  |      |                   | 30                  |      | $\Omega$         |
| CMRR Common-mode rejection ratio                                                | $V_{IC} = V_{ICRmin}$ , $R_S = 50\Omega$                  | 25°C                 | 85                | 108                 |      | 85                | 108                 |      | dB               |
|                                                                                 |                                                           | Full range           | 80                |                     |      | 80                |                     |      |                  |
| $k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ ) | $V_{CC\pm} = \pm 2.5V$ to $\pm 15V$ ,<br>$R_S = 50\Omega$ | 25°C                 | 90                | 106                 |      | 90                | 106                 |      | dB               |
|                                                                                 |                                                           | Full range           | 85                |                     |      | 85                |                     |      |                  |
| $I_{OS}$ Short circuit output current                                           | $V_O = 0$                                                 | 25°C                 | $V_{ID} = 1V$     |                     | –25  | –50               | –25                 | –50  | mA               |
|                                                                                 |                                                           |                      | $V_{ID} = -1V$    |                     | 20   | 31                | 20                  | 31   |                  |
| $I_{CC}$ Supply current                                                         | $V_O = 0V$ , No load                                      | 25°C                 |                   | 13.8                | 18   |                   | 13.8                | 18   | mA               |
|                                                                                 |                                                           | Full range           |                   |                     | 18.8 |                   |                     | 18.8 |                  |

(1) Full range is 0°C to 70°C.

## 5.14 TLE2144C Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                             |          | TLE2144C        |     |     | TLE2144AC       |     |     | UNIT    |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|----------|-----------------|-----|-----|-----------------|-----|-----|---------|
|                    |                                               |                                                                                             |          | MIN             | TYP | MAX | MIN             | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = - 1, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 500pF                         |          | 27 <sup>1</sup> | 45  |     | 27 <sup>1</sup> | 45  |     | V/μs    |
| SR-                | Negative slew rate                            |                                                                                             |          | 27 <sup>1</sup> | 42  |     | 27 <sup>1</sup> | 42  |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = -1, 10V step                                                              | To 0.1%  | 0.43            |     |     | 0.43            |     |     | μs      |
|                    |                                               |                                                                                             | To 0.01% | 0.64            |     |     | 0.64            |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                              |          | 15              |     |     | 15              |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                              |          | 10.5            |     |     | 10.5            |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                            |          | 0.48            |     |     | 0.48            |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                           |          | 0.51            |     |     | 0.51            |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                    |          | 1.89            |     |     | 1.89            |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                    |          | 0.47            |     |     | 0.47            |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 10, f = 10kHz             |          | 0.06%           |     |     | 0.06%           |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 6               |     |     | 6               |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF, f = 100kHz                                    |          | 5.9             |     |     | 5.9             |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(2)</sup> | V <sub>O(PP)</sub> = 2V , R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF |          | 668             |     |     | 668             |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 58°             |     |     | 58°             |     |     |         |

(1) Specified by characterization.

(2) Measured at -0.1dB.



## 5.15 TLE2141I Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER                                                                          | TEST CONDITIONS                                                   | $T_A$ <sup>(1)</sup> | TLE2141I       |                   |      | TLE2141AI      |                   |      | UNIT             |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------|----------------------|----------------|-------------------|------|----------------|-------------------|------|------------------|
|                                                                                    |                                                                   |                      | MIN            | TYP               | MAX  | MIN            | TYP               | MAX  |                  |
| $V_{IO}$ Input offset voltage                                                      | $V_O = 2.5V$ , $R_S = 50\Omega$ ,<br>$V_{IC} = 2.5V$              | 25°C                 |                | 225               | 1400 |                | 200               | 1000 | mV               |
|                                                                                    |                                                                   | Full range           |                |                   | 1900 |                |                   | 1500 |                  |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage                     |                                                                   | Full range           |                | 1.7               |      |                | 1.7               |      | $\mu V/^\circ C$ |
| $I_{IO}$ Input offset current                                                      |                                                                   | 25°C                 |                | 8                 | 100  |                | 8                 | 100  | nA               |
|                                                                                    |                                                                   | Full range           |                |                   | 200  |                |                   | 200  |                  |
| $I_{IB}$ Input bias current                                                        |                                                                   | 25°C                 |                | –0.8              | –2   |                | –0.8              | –2   | $\mu A$          |
|                                                                                    |                                                                   | Full range           |                |                   | –2.2 |                |                   | –2.2 |                  |
| $V_{ICR}$ Common-mode input voltage range                                          | $R_S = 50\Omega$                                                  | 25°C                 | 0<br>to<br>3   | –0.3<br>to<br>3.2 |      | 0<br>to<br>3   | –0.3<br>to<br>3.2 |      | V                |
|                                                                                    |                                                                   | Full range           | 0<br>to<br>2.7 | –0.3<br>to<br>2.9 |      | 0<br>to<br>2.7 | –0.3<br>to<br>2.9 |      | V                |
| $V_{OH}$ High-level output voltage                                                 | $I_{OH} = -150\mu A$                                              | 25°C                 | 3.9            | 4.1               |      | 3.9            | 4.1               |      | V                |
|                                                                                    | $I_{OH} = -1.5mA$                                                 |                      | 3.8            | 4                 |      | 3.8            | 4                 |      |                  |
|                                                                                    | $I_{OH} = -15mA$                                                  |                      | 3.2            | 3.7               |      | 3.2            | 3.7               |      |                  |
|                                                                                    | $I_{OH} = -100\mu A$                                              | Full range           | 3.8            |                   |      | 3.8            |                   |      | V                |
|                                                                                    | $I_{OH} = -1mA$                                                   |                      | 3.7            |                   |      | 3.7            |                   |      |                  |
|                                                                                    | $I_{OH} = -10mA$                                                  |                      | 3.3            |                   |      | 3.3            |                   |      |                  |
| $V_{OL}$ Low-level output voltage                                                  | $I_{OL} = 150\mu A$                                               | 25°C                 |                | 75                | 125  |                | 75                | 125  | mV               |
|                                                                                    | $I_{OL} = 1.5mA$                                                  |                      |                | 150               | 225  |                | 150               | 225  |                  |
|                                                                                    | $I_{OL} = 15mA$                                                   |                      |                | 1.2               | 1.6  |                | 1.2               | 1.6  | V                |
|                                                                                    | $I_{OL} = 100\mu A$                                               | Full range           |                |                   | 175  |                |                   | 175  | mV               |
|                                                                                    | $I_{OL} = 1mA$                                                    |                      |                |                   | 225  |                |                   | 225  |                  |
|                                                                                    | $I_{OL} = 10mA$                                                   |                      |                |                   | 1.4  |                |                   | 1.4  | V                |
| $A_{VD}$ Large-signal differential voltage amplification                           | $V_{CC} = \pm 2.5V$ , $R_L = 2k\Omega$ ,<br>$V_O = 1V$ to $-1.5V$ | 25°C                 | 50             | 220               |      | 50             | 220               |      | V/mV             |
|                                                                                    |                                                                   | Full range           | 10             |                   |      | 10             |                   |      |                  |
| $r_i$ Input resistance                                                             |                                                                   | 25°C                 |                | 70                |      |                | 70                |      | M $\Omega$       |
| $c_i$ Input capacitance                                                            |                                                                   | 25°C                 |                | 2.5               |      |                | 2.5               |      | pF               |
| $z_o$ Open-loop output impedance                                                   | $f = 1MHz$                                                        | 25°C                 |                | 30                |      |                | 30                |      | $\Omega$         |
| CMRR Common-mode rejection ratio                                                   | $V_{IC} = V_{ICRmin}$ , $R_S = 50\Omega$                          | 25°C                 | 85             | 118               |      | 85             | 118               |      | dB               |
|                                                                                    |                                                                   | Full range           | 80             |                   |      | 80             |                   |      |                  |
| $k_{SVR}$ Supply-voltage rejection ratio<br>( $\Delta V_{CC\pm} / \Delta V_{IO}$ ) | $V_{CC\pm} = \pm 2.5V$ to $\pm 15V$ ,<br>$R_S = 50\Omega$         | 25°C                 | 90             | 106               |      | 90             | 106               |      | dB               |
|                                                                                    |                                                                   | Full range           | 85             |                   |      | 85             |                   |      |                  |
| $I_{CC}$ Supply current                                                            | $V_O = 2.5V$ , No load, $V_{IC} = 2.5V$                           | 25°C                 |                | 3.4               | 4.4  |                | 3.4               | 4.4  | mA               |
|                                                                                    |                                                                   | Full range           |                |                   | 4.6  |                |                   | 4.6  |                  |

(1) Full range is  $-40^\circ C$  to  $105^\circ C$ .

## 5.16 TLE2141I Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                                               |          | TLE2141I |     |     | TLE2141AI |     |     | UNIT    |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|---------|
|                    |                                               |                                                                                                               |          | MIN      | TYP | MAX | MIN       | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = -1, R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 500pF                            |          | 45       |     |     | 45        |     |     | V/μs    |
| SR-                | Negative slew rate                            |                                                                                                               |          | 42       |     |     | 42        |     |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = -1, 2.5V step                                                                               | To 0.1%  | 0.66     |     |     | 0.66      |     |     | μs      |
|                    |                                               |                                                                                                               | To 0.01% | 0.99     |     |     | 0.99      |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                                                |          | 15       |     |     | 15        |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                                                |          | 10.5     |     |     | 10.5      |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                                              |          | 0.48     |     |     | 0.48      |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                                             |          | 0.51     |     |     | 0.51      |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                                      |          | 1.92     |     |     | 1.92      |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                                      |          | 0.5      |     |     | 0.5       |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O</sub> = 1V to 3V , R <sub>L</sub> = 2kΩ, <sup>(1)</sup><br>A <sub>VD</sub> = 2, f = 10kHz            |          | 0.0052%  |     |     | 0.0052%   |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 100pF <sup>(1)</sup>                                   |          | 5.9      |     |     | 5.9       |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 100pF, <sup>(1)</sup><br>f = 100kHz                    |          | 5.8      |     |     | 5.8       |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(2)</sup> | V <sub>O(PP)</sub> = 2V , R <sub>L</sub> = 2kΩ, <sup>(1)</sup><br>A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF |          | 380      |     |     | 380       |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 100pF <sup>(1)</sup>                                   |          | 57°      |     |     | 57°       |     |     |         |

(1)  $R_L$  and  $C_L$  terminated to 2.5V.

(2) Measured at -0.1dB.

## 5.17 TLE2141I Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                                  |                      | T <sub>A</sub> <sup>(1)</sup> | TLE2141I              |             |               | TLE2141AI |     |       | UNIT |
|------------------|-----------------------------------------------------------------------|------------------------------------------------------------------|----------------------|-------------------------------|-----------------------|-------------|---------------|-----------|-----|-------|------|
|                  |                                                                       |                                                                  |                      |                               | MIN                   | TYP         | MAX           | MIN       | TYP | MAX   |      |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>IC</sub> = 0, R <sub>S</sub> = 50Ω,<br>V <sub>O</sub> = 0 |                      | 25°C                          | 200                   | 900         | 175           | 500       | μV  |       |      |
|                  | Full range                                                            |                                                                  |                      | 1500                          |                       |             | 1000          |           |     |       |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                                  |                      | Full range                    | 1.7                   |             |               | 1.7       |     | μV/°C |      |
| I <sub>IO</sub>  | Input offset current                                                  |                                                                  |                      | 25°C                          | 7                     | 100         | 7             | 100       | nA  |       |      |
|                  |                                                                       |                                                                  |                      | Full range                    | 200                   |             |               | 200       |     |       |      |
| I <sub>IB</sub>  | Input bias current                                                    |                                                                  |                      | 25°C                          | −0.7                  | −1.5        | −0.7          | −1.5      | μA  |       |      |
|                  |                                                                       |                                                                  |                      | Full range                    | −1.7                  |             |               | −1.7      |     |       |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                             | 25°C                 | −15 to 13                     | −15.3 to 13.2         | −15 to 13   | −15.3 to 13.2 | V         |     |       |      |
|                  |                                                                       |                                                                  | Full range           | −15 to 12.7                   | 15.3 to 12.9          | −15 to 12.7 | −15.3 to 12.9 | V         |     |       |      |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                            | I <sub>O</sub> = −150μA                                          | 25°C                 | 13.8                          | 14.1                  | 13.8        | 14.1          | V         |     |       |      |
|                  |                                                                       | I <sub>O</sub> = −1.5mA                                          |                      | 13.7                          | 14                    | 13.7        | 14            |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = −15mA                                           |                      | 13.1                          | 13.7                  | 13.1        | 13.7          |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 100μA                                           | Full range           | 13.7                          | 13.7                  |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 1mA                                             |                      | 13.6                          | 13.6                  |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 10mA                                            |                      | 13.1                          | 13.1                  |             |               |           |     |       |      |
| V <sub>OM−</sub> | Maximum negative peak output voltage swing                            | I <sub>O</sub> = 150μA                                           | 25°C                 | −14.7                         | −14.9                 | −14.7       | −14.9         | V         |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 1.5mA                                           | −14.5                | −14.8                         | −14.5                 | −14.8       |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 15mA                                            | −13.4                | −13.8                         | −13.4                 | −13.8       |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 100μA                                           | Full range           | −14.6                         | −14.6                 |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 1mA                                             | −14.5                | −14.5                         |                       |             |               |           |     |       |      |
|                  |                                                                       | I <sub>O</sub> = 10mA                                            | −13.4                | −13.4                         |                       |             |               |           |     |       |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>O</sub> = ±10V, R <sub>L</sub> = 2kΩ                      | 25°C                 | 100                           | 450                   | 100         | 450           | V/mV      |     |       |      |
|                  |                                                                       |                                                                  | Full range           | 40                            | 40                    |             |               |           |     |       |      |
| r <sub>i</sub>   | Input resistance                                                      |                                                                  | 25°C                 | 65                            |                       |             | 65            |           |     | MΩ    |      |
| c <sub>i</sub>   | Input capacitance                                                     |                                                                  | 25°C                 | 2.5                           |                       |             | 2.5           |           |     | pF    |      |
| Z <sub>o</sub>   | Open-loop output impedance                                            | f = 1MHz                                                         | 25°C                 | 30                            |                       |             | 30            |           |     | Ω     |      |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω     |                      | 25°C                          | 85                    | 108         | 85            | 108       | dB  |       |      |
|                  |                                                                       |                                                                  |                      | Full range                    | 80                    | 80          |               |           |     |       |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω       |                      | 25°C                          | 90                    | 106         | 90            | 106       | dB  |       |      |
|                  |                                                                       |                                                                  |                      | Full range                    | 85                    | 85          |               |           |     |       |      |
| I <sub>OS</sub>  | Short circuit output current                                          | V <sub>O</sub> = 0                                               | V <sub>ID</sub> = 1V | 25°C                          | −25                   | −50         | −25           | −50       | mA  |       |      |
|                  |                                                                       |                                                                  |                      |                               | V <sub>ID</sub> = −1V | 20          | 31            | 20        |     |       | 31   |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 0V, No load                                     |                      | 25°C                          |                       | 3.5         | 4.5           | 3.5       | 4.5 | mA    |      |
|                  |                                                                       |                                                                  |                      | Full range                    | 4.7                   |             |               | 4.7       |     |       |      |

(1) Full range is  $-40^\circ C$  to  $105^\circ C$ .

## 5.18 TLE2141I Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                             |          | TLE2141I          |     |     | TLE2141AI         |     |     | UNIT    |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|----------|-------------------|-----|-----|-------------------|-----|-----|---------|
|                    |                                               |                                                                                             |          | MIN               | TYP | MAX | MIN               | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = - 1, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 500pF                         |          | 27 <sup>(1)</sup> | 45  |     | 27 <sup>(1)</sup> | 45  |     | V/μs    |
| SR–                | Negative slew rate                            |                                                                                             |          | 27 <sup>(1)</sup> | 42  |     | 27 <sup>(1)</sup> | 42  |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = -1, 10V step                                                              | To 0.1%  | 0.43              |     |     | 0.43              |     |     | μs      |
|                    |                                               |                                                                                             | To 0.01% | 0.64              |     |     | 0.64              |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                              |          | 15                |     |     | 15                |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                              |          | 10.5              |     |     | 10.5              |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                            |          | 0.48              |     |     | 0.48              |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                           |          | 0.51              |     |     | 0.51              |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                    |          | 1.89              |     |     | 1.89              |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                    |          | 0.47              |     |     | 0.47              |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 10, f = 10kHz             |          | 0.06%             |     |     | 0.06%             |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 6                 |     |     | 6                 |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF, f = 100kHz                                    |          | 5.9               |     |     | 5.9               |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(2)</sup> | V <sub>O(PP)</sub> = 2V , R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF |          | 668               |     |     | 668               |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 58°               |     |     | 58°               |     |     |         |

(1) Specified by characterization.

(2) Measured at -0.1dB.

## 5.19 TLE2142I Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                                                 | T <sub>A</sub> <sup>(1)</sup> | TLE2142I |             |          | TLE2142AI   |       |     | UNIT |
|------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------|----------|-------------|----------|-------------|-------|-----|------|
|                  |                                                                       |                                                                                 |                               | MIN      | TYP         | MAX      | MIN         | TYP   | MAX |      |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>O</sub> = 2.5V , R <sub>S</sub> = 50Ω,<br>V <sub>IC</sub> = 2.5V         | 25°C                          | 220      | 1900        | 220      | 1500        | μV    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 2400     |             |          | 2000        |       |     |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                                                 | Full range                    | 1.7      |             |          | 1.7         | μV/°C |     |      |
| I <sub>IO</sub>  | Input offset current                                                  |                                                                                 | 25°C                          | 8        | 100         | 8        | 100         | nA    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 200      |             |          | 200         |       |     |      |
| I <sub>IB</sub>  | Input bias current                                                    |                                                                                 | 25°C                          | −0.8     | −2          | −0.8     | −2          | μA    |     |      |
|                  |                                                                       | Full range                                                                      | −2.2                          |          |             | −2.2     |             |       |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                                            | 25°C                          | 0 to 3   | −0.3 to 3.2 | 0 to 3   | −0.3 to 3.2 | V     |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 0 to 2.7 | −0.3 to 2.9 | 0 to 2.7 | −0.3 to 2.9 | V     |     |      |
| V <sub>OH</sub>  | High-level output voltage                                             | I <sub>OH</sub> = −150μA                                                        | 25°C                          | 13.8     | 14.1        | 13.8     | 14.1        | V     |     |      |
|                  |                                                                       | I <sub>OH</sub> = −1.5mA                                                        |                               | 13.7     | 14          | 13.7     | 14          |       |     |      |
|                  |                                                                       | I <sub>OH</sub> = −15mA                                                         |                               | 13.1     | 13.7        | 13.1     | 13.7        |       |     |      |
|                  |                                                                       | I <sub>OH</sub> = 100μA                                                         | Full range                    | 13.7     | 13.7        |          |             |       |     |      |
|                  |                                                                       | I <sub>OH</sub> = 1mA                                                           |                               | 13.6     | 13.6        |          |             |       |     |      |
|                  |                                                                       | I <sub>OH</sub> = 10mA                                                          |                               | 13.1     | 13.1        |          |             |       |     |      |
| V <sub>OI</sub>  | Low-level output voltage                                              | I <sub>OL</sub> = 150μA                                                         | 25°C                          | 3.9      | 4.1         | 3.9      | 4.1         | mV    |     |      |
|                  |                                                                       | I <sub>OL</sub> = 1.5mA                                                         |                               | 3.8      | 4           | 3.8      | 4           |       |     |      |
|                  |                                                                       | I <sub>OL</sub> = 15mA                                                          |                               | 3.4      | 3.7         | 3.4      | 3.7         | V     |     |      |
|                  |                                                                       | I <sub>OL</sub> = 100μA                                                         | Full range                    | 3.8      | 3.8         |          |             | mV    |     |      |
|                  |                                                                       | I <sub>OL</sub> = 1mA                                                           |                               | 3.7      | 3.7         |          |             |       |     |      |
|                  |                                                                       | I <sub>OL</sub> = 10mA                                                          |                               | 3.5      | 3.5         |          |             | V     |     |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>IC</sub> = ±2.5V , R <sub>L</sub> = 2kΩ,<br>V <sub>O</sub> = 1V to −1.5V | 25°C                          | 50       | 220         | 50       | 220         | V/mV  |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 10       | 10          |          |             |       |     |      |
| r <sub>i</sub>   | Input resistance                                                      |                                                                                 | 25°C                          | 70       |             |          | 70          | MΩ    |     |      |
| c <sub>i</sub>   | Input capacitance                                                     |                                                                                 | 25°C                          | 2.5      |             |          | 2.5         | pF    |     |      |
| Z <sub>O</sub>   | Open-loop output impedance                                            | f = 1MHz                                                                        | 25°C                          | 30       |             |          | 30          | Ω     |     |      |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω                    | 25°C                          | 85       | 118         | 85       | 118         | dB    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 80       | 80          |          |             |       |     |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω                      | 25°C                          | 90       | 106         | 90       | 106         | dB    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 85       | 85          |          |             |       |     |      |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 2.5V , V <sub>IC</sub> = 2.5V , No load                        | 25°C                          | 6.6      | 8.8         | 6.6      | 8.8         | mA    |     |      |
|                  |                                                                       |                                                                                 | Full range                    | 9.2      |             |          | 9.2         |       |     |      |

(1) Full range is  $-40^\circ C$  to  $105^\circ C$ .

## 5.20 TLE2142I Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER   |                                               | TEST CONDITIONS                                                 |          | TLE2142I |     |     | TLE2142AI |     |     | UNIT            |
|-------------|-----------------------------------------------|-----------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|-----------------|
|             |                                               |                                                                 |          | MIN      | TYP | MAX | MIN       | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1, R_L = 2k\Omega^{(1)}, C_L = 500pF$                |          | 45       |     |     | 45        |     |     | V/ $\mu s$      |
| SR-         | Negative slew rate                            |                                                                 |          | 42       |     |     | 42        |     |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1, 2.5V$ step                                        | To 0.1%  | 0.66     |     |     | 0.66      |     |     | $\mu s$         |
|             |                                               |                                                                 | To 0.01% | 0.99     |     |     | 0.99      |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega, f = 10Hz$                                      |          | 15       |     |     | 15        |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega, f = 1kHz$                                      |          | 10.5     |     |     | 10.5      |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to $1Hz$                                            |          | 0.48     |     |     | 0.48      |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to $10Hz$                                           |          | 0.51     |     |     | 0.51      |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                      |          | 1.92     |     |     | 1.92      |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                      |          | 0.5      |     |     | 0.5       |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_O = 1V$ to $3V, R_L = 2k\Omega^{(1)}, A_{VD} = 2, f = 10kHz$ |          | 0.0052%  |     |     | 0.0052%   |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega^{(1)}, C_L = 100pF$                             |          | 5.9      |     |     | 5.9       |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega^{(1)}, C_L = 100pF, f = 100kHz$                 |          | 5.8      |     |     | 5.8       |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V, R_L = 2k\Omega^{(1)}, A_{VD} = 1, C_L = 100pF$ |          | 380      |     |     | 380       |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega^{(1)}, C_L = 100pF$                             |          | 57°      |     |     | 57°       |     |     |                 |

(1)  $R_L$  terminates at 2.5V .

(2) Measured at -0.1dB.

## 5.21 TLE2142I Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                                  |                       | T <sub>A</sub> <sup>(1)</sup> | TLE2142I    |               |             | TLE2142I      |      |       | UNIT |
|------------------|-----------------------------------------------------------------------|------------------------------------------------------------------|-----------------------|-------------------------------|-------------|---------------|-------------|---------------|------|-------|------|
|                  |                                                                       |                                                                  |                       |                               | MIN         | TYP           | MAX         | MIN           | TYP  | MAX   |      |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>IC</sub> = 0, R <sub>S</sub> = 50Ω,<br>V <sub>O</sub> = 0 |                       | 25°C                          | 290         | 1200          | 275         | 750           | μV   |       |      |
|                  | Full range                                                            |                                                                  |                       | 1800                          |             |               | 1400        |               |      |       |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                                  |                       | Full range                    | 1.7         |               |             | 1.7           |      | μV/°C |      |
| I <sub>IO</sub>  | Input offset current                                                  |                                                                  |                       | 25°C                          | 7           | 100           | 7           | 100           | nA   |       |      |
|                  |                                                                       |                                                                  |                       | Full range                    | 200         |               |             | 200           |      |       |      |
| I <sub>IB</sub>  | Input bias current                                                    |                                                                  |                       | 25°C                          | −0.7        | −1.5          | −0.7        | −1.5          | μA   |       |      |
|                  |                                                                       |                                                                  |                       | Full range                    | −1.7        |               |             | −1.7          |      |       |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                             |                       | 25°C                          | −15 to 13   | −15.3 to 13.2 | −15 to 13   | −15.3 to 13.2 | V    |       |      |
|                  |                                                                       |                                                                  |                       | Full range                    | −15 to 12.7 | 15.3 to 12.9  | −15 to 12.7 | −15.3 to 12.9 | V    |       |      |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                            | I <sub>O</sub> = −150μA                                          | 25°C                  | 13.8                          | 14.1        | 13.8          | 14.1        | V             |      |       |      |
|                  |                                                                       | I <sub>O</sub> = −1.5mA                                          |                       | 13.7                          | 14          | 13.7          | 14          |               |      |       |      |
|                  |                                                                       | I <sub>O</sub> = −15mA                                           |                       | 13.3                          | 13.7        | 13.3          | 13.7        |               |      |       |      |
|                  |                                                                       | I <sub>O</sub> = −100μA                                          | Full range            | 13.7                          | 13.7        | 13.7          | 13.7        | V             |      |       |      |
|                  |                                                                       | I <sub>O</sub> = −1mA                                            |                       | 13.6                          | 13.6        |               |             |               |      |       |      |
|                  |                                                                       | I <sub>O</sub> = −10mA                                           |                       | 13.3                          | 13.3        |               |             |               |      |       |      |
| V <sub>OM−</sub> | Maximum negative peak output voltage swing                            | I <sub>O</sub> = 150μA                                           | 25°C                  | −14.7                         | −14.9       | −14.7         | −14.9       | V             |      |       |      |
|                  |                                                                       | I <sub>O</sub> = 1.5mA                                           |                       | −14.5                         | −14.8       | −14.5         | −14.8       |               |      |       |      |
|                  |                                                                       | I <sub>O</sub> = 15mA                                            |                       | −13.4                         | −13.8       | −13.4         | −13.8       |               |      |       |      |
|                  |                                                                       | I <sub>O</sub> = 100μA                                           | Full range            | −14.6                         | −14.6       | V             |             |               |      |       |      |
|                  |                                                                       | I <sub>O</sub> = 1mA                                             |                       | −14.5                         | −14.5       |               |             |               |      |       |      |
|                  |                                                                       | I <sub>O</sub> = 10mA                                            |                       | −13.4                         | −13.4       |               |             |               |      |       |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>O</sub> = ±10V, R <sub>L</sub> = 2kΩ                      |                       | 25°C                          | 100         | 450           | 100         | 450           | V/mV |       |      |
|                  | Full range                                                            |                                                                  |                       | 40                            | 40          |               |             |               |      |       |      |
| r <sub>i</sub>   | Input resistance                                                      |                                                                  |                       | 25°C                          | 65          |               | 65          |               | MΩ   |       |      |
| c <sub>i</sub>   | Input capacitance                                                     |                                                                  |                       | 25°C                          | 2.5         |               | 2.5         |               | pF   |       |      |
| Z <sub>o</sub>   | Open-loop output impedance                                            | f = 1MHz                                                         |                       | 25°C                          | 30          |               | 30          |               | Ω    |       |      |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICR</sub> min                           |                       | 25°C                          | 85          | 108           | 85          | 108           | dB   |       |      |
|                  |                                                                       | R <sub>S</sub> = 50Ω                                             |                       | Full range                    | 80          | 80            |             |               |      |       |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V ,<br>R <sub>S</sub> = 50Ω       |                       | 25°C                          | 90          | 106           | 90          | 106           | dB   |       |      |
|                  |                                                                       |                                                                  |                       | Full range                    | 85          | 85            |             |               |      |       |      |
| I <sub>OS</sub>  | Short circuit output current                                          | V <sub>O</sub> = 0                                               | V <sub>ID</sub> = 1V  | 25°C                          | −25         | −50           | −25         | −50           | mA   |       |      |
|                  |                                                                       |                                                                  | V <sub>ID</sub> = −1V |                               | 20          | 31            | 20          | 31            |      |       |      |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 0V, No load                                     |                       | 25°C                          | 6.9         | 9             | 6.9         | 9             | mA   |       |      |
|                  |                                                                       |                                                                  |                       | Full range                    | 9.4         |               | 9.4         |               |      |       |      |

(1) Full range is  $-40^\circ C$  to  $105^\circ C$ .

## 5.22 TLE2142I Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER   | TEST CONDITIONS                               | TLE2142I                                                           |                   |       | TLE2142AI         |     |     | UNIT            |
|-------------|-----------------------------------------------|--------------------------------------------------------------------|-------------------|-------|-------------------|-----|-----|-----------------|
|             |                                               | MIN                                                                | TYP               | MAX   | MIN               | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega$ , $C_L = 500pF$                   | 30 <sup>(1)</sup> | 45    | 30 <sup>(1)</sup> | 45  |     | V/ $\mu s$      |
| SR-         | Negative slew rate                            |                                                                    | 30 <sup>5</sup>   | 42    | 30 <sup>(1)</sup> | 42  |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1$ , 10V step                                           | To 0.1%           |       | 0.43              |     |     | $\mu s$         |
|             |                                               |                                                                    | To 0.01%          |       | 0.64              |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 10Hz$                                      |                   | 15    | 15                |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega$ , $f = 1kHz$                                      |                   | 10.5  | 10.5              |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to 1Hz                                                 |                   | 0.48  | 0.48              |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to 10Hz                                                |                   | 0.51  | 0.51              |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                         |                   | 1.89  | 1.89              |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                         |                   | 0.47  | 0.47              |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_{O(PP)} = 20V$ , $R_L = 2k\Omega$ , $A_{VD} = 10$ , $f = 10kHz$ |                   | 0.06% | 0.06%             |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega$ , $C_L = 100pF$                                   |                   | 6     | 6                 |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega$ , $C_L = 100pF$ , $f = 100kHz$                    |                   | 5.9   | 5.9               |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega$ , $A_{VD} = 1$ , $C_L = 100pF$ |                   | 668   | 668               |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega$ , $C_L = 100pF$                                   |                   | 58°   | 58°               |     |     |                 |

(1) Specified by characterization.

(2) Measured at -0.1dB.



## 5.23 TLE2144I Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER                                                                       | TEST CONDITIONS                                                 | $T_A$ <sup>(1)</sup> | TLE2144I |             |      | TLE2144AI |             |      | UNIT             |
|---------------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------|----------|-------------|------|-----------|-------------|------|------------------|
|                                                                                 |                                                                 |                      | MIN      | TYP         | MAX  | MIN       | TYP         | MAX  |                  |
| $V_{IO}$ Input offset voltage                                                   | $V_O = 0, R_S = 50\Omega, V_O = 0$                              | 25°C                 |          | 0.5         | 3.8  |           | 0.5         | 3    | mV               |
|                                                                                 |                                                                 | Full range           |          |             | 4.8  |           |             | 4    |                  |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage                  |                                                                 | Full range           |          | 1.7         |      |           | 1.7         |      | $\mu V/^\circ C$ |
| $I_{IO}$ Input offset current                                                   |                                                                 | 25°C                 |          | 8           | 100  |           | 8           | 100  | nA               |
|                                                                                 |                                                                 | Full range           |          |             | 200  |           |             | 200  |                  |
| $I_{IB}$ Input bias current                                                     |                                                                 | 25°C                 |          | –0.8        | –2   |           | –0.8        | –2   | $\mu A$          |
|                                                                                 |                                                                 | Full range           |          |             | –2.2 |           |             | –2.2 |                  |
| $V_{ICR}$ Common-mode input voltage range                                       | $R_S = 50\Omega$                                                | 25°C                 | 0 to 3   | –0.3 to 3.2 |      | 0 to 3    | –0.3 to 3.2 |      | V                |
|                                                                                 |                                                                 | Full range           | 0 to 2.7 | –0.3 to 2.9 |      | 0 to 2.7  | –0.3 to 2.9 |      | V                |
| $V_{OH}$ High-level output voltage                                              | $I_{OH} = -150\mu A$                                            | 25°C                 | 3.9      | 4.1         |      | 3.9       | 4.1         |      | V                |
|                                                                                 | $I_{OH} = -1.5mA$                                               |                      | 3.8      | 4           |      | 3.8       | 4           |      |                  |
|                                                                                 | $I_{OH} = -15mA$                                                |                      | 3.4      | 3.7         |      | 3.4       | 3.7         |      |                  |
|                                                                                 | $I_{OH} = 100\mu A$                                             | Full range           | 3.8      |             |      | 3.8       |             |      | V                |
|                                                                                 | $I_{OH} = 1mA$                                                  |                      | 3.7      |             |      | 3.7       |             |      |                  |
|                                                                                 | $I_{OH} = 10mA$                                                 |                      | 3.5      |             |      | 3.5       |             |      |                  |
| $V_{OL}$ Low-level output voltage                                               | $I_{OL} = 150\mu A$                                             | 25°C                 |          | 75          | 125  |           | 75          | 125  | mV               |
|                                                                                 | $I_{OL} = 1.5mA$                                                |                      |          | 150         | 225  |           | 150         | 225  |                  |
|                                                                                 | $I_{OL} = 15mA$                                                 |                      |          | 1.2         | 1.6  |           | 1.2         | 1.6  | V                |
|                                                                                 | $I_{OL} = 100\mu A$                                             | Full range           |          |             | 175  |           |             | 175  | mV               |
|                                                                                 | $I_{OL} = 1mA$                                                  |                      |          |             | 225  |           |             | 225  |                  |
|                                                                                 | $I_{OL} = 10mA$                                                 |                      |          |             | 1.4  |           |             | 1.4  | V                |
| $A_{VD}$ Large-signal differential voltage amplification                        | $V_{CC} = \pm 2.5V, R_L = 2k\Omega, V_O = 1V \text{ to } -1.5V$ | 25°C                 | 50       | 95          |      | 50        | 95          |      | V/mV             |
|                                                                                 |                                                                 | Full range           | 10       |             |      | 10        |             |      |                  |
| $r_i$ Input resistance                                                          |                                                                 | 25°C                 |          | 70          |      |           | 70          |      | M $\Omega$       |
| $c_i$ Input capacitance                                                         |                                                                 | 25°C                 |          | 2.5         |      |           | 2.5         |      | pF               |
| $z_o$ Open-loop output impedance                                                | $f = 1MHz$                                                      | 25°C                 |          | 30          |      |           | 30          |      | $\Omega$         |
| CMRR Common-mode rejection ratio                                                | $V_{IC} = V_{ICRmin}, R_S = 50\Omega$                           | 25°C                 | 85       | 118         |      | 85        | 118         |      | dB               |
|                                                                                 |                                                                 | Full range           | 80       |             |      | 80        |             |      |                  |
| $k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ ) | $V_{CC\pm} = \pm 2.5V \text{ to } \pm 15V, R_S = 50\Omega$      | 25°C                 | 90       | 106         |      | 90        | 106         |      | dB               |
|                                                                                 |                                                                 | Full range           | 85       |             |      | 85        |             |      |                  |
| $I_{CC}$ Supply current                                                         | $V_O = 2.5V, \text{ No load, } V_{IC} = 2.5V$                   | 25°C                 |          | 13.2        | 17.6 |           | 13.2        | 17.6 | mA               |
|                                                                                 |                                                                 | Full range           |          |             | 18.4 |           |             | 18.4 |                  |

(1) Full range is –40°C to 105°C.

## 5.24 TLE2144C Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER   |                                               | TEST CONDITIONS                                                             |          | TLE2144C |     |     | TLE2144AC |     |     | UNIT            |
|-------------|-----------------------------------------------|-----------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|-----------------|
|             |                                               |                                                                             |          | MIN      | TYP | MAX | MIN       | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega^{(1)}$ ,<br>$C_L = 500pF$                   |          | 45       |     |     | 45        |     |     | V/ $\mu s$      |
| SR-         | Negative slew rate                            |                                                                             |          | 42       |     |     | 42        |     |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1$ , 2.5V step                                                   | To 0.1%  | 0.66     |     |     | 0.66      |     |     | $\mu s$         |
|             |                                               |                                                                             | To 0.01% | 0.99     |     |     | 0.99      |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 10Hz$                                               |          | 15       |     |     | 15        |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega$ , $f = 1kHz$                                               |          | 10.5     |     |     | 10.5      |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to $1Hz$                                                        |          | 0.48     |     |     | 0.48      |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to $10Hz$                                                       |          | 0.51     |     |     | 0.51      |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                                  |          | 1.92     |     |     | 1.92      |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                                  |          | 0.5      |     |     | 0.5       |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_O = 1V$ to $3V$ , $R_L = 2k\Omega^{(1)}$ ,<br>$A_{VD} = 2$ , $f = 10kHz$ |          | 0.0052%  |     |     | 0.0052%   |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$                                      |          | 5.9      |     |     | 5.9       |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$ ,<br>$f = 100kHz$                    |          | 5.8      |     |     | 5.8       |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega^{(1)}$ ,<br>$A_{VD} = 1$ , $C_L = 100pF$ |          | 380      |     |     | 380       |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$                                      |          | 57°      |     |     | 57°       |     |     |                 |

(1)  $R_L$  terminated to 2.5V.

(2) Measured at -0.1dB.

## 5.25 TLE2144I Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER                                                                       | TEST CONDITIONS                                           | $T_A$ <sup>(1)</sup> | TLE2144I    |               |      | TLE2144AI   |               |      | UNIT             |
|---------------------------------------------------------------------------------|-----------------------------------------------------------|----------------------|-------------|---------------|------|-------------|---------------|------|------------------|
|                                                                                 |                                                           |                      | MIN         | TYP           | MAX  | MIN         | TYP           | MAX  |                  |
| $V_{IO}$ Input offset voltage                                                   | $V_{IC} = 0, R_S = 50\Omega, V_O = 0$                     | 25°C                 | 0.6         | 2.4           |      | 0.5         | 1.5           |      | $\mu V$          |
|                                                                                 |                                                           | Full range           |             |               | 3.2  |             |               | 2.8  |                  |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage                  |                                                           | Full range           | 1.7         |               |      | 1.7         |               |      | $\mu V/^\circ C$ |
| $I_{IO}$ Input offset current                                                   |                                                           | 25°C                 | 7           | 100           |      | 7           | 100           |      | nA               |
|                                                                                 |                                                           | Full range           |             |               | 200  |             |               | 200  |                  |
| $I_{IB}$ Input bias current                                                     |                                                           | 25°C                 | –0.7        | –1.5          |      | –0.7        | –1.5          |      | $\mu A$          |
|                                                                                 |                                                           | Full range           |             |               | –1.7 |             |               | –1.7 |                  |
| $V_{ICR}$ Common-mode input voltage range                                       | $R_S = 50\Omega$                                          | 25°C                 | –15 to 13   | –15.3 to 13.2 |      | –15 to 13   | –15.3 to 13.2 |      | V                |
|                                                                                 |                                                           | Full range           | –15 to 12.7 | 15.3 to 12.9  |      | –15 to 12.7 | 15.3 to 12.9  |      | V                |
| $V_{OM+}$ Maximum positive peak output voltage swing                            | $I_O = -150\mu A$                                         | 25°C                 | 13.8        | 14.1          |      | 13.8        | 14.1          |      | V                |
|                                                                                 | $I_O = -1.5mA$                                            |                      | 13.7        | 14            |      | 13.7        | 14            |      |                  |
|                                                                                 | $I_O = -15mA$                                             |                      | 13.1        | 13.7          |      | 13.1        | 13.7          |      |                  |
|                                                                                 | $I_O = -100\mu A$                                         | Full range           | 13.7        |               |      | 13.7        |               |      | V                |
|                                                                                 | $I_O = -1mA$                                              |                      | 13.6        |               |      | 13.6        |               |      |                  |
|                                                                                 | $I_O = -10mA$                                             |                      | 13.1        |               |      | 13.1        |               |      |                  |
| $V_{OM-}$ Maximum negative peak output voltage swing                            | $I_O = 150\mu A$                                          | 25°C                 | –14.7       | –14.9         |      | –14.7       | –14.9         |      | V                |
|                                                                                 | $I_O = 1.5mA$                                             |                      | –14.5       | –14.8         |      | –14.5       | –14.8         |      |                  |
|                                                                                 | $I_O = 15mA$                                              |                      | –13.4       | –13.8         |      | –13.4       | –13.8         |      |                  |
|                                                                                 | $I_O = 100\mu A$                                          | Full range           | –14.6       |               |      | –14.6       |               |      | V                |
|                                                                                 | $I_O = 1mA$                                               |                      | –14.5       |               |      | –14.5       |               |      |                  |
|                                                                                 | $I_O = 10mA$                                              |                      | –13.4       |               |      | –13.4       |               |      |                  |
| $A_{VD}$ Large-signal differential voltage amplification                        | $V_O = \pm 10V, R_L = 2k\Omega$                           | 25°C                 | 100         | 170           |      | 100         | 170           |      | V/mV             |
|                                                                                 |                                                           | Full range           | 40          |               |      | 40          |               |      |                  |
| $r_i$ Input resistance                                                          |                                                           | 25°C                 |             | 65            |      |             | 65            |      | M $\Omega$       |
| $c_i$ Input capacitance                                                         |                                                           | 25°C                 |             | 2.5           |      |             | 2.5           |      | pF               |
| $z_o$ Open-loop output impedance                                                | $f = 1MHz$                                                | 25°C                 |             | 30            |      |             | 30            |      | $\Omega$         |
| CMRR Common-mode rejection ratio                                                | $V_{IC} = V_{ICRmin}$                                     | 25°C                 | 85          | 108           |      | 85          | 108           |      | dB               |
|                                                                                 | $R_S = 50\Omega$                                          | Full range           | 80          |               |      | 80          |               |      |                  |
| $k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ ) | $V_{CC\pm} = \pm 2.5V$ to $\pm 15V$ ,<br>$R_S = 50\Omega$ | 25°C                 | 90          | 106           |      | 90          | 106           |      | dB               |
|                                                                                 |                                                           | Full range           | 85          |               |      | 85          |               |      |                  |
| $I_{OS}$ Short circuit output current                                           | $V_O = 0$                                                 | 25°C                 | –25         | –50           |      | –25         | –50           |      | mA               |
|                                                                                 |                                                           |                      | 20          | 31            |      | 20          | 31            |      |                  |
| $I_{CC}$ Supply current                                                         | $V_O = 0V$ , No load                                      | 25°C                 |             | 13.8          | 18   |             | 13.8          | 18   | mA               |
|                                                                                 |                                                           | Full range           |             |               | 18.8 |             |               | 18.8 |                  |

(1) Full range is  $-40^\circ C$  to  $105^\circ C$ .

## 5.26 TLE2144I Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                             |          | TLE2144I          |     |     | TLE2144AI         |     |     | UNIT    |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|----------|-------------------|-----|-----|-------------------|-----|-----|---------|
|                    |                                               |                                                                                             |          | MIN               | TYP | MAX | MIN               | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = − 1, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 500pF                         |          | 27 <sup>(1)</sup> | 45  |     | 27 <sup>(1)</sup> | 45  |     | V/μs    |
| SR−                | Negative slew rate                            |                                                                                             |          | 27 <sup>(1)</sup> | 42  |     | 27 <sup>(1)</sup> | 42  |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = −1, 10V step                                                              | To 0.1%  | 0.43              |     |     | 0.43              |     |     | μs      |
|                    |                                               |                                                                                             | To 0.01% | 0.64              |     |     | 0.64              |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                              |          | 15                |     |     | 15                |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                              |          | 10.5              |     |     | 10.5              |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                            |          | 0.48              |     |     | 0.48              |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                           |          | 0.51              |     |     | 0.51              |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                    |          | 1.89              |     |     | 1.89              |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                    |          | 0.47              |     |     | 0.47              |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 10, f = 10kHz             |          | 0.06%             |     |     | 0.06%             |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 6                 |     |     | 6                 |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF, f = 100kHz                                    |          | 5.9               |     |     | 5.9               |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(2)</sup> | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF |          | 668               |     |     | 668               |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 58°               |     |     | 58°               |     |     |         |

(1) Specified by characterization.

(2) Measured at -0.1dB.

## 5.27 TLE2144I Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER                                                                       | TEST CONDITIONS                                                   | $T_A$ <sup>(1)</sup> | TLE2141M |             |      | TLE2141AM |             |      | UNIT              |
|---------------------------------------------------------------------------------|-------------------------------------------------------------------|----------------------|----------|-------------|------|-----------|-------------|------|-------------------|
|                                                                                 |                                                                   |                      | MIN      | TYP         | MAX  | MIN       | TYP         | MAX  |                   |
| $V_{IO}$ Input offset voltage                                                   | $V_O = 2.5V$ , $R_S = 50\Omega$ ,<br>$V_O = 2.5V$                 | 25°C                 |          | 225         | 1400 |           | 200         | 1000 | $\mu V$           |
|                                                                                 |                                                                   | Full range           |          |             | 2100 |           |             | 1700 |                   |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage                  |                                                                   | Full range           |          | 1.7         |      |           | 1.7         |      | $\mu V/^{\circ}C$ |
| $I_{IO}$ Input offset current                                                   |                                                                   | 25°C                 |          | 8           | 100  |           | 8           | 100  | nA                |
|                                                                                 |                                                                   | Full range           |          |             | 250  |           |             | 250  |                   |
| $I_{IB}$ Input bias current                                                     |                                                                   | 25°C                 |          | -0.8        | -2   |           | -0.8        | -2   | $\mu A$           |
|                                                                                 |                                                                   | Full range           |          |             | -2.3 |           |             | -2.3 |                   |
| $V_{ICR}$ Common-mode input voltage range                                       | $R_S = 50\Omega$                                                  | 25°C                 | 0 to 3   | -0.3 to 3.2 |      | 0 to 3    | -0.3 to 3.2 |      | V                 |
|                                                                                 |                                                                   | Full range           | 0 to 2.7 | -0.3 to 2.9 |      | 0 to 2.7  | -0.3 to 2.9 |      | V                 |
| $V_{OH}$ High-level output voltage                                              | $I_{OH} = -150\mu A$                                              | 25°C                 | 3.9      | 4.1         |      | 3.9       | 4.1         |      | V                 |
|                                                                                 | $I_{OH} = -1.5mA$                                                 |                      | 3.8      | 4           |      | 3.8       | 4           |      |                   |
|                                                                                 | $I_{OH} = -15mA$                                                  |                      | 3.2      | 3.7         |      | 3.2       | 3.7         |      |                   |
|                                                                                 | $I_{OH} = -100\mu A$                                              | Full range           | 3.75     |             |      | 3.75      |             |      | V                 |
|                                                                                 | $I_{OH} = -1mA$                                                   |                      | 3.65     |             |      | 3.65      |             |      |                   |
|                                                                                 | $I_{OH} = -10mA$                                                  |                      | 3.25     |             |      | 3.25      |             |      |                   |
| $V_{OL}$ Low-level output voltage                                               | $I_{OL} = 150\mu A$                                               | 25°C                 |          | 75          | 125  |           | 75          | 125  | mV                |
|                                                                                 | $I_{OL} = 1.5mA$                                                  |                      |          | 150         | 225  |           | 150         | 225  |                   |
|                                                                                 | $I_{OL} = 15mA$                                                   |                      |          | 1.2         | 1.4  |           | 1.2         | 1.4  | V                 |
|                                                                                 | $I_{OL} = 100\mu A$                                               | Full range           |          |             | 200  |           |             | 200  | mV                |
|                                                                                 | $I_{OL} = 1mA$                                                    |                      |          |             | 250  |           |             | 225  |                   |
|                                                                                 | $I_{OL} = 10mA$                                                   |                      |          |             | 1.25 |           |             | 1.25 | V                 |
| $A_{VD}$ Large-signal differential voltage amplification                        | $V_{CC} = \pm 2.5V$ , $R_L = 2k\Omega$ ,<br>$V_O = 1V$ to $-1.5V$ | 25°C                 | 50       | 220         |      | 50        | 220         |      | V/mV              |
|                                                                                 |                                                                   | Full range           | 5        |             |      | 5         |             |      |                   |
| $r_i$ Input resistance                                                          |                                                                   | 25°C                 |          | 70          |      |           | 70          |      | M $\Omega$        |
| $c_i$ Input capacitance                                                         |                                                                   | 25°C                 |          | 2.5         |      |           | 2.5         |      | pF                |
| $z_o$ Open-loop output impedance                                                | $f = 1MHz$                                                        | 25°C                 |          | 30          |      |           | 30          |      | $\Omega$          |
| CMRR Common-mode rejection ratio                                                | $V_{IC} = V_{ICRmin}$ , $R_S = 50\Omega$                          | 25°C                 | 85       | 118         |      | 85        | 118         |      | dB                |
|                                                                                 |                                                                   | Full range           | 80       |             |      | 80        |             |      |                   |
| $k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ ) | $V_{CC\pm} = \pm 2.5V$ to $\pm 15V$ ,<br>$R_S = 50\Omega$         | 25°C                 | 90       | 106         |      | 90        | 106         |      | dB                |
|                                                                                 |                                                                   | Full range           | 85       |             |      | 85        |             |      |                   |
| $I_{CC}$ Supply current                                                         | $V_O = 2.5V$ , No load, $V_{IC} = 2.5V$                           | 25°C                 |          | 3.4         | 4.4  |           | 3.4         | 4.4  | mA                |
|                                                                                 |                                                                   | Full range           |          |             | 4.6  |           |             | 4.6  |                   |

(1) Full range is -55°C to 125°C.

## 5.28 TLE2141M Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER   |                                               | TEST CONDITIONS                                                                                     |          | TLE2141M |     |     | TLE2141AM |     |     | UNIT            |
|-------------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|-----------------|
|             |                                               |                                                                                                     |          | MIN      | TYP | MAX | MIN       | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$C_L = 500pF$ <sup>(1)</sup>                   |          | 45       |     |     | 45        |     |     | V/ $\mu s$      |
| SR-         | Negative slew rate                            |                                                                                                     |          | 42       |     |     | 42        |     |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1$ , 2.5V step                                                                           | To 0.1%  | 0.66     |     |     | 0.66      |     |     | $\mu s$         |
|             |                                               |                                                                                                     | To 0.01% | 0.99     |     |     | 0.99      |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 10Hz$                                                                       |          | 15       |     |     | 15        |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega$ , $f = 1kHz$                                                                       |          | 10.5     |     |     | 10.5      |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to $1Hz$                                                                                |          | 0.48     |     |     | 0.48      |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to $10Hz$                                                                               |          | 0.51     |     |     | 0.51      |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                                                          |          | 1.92     |     |     | 1.92      |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                                                          |          | 0.5      |     |     | 0.5       |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_O = 1V$ to $3V$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 2$ , $f = 10kHz$                |          | 0.0052%  |     |     | 0.0052%   |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$ <sup>(1)</sup>                                      |          | 5.9      |     |     | 5.9       |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$ , <sup>(1)</sup><br>$f = 100kHz$                    |          | 5.8      |     |     | 5.8       |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega$ , <sup>(1)</sup><br>$A_{VD} = 1$ , $C_L = 100pF$ <sup>(1)</sup> |          | 380      |     |     | 380       |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega$ <sup>(1)</sup> , $C_L = 100pF$ <sup>(1)</sup>                                      |          | 57°      |     |     | 57°       |     |     |                 |

(1)  $R_L$  and  $C_L$  terminated to 2.5V.

(2) Measured at -0.1dB.

## 5.29 TLE2141M Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                              |                      | T <sub>A</sub> <sup>(1)</sup> | TLE2141M              |      |             | TLE2141AM     |      |     | UNIT  |
|------------------|-----------------------------------------------------------------------|--------------------------------------------------------------|----------------------|-------------------------------|-----------------------|------|-------------|---------------|------|-----|-------|
|                  |                                                                       |                                                              |                      |                               | MIN                   | TYP  | MAX         | MIN           | TYP  | MAX |       |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>IC</sub> = 0, R <sub>S</sub> = 50Ω                    |                      | 25°C                          | 200                   | 900  |             | 175           | 500  | μV  |       |
|                  | Full range                                                            |                                                              |                      | 1700                          |                       |      | 1200        |               |      |     |       |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                              |                      | Full range                    | 1.7                   |      |             | 1.7           |      |     | μV/°C |
| I <sub>IO</sub>  | Input offset current                                                  |                                                              |                      | 25°C                          | 7                     | 100  |             | 7             | 100  | nA  |       |
|                  |                                                                       |                                                              |                      | Full range                    | 250                   |      |             | 250           |      |     |       |
| I <sub>IB</sub>  | Input bias current                                                    |                                                              |                      | 25°C                          | −0.7                  | −1.5 |             | −0.7          | −1.5 | μA  |       |
|                  |                                                                       |                                                              |                      | Full range                    | −1.8                  |      |             | −1.8          |      |     |       |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                         | 25°C                 | −15 to 13                     | −15.3 to 13.2         |      | −15 to 13   | −15.3 to 13.2 | V    |     |       |
|                  |                                                                       |                                                              | Full range           | −15 to 12.7                   | 15.3 to 12.9          |      | −15 to 12.7 | −15.3 to 12.9 | V    |     |       |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                            | I <sub>O</sub> = −150μA                                      | 25°C                 | 13.8                          | 14.1                  |      | 13.8        | 14.1          | V    |     |       |
|                  |                                                                       | I <sub>O</sub> = −1.5mA                                      |                      | 13.7                          | 14                    |      | 13.7        | 14            |      |     |       |
|                  |                                                                       | I <sub>O</sub> = −15mA                                       |                      | 13.1                          | 13.7                  |      | 13.1        | 13.7          |      |     |       |
|                  |                                                                       | I <sub>O</sub> = −100μA                                      | Full range           | 13.7                          |                       |      | 13.7        |               | V    |     |       |
|                  |                                                                       | I <sub>O</sub> = −1mA                                        |                      | 13.6                          |                       |      | 13.6        |               |      |     |       |
|                  |                                                                       | I <sub>O</sub> = −10mA                                       |                      | 13.1                          |                       |      | 13.1        |               |      |     |       |
| V <sub>OM−</sub> | Maximum negative peak output voltage swing                            | I <sub>O</sub> = 150μA                                       | 25°C                 | −14.7                         | −14.9                 |      | −14.7       | −14.9         | V    |     |       |
|                  |                                                                       | I <sub>O</sub> = 1.5mA                                       |                      | −14.5                         | −14.8                 |      | −14.5       | −14.8         |      |     |       |
|                  |                                                                       | I <sub>O</sub> = 15mA                                        |                      | −13.4                         | −13.8                 |      | −13.4       | −13.8         |      |     |       |
|                  |                                                                       | I <sub>O</sub> = 100μA                                       | Full range           | −14.6                         |                       |      | −14.6       |               | V    |     |       |
|                  |                                                                       | I <sub>O</sub> = 1mA                                         |                      | −14.5                         |                       |      | −14.5       |               |      |     |       |
|                  |                                                                       | I <sub>O</sub> = 10mA                                        |                      | −13.4                         |                       |      | −13.4       |               |      |     |       |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>O</sub> = ±10V, R <sub>L</sub> = 2kΩ                  | 25°C                 | 100                           | 450                   |      | 100         | 450           | V/mV |     |       |
|                  |                                                                       |                                                              | Full range           | 20                            |                       |      | 20          |               |      |     |       |
| r <sub>i</sub>   | Input resistance                                                      |                                                              | 25°C                 | 65                            |                       |      | 65          |               |      | MΩ  |       |
| c <sub>i</sub>   | Input capacitance                                                     |                                                              | 25°C                 | 2.5                           |                       |      | 2.5         |               |      | pF  |       |
| Z <sub>o</sub>   | Open-loop output impedance                                            | f = 1MHz                                                     | 25°C                 | 30                            |                       |      | 30          |               |      | Ω   |       |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω |                      | 25°C                          | 85                    | 108  |             | 85            | 108  | dB  |       |
|                  |                                                                       |                                                              |                      | Full range                    | 80                    |      |             | 80            |      |     |       |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V , R <sub>S</sub> = 50Ω      |                      | 25°C                          | 90                    | 106  |             | 90            | 106  | dB  |       |
|                  |                                                                       |                                                              |                      | Full range                    | 85                    |      |             | 85            |      |     |       |
| I <sub>OS</sub>  | Short circuit output current                                          | V <sub>O</sub> = 0                                           | V <sub>ID</sub> = 1V | 25°C                          | −25                   | −50  |             | −25           | −50  | mA  |       |
|                  |                                                                       |                                                              |                      |                               | V <sub>ID</sub> = −1V | 20   | 31          |               | 20   |     | 31    |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 0V, V <sub>IC</sub> = 2.5V , No load        |                      | 25°C                          | 3.5                   | 4.5  |             | 3.5           | 4.5  | mA  |       |
|                  |                                                                       |                                                              |                      | Full range                    | 4.7                   |      |             | 4.7           |      |     |       |

(1) Full range is –55°C to 125°C.

### 5.30 TLE2141M Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                             |          | TLE2141M          |     |     | TLE2141AM         |     |     | UNIT    |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|----------|-------------------|-----|-----|-------------------|-----|-----|---------|
|                    |                                               |                                                                                             |          | MIN               | TYP | MAX | MIN               | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = - 1, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                         |          | 27 <sup>(1)</sup> | 45  |     | 27 <sup>(1)</sup> | 45  |     | V/μs    |
| SR–                | Negative slew rate                            |                                                                                             |          | 27 <sup>(1)</sup> | 42  |     | 27 <sup>(1)</sup> | 42  |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = -1, 10V step                                                              | To 0.1%  | 0.43              |     |     | 0.43              |     |     | μs      |
|                    |                                               |                                                                                             | To 0.01% | 0.64              |     |     | 0.64              |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                              |          | 15                |     |     | 15                |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                              |          | 10.5              |     |     | 10.5              |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                            |          | 0.48              |     |     | 0.48              |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                           |          | 0.51              |     |     | 0.51              |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                    |          | 1.89              |     |     | 1.89              |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                    |          | 0.47              |     |     | 0.47              |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 10, f = 10kHz             |          | 0.06%             |     |     | 0.06%             |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 6                 |     |     | 6                 |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF, f = 100kHz                                    |          | 5.9               |     |     | 5.9               |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(2)</sup> | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF |          | 668               |     |     | 668               |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 58°               |     |     | 58°               |     |     |         |

(1) Specified by characterization.

(2) Measured at -0.1dB.



## 5.31 TLE2142M Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER        |                                                                       | TEST CONDITIONS                                                              | T <sub>A</sub> <sup>(1)</sup> | TLE2142M |             |          | TLE2142AM   |       |     | UNIT |
|------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------|----------|-------------|----------|-------------|-------|-----|------|
|                  |                                                                       |                                                                              |                               | MIN      | TYP         | MAX      | MIN         | TYP   | MAX |      |
| V <sub>IO</sub>  | Input offset voltage                                                  | V <sub>IC</sub> = 0, R <sub>S</sub> = 50Ω                                    | 25°C                          | 220      | 1900        | 200      | 1500        | μV    |     |      |
|                  |                                                                       |                                                                              | Full range                    | 2600     |             |          | 2200        |       |     |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                       |                                                                              | Full range                    | 1.7      |             |          | 1.7         | μV/°C |     |      |
| I <sub>IO</sub>  | Input offset current                                                  |                                                                              | 25°C                          | 8        | 100         | 8        | 100         | nA    |     |      |
|                  |                                                                       |                                                                              | Full range                    | 200      |             |          | 200         |       |     |      |
| I <sub>IB</sub>  | Input bias current                                                    |                                                                              | 25°C                          | −0.8     | −2          | −0.8     | −2          | μA    |     |      |
|                  |                                                                       |                                                                              | Full range                    | −2.3     |             |          | −2.3        |       |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                       | R <sub>S</sub> = 50Ω                                                         | 25°C                          | 0 to 3   | −0.3 to 3.2 | 0 to 3   | −0.3 to 3.2 | V     |     |      |
|                  |                                                                       |                                                                              | Full range                    | 0 to 2.7 | −0.3 to 2.9 | 0 to 2.7 | −0.3 to 2.9 | V     |     |      |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                            | I <sub>O</sub> = −150μA                                                      | 25°C                          | 3.9      | 4.1         | 3.9      | 4.1         | V     |     |      |
|                  |                                                                       | I <sub>O</sub> = −1.5mA                                                      |                               | 3.8      | 4           | 3.8      | 4           |       |     |      |
|                  |                                                                       | I <sub>O</sub> = −15mA                                                       |                               | 3.4      | 3.7         | 3.4      | 3.7         |       |     |      |
|                  |                                                                       | I <sub>O</sub> = 100μA                                                       | Full range                    | 3.75     |             | 3.75     |             | V     |     |      |
|                  |                                                                       | I <sub>O</sub> = 1mA                                                         |                               | 3.65     |             | 3.65     |             |       |     |      |
|                  |                                                                       | I <sub>O</sub> = 10mA                                                        |                               | 3.45     |             | 3.45     |             |       |     |      |
| V <sub>OM−</sub> | Maximum negative peak output voltage swing                            | I <sub>O</sub> = 150μA                                                       | 25°C                          | 75       | 125         | 75       | 125         | mV    |     |      |
|                  |                                                                       | I <sub>O</sub> = 1.5mA                                                       |                               | 150      | 225         | 150      | 225         |       |     |      |
|                  |                                                                       | I <sub>O</sub> = 15mA                                                        |                               | 1.2      | 1.4         | 1.2      | 1.4         |       |     |      |
|                  |                                                                       | I <sub>O</sub> = 100μA                                                       | Full range                    | 200      |             | 200      |             | mV    |     |      |
|                  |                                                                       | I <sub>O</sub> = 1mA                                                         |                               | 250      |             | 250      |             |       |     |      |
|                  |                                                                       | I <sub>O</sub> = 10mA                                                        |                               | 125      |             | 125      |             |       |     |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                       | V <sub>IC</sub> = ±2.5V , R <sub>L</sub> = 2kΩ, V <sub>O</sub> = 1V to −1.5V | 25°C                          | 50       | 220         | 50       | 220         | V/mV  |     |      |
|                  |                                                                       |                                                                              | Full range                    | 5        |             | 5        |             |       |     |      |
| r <sub>i</sub>   | Input resistance                                                      |                                                                              | 25°C                          | 70       |             |          | 70          | MΩ    |     |      |
| c <sub>i</sub>   | Input capacitance                                                     |                                                                              | 25°C                          | 2.5      |             |          | 2.5         | pF    |     |      |
| Z <sub>o</sub>   | Open-loop output impedance                                            | f = 1MHz                                                                     | 25°C                          | 30       |             |          | 30          | Ω     |     |      |
| CMRR             | Common-mode rejection ratio                                           | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω                 | 25°C                          | 85       | 118         | 85       | 118         | dB    |     |      |
|                  |                                                                       |                                                                              | Full range                    | 80       |             | 80       |             |       |     |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V , R <sub>S</sub> = 50Ω                      | 25°C                          | 90       | 106         | 90       | 106         | dB    |     |      |
|                  |                                                                       |                                                                              | Full range                    | 85       |             | 85       |             |       |     |      |
| I <sub>OS</sub>  | Short circuit output current                                          | V <sub>O</sub> = 0                                                           | 25°C                          | −25      | −50         | −25      | −50         | mA    |     |      |
|                  |                                                                       |                                                                              |                               | 20       | 31          | 20       | 31          |       |     |      |
| I <sub>CC</sub>  | Supply current                                                        | V <sub>O</sub> = 0V, V <sub>IC</sub> = 2.5V , No load                        | 25°C                          | 6.6      | 8.8         | 6.6      | 8.8         | mA    |     |      |
|                  |                                                                       |                                                                              | Full range                    | 9.2      |             |          | 9.2         |       |     |      |

(1) Full range is –55°C to 125°C.

## 5.32 TLE2142M Operating Characteristics, $V_{CC} = 5V$ , $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                                             |          | TLE2142M |     |     | TLE2142AM |     |     | UNIT    |
|--------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|---------|
|                    |                                               |                                                                                                             |          | MIN      | TYP | MAX | MIN       | TYP | MAX |         |
| SR+                | Positive slew rate                            | A <sub>VD</sub> = - 1, R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 500pF                         |          | 45       |     |     | 45        |     |     | V/μs    |
| SR-                | Negative slew rate                            |                                                                                                             |          | 42       |     |     | 42        |     |     |         |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = -1, 10V step                                                                              | To 0.1%  | 0.66     |     |     | 0.66      |     |     | μs      |
|                    |                                               |                                                                                                             | To 0.01% | 0.99     |     |     | 0.99      |     |     |         |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                                              |          | 15       |     |     | 15        |     |     | nV/√ Hz |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                                              |          | 10.5     |     |     | 10.5      |     |     |         |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                                            |          | 0.48     |     |     | 0.48      |     |     | μV      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                                           |          | 0.51     |     |     | 0.51      |     |     |         |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                                    |          | 1.92     |     |     | 1.92      |     |     | pA/√ Hz |
|                    |                                               | f = 1kHz                                                                                                    |          | 0.5      |     |     | 0.5       |     |     |         |
| THD + N            | Total harmonic distortion plus noise          | V <sub>O</sub> = 1V to 3V , R <sub>L</sub> = 2kΩ <sup>(1)</sup> , A <sub>VD</sub> = 2, f = 10kHz            |          | 0.0052%  |     |     | 0.0052 %  |     |     |         |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 100pF                                                |          | 5.9      |     |     | 5.9       |     |     | MHz     |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 100pF, f = 100kHz                                    |          | 5.8      |     |     | 5.8       |     |     | MHz     |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(2)</sup> | V <sub>O(PP)</sub> = 2V , R <sub>L</sub> = 2kΩ <sup>(1)</sup> , A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF |          | 380      |     |     | 380       |     |     | kHz     |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ <sup>(1)</sup> , C <sub>L</sub> = 100pF                                                |          | 57°      |     |     | 57°       |     |     |         |

(1)  $R_L$  terminates at 2.5V .

(2) Measured at -0.1dB.

### 5.33 TLE2142M Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER        |                                                                        | TEST CONDITIONS                                              | T <sub>A</sub> <sup>(1)</sup> | TLE2142M    |               |             | TLE2142AM     |       |     | UNIT |
|------------------|------------------------------------------------------------------------|--------------------------------------------------------------|-------------------------------|-------------|---------------|-------------|---------------|-------|-----|------|
|                  |                                                                        |                                                              |                               | MIN         | TYP           | MAX         | MIN           | TYP   | MAX |      |
| V <sub>IO</sub>  | Input offset voltage                                                   | V <sub>IC</sub> = 0, R <sub>S</sub> = 50Ω                    | 25°C                          | 290         | 1200          | 275         | 750           | μV    |     |      |
|                  |                                                                        |                                                              | Full range                    | 2000        |               |             | 1600          |       |     |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                        |                                                              | Full range                    | 1.7         |               |             | 1.7           | μV/°C |     |      |
| I <sub>IO</sub>  | Input offset current                                                   |                                                              | 25°C                          | 7           | 100           | 7           | 100           | nA    |     |      |
|                  |                                                                        |                                                              | Full range                    | 250         |               |             | 250           |       |     |      |
| I <sub>IB</sub>  | Input bias current                                                     |                                                              | 25°C                          | -0.7        | -1.5          | -0.7        | -1.5          | μA    |     |      |
|                  |                                                                        |                                                              | Full range                    | -1.8        |               |             | -1.8          |       |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                        | R <sub>S</sub> = 50Ω                                         | 25°C                          | -15 to 13   | -15.3 to 13.2 | -15 to 13   | -15.3 to 13.2 | V     |     |      |
|                  |                                                                        |                                                              | Full range                    | -15 to 12.7 | -15.3 to 12.9 | -15 to 12.7 | -15.3 to 12.9 | V     |     |      |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                             | I <sub>O</sub> = -150μA                                      | 25°C                          | 13.8        | 14.1          | 13.8        | 14.1          | V     |     |      |
|                  |                                                                        | I <sub>O</sub> = -1.5mA                                      |                               | 13.7        | 14            | 13.7        | 14            |       |     |      |
|                  |                                                                        | I <sub>O</sub> = -15mA                                       |                               | 13.3        | 13.7          | 13.3        | 13.7          |       |     |      |
|                  |                                                                        | I <sub>O</sub> = -100μA                                      | Full range                    | 13.7        |               | 13.7        |               | V     |     |      |
|                  |                                                                        | I <sub>O</sub> = -1mA                                        |                               | 13.6        |               | 13.6        |               |       |     |      |
|                  |                                                                        | I <sub>O</sub> = -10mA                                       |                               | 13.3        |               | 13.3        |               |       |     |      |
| V <sub>OM-</sub> | Maximum negative peak output voltage swing                             | I <sub>O</sub> = 150μA                                       | 25°C                          | -14.7       | -14.9         |             |               | V     |     |      |
|                  |                                                                        | I <sub>O</sub> = 1.5mA                                       |                               | -14.5       | -14.8         |             |               |       |     |      |
|                  |                                                                        | I <sub>O</sub> = 15mA                                        |                               | -13.4       | -13.8         |             |               |       |     |      |
|                  |                                                                        | I <sub>O</sub> = 100μA                                       | Full range                    | -14.6       |               | -14.6       |               | V     |     |      |
|                  |                                                                        | I <sub>O</sub> = 1mA                                         |                               | -14.5       |               | -14.5       |               |       |     |      |
|                  |                                                                        | I <sub>O</sub> = 10mA                                        |                               | -13.4       |               | -13.4       |               |       |     |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                        | V <sub>O</sub> = ±10V, R <sub>L</sub> = 2kΩ,                 | 25°C                          | 100         | 450           | 100         | 450           | V/mV  |     |      |
|                  |                                                                        |                                                              | Full range                    | 20          |               | 20          |               |       |     |      |
| r <sub>i</sub>   | Input resistance                                                       |                                                              | 25°C                          | 65          |               | 65          |               | MΩ    |     |      |
| c <sub>i</sub>   | Input capacitance                                                      |                                                              | 25°C                          | 2.5         |               | 2.5         |               | pF    |     |      |
| z <sub>o</sub>   | Open-loop output impedance                                             | f = 1MHz                                                     | 25°C                          | 30          |               | 30          |               | Ω     |     |      |
| CMRR             | Common-mode rejection ratio                                            | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω | 25°C                          | 85          | 108           | 85          | 108           | dB    |     |      |
|                  |                                                                        |                                                              | Full range                    | 80          |               | 80          |               |       |     |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> / ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V , R <sub>S</sub> = 50Ω      | 25°C                          | 90          | 106           | 90          | 106           | dB    |     |      |
|                  |                                                                        |                                                              | Full range                    | 85          |               | 85          |               |       |     |      |
| I <sub>OS</sub>  | Short circuit output current                                           | V <sub>O</sub> = 0                                           | 25°C                          | -25         | -50           | -25         | -50           | mA    |     |      |
|                  |                                                                        |                                                              |                               | 20          | 31            | 20          | 31            |       |     |      |
| I <sub>CC</sub>  | Supply current                                                         | V <sub>O</sub> = 0V, V <sub>IC</sub> = 2.5V , No load        | 25°C                          | 6.9         | 9             | 6.9         | 9             | mA    |     |      |
|                  |                                                                        |                                                              | Full range                    | 9.4         |               | 9.4         |               |       |     |      |

(1) Full range is  $-55^\circ C$  to  $125^\circ C$ .

### 5.34 TLE2142M Operating Characteristics, $V_{CC\pm} = \pm 15V$ , $T_A = 25^\circ C$

| PARAMETER   |                                               | TEST CONDITIONS                                                    |          | TLE2142M          |     |     | TLE2142AM       |     |     | UNIT            |
|-------------|-----------------------------------------------|--------------------------------------------------------------------|----------|-------------------|-----|-----|-----------------|-----|-----|-----------------|
|             |                                               |                                                                    |          | MIN               | TYP | MAX | MIN             | TYP | MAX |                 |
| SR+         | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega$ , $C_L = 100pF$                   |          | 27 <sup>(1)</sup> | 45  |     | 27 <sup>s</sup> | 45  |     | V/ $\mu s$      |
| SR–         | Negative slew rate                            |                                                                    |          | 27 <sup>(1)</sup> | 42  |     | 27 <sup>s</sup> | 42  |     |                 |
| $t_s$       | Settling time                                 | $A_{VD} = -1$ , 10V step                                           | To 0.1%  | 0.43              |     |     | 0.43            |     |     | $\mu s$         |
|             |                                               |                                                                    | To 0.01% | 0.64              |     |     | 0.64            |     |     |                 |
| $V_n$       | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 10Hz$                                      |          | 15                |     |     | 15              |     |     | nV/ $\sqrt{Hz}$ |
|             |                                               | $R_S = 20\Omega$ , $f = 1kHz$                                      |          | 10.5              |     |     | 10.5            |     |     |                 |
| $V_{N(PP)}$ | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to 1Hz                                                 |          | 0.48              |     |     | 0.48            |     |     | $\mu V$         |
|             |                                               | $f = 0.1Hz$ to 10Hz                                                |          | 0.51              |     |     | 0.51            |     |     |                 |
| $I_n$       | Equivalent input noise current                | $f = 10Hz$                                                         |          | 1.89              |     |     | 1.89            |     |     | pA/ $\sqrt{Hz}$ |
|             |                                               | $f = 1kHz$                                                         |          | 0.47              |     |     | 0.47            |     |     |                 |
| THD + N     | Total harmonic distortion plus noise          | $V_{O(PP)} = 20V$ , $R_L = 2k\Omega$ , $A_{VD} = 2$ , $f = 10kHz$  |          | 0.06%             |     |     | 0.06%           |     |     |                 |
| $B_1$       | Unity-gain bandwidth                          | $R_L = 2k\Omega$ , $C_L = 100pF$                                   |          | 6                 |     |     | 6               |     |     | MHz             |
|             | Gain-bandwidth product                        | $R_L = 2k\Omega$ , $C_L = 100pF$ , $f = 100kHz$                    |          | 5.9               |     |     | 5.9             |     |     | MHz             |
| $B_{OM}$    | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega$ , $A_{VD} = 1$ , $C_L = 100pF$ |          | 668               |     |     | 668             |     |     | kHz             |
| $\phi_m$    | Phase margin at unity gain                    | $R_L = 2k\Omega$ , $C_L = 100pF$                                   |          | 58°               |     |     | 58°             |     |     |                 |

(1) Specified by characterization.

(2) Measured at -0.1dB.

## 5.35 TLE2144M Electrical Characteristics

at specified free-air temperature,  $V_{CC} = 5V$  (unless otherwise noted)

| PARAMETER        |                                                                           | TEST CONDITIONS                                                                 | T <sub>A</sub> <sup>(1)</sup> | TLE2144M       |             |          | TLE2144AM   |       |     | UNIT |
|------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------|----------------|-------------|----------|-------------|-------|-----|------|
|                  |                                                                           |                                                                                 |                               | MIN            | TYP         | MAX      | MIN         | TYP   | MAX |      |
| V <sub>IO</sub>  | Input offset voltage                                                      | V <sub>O</sub> = 2.5V , R <sub>S</sub> = 50Ω,<br>V <sub>IC</sub> = 2.5V         | 25°C                          | 0.5    3.8     |             | 0.5    3 |             | mV    |     |      |
|                  |                                                                           |                                                                                 | Full range                    | 5.2            |             | 4.4      |             |       |     |      |
| α <sub>VIO</sub> | Temperature coefficient of input offset voltage                           |                                                                                 | Full range                    | 1.7            |             | 1.7      |             | μV/°C |     |      |
|                  |                                                                           |                                                                                 | 25°C                          | 8    100       |             | 8    100 |             | nA    |     |      |
| I <sub>IO</sub>  | Input offset current                                                      |                                                                                 | Full range                    | 250            |             | 250      |             |       |     |      |
|                  |                                                                           |                                                                                 | 25°C                          | 8    -0.    -2 | -0.8    -2  |          |             |       |     |      |
| I <sub>IB</sub>  | Input bias current                                                        |                                                                                 | Full range                    | -2.3           |             | -2.3     |             | μA    |     |      |
| V <sub>ICR</sub> | Common-mode input voltage range                                           | R <sub>S</sub> = 50Ω                                                            | 25°C                          | 0 to 3         | -0.3 to 3.2 | 0 to 3   | -0.3 to 3.2 | V     |     |      |
|                  |                                                                           |                                                                                 | Full range                    | 0 to 2.7       | -0.3 to 2.9 | 0 to 2.7 | -0.3 to 2.9 | V     |     |      |
| V <sub>OH</sub>  | High-level output voltage                                                 | I <sub>OH</sub> = -150μA                                                        | 25°C                          | 3.9            | 4.1         | 3.9      | 4.1         | V     |     |      |
|                  |                                                                           | I <sub>OH</sub> = -1.5mA                                                        |                               | 3.8            | 4           | 3.8      | 4           |       |     |      |
|                  |                                                                           | I <sub>OH</sub> = -15mA                                                         |                               | 3.4            | 3.7         | 3.4      | 3.7         |       |     |      |
|                  |                                                                           | I <sub>OH</sub> = 100μA                                                         | Full range                    | 3.75           |             | 3.75     |             |       |     |      |
|                  |                                                                           | I <sub>OH</sub> = 1mA                                                           |                               | 3.65           |             | 3.65     |             |       |     |      |
|                  |                                                                           | I <sub>OH</sub> = 10mA                                                          |                               | 3.45           |             | 3.45     |             |       |     |      |
| V <sub>OL</sub>  | Low level output voltage                                                  | I <sub>OL</sub> = 150μA                                                         | 25°C                          | 75             | 125         | 75       | 125         | mV    |     |      |
|                  |                                                                           | I <sub>OL</sub> = 1.5μA                                                         |                               | 150            | 225         | 150      | 225         |       |     |      |
|                  |                                                                           | I <sub>OL</sub> = 15mA                                                          |                               | 1.2            | 1.6         | 1.2      | 1.6         |       | V   |      |
|                  |                                                                           | I <sub>OL</sub> = 100μA                                                         | Full range                    | 200            |             | 200      |             | mV    |     |      |
|                  |                                                                           | I <sub>OL</sub> = 1mA                                                           |                               | 250            |             | 250      |             |       |     |      |
|                  |                                                                           | I <sub>OL</sub> = 10mA                                                          |                               | 1.45           |             | 1.45     |             |       | V   |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                           | V <sub>IC</sub> = ±2.5V , R <sub>L</sub> = 2kΩ,<br>V <sub>O</sub> = 1V to -1.5V | 25°C                          | 50             | 95          | 50       | 95          | V/mV  |     |      |
|                  |                                                                           |                                                                                 | Full range                    | 5              |             | 5        |             |       |     |      |
| r <sub>i</sub>   | Input resistance                                                          |                                                                                 | 25°C                          | 70             |             | 70       |             | MΩ    |     |      |
| c <sub>i</sub>   | Input capacitance                                                         |                                                                                 | 25°C                          | 2.5            |             | 2.5      |             | pF    |     |      |
| Z <sub>O</sub>   | Open-loop output impedance                                                | f = 1MHz                                                                        | 25°C                          | 30             |             | 30       |             | Ω     |     |      |
| CMR<br>R         | Common-mode rejection ratio                                               | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω                    | 25°C                          | 85             | 118         | 85       | 118         | dB    |     |      |
|                  |                                                                           |                                                                                 | Full range                    | 80             |             | 80       |             |       |     |      |
| k <sub>SVR</sub> | Supply-voltage rejection ratio<br>(ΔV <sub>CC</sub> ± /ΔV <sub>IO</sub> ) | V <sub>CC</sub> ± = ± 2.5V to ± 15V ,<br>R <sub>S</sub> = 50Ω                   | 25°C                          | 90             | 106         | 90       | 106         | dB    |     |      |
|                  |                                                                           |                                                                                 | Full range                    | 85             |             | 85       |             |       |     |      |
| I <sub>CC</sub>  | Supply current                                                            | V <sub>O</sub> = 2.5V , No load,<br>V <sub>IC</sub> = 2.5V                      | 25°C                          | 13.2           | 17.6        | 13.2     | 17.6        | mA    |     |      |
|                  |                                                                           |                                                                                 | Full range                    | 18.4           |             | 18.4     |             |       |     |      |

(1) Full range is  $-55^\circ C$  to  $125^\circ C$ .

## 5.36 TLE2144M Operating Characteristics

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

| PARAMETER              |                                               | TEST CONDITIONS                                                          |          | TLE2144M |     |     | TLE2144AM |     |     | UNIT            |
|------------------------|-----------------------------------------------|--------------------------------------------------------------------------|----------|----------|-----|-----|-----------|-----|-----|-----------------|
|                        |                                               |                                                                          |          | MIN      | TYP | MAX | MIN       | TYP | MAX |                 |
| SR+                    | Positive slew rate                            | $A_{VD} = -1$ , $R_L = 2k\Omega^{(1)}$ , $C_L = 500pF$                   |          | 45       |     |     | 45        |     |     | V/ $\mu s$      |
| SR-                    | Negative slew rate                            |                                                                          |          | 42       |     |     | 42        |     |     |                 |
| $t_s$                  | Settling time                                 | $A_{VD} = -1$ , 2.5V step                                                | To 0.1%  | 0.66     |     |     | 0.66      |     |     | $\mu s$         |
|                        |                                               |                                                                          | To 0.01% | 0.99     |     |     | 0.99      |     |     |                 |
|                        |                                               | $R_S = 20\Omega$ , $f = 10Hz$                                            |          | 15       |     |     | 15        |     |     | nV/ $\sqrt{Hz}$ |
| $V_n$                  | Equivalent input noise voltage                | $R_S = 20\Omega$ , $f = 1kHz$                                            |          | 10.5     |     |     | 10.5      |     |     |                 |
| $V_{N(PP)}$            | Peak-to-peak equivalent input noise voltage   | $f = 0.1Hz$ to $1Hz$                                                     |          | 0.48     |     |     | 0.48      |     |     | $\mu V$         |
|                        |                                               | $f = 0.1Hz$ to $10Hz$                                                    |          | 0.51     |     |     | 0.51      |     |     |                 |
| $I_n$                  | Equivalent input noise current                | $f = 10Hz$                                                               |          | 1.92     |     |     | 1.92      |     |     | pA/ $\sqrt{Hz}$ |
|                        |                                               | $f = 1kHz$                                                               |          | 0.5      |     |     | 0.5       |     |     |                 |
| THD + N                | Total harmonic distortion plus noise          | $V_O = 1V$ to $3V$ , $R_L = 2k\Omega^{(1)}$ , $A_{VD} = 2$ , $f = 10kHz$ |          | 0.0052%  |     |     | 0.0052%   |     |     |                 |
| $B_1$                  | Unity-gain bandwidth                          | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$                                   |          | 5.9      |     |     | 5.9       |     |     | MHz             |
| Gain-bandwidth product |                                               | $R_L = 2k\Omega^{(1)}$ , $C_L = 100pF$ , $f = 100kHz$                    |          | 5.8      |     |     | 5.8       |     |     | MHz             |
| $B_{OM}$               | Maximum output-swing bandwidth <sup>(2)</sup> | $V_{O(PP)} = 2V$ , $R_L = 2k\Omega^{(1)}$ , $A_{VD} = 1$                 |          | 380      |     |     | 380       |     |     | kHz             |
| $\varphi_m$            | Phase margin                                  | $R_L = 2k\Omega^{(1)}$ <sup>(1)</sup> , $C_L = 100pF$                    |          | 57°      |     |     | 57°       |     |     |                 |

(1)  $R_L$  terminates at 2.5V.

(2) Measured at -0.1dB.

## 5.37 TLE2144M Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$  (unless otherwise noted)

| PARAMETER                                                                        | TEST CONDITIONS                                     | $T_A$ <sup>(1)</sup> | TLE2144M          |                     |      | TLE2144AM         |                     |      | UNIT             |
|----------------------------------------------------------------------------------|-----------------------------------------------------|----------------------|-------------------|---------------------|------|-------------------|---------------------|------|------------------|
|                                                                                  |                                                     |                      | MIN               | TYP                 | MAX  | MIN               | TYP                 | MAX  |                  |
| $V_{IO}$ Input offset voltage                                                    | $V_{IC} = 0, R_S = 50\Omega$                        | 25°C                 |                   | 0.6                 | 2.4  |                   | 0.5                 | 1.5  | mV               |
|                                                                                  |                                                     | Full range           |                   |                     | 4    |                   |                     | 3.2  |                  |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage                   |                                                     | Full range           |                   | 1.7                 |      |                   | 1.7                 |      | $\mu V/^\circ C$ |
|                                                                                  |                                                     | 25°C                 |                   | 7                   | 100  |                   | 7                   | 100  | nA               |
| $I_{IO}$ Input offset current                                                    |                                                     | Full range           |                   |                     | 250  |                   |                     | 250  |                  |
|                                                                                  |                                                     | 25°C                 |                   | -0.7                | -1.5 |                   | -0.7                | -1.5 |                  |
| $I_{IB}$ Input bias current                                                      |                                                     | Full range           |                   |                     | -1.8 |                   |                     | -1.8 | $\mu A$          |
| $V_{ICR}$ Common-mode input voltage range                                        | $R_S = 50\Omega$                                    | 25°C                 | -15<br>to<br>13   | -15.3<br>to<br>13.2 |      | -15<br>to<br>13   | -15.3<br>to<br>13.2 |      | V                |
|                                                                                  |                                                     | Full range           | -15<br>to<br>12.7 | -15.3<br>to<br>12.9 |      | -15<br>to<br>12.7 | -15.3<br>to<br>12.9 |      |                  |
| $V_{OM+}$ Maximum positive peak output voltage swing                             | $I_O = -150\mu A$                                   | 25°C                 | 13.8              | 14.1                |      | 13.8              | 14.1                |      | V                |
|                                                                                  | $I_O = -1.5mA$                                      |                      | 13.7              | 14                  |      | 13.7              | 14                  |      |                  |
|                                                                                  | $I_O = -15mA$                                       |                      | 13.1              | 13.7                |      | 13.1              | 13.7                |      |                  |
|                                                                                  | $I_O = -100\mu A$                                   | Full range           | 13.7              |                     |      | 13.7              |                     |      |                  |
|                                                                                  | $I_O = -1mA$                                        |                      | 13.6              |                     |      | 13.6              |                     |      |                  |
|                                                                                  | $I_O = -10mA$                                       |                      | 13.1              |                     |      | 13.1              |                     |      |                  |
| $V_{OM-}$ Maximum negative peak output voltage swing                             | $I_O = 150\mu A$                                    | 25°C                 | -14.7             | -14.9               |      | -14.7             | -14.9               |      | V                |
|                                                                                  | $I_O = 1.5mA$                                       |                      | -14.5             | -14.8               |      | -14.5             | -14.8               |      |                  |
|                                                                                  | $I_O = 15mA$                                        |                      | -13.4             | -13.8               |      | -13.4             | -13.8               |      |                  |
|                                                                                  | $I_O = 100\mu A$                                    | Full range           | -14.6             |                     |      | -14.6             |                     |      |                  |
|                                                                                  | $I_O = 1mA$                                         |                      | -14.5             |                     |      | -14.5             |                     |      |                  |
|                                                                                  | $I_O = 10mA$                                        |                      | -13.4             |                     |      | -13.4             |                     |      |                  |
| $A_{VD}$ Large-signal differential voltage amplification                         | $V_O = \pm 10V, R_L = 2k\Omega$                     | 25°C                 | 100               | 170                 |      | 100               | 170                 |      | V/mV             |
|                                                                                  |                                                     | Full range           | 20                |                     |      | 20                |                     |      |                  |
| $r_i$ Input resistance                                                           |                                                     | 25°C                 | 65                |                     |      | 65                |                     |      | M $\Omega$       |
| $c_i$ Input capacitance                                                          |                                                     | 25°C                 | 2.5               |                     |      | 2.5               |                     |      | pF               |
| $z_o$ Open-loop output impedance                                                 | $f = 1MHz$                                          | 25°C                 | 30                |                     |      | 30                |                     |      | $\Omega$         |
| CMR<br>R Common-mode rejection ratio                                             | $V_{IC} = V_{ICRmin}, R_S = 50\Omega$               | 25°C                 | 85                | 108                 |      | 85                | 108                 |      | dB               |
|                                                                                  |                                                     | Full range           | 80                |                     |      | 80                |                     |      |                  |
| $k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC} \pm / \Delta V_{IO}$ ) | $V_{CC\pm} = \pm 2.5V$ to $\pm 15V, R_S = 50\Omega$ | 25°C                 | 90                | 106                 |      | 90                | 106                 |      | dB               |
|                                                                                  |                                                     | Full range           | 85                |                     |      | 85                |                     |      |                  |
| $I_{OS}$ Short circuit output current                                            | $V_O = 0$                                           | 25°C                 | -25               | -50                 |      | -25               | -50                 |      | mA               |
|                                                                                  |                                                     |                      | 20                | 31                  |      | 20                | 31                  |      |                  |
| $I_{CC}$ Supply current                                                          | $V_O = 0, \text{No load}, V_{IC} = 2.5V$            | 25°C                 | 13.8              | 18                  |      | 13.8              | 18                  |      | mA               |
|                                                                                  |                                                     | Full range           | 18.8              |                     |      | 18.8              |                     |      |                  |

(1) Full range is -55°C to 125°C

## 5.38 TLE2144M Operating Characteristics

$V_{CC\pm} = \pm 15V$ ,  $T_A = 25^\circ C$

| PARAMETER          |                                               | TEST CONDITIONS                                                                             |          | TLE2144M          |     |       | TLE2144AM         |         |     | UNIT |
|--------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|----------|-------------------|-----|-------|-------------------|---------|-----|------|
|                    |                                               |                                                                                             |          | MIN               | TYP | MAX   | MIN               | TYP     | MAX |      |
| SR+                | Positive slew rate                            | R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = - 1, C <sub>L</sub> = 100pF                         |          | 27 <sup>(1)</sup> | 45  |       | 27 <sup>(1)</sup> | 45      |     | V/μs |
| SR-                | Negative slew rate                            |                                                                                             |          | 27 <sup>(1)</sup> | 42  |       | 27 <sup>(1)</sup> | 42      |     |      |
| t <sub>s</sub>     | Settling time                                 | A <sub>VD</sub> = - 1, 10V step                                                             | To 0.1%  | 0.43              |     | 0.43  |                   | μs      |     |      |
|                    |                                               |                                                                                             | To 0.01% | 0.64              |     | 0.64  |                   |         |     |      |
| V <sub>n</sub>     | Equivalent input noise voltage                | R <sub>S</sub> = 20Ω, f = 10Hz                                                              |          | 15                |     | 15    |                   | nV/√ Hz |     |      |
|                    |                                               | R <sub>S</sub> = 20Ω, f = 1kHz                                                              |          | 10.5              |     | 10.5  |                   |         |     |      |
| V <sub>N(PP)</sub> | Peak-to-peak equivalent input noise voltage   | f = 0.1Hz to 1Hz                                                                            |          | 0.48              |     | 0.48  |                   | μV      |     |      |
|                    |                                               | f = 0.1Hz to 10Hz                                                                           |          | 0.51              |     | 0.51  |                   |         |     |      |
| I <sub>n</sub>     | Equivalent input noise current                | f = 10Hz                                                                                    |          | 1.89              |     | 1.89  |                   | pA/√ Hz |     |      |
|                    |                                               | f = 10kHz                                                                                   |          | 0.47              |     | 0.47  |                   |         |     |      |
| THD+N              | Total harmonic distortion plus noise          | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 10, f = 10kHz             |          | 0.06%             |     | 0.06% |                   |         |     |      |
| B <sub>1</sub>     | Unity-gain bandwidth                          | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 6                 |     | 6     |                   | MHz     |     |      |
|                    | Gain-bandwidth product                        | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF, f = 100kHz                                    |          | 5.9               |     | 5.9   |                   | MHz     |     |      |
| B <sub>OM</sub>    | Maximum output-swing bandwidth <sup>(2)</sup> | V <sub>O(PP)</sub> = 20V, R <sub>L</sub> = 2kΩ, A <sub>VD</sub> = 1, C <sub>L</sub> = 100pF |          | 668               |     | 668   |                   | kHz     |     |      |
| φ <sub>m</sub>     | Phase margin at unity gain                    | R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF                                                |          | 58°               |     | 58°   |                   |         |     |      |

(1) Specified by characterization.

(2) Measured at -0.1dB.



### 5.39 TLE2141Y Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$ ,  $T_A = 25^\circ C$  (unless otherwise noted)

| PARAMETER                                                                        | TEST CONDITIONS                                        | TLE2141Y        |                     |      | UNIT       |
|----------------------------------------------------------------------------------|--------------------------------------------------------|-----------------|---------------------|------|------------|
|                                                                                  |                                                        | MIN             | TYP                 | MAX  |            |
| $V_{IO}$ Input offset voltage                                                    |                                                        |                 | 200                 | 1000 | $\mu V$    |
| $I_{IO}$ Input offset current                                                    | $V_{IC} = 0$ , $R_S = 50\Omega$ , $V_O = 0$            |                 | 7                   | 100  | nA         |
| $I_{IB}$ Input bias current                                                      |                                                        |                 | -0.7                | -1.5 | $\mu A$    |
| $V_{ICR}$ Common-mode input voltage range                                        | $R_S = 50\Omega$                                       | -15<br>to<br>13 | -15.3<br>to<br>13.2 |      | V          |
| $V_{OM+}$ Maximum positive peak output voltage swing                             | $I_O = -150\mu A$                                      | 13.8            | 14.1                |      | V          |
|                                                                                  | $I_O = -1.5mA$                                         | 13.7            | 14                  |      |            |
|                                                                                  | $I_O = -15mA$                                          | 13.3            | 13.7                |      |            |
| $V_{OM-}$ Maximum negative peak output voltage swing                             | $I_O = 150\mu A$                                       | -14.7           | -14.9               |      | V          |
|                                                                                  | $I_O = 1.5mA$                                          | -14.5           | -14.8               |      |            |
|                                                                                  | $I_O = 15mA$                                           | -13.4           | -13.8               |      |            |
| $A_{VD}$ Large-signal differential voltage amplification                         | $V_O = \pm 10V$ , $R_L = 2k\Omega$                     | 100             | 450                 |      | V/mV       |
| $r_i$ Input resistance                                                           |                                                        |                 | 65                  |      | M $\Omega$ |
| $c_i$ Input capacitance                                                          |                                                        |                 | 2.5                 |      | pF         |
| $z_o$ Open-loop output impedance                                                 | $f = 1MHz$                                             |                 | 30                  |      | $\Omega$   |
| CMRR Common-mode rejection ratio                                                 | $V_{IC} = V_{ICRmin}$ , $R_S = 50\Omega$               | 80              | 108                 |      | dB         |
| $k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC} \pm / \Delta V_{IO}$ ) | $V_{CC\pm} = \pm 2.5V$ to $\pm 15V$ , $R_S = 50\Omega$ | 85              | 106                 |      | dB         |
| $I_{OS}$ Short-circuit output current                                            | $V_O = 0$                                              | $V_{ID} = 1V$   |                     | -25  | mA         |
|                                                                                  |                                                        | $V_{ID} = -1V$  |                     | 20   |            |
| $I_{CC}$ Supply current                                                          | $V_O = 0$ , No load                                    | 3.5             | 4.5                 |      | mA         |

## 5.40 TLE2142Y Electrical Characteristics

at specified free-air temperature,  $V_{CC\pm} = \pm 15V$ ,  $T_A = 25^\circ$  (unless otherwise noted)

| PARAMETER        |                                                                        | TEST CONDITIONS                                               | TLE2142Y              |                     |      | UNIT |    |
|------------------|------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------|---------------------|------|------|----|
|                  |                                                                        |                                                               | MIN                   | TYP                 | MAX  |      |    |
| V <sub>IO</sub>  | Input offset voltage                                                   |                                                               | 150                   |                     | 875  | μV   |    |
| I <sub>IO</sub>  | Input offset current                                                   | V <sub>IC</sub> = 0, R <sub>S</sub> = 50Ω, V <sub>O</sub> = 0 | 7                     |                     | 100  | nA   |    |
| I <sub>IB</sub>  | Input bias current                                                     |                                                               | -0.7                  |                     | -1.5 | μA   |    |
| V <sub>ICR</sub> | Common-mode input voltage range                                        | R <sub>S</sub> = 50Ω                                          | -15<br>to<br>13       | -15.3<br>to<br>13.2 |      | V    |    |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                             | I <sub>O</sub> = -150μA                                       | 13.8                  | 14.1                |      | V    |    |
|                  |                                                                        | I <sub>O</sub> = -1.5mA                                       | 13.7                  | 14                  |      |      |    |
|                  |                                                                        | I <sub>O</sub> = -15mA                                        | 13.3                  | 13.7                |      |      |    |
| V <sub>OM-</sub> | Maximum negative peak output voltage swing                             | I <sub>O</sub> = 150μA                                        | -14.7                 | -14.9               |      | V    |    |
|                  |                                                                        | I <sub>O</sub> = 1.5mA                                        | -14.5                 | -14.8               |      |      |    |
|                  |                                                                        | I <sub>O</sub> = 15mA                                         | -13.4                 | -13.8               |      |      |    |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                        | V <sub>O</sub> = ±10V, R <sub>L</sub> = 2kΩ                   | 100                   | 450                 |      | V/mV |    |
| r <sub>i</sub>   | Input resistance                                                       |                                                               | 65                    |                     |      | MΩ   |    |
| c <sub>i</sub>   | Input capacitance                                                      |                                                               | 2.5                   |                     |      | pF   |    |
| z <sub>o</sub>   | Open-loop output impedance                                             | f = 1MHz                                                      | 30                    |                     |      | Ω    |    |
| CMRR             | Common-mode rejection ratio                                            | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω  | 80                    | 108                 |      | dB   |    |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC</sub> ± /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V , R <sub>S</sub> = 50Ω       | 85                    | 106                 |      | dB   |    |
| I <sub>OS</sub>  | Short-circuit output current                                           | V <sub>O</sub> = 0                                            | V <sub>ID</sub> = 1V  |                     | -25  | -50  | mA |
|                  |                                                                        |                                                               | V <sub>ID</sub> = -1V |                     | 20   | 31   |    |
| I <sub>CC</sub>  | Supply current                                                         | V <sub>O</sub> = 0, No load                                   | 6.9                   |                     | 9    | mA   |    |

## 5.41 TLE2144Y Electrical Characteristics

at  $V_{CC\pm} = \pm 15V$ ,  $T_A = 25^\circ C$  (unless otherwise noted)

| PARAMETER        |                                                                        | TEST CONDITIONS                                               |                       | TLE2144Y        |                     |      | UNIT |
|------------------|------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------|-----------------|---------------------|------|------|
|                  |                                                                        |                                                               |                       | MIN             | TYP                 | MAX  |      |
| V <sub>IO</sub>  | Input offset voltage                                                   |                                                               |                       | 0.3             |                     | 1.8  | μV   |
| I <sub>IO</sub>  | Input offset current                                                   | V <sub>IC</sub> = 0, R <sub>S</sub> = 50Ω, V <sub>O</sub> = 0 |                       | 7               |                     | 100  | nA   |
| I <sub>IB</sub>  | Input bias current                                                     |                                                               |                       | -0.7            |                     | -1.5 | μA   |
| V <sub>ICR</sub> | Common-mode input voltage range                                        | R <sub>S</sub> = 50Ω                                          |                       | -15<br>to<br>13 | -15.3<br>to<br>13.2 |      | V    |
| V <sub>OM+</sub> | Maximum positive peak output voltage swing                             | I <sub>O</sub> = -150μA                                       |                       | 13.8            | 14.1                |      | V    |
|                  |                                                                        | I <sub>O</sub> = -1.5mA                                       |                       | 13.7            | 14                  |      |      |
|                  |                                                                        | I <sub>O</sub> = -15mA                                        |                       | 13.3            | 13.7                |      |      |
| V <sub>OM-</sub> | Maximum negative peak output voltage swing                             | I <sub>O</sub> = 150μA                                        |                       | -14.7           | -14.9               |      | V    |
|                  |                                                                        | I <sub>O</sub> = 1.5mA                                        |                       | -14.5           | -14.8               |      |      |
|                  |                                                                        | I <sub>O</sub> = 15mA                                         |                       | -13.4           | -13.8               |      |      |
| A <sub>VD</sub>  | Large-signal differential voltage amplification                        | V <sub>O</sub> = ±10V, R <sub>L</sub> = 2kΩ                   |                       | 100             | 450                 |      | V/mV |
| r <sub>i</sub>   | Input resistance                                                       |                                                               |                       | 65              |                     |      | MΩ   |
| c <sub>i</sub>   | Input capacitance                                                      |                                                               |                       | 2.5             |                     |      | pF   |
| Z <sub>o</sub>   | Open-loop output impedance                                             | f = 1MHz                                                      |                       | 30              |                     |      | Ω    |
| CMRR             | Common-mode rejection ratio                                            | V <sub>IC</sub> = V <sub>ICRmin</sub> , R <sub>S</sub> = 50Ω  |                       | 80              | 108                 |      | dB   |
| k <sub>SVR</sub> | Supply-voltage rejection ratio (ΔV <sub>CC</sub> ± /ΔV <sub>IO</sub> ) | V <sub>CC±</sub> = ±2.5V to ±15V , R <sub>S</sub> = 50Ω       |                       | 85              | 106                 |      | dB   |
| I <sub>OS</sub>  | Short-circuit output current                                           | V <sub>O</sub> = 0                                            | V <sub>ID</sub> = 1V  | -25             | -50                 |      | mA   |
|                  |                                                                        |                                                               | V <sub>ID</sub> = -1V | 20              | 31                  |      |      |
| I <sub>CC</sub>  | Supply current                                                         | V <sub>O</sub> = 0, No load                                   |                       | 13.8            |                     | 18   | mA   |

## 5.42 Typical Characteristics

Table of Graphs

|                |                                                 |                              | FIGURE  |
|----------------|-------------------------------------------------|------------------------------|---------|
| $V_{IO}$       | Input offset voltage                            | Distribution                 | 1, 2, 3 |
| $I_{IO}$       | Input offset current                            | vs Free-air temperature      | 4       |
| $I_{IB}$       | Input bias current                              | vs Common-mode input voltage | 5       |
|                |                                                 | vs Free-air temperature      | 6       |
| $V_{OM+}$      | Maximum positive peak output voltage            | vs Supply voltage            | 7       |
|                |                                                 | vs Free-air temperature      | 8       |
|                |                                                 | vs Output current            | 9       |
|                |                                                 | vs Settling time             | 11      |
| $V_{OM-}$      | Maximum negative peak output voltage            | vs Supply voltage            | 7       |
|                |                                                 | vs Free-air temperature      | 8       |
|                |                                                 | vs Output current            | 10      |
|                |                                                 | vs Settling time             | 11      |
| $V_{O(PP)}$    | Maximum peak-to-peak output voltage             | vs Frequency                 | 12      |
| $V_{OH}$       | High-level output voltage                       | vs Output current            | 13      |
| $V_{OL}$       | Low-level output voltage                        | vs Output current            | 14      |
| $A_{VD}$       | Large-signal differential voltage amplification | vs Frequency                 | 15      |
|                |                                                 | vs Free-air temperature      | 16      |
|                | Phase shift                                     | vs Frequency                 | 15      |
| $z_o$          | Closed-loop output impedance                    | vs Frequency                 | 17      |
| $I_{OS}$       | Short-circuit output current                    | vs Free-air temperature      | 18      |
| $CMRR$         | Common-mode rejection ratio                     | vs Frequency                 | 19      |
|                |                                                 | vs Free-air temperature      | 20      |
| $k_{SVR}$      | Supply-voltage rejection ratio                  | vs Frequency                 | 21      |
|                |                                                 | vs Free-air temperature      | 22      |
|                |                                                 | vs Supply voltage            | 23      |
| $I_{CC}$       | Supply current                                  | vs Free-air temperature      | 24      |
| $V_n$          | Equivalent input noise voltage                  | vs Frequency                 | 25      |
| $V_n$          | Input noise voltage                             | Over a 10-second period      | 26      |
| $I_n$          | Noise current                                   | vs Frequency                 | 27      |
| $THD + N$      | Total harmonic distortion plus noise            | vs Frequency                 | 28      |
| $SR$           | Slew rate                                       | vs Free-air temperature      | 29      |
|                |                                                 | vs Load capacitance          | 30      |
| Pulse response | Noninverting large signal                       | vs Time                      | 31      |
|                | Inverting large signal                          | vs Time                      | 32      |
|                | Small signal                                    | vs Time                      | 33      |
| $B_1$          | Unity-gain bandwidth                            | vs Load capacitance          | 34      |
|                | Gain margin                                     | vs Load capacitance          | 35      |
| $\phi_m$       | Phase margin                                    | vs Load capacitance          | 36      |

## 5.42 Typical Characteristics (continued)

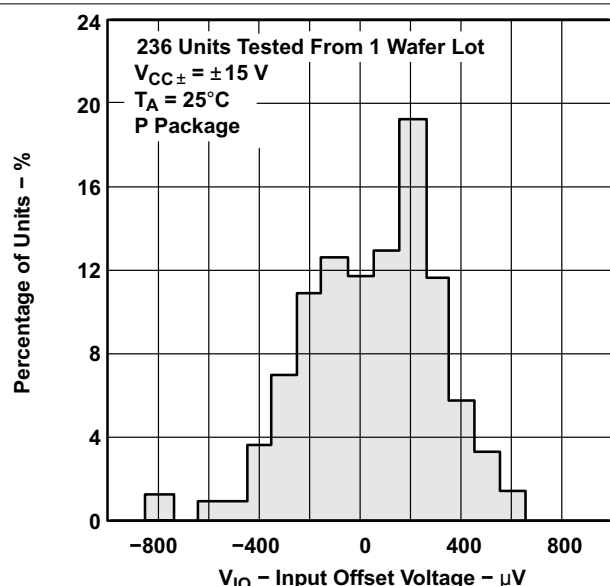


Figure 5-1. TLE2141 Distribution of Input Offset Voltage

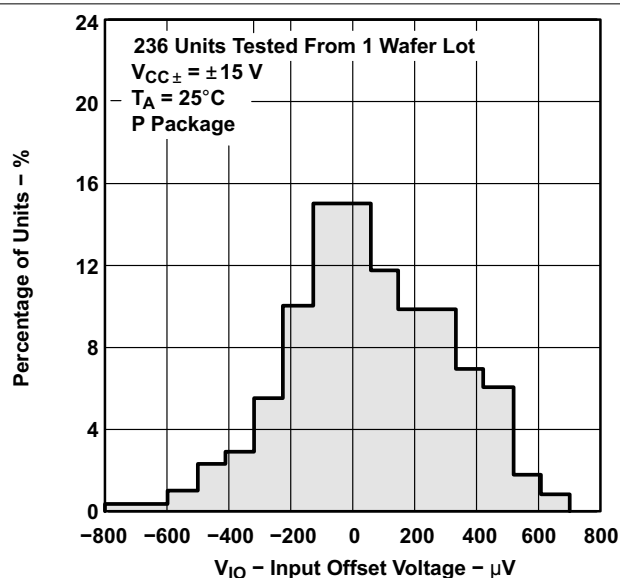
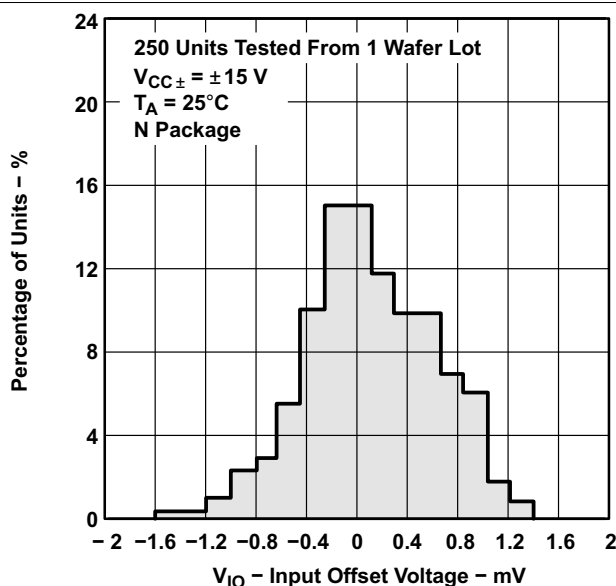
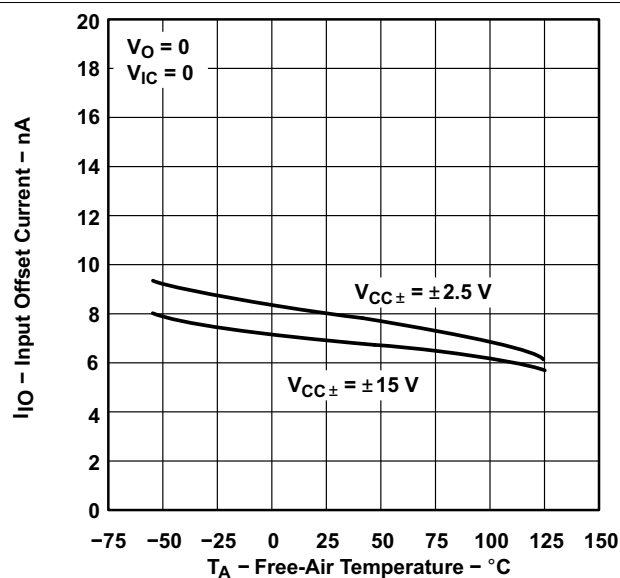


Figure 5-2. TLE2142 Distribution of Input Offset Voltage



TEST To remove kickback errors

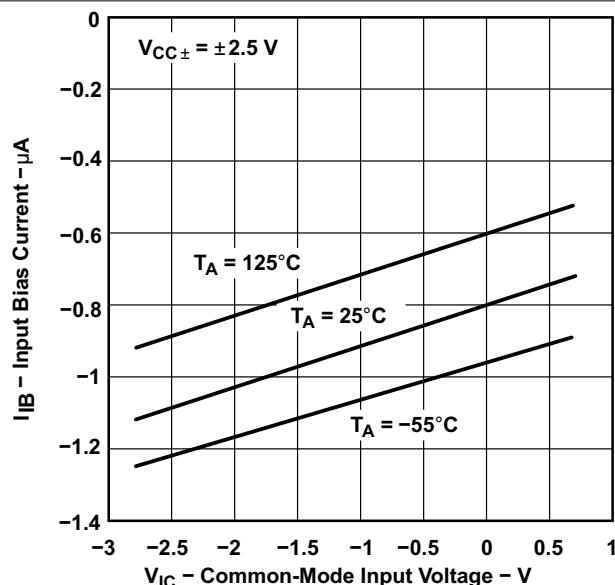
Figure 5-3. TLE2144 Distribution of Input Offset Voltage



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

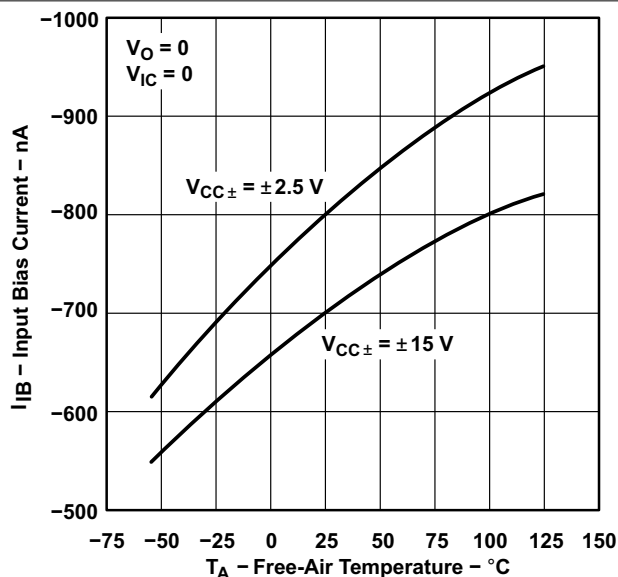
Figure 5-4. Input Offset Current<sup>(1)</sup> Offset Voltage

## 5.42 Typical Characteristics (continued)



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-5. Input Bias Current<sup>(1)</sup> vs Common-Mode Input Voltage



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-6. Input Bias Current<sup>(1)</sup> vs Free-Air Temperature

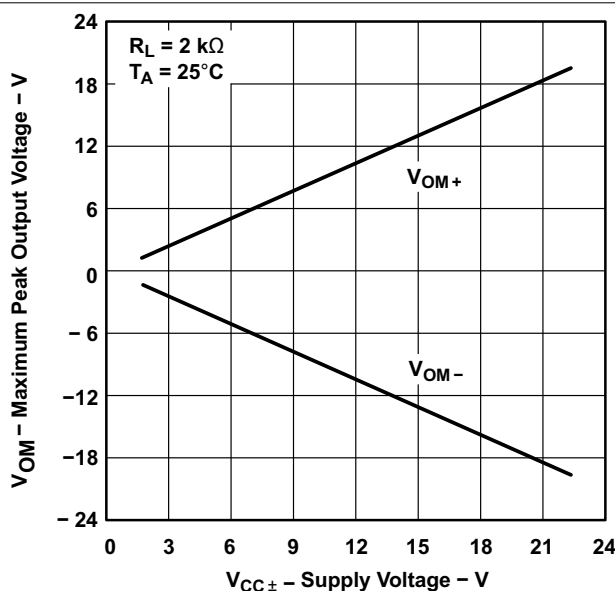


Figure 5-7. Maximum Peak Output Voltage vs Supply Voltage

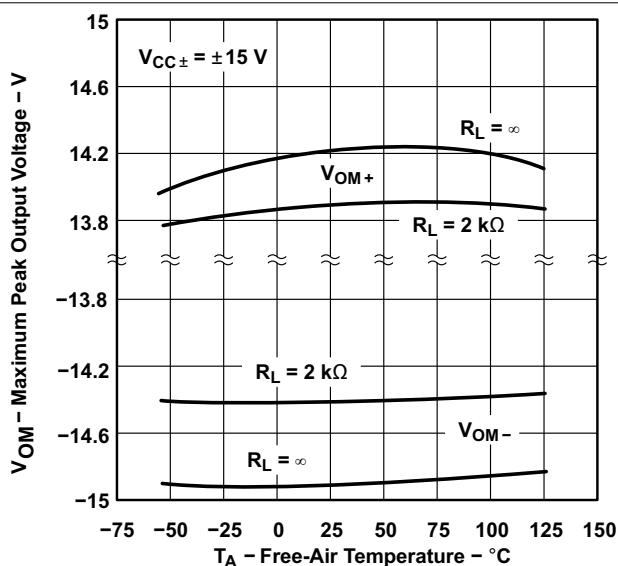
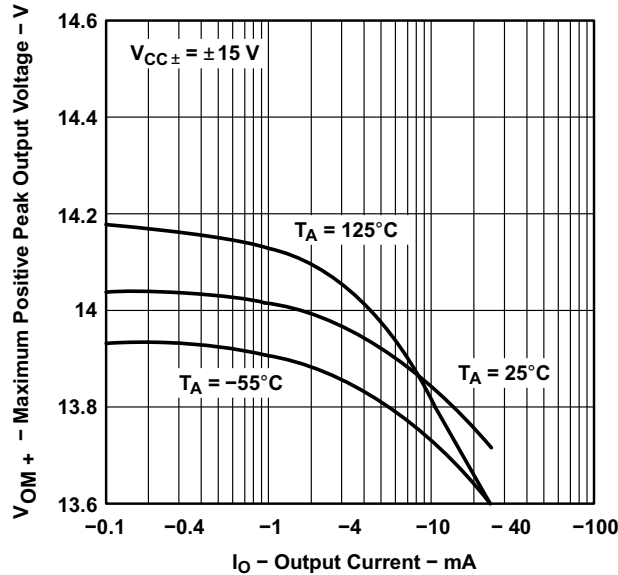


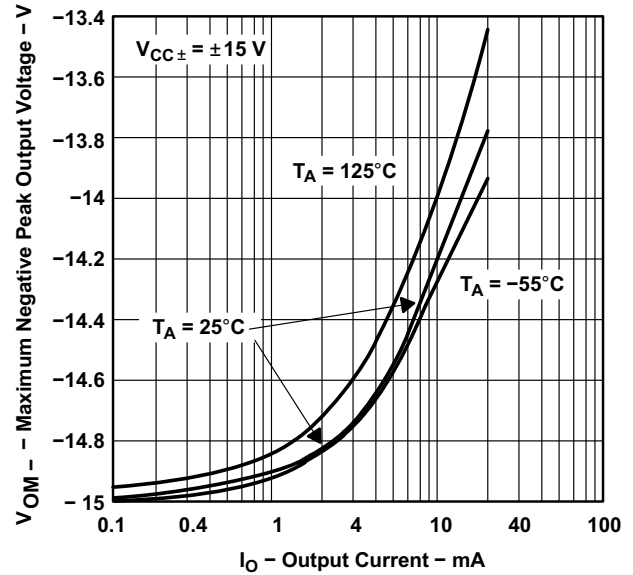
Figure 5-8. Maximum Peak Output Voltage vs Free-Air Temperature

## 5.42 Typical Characteristics (continued)



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-9. Maximum Positive Peak Output Voltage<sup>(1)</sup> vs Output Current



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-10. Maximum Negative Peak Output Voltage<sup>(1)</sup> vs Output Current

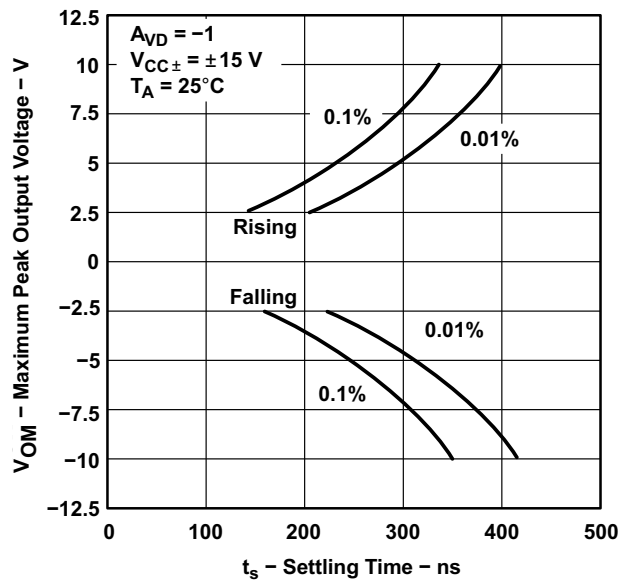
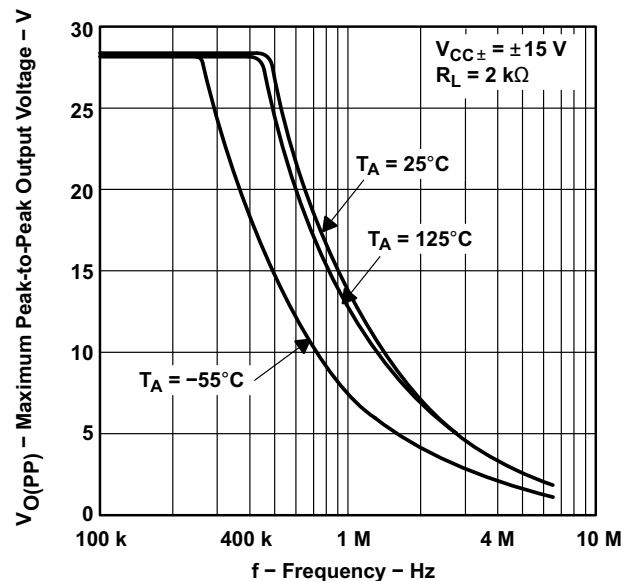


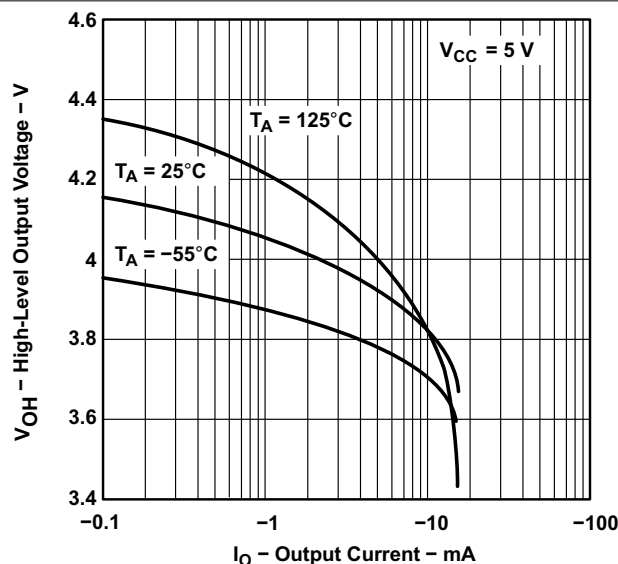
Figure 5-11. Maximum Peak Output Voltage vs Settling Time



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

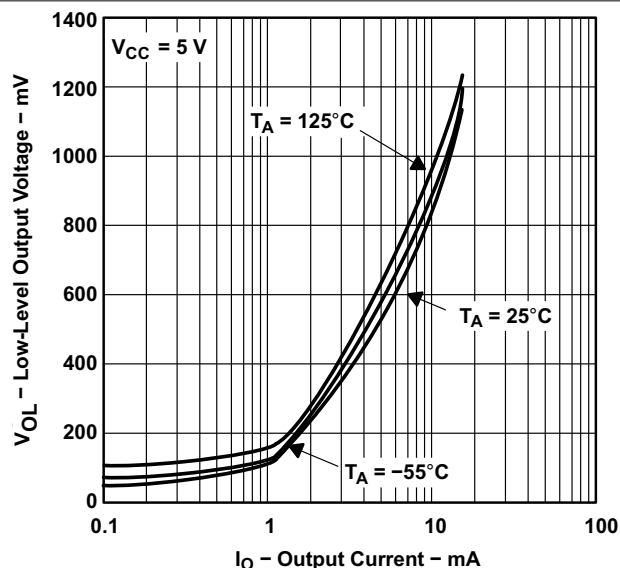
Figure 5-12. Maximum Peak-to-Peak Output Voltage<sup>(1)</sup> vs Frequency

## 5.42 Typical Characteristics (continued)



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-13. High-Level Output Voltage<sup>(1)</sup> vs Output Current



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-14. Low-Level Output Voltage<sup>(1)</sup> vs Output Current

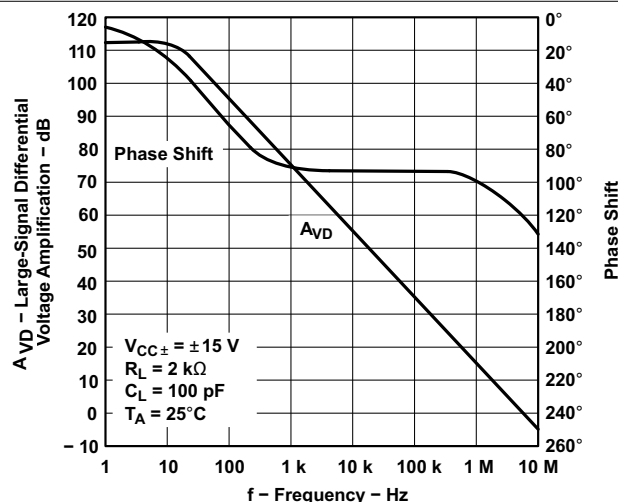
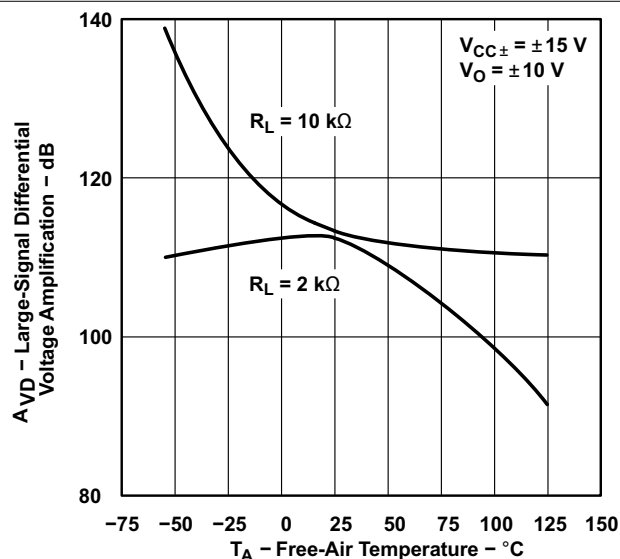


Figure 5-15. Large-Signal Differential Voltage Amplification and Phase Shift vs Frequency



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-16. Large-Signal Differential Voltage Amplification<sup>(1)</sup> vs Free-Air Temperature



## 5.42 Typical Characteristics (continued)

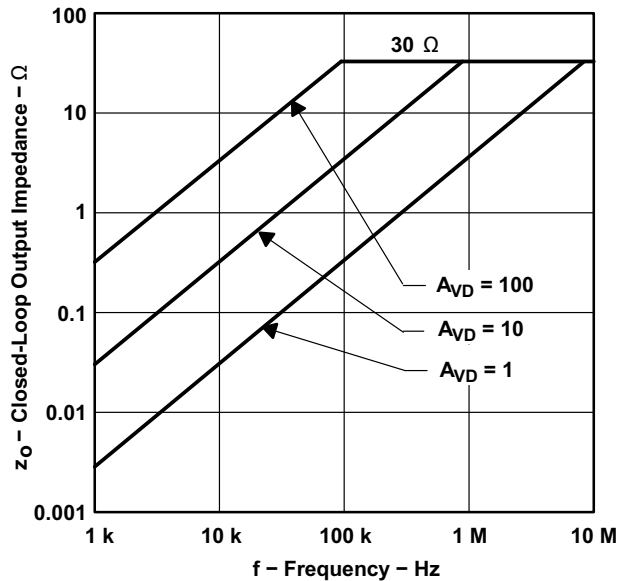
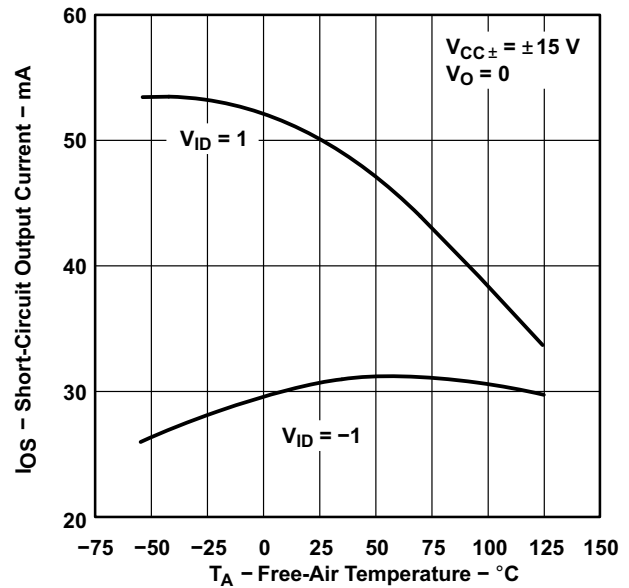


Figure 5-17. Closed-Loop Output Impedance vs Frequency



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-18. Short-Circuit Output Current<sup>(1)</sup> vs Free-Air Temperature

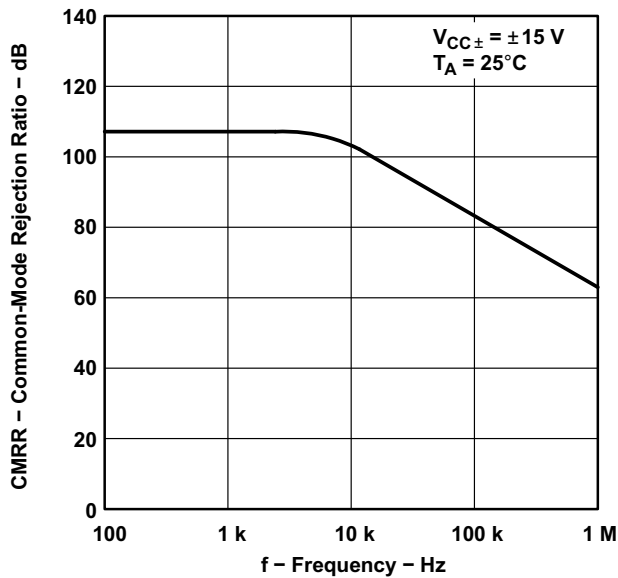
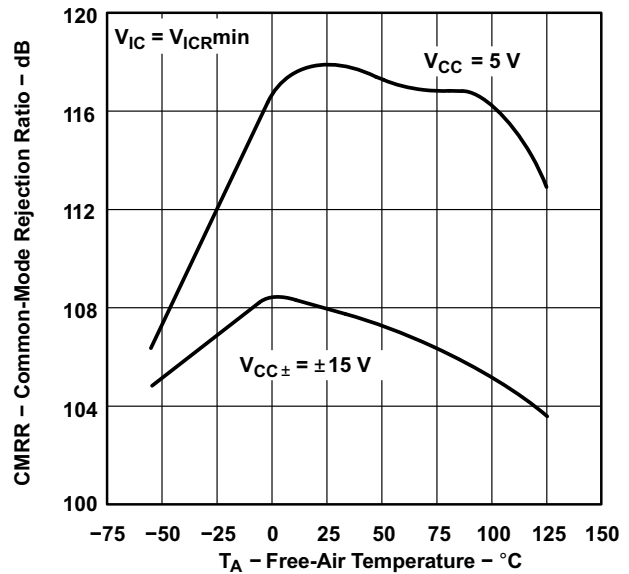


Figure 5-19. Common-Mode Rejection Ratio vs Frequency



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-20. Common-Mode Rejection Ratio<sup>(1)</sup> vs Free-Air Temperature

## 5.42 Typical Characteristics (continued)

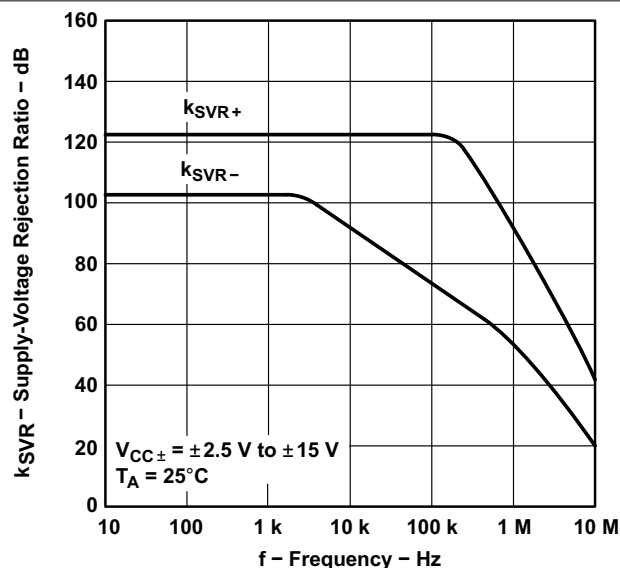
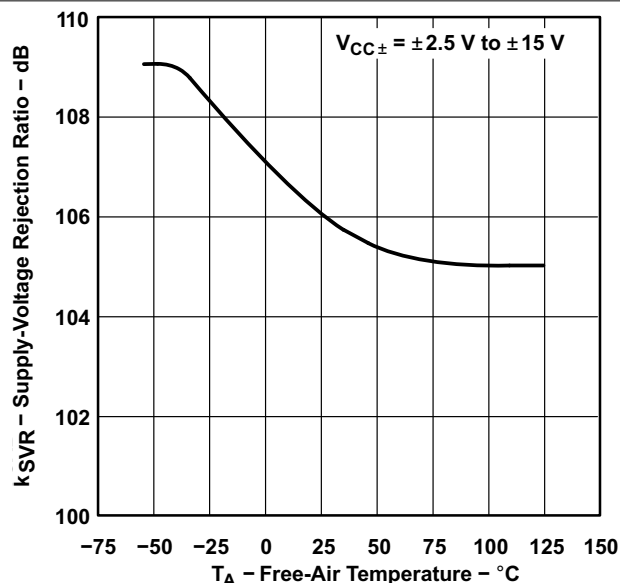
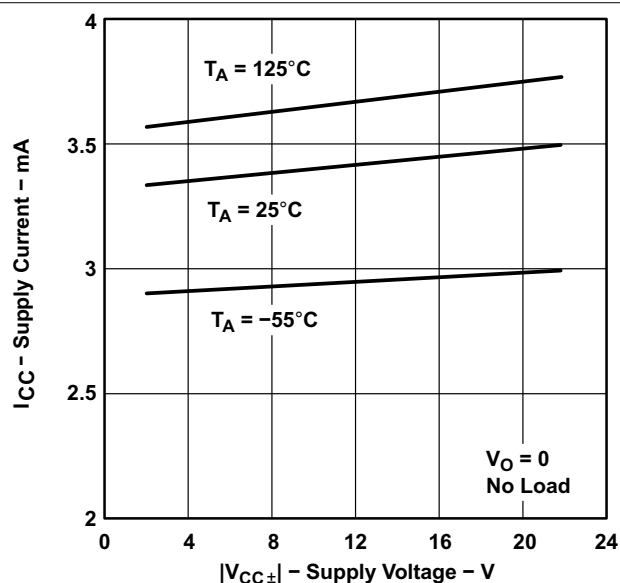


Figure 5-21. Supply-Voltage Rejection Ratio vs Frequency



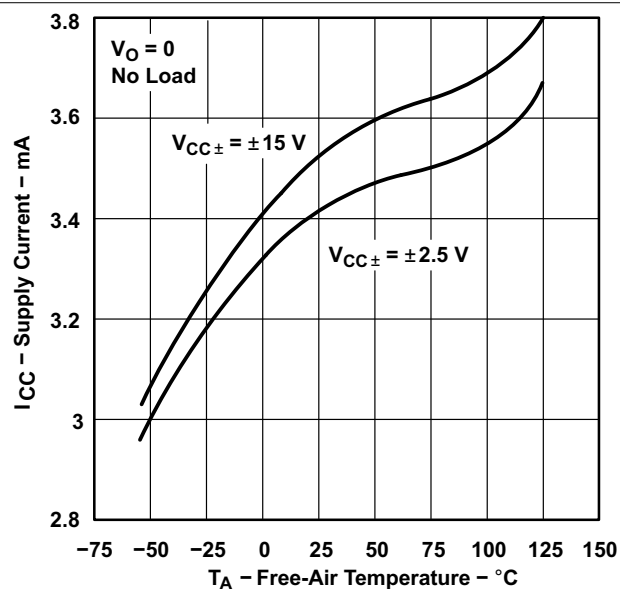
1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-22. Supply-Voltage Rejection Ratio<sup>(1)</sup> vs Free-Air Temperature



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

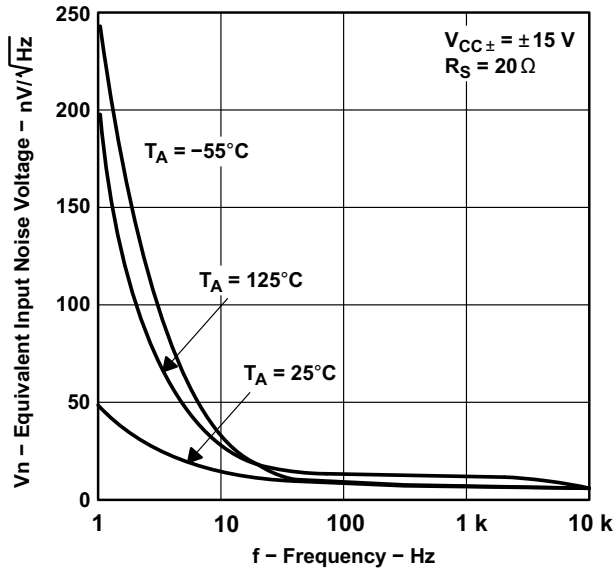
Figure 5-23. Supply Current<sup>(1)</sup> vs Supply Voltage



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-24. Supply Current<sup>(1)</sup> vs Free-Air Temperature

## 5.42 Typical Characteristics (continued)



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-25. Equivalent Input Noise Voltage<sup>(1)</sup> vs Frequency

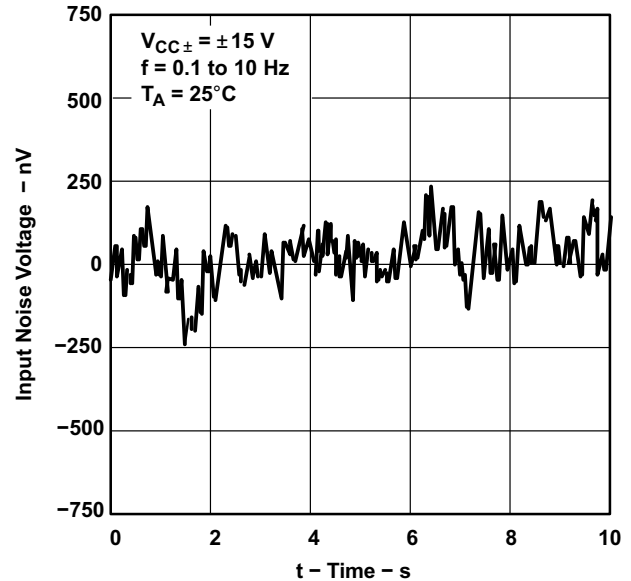
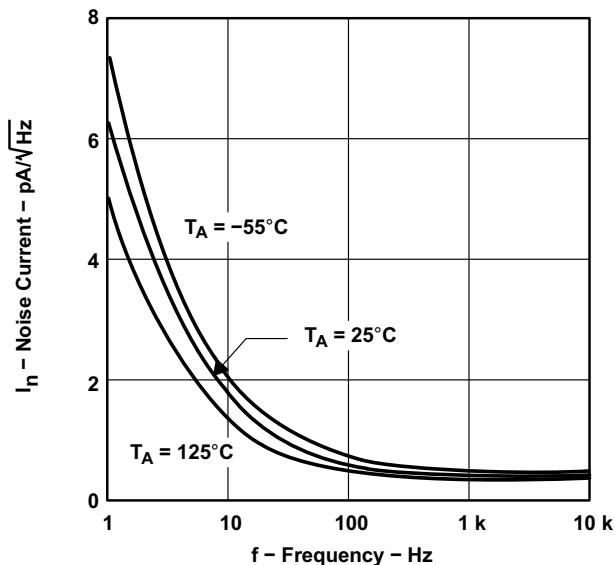


Figure 5-26. Input Noise Voltage Over a 10-Second Period



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-27. Noise Current<sup>(1)</sup> vs Frequency

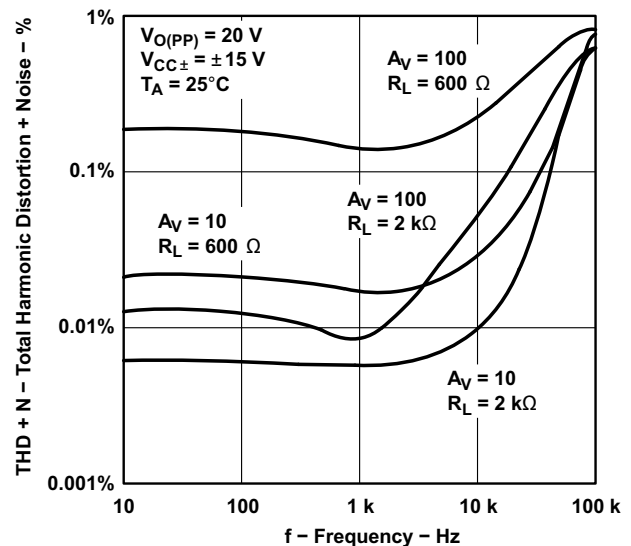
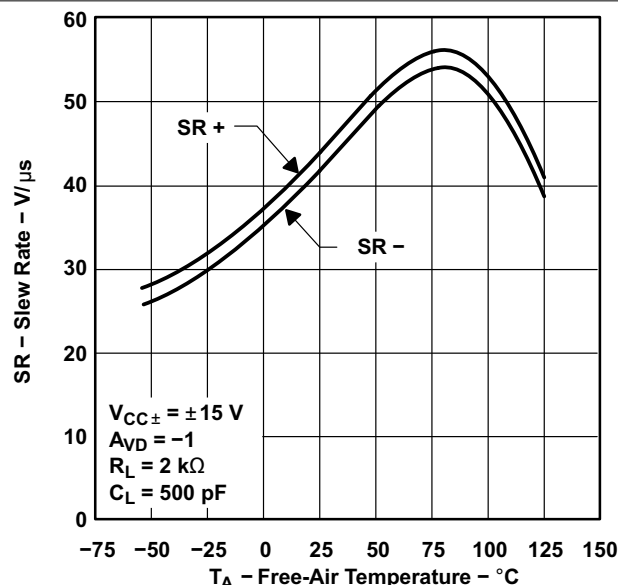


Figure 5-28. Total Harmonic Distortion Plus Noise vs Frequency

## 5.42 Typical Characteristics (continued)



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-29. Slew Rate<sup>(1)</sup> vs Free-Air Temperature

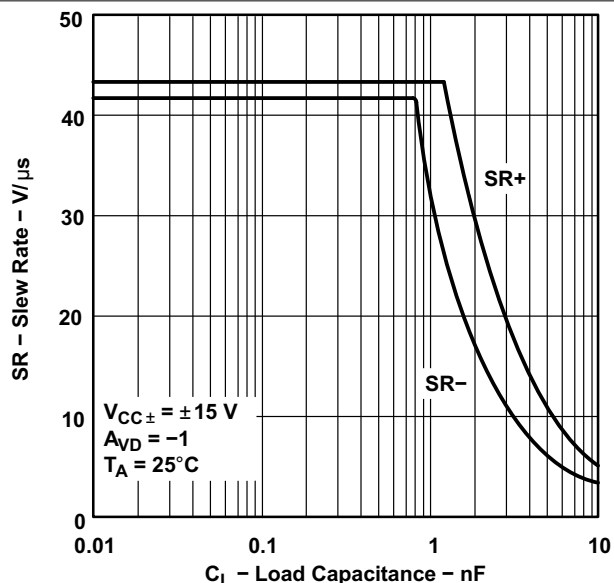
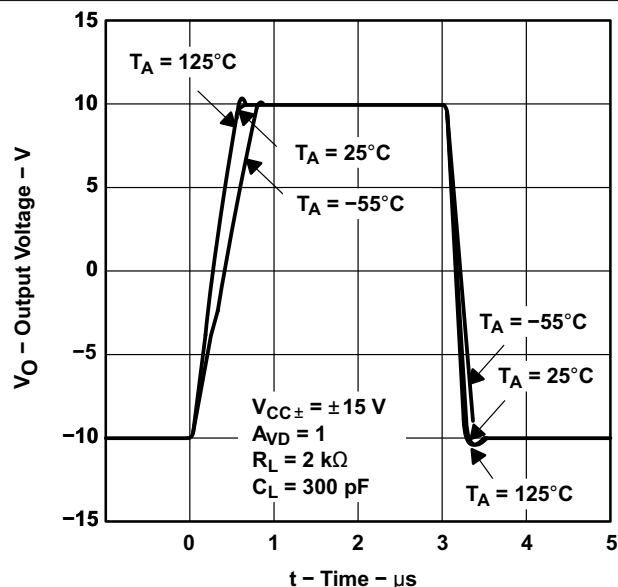
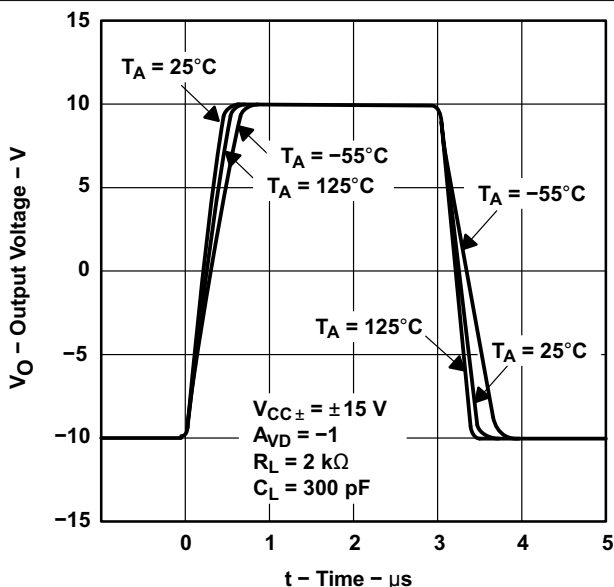


Figure 5-30. Slew Rate vs Load Capacitance



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-31. Noninverting Large-Signal Pulse Response<sup>(1)</sup>



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-32. Inverting Large-Signal Pulse Response<sup>(1)</sup>

## 5.42 Typical Characteristics (continued)

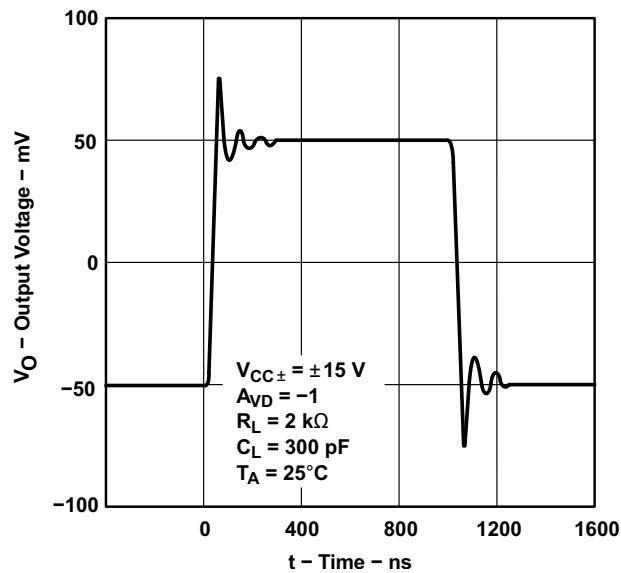
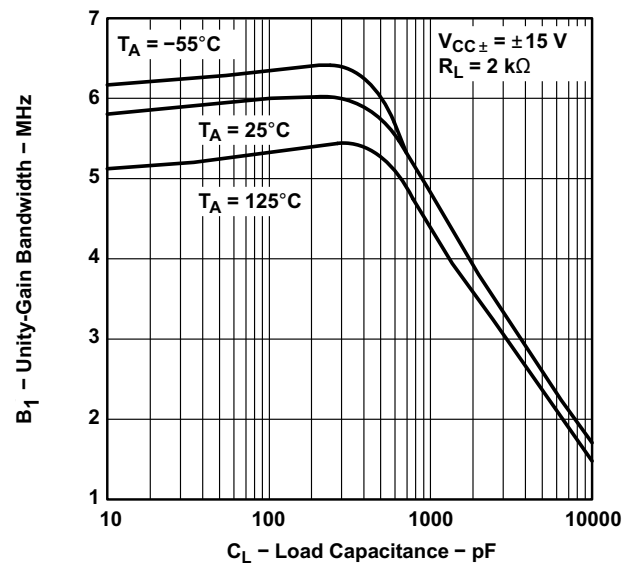


Figure 5-33. Small-Signal Pulse Response



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-34. Unity-Gain Bandwidth<sup>(1)</sup> vs Load Capacitance

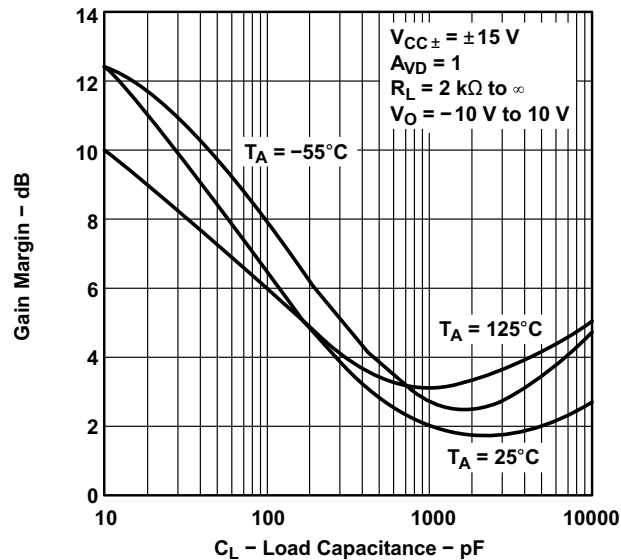
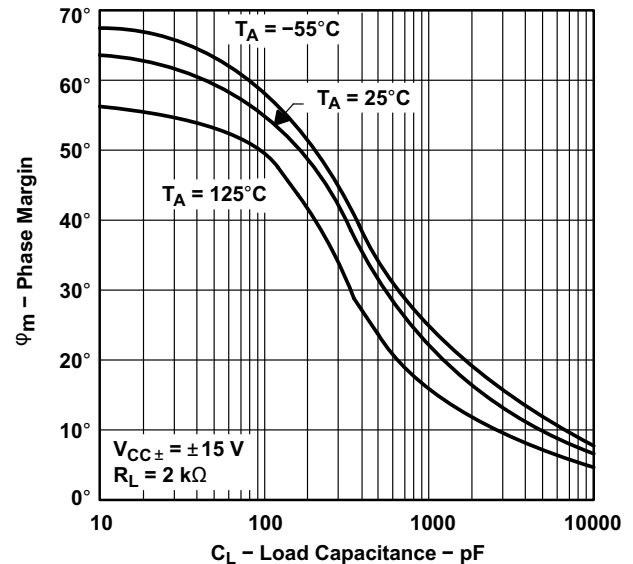


Figure 5-35. Gain Margin vs Load Capacitance



1. Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

Figure 5-36. Phase Margin<sup>(1)</sup> vs Load Capacitance

## 6 Detailed Description

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

### 6.1 Overview

The TLE214x amplifiers are stable with capacitive loads up to 10nF, although the 6MHz bandwidth decreases to 1.8MHz at this high loading level. As such, these devices are useful for low-droop sample-and-holds and direct buffering of long cables, including 4mA to 20mA current loops.

The special design also exhibits an improved insensitivity to inherent integrated circuit component mismatches as is evidenced by a 500 $\mu$ V maximum offset voltage and 1.7 $\mu$ V/ $^{\circ}$ C typical drift. Minimum common-mode rejection ratio and supply-voltage rejection ratio are 85dB and 90dB, respectively.

Device performance is relatively independent of supply voltage over the  $\pm 2$ V to  $\pm 22$ V range. Inputs can operate between  $V_{CC-} - 0.3$ V to  $V_{CC+} - 1.8$ V without inducing phase reversal, although excessive input current can flow out of each input exceeding the lower common-mode input range. The all-npn output stage provides a nearly rail-to-rail output swing of  $V_{CC-} - 0.1$ V to  $V_{CC+} - 1$ V under light current-loading conditions. The device can sustain shorts to either supply since output current is internally limited, but care must be taken to make sure that maximum package power dissipation is not exceeded.

## 7 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

### 7.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 7.2 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 7.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.  
All trademarks are the property of their respective owners.

### 7.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 7.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 8 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| <b>Changes from Revision D (October 2012) to Revision E (July 2025)</b>                                                                                                                                                                                                | <b>Page</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document.....                                                                                                                                                                  | 1           |
| • Changed pins 1 and 5 from OFFSET N1 to NC and OFFSET N2 to NC for TLE2141 D, JG, and P package pinouts.....                                                                                                                                                          | 3           |
| • Changed typical settling time specification across all devices from 0.34μs (0.1%, ±15V V <sub>S</sub> ) to 0.43μs, 0.4μs (0.01%, ±15V V <sub>S</sub> ) to 0.64μs, 0.16μs (0.1%, 5V V <sub>S</sub> ) to 0.66μs, and 0.22μs (0.01%, 5V V <sub>S</sub> ) to 0.99μs..... | 4           |
| • Changed typical THD+N specification at ±15V V <sub>S</sub> across all devices from 0.01% to 0.06%.....                                                                                                                                                               | 4           |
| • Changed typical maximum output bandwidth specification at 5V V <sub>S</sub> across all devices from 660kHz to 380kHz.....                                                                                                                                            | 4           |

## 9 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

## PACKAGING INFORMATION

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)                     |
|---------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------------------------|
| <a href="#">5962-9321603Q2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321603Q2A<br>TLE2142MFKB      |
| <a href="#">5962-9321603QHA</a> | Active        | Production           | CFP (U)   10   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321603QHA<br>TLE2142M                  |
| <a href="#">5962-9321603QPA</a> | Active        | Production           | CDIP (JG)   8  | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321603QPA<br>TLE2142M                  |
| <a href="#">5962-9321604Q2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321604Q2A<br>TLE2142<br>AMFKB |
| <a href="#">5962-9321604QHA</a> | Active        | Production           | CFP (U)   10   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321604QHA<br>TLE2142AM                 |
| <a href="#">5962-9321604QPA</a> | Active        | Production           | CDIP (JG)   8  | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321604QPA<br>TLE2142AM                 |
| <a href="#">5962-9321605Q2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321605Q2A<br>TLE2144MFKB      |
| <a href="#">5962-9321605QCA</a> | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321605QC<br>A<br>TLE2144MJB       |
| <a href="#">5962-9321606Q2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321606Q2A<br>TLE2144<br>AMFKB |
| <a href="#">5962-9321606QCA</a> | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321606QC<br>A<br>TLE2144AMJB      |
| <a href="#">TLE2141ACD</a>      | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | -            | 2141AC                                  |
| <a href="#">TLE2141ACP</a>      | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -            | TLE2141AC                               |
| TLE2141ACP.A                    | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | TLE2141AC                               |
| <a href="#">TLE2141AID</a>      | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | -            | 2141AI                                  |
| <a href="#">TLE2141AIDR</a>     | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | 2141AI                                  |
| TLE2141AIDR.A                   | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | 2141AI                                  |



| Orderable part number         | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C)   | Part marking<br>(6)                     |
|-------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|----------------|-----------------------------------------|
| <a href="#">TLE2141AIP</a>    | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70        | TLE2141AI                               |
| TLE2141AIP.A                  | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70        | TLE2141AI                               |
| <a href="#">TLE2141CD</a>     | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | -              | 2141C                                   |
| <a href="#">TLE2141CDR</a>    | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -              | 2141C                                   |
| TLE2141CDR.A                  | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | 2141C                                   |
| TLE2141CDRG4                  | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | -           | Call TI                              | Call TI                           | See TLE2141CDR |                                         |
| <a href="#">TLE2141CP</a>     | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -              | TLE2141CP                               |
| TLE2141CP.A                   | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -55 to 125     | TLE2141CP                               |
| <a href="#">TLE2141ID</a>     | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | -              | 2141I                                   |
| <a href="#">TLE2141IDR</a>    | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -              | 2141I                                   |
| TLE2141IDR.A                  | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | 2141I                                   |
| <a href="#">TLE2141IP</a>     | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -              | TLE2141IP                               |
| TLE2141IP.A                   | Active        | Production           | PDIP (P)   8   | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -55 to 125     | TLE2141IP                               |
| <a href="#">TLE2141MD</a>     | Active        | Production           | SOIC (D)   8   | 75   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | 2141M                                   |
| TLE2141MD.A                   | Active        | Production           | SOIC (D)   8   | 75   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | 2141M                                   |
| <a href="#">TLE2141MDR</a>    | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | 2141M                                   |
| TLE2141MDR.A                  | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | 2141M                                   |
| <a href="#">TLE2142ACD</a>    | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | 0 to 70        | 2142AC                                  |
| <a href="#">TLE2142ACDR</a>   | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -              | 2142AC                                  |
| TLE2142ACDR.A                 | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85      | 2142AC                                  |
| <a href="#">TLE2142AID</a>    | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | -40 to 85      | 2142AI                                  |
| <a href="#">TLE2142AIDR</a>   | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -              | 2142AI                                  |
| TLE2142AIDR.A                 | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85      | 2142AI                                  |
| <a href="#">TLE2142AMD</a>    | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | -55 to 125     | E2142A                                  |
| <a href="#">TLE2142AMDR</a>   | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | E2142A                                  |
| TLE2142AMDR.A                 | Active        | Production           | SOIC (D)   8   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125     | E2142A                                  |
| <a href="#">TLE2142AMDRG4</a> | Obsolete      | Production           | SOIC (D)   8   | -                     | -           | Call TI                              | Call TI                           | -              | E2142A                                  |
| <a href="#">TLE2142AMFKB</a>  | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125     | 5962-<br>9321604Q2A<br>TLE2142<br>AMFKB |

| Orderable part number        | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)                     |
|------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------------------------|
| TLE2142AMFKB.A               | Active        | Production           | LCCC (FK)   20  | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321604Q2A<br>TLE2142<br>AMFKB |
| <a href="#">TLE2142AMJG</a>  | Active        | Production           | CDIP (JG)   8   | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -            | TLE2142AMJG                             |
| TLE2142AMJG.A                | Active        | Production           | CDIP (JG)   8   | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | TLE2142AMJG                             |
| <a href="#">TLE2142AMJGB</a> | Active        | Production           | CDIP (JG)   8   | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321604QPA<br>TLE2142AM                 |
| TLE2142AMJGB.A               | Active        | Production           | CDIP (JG)   8   | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321604QPA<br>TLE2142AM                 |
| <a href="#">TLE2142AMUB</a>  | Active        | Production           | CFP (U)   10    | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321604QHA<br>TLE2142AM                 |
| TLE2142AMUB.A                | Active        | Production           | CFP (U)   10    | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321604QHA<br>TLE2142AM                 |
| <a href="#">TLE2142CD</a>    | Obsolete      | Production           | SOIC (D)   8    | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | 2142C                                   |
| <a href="#">TLE2142CDR</a>   | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | 2142C                                   |
| TLE2142CDR.A                 | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | 2142C                                   |
| TLE2142CDRG4                 | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | -           | Call TI                              | Call TI                           | 0 to 70      |                                         |
| <a href="#">TLE2142CP</a>    | Active        | Production           | PDIP (P)   8    | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | TLE2142CP                               |
| TLE2142CP.A                  | Active        | Production           | PDIP (P)   8    | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | TLE2142CP                               |
| <a href="#">TLE2142CPWR</a>  | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | Q2142                                   |
| TLE2142CPWR.A                | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | Q2142                                   |
| <a href="#">TLE2142ID</a>    | Obsolete      | Production           | SOIC (D)   8    | -                     | -           | Call TI                              | Call TI                           | -40 to 105   | 2142I                                   |
| <a href="#">TLE2142IDR</a>   | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 105   | 2142I                                   |
| TLE2142IDR.A                 | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 105   | 2142I                                   |
| <a href="#">TLE2142IP</a>    | Active        | Production           | PDIP (P)   8    | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 105   | TLE2142IP                               |
| TLE2142IP.A                  | Active        | Production           | PDIP (P)   8    | 50   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 105   | TLE2142IP                               |
| <a href="#">TLE2142MD</a>    | Obsolete      | Production           | SOIC (D)   8    | -                     | -           | Call TI                              | Call TI                           | -55 to 125   | 2142M                                   |
| <a href="#">TLE2142MDG4</a>  | Obsolete      | Production           | SOIC (D)   8    | -                     | -           | Call TI                              | Call TI                           | -            | 2142M                                   |
| <a href="#">TLE2142MDR</a>   | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | 2142M                                   |
| TLE2142MDR.A                 | Active        | Production           | SOIC (D)   8    | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | 2142M                                   |

| Orderable part number        | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)                     |
|------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------------------------|
| <a href="#">TLE2142MFKB</a>  | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321603Q2A<br>TLE2142MFKB      |
| TLE2142MFKB.A                | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321603Q2A<br>TLE2142MFKB      |
| <a href="#">TLE2142MJGB</a>  | Active        | Production           | CDIP (JG)   8  | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321603QPA<br>TLE2142M                  |
| TLE2142MJGB.A                | Active        | Production           | CDIP (JG)   8  | 50   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321603QPA<br>TLE2142M                  |
| <a href="#">TLE2142MUB</a>   | Active        | Production           | CFP (U)   10   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321603QHA<br>TLE2142M                  |
| TLE2142MUB.A                 | Active        | Production           | CFP (U)   10   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 9321603QHA<br>TLE2142M                  |
| <a href="#">TLE2144ACN</a>   | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | TLE2144ACN                              |
| TLE2144ACN.A                 | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | TLE2144ACN                              |
| <a href="#">TLE2144AIN</a>   | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | TLE2144AIN                              |
| TLE2144AIN.A                 | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | TLE2144AIN                              |
| <a href="#">TLE2144AMFKB</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321606Q2A<br>TLE2144<br>AMFKB |
| TLE2144AMFKB.A               | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>9321606Q2A<br>TLE2144<br>AMFKB |
| <a href="#">TLE2144AMJB</a>  | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321606QC<br>A<br>TLE2144AMJB      |
| TLE2144AMJB.A                | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321606QC<br>A<br>TLE2144AMJB      |
| <a href="#">TLE2144CDW</a>   | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | TLE2144C                                |
| TLE2144CDW.A                 | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | TLE2144C                                |
| <a href="#">TLE2144CDWR</a>  | Active        | Production           | SOIC (DW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | TLE2144C                                |

| Orderable part number        | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)               |
|------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------------------|
| TLE2144CDWR.A                | Active        | Production           | SOIC (DW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | TLE2144C                          |
| <a href="#">TLE2144CN</a>    | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | TLE2144CN                         |
| TLE2144CN.A                  | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | TLE2144CN                         |
| <a href="#">TLE2144IDW</a>   | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 105   | TLE2144I                          |
| TLE2144IDW.A                 | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 105   | TLE2144I                          |
| <a href="#">TLE2144IDWR</a>  | Active        | Production           | SOIC (DW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 105   | TLE2144I                          |
| TLE2144IDWR.A                | Active        | Production           | SOIC (DW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 105   | TLE2144I                          |
| <a href="#">TLE2144IN</a>    | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 105   | TLE2144IN                         |
| TLE2144IN.A                  | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 105   | TLE2144IN                         |
| <a href="#">TLE2144MDW</a>   | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | TLE2144M                          |
| TLE2144MDW.A                 | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | TLE2144M                          |
| <a href="#">TLE2144MDWG4</a> | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | TLE2144M                          |
| TLE2144MDWG4.A               | Active        | Production           | SOIC (DW)   16 | 40   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -55 to 125   | TLE2144M                          |
| <a href="#">TLE2144MFKB</a>  | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321605Q2A<br>TLE2144MFKB    |
| TLE2144MFKB.A                | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321605Q2A<br>TLE2144MFKB    |
| <a href="#">TLE2144MJB</a>   | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321605QC<br>A<br>TLE2144MJB |
| TLE2144MJB.A                 | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-9321605QC<br>A<br>TLE2144MJB |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF TLE2141, TLE2141A, TLE2142, TLE2142A, TLE2142AM, TLE2142M, TLE2144, TLE2144A, TLE2144AM, TLE2144M :**

- Catalog : [TLE2142A](#), [TLE2142](#), [TLE2144A](#), [TLE2144](#)
- Automotive : [TLE2141-Q1](#), [TLE2142-Q1](#), [TLE2142-Q1](#)
- Enhanced Product : [TLE2141-EP](#), [TLE2144-EP](#), [TLE2144-EP](#)
- Military : [TLE2141M](#), [TLE2141AM](#), [TLE2142M](#), [TLE2142AM](#), [TLE2144M](#), [TLE2144AM](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications

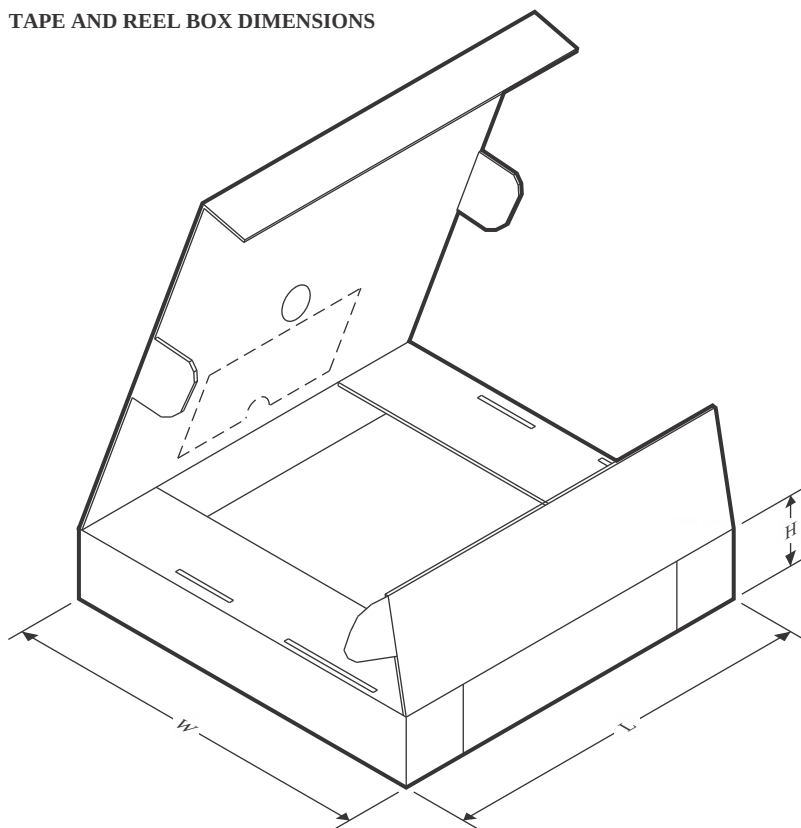
## TAPE AND REEL INFORMATION



\*All dimensions are nominal

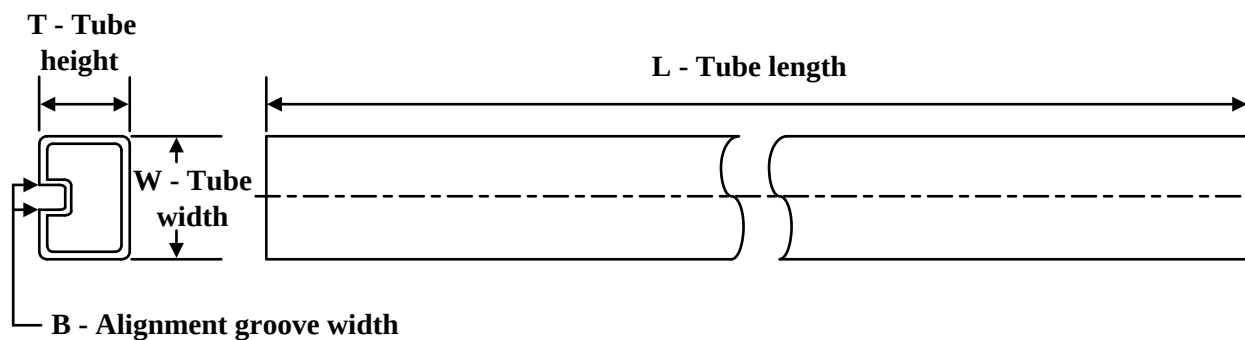
| Device      | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLE2141AIDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2141CDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2141IDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2141MDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2142ACDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2142AIDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2142AMDR | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2142CDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2142CPWR | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TLE2142IDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2142MDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TLE2144CDWR | SOIC         | DW              | 16   | 2000 | 330.0              | 16.4               | 10.75   | 10.7    | 2.7     | 12.0    | 16.0   | Q1            |
| TLE2144IDWR | SOIC         | DW              | 16   | 2000 | 330.0              | 16.4               | 10.75   | 10.7    | 2.7     | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLE2141AIDR | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TLE2141CDR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TLE2141IDR  | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TLE2141MDR  | SOIC         | D               | 8    | 2500 | 350.0       | 350.0      | 43.0        |
| TLE2142ACDR | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TLE2142AIDR | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TLE2142AMDR | SOIC         | D               | 8    | 2500 | 350.0       | 350.0      | 43.0        |
| TLE2142CDR  | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TLE2142CPWR | TSSOP        | PW              | 16   | 2000 | 353.0       | 353.0      | 32.0        |
| TLE2142IDR  | SOIC         | D               | 8    | 2500 | 353.0       | 353.0      | 32.0        |
| TLE2142MDR  | SOIC         | D               | 8    | 2500 | 350.0       | 350.0      | 43.0        |
| TLE2144CDWR | SOIC         | DW              | 16   | 2000 | 350.0       | 350.0      | 43.0        |
| TLE2144IDWR | SOIC         | DW              | 16   | 2000 | 350.0       | 350.0      | 43.0        |

**TUBE**


\*All dimensions are nominal

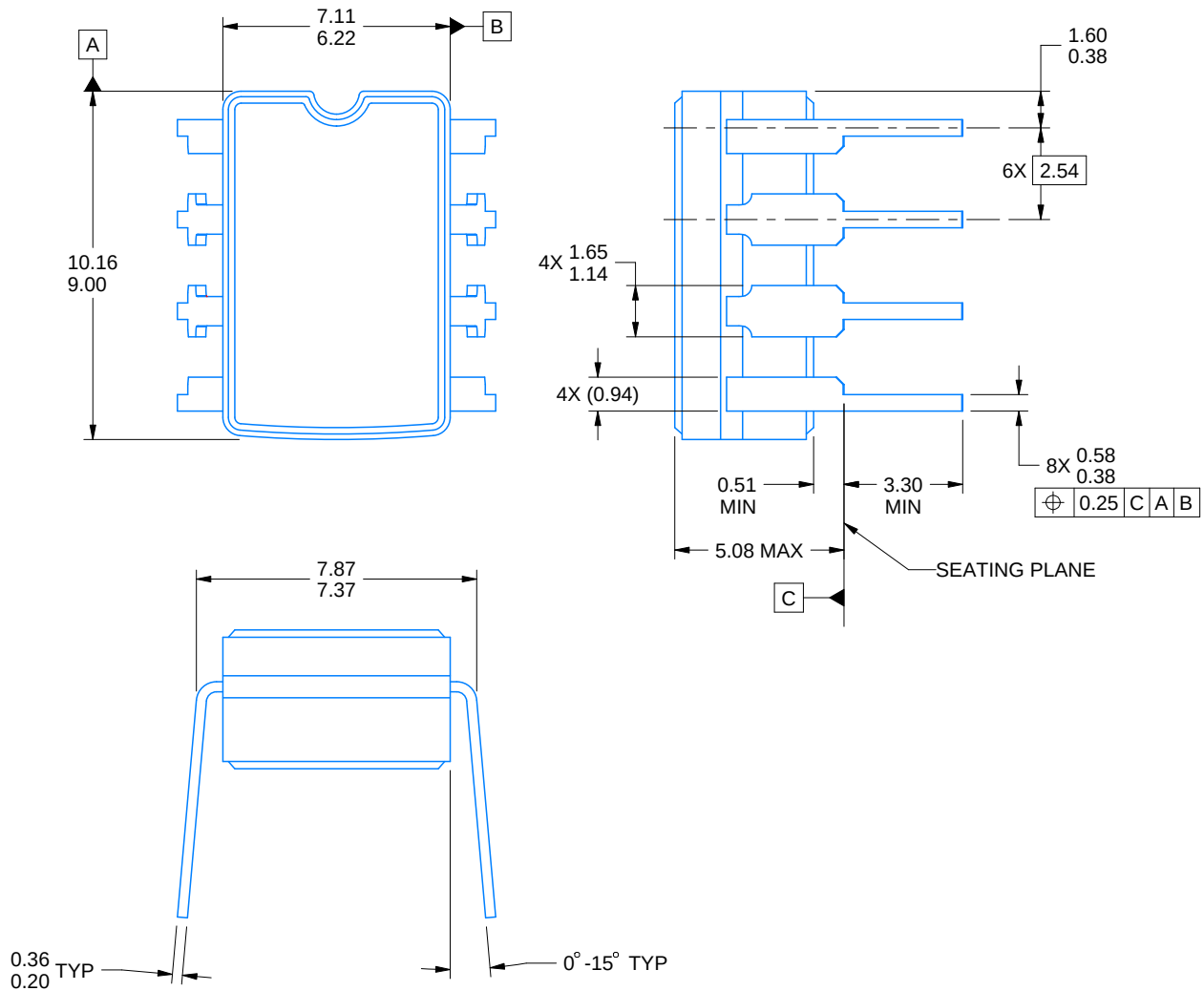
| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-9321603Q2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| 5962-9321603QHA | U            | CFP          | 10   | 25  | 506.98 | 26.16  | 6220   | NA     |
| 5962-9321604Q2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| 5962-9321604QHA | U            | CFP          | 10   | 25  | 506.98 | 26.16  | 6220   | NA     |
| 5962-9321605Q2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| 5962-9321606Q2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2141ACP      | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141ACP.A    | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141AIP      | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141AIP.A    | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141CP       | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141CP.A     | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141IP       | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141IP.A     | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2141MD       | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| TLE2141MD.A     | D            | SOIC         | 8    | 75  | 505.46 | 6.76   | 3810   | 4      |
| TLE2142AMFKB    | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2142AMFKB.A  | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2142AMUB     | U            | CFP          | 10   | 25  | 506.98 | 26.16  | 6220   | NA     |
| TLE2142AMUB.A   | U            | CFP          | 10   | 25  | 506.98 | 26.16  | 6220   | NA     |
| TLE2142CP       | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2142CP.A     | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2142IP       | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2142IP.A     | P            | PDIP         | 8    | 50  | 506    | 13.97  | 11230  | 4.32   |
| TLE2142MFKB     | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2142MFKB.A   | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2142MUB      | U            | CFP          | 10   | 25  | 506.98 | 26.16  | 6220   | NA     |
| TLE2142MUB.A    | U            | CFP          | 10   | 25  | 506.98 | 26.16  | 6220   | NA     |
| TLE2144ACN      | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |



| Device         | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| TLE2144ACN.A   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| TLE2144AIN     | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| TLE2144AIN.A   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| TLE2144AMFKB   | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2144AMFKB.A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2144CDW     | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144CDW.A   | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144CN      | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| TLE2144CN.A    | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| TLE2144IDW     | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144IDW.A   | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144IN      | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| TLE2144IN.A    | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| TLE2144MDW     | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144MDW.A   | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144MDWG4   | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144MDWG4.A | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| TLE2144MFKB    | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| TLE2144MFKB.A  | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |

**JG0008A****PACKAGE OUTLINE****CDIP - 5.08 mm max height**

CERAMIC DUAL IN-LINE PACKAGE



4230036/A 09/2023

**NOTES:**

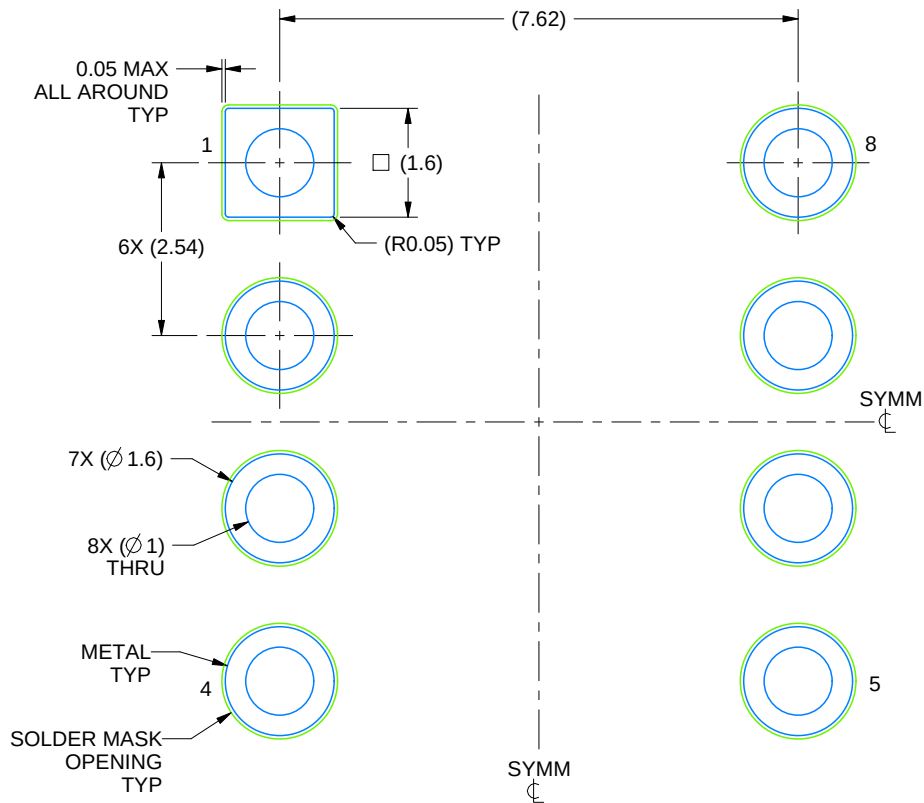
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package can be hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification.
5. Falls within MIL STD 1835 GDIP1-T8

# EXAMPLE BOARD LAYOUT

JG0008A

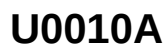
CDIP - 5.08 mm max height

CERAMIC DUAL IN-LINE PACKAGE



LAND PATTERN EXAMPLE  
NON SOLDER MASK DEFINED  
SCALE: 9X

4230036/A 09/2023



**CFP - 2.03 mm max height**

CERAMIC FLATPACK



1. All linear dimensions are in inches. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

2. This drawing is subject to change without notice.

## GENERIC PACKAGE VIEW

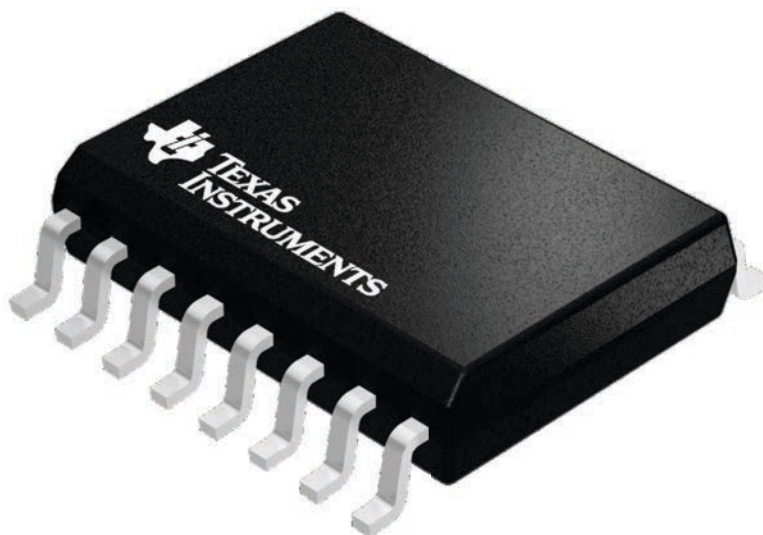
**DW 16**

**SOIC - 2.65 mm max height**

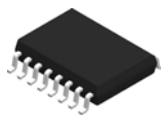
7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

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



4224780/A

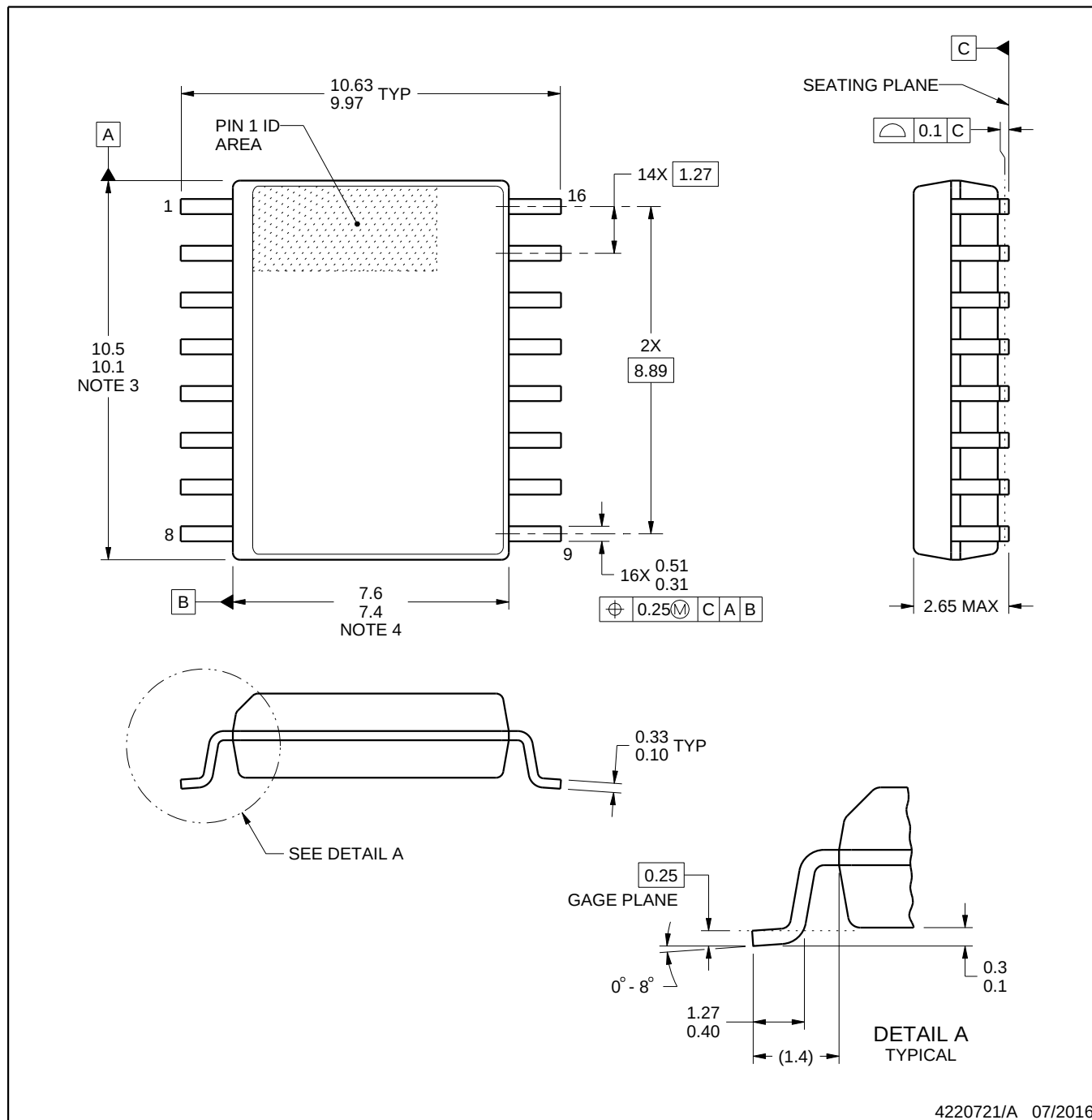


DW0016A

# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4220721/A 07/2016

### NOTES:

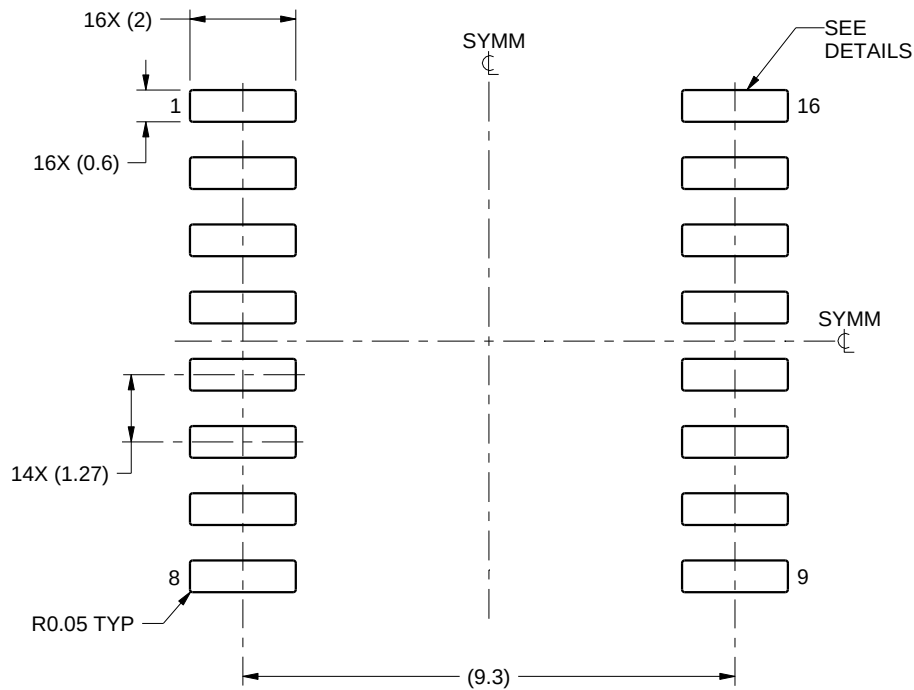
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

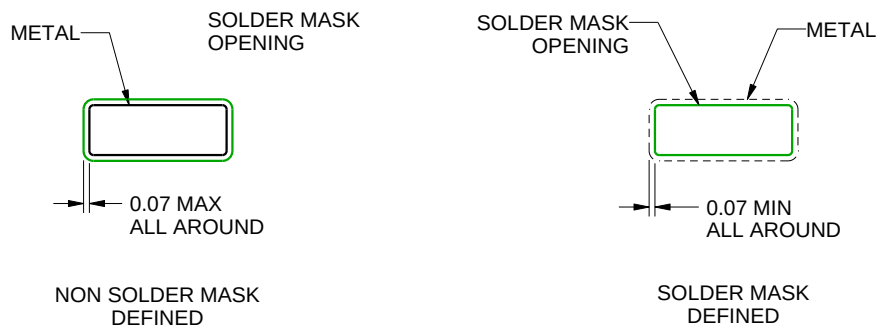
DW0016A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:7X



SOLDER MASK DETAILS

4220721/A 07/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

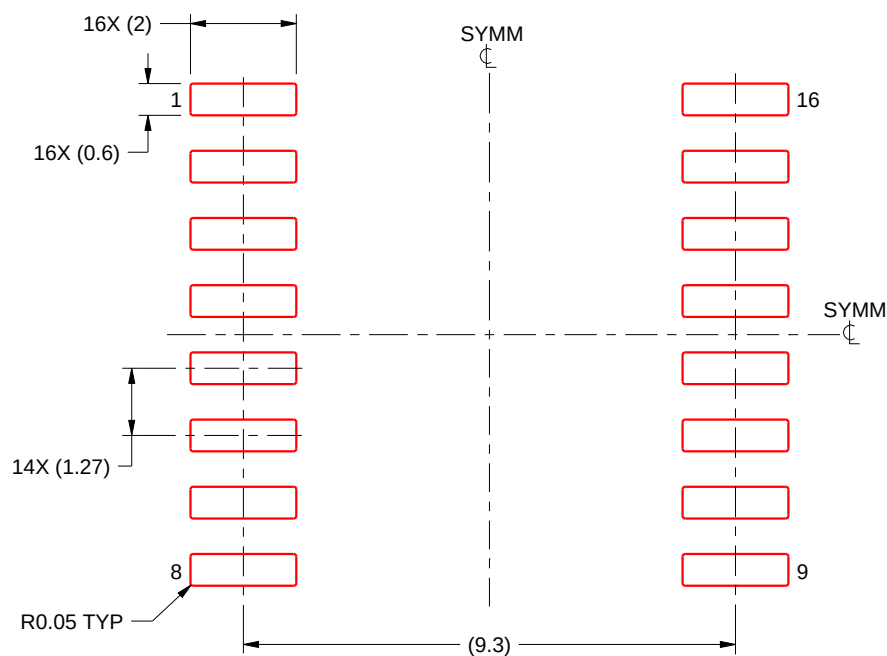
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0016A

SOIC - 2.65 mm max height

SOIC



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

4220721/A 07/2016

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.



## GENERIC PACKAGE VIEW

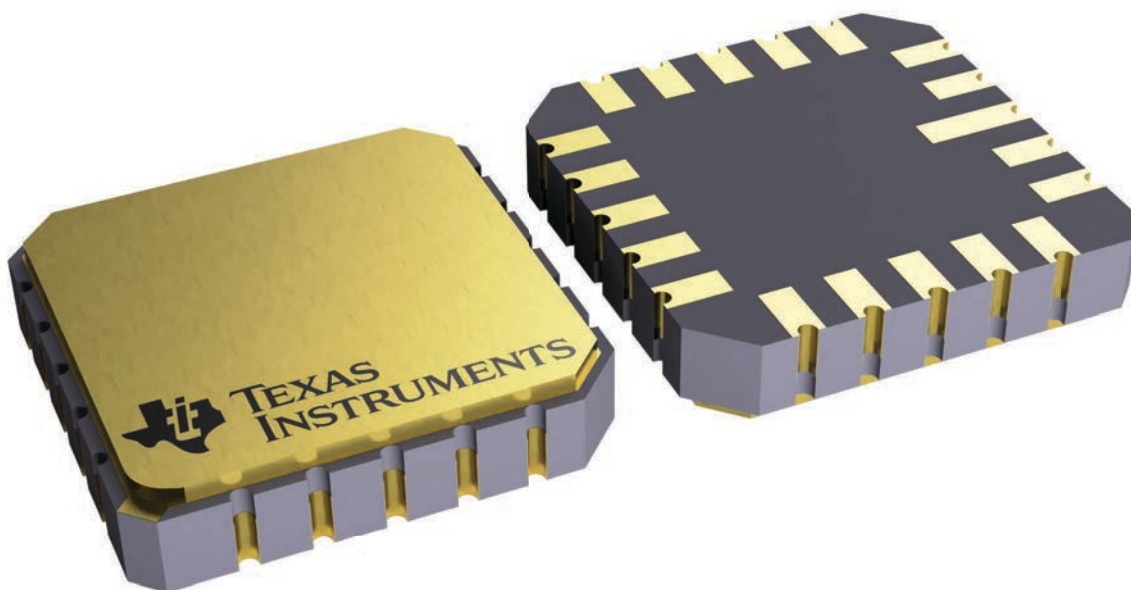
**FK 20**

**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.



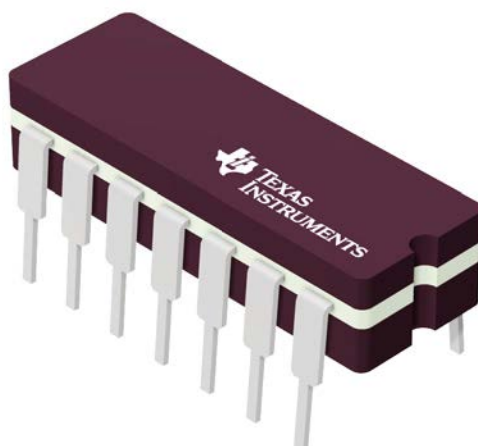
4229370VA\

**J 14**

## GENERIC PACKAGE VIEW

**CDIP - 5.08 mm max height**

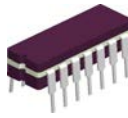
CERAMIC DUAL IN LINE PACKAGE



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

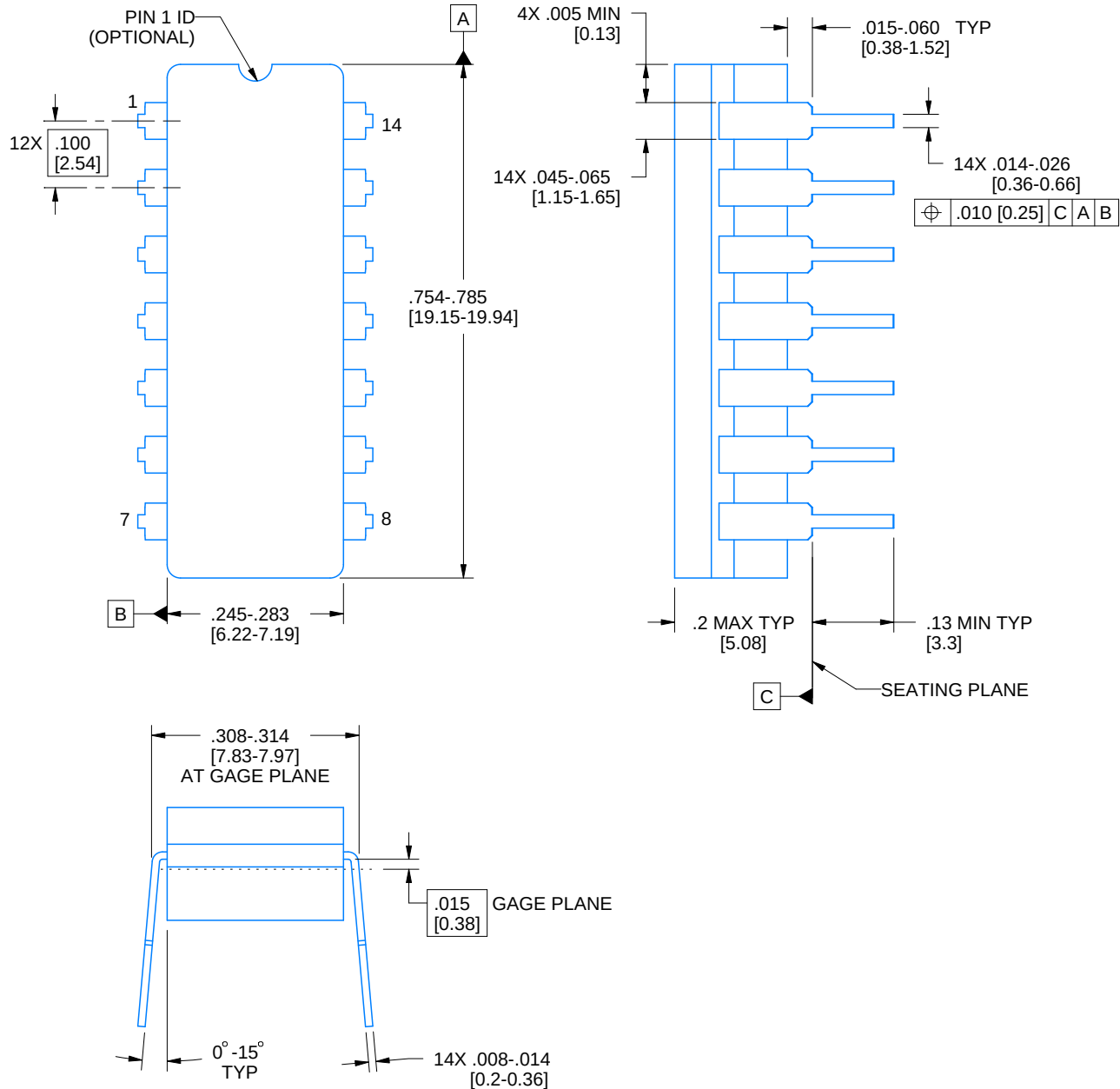
J0014A



## PACKAGE OUTLINE

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



4214771/A 05/2017

### NOTES:

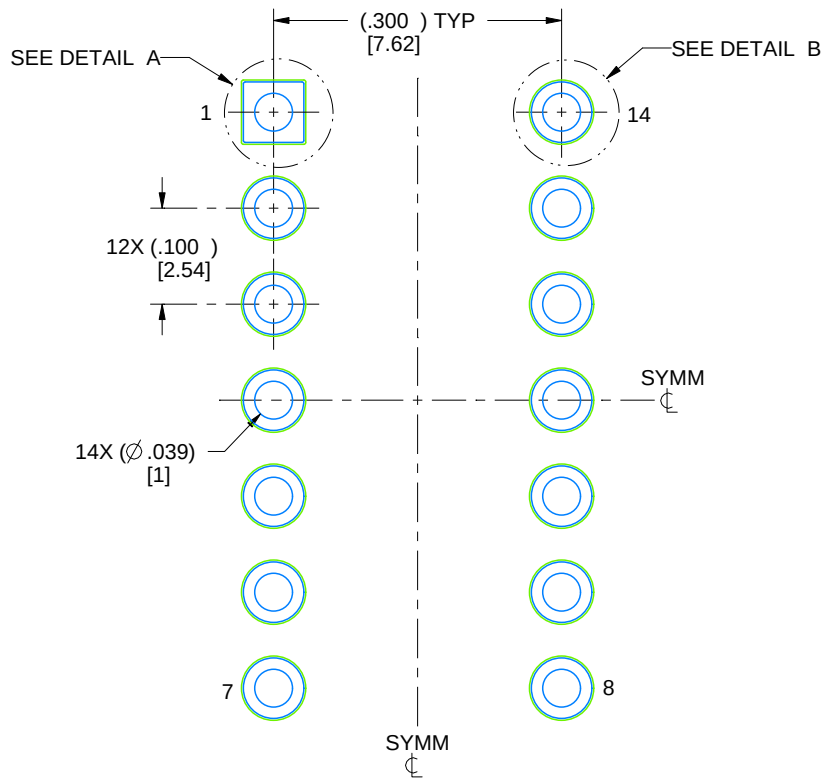
1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with 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

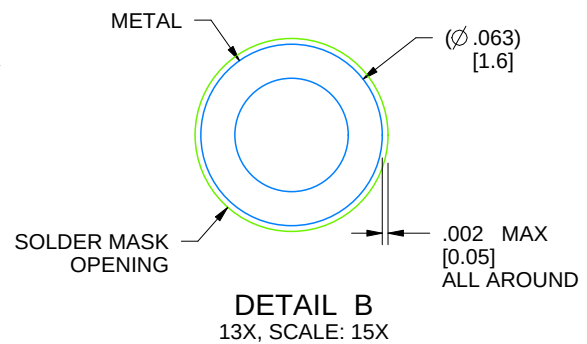
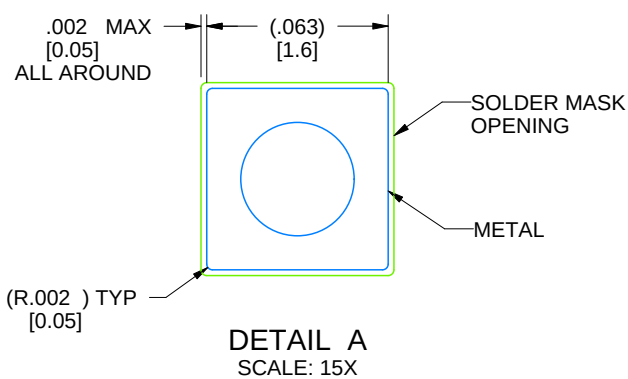
J0014A

CDIP - 5.08 mm max height

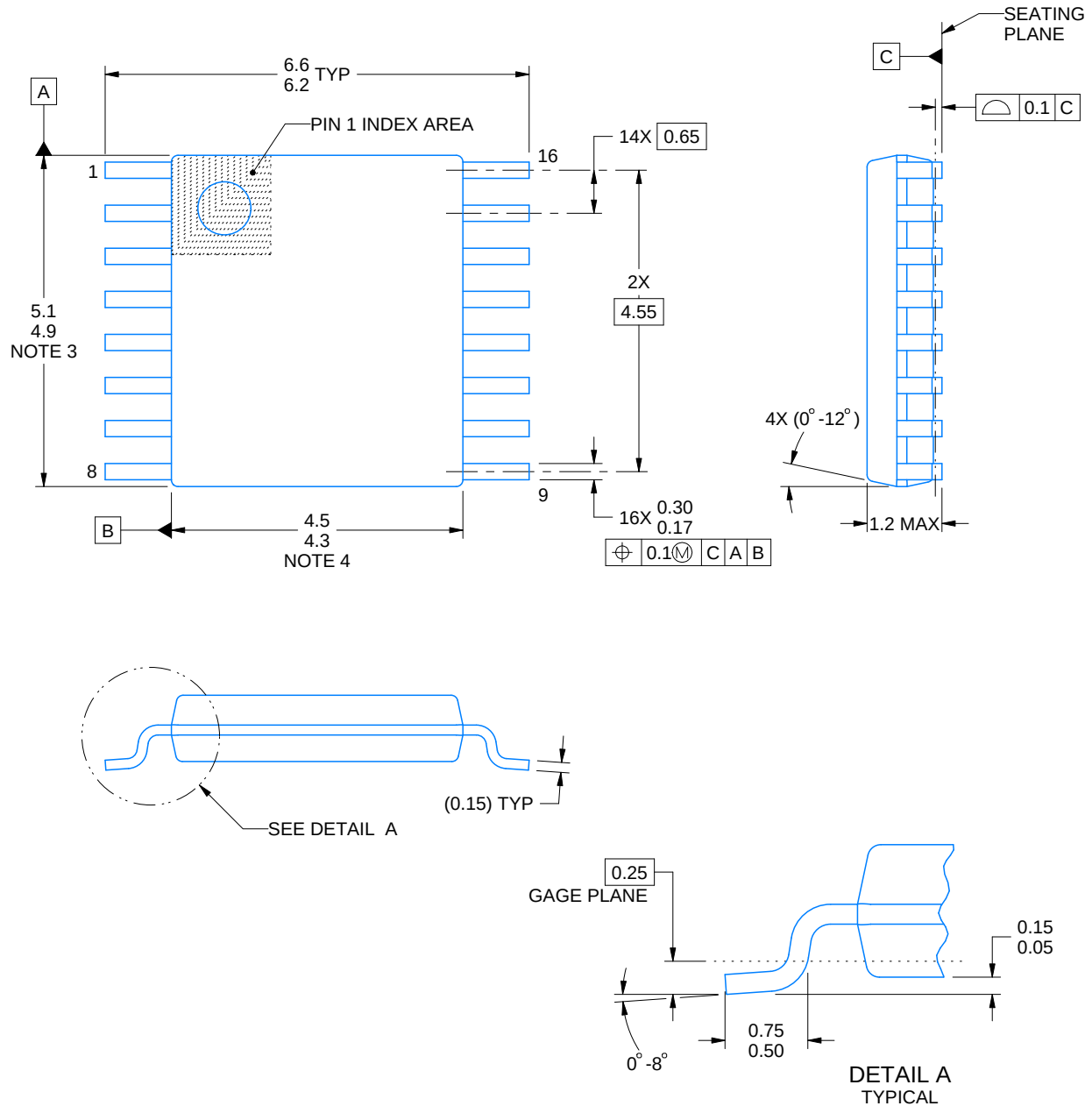
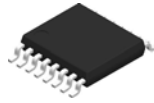
CERAMIC DUAL IN LINE PACKAGE



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



4214771/A 05/2017



4220204/B 12/2023

## NOTES:

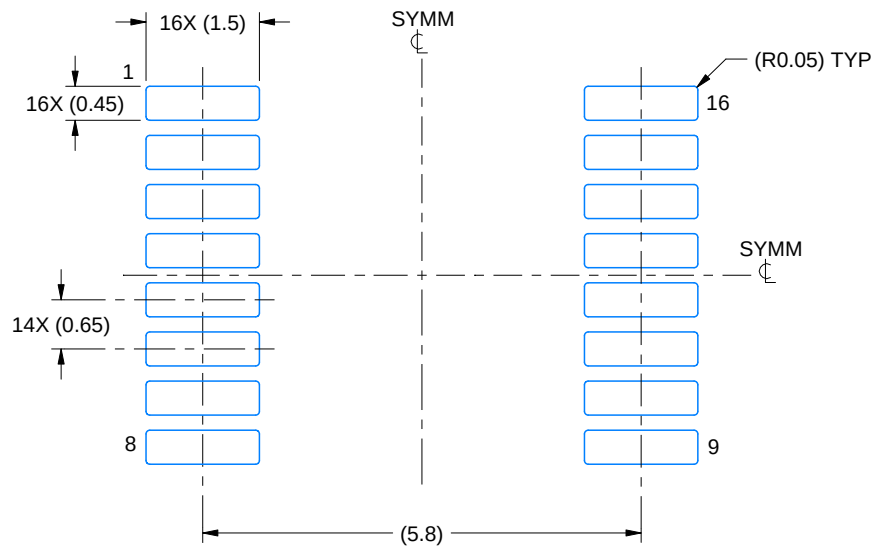
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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

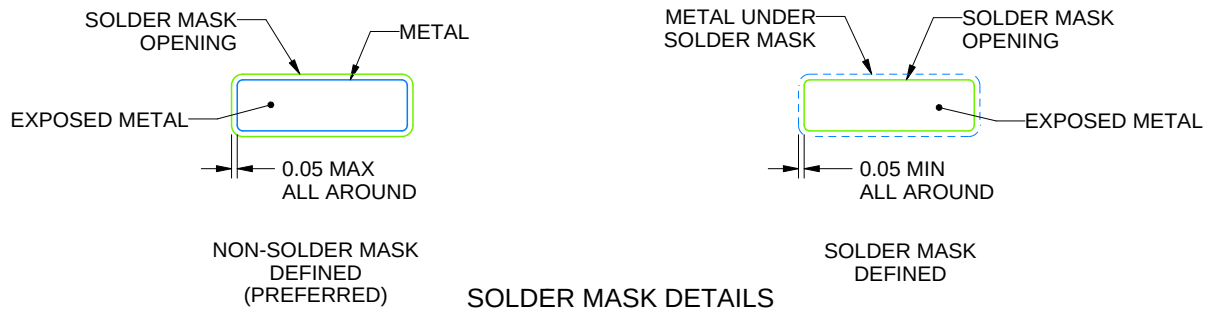
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220204/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

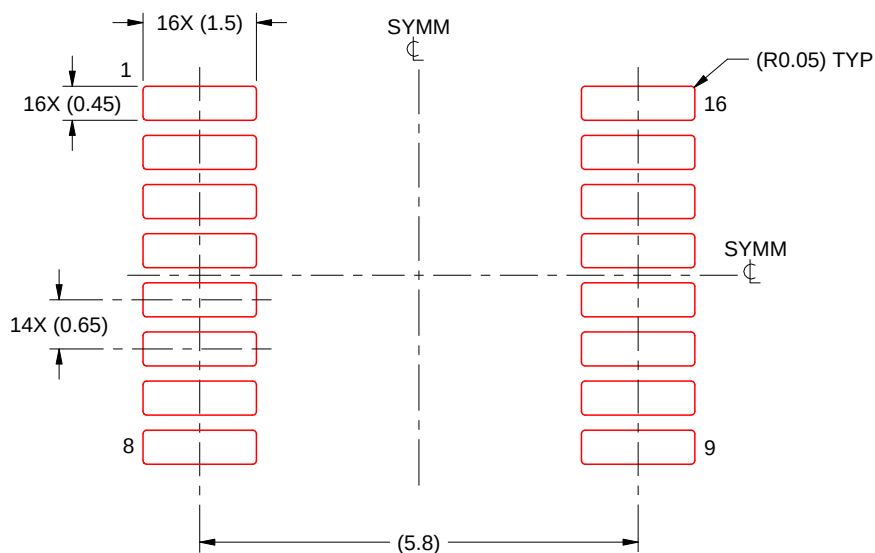
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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/B 12/2023

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.



## PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES:

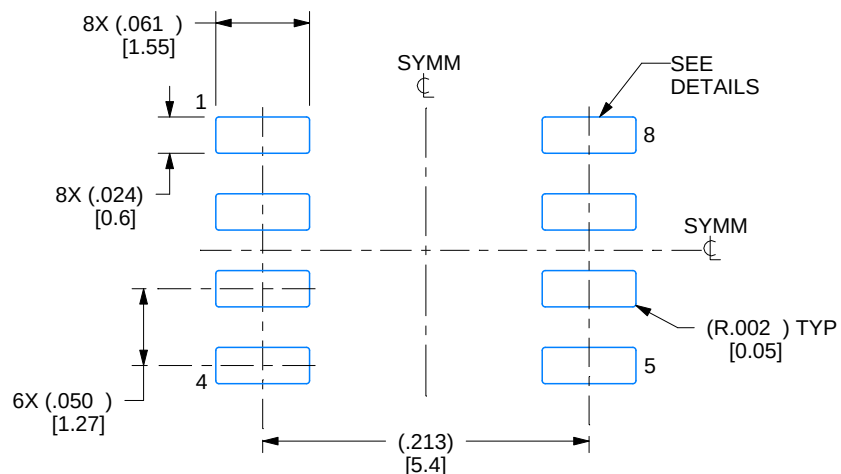
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



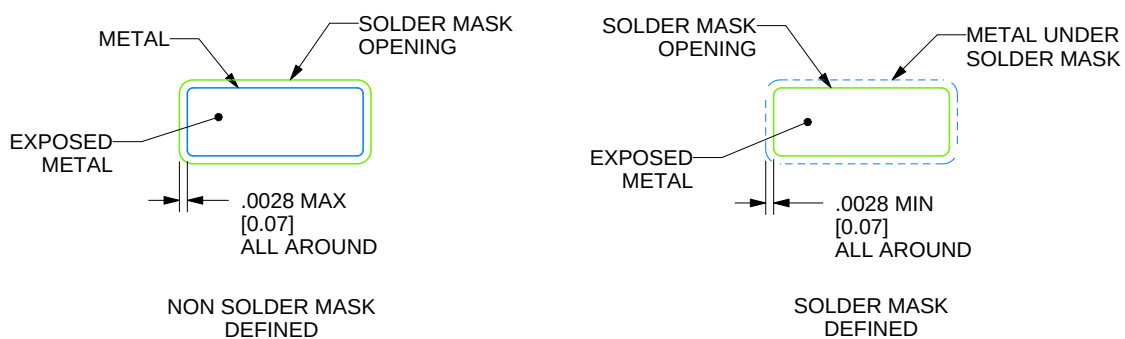
**D0008A**

### SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



## SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

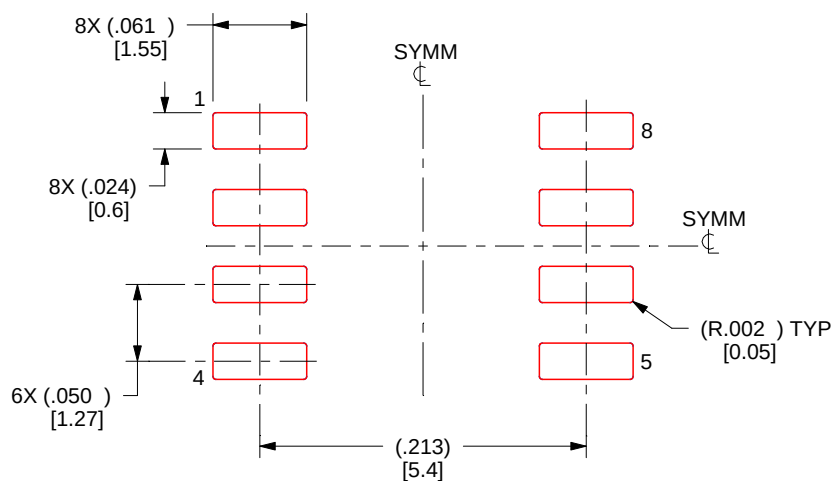
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

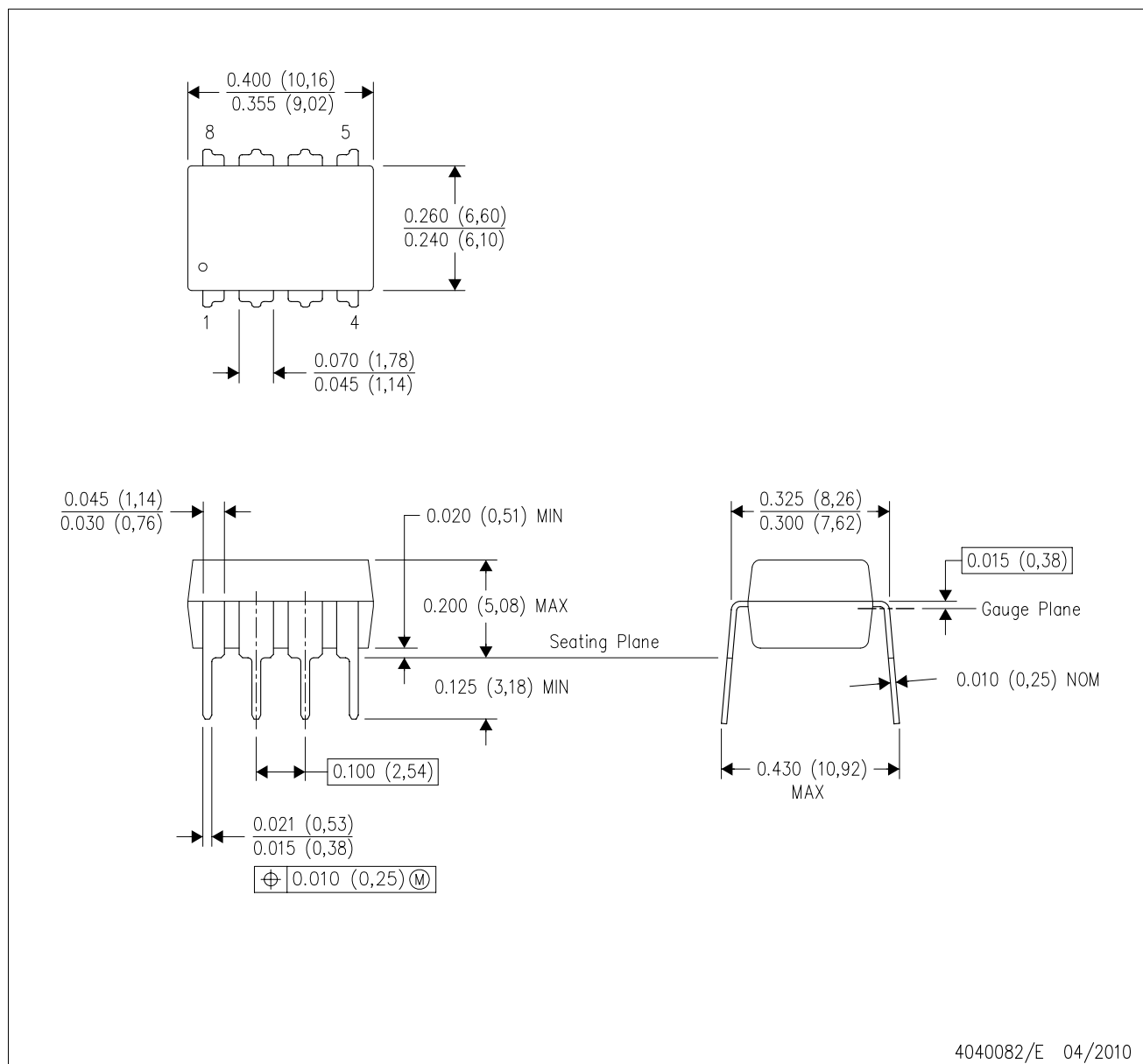
4214825/C 02/2019

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.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE

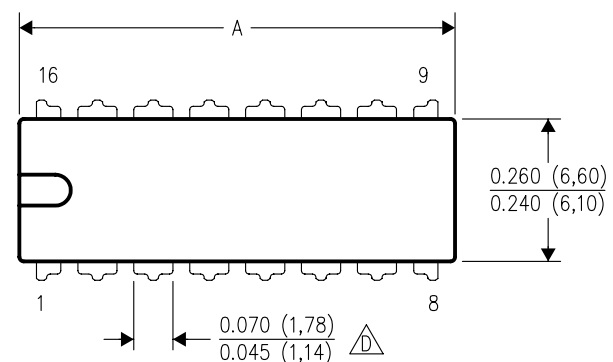


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

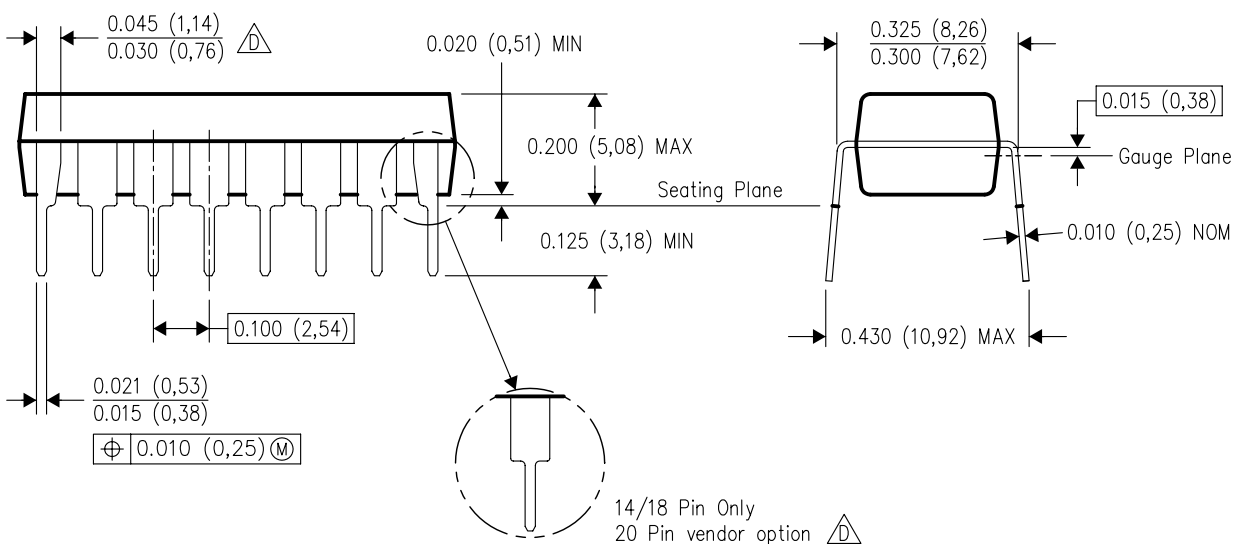
N (R-PDIP-T\*\*)

16 PINS SHOWN

# PLASTIC DUAL-IN-LINE PACKAGE



| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



4040049/E 12/2002

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.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#), [TI's General Quality Guidelines](#), or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2025, Texas Instruments Incorporated

Last updated 10/2025