

## AMC1200/B 全差分隔离放大器

### 1 特性

- 针对分流电阻进行优化的  $\pm 250\text{mV}$  输入电压范围
- 极低非线性度：5V 时最大值为 0.075%
- 低偏移误差：最大值为 1.5mV
- 低噪声：3.1mV<sub>RMS</sub>（典型值）
- 低高侧电源电流：  
5V 时最大值为 8mA
- 输入带宽：最小值为 60kHz
- 固定增益：8（精度为 0.5%）
- 高共模抑制比：108dB
- 3.3V 低侧工作电压
- 经认证的电流隔离：
  - 已通过 UL1577 和 VDE V 0884-10 批准
  - 隔离电压：4250 V<sub>PEAK</sub> (AMC1200B)
  - 工作电压：1200 V<sub>PEAK</sub>
  - 瞬态抗扰度：10kV/ $\mu\text{s}$ （最小值）
- 在额定工作电压下使用寿命通常为 10 年（请参阅应用报告）
- 可在扩展工业温度范围内运行

### 2 应用

- 在下列应用中基于分流电阻器的电流感测：
  - 电机控制
  - 绿色环保能源
  - 变频器
  - 不间断电源

### 3 说明

AMC1200 和 AMC1200B 是高精度隔离放大器，通过磁场抗扰度较高的二氧化硅 (SiO<sub>2</sub>) 隔离层隔离输出和输入电路。该隔离层经 UL1577 与 VDE V 0884-10 标准认证，可提供高达 4250 V<sub>PEAK</sub> (AMC1200B) 或 4000 V<sub>PEAK</sub> (AMC1200) 的电流隔离。通过与隔离电源配合使用，这些器件可防止共模高电压线路上的噪声电流进入本地接地并干扰或损害敏感电路。

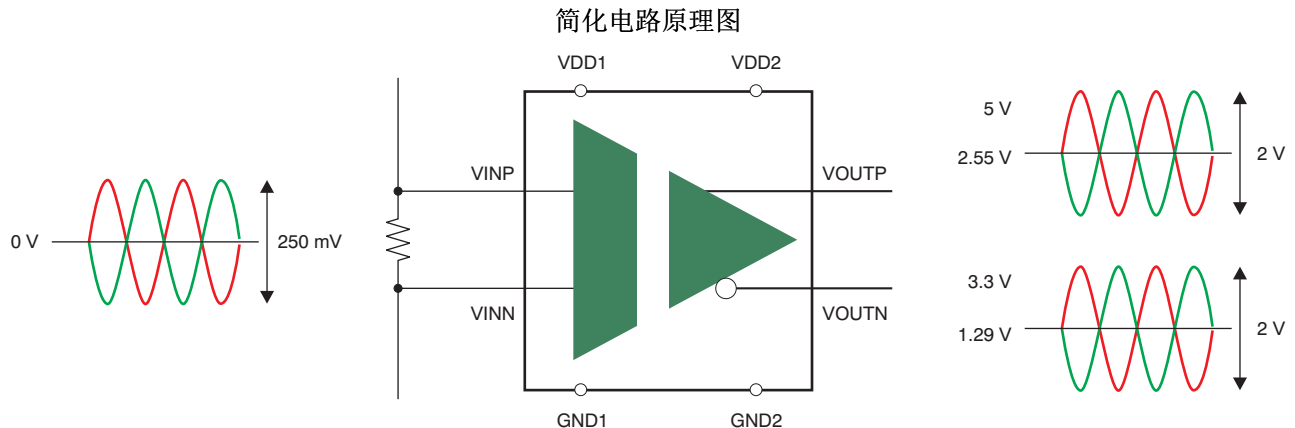
AMC1200 或 AMC1200B 的输入针对直接连接至分流电阻器或其它低电压电平信号源进行了优化。该器件性能优异，支持精确电流控制，从而降低系统级功耗（尤其在电机控制应用中）并减少扭矩纹波。可自动将输出信号的共模电压调节为 3V 或 5V 低侧电源电压。

AMC1200 和 AMC1200B 在扩展工业温度范围内（-40°C 到 105°C）完全额定运行，采用宽体 8 引脚小外形尺寸集成电路 (SOIC) (DWV) 封装以及 gullwing 8 (DUB) 封装。

器件信息<sup>(1)</sup>

| 器件型号               | 封装       | 封装尺寸（标称值）       |
|--------------------|----------|-----------------|
| AMC1200 和 AMC1200B | SOP (8)  | 9.50mm × 6.57mm |
|                    | SOIC (8) | 5.85mm × 7.50mm |

(1) 要了解所有可用封装，请见数据表末尾的可订购产品附录。



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## 4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

| Changes from Revision C (September 2013) to Revision D                              | Page |
|-------------------------------------------------------------------------------------|------|
| • 已添加 ESD 额定值表，特性 描述 部分，器件功能模式，应用和实施部分，电源相关建议部分，布局部分，器件和文档支持部分以及机械、封装和可订购信息部分 ..... | 1    |

| Changes from Revision B (August 2012) to Revision C                                                | Page |
|----------------------------------------------------------------------------------------------------|------|
| • 已删除 器件图 .....                                                                                    | 1    |
| • 已添加 DWV (SOIC-9) 封装至文档 .....                                                                     | 1    |
| • 已更改 部分的最后一段 .....                                                                                | 1    |
| • Added DWV pin out drawing .....                                                                  | 3    |
| • Added DWV column to Thermal Information table .....                                              | 4    |
| • Added row for DWV package to L(I01) and L(I02) parameters in Package Characteristics table ..... | 12   |

| Changes from Revision A (August 2011) to Revision B                                                     | Page |
|---------------------------------------------------------------------------------------------------------|------|
| • 已更改隔离电压特性着重号 .....                                                                                    | 1    |
| • 已添加 AMC1200B 器件至数据表 .....                                                                             | 1    |
| • Changed title for Figure 25 .....                                                                     | 10   |
| • Changed CTI parameter minimum value in Electrical Characteristics from $\geq 175$ to $\geq 400$ ..... | 12   |

| Changes from Original (April 2011) to Revision A                                | Page |
|---------------------------------------------------------------------------------|------|
| • Changed sign for maximum junction temperature from minus to plus (typo) ..... | 4    |
| • Added "0.5-V step" to test condition for Rise/fall time parameter .....       | 5    |
| • Changed Figure 12 .....                                                       | 6    |
| • Changed Figure 13 .....                                                       | 7    |
| • Changed surge immunity parameter from $\pm 4000$ to $\pm 6000$ .....          | 12   |

## 5 Pin Configuration and Functions



### Pin Functions

| PIN |       | I/O           | DESCRIPTION                |
|-----|-------|---------------|----------------------------|
| NO. | NAME  |               |                            |
| 1   | VDD1  | Power         | High-side power supply     |
| 2   | VINP  | Analog input  | Noninverting analog input  |
| 3   | VINN  | Analog input  | Inverting analog input     |
| 4   | GND1  | Power         | High-side analog ground    |
| 5   | GND2  | Power         | Low-side analog ground     |
| 6   | VOUTN | Analog output | Inverting analog output    |
| 7   | VOUTP | Analog output | Noninverting analog output |
| 8   | VDD2  | Power         | Low-side power supply      |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

Over the operating ambient temperature range, unless otherwise noted.<sup>(1)</sup>

|                                                  | MIN        | MAX        | UNIT |
|--------------------------------------------------|------------|------------|------|
| Supply voltage, VDD1 to GND1 or VDD2 to GND2     | –0.5       | 6          | V    |
| Analog input voltage at VINP, VINN               | GND1 – 0.5 | VDD1 + 0.5 | V    |
| Input current to any pin except supply pins      | –10        | 10         | mA   |
| Maximum junction temperature, T <sub>J</sub> Max |            | 150        | °C   |
| Storage Temperature, T <sub>stg</sub>            | –65        | 150        | °C   |

- (1) 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 is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

### 6.2 ESD Ratings

|                                            |                                                                                | VALUE | UNIT |
|--------------------------------------------|--------------------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> Electrostatic discharge | Human-body model (HBM) JEDEC standard 22, test method A114-C.01 <sup>(1)</sup> | ±2500 | V    |
|                                            | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | ±1000 |      |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

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

|                                                    | MIN | NOM | MAX | UNIT |
|----------------------------------------------------|-----|-----|-----|------|
| T <sub>A</sub> Operating ambient temperature range | –40 |     | 105 | °C   |
| VDD1 High-side power supply                        | 4.5 | 5   | 5.5 | V    |
| VDD2 Low-side power supply                         | 2.7 | 5   | 5.5 | V    |

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | AMC1200, AMC1200B |            | UNIT |
|-------------------------------|----------------------------------------------|-------------------|------------|------|
|                               |                                              | DUB (SOP)         | DWV (SOIC) |      |
|                               |                                              | 8 PINS            | 8 PINS     |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 75.1              | 102.8      | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 61.6              | 49.8       | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 39.8              | 56.6       | °C/W |
| Ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 27.2              | 16         | °C/W |
| Ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 39.4              | 55.2       | °C/W |

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

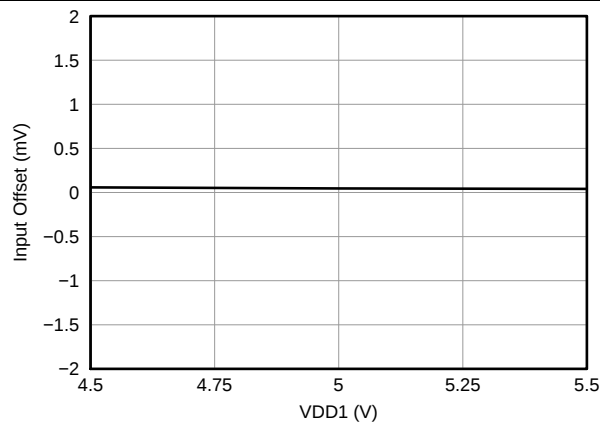
## 6.5 Electrical Characteristics

All minimum/maximum specifications at  $T_A = -40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$  and within the specified voltage range, unless otherwise noted. Typical values are at  $T_A = 25^{\circ}\text{C}$ ,  $V_{DD1} = 5\text{ V}$ , and  $V_{DD2} = 3.3\text{ V}$ .

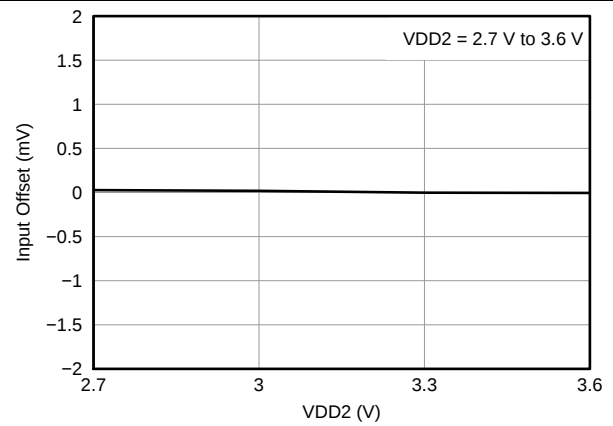
| PARAMETER           |                                       | TEST CONDITIONS                               | MIN     | TYP           | MAX       | UNIT              |
|---------------------|---------------------------------------|-----------------------------------------------|---------|---------------|-----------|-------------------|
| <b>INPUT</b>        |                                       |                                               |         |               |           |                   |
|                     | Maximum input voltage before clipping | $V_{INP} - V_{INN}$                           |         | $\pm 320$     |           | mV                |
|                     | Differential input voltage            | $V_{INP} - V_{INN}$                           | -250    |               | 250       | mV                |
| $V_{CM}$            | Common mode operating range           |                                               | -0.16   |               | $V_{DD1}$ | V                 |
| $V_{OS}$            | Input offset voltage                  |                                               | -1.5    | $\pm 0.2$     | 1.5       | mV                |
| $TCV_{OS}$          | Input offset thermal drift            |                                               | -10     | $\pm 1.5$     | 10        | $\mu\text{V/K}$   |
| CMRR                | Common mode rejection ratio           | $V_{IN}$ from 0 V to 5 V at 0 Hz              |         | 108           |           | dB                |
|                     |                                       | $V_{IN}$ from 0 V to 5 V at 50 kHz            |         | 95            |           | dB                |
| $C_{IN}$            | Input capacitance to GND1             | $V_{INP}$ or $V_{INN}$                        |         | 3             |           | pF                |
| $C_{IND}$           | Differential input capacitance        |                                               |         | 3.6           |           | pF                |
| $R_{IN}$            | Differential input resistance         |                                               |         | 28            |           | k $\Omega$        |
|                     | Small-signal bandwidth                |                                               | 60      | 100           |           | kHz               |
| <b>OUTPUT</b>       |                                       |                                               |         |               |           |                   |
|                     | Nominal gain                          |                                               |         | 8             |           |                   |
| $G_{ERR}$           | Gain error                            | Initial, at $T_A = 25^{\circ}\text{C}$        | -0.5%   | $\pm 0.05\%$  | 0.5%      |                   |
|                     |                                       |                                               | -1%     | $\pm 0.05\%$  | 1%        |                   |
| $TCG_{ERR}$         | Gain error thermal drift              |                                               |         | $\pm 56$      |           | ppm/K             |
|                     | Nonlinearity                          | $4.5\text{ V} \leq V_{DD2} \leq 5.5\text{ V}$ | -0.075% | $\pm 0.015\%$ | 0.075%    |                   |
|                     |                                       | $2.7\text{ V} \leq V_{DD2} \leq 3.6\text{ V}$ | -0.1%   | $\pm 0.023\%$ | 0.1%      |                   |
|                     | Nonlinearity thermal drift            |                                               |         | 2.4           |           | ppm/K             |
|                     | Output noise                          | $V_{INP} = V_{INN} = 0\text{ V}$              |         | 3.1           |           | mV <sub>RMS</sub> |
| PSRR                | Power-supply rejection ratio          | vs $V_{DD1}$ , 10-kHz ripple                  |         | 80            |           | dB                |
|                     |                                       | vs $V_{DD2}$ , 10-kHz ripple                  |         | 61            |           | dB                |
|                     | Rise/fall time                        | 0.5-V step, 10% to 90%                        |         | 3.66          | 6.6       | $\mu\text{s}$     |
|                     | $V_{IN}$ to $V_{OUT}$ signal delay    | 0.5-V step, 50% to 10%, unfiltered output     |         | 1.6           | 3.3       | $\mu\text{s}$     |
|                     |                                       | 0.5-V step, 50% to 50%, unfiltered output     |         | 3.15          | 5.6       | $\mu\text{s}$     |
|                     |                                       | 0.5-V step, 50% to 90%, unfiltered output     |         | 5.26          | 9.9       | $\mu\text{s}$     |
| CMTI                | Common mode transient immunity        | $V_{CM} = 1\text{ kV}$                        | 10      | 15            |           | kV/ $\mu\text{s}$ |
|                     | Output common mode voltage            | $2.7\text{ V} \leq V_{DD2} \leq 3.6\text{ V}$ | 1.15    | 1.29          | 1.45      | V                 |
|                     |                                       | $4.5\text{ V} \leq V_{DD2} \leq 5.5\text{ V}$ | 2.4     | 2.55          | 2.7       | V                 |
|                     | Short circuit current                 |                                               |         | 20            |           | mA                |
| $R_{OUT}$           | Output resistance                     |                                               |         | 2.5           |           | $\Omega$          |
| <b>POWER SUPPLY</b> |                                       |                                               |         |               |           |                   |
| $V_{DD1}$           | High-side supply voltage              |                                               | 4.5     | 5             | 5.5       | V                 |
| $V_{DD2}$           | Low-side supply voltage               |                                               | 2.7     | 5             | 5.5       | V                 |
| $I_{DD1}$           | High-side supply current              |                                               |         | 5.4           | 8         | mA                |
| $I_{DD2}$           | Low-side supply current               | $2.7\text{ V} < V_{DD2} < 3.6\text{ V}$       |         | 3.8           | 6         | mA                |
|                     |                                       | $4.5\text{ V} < V_{DD2} < 5.5\text{ V}$       |         | 4.4           | 7         | mA                |
| $P_{DD1}$           | High-side power dissipation           |                                               |         | 27            | 44        | mW                |
| $P_{DD2}$           | Low-side power dissipation            | $2.7\text{ V} < V_{DD2} < 3.6\text{ V}$       |         | 11.4          | 21.6      | mW                |
|                     |                                       | $4.5\text{ V} < V_{DD2} < 5.5\text{ V}$       |         | 22            | 38.5      | mW                |

## 6.6 Typical Characteristics

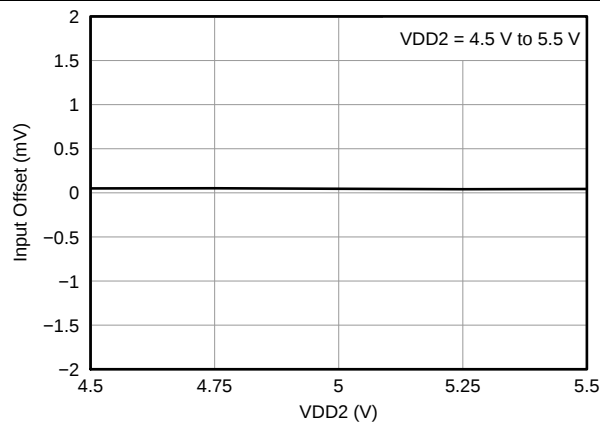
At  $V_{DD1} = V_{DD2} = 5\text{ V}$ ,  $V_{INP} = -250\text{ mV}$  to  $250\text{ mV}$ , and  $V_{INN} = 0\text{ V}$ , unless otherwise noted.



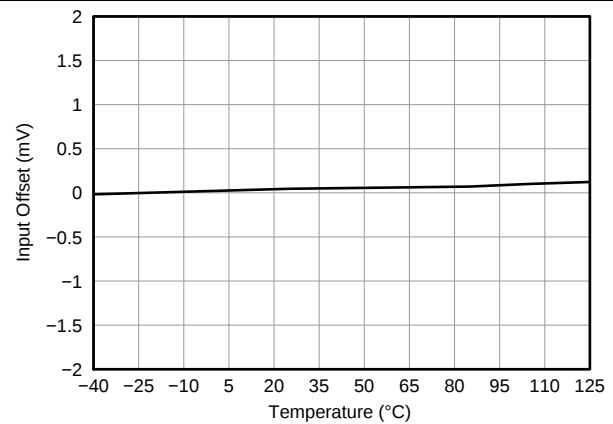
**Figure 1. Input Offset vs High-Side Supply Voltage**



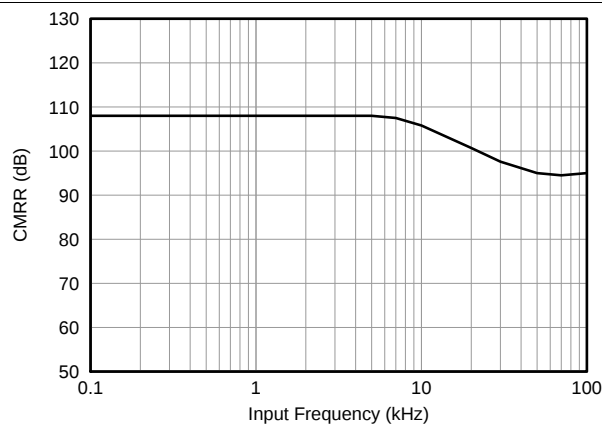
**Figure 2. Input Offset vs Low-Side Supply Voltage**



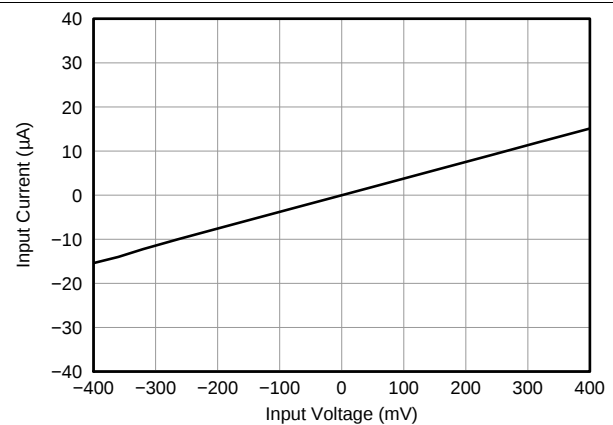
**Figure 3. Input Offset vs Low-Side Supply Voltage**



**Figure 4. Input Offset vs Temperature**



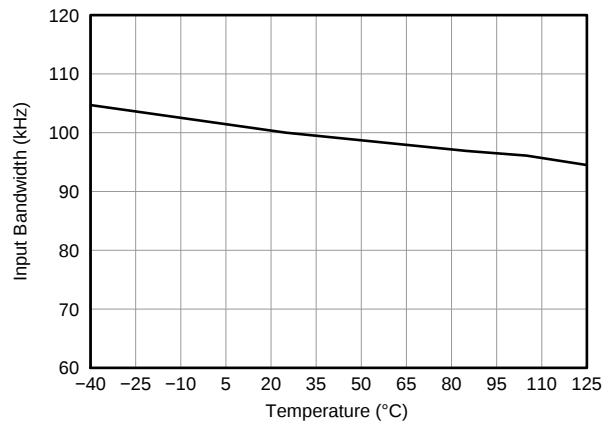
**Figure 5. Common Mode Rejection Ratio vs Input Frequency**



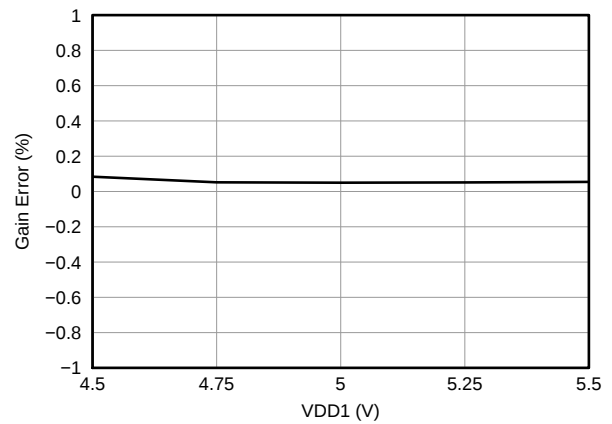
**Figure 6. Input Current vs Input Voltage**

## Typical Characteristics (continued)

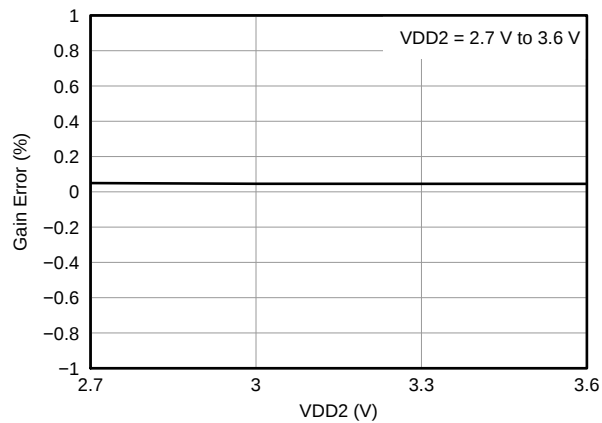
At  $V_{DD1} = V_{DD2} = 5\text{ V}$ ,  $V_{INP} = -250\text{ mV}$  to  $250\text{ mV}$ , and  $V_{INN} = 0\text{ V}$ , unless otherwise noted.



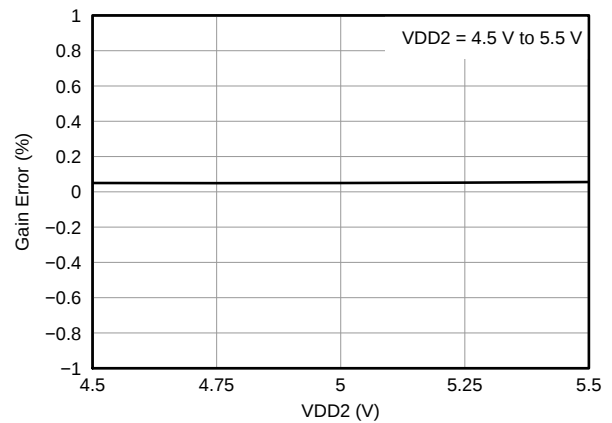
**Figure 7. Input Bandwidth vs Temperature**



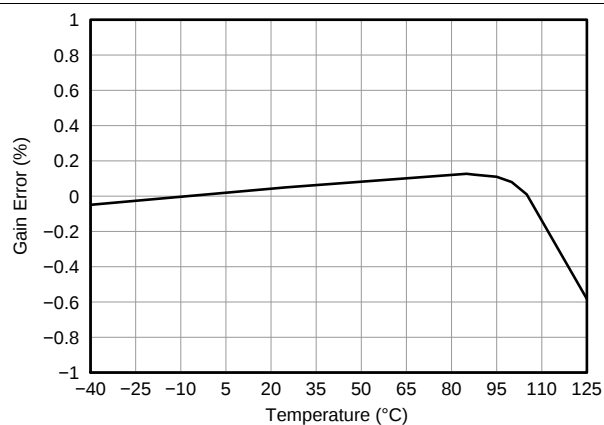
**Figure 8. Gain Error vs High-Side Supply Voltage**



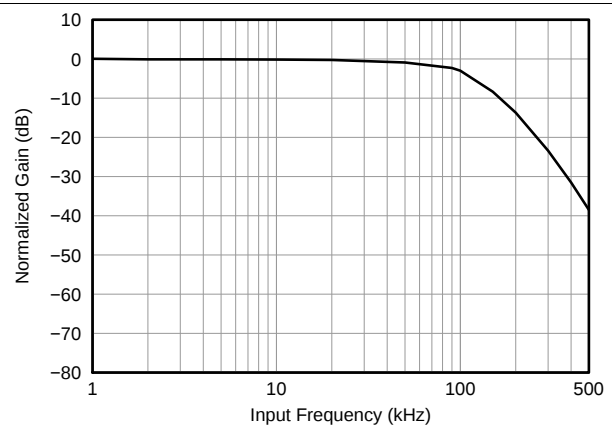
**Figure 9. Gain Error vs Low-Side Supply Voltage**



**Figure 10. Gain Error vs Low-Side Supply Voltage**



**Figure 11. Gain Error vs Temperature**



**Figure 12. Normalized Gain vs Input Frequency**

## Typical Characteristics (continued)

At  $V_{DD1} = V_{DD2} = 5\text{ V}$ ,  $V_{INP} = -250\text{ mV}$  to  $250\text{ mV}$ , and  $V_{INN} = 0\text{ V}$ , unless otherwise noted.

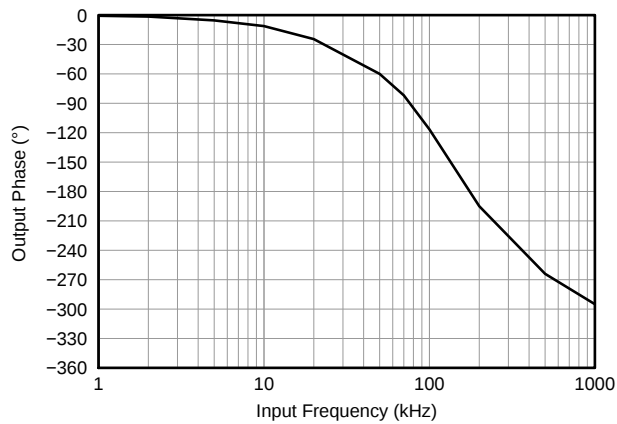


Figure 13. Output Phase vs Input Frequency

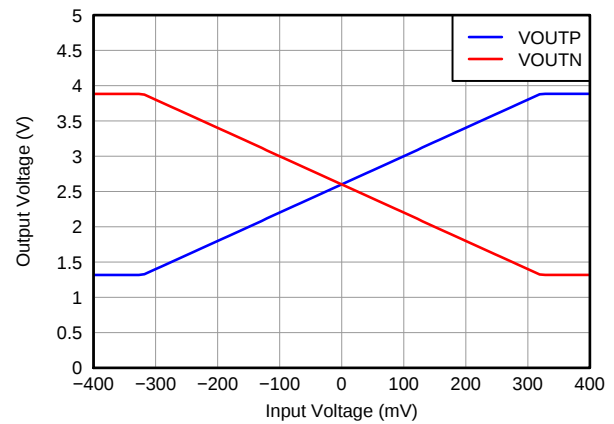


Figure 14. Output Voltage vs Input Voltage

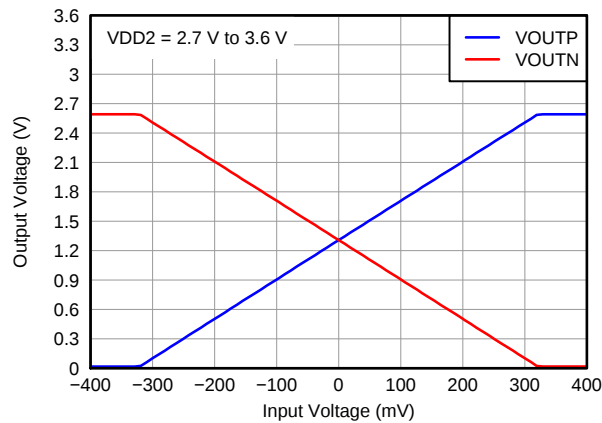


Figure 15. Output Voltage vs Input Voltage

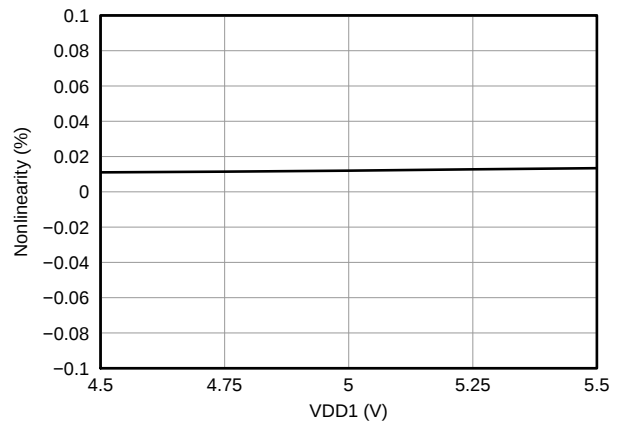


Figure 16. Nonlinearity vs High-Side Supply Voltage

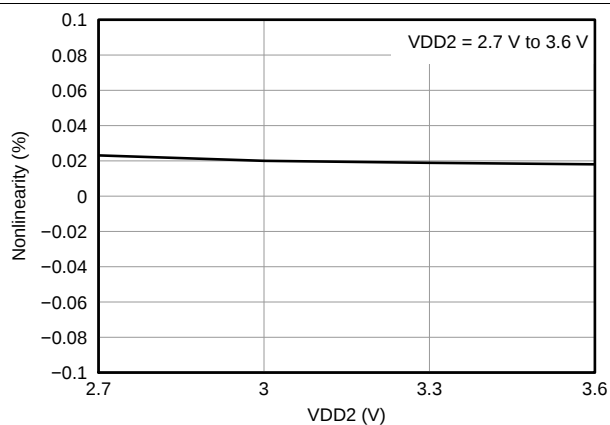


Figure 17. Nonlinearity vs Low-Side Supply Voltage

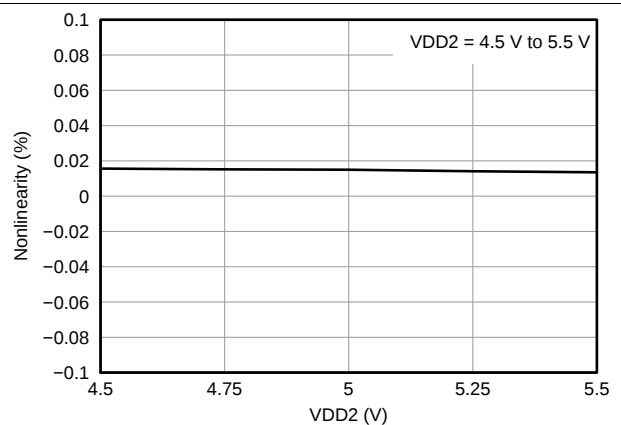
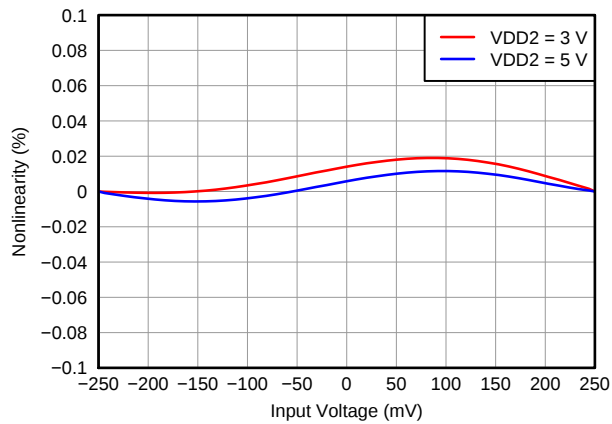


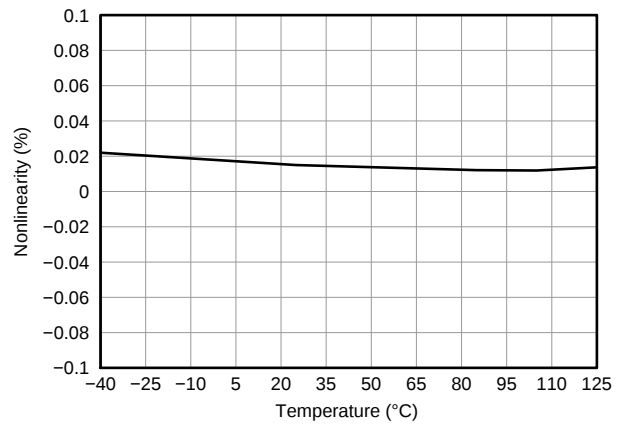
Figure 18. Nonlinearity vs Low-Side Supply Voltage

## Typical Characteristics (continued)

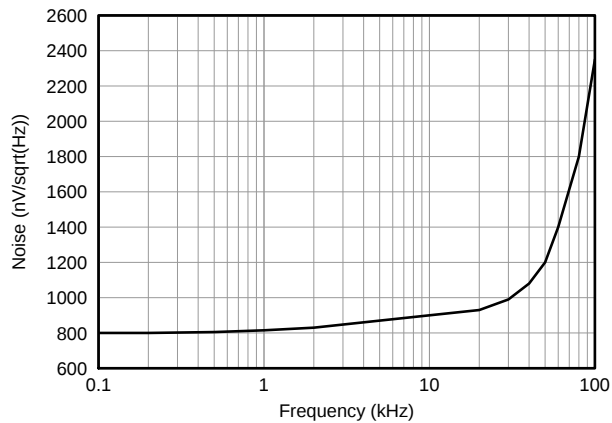
At  $V_{DD1} = V_{DD2} = 5\text{ V}$ ,  $V_{INP} = -250\text{ mV}$  to  $250\text{ mV}$ , and  $V_{INN} = 0\text{ V}$ , unless otherwise noted.



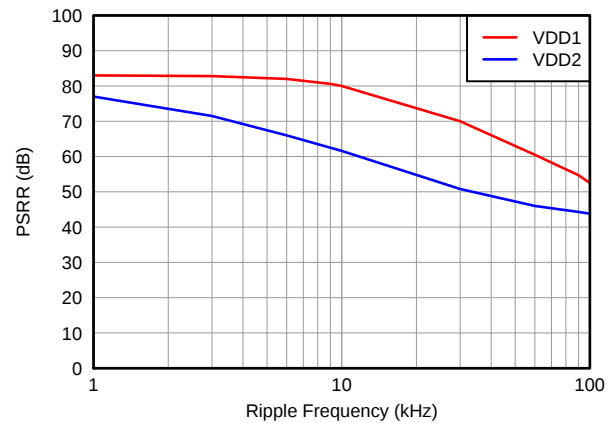
**Figure 19. Nonlinearity vs Input Voltage**



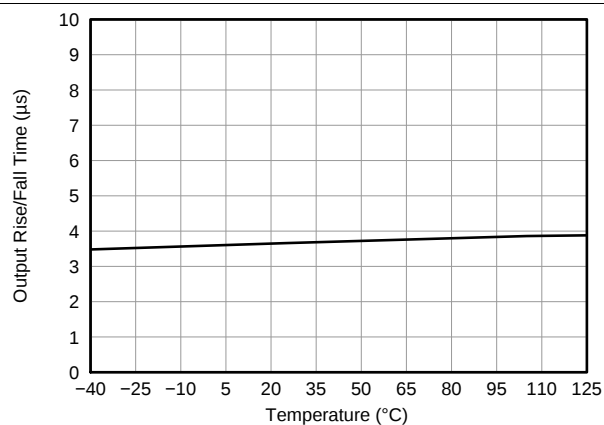
**Figure 20. Nonlinearity vs Temperature**



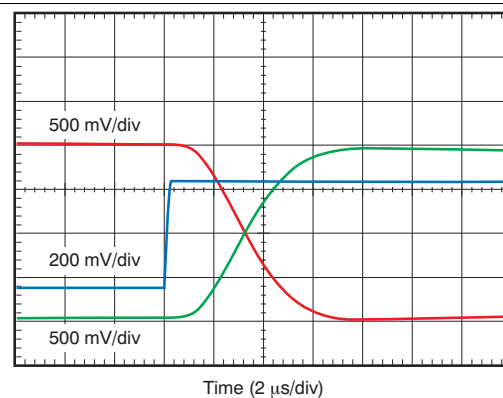
**Figure 21. Output Noise Density vs Frequency**



**Figure 22. Power-Supply Rejection Ratio vs Ripple Frequency**



**Figure 23. Output Rise and Fall Time vs Temperature**



**Figure 24. Full-Scale Step Response**

## Typical Characteristics (continued)

At  $V_{DD1} = V_{DD2} = 5\text{ V}$ ,  $V_{INP} = -250\text{ mV}$  to  $250\text{ mV}$ , and  $V_{INN} = 0\text{ V}$ , unless otherwise noted.

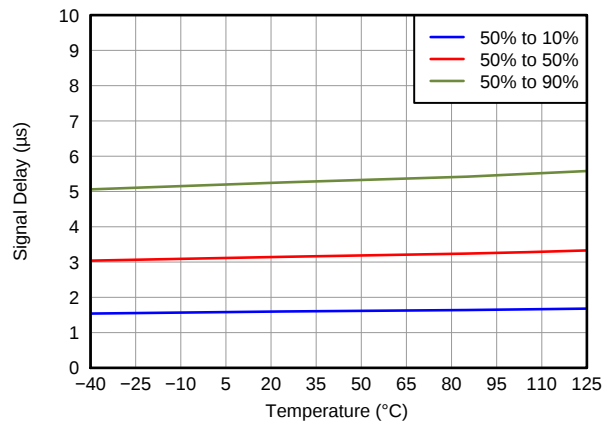


Figure 25. Output Signal Delay Time vs Temperature

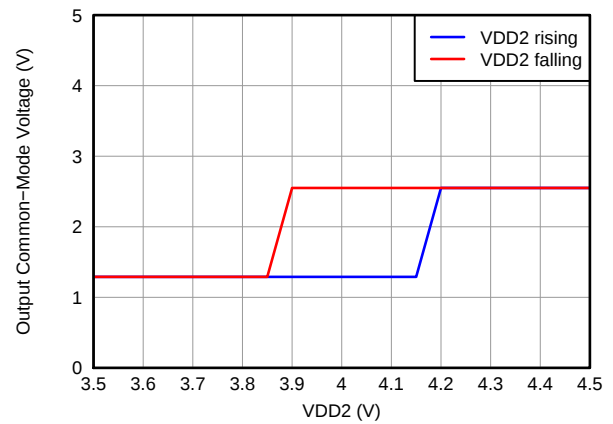


Figure 26. Output Common Mode Voltage vs Low-Side Supply Voltage

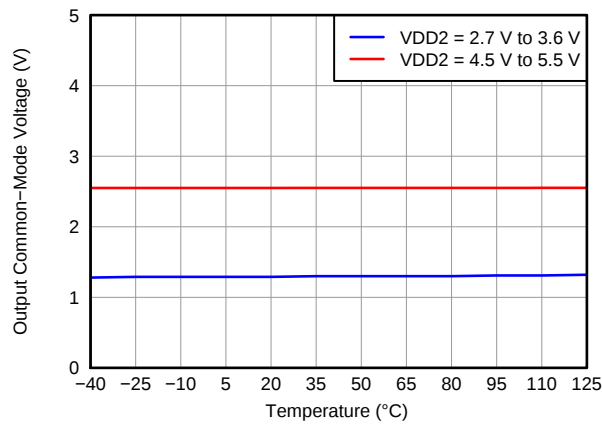


Figure 27. Output Common Mode Voltage vs Temperature

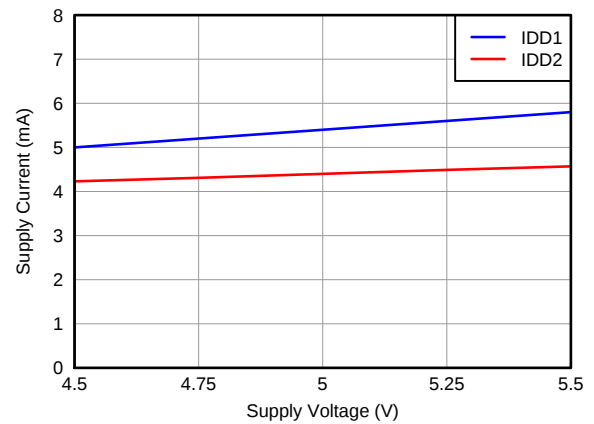


Figure 28. Supply Current vs Supply Voltage

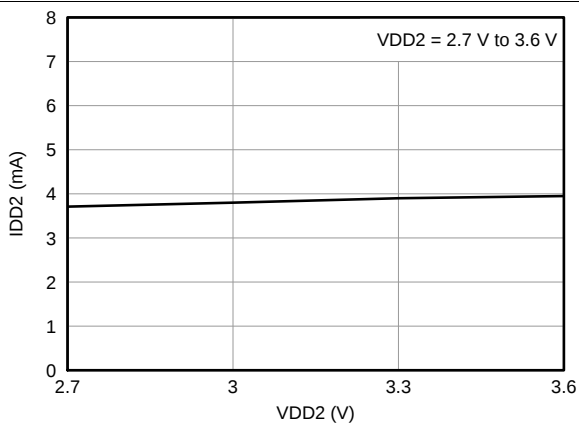


Figure 29. Low-Side Supply Current vs Low-Side Supply Voltage

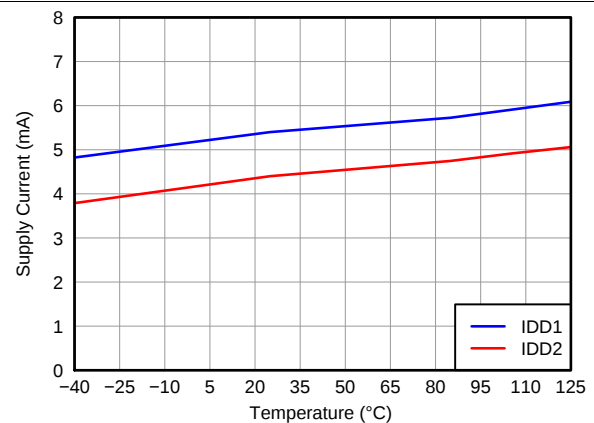


Figure 30. Supply Current vs Temperature

## 7 Detailed Description

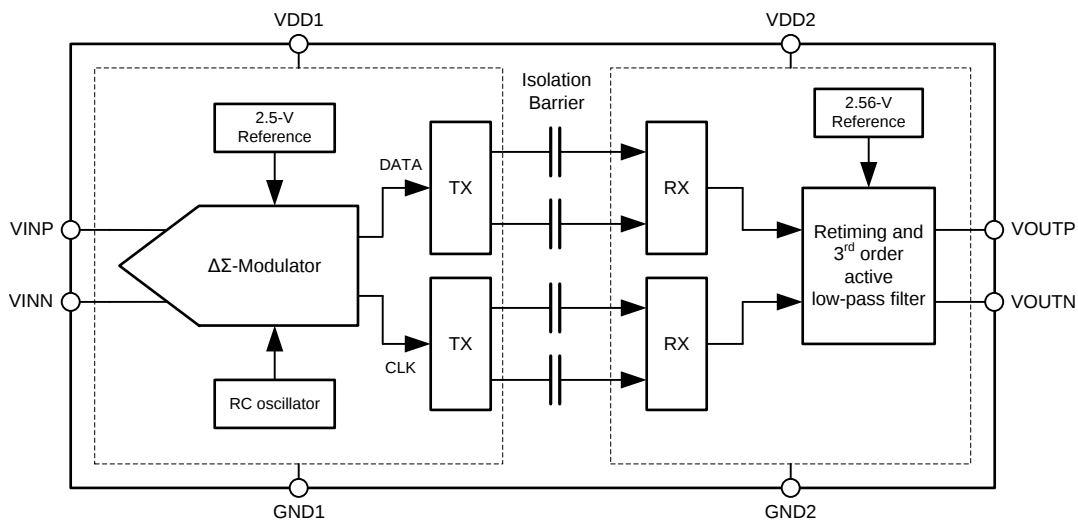
### 7.1 Overview

The AMC1200 is a fully-differential precision isolation amplifier. The analog input signal is converted to a digital signal and then transferred across a capacitive isolation barrier. The digital modulation used in the AMC1200 together with the isolation barrier characteristics result in excellent reliability and transient immunity.

After processing the digital signal with a low-pass filter, an analog signal is provided at the outputs. The main building blocks are shown in the [Functional Block Diagram](#) section.

The SiO<sub>2</sub>-based capacitive isolation barrier supports a high level of magnetic field immunity, as described in application report, *ISO72x Digital Isolator Magnetic-Field Immunity (SLLA181)*, available for download at [www.ti.com](http://www.ti.com).

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Insulation Characteristics

| PARAMETER                                            | TEST CONDITIONS                                                                                                                                   | MIN      | TYP               | MAX  | UNIT              |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------|------|-------------------|
| V <sub>IORM</sub> Maximum working insulation voltage |                                                                                                                                                   |          |                   | 1200 | V <sub>PEAK</sub> |
| V <sub>PR</sub> Input to output test voltage         | Qualification test: after Input/Output Safety Test Subgroup 2/3 V <sub>PR</sub> = V <sub>IORM</sub> × 1.2, t = 10 s, partial discharge < 5 pC     |          |                   | 1140 | V <sub>PEAK</sub> |
|                                                      | Qualification test: method a, after environmental tests subgroup 1, V <sub>PR</sub> = V <sub>IORM</sub> × 1.6, t = 10 s, partial discharge < 5 pC |          |                   | 1920 | V <sub>PEAK</sub> |
|                                                      | 100% production test: method b1, V <sub>PR</sub> = V <sub>IORM</sub> × 1.875, t = 1 s, partial discharge < 5 pC                                   |          |                   | 2250 | V <sub>PEAK</sub> |
| V <sub>IOTM</sub> Transient overvoltage              | Qualification test: t = 60 s                                                                                                                      | AMC1200  |                   | 4000 | V <sub>PEAK</sub> |
|                                                      |                                                                                                                                                   | AMC1200B |                   | 4250 | V <sub>PEAK</sub> |
| V <sub>ISO</sub> Insulation voltage per UL           | Qualification test: V <sub>TEST</sub> = V <sub>ISO</sub> , t = 60 s                                                                               | AMC1200  |                   | 4000 | V <sub>PEAK</sub> |
|                                                      |                                                                                                                                                   | AMC1200B |                   | 4250 | V <sub>PEAK</sub> |
|                                                      | 100% production test: V <sub>TEST</sub> = 1.2 × V <sub>ISO</sub> , t = 1 s                                                                        | AMC1200  |                   | 4800 | V <sub>PEAK</sub> |
|                                                      |                                                                                                                                                   | AMC1200B |                   | 5100 | V <sub>PEAK</sub> |
| R <sub>S</sub> Insulation resistance                 | V <sub>IO</sub> = 500 V at T <sub>S</sub>                                                                                                         |          | > 10 <sup>9</sup> |      | Ω                 |

## Feature Description (continued)

| PARAMETER           | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------|-----------------|-----|-----|-----|------|
| PD Pollution degree |                 |     | 2   |     | °    |

### 7.3.2 IEC 61000-4-5 Ratings

| PARAMETER                        | TEST CONDITIONS                                         | VALUE | UNIT |
|----------------------------------|---------------------------------------------------------|-------|------|
| V <sub>IOSM</sub> Surge immunity | 1.2-μs/50-μs voltage surge and 8-μs/20-μs current surge | ±6000 | V    |

### 7.3.3 IEC 60664-1 Ratings<sup>(1)</sup>

| PARAMETER                   | TEST CONDITIONS                            | SPECIFICATION |
|-----------------------------|--------------------------------------------|---------------|
| Basic isolation group       | Material group                             | II            |
| Installation classification | Rated mains voltage ≤ 150 V <sub>RMS</sub> | I-IV          |
|                             | Rated mains voltage ≤ 300 V <sub>RMS</sub> | I-IV          |
|                             | Rated mains voltage ≤ 400 V <sub>RMS</sub> | I-III         |
|                             | Rated mains voltage < 600 V <sub>RMS</sub> | I-III         |

(1) Over operating free-air temperature range (unless otherwise noted).

### 7.3.4 Package Characteristics<sup>(1)</sup>

| PARAMETER                                            | TEST CONDITIONS                                                                                                                                     | MIN         | TYP                | MAX | UNIT |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------|-----|------|
| L(I01) Minimum air gap (clearance)                   | Shortest terminal to terminal distance through air                                                                                                  | DWV package | 8                  |     | mm   |
|                                                      |                                                                                                                                                     | DUB package | 7                  |     | mm   |
| L(I02) Minimum external tracking (creepage)          | Shortest terminal to terminal distance across the package surface                                                                                   | DWV package | 8                  |     | mm   |
|                                                      |                                                                                                                                                     | DUB package | 7                  |     | mm   |
| CTI Tracking resistance (comparative tracking index) | DIN IEC 60112/VDE 0303 part 1                                                                                                                       | ≥ 400       |                    |     | V    |
| Minimum internal gap (internal clearance)            | Distance through the insulation                                                                                                                     | 0.014       |                    |     | mm   |
| R <sub>IO</sub> Isolation resistance                 | Input to output, V <sub>IO</sub> = 500 V, all pins on each side of the barrier tied together to create a two-terminal device, T <sub>A</sub> < 85°C |             | > 10 <sup>12</sup> |     | Ω    |
|                                                      | Input to output, V <sub>IO</sub> = 500 V, 85°C ≤ T <sub>A</sub> < T <sub>A</sub> max                                                                |             | > 10 <sup>11</sup> |     | Ω    |
| C <sub>IO</sub> Barrier capacitance input to output  | V <sub>I</sub> = 0.5 V <sub>PP</sub> at 1 MHz                                                                                                       |             | 1.2                |     | pF   |
| C <sub>I</sub> Input capacitance to ground           | V <sub>I</sub> = 0.5 V <sub>PP</sub> at 1 MHz                                                                                                       |             | 3                  |     | pF   |

(1) Creepage and clearance requirements should be applied according to the specific equipment isolation standards of a specific application. Take care to maintain the creepage and clearance distance of the board design to ensure that the mounting pads of the isolator on the printed-circuit-board (PCB) do not reduce this distance. Creepage and clearance on a PCB become equal according to the measurement techniques shown in the [TI Isolation Glossary](#). Techniques such as inserting grooves and/or ribs on the PCB are used to help increase these specifications.

### 7.3.5 IEC Safety Limiting Values

Safety limiting intends to prevent potential damage to the isolation barrier upon failure of input or output (I/O) circuitry. A failure of the I/O circuitry can allow low resistance to ground or the supply and, without current limiting, dissipate sufficient power to overheat the die and damage the isolation barrier, potentially leading to secondary system failures.

| PARAMETER                                              | TEST CONDITIONS                                                                                   | MIN | TYP | MAX | UNIT |
|--------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| I <sub>S</sub> Safety input, output, or supply current | θ <sub>JA</sub> = 246°C/W, V <sub>IN</sub> = 5.5 V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C |     |     | 10  | mA   |
| T <sub>C</sub> Maximum case temperature                |                                                                                                   |     |     | 150 | °C   |

The safety-limiting constraint is the operating virtual junction temperature range specified in the [Absolute Maximum Ratings](#) table. The power dissipation and junction-to-air thermal impedance of the device installed in the application hardware determine the junction temperature. The assumed junction-to-air thermal resistance in the [Thermal Information](#) table is that of a device installed in the JESD51-3, *Low Effective Thermal Conductivity Test Board for Leadless Surface Mount Packages* and is conservative. The power is the recommended maximum input voltage times the current. The junction temperature is then the ambient temperature plus the power times the junction-to-air thermal resistance.

### 7.3.6 Regulatory Information

| VDE/IEC                              | UL                                                  |
|--------------------------------------|-----------------------------------------------------|
| Certified according to VDE V 0884-10 | Recognized under 1577 component recognition program |
| Certificate number: 40016131         | File number: E181974                                |

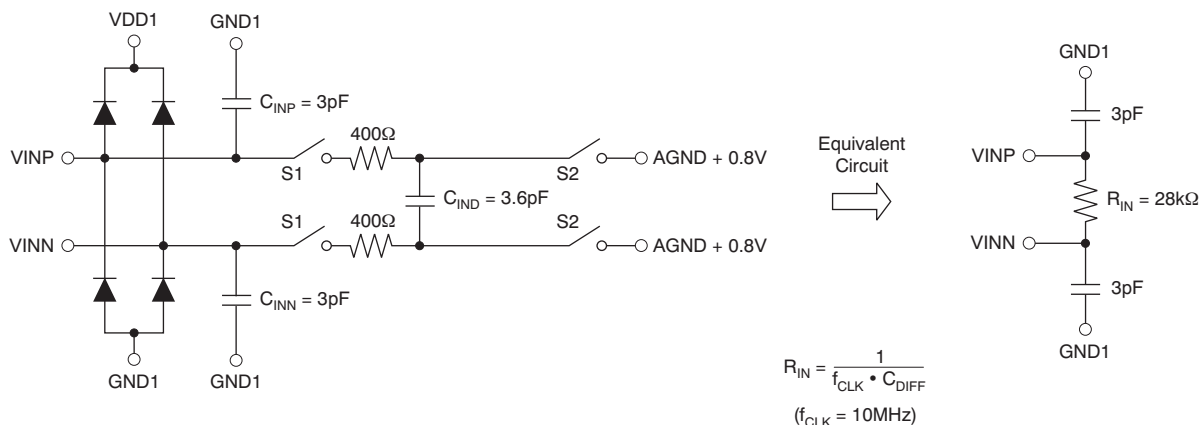
### 7.3.7 Isolation Amplifier

The AMC1200 device consists of a second order delta-sigma modulator input stage including an internal reference and clock generator. The output of the modulator and clock signal are differentially transmitted over the integrated capacitive isolation barrier that separates the high- and low-voltage domains. The received bitstream and clock signals are synchronized and processed by a third-order analog filter with a nominal gain of 8 on the low-side and presented as a differential output of the device, as shown in [Functional Block Diagram](#) section.

### 7.3.8 Analog Input

The analog input range is tailored to directly accommodate a voltage drop across a shunt resistor used for current sensing. However, there are two restrictions on the analog input signals, VINP and VINN. If the input voltage exceeds the range AGND – 0.5 V to AVDD + 0.5 V, the input current must be limited to 10 mA to prevent the implemented input protection diodes from damage. In addition, the linearity and the noise performance of the device are ensured only when the differential analog input voltage remains within ±250 mV.

The differential analog input of the AMC1200 and AMC1200B devices is a switched-capacitor circuit based on a second-order modulator stage that digitizes the input signal into a 1-bit output stream. These devices compare the differential input signal ( $V_{IN} = V_{INP} - V_{INN}$ ) against the internal reference of 2.5 V using internal capacitors that are continuously charged and discharged with a typical frequency of 10 MHz. With the S1 switches closed,  $C_{IND}$  charges to the voltage difference across VINP and VINN. For the discharge phase, both S1 switches open first and then both S2 switches close.  $C_{IND}$  discharges to approximately AGND + 0.8 V during this phase. [Figure 31](#) shows the simplified equivalent input circuitry.



**Figure 31. Equivalent Input Circuit**

## 7.4 Device Functional Modes

The AMC1200 is operational when the power supplies VDD1 and VDD2 are applied as specified in the [Recommended Operating Conditions](#) section.

**AMC1200, AMC1200B**

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[www.ti.com.cn](http://www.ti.com.cn)**Device Functional Modes (continued)**

The AMC1200 does not have any additional functional modes.

## 8 Application and Implementation

### 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. Customers should validate and test their design implementation to confirm system functionality.

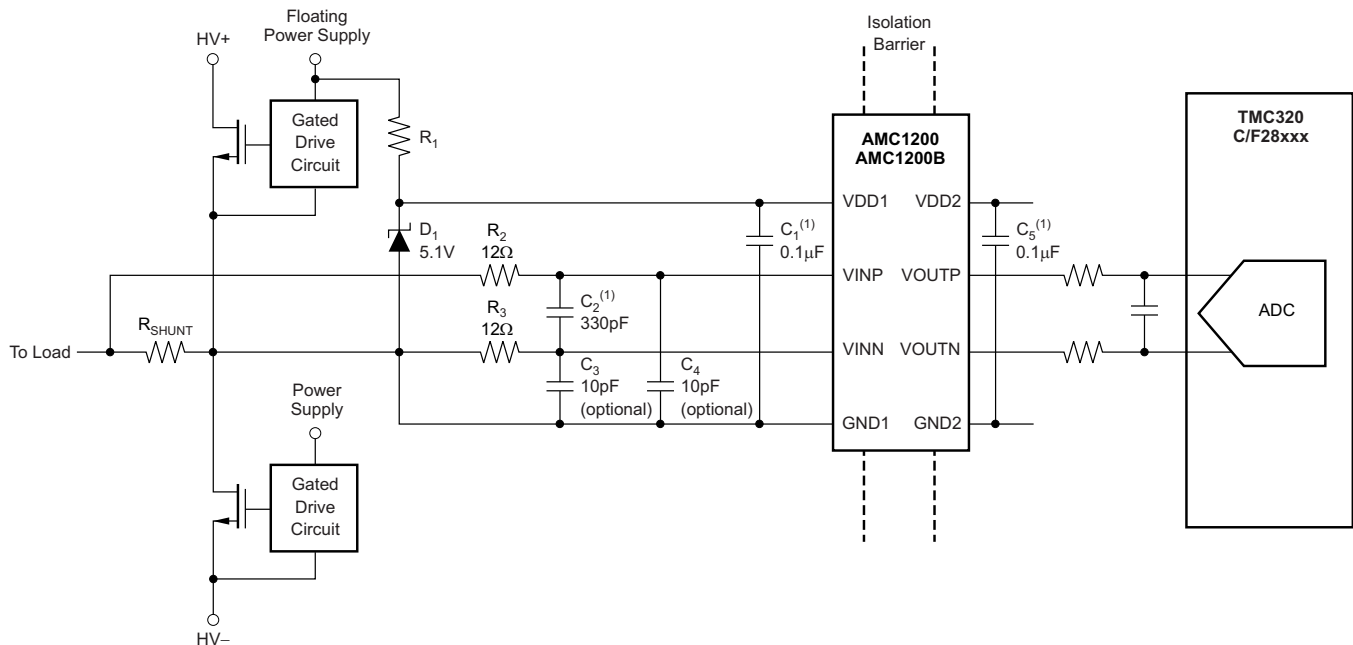
### 8.1 Application Information

The AMC1200 and AMC1200B devices offer unique linearity, high input common mode rejection, low DC errors and low temperature drift. These features make the AMC1200 a robust, high-performance isolation amplifier for industrial applications where high voltage isolation is required.

### 8.2 Typical Applications

#### 8.2.1 Motor Control

Figure 32 shows a typical operation of the AMC1200 and AMC1200B devices in a motor-control application. Measurement of the motor phase current is done through the shunt resistor,  $R_{SHUNT}$  (in this case, a two-terminal shunt).



(1) Place these capacitors as close as possible to the AMC device.

Figure 32. Typical Application Diagram

The high-side power supply (VDD1) for the AMC1200 and AMC1200B are derived from the power supply of the upper gate driver. Further details are provided in the [Power Supply Recommendations](#) section.

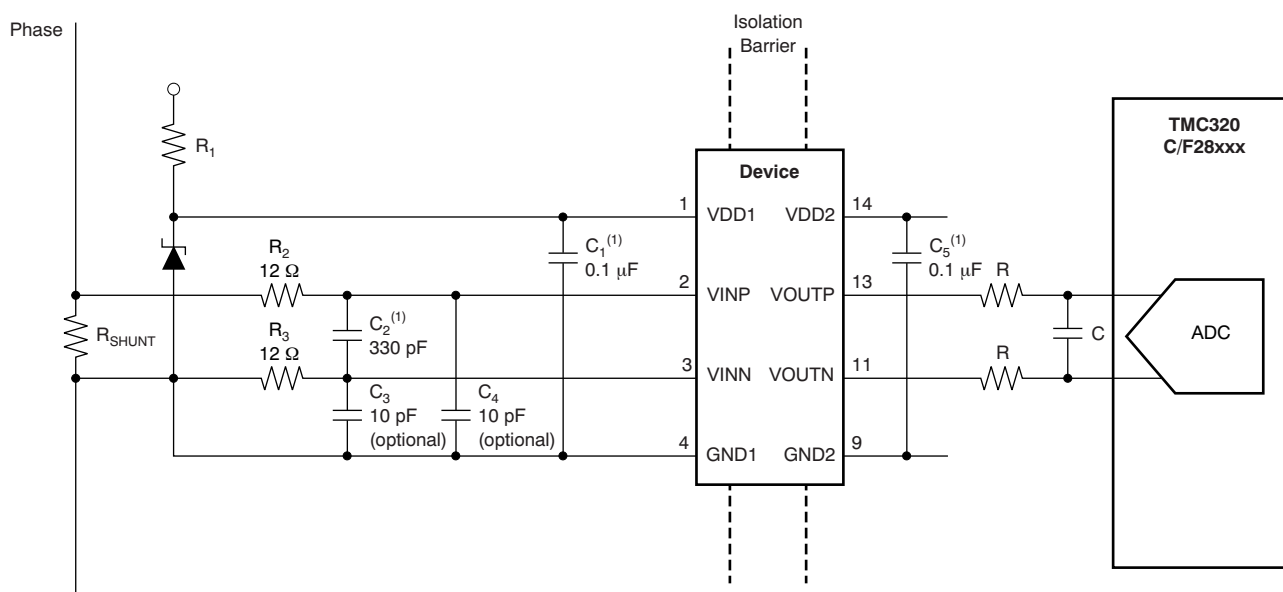
The high transient immunity of the AMC1200 and AMC1200B ensures reliable and accurate operation even in high-noise environments such as the power stages of the motor drives.

As shown in Figure 37, TI recommends placing the bypass and filter capacitors as close as possible to the AMC device to ensure best performance.

## Typical Applications (continued)

### 8.2.1.1 Design Requirements

For better performance, the differential input signal is filtered using RC filters (components  $R_2$ ,  $R_3$ , and  $C_2$ ). Optionally,  $C_3$  and  $C_4$  can be used to reduce charge dumping from the inputs. In this case, take care when choosing the quality of these capacitors; mismatch in values of these capacitors leads to a common mode error at the modulator input. If implemented, TI recommends using NP0 capacitors for  $C_2$ ,  $C_3$  and  $C_4$ .



**Figure 33. Shunt-Based Current Sensing with the AMC1200**

Similar to the current measurements, isolated voltage measurements can be performed as described in the .

### 8.2.1.2 Detailed Design Procedure

The floating ground reference (GND1) is derived from the end of the shunt resistor, which is connected to the negative input of the AMC1200 (VINN). If a four-terminal shunt is used, the inputs of the AMC1200 are connected to the inner leads and GND1 is connected to one of the outer shunt leads. The differential input of the AMC1200 ensures accurate operation even in noisy environments.

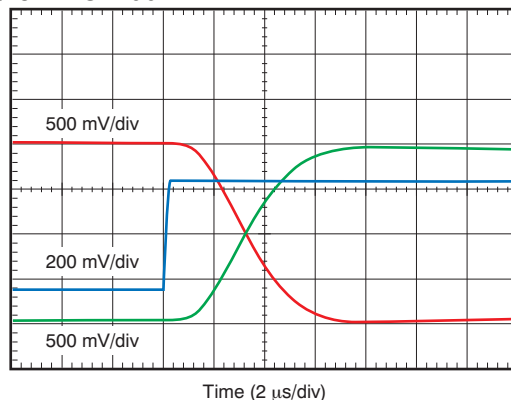
TI recommends limiting the value of resistors  $R_2$  and  $R_3$  to less than 24  $\Omega$  to avoid the incomplete settling of the AMC1200 input circuitry. The section provides more details on the AMC1200 input circuitry.

The differential output of the AMC1200 can either directly drive an analog-to-digital converter (ADC) input or can be further filtered before being processed by the ADC. For more information on the general procedure to design the filtering and driving stages for SAR ADCs, consult the TI Precision Designs *18 bit, 1Msps Data Acquisition Block Optimized for Lowest Distortion and Noise* ([SLAU515](#)), and *18 bit Data Acquisition Block Optimized for Lowest Power* ([SLAU513](#)) available for download at [www.ti.com](http://www.ti.com)

## Typical Applications (continued)

### 8.2.1.3 Application Curve

In frequency inverter applications the power switches must be protected in case of an overcurrent condition. To allow fast powering off of the system, low delay caused by the isolation amplifier is required. [Figure 34](#) shows the typical full-scale step response of the AMC1200.



**Figure 34. Typical Step Response of the AMC1200**

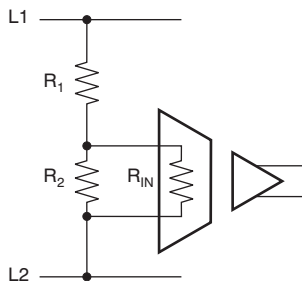
### 8.2.2 Isolated Voltage Measurement

The AMC1200 and AMC1200B can also be used for isolated voltage measurement applications, as shown in a simplified way in [Figure 35](#). In such applications, usually a resistor divider ( $R_1$  and  $R_2$  in [Figure 35](#)) is used to match the relatively small input voltage range of the AMC device.  $R_2$  and the input resistance  $R_{IN}$  of the AMC1200 also create a resistance divider that results in additional gain error. With the assumption that  $R_1$  and  $R_{IN}$  have a considerably higher value than  $R_2$ , the resulting total gain error can be estimated using [Equation 1](#):

$$G_{ERRTOT} = G_{ERR} + \frac{R_2}{R_{IN}}$$

where

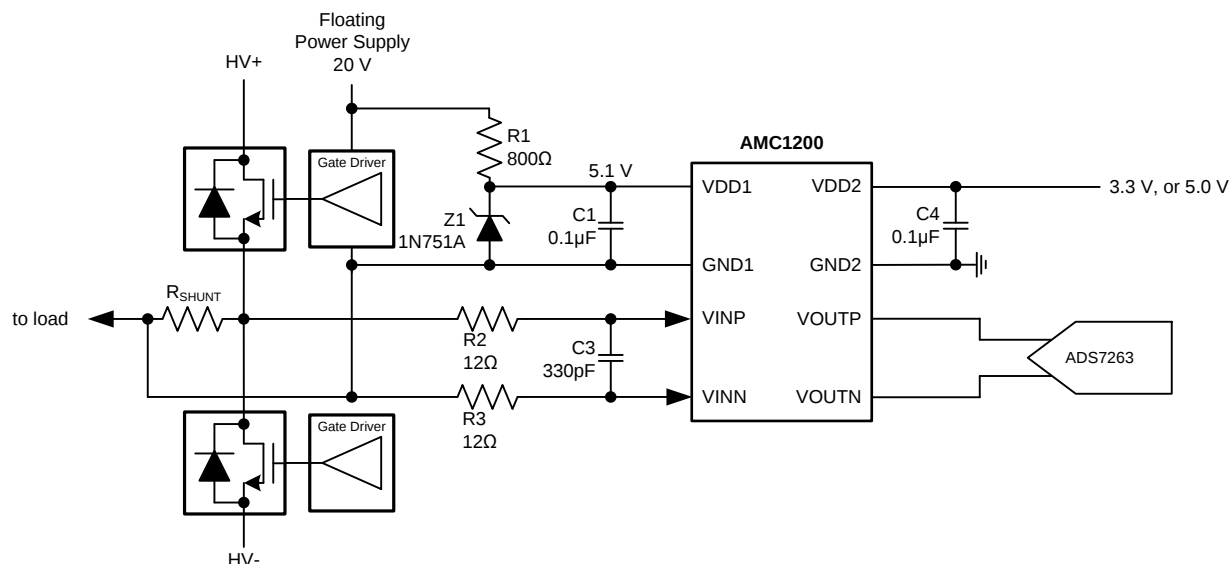
- $G_{ERR}$  = the gain error of AMC device. (1)



**Figure 35. Voltage Measurement Application**

## 9 Power Supply Recommendations

In a typical frequency inverter application, the high-side power supply for the AMC1200 (VDD1) is derived from the system supply, as shown in Figure 36. For lowest cost, a Zener diode can be used to limit the voltage to 5 V  $\pm$  10%. TI recommends using a 0.1- $\mu$ F, low-ESR decoupling capacitor for filtering this power-supply. TI also recommends using a 0.1- $\mu$ F decoupling capacitor for filtering the power-supply on the VDD2 side. For best performance, place these capacitors ( $C_1$  and  $C_4$ ) as close as possible to the VDD1 and VDD2 pins respectively. If better filtering is required, an additional 1- $\mu$ F to 10- $\mu$ F capacitor can be used in parallel to  $C_1$  and  $C_4$ .



**Figure 36. Zener Diode Based High-Side Supply**

For higher power efficiency and better performance, a buck converter can be used; an example of such an approach is based on the LM5017. A reference design including performance test results and layout documentation can be downloaded at [PMP9480, Isolated Bias Supplies + Isolated Amplifier Combo for Line Voltage or Current Measurement](#).

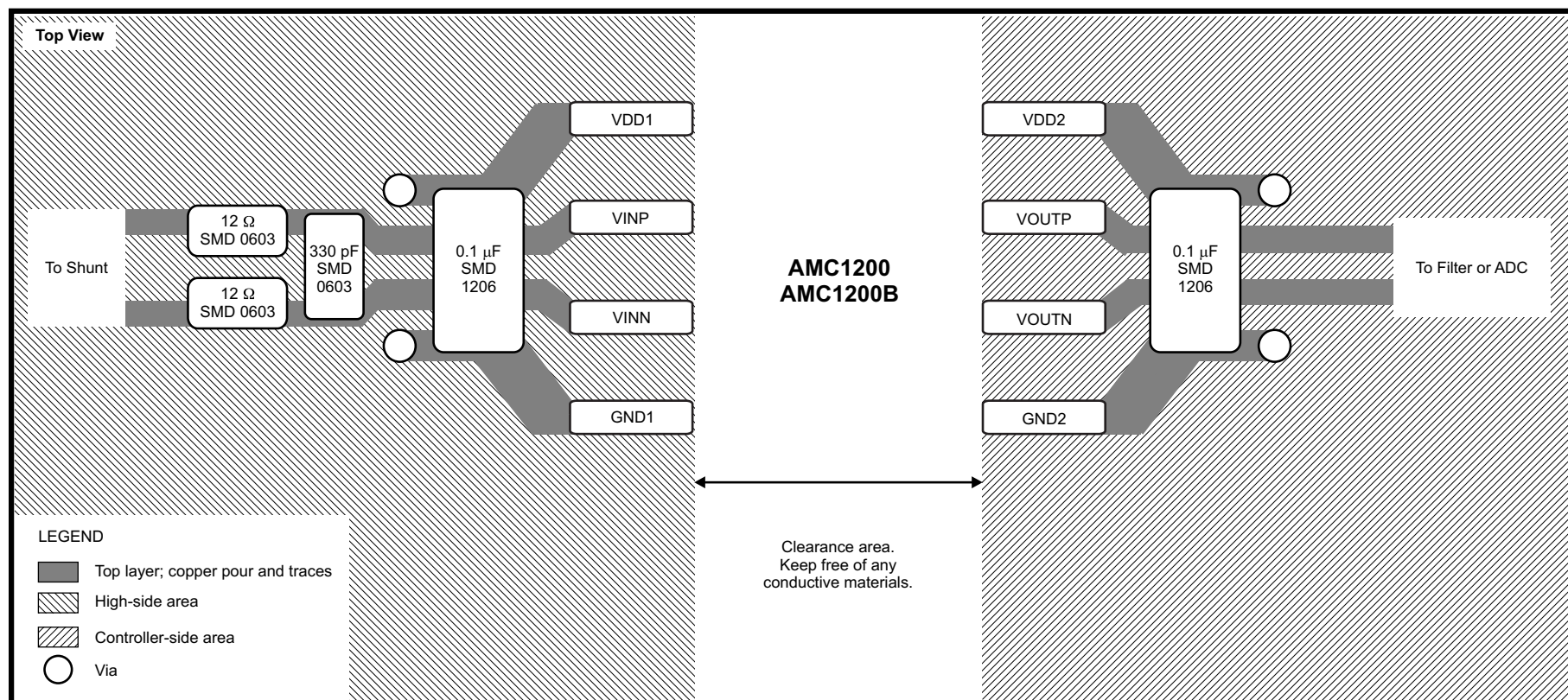
## 10 Layout

### 10.1 Layout Guidelines

A layout recommendation showing the critical placement of the decoupling capacitors that be placed as close as possible to the AMC1200 while maintaining a differential routing of the input signals is shown in Figure 37.

To maintain the isolation barrier and the high CMTI of the device, the distance between the high-side ground (GND1) and the low-side ground (GND2) should be kept at maximum; that is, the entire area underneath the device should be kept free of any conducting materials.

## 10.2 Layout Example



**Figure 37. Layout Recommendation**

## 11 器件和文档支持

### 11.1 文档支持

#### 11.1.1 相关文档

相关文档如下：

- 《TI 隔离相关术语》， [SLLA353](#)
- 《针对最低失真和最低噪声进行优化的 18 位 1Msps 数据采集模块》， [SLAU515](#)
- 《针对最低功耗进行优化的 18 位数据采集模块》， [SLAU513](#)
- 《ISO72x 系列数字隔离器高压使用寿命》， [SLLA197](#)
- 《ISO72x 数字隔离器磁场抗扰度》， [SLLA181](#)
- 《AMC1100：使用隔离放大器替代逆变器中的输入主感应变压器》， [SLAA552](#)
- 隔离型电流感测参考设计解决方案， 5A， 2kV， [TIPD121](#)
- 用于线路电压或电流测量的隔离式偏置电源 + 隔离式放大器组合， [PMP9480](#)
- 《TPS62120 数据表》， [SLVSAD5](#)
- 《MSP430F471xx 数据表》， [SLAS626](#)
- 《SN6501 数据表》， [SLLSEA0](#)
- 《LM5017 数据表》， [SNVS783](#)

### 11.2 相关链接

下面的表格中列出了快速访问链接。范围包括技术文档、支持与社区资源、工具和软件，并且可以快速访问样片或购买链接。

表 1. 相关链接

| 器件       | 产品文件夹                 | 样片与购买                 | 技术文档                  | 工具与软件                 | 支持与社区                 |
|----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| AMC1200  | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> |
| AMC1200B | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> | <a href="#">请单击此处</a> |

### 11.3 社区资源

The following links connect to TI community resources. Linked contents are 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](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](#), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 11.4 商标

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### 11.5 静电放电警告



ESD 可能会损坏该集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理措施和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 11.6 Glossary

[SLY022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 12 机械、封装和可订购信息

以下页中包括机械、封装和可订购信息。这些信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。欲获得该数据表的浏览器版本，请查阅左侧的导航栏。

## 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="#">AMC1200BDUB</a>  | Active        | Production           | SOP (DUB)   8  | 50   TUBE             | Yes         | NIPDAU                               | Level-4-260C-72 HR                | -40 to 105   | 1200B               |
| <a href="#">AMC1200BDUBR</a> | Active        | Production           | SOP (DUB)   8  | 350   LARGE T&R       | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 105   | 1200B               |
| <a href="#">AMC1200BDWV</a>  | Active        | Production           | SOIC (DWV)   8 | 64   TUBE             | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 105   | AMC1200B            |
| <a href="#">AMC1200BDWVR</a> | Active        | Production           | SOIC (DWV)   8 | 1000   LARGE T&R      | Yes         | NIPDAU                               | Level-2-260C-1 YEAR               | -40 to 105   | AMC1200B            |
| <a href="#">AMC1200SDUB</a>  | Active        | Production           | SOP (DUB)   8  | 50   TUBE             | Yes         | NIPDAU                               | Level-4-260C-72 HR                | -40 to 105   | AMC1200             |
| <a href="#">AMC1200SDUBR</a> | Active        | Production           | SOP (DUB)   8  | 350   LARGE T&R       | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 105   | AMC1200             |

<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.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **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.

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**OTHER QUALIFIED VERSIONS OF AMC1200 :**

- Automotive : [AMC1200-Q1](#)

**NOTE:** Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| AMC1200BDUBR | SOP          | DUB             | 8    | 350  | 330.0              | 24.4               | 13.1    | 9.75    | 6.0     | 16.0    | 24.0   | Q1            |
| AMC1200BDWVR | SOIC         | DWV             | 8    | 1000 | 330.0              | 16.4               | 12.15   | 6.2     | 3.05    | 16.0    | 16.0   | Q1            |
| AMC1200SDUBR | SOP          | DUB             | 8    | 350  | 330.0              | 24.4               | 13.1    | 9.75    | 6.0     | 16.0    | 24.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| AMC1200BDUBR | SOP          | DUB             | 8    | 350  | 367.0       | 367.0      | 45.0        |
| AMC1200BDWVR | SOIC         | DWV             | 8    | 1000 | 356.0       | 356.0      | 35.0        |
| AMC1200SDUBR | SOP          | DUB             | 8    | 350  | 367.0       | 367.0      | 45.0        |

## TUBE



\*All dimensions are nominal

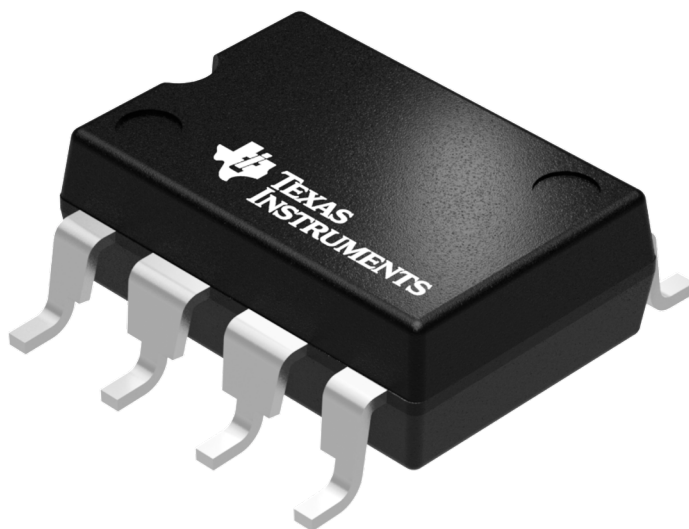
| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| AMC1200BDUB | DUB          | SOP          | 8    | 50  | 532.13 | 13.51  | 7.36   | 6.91   |
| AMC1200BDUB | DUB          | SOP          | 8    | 50  | 532.13 | 13     | 7300   | 6.6    |
| AMC1200BDWV | DWV          | SOIC         | 8    | 64  | 505.46 | 13.94  | 4826   | 6.6    |
| AMC1200SDUB | DUB          | SOP          | 8    | 50  | 532.13 | 13     | 7300   | 6.6    |
| AMC1200SDUB | DUB          | SOP          | 8    | 50  | 532.13 | 13.51  | 7.36   | 6.91   |

## GENERIC PACKAGE VIEW

**DUB 8**

**SOP - 4.85 mm max height**

SMALL OUTLINE PACKAGE



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

4207614/E

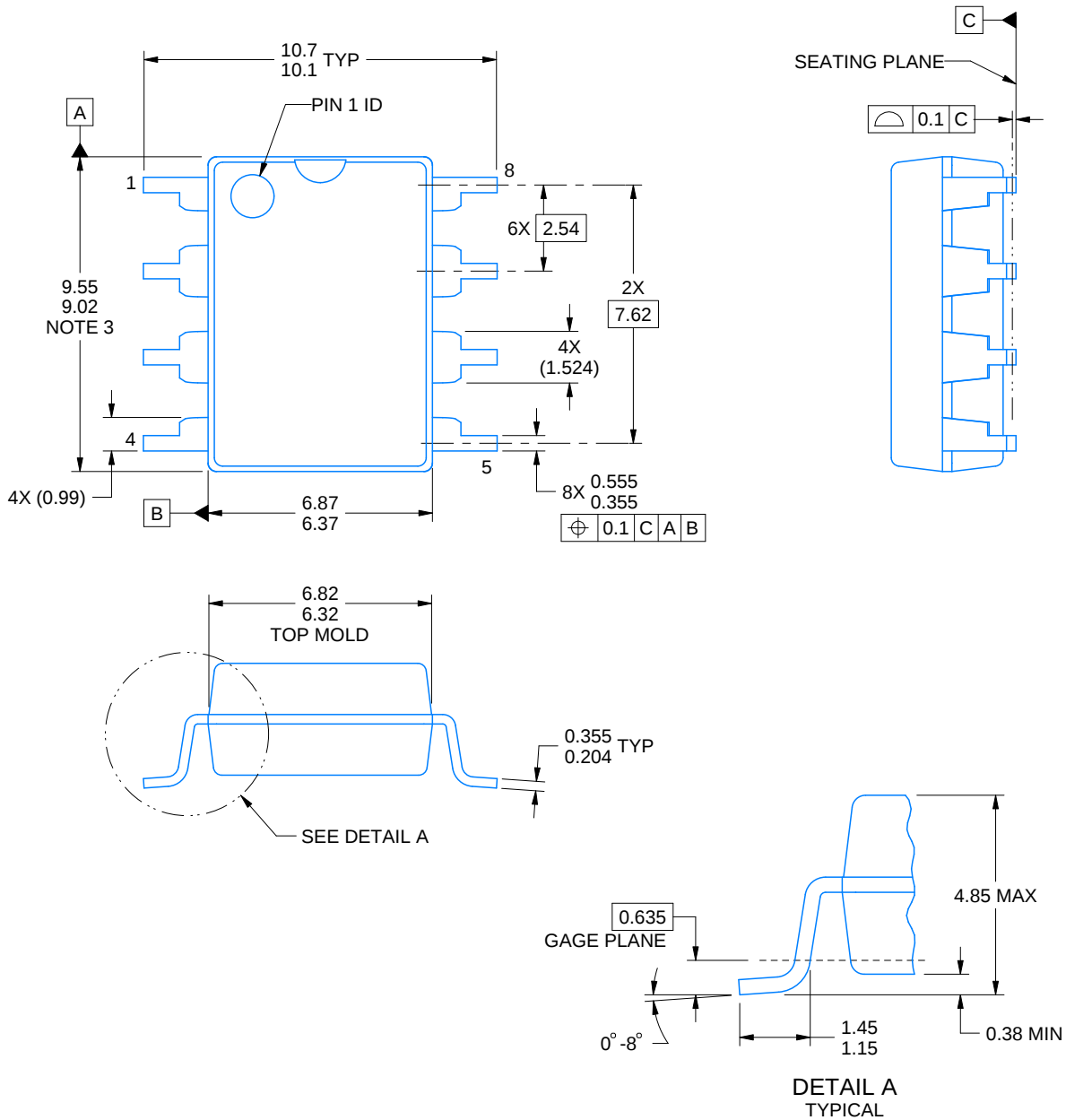
DUB0008A



## PACKAGE OUTLINE

SOP - 4.85 mm max height

SMALL OUTLINE PACKAGE



4222355/G 04/2019

### NOTES:

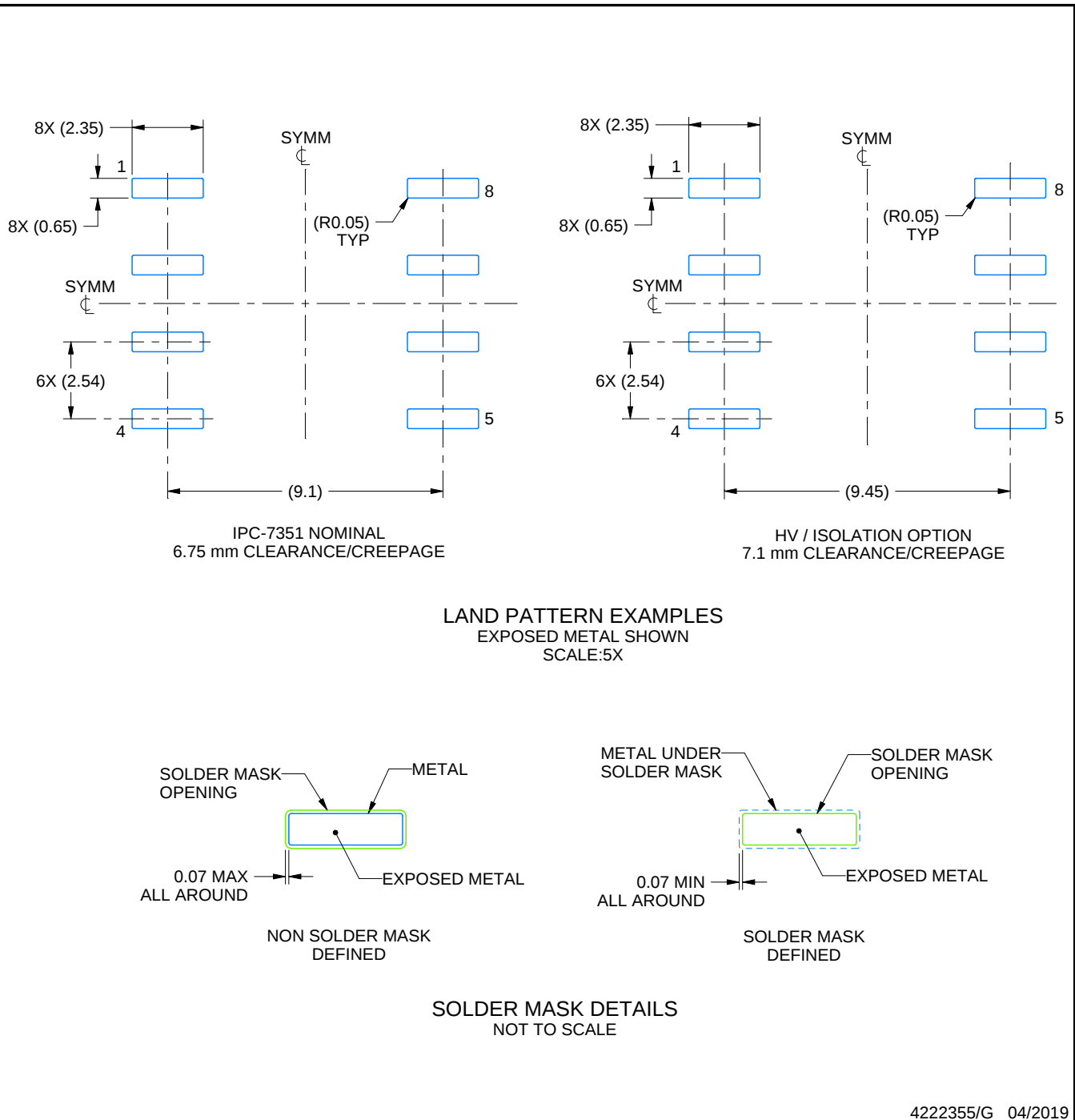
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.254 mm per side.

# EXAMPLE BOARD LAYOUT

DUB0008A

SOP - 4.85 mm max height

SMALL OUTLINE PACKAGE



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NOTES: (continued)

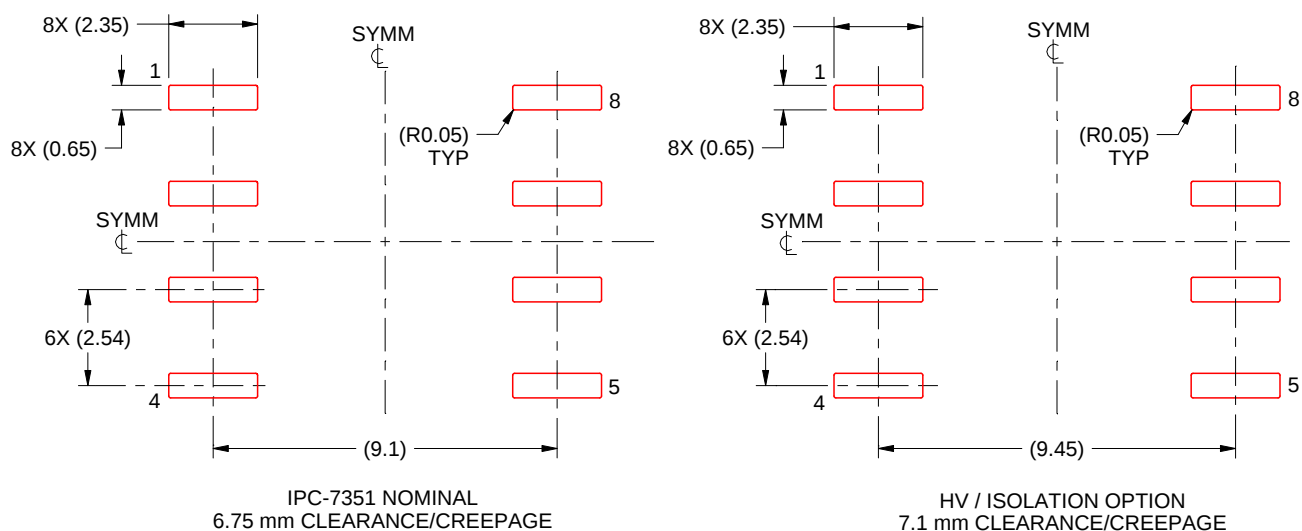
4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DUB0008A

SOP - 4.85 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:5X

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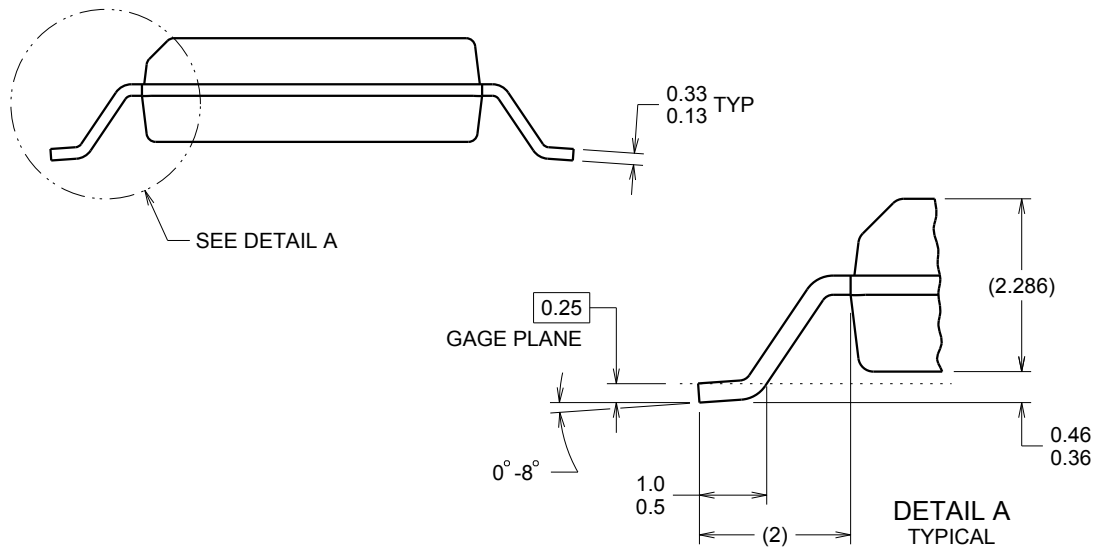
NOTES: (continued)

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

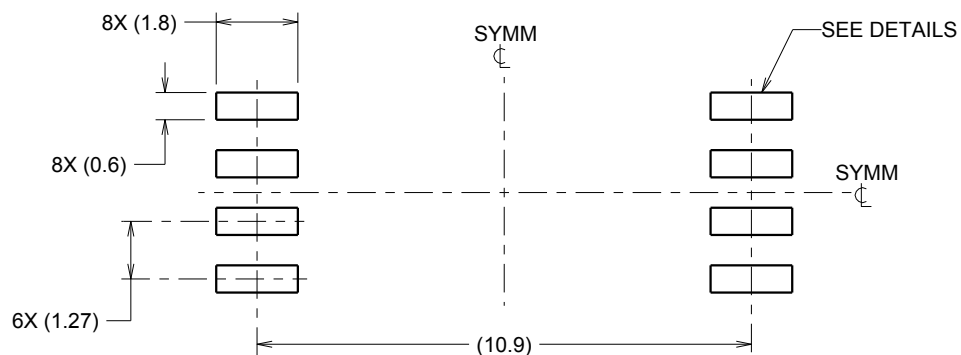


SOIC - 2.8 mm max height

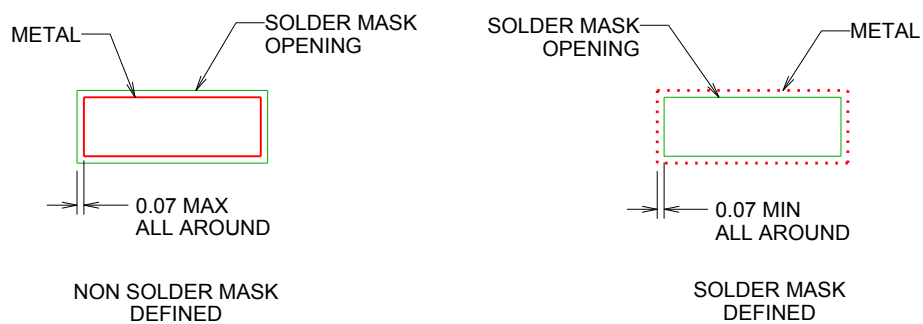
PIN 1 ID AREA  
 11.5 ± 0.25 TYP  
 5.95  
 5.75  
 NOTE 3  
 4  
 8  
 6X 1.27  
 2X 3.81  
 5  
 8X 0.51 0.31  
 7.6  
 7.4  
 NOTE 4  
 A B  
 SEATING PLANE  
 0.1 C  
 2.8 MAX  
 C A S B S  
 0.25 M



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.



**LAND PATTERN EXAMPLE**  
9.1 mm NOMINAL CLEARANCE/CREEPAGE  
SCALE:6X

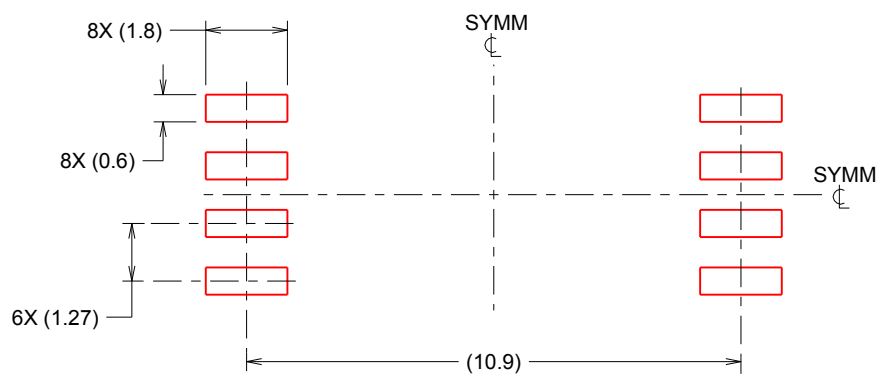


**SOLDER MASK DETAILS**

4218796/A 09/2013

NOTES: (continued)

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



SOLDER PASTE EXAMPLE  
 BASED ON 0.125 mm THICK STENCIL  
 SCALE:6X

4218796/A 09/2013

NOTES: (continued)

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

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