

## LMV1012 Analog Series: Pre-Amplified IC's for High Gain 2-Wire Microphones

Check for Samples: [LMV1012](#)

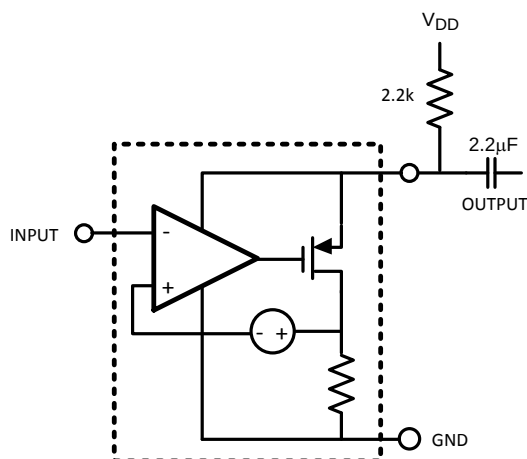
### FEATURES

- Typical LMV1012-15, 2.2V Supply,  $R_L = 2.2\text{ k}\Omega$ ,  $C = 2.2\text{ }\mu\text{F}$ ,  $V_{IN} = 18\text{ mV}_{PP}$ , Unless Otherwise Specified
- Supply Voltage: 2V - 5V
- Supply Current: <180  $\mu\text{A}$
- Signal to Noise Ratio (A-Weighted): 60 dB
- Output Voltage Noise (A-Weighted): -89 dBV
- Total Harmonic Distortion: 0.09%
- Voltage Gain
  - LMV1012-07: 7.8 dB
  - LMV1012-15: 15.6 dB
  - LMV1012-20: 20.9 dB
  - LMV1012-25: 23.8 dB
- Temperature Range: -40°C to 85°C
- Offered in 4-Bump DSBGA Packages

### APPLICATIONS

- Cellular Phones
- Headsets
- Mobile Communications
- Automotive Accessories
- PDAs
- Accessory Microphone Products

### Schematic Diagram



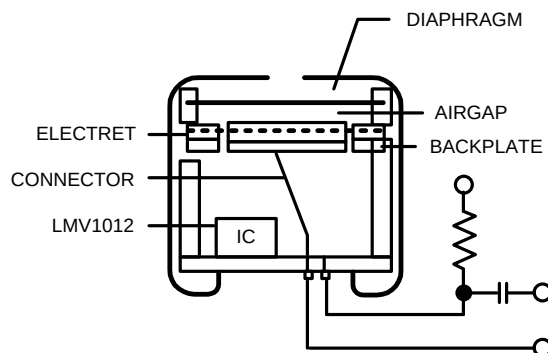
### DESCRIPTION

The LMV1012 is an audio amplifier series for small form factor electret microphones. This 2-wire portfolio is designed to replace the JFET amplifier currently being used. The LMV1012 series is ideally suited for applications requiring high signal integrity in the presence of ambient or RF noise, such as in cellular communications. The LMV1012 audio amplifiers are specified to operate over a 2.2V to 5.0V supply voltage range with fixed gains of 7.8 dB, 15.6 dB, 20.9 dB, and 23.8 dB. The devices offer excellent THD, gain accuracy and temperature stability as compared to a JFET microphone.

The LMV1012 series enables a two-pin electret microphone solution, which provides direct pin-to-pin compatibility with the existing JFET market.

The devices are offered in extremely thin space saving 4-bump DSBGA packages. The LMV1012XP is designed for 1.0 mm canisters and thicker ECM canisters. These extremely miniature packages are designed for electret condenser microphones (ECM) form factor.

### Built-In Gain Electret Microphone



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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.

### Absolute Maximum Ratings<sup>(1)(2)</sup>

|                                     |                                  |                |
|-------------------------------------|----------------------------------|----------------|
| ESD Tolerance <sup>(3)</sup>        | Human Body Model                 | 2500V          |
|                                     | Machine Model                    | 250V           |
| Supply Voltage                      | V <sub>DD</sub> - GND            | 5.5V           |
| Storage Temperature Range           |                                  | -65°C to 150°C |
| Junction Temperature <sup>(4)</sup> |                                  | 150°C max      |
| Mounting Temperature                | Infrared or Convection (20 sec.) | 235°C          |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the [5V Electrical Characteristics](#).
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
- (3) Human Body Model (HBM) is 1.5 kΩ in series with 100 pF.
- (4) The 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 ambient temperature is P<sub>D</sub> = (T<sub>J(MAX)</sub> - T<sub>A</sub>)/θ<sub>JA</sub>. All numbers apply for packages soldered directly into a PC board.

### Operating Ratings<sup>(1)</sup>

|                   |               |
|-------------------|---------------|
| Supply Voltage    | 2V to 5V      |
| Temperature Range | -40°C to 85°C |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the [5V Electrical Characteristics](#).

## 2.2V Electrical Characteristics<sup>(1)</sup>

Unless otherwise specified, all limits are specified for  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 2.2\text{V}$ ,  $V_{IN} = 18\text{ mV}$ ,  $R_L = 2.2\text{ k}\Omega$  and  $C = 2.2\text{ }\mu\text{F}$ .

**Boldface** limits apply at the temperature extremes.

| Symbol     | Parameter                     | Conditions                                                   |            | Min <sup>(2)</sup>  | Typ <sup>(3)</sup> | Max <sup>(2)</sup>  | Units            |
|------------|-------------------------------|--------------------------------------------------------------|------------|---------------------|--------------------|---------------------|------------------|
| $I_{DD}$   | Supply Current                | $V_{IN} = \text{GND}$                                        | LMV1012-07 |                     | 139                | 250<br><b>300</b>   | $\mu\text{A}$    |
|            |                               |                                                              | LMV1012-15 |                     | 180                | 300<br><b>325</b>   |                  |
|            |                               |                                                              | LMV1012-20 |                     | 160                | 250<br><b>300</b>   |                  |
|            |                               |                                                              | LMV1012-25 |                     | 141                | 250<br><b>300</b>   |                  |
| SNR        | Signal to Noise Ratio         | $f = 1\text{ kHz}$ , $V_{IN} = 18\text{ mV}$ ,<br>A-Weighted | LMV1012-07 |                     | 59                 |                     | dB               |
|            |                               |                                                              | LMV1012-15 |                     | 60                 |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | 61                 |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | 61                 |                     |                  |
| $V_{IN}$   | Max Input Signal              | $f = 1\text{ kHz}$ and THD+N < 1%                            | LMV1012-07 |                     | 170                |                     | $\text{mV}_{PP}$ |
|            |                               |                                                              | LMV1012-15 |                     | 100                |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | 50                 |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | 28                 |                     |                  |
| $V_{OUT}$  | Output Voltage                | $V_{IN} = \text{GND}$                                        | LMV1012-07 | 1.65<br><b>1.54</b> | 1.90               | 2.03<br><b>2.09</b> | V                |
|            |                               |                                                              | LMV1012-15 | 1.54<br><b>1.48</b> | 1.81               | 1.94<br><b>2.00</b> |                  |
|            |                               |                                                              | LMV1012-20 | 1.65<br><b>1.55</b> | 1.85               | 2.03<br><b>2.13</b> |                  |
|            |                               |                                                              | LMV1012-25 | 1.65<br><b>1.49</b> | 1.90               | 2.02<br><b>2.18</b> |                  |
| $f_{LOW}$  | Lower –3dB Roll Off Frequency | $R_{SOURCE} = 50\Omega$                                      |            |                     | 65                 |                     | Hz               |
| $f_{HIGH}$ | Upper –3dB Roll Off Frequency | $R_{SOURCE} = 50\Omega$                                      |            |                     | 95                 |                     | kHz              |
| $e_n$      | Output Noise                  | A-Weighted                                                   | LMV1012-07 |                     | –96                |                     | dBV              |
|            |                               |                                                              | LMV1012-15 |                     | –89                |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | –84                |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | –82                |                     |                  |
| THD        | Total Harmonic Distortion     | $f = 1\text{ kHz}$ ,<br>$V_{IN} = 18\text{ mV}$              | LMV1012-07 |                     | 0.10               |                     | %                |
|            |                               |                                                              | LMV1012-15 |                     | 0.09               |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | 0.12               |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | 0.15               |                     |                  |
| $C_{IN}$   | Input Capacitance             |                                                              |            |                     | 2                  |                     | pF               |
| $Z_{IN}$   | Input Impedance               |                                                              |            |                     | >1000              |                     | G $\Omega$       |
| $A_V$      | Gain                          | $f = 1\text{ kHz}$ ,<br>$R_{SOURCE} = 50\Omega$              | LMV1012-07 | 6.4<br><b>5.5</b>   | 7.8                | 9.5<br><b>10.0</b>  | dB               |
|            |                               |                                                              | LMV1012-15 | 14.0<br><b>13.1</b> | 15.6               | 16.9<br><b>17.5</b> |                  |
|            |                               |                                                              | LMV1012-20 | 19.5<br><b>17.4</b> | 20.9               | 22.0<br><b>23.3</b> |                  |
|            |                               |                                                              | LMV1012-25 | 22.5<br><b>21.4</b> | 23.8               | 25.0<br><b>25.7</b> |                  |

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No specification of parametric performance is indicated in the electrical tables under conditions of internal self-heating where  $T_J > T_A$ .
- (2) All limits are specified by design or statistical analysis.
- (3) Typical values represent the most likely parametric norm.

## 5V Electrical Characteristics<sup>(1)</sup>

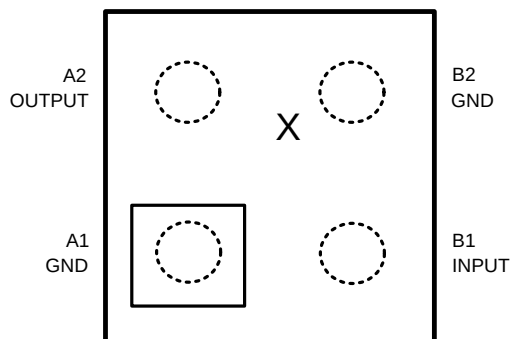
Unless otherwise specified, all limits are specified for  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 5\text{V}$ ,  $V_{IN} = 18\text{ mV}$ ,  $R_L = 2.2\text{ k}\Omega$  and  $C = 2.2\text{ }\mu\text{F}$ .

**Boldface** limits apply at the temperature extremes.

| Symbol     | Parameter                     | Conditions                                                   |            | Min <sup>(2)</sup>  | Typ <sup>(3)</sup> | Max <sup>(2)</sup>  | Units            |
|------------|-------------------------------|--------------------------------------------------------------|------------|---------------------|--------------------|---------------------|------------------|
| $I_{DD}$   | Supply Current                | $V_{IN} = \text{GND}$                                        | LMV1012-07 |                     | 158                | 250<br><b>300</b>   | $\mu\text{A}$    |
|            |                               |                                                              | LMV1012-15 |                     | 200                | 300<br><b>325</b>   |                  |
|            |                               |                                                              | LMV1012-20 |                     | 188                | 260<br><b>310</b>   |                  |
|            |                               |                                                              | LMV1012-25 |                     | 160                | 250<br><b>300</b>   |                  |
| SNR        | Signal to Noise Ratio         | $f = 1\text{ kHz}$ , $V_{IN} = 18\text{ mV}$ ,<br>A-Weighted | LMV1012-07 |                     | 59                 |                     | dB               |
|            |                               |                                                              | LMV1012-15 |                     | 60                 |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | 61                 |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | 61                 |                     |                  |
| $V_{IN}$   | Max Input Signal              | $f = 1\text{ kHz}$ and THD+N < 1%                            | LMV1012-07 |                     | 170                |                     | $\text{mV}_{PP}$ |
|            |                               |                                                              | LMV1012-15 |                     | 100                |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | 55                 |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | 28                 |                     |                  |
| $V_{OUT}$  | Output Voltage                | $V_{IN} = \text{GND}$                                        | LMV1012-07 | 4.45<br><b>4.38</b> | 4.65               | 4.80<br><b>4.85</b> | V                |
|            |                               |                                                              | LMV1012-15 | 4.34<br><b>4.28</b> | 4.56               | 4.74<br><b>4.80</b> |                  |
|            |                               |                                                              | LMV1012-20 | 4.40<br><b>4.30</b> | 4.58               | 4.75<br><b>4.85</b> |                  |
|            |                               |                                                              | LMV1012-25 | 4.45<br><b>4.39</b> | 4.65               | 4.83<br><b>4.86</b> |                  |
| $f_{LOW}$  | Lower –3dB Roll Off Frequency | $R_{SOURCE} = 50\Omega$                                      |            |                     | 67                 |                     | Hz               |
| $f_{HIGH}$ | Upper –3dB Roll Off Frequency | $R_{SOURCE} = 50\Omega$                                      |            |                     | 150                |                     | kHz              |
| $e_n$      | Output Noise                  | A-Weighted                                                   | LMV1012-07 |                     | –96                |                     | dBV              |
|            |                               |                                                              | LMV1012-15 |                     | –89                |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | –84                |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | –82                |                     |                  |
| THD        | Total Harmonic Distortion     | $f = 1\text{ kHz}$ ,<br>$V_{IN} = 18\text{ mV}$              | LMV1012-07 |                     | 0.12               |                     | %                |
|            |                               |                                                              | LMV1012-15 |                     | 0.13               |                     |                  |
|            |                               |                                                              | LMV1012-20 |                     | 0.18               |                     |                  |
|            |                               |                                                              | LMV1012-25 |                     | 0.21               |                     |                  |
| $C_{IN}$   | Input Capacitance             |                                                              |            |                     | 2                  |                     | pF               |
| $Z_{IN}$   | Input Impedance               |                                                              |            |                     | >1000              |                     | G $\Omega$       |
| $A_V$      | Gain                          | $f = 1\text{ kHz}$ ,<br>$R_{SOURCE} = 50\Omega$              | LMV1012-07 | 6.4<br><b>5.5</b>   | 8.1                | 9.5<br><b>10.7</b>  | dB               |
|            |                               |                                                              | LMV1012-15 | 14.0<br><b>13.1</b> | 15.6               | 16.9<br><b>17.5</b> |                  |
|            |                               |                                                              | LMV1012-20 | 19.2<br><b>17.0</b> | 21.1               | 22.3<br><b>23.5</b> |                  |
|            |                               |                                                              | LMV1012-25 | 22.5<br><b>21.2</b> | 23.9               | 25.0<br><b>25.8</b> |                  |

- (1) Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No specification of parametric performance is indicated in the electrical tables under conditions of internal self-heating where  $T_J > T_A$ .
- (2) All limits are specified by design or statistical analysis.
- (3) Typical values represent the most likely parametric norm.

### Connection Diagram



**4-Bump DSBGA (Top View)**

#### NOTE

Pin numbers are referenced to package marking text orientation.

The actual physical placement of the package marking will vary slightly from part to part. The package will designate the date code and will vary considerably. Package marking does not correlate to device type in any way.

## Typical Performance Characteristics

Unless otherwise specified,  $V_S = 2.2V$ ,  $R_L = 2.2\text{ k}\Omega$ ,  $C = 2.2\text{ }\mu\text{F}$ , single supply,  $T_A = 25^\circ\text{C}$

Supply Current vs. Supply Voltage (LMV1012-07)

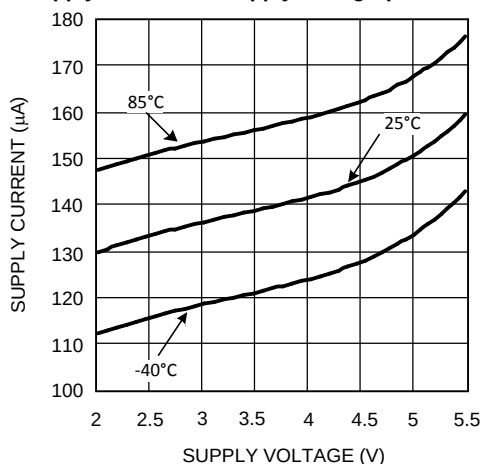


Figure 1.

Supply Current vs. Supply Voltage (LMV1012-15)

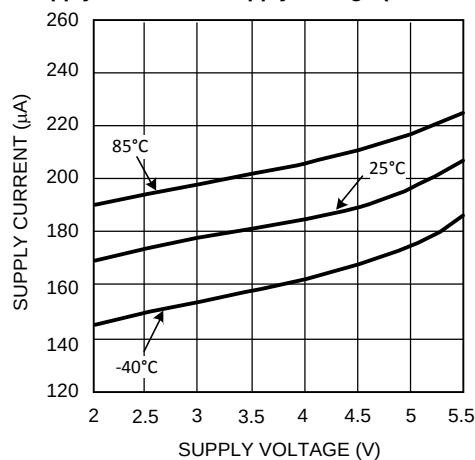


Figure 2.

Supply Current vs. Supply Voltage (LMV1012-20)

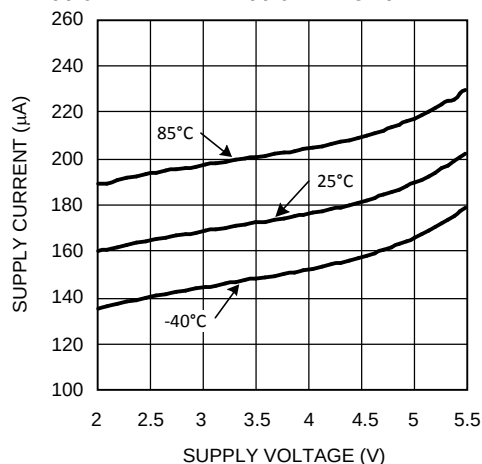


Figure 3.

Supply Current vs. Supply Voltage (LMV1012-25)

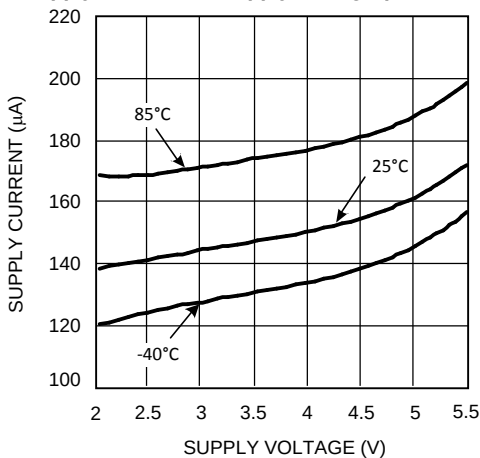


Figure 4.

Gain and Phase vs. Frequency (LMV1012-07)

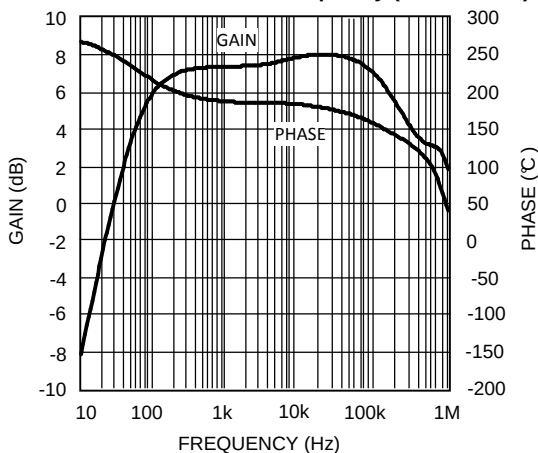


Figure 5.

Gain and Phase vs. Frequency (LMV1012-15)

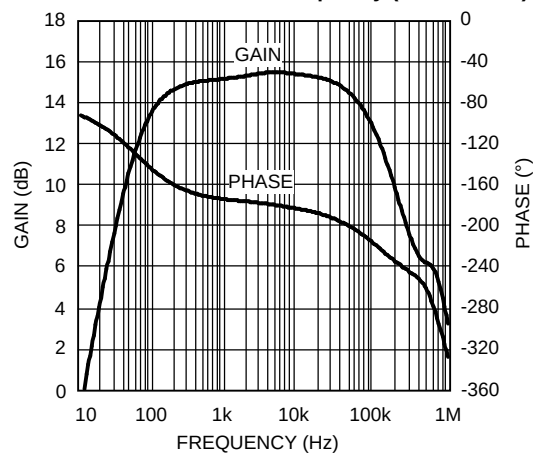


Figure 6.

## Typical Performance Characteristics (continued)

Unless otherwise specified,  $V_S = 2.2\text{V}$ ,  $R_L = 2.2\text{ k}\Omega$ ,  $C = 2.2\text{ }\mu\text{F}$ , single supply,  $T_A = 25^\circ\text{C}$

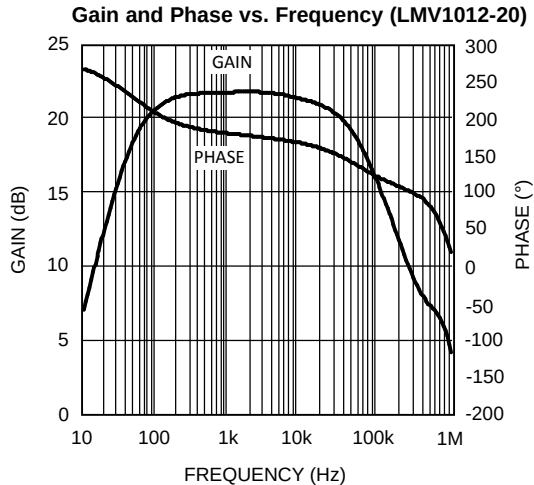


Figure 7.

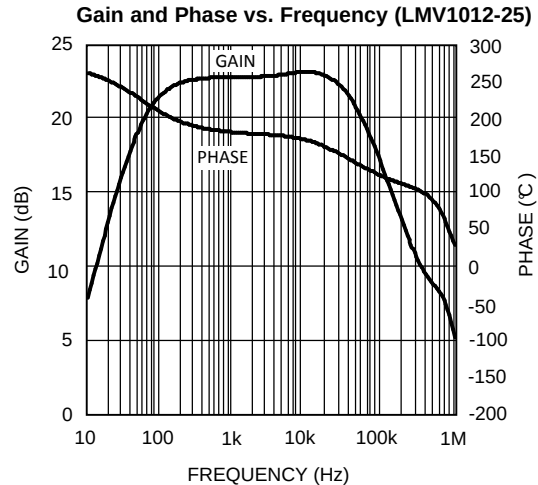


Figure 8.

**Total Harmonic Distortion vs. Frequency (LMV1012-07)**

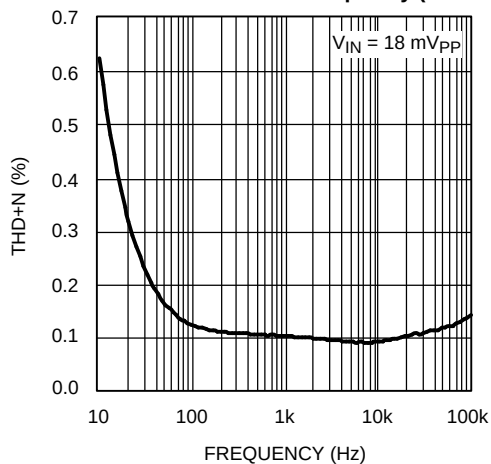


Figure 9.

**Total Harmonic Distortion vs. Frequency (LMV1012-15)**

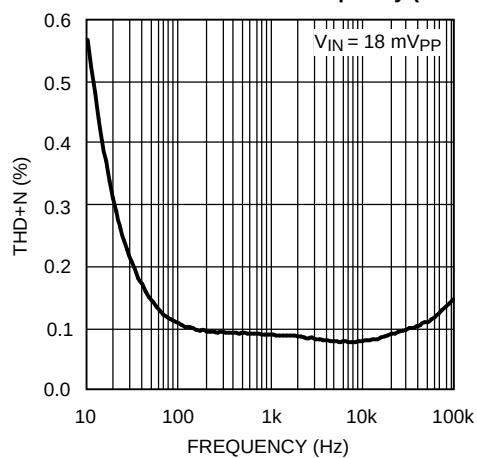


Figure 10.

**Total Harmonic Distortion vs. Frequency (LMV1012-20)**

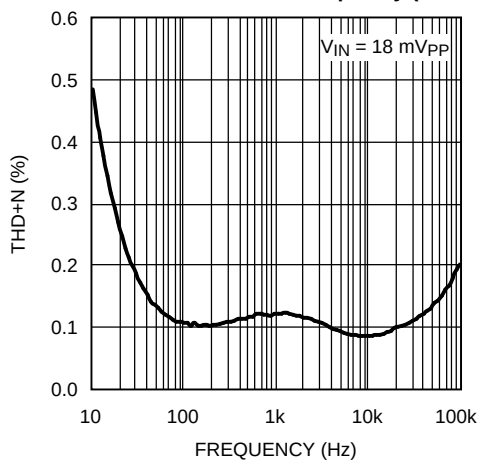


Figure 11.

**Total Harmonic Distortion vs. Frequency (LMV1012-25)**

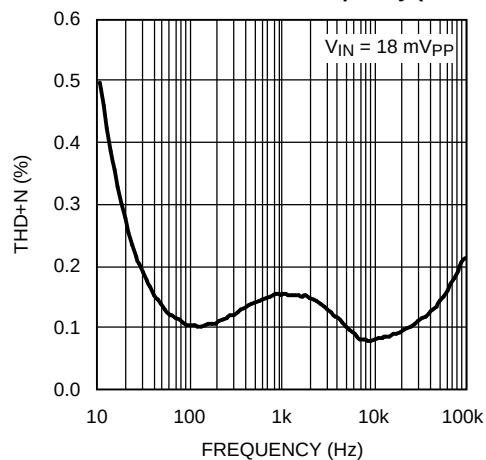
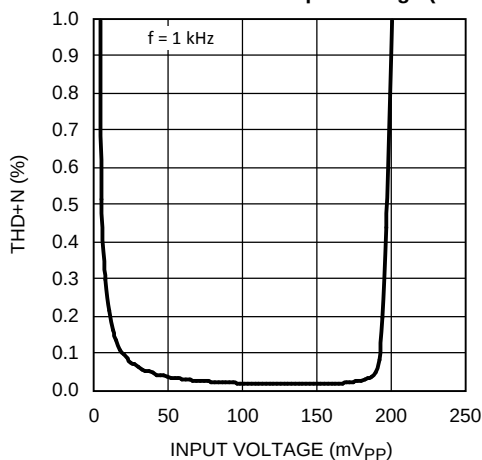


Figure 12.

## Typical Performance Characteristics (continued)

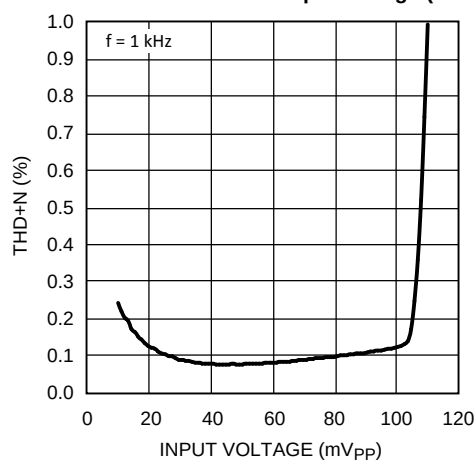
Unless otherwise specified,  $V_S = 2.2\text{V}$ ,  $R_L = 2.2\text{ k}\Omega$ ,  $C = 2.2\text{ }\mu\text{F}$ , single supply,  $T_A = 25^\circ\text{C}$

**Total Harmonic Distortion vs. Input Voltage (LMV1012-07)**



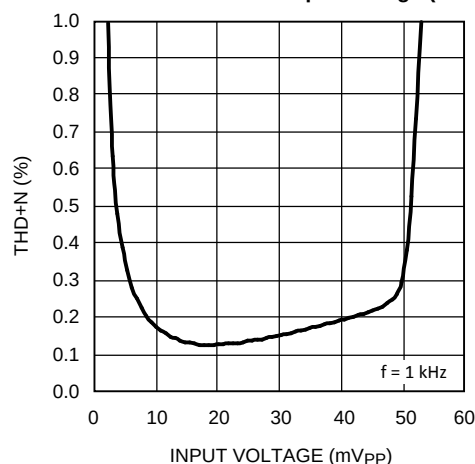
**Figure 13.**

**Total Harmonic Distortion vs. Input Voltage (LMV1012-15)**



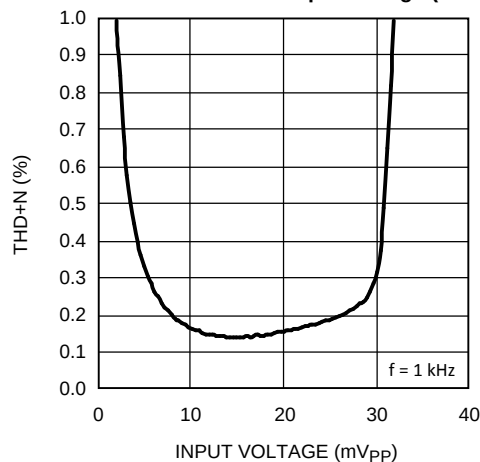
**Figure 14.**

**Total Harmonic Distortion vs. Input Voltage (LMV1012-20)**



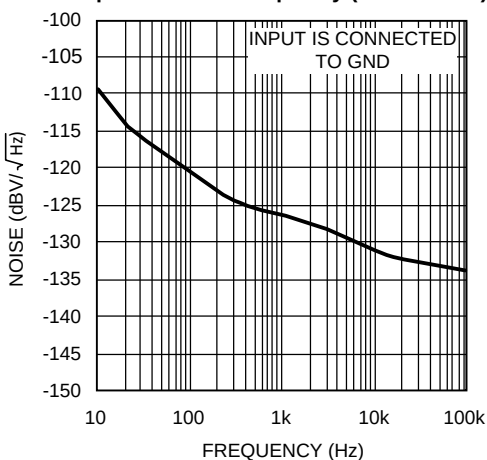
**Figure 15.**

**Total Harmonic Distortion vs. Input Voltage (LMV1012-25)**



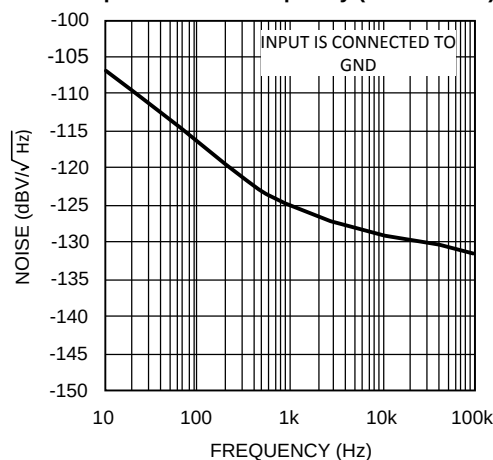
**Figure 16.**

**Output Noise vs. Frequency (LMV1012-07)**



**Figure 17.**

**Output Noise vs. Frequency (LMV1012-15)**

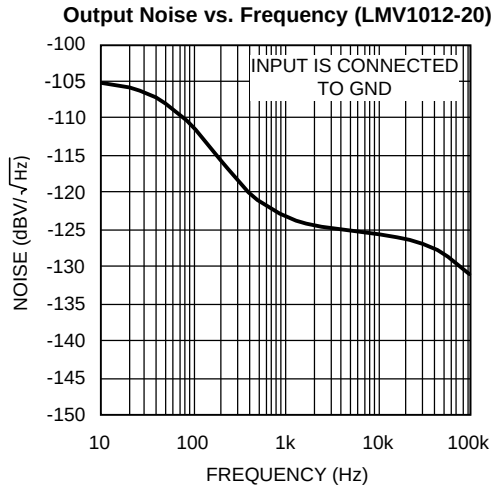


**Figure 18.**

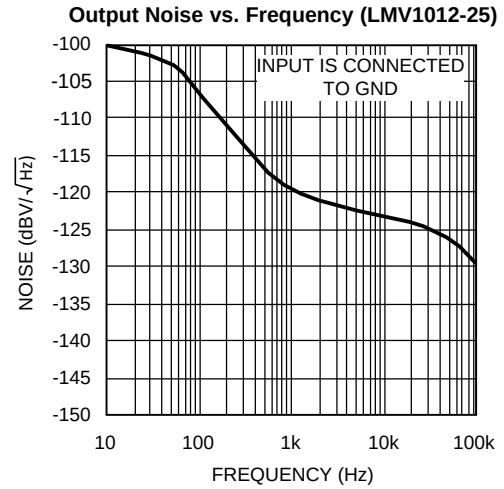


## Typical Performance Characteristics (continued)

Unless otherwise specified,  $V_S = 2.2\text{V}$ ,  $R_L = 2.2\text{ k}\Omega$ ,  $C = 2.2\text{ }\mu\text{F}$ , single supply,  $T_A = 25^\circ\text{C}$



**Figure 19.**



**Figure 20.**

## APPLICATION SECTION

### HIGH GAIN

The LMV1012 series provides outstanding gain versus the JFET and still maintains the same ease of implementation, with improved gain, linearity and temperature stability. A high gain eliminates the need for extra external components.

### BUILT IN GAIN

The LMV1012 is offered in 0.3 mm height space saving small 4-pin DSBGA packages in order to fit inside the different size ECM canisters of a microphone. The LMV1012 is placed on the PCB inside the microphone.

The bottom side of the PCB usually shows a bull's eye pattern where the outer ring, which is shorted to the metal can, should be connected to the ground. The center dot on the PCB is connected to the  $V_{DD}$  through a resistor. This phantom biasing allows both supply voltage and output signal on one connection.

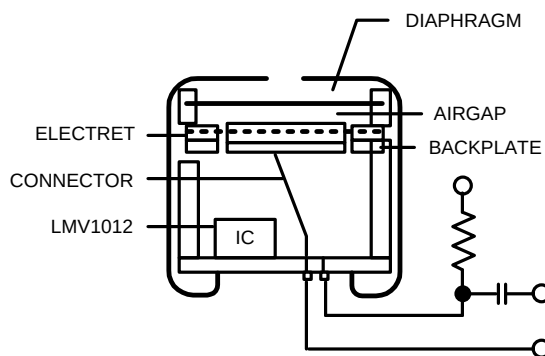


Figure 21. Built in Gain

### A-WEIGHTED FILTER

The human ear has a frequency range from 20 Hz to about 20 kHz. Within this range the sensitivity of the human ear is not equal for each frequency. To approach the hearing response weighting filters are introduced. One of those filters is the A-weighted filter.

The A-weighted filter is usually used in signal to noise ratio measurements, where sound is compared to device noise. This filter improves the correlation of the measured data to the signal to noise ratio perceived by the human ear.

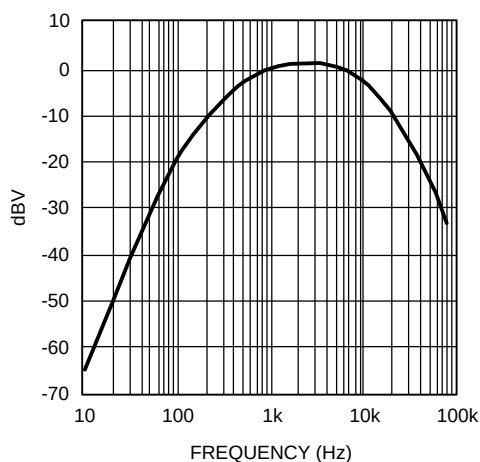
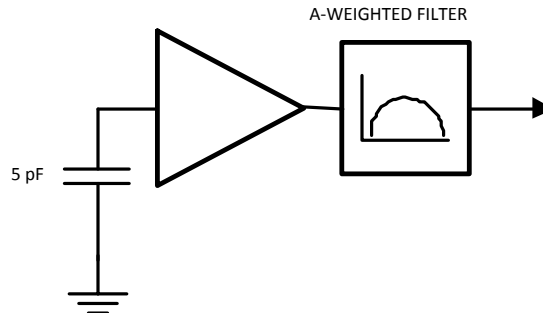


Figure 22. A-Weighted Filter

## MEASURING NOISE AND SNR

The overall noise of the LMV1012 is measured within the frequency band from 10 Hz to 22 kHz using an A-weighted filter. The input of the LMV1012 is connected to ground with a 5 pF capacitor, as in Figure 23. Special precautions in the internal structure of the LMV1012 have been taken to reduce the noise on the output.



**Figure 23. Noise Measurement Setup**

The signal to noise ratio (SNR) is measured with a 1 kHz input signal of 18 mV<sub>pp</sub> using an A-weighted filter. This represents a sound pressure level of 94 dB SPL. No input capacitor is connected for the measurement.

## SOUND PRESSURE LEVEL

The volume of sound applied to a microphone is usually stated as a pressure level referred to the threshold of hearing of the human ear. The sound pressure level (SPL) in decibels is defined by:

$$\text{Sound pressure level (dB)} = 20 \log P_m/P_o$$

where

- $P_m$  is the measured sound pressure
- $P_o$  is the threshold of hearing (20  $\mu$ Pa).

(1)

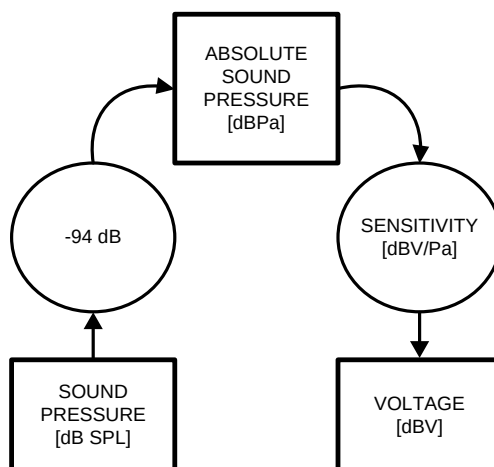
In order to be able to calculate the resulting output voltage of the microphone for a given SPL, the sound pressure in dB SPL needs to be converted to the absolute sound pressure in dBPa. This is the sound pressure level in decibels referred to 1 Pascal (Pa).

The conversion is given by:

$$\text{dBPa} = \text{dB SPL} + 20 \log 20 \mu\text{Pa} \quad (2)$$

$$\text{dBPa} = \text{dB SPL} - 94 \text{ dB} \quad (3)$$

Translation from absolute sound pressure level to a voltage is specified by the sensitivity of the microphone. A conventional microphone has a sensitivity of -44 dBV/Pa.



**Figure 24. dB SPL to dBV Conversion**

Example: Busy traffic is 70 dB SPL

$$V_{OUT} = 70 - 94 - 44 = -68 \text{ dBV}$$

(4)

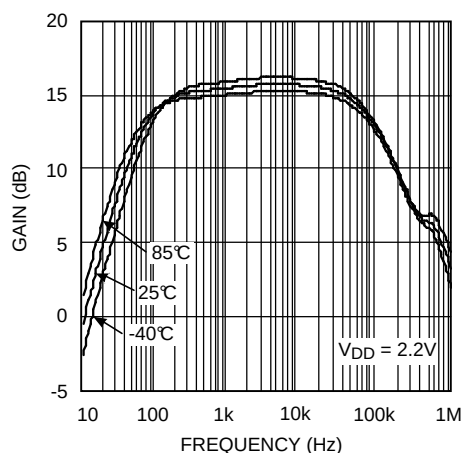
This is equivalent to 1.13 mV<sub>PP</sub>

Since the LMV1012-15 has a gain of 6 (15.6 dB) over the JFET, the output voltage of the microphone is 6.78 mV<sub>PP</sub>. By implementing the LMV1012-15, the sensitivity of the microphone is -28.4 dBV/Pa (-44 + 15.6).

## LOW FREQUENCY CUT OFF FILTER

To reduce noise on the output of the microphone a low frequency cut off filter has been implemented. This filter reduces the effect of wind and handling noise.

It's also helpful to reduce the proximity effect in directional microphones. This effect occurs when the sound source is very close to the microphone. The lower frequencies are amplified which gives a bass sound. This amplification can cause an overload, which results in a distortion of the signal.



**Figure 25. LMV1012-15 Gain vs. Frequency Over Temperature**

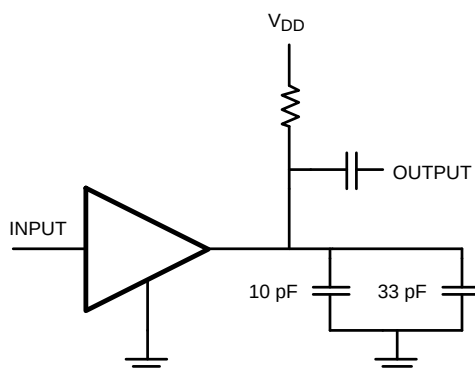
The LMV1012 is optimized to be used in audio band applications. By using the LMV1012, the gain response is flat within the audio band and has linearity and temperature stability (see [Figure 25](#)).

## NOISE

Noise pick-up by a microphone in cell phones is a well-known problem. A conventional JFET circuit is sensitive for noise pick-up because of its high output impedance, which is usually around 2.2 k $\Omega$ .

RF noise is amongst other caused by non-linear behavior. The non-linear behavior of the amplifier at high frequencies, well above the usable bandwidth of the device, causes AM-demodulation of high frequency signals. The AM modulation contained in such signals folds back into the audio band, thereby disturbing the intended microphone signal. The GSM signal of a cell phone is such an AM-modulated signal. The modulation frequency of 216 Hz and its harmonics can be observed in the audio band. This kind of noise is called bumblebee noise.

RF noise caused by a GSM signal can be reduced by connecting two external capacitors to ground, see [Figure 26](#). One capacitor reduces the noise caused by the 900 MHz carrier and the other reduces the noise caused by 1800/1900 MHz.



**Figure 26. RF Noise Reduction**

## REVISION HISTORY

| Changes from Revision G (May 2013) to Revision H           | Page               |
|------------------------------------------------------------|--------------------|
| • Changed layout of National Data Sheet to TI format ..... | <a href="#">13</a> |

## 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="#">LMV1012TP-25/NOPB</a>  | Active        | Production           | DSBGA (YPB)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -            |                     |
| LMV1012TP-25/NOPB.A                | Active        | Production           | DSBGA (YPB)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| <a href="#">LMV1012TPX-15/NOPB</a> | Active        | Production           | DSBGA (YPB)   4 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| LMV1012TPX-15/NOPB.A               | Active        | Production           | DSBGA (YPB)   4 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| <a href="#">LMV1012TPX-25/NOPB</a> | Active        | Production           | DSBGA (YPB)   4 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| LMV1012TPX-25/NOPB.A               | Active        | Production           | DSBGA (YPB)   4 | 3000   LARGE T&R      | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| <a href="#">LMV1012UP-07/NOPB</a>  | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -            |                     |
| LMV1012UP-07/NOPB.A                | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| <a href="#">LMV1012UP-15/NOPB</a>  | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -            |                     |
| LMV1012UP-15/NOPB.A                | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| <a href="#">LMV1012UP-20/NOPB</a>  | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -            |                     |
| LMV1012UP-20/NOPB.A                | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |
| <a href="#">LMV1012UP-25/NOPB</a>  | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -            |                     |
| LMV1012UP-25/NOPB.A                | Active        | Production           | DSBGA (YPC)   4 | 250   SMALL T&R       | Yes         | SNAGCU                               | Level-1-260C-UNLIM                | -40 to 85    |                     |

<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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## 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 |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LMV1012TP-25/NOPB  | DSBGA        | YPB             | 4    | 250  | 178.0              | 8.4                | 1.02    | 1.09    | 0.66    | 4.0     | 8.0    | Q1            |
| LMV1012TPX-15/NOPB | DSBGA        | YPB             | 4    | 3000 | 178.0              | 8.4                | 1.02    | 1.09    | 0.66    | 4.0     | 8.0    | Q1            |
| LMV1012TPX-25/NOPB | DSBGA        | YPB             | 4    | 3000 | 178.0              | 8.4                | 1.02    | 1.09    | 0.66    | 4.0     | 8.0    | Q1            |
| LMV1012UP-07/NOPB  | DSBGA        | YPC             | 4    | 250  | 178.0              | 8.4                | 1.02    | 1.09    | 0.56    | 4.0     | 8.0    | Q1            |
| LMV1012UP-15/NOPB  | DSBGA        | YPC             | 4    | 250  | 178.0              | 8.4                | 1.02    | 1.09    | 0.56    | 4.0     | 8.0    | Q1            |
| LMV1012UP-20/NOPB  | DSBGA        | YPC             | 4    | 250  | 178.0              | 8.4                | 1.02    | 1.09    | 0.56    | 4.0     | 8.0    | Q1            |
| LMV1012UP-25/NOPB  | DSBGA        | YPC             | 4    | 250  | 178.0              | 8.4                | 1.02    | 1.09    | 0.56    | 4.0     | 8.0    | Q1            |

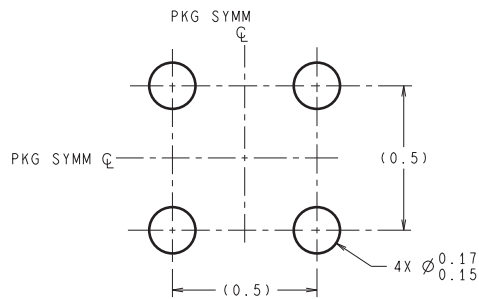
## TAPE AND REEL BOX DIMENSIONS



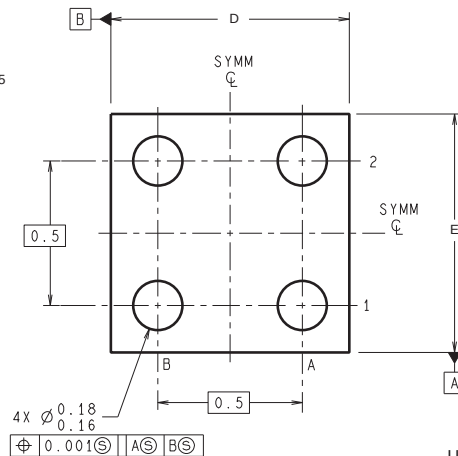
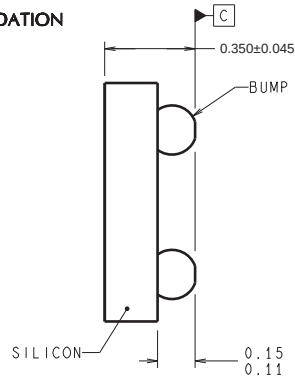
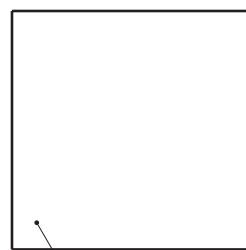
\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LMV1012TP-25/NOPB  | DSBGA        | YPB             | 4    | 250  | 208.0       | 191.0      | 35.0        |
| LMV1012TPX-15/NOPB | DSBGA        | YPB             | 4    | 3000 | 208.0       | 191.0      | 35.0        |
| LMV1012TPX-25/NOPB | DSBGA        | YPB             | 4    | 3000 | 208.0       | 191.0      | 35.0        |
| LMV1012UP-07/NOPB  | DSBGA        | YPC             | 4    | 250  | 208.0       | 191.0      | 35.0        |
| LMV1012UP-15/NOPB  | DSBGA        | YPC             | 4    | 250  | 208.0       | 191.0      | 35.0        |
| LMV1012UP-20/NOPB  | DSBGA        | YPC             | 4    | 250  | 208.0       | 191.0      | 35.0        |
| LMV1012UP-25/NOPB  | DSBGA        | YPC             | 4    | 250  | 208.0       | 191.0      | 35.0        |

YPC0004



**DIMENSIONS ARE IN MILLIMETERS**  
 DIMENSIONS IN ( ) FOR REFERENCE ONLY

**LAND PATTERN RECOMMENDATION**

UPA04XXX (Rev C)

D: Max = 1.057 mm, Min = 0.996 mm

E: Max = 0.981 mm, Min = 0.92 mm

4215139/A 12/12

NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.  
 B. This drawing is subject to change without notice.

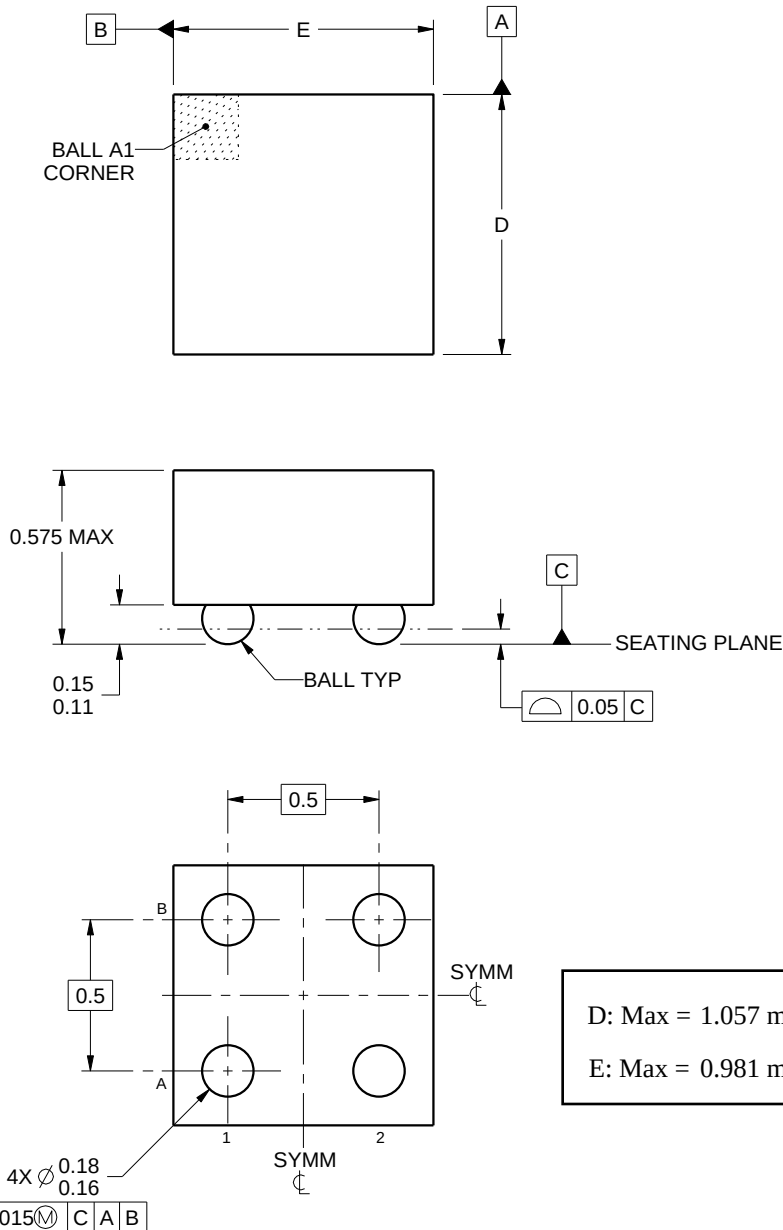


YPB0004

# PACKAGE OUTLINE

DSBGA - 0.575 mm max height

DIE SIZE BALL GRID ARRAY



4215097/B 07/2016

## NOTES:

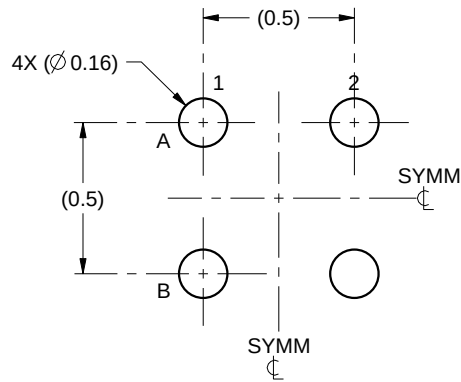
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

# EXAMPLE BOARD LAYOUT

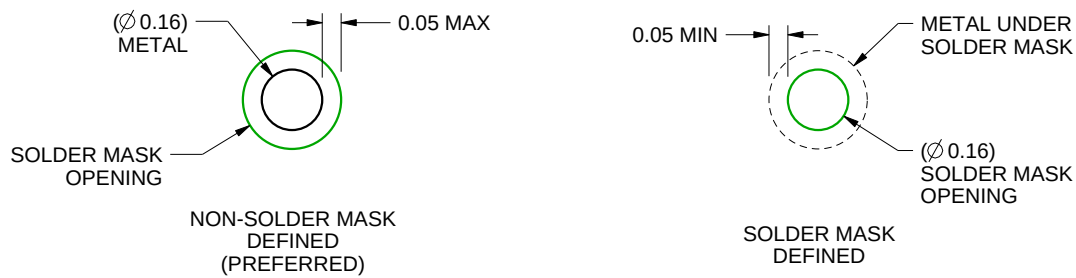
YPB0004

DSBGA - 0.575 mm max height

DIE SIZE BALL GRID ARRAY



LAND PATTERN EXAMPLE  
SCALE:40X



SOLDER MASK DETAILS  
NOT TO SCALE

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NOTES: (continued)

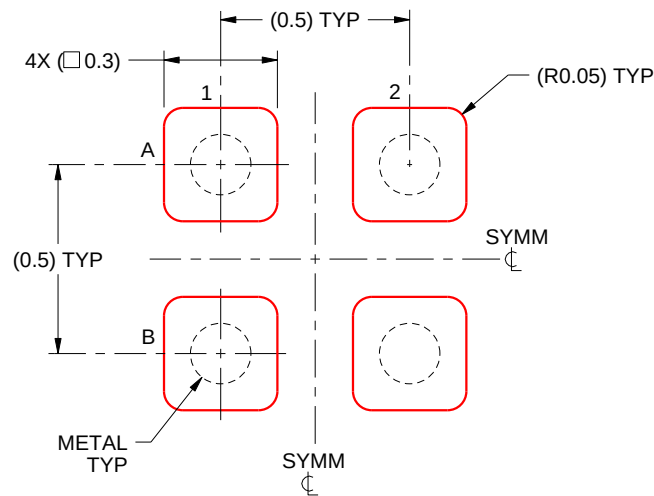
3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.  
See Texas Instruments Literature No. SNVA009 ([www.ti.com/lit/snva009](http://www.ti.com/lit/snva009)).

# EXAMPLE STENCIL DESIGN

YPB0004

DSBGA - 0.575 mm max height

DIE SIZE BALL GRID ARRAY



SOLDER PASTE EXAMPLE  
BASED ON 0.125mm THICK STENCIL  
SCALE:50X

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NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

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