LMH6702QML-SP 1.7GHz、超低歪、広帯域オペアンプ

1 特長

- V_S = ±5V、T_A = 25°C、A_V = +2V/V、R_L = 100Ω、V_{OUT} = $2V_{PP}$、特に記載のない限り標準値
- 放射線耐性ありで供給可能
  - 高線量率 300krad(Si)
  - ELDRS フリー 300krad(Si)
- -3dB 帯域幅 (V_{OUT} = $0.2V_{PP}$) 720MHz
- 低ノイズ:1.83nV/√Hz
- 速いセトリング:0.1% まで 13.4ns
- 速いスルーレート:3100V/µs
- 消費電流:12.5mA
- 出力電流:80mA
- 低相互変調歪み (75MHz):-67dBc
- CLC409 および CLC449 の改良代替製品

2 アプリケーション

- フラッシュ A/D ドライバ
- D/A トランスインピーダンス バッファ
- 広いダイナミック レンジの IF アンプ
- レーダ / 通信用受信機
- ライン ドライバ
- 高解像度ビデオ

3 概要

LMH6702QML-SP は、非常に帯域幅の広い DC 結合モノリシック オペアンプであり、優れた信号忠実度を必要とするダイナミック レンジの広いシステム用に設計されています。テキサス・インスツルメンツの電流帰還型アーキテクチャを活かして、LMH6702QML-SP は、外部での補償の必要なしに非常に高速な動作とユニティ ゲイン安定性を実現します。

720MHz 帯域幅 (A_V = 2V/V、V_O = $2V_{PP}$)、60MHz で 10 ビットの歪みレベル (R_L = 100Ω)、1.83nV/√Hz の入力換算ノイズ、12.5mA の消費電流を実現した LMH6702QML-SP は、高速フラッシュ A/D および D/A コンバータの優れたドライバまたはバッファです。

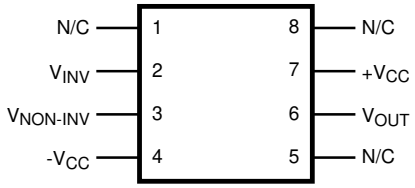
LMH6702QML-SP は、レーダーや通信用受信機など、非常に優れた信号純度を提供する広帯域アンプを必要とする、ダイナミック レンジの広いシステムに適しています。入力換算ノイズが低く、高調波および相互変調歪みが小さいので、このデバイスは高速アプリケーションに最適です。

LMH6702QML-SP は、テキサス・インスツルメンツの VIP10 相補型バイポーラ プロセスと、テキサス・インスツルメンツの実績ある電流帰還アーキテクチャを使用して構築されています。

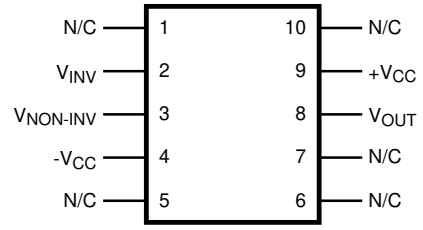
パッケージ情報

部品番号	パッケージ (1)	パッケージ サイズ(2)
LMH6702QML-SP	NAB (CDIP、8)	10.16mm × 7.87 mm
	NAC (CFP、10)	9.91mm × 6.45 mm

(1) 詳細については、セクション 9 を参照してください。
(2) パッケージ サイズ (長さ × 幅) は公称値であり、該当する場合はピンも含まれます。



NAB パッケージ、8 ピン CDIP (上面図)



NAC パッケージ、10 ピン CLGA (上面図)

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4 Pin Configuration and Functions

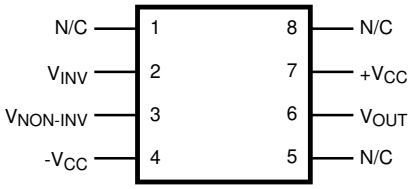

図 4-1. NAB Package, 8-Pin CDIP (Top View)

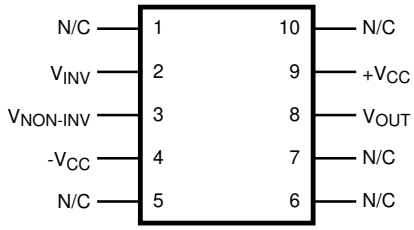

図 4-2. NAC Package, 10-Pin CLGA (Top View)

5 Specifications

5.1 Absolute Maximum Ratings

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

	VALUE
Supply voltage (V_{CC})	±6.75V_{DC}
Common-mode input voltage (V_{CM})	V^- to V^+
Power dissipation (P_D) (2)	1W
Junction temperature (T_J)	175°C
Lead temperature (soldering, 10 seconds)	300°C
Storage temperature	–65°C ≤ T_A ≤ +150°C
Thermal resistance	
θ_{JA}	
CDIP (still air)	170°C/W
CDIP (500LF/min air flow)	100°C/W
CLGA (still air)	220°C/W
CLGA (500LF/min air flow)	150°C/W
θ_{JC}	
CDIP	35°C/W
CLGA	37°C/W
Package weight (typical)	
CDIP	1078mg
CLGA	227mg
ESD tolerance (3)	1000V

(1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

(2) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} – T_A) / \theta_{JA}$ or the number given in the *Absolute Maximum Ratings*, whichever is lower.

(3) Human body model, 1.5kΩ in series with 100pF.

5.2 Recommended Operating Conditions

	VALUE
Supply voltage (V_{CC})	±5V_{DC} to ±6V_{DC}
Gain	±1 to ±10
Ambient operating temperature (T_A)	–55°C to +125°C

5.3 Quality Conformance Inspection

MIL-STD-883, Method 5005, Group A

SUBGROUP	DESCRIPTION	TEMPERATURE (°C)
1	Static tests at	25
2	Static tests at	125
3	Static tests at	–55
4	Dynamic tests at	25
5	Dynamic tests at	125
6	Dynamic tests at	–55
7	Functional tests at	25
8A	Functional tests at	125
8B	Functional tests at	–55
9	Switching tests at	25
10	Switching tests at	125
11	Switching tests at	–55

5.4 Electrical Characteristics: DC Parameters

The following conditions apply (unless otherwise specified)(1) (2):
R_L = 100Ω, V_{CC} = ±5V_{DC}, A_V = +2 feedback resistor (R_F) = 250Ω, gain resistor (R_G) = 250Ω

PARAMETER		TEST CONDITIONS	NOTES	MIN	MAX	UNIT	SUB-GROUPS
I_{BN}	Input bias current, noninverting			–15	15	µA	1, 2
				–21	21	µA	3
I_{BI}	Input bias current, inverting			–30	30	µA	1, 2
				–34	34	µA	3
V_{IO}	Input offset voltage			–4.5	4.5	mV	1, 3
				–6.0	6.0	mV	2
I_{CC}	Supply current, no load	R_L = ∞			15	mA	1, 2, 3
PSSR	Power supply rejection ratio	$-V_{CC}$ = –4.5V to –5.0V, $+V_{CC}$ = 4.5V to 5.0V		45		dB	1, 2, 3

(1) The algebraic convention, whereby the most negative value is a minimum and most positive is a maximum, is used in this table. Negative current shall be defined as conventional current flow out of a device terminal.
(2) Pre- and post-irradiation limits are identical to those listed under the dc parameter tables. Post-irradiation testing is conducted at room temperature, 25°C, only. Testing is performed as specified in MIL-STD-883 Test Method 1019 Condition A. The ELDRS-Free part is also tested per Test Method 1019 Conditions D.

5.5 Electrical Characteristics: AC Parameters

The following conditions apply (unless otherwise specified)(1) (2):
R_L = 100Ω, V_{CC} = ±5V_{DC}, A_V = +2 feedback resistor (R_F) = 250Ω, gain resistor (R_G) = 250Ω

PARAMETER		TEST CONDITIONS	NOTES	MIN	MAX	UNIT	SUB-GROUPS
HD_3	3rd harmonic distortion	$2V_{PP}$ at 20MHz			–62	dBc	4
GFPL	Gain flatness peaking	0.1MHz to 75MHz, $V_O < 0.5V_{PP}$			0.4	dB	4
GFPH	Gain flatness peaking	> 75MHz, $V_O < 0.5V_{PP}$			2.0	dB	4
GFRH	Gain flatness rolloff	75MHz to 125MHz, $V_O < 0.5V_{PP}$			0.2	dB	4
HD_2	2nd harmonic distortion	$2V_{PP}$ at 20MHz			–52	dBc	4

(1) The algebraic convention, whereby the most negative value is a minimum and most positive is a maximum, is used in this table. Negative current shall be defined as conventional current flow out of a device terminal.
(2) These parameters are not post irradiation tested.

5.6 Electrical Characteristics: Drift Values Parameters

The following conditions apply (unless otherwise specified)(1):
R_L = 100Ω, V_{CC} = ±5V_{DC}, A_V = +2 feedback resistor (R_F) = 250Ω, gain resistor (R_G) = 250Ω
Delta not required on B level product. Delta required for S-level product at Group B5 only, or as specified on the internal processing instruction (IPI).

PARAMETER		TEST CONDITIONS	PACKAGE	MIN	MAX	UNIT	SUB-GROUPS
I_{BN}	Input bias current noninverting		NAB	–0.3	0.3	µA	1
			NAC	–0.75	0.75		
I_{BI}	Input bias current inverting			–3.0	3.0	µA	1
V_{IO}	Input offset voltage		NAB	–0.3	0.3	mV	1
			NAC	–1.0	1.0		

(1) The algebraic convention, whereby the most negative value is a minimum and most positive is a maximum, is used in this table. Negative current shall be defined as conventional current flow out of a device terminal.

5.7 Typical Characteristics

at T_A = 25°C, V_S = ±5V, R_L = 100Ω, and R_F = 237Ω (unless otherwise noted)

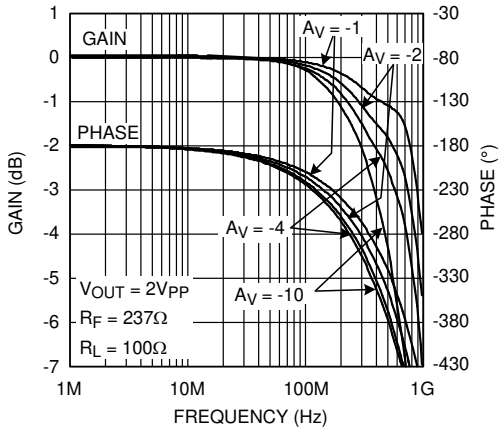

図 5-1. Inverting Frequency Response

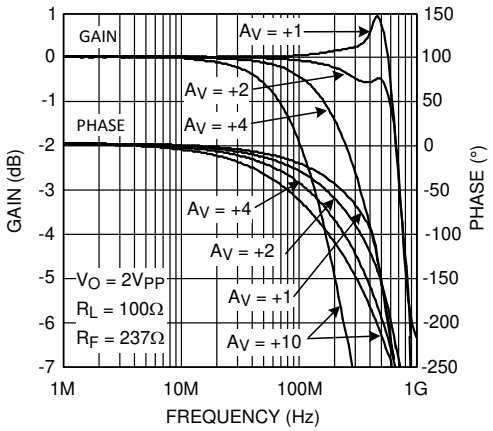

図 5-2. Noninverting Frequency Response

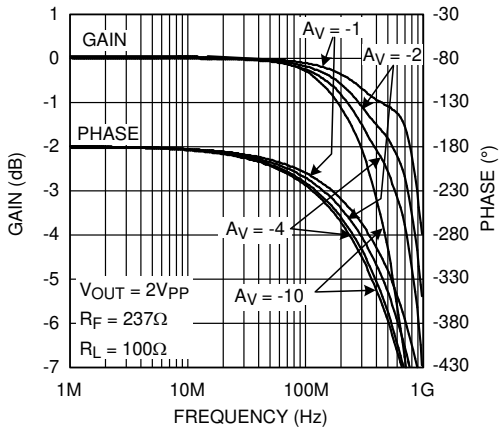

図 5-3. Inverting Frequency Response

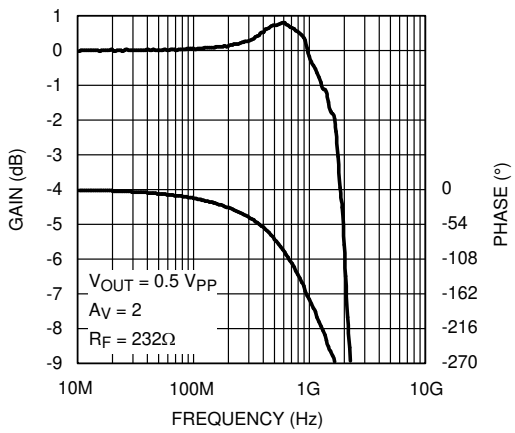

図 5-4. Small-Signal Bandwidth

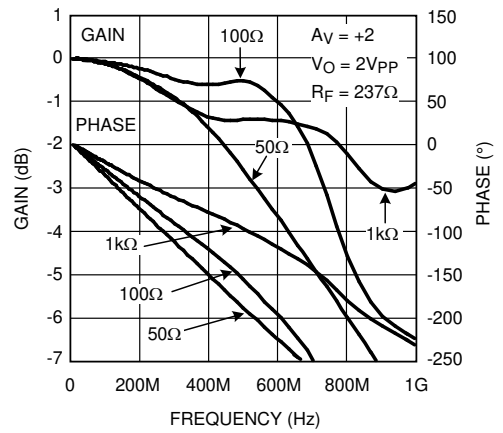

図 5-5. Frequency Response for Various R_L, A_V = +2

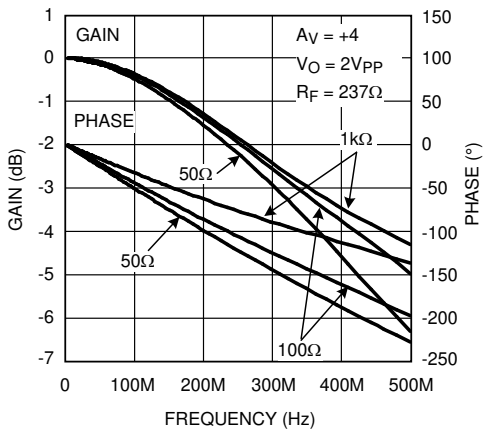

図 5-6. Frequency Response for Various R_L, A_V = +4

5.7 Typical Characteristics (continued)

at T_A = 25°C, V_S = ±5V, R_L = 100Ω, and R_F = 237Ω (unless otherwise noted)

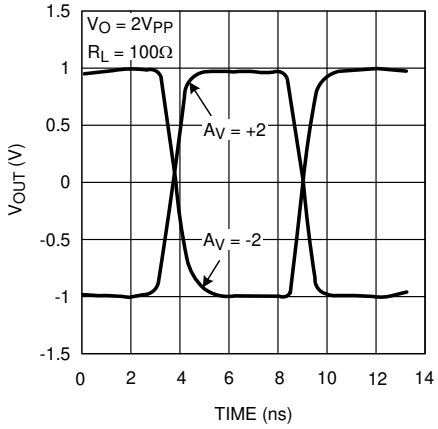

図 5-7. Step Response, $2V_{PP}$

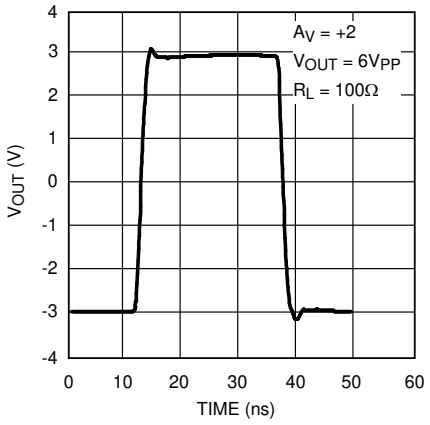

図 5-8. Step Response, $6V_{PP}$

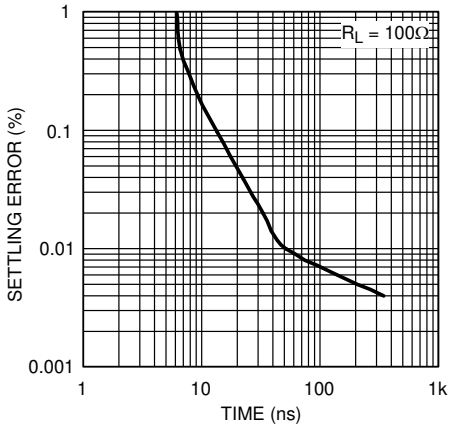

図 5-9. Percent Settling vs Time

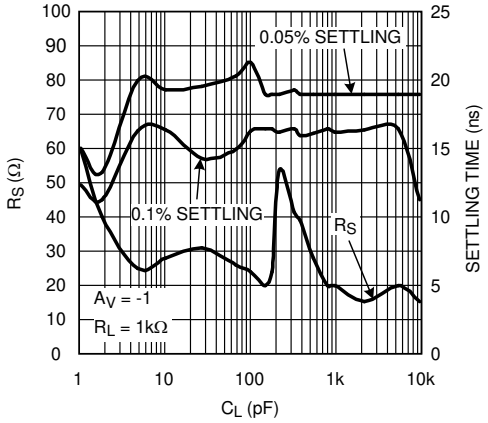

図 5-10. R_S and Settling Time vs C_L

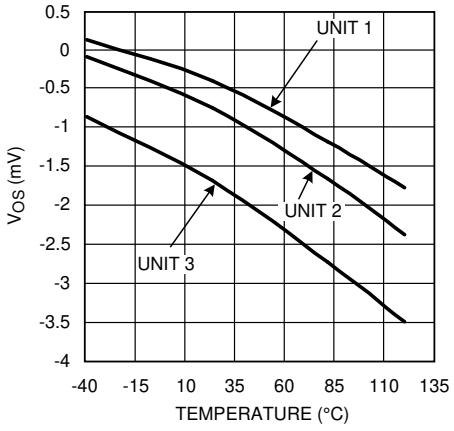

図 5-11. Input Offset for Three Representative Units

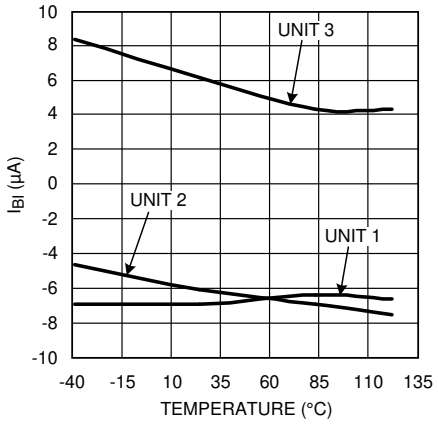

図 5-12. Inverting Input Bias for Three Representative Units

5.7 Typical Characteristics (continued)

at T_A = 25°C, V_S = ±5V, R_L = 100Ω, and R_F = 237Ω (unless otherwise noted)

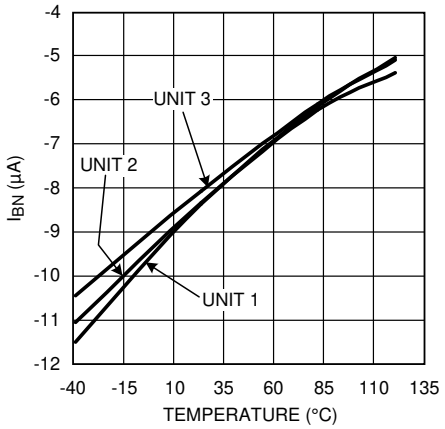

図 5-13. Noninverting Input Bias for Three Representative Units

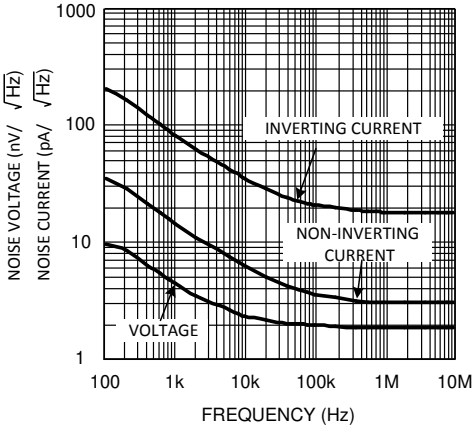

図 5-14. Noise

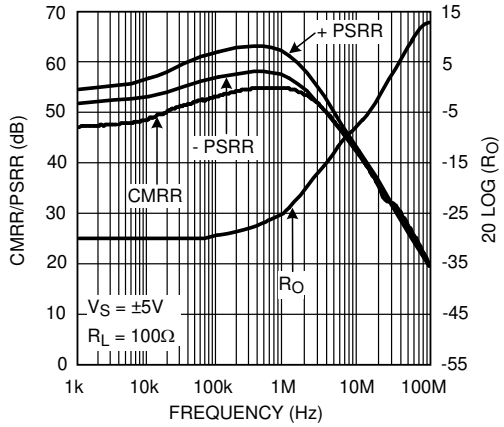

図 5-15. CMRR, PSRR, R_{OUT}

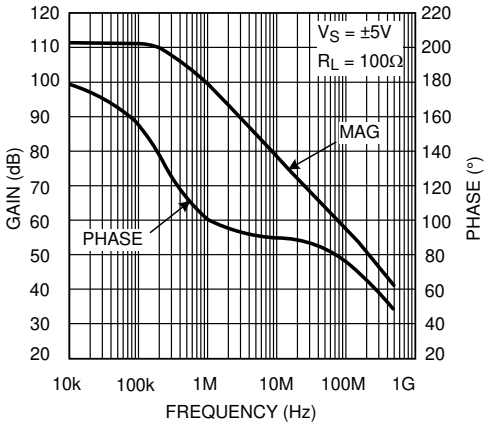

図 5-16. Transimpedance

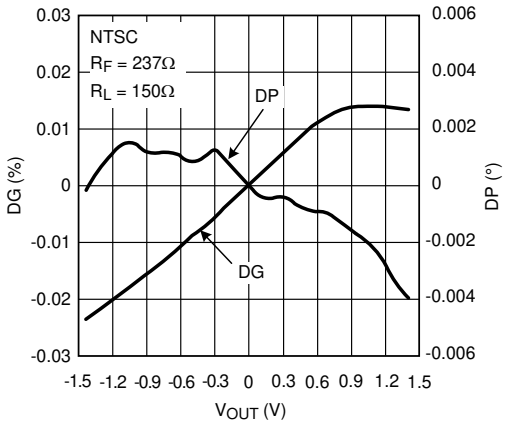

図 5-17. DG/DP (NTSC)

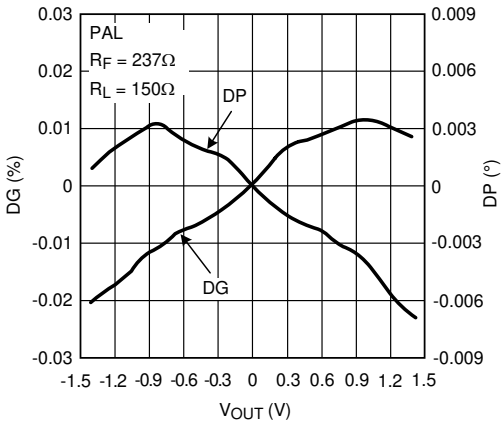

図 5-18. DG/DP (PAL)

6 Application and Implementation

注

以下のアプリケーション情報は、TI の製品仕様に含まれるものではなく、TI ではその正確性または完全性を保証いたしません。個々の目的に対する製品の適合性については、お客様の責任で判断していただくことになります。お客様は自身の設計実装を検証しテストすることで、システムの機能を確認する必要があります。

6.1 Application Information

6.1.1 Feedback Resistor

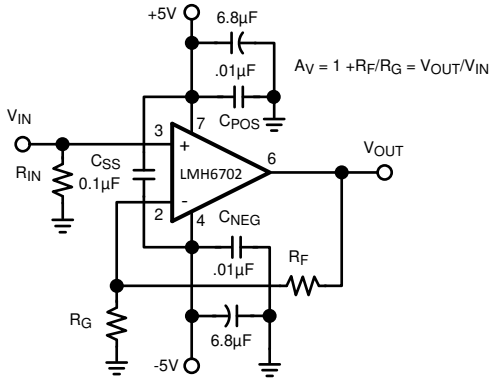

図 6-1. Recommended Noninverting Gain Circuit

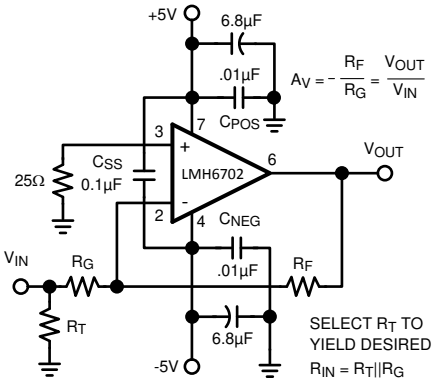

図 6-2. Recommended Inverting Gain Circuit

The LMH6702 achieves excellent pulse and distortion performance by using current feedback topology. The loop gain for a current-feedback op amp, and thus the frequency response, is predominantly set by the feedback-resistor value. The LMH6702 is optimized for use with a 237Ω feedback resistor. Using lower values can lead to excessive ringing in the pulse response while a higher value limits the bandwidth. Application Note OA-13 SNOA366 discusses this configuration in detail along with the occasions where a different R_F can be advantageous.

6.1.2 Harmonic Distortion

The LMH6702 has been optimized for exceptionally low harmonic distortion while driving very demanding resistive or capacitive loads. Generally, when used as the input amplifier to very high-speed flash ADCs, the distortions introduced by the converter dominate over the low LMH6702 distortions. Capacitor C_{SS}, shown across the supplies in 図 6-1 and 図 6-2, is critical to achieving the lowest 2nd harmonic distortion. For absolute

minimum distortion levels, keep the supply decoupling currents (ground connections to C_{POS}, and C_{NEG} in 図 6-1 and 図 6-2) separate from the ground connections to sensitive input circuitry (such as R_G, R_T, and R_{IN} ground connections). Splitting the ground plane in this manner, and separately routing the high frequency current spikes on the decoupling caps back to the power supply (similar to a *star connection* layout technique) provides minimum coupling back to the input circuitry and results in best harmonic distortion response (especially 2nd-order distortion).

If this layout technique has not been observed on a particular application board, the supply decoupling capacitors can adversely affect HD2 performance by increasing the coupling phenomenon already mentioned. 図 6-3 shows actual HD2 data on a board where the ground plane is shared between the supply decoupling capacitors and the rest of the circuit. After these capacitors are removed, the HD2 distortion levels reduce significantly, especially between 10MHz to 20MHz, as shown in 図 6-3.

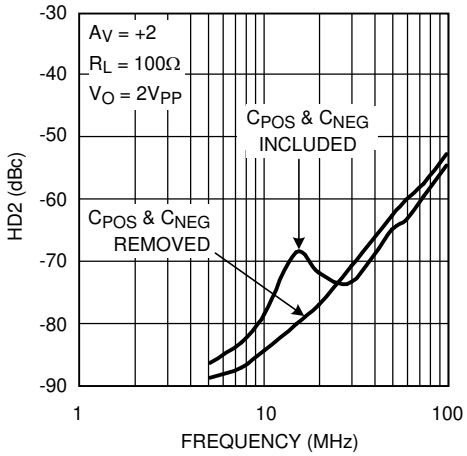

図 6-3. Decoupling Current Adverse Effect on a Board With Shared Ground Plane

At these extremely low distortion levels, the high-frequency behavior of decoupling capacitors themselves can be significant. In general, lower-value decoupling capacitors tend to have higher resonance frequencies, making lower-value decoupling capacitors more effective for higher-frequency regions. A particular application board that has been laid out correctly with ground returns split to minimize coupling benefits the most by having low-value and higher-value capacitors paralleled to take advantage of the effective bandwidth of each, and extend the low-distortion frequency range.

6.1.3 Capacitive Load Drive

図 6-4 shows a typical application using the LMH6702 to drive an ADC.

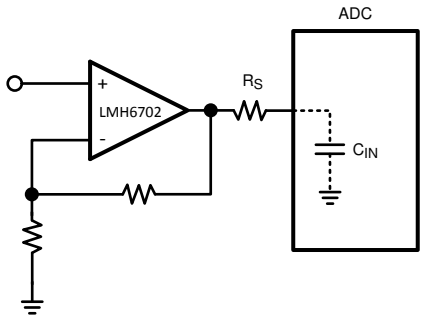

図 6-4. Input Amplifier to ADC

The series resistor, R_S, between the amplifier output and the ADC input is critical to achieving best system performance. This load capacitance, if applied directly to the output pin, can quickly lead to unacceptable levels

of ringing in the pulse response. The plot of *R_S and Settling Time vs C_L* in the *Typical Characteristics* is an excellent starting point for selecting R_S. The value derived in that plot minimizes the step settling time into a fixed discrete capacitive load with the output driving a very light resistive load (1kΩ). Sensitivity to capacitive loading is greatly reduced after the output is loaded more heavily. Therefore, for cases where the output is heavily loaded, R_S value can be reduced. The exact value can best be determined experimentally for these cases.

In applications where the LMH6702 is replacing the CLC409, take care when the device is lightly loaded and some capacitance is present at the output. As a result of the much higher frequency response of the LMH6702 compared to the CLC409, increased susceptibility to low value output capacitance (parasitic or inherent to the board layout or otherwise being part of the output load) is possible. As previously mentioned, this susceptibility is most noticeable when the LMH6702 resistive load is light. Parasitic capacitance can be minimized by careful layout. Addition of an output snubber R-C network also helps by increasing the high-frequency resistive loading.

Referring back to 図 6-4, consider several additional constraints in driving the capacitive input of an ADC. There is an option to increase R_S, band-limiting at the ADC input for either noise or Nyquist band-limiting purposes. However, increasing R_S too much can induce an unacceptably large input glitch due to switching transients coupling through from the convert signal. Also, C_{IN} is often a voltage-dependent capacitance. This input impedance nonlinearity induces distortion terms that increase as R_S is increased. Therefore, attempt only slight adjustments up or down from the recommended R_S value in optimizing system performance.

6.1.4 DC Accuracy and Noise

Example below shows the output offset computation equation for the noninverting configuration using the typical bias current and offset specifications for A_V = +2:

Output Offset: $V_O = (\pm I_{BN} \times R_{IN} \pm V_{IO}) (1 + R_F/R_G) \pm I_{BI} \times R_F$

Where R_{IN} is the equivalent input impedance on the noninverting input.

Example computation for A_V = +2, R_F = 237Ω, R_{IN} = 25Ω:

$V_O = (\pm 6\mu A \times 25\Omega \pm 1mV) (1 + 237/237) \pm 8\mu A \times 237 = \pm 4.20mV$

A good design, however, includes a worst-case calculation using minimum and maximum numbers in the data sheet tables to provide worst-case operation.

Further improvement in the output offset voltage and drift is possible using composite amplifiers. The two input bias currents are physically unrelated in both magnitude and polarity for the current feedback topology. Therefore, to cancel the effects by matching the source impedance for the two inputs (as is commonly done for matched input bias current devices) is not possible.

The total output noise is computed in a similar fashion to the output offset voltage. Using the input noise voltage and the two input noise currents, the output noise is developed through the same gain equations for each term but combined as the square root of the sum of squared contributing elements. See the *OA-12 Noise Analysis for Comlinear Amplifiers* application report for a full discussion of noise calculations for current-feedback amplifiers.

6.2 Layout

6.2.1 Layout Guidelines

Generally, a good high frequency layout keeps power supply and ground traces away from the inverting input and output pins. Parasitic capacitance on these nodes to ground cause frequency-response peaking and possible circuit oscillations (see the *OA-15 Frequent Faux Pas in Applying Wideband Current Feedback Amplifiers* application report for more information). Texas Instruments suggests the following evaluation boards as a guide for high-frequency layout and as an aid in device testing and characterization:

DEVICE	PACKAGE	EVALUATION BOARD PART NUMBER
LMH6702QMLMF	SOT-23-5	CLC730216
LMH6702QMLMA	Plastic SOIC	CLC730227

7 Device and Documentation Support

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

7.1 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、www.tij.co.jp のデバイス製品フォルダを開いてください。[通知] をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取ることができます。 変更の詳細については、改訂されたドキュメントに含まれている改訂履歴をご覧ください。

7.2 サポート・リソース

テキサス・インスツルメンツ E2E™ サポート・フォーラムは、エンジニアが検証済みの回答と設計に関するヒントをエキスパートから迅速かつ直接得ることができる場所です。既存の回答を検索したり、独自の質問をしたりすることで、設計で必要な支援を迅速に得ることができます。

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7.3 Trademarks

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7.4 静電気放電に関する注意事項

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ESD による破損は、わずかな性能低下からデバイスの完全な故障まで多岐にわたります。精密な IC の場合、パラメータがわずかに変化するだけで公表されている仕様から外れる可能性があるため、破損が発生しやすくなっています。

7.5 用語集

テキサス・インスツルメンツ用語集　　この用語集には、用語や略語の一覧および定義が記載されています。

8 Revision History

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Changes from Revision E (March 2013) to Revision F (August 2024)	Page
• ドキュメント全体にわたって表、図、相互参照の採番方法を更新	1
• Changed input bias current noninverting limits from ±0.3µA to ±0.75µA for NAC package type in *LMH6702 Electrical Characteristics Drift Values Parameters*	5
• Changed input offset voltage limits from ±0.3mA to ±1mV for NAC package type in *LMH6702 Electrical Characteristics Drift Values Parameters*	5

Changes from Revision D (October 2011) to Revision E (March 2013)	Page
• ナショナル セミコンダクターのデータシートのレイアウトをテキサス・インスツルメンツ形式に変更	1

9 Mechanical, Packaging, and Orderable Information

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

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郵送先住所:Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-0254601VPA	ACTIVE	CDIP	NAB	8	40	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702J-QV 5962-02546 01VPA Q ACO 01VPA Q >T	Samples
5962-0254601VZA	ACTIVE	CFP	NAC	10	54	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702 WGQMLV Q 5962-02546 01VZA ACO 01VZA >T	Samples
5962F0254601VPA	ACTIVE	CDIP	NAB	8	40	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702JFQV 5962F02546 01VPA Q ACO 01VPA Q >T	Samples
5962F0254601VZA	ACTIVE	CFP	NAC	10	54	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702 WGFQMLV Q 5962F02546 01VZA ACO 01VZA >T	Samples
5962F0254602VPA	ACTIVE	CDIP	NAB	8	40	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702JFLQV 5962F02546 02VPA Q ACO 02VPA Q >T	Samples
LMH6702J-QMLV	ACTIVE	CDIP	NAB	8	40	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702J-QV 5962-02546 01VPA Q ACO 01VPA Q >T	Samples
LMH6702JFLQMLV	ACTIVE	CDIP	NAB	8	40	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702JFLQV 5962F02546 02VPA Q ACO 02VPA Q >T	Samples
LMH6702JFQMLV	ACTIVE	CDIP	NAB	8	40	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702JFQV 5962F02546 01VPA Q ACO 01VPA Q >T	Samples
LMH6702WG-QMLV	ACTIVE	CFP	NAC	10	54	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702 WGQMLV Q	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
										5962-02546 01VZA ACO 01VZA >T	
LMH6702WGFQMLV	ACTIVE	CFP	NAC	10	54	Non-RoHS & Green	Call TI	Level-1-NA-UNLIM	-55 to 125	LMH6702 WGFQMLV Q 5962F02546 01VZA ACO 01VZA >T	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

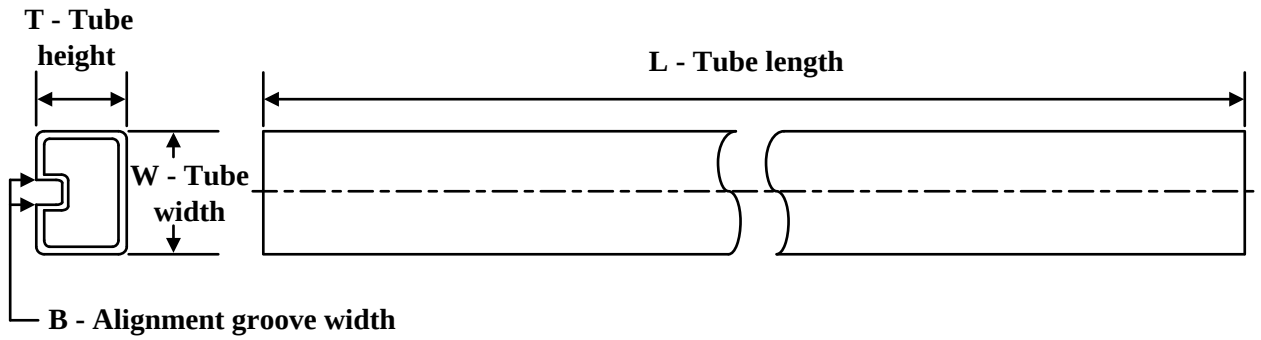
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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

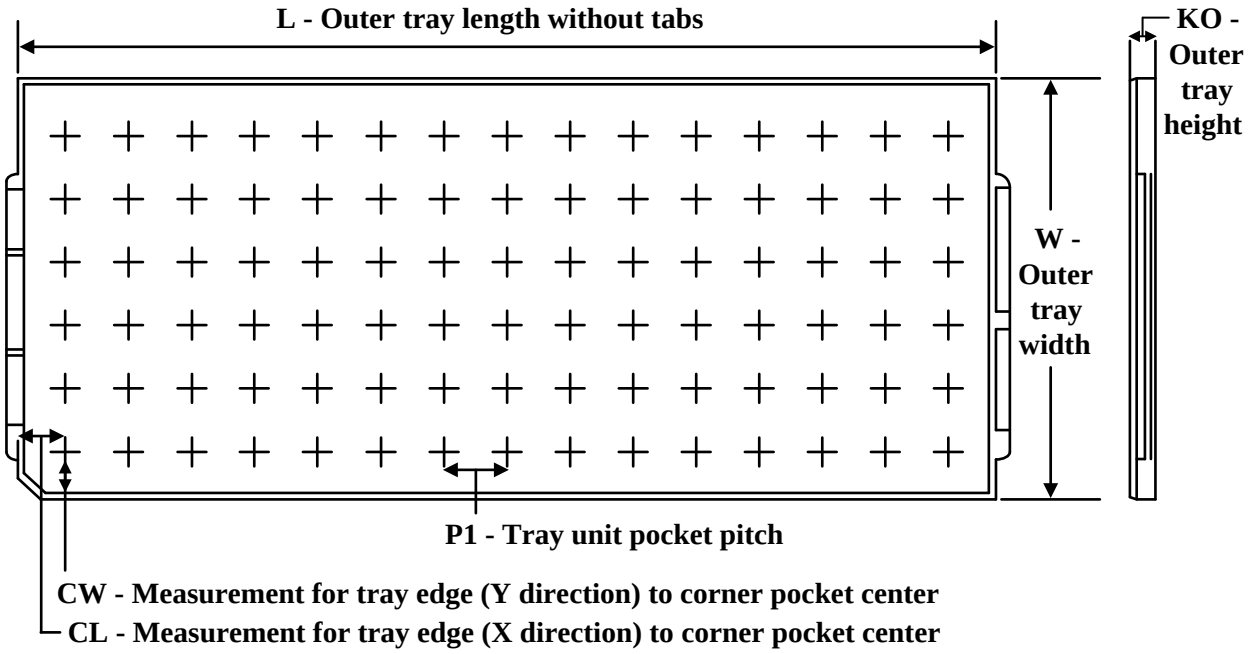
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
5962-0254601VPA	NAB	CDIP	8	40	506.98	15.24	13440	NA
5962F0254601VPA	NAB	CDIP	8	40	506.98	15.24	13440	NA
LMH6702J-QMLV	NAB	CDIP	8	40	506.98	15.24	13440	NA
LMH6702JFQMLV	NAB	CDIP	8	40	506.98	15.24	13440	NA

TRAY

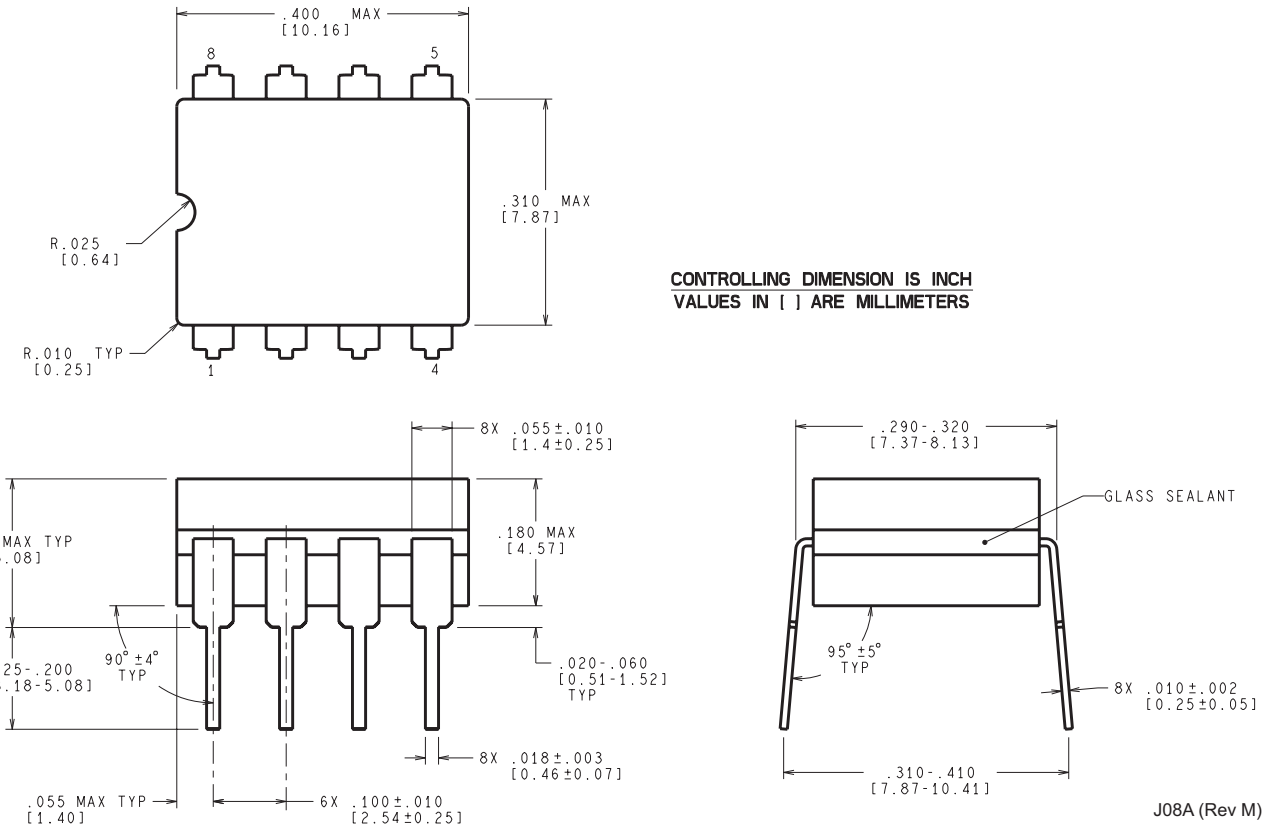


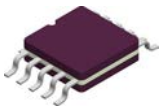
Chamfer on Tray corner indicates Pin 1 orientation of packed units.

*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
5962-0254601VZA	NAC	CFP	10	54	6 X 9	100	101.6	101.6	8001	2.78	16.08	16.08
5962F0254601VZA	NAC	CFP	10	54	6 X 9	100	101.6	101.6	8001	2.78	16.08	16.08
LMH6702WG-QMLV	NAC	CFP	10	54	6 X 9	100	101.6	101.6	8001	2.78	16.08	16.08
LMH6702WGFQMLV	NAC	CFP	10	54	6 X 9	100	101.6	101.6	8001	2.78	16.08	16.08

NAB0008A


.400 MAX
[10.16]
8
5
.310 MAX
[7.87]
R.025
[0.64]
R.010 TYP
[0.25]
1
4
CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS
8X .055±.010
[1.4±0.25]
.200 MAX TYP
[5.08]
.180 MAX
[4.57]
8X .125-.200
[3.18-5.08]
90° ±4°
TYP
.020-.060
[0.51-1.52]
TYP
8X .018±.003
[0.46±0.07]
.055 MAX TYP
[1.40]
6X .100±.010
[2.54±0.25]
.290-.320
[7.37-8.13]
GLASS SEALANT
95° ±5°
TYP
8X .010±.002
[0.25±0.05]
.310-.410
[7.87-10.41]
J08A (Rev M)

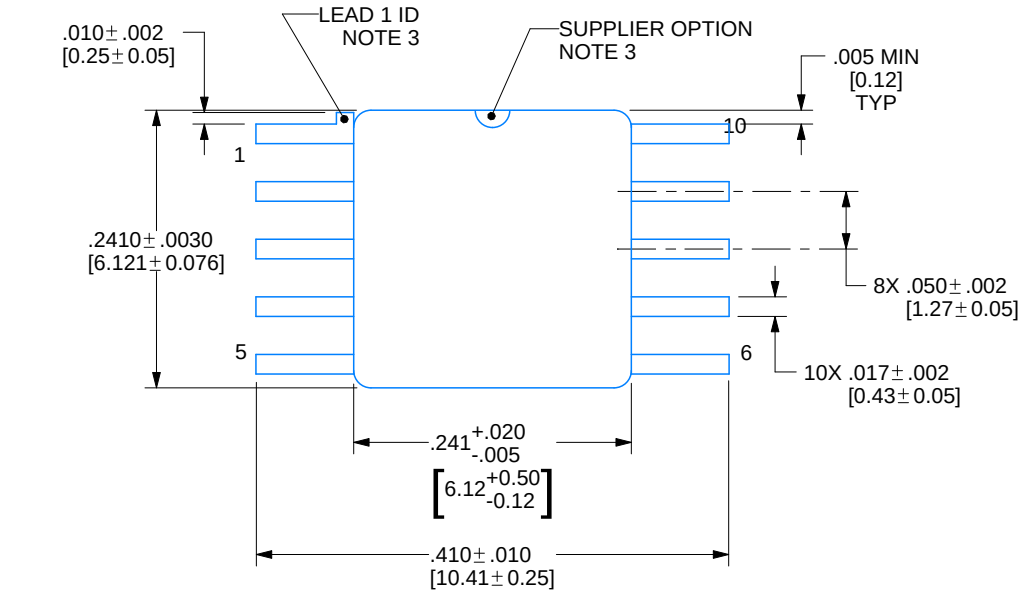


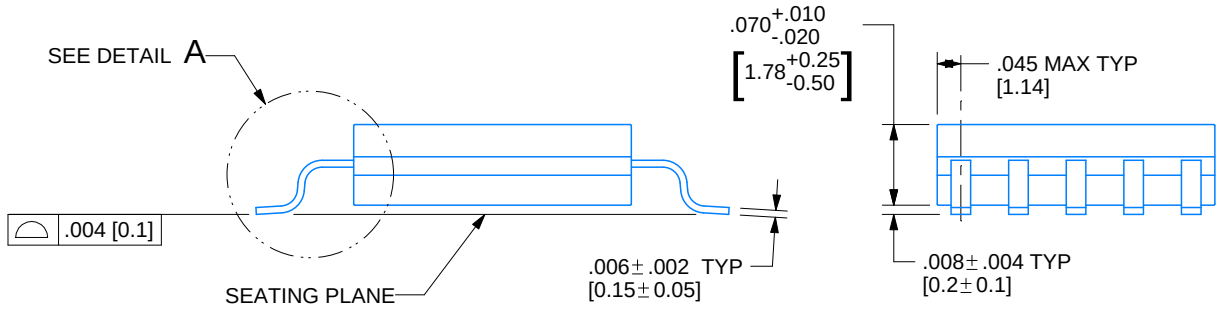
PACKAGE OUTLINE

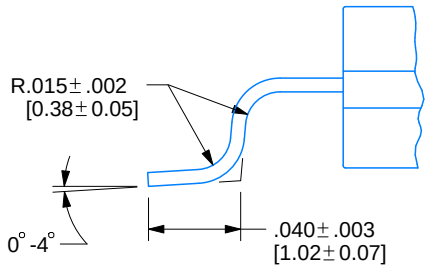
NAC0010A

CFP - 2.33mm max height

CERAMIC FLATPACK







DETAIL A
TYPICAL

4215196/D 08/2022

NOTES:

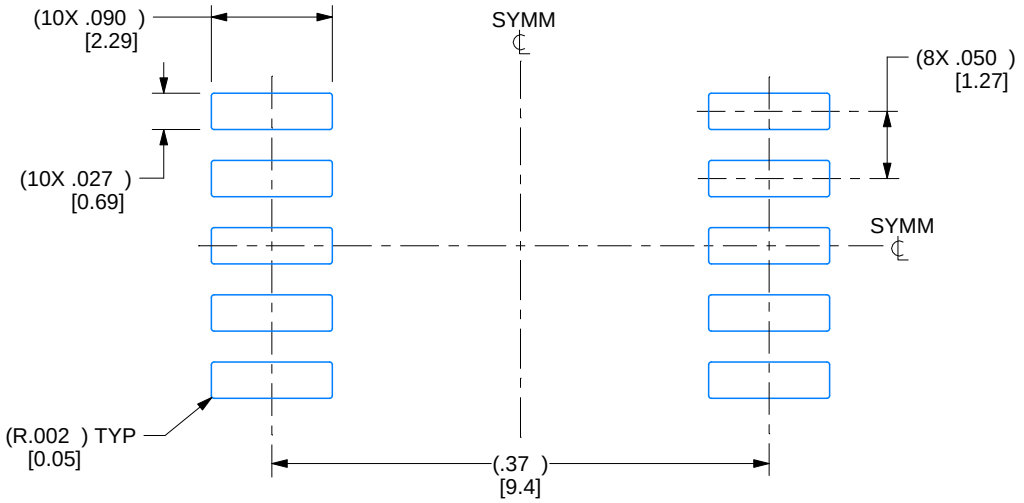
1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. For solder thickness and composition, see the "Lead Finish Composition/Thickness" link in the packaging section of the Texas Instruments website
3. Lead 1 identification shall be:
   a) A notch or other mark within this area
   b) A tab on lead 1, either side
4. No JEDEC registration as of December 2021

EXAMPLE BOARD LAYOUT

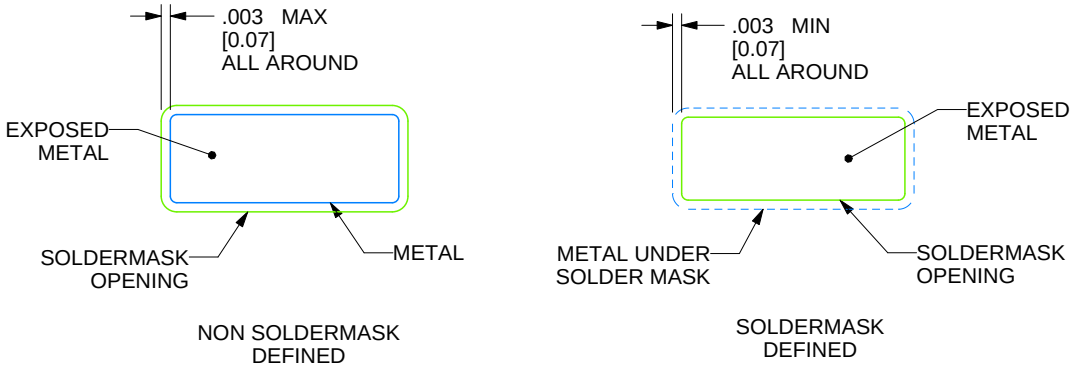
NAC0010A

CFP - 2.33mm max height

CERAMIC FLATPACK



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 7X



4215196/D 08/2022

REVISIONS

REV	DESCRIPTION	E.C.N.	DATE	BY/APP'D
A	RELEASE TO DOCUMENT CONTROL	2197877	12/30/2021	DAVID CHIN / ANIS FAUZI
B	NO CHANGE TO DRAWING; REVISION FOR YODA RELEASE;	2198820	02/14/2022	K. SINCERBOX
C	CHANGE PIN 1 ID LOCATION ON PIN	2198845	02/18/2022	D. CHIN / K. SINCERBOX
D	.2410± .0030 WAS .2700 +.0012/-.0002;	2200915	08/08/2022	D. CHIN / K. SINCERBOX

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