National Semiconductor

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LM2481
145V Triple Bias Clamp

General Description

The LM2481 driver is an Integrated 145V triple bias clamp circuit for DC recovery of each of the AC coupled outputs of a HDTV CRT driver. It is well matched with the DAC outputs of the LM126X family of pre-amplifiers. Each amplifier has its gain internally set to -20. The LM2481 is packaged in an industry standard 14 lead molded plastic dual-in-line package.

Features

- Wide range integrated triple bias clamp
- High input impedance
- Matched to LM2421 HDTV Driver

Applications

- AC coupled HDTV applications using the 1080i and 720p formats

Schematic and Connection Diagrams

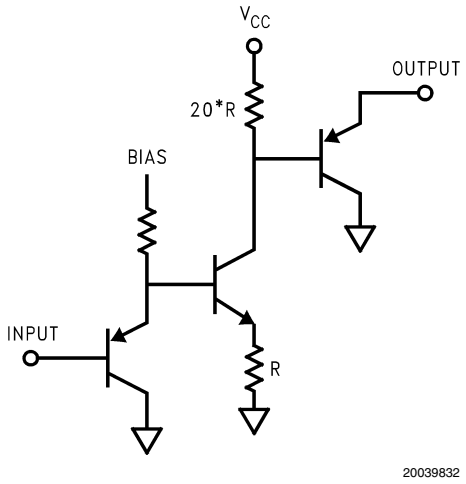
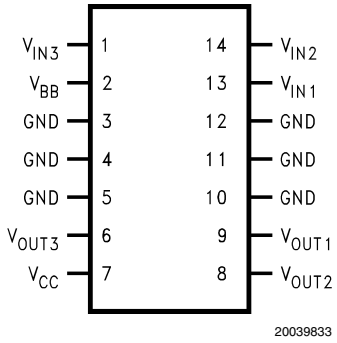


FIGURE 1. Simplified Schematic Diagram (One Channel)



Top View
Order Number LM2481NA

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Absolute Maximum Ratings (Notes 1, 3)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage, V_{CC}	+155V
Bias Voltage, V_{BB}	+15V
Input Voltage, V_{IN}	-0.5V to V_{BB} +0.55V
Storage Temperature Range, T_{STG}	-65˚C to +150˚C
Lead Temperature (Soldering, <10sec.)	300˚C
ESD Tolerance	
Machine Model	200V
Human Body Model	2KV
Max Junction Temperature	150˚C
θ_{JA} (Typ) (Note 5)	70˚C

Limits of Operating Ranges (Note 3)

V_{CC}	130V to 150V
V_{BB}	7V to 13V
V_{IN}	1V to 5V
V_{OUT}	25V to 140V
Ambient Temperature Range, T_A	0˚C to 70˚C

DC Clamp Electrical Characteristics

(See Figure 2 for Test Circuit)

Unless otherwise noted: V_{CC} = +145V, V_{BB} = 8V, V_{IN} = +2.5V, T_A = 30˚C

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_{CC}	Supply Current	All three channels, includes 100K pull-up resistor current		4.5	7	mA
I_{BB}	Bias Supply Current	All channels		2		mA
V_{OUT}	DC Output Voltage		100	108	115	V_{DC}
$V_{OUT\text{-}Range}$	Output Voltage Range	V_{IN} Range = +1.5V to 4.5V		60		V
A_V	DC Voltage Gain		-18	-20	-22	V/V
LE	Linearity Error	See Note 4		5		%

Note 1: Absolute Maximum Ratings indicate beyond which damage to the device may occur.

Note 2: Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and the test conditions, see the Electrical Characteristics. Datasheet min/max specification limits are guaranteed by design, test, or statistical analysis. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may change when the device is not operated under the listed test conditions.

Note 3: All voltages are measured with respect to GND, unless otherwise specified.

Note 4: Linearity Error is the variation in dc gain from V_{IN}= 1.5 volts to V_{IN} = 4.5 volts.

Note 5: Measured with 1in^2 copper on PCB connected to pins 3, 4, 5, 10, 11, 12. See Thermal Considerations Section.

Test Circuit

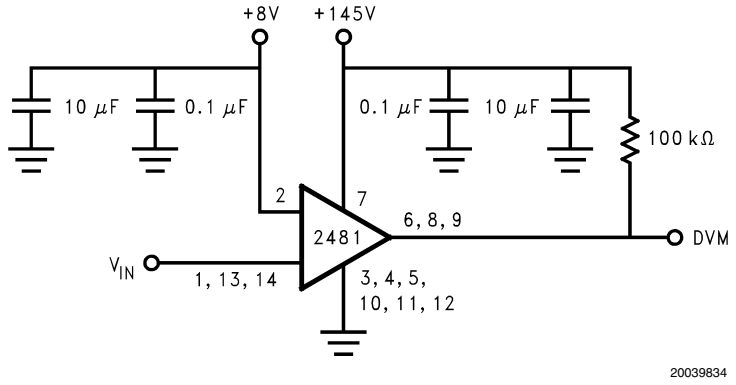


FIGURE 2. Test Circuit

Figure 2 shows the test circuit for evaluation of the LM2481 Clamp Amplifier. A high impedance Voltmeter (>100MΩ) is used for DC measurements at the output.

Typical Performance Characteristics

(V_{CC} = +145V, V_{BB} = +8V, V_{IN} = +2.5V, Test Circuit - Figure 2)

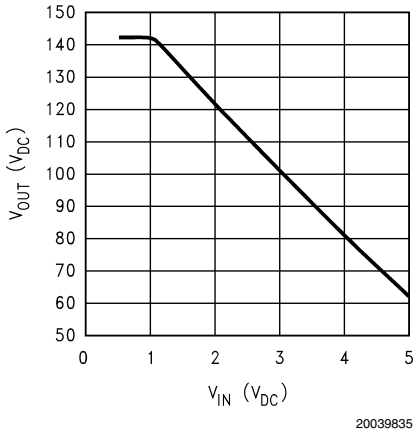


FIGURE 3. V_{out} vs V_{in}

Theory of Operation

The simplified circuit diagram of the LM2481 is shown in Figure 1. The DC clamp circuit amplifies the input signal by -20 and the gain is set by the resistor ratio of 20R and R. The output will require a pull-up resistor to 145V.

Figure 2 shows the test circuit for evaluation of the LM2481 Clamp Amplifier. A high impedance voltmeter (>100MΩ) is used for DC measurements at the output.

Application Hints

INTRODUCTION

National Semiconductor (NSC) is committed to provide application information that assists our customers in obtaining the best performance possible from our products. The following information is provided in order to support this commitment. The reader should be aware that the optimization of performance was done using a specific printed circuit board designed at NSC. Variations in performance can be realized due to physical changes in the printed circuit board and the application. Therefore, the designer should know that component value changes may be required in order to optimize performance in a given application. The values shown in this document can be used as a starting point for evaluation purposes.

POWER SUPPLY BYPASS

The LM2481 should have proper power supply bypassing for optimum performance. A 0.1 µF capacitor should be connected from the supply pins, VCC and VBB, to ground, as close to the supply and ground pins as is practical. Additionally, a 1 µF electrolytic capacitor should be connected from the supply pins to ground. The electrolytic capacitor should also be placed reasonably close to the LM2481's supply and ground pins.

ARC PROTECTION

During normal CRT operation, internal arcing may occasionally occur. To protect the LM2481 against arcing the following steps should be done (See Figure 7):

- The traces connecting the LM126X preamp DACs and the LM2481 input pins (pins 1, 13, and 14) should be run around the top of the LM2421. They should not go through the output circuit of the LM2421.
- C43, C44, and C45 should be located close to the LM126X preamp.
- R44, R45, and R46 should be located close to the LM2481.
- C21, C24, and C25 on the output pins of the LM2481 (pins 6, 8, and 9) should be located close to the LM2481. The grounds of these capacitors should have a short direct return to GND (pins 3, 4, 5, 10, 11, and 12) of the LM2481.
- C9 and C36 on the supply lines (pins 2 and 7) should be located close to the LM2481. The grounds of these capacitors should have a short direct return to GND (pins 3, 4, 5, 10, 11, and 12) of the LM2481.
- The ground of the LM2481 should have a short direct connection to the ground of the LM2421.

Thermal Considerations

The package the LM2481 is in uses the ground pins (3, 4, 5, 10, 11, and 12) to conduct heat from the LM2481. These pins should be connected to a ground plane that acts as a heat sink. See the example ground plane connected to these pins in the National Semiconductor PCB shown in Figure 7.

Figure 4 is used to determine the size of ground plane heat sink. The lines in Figure 4 represent a junction temperature of 150˚C when the size of heat sink noted by the line is used. The area under the line is the safe operating area. Using Figure 4, the following example shows how to determine the size of the ground plane.

The LM2481 uses about 0.4W of quiescent power. If V_{CC} = +145V, and each channel of the LM2481 needs to sink an average of 1mA, the LM2481 will use:

0.4W + 3 x (145V x 1mA) = 0.835W

Figure 4 shows that the LM2481 dissipating 0.835W with one sq. in. of copper ground plane heat sink is in the safe operating range for any ambient temperature up to 70˚C.

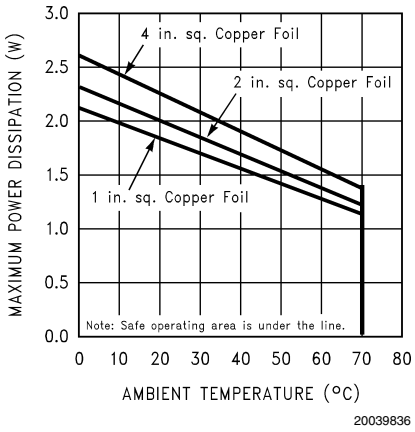


FIGURE 4. Maximum Power Dissipation vs. Ambient Temperature

Typical Application

A typical application of the LM2481 is shown in Figures 5 and Figure 6. Used in conjunction with an LM126X Preamp and an LM2421 CRT Driver, a complete video channel from input to CRT cathode can be achieved. Performance is ideal for HDTV applications. Figure 5 and Figure 6 are the schematic for the NSC demonstration board that can be used to evaluate the LM126X/LM2421/LM2481.

NSC Demonstration Board

Figure 7 shows the routing and component placement on the NSC LM126X/LM2421/LM2481 demonstration board. The schematic of the board is shown in Figure 5 and Figure 6. This board provides a good example of a layout that can be used as a guide.

Demonstration Board Schematics

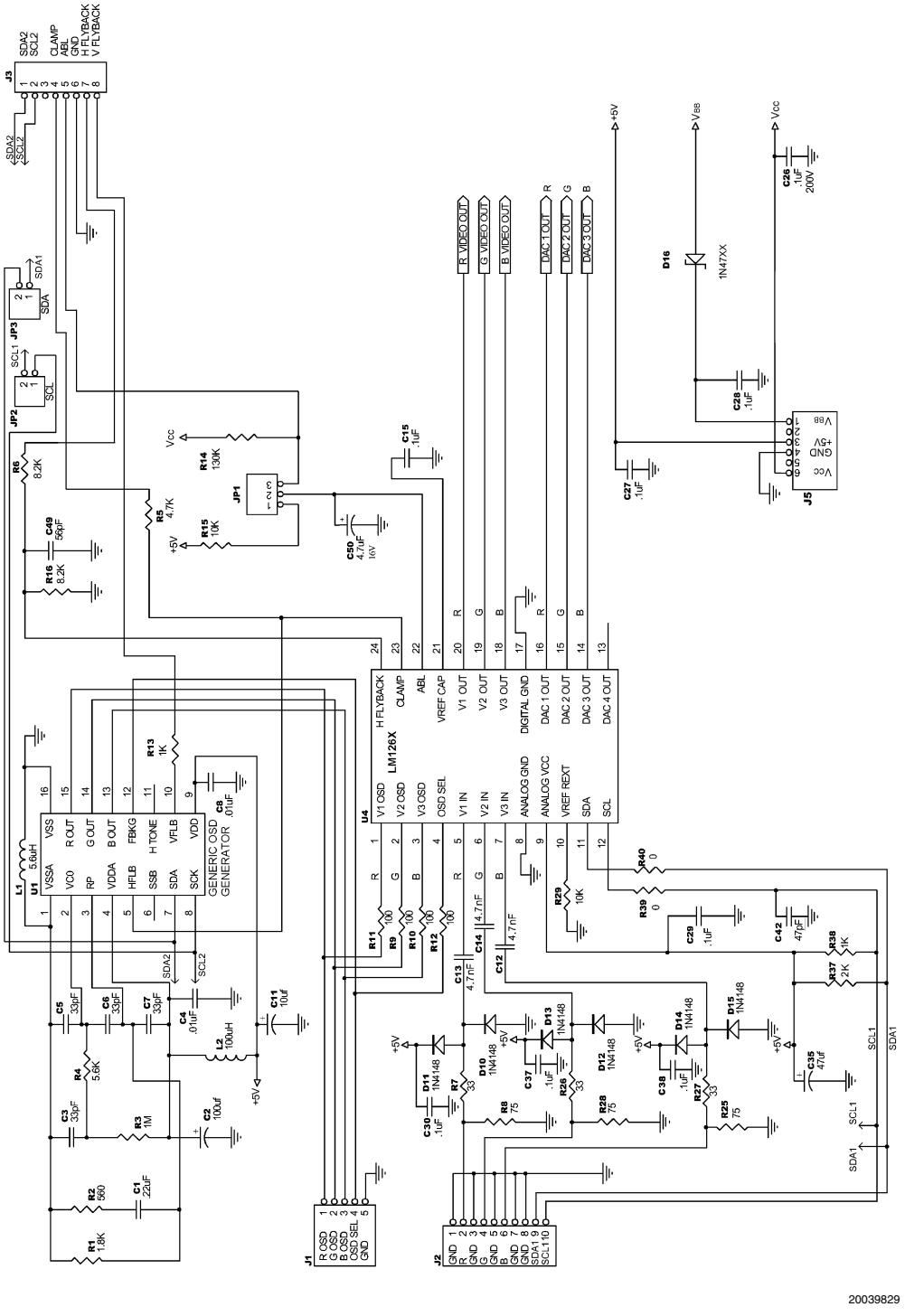


FIGURE 5. LM126X/LM2421/LM2481 Demonstration Board Schematic

Demonstration Board Schematics (Continued)

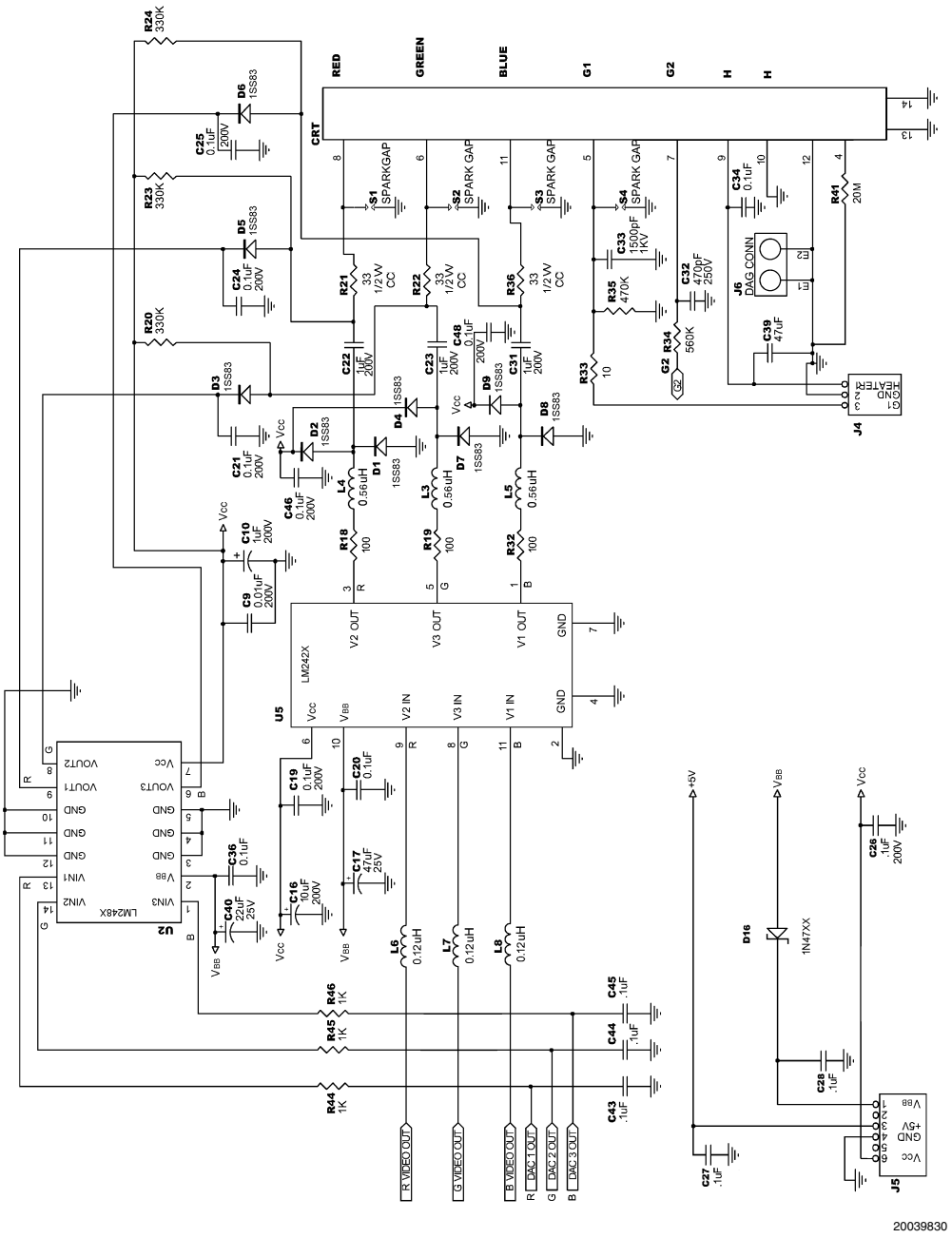
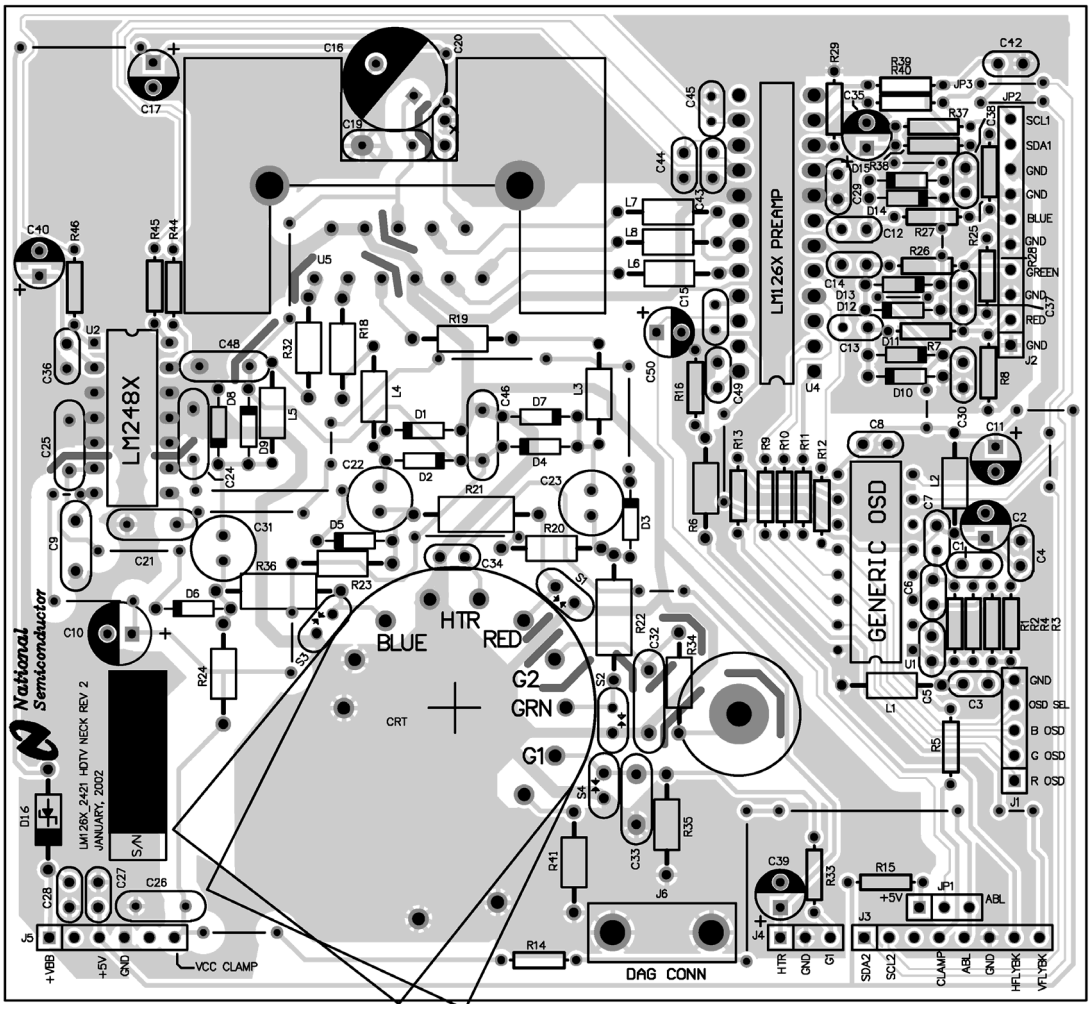


FIGURE 6. LM126X/LM2421/LM2481 Demonstration Board Schematic

Demonstration Board Schematics (Continued)

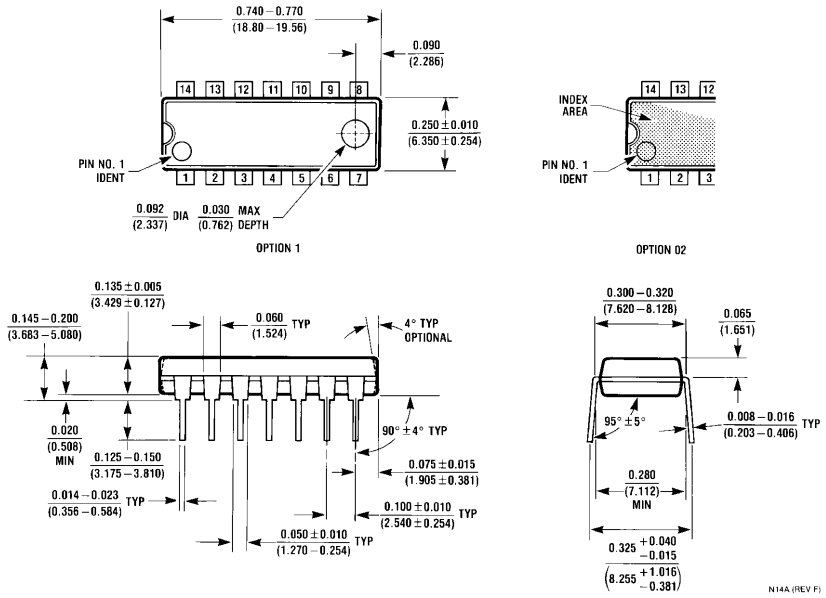


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FIGURE 7. LM126X/LM2421/LM2481 Demonstration Board Layout

Physical Dimensions inches (millimeters)

unless otherwise noted



Note: Information contained in this data sheet is preliminary and may be subject to change without notice.

Molded Dual-In-Line Package
Order Number LM2481NA
NS Package Number N14A

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