

## LM136-5.0, LM236-5.0, LM336-5.0 5.0V Reference Diode

 Check for Samples: [LM136-5.0](#), [LM236-5.0](#), [LM336-5.0](#)

### FEATURES

- Adjustable 4V to 6V
- Low Temperature Coefficient
- Wide Operating Current of 600  $\mu$ A to 10 mA
- 0.6 $\Omega$  Dynamic Impedance
- $\pm$  1% Initial Tolerance Available
- Specified Temperature Stability
- Easily Trimmed for Minimum Temperature Drift
- Fast Turn-on
- Three Lead Transistor Package

### DESCRIPTION

The LM136-5.0/LM236-5.0/LM336-5.0 integrated circuits are precision 5.0V shunt regulator diodes. These monolithic IC voltage references operate as a low temperature coefficient 5.0V zener with 0.6 $\Omega$  dynamic impedance. A third terminal on the LM136-5.0 allows the reference voltage and temperature coefficient to be trimmed easily.

The LM136-5.0 series is useful as a precision 5.0V low voltage reference for digital voltmeters, power supplies or op amp circuitry. The 5.0V makes it convenient to obtain a stable reference from low voltage supplies. Further, since the LM136-5.0 operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

The LM136-5.0 is rated for operation over  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  while the LM236-5.0 is rated over a  $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  temperature range. The LM336-5.0 is rated for operation over a  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  temperature range. See the [Connection Diagrams](#) for available packages. For applications requiring 2.5V see LM136-2.5.

### Connection Diagrams

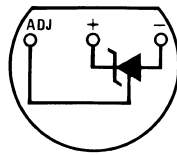


Figure 1. TO-92 Plastic Package (Bottom View)

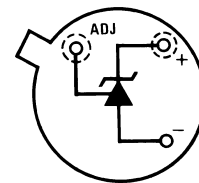


Figure 2. TO Metal Can Package (Bottom View)

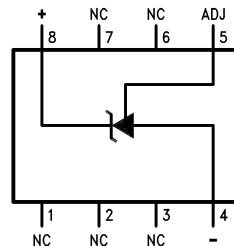


Figure 3. SOIC Package



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## Typical Applications

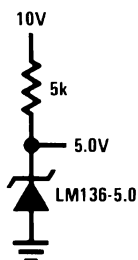
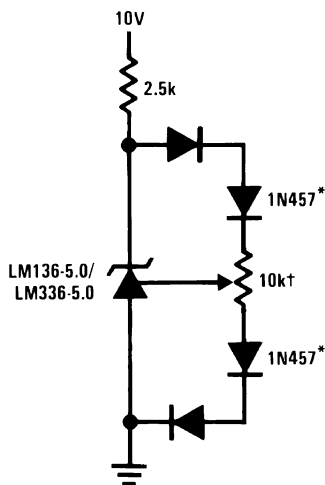


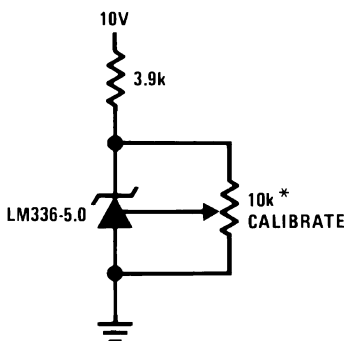
Figure 4. 5.0V Reference



† Adjust to 5.00V

\* Any silicon signal diode

Figure 5. 5.0V Reference with Minimum Temperature Coefficient



\* Does not affect temperature coefficient

Figure 6. Trimmed 4V to 6V Reference with Temperature Coefficient Independent of Breakdown Voltage



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>

Reverse Current	15	mA
Forward Current	10	mA
Storage Temperature	-60 to +150	°C
Operating Temperature Range <sup>(2)</sup>		
LM136-5.0	-55 to +150	°C
LM236-5.0	-25 to +85	°C
LM336-5.0	0 to +70	°C
Soldering Information		
TO-92 Package (10 sec.)	260	°C
TO Package (10 sec.)	300	°C
SOIC Package		
Vapor Phase (60 sec.)	215	°C
Infrared (15 sec.)	220	°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device beyond its specified operating conditions.

(2) For elevated temperature operation,  $T_j$  max see [THERMAL CHARACTERISTICS](#)

## THERMAL CHARACTERISTICS

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

	<b>LM136</b>	<b>150°C</b>	
	<b>LM236</b>	<b>125°C</b>	
	<b>LM336</b>	<b>100°C</b>	
<b>Thermal Resistance</b>	<b>TO-92</b>	<b>TO</b>	<b>SOIC-8</b>
$\theta_{ja}$ (Junction to Ambient)	180°C/W (0.4" Leads)	440°C/W	165°C/W
	170°C/W (0.125" Leads)		
$\theta_{jc}$ (Junction to Case)	N/A	80°C/W	N/A

## ELECTRICAL CHARACTERISTICS

Parameter	Conditions	LM136A-5.0/LM236A-5.0			LM336B-5.0			Units
		LM136-5.0/LM236-5.0			LM336-5.0			
		Min	Typ	Max	Min	Typ	Max	
Reverse Breakdown Voltage	$T_A=25^\circ\text{C}$ , $I_R=1\text{ mA}$							
	LM136-5.0/LM236-5.0/LM336-5.0	4.9	5.00	5.1	4.8	5.00	5.2	V
	LM136A-5.0/LM236A-5.0, LM336B-5.0	4.95	5.00	5.05	4.90	5.00	5.1	V
Reverse Breakdown Change	$T_A=25^\circ\text{C}$ ,		6	12		6	20	mV
With Current	$600\ \mu\text{A} \leq I_R \leq 10\text{ mA}$							
Reverse Dynamic Impedance	$T_A=25^\circ\text{C}$ , $I_R=1\text{ mA}$ , $f = 100\text{ Hz}$		0.6	1.2		0.6	2	$\Omega$
Temperature Stability <sup>(2)</sup>	$V_R$ Adjusted 5.00V $I_R=1\text{ mA}$ , (Figure 15) $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ (LM336-5.0)					4	12	mV

(1) Unless otherwise specified, the LM136-5.0 is specified from  $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ , the LM236-5.0 from  $-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$  and the LM336-5.0 from  $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$ .

(2) Temperature stability for the LM336 and LM236 family is specified by design. Design limits are specified (but not 100% percent production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels. Stability is defined as the maximum change in  $V_{REF}$  from  $25^\circ\text{C}$  to  $T_A(\text{min})$  or  $T_A(\text{max})$ .

**ELECTRICAL CHARACTERISTICS (continued)**

(1)

Parameter	Conditions	LM136A-5.0/LM236A-5.0			LM336B-5.0			Units
		LM136-5.0/LM236-5.0			LM336-5.0			
		Min	Typ	Max	Min	Typ	Max	
	-25°C ≤ T <sub>A</sub> ≤ +85°C (LM236-5.0)		7	18				mV
	-55°C ≤ T <sub>A</sub> ≤ +125°C (LM136-5.0)		20	36				mV
Reverse Breakdown Change With Current	600 μA ≤ I <sub>R</sub> ≤ 10 mA		6	17		6	24	mV
Adjustment Range	Circuit of <a href="#">Figure 14</a>		±1			±1		V
Reverse Dynamic Impedance	I <sub>R</sub> = 1 mA		0.8	1.6		0.8	2.5	Ω
Long Term Stability	T <sub>A</sub> = 25°C ± 0.1°C, I <sub>R</sub> = 1 mA, t = 1000 hrs		20			20		ppm

TYPICAL PERFORMANCE CHARACTERISTICS

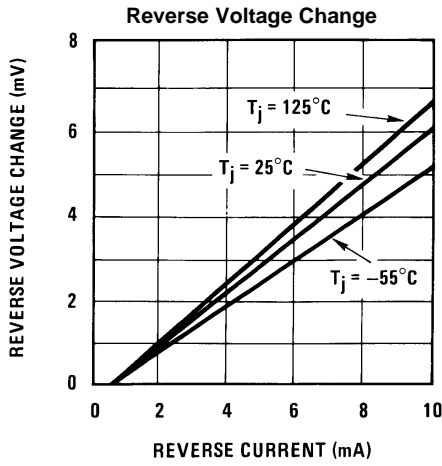


Figure 7.

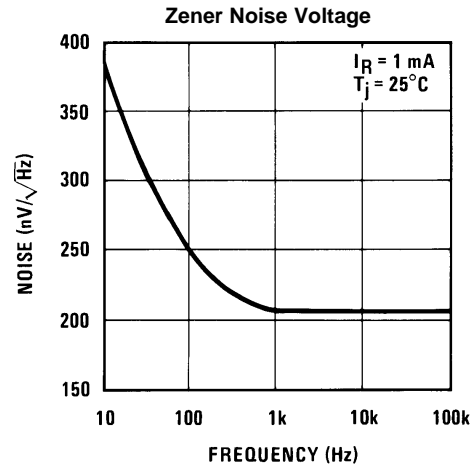


Figure 8.

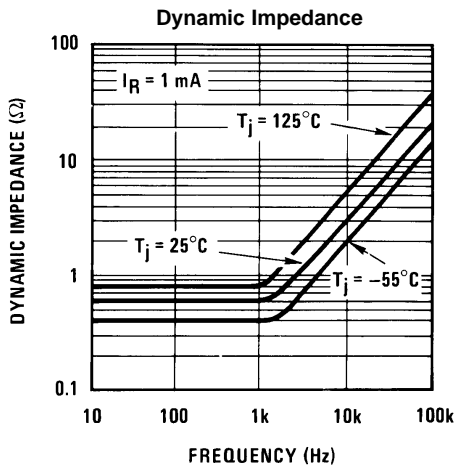


Figure 9.

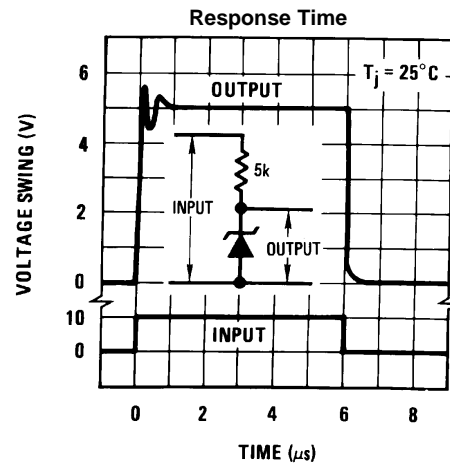


Figure 10.

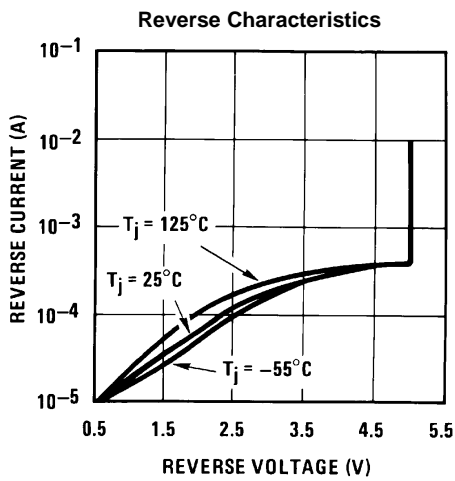


Figure 11.

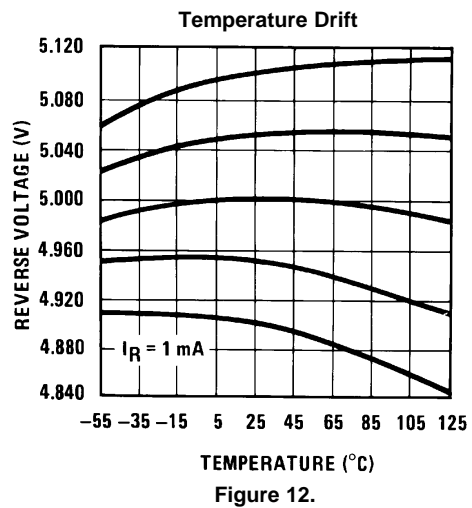


Figure 12.

### TYPICAL PERFORMANCE CHARACTERISTICS (continued)

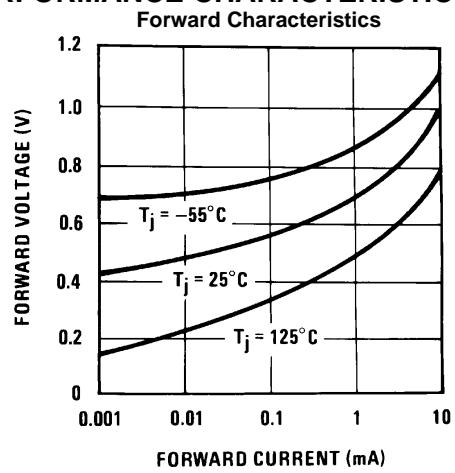


Figure 13.

### APPLICATION HINTS

The LM136-5.0 series voltage references are much easier to use than ordinary zener diodes. Their low impedance and wide operating current range simplify biasing in almost any circuit. Further, either the breakdown voltage or the temperature coefficient can be adjusted to optimize circuit performance.

Figure 14 shows an LM136-5.0 with a 10k potentiometer for adjusting the reverse breakdown voltage. With the addition of R1 the breakdown voltage can be adjusted without affecting the temperature coefficient of the device. The adjustment range is usually sufficient to adjust for both the initial device tolerance and inaccuracies in buffer circuitry.

If minimum temperature coefficient is desired, four diodes can be added in series with the adjustment potentiometer as shown in Figure 15. When the device is adjusted to 5.00V the temperature coefficient is minimized. Almost any silicon signal diode can be used for this purpose such as a 1N914, 1N4148 or a 1N457. For proper temperature compensation the diodes should be in the same thermal environment as the LM136-5.0. It is usually sufficient to mount the diodes near the LM136-5.0 on the printed circuit board. The absolute resistance of the network is not critical and any value from 2k to 20k will work. Because of the wide adjustment range, fixed resistors should be connected in series with the pot to make pot setting less critical.

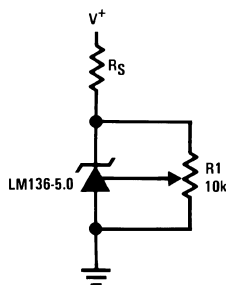


Figure 14. LM136-5.0 with Pot for Adjustment of Breakdown Voltage (Trim Range = ±1.0V Typical)

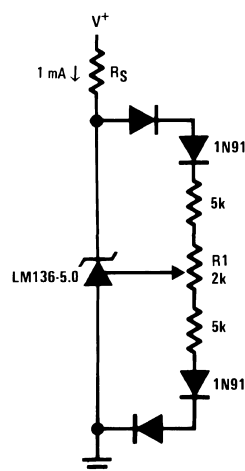
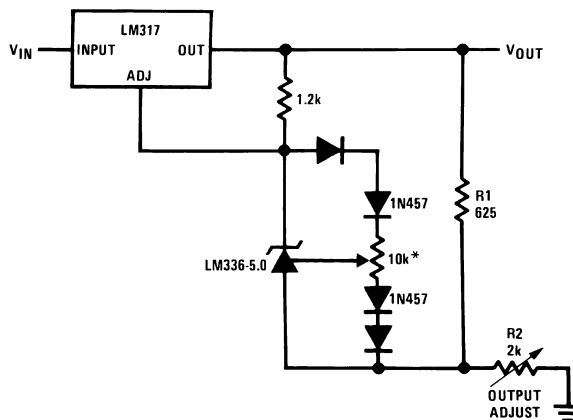


Figure 15. Temperature Coefficient Adjustment (Trim Range = ±0.5V Typical)

### Typical Applications



\* Adjust for 6.25V across R1

Figure 16. Precision Power Regulator with Low Temperature Coefficient

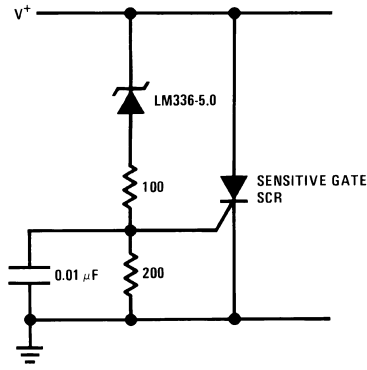


Figure 17. 5V Crowbar

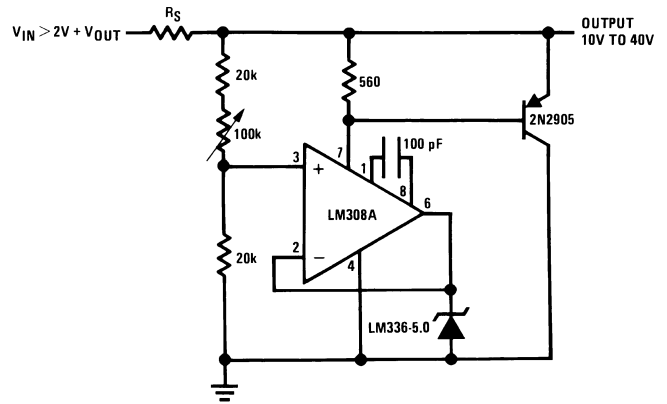


Figure 18. Adjustable Shunt Regulator

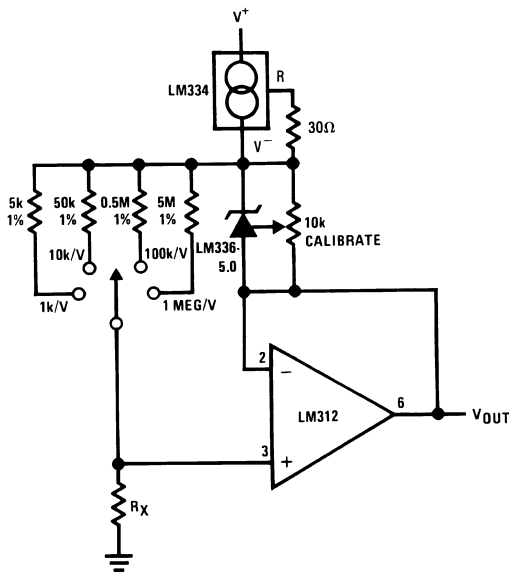


Figure 19. Linear Ohmmeter

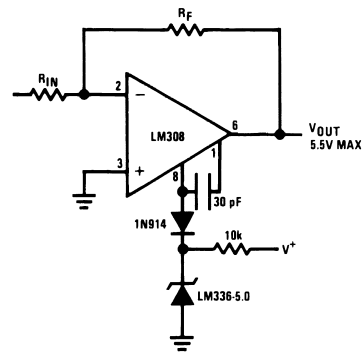


Figure 20. Op Amp with Output Clamped

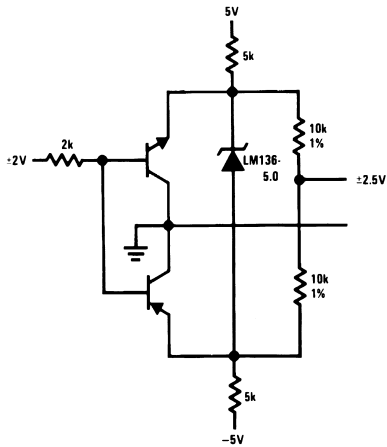


Figure 21. Bipolar Output Reference

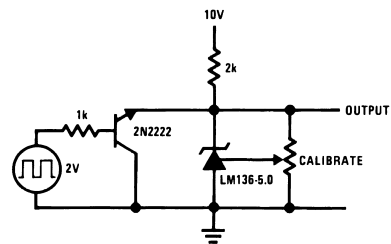


Figure 22. 5.0V Square Wave Calibrator



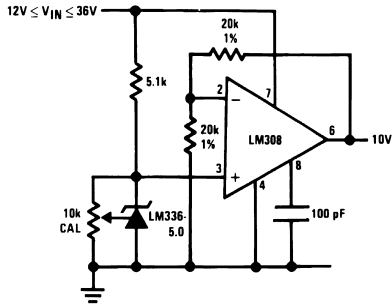


Figure 23. 10V Buffered Reference

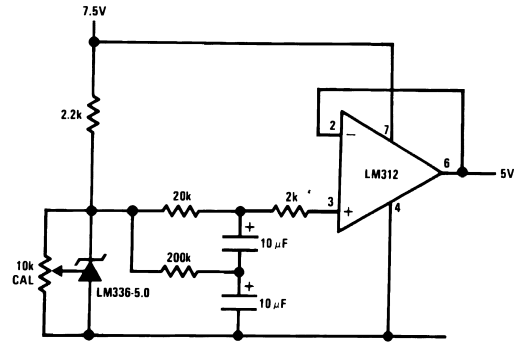


Figure 24. Low Noise Buffered Reference

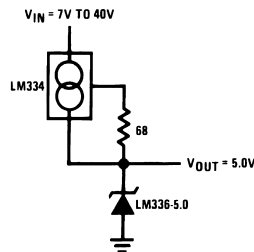
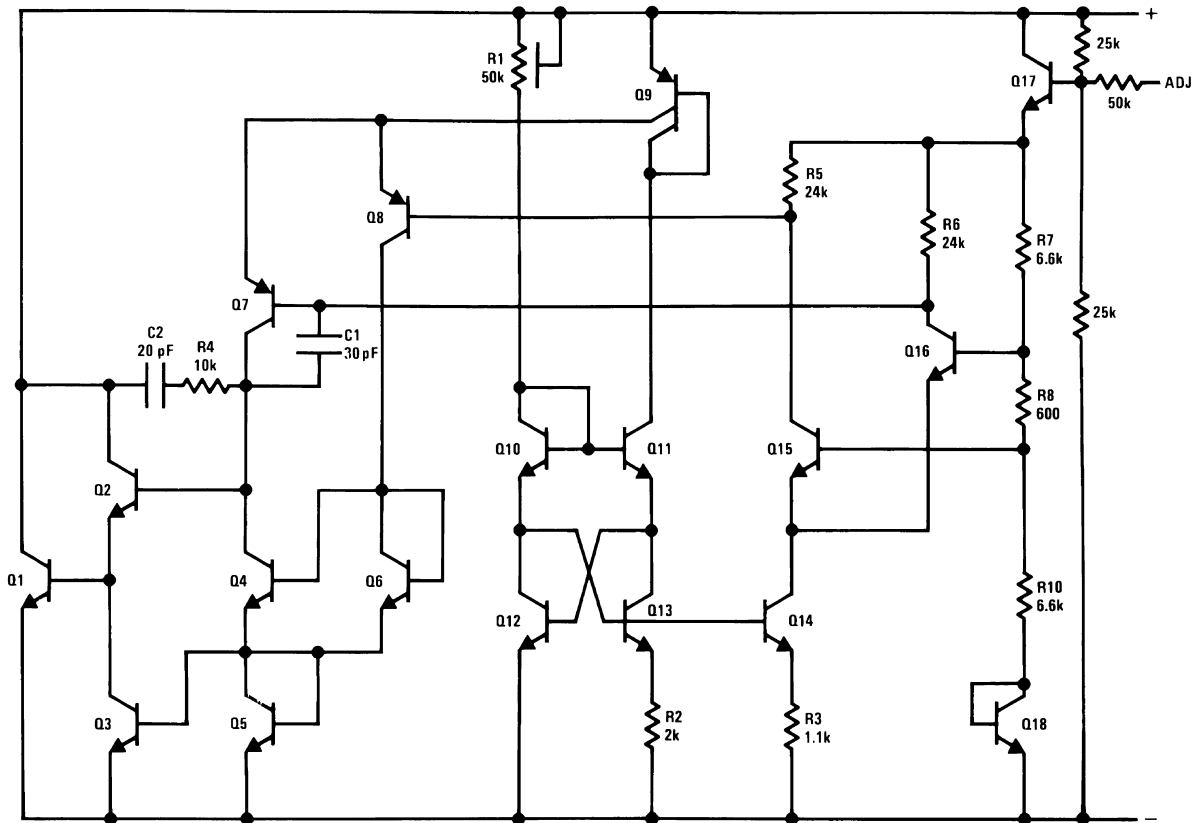


Figure 25. Wide Input Range Reference

Schematic Diagram



## REVISION HISTORY

Changes from Revision C (March 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format .....	<a href="#">9</a>

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM136-5.0-MW8	Active	Production	WAFERSALE (YS)   0	1   NOT REQUIRED	-	Call TI	Level-1-NA-UNLIM	-55 to 125	
<a href="#">LM136AH-5.0</a>	Active	Production	TO (NDV)   3	1000   BULK	No	Call TI	Level-1-NA-UNLIM	-40 to 125	( LM136AH5.0, LM136AH5.0)
<a href="#">LM136AH-5.0/NOPB</a>	Active	Production	TO (NDV)   3	1000   BULK	Yes	Call TI	Level-1-NA-UNLIM	-40 to 125	( LM136AH5.0, LM136AH5.0)
<a href="#">LM136H-5.0</a>	Active	Production	TO (NDV)   3	1000   BULK	No	Call TI	Level-1-NA-UNLIM	-55 to 125	( LM136H5.0, LM136H5.0)
<a href="#">LM136H-5.0/NOPB</a>	Active	Production	TO (NDV)   3	1000   BULK	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	( LM136H5.0, LM136H5.0)
<a href="#">LM236AH-5.0/NOPB</a>	Active	Production	TO (NDV)   3	1000   BULK	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	( LM236AH5.0, LM236AH5.0)
<a href="#">LM236H-5.0</a>	Active	Production	TO (NDV)   3	1000   BULK	No	Call TI	Level-1-NA-UNLIM	-25 to 85	( LM236H5.0, LM236H5.0)
<a href="#">LM236H-5.0/NOPB</a>	Active	Production	TO (NDV)   3	1000   BULK	Yes	Call TI	Level-1-NA-UNLIM	-25 to 85	( LM236H5.0, LM236H5.0)
LM336-5 MWC	Active	Production	WAFERSALE (YS)   0	1   NOT REQUIRED	-	Call TI	Level-1-NA-UNLIM	-40 to 85	
<a href="#">LM336BM-5.0/NOPB</a>	Active	Production	SOIC (D)   8	95   TUBE	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336BM5.0
LM336BM-5.0/NOPB.B	Active	Production	SOIC (D)   8	95   TUBE	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336BM5.0
<a href="#">LM336BMX-5.0/NOPB</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336BM5.0
LM336BMX-5.0/NOPB.B	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336BM5.0
<a href="#">LM336BZ-5.0/NOPB</a>	Active	Production	TO-92 (LP)   3	1800   BULK	Yes	Call TI	N/A for Pkg Type	0 to 70	LM336BZ5.0
LM336BZ-5.0/NOPB.B	Active	Production	TO-92 (LP)   3	1800   BULK	Yes	Call TI	N/A for Pkg Type	0 to 70	LM336BZ5.0
<a href="#">LM336M-5.0/NOPB</a>	Active	Production	SOIC (D)   8	95   TUBE	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336M5.0
LM336M-5.0/NOPB.B	Active	Production	SOIC (D)   8	95   TUBE	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336M5.0

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">LM336MX-5.0/NOPB</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336 M5.0
LM336MX-5.0/NOPB.B	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM336 M5.0
<a href="#">LM336Z-5.0/NOPB</a>	Active	Production	TO-92 (LP)   3	1800   BULK	Yes	Call TI	N/A for Pkg Type	0 to 70	LM336 Z-5.0
LM336Z-5.0/NOPB.B	Active	Production	TO-92 (LP)   3	1800   BULK	Yes	Call TI	N/A for Pkg Type	0 to 70	LM336 Z-5.0

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

(2) **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.

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

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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

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

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

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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.

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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
LM336BMX-5.0/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM336MX-5.0/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM336BMX-5.0/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LM336MX-5.0/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
LM336BM-5.0/NOPB	D	SOIC	8	95	495	8	4064	3.05
LM336BM-5.0/NOPB.B	D	SOIC	8	95	495	8	4064	3.05
LM336M-5.0/NOPB	D	SOIC	8	95	495	8	4064	3.05
LM336M-5.0/NOPB.B	D	SOIC	8	95	495	8	4064	3.05

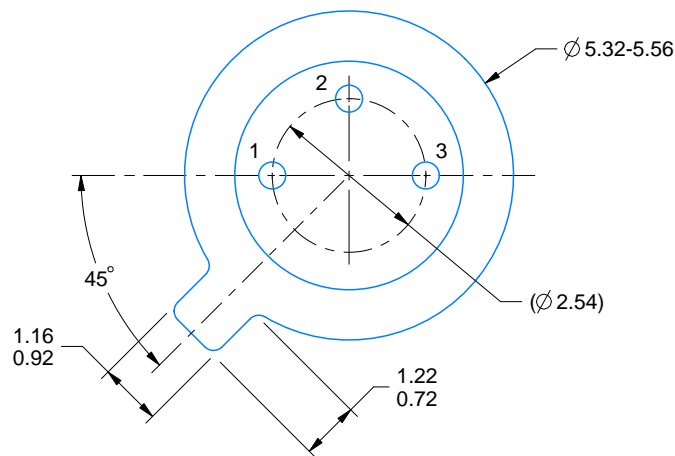
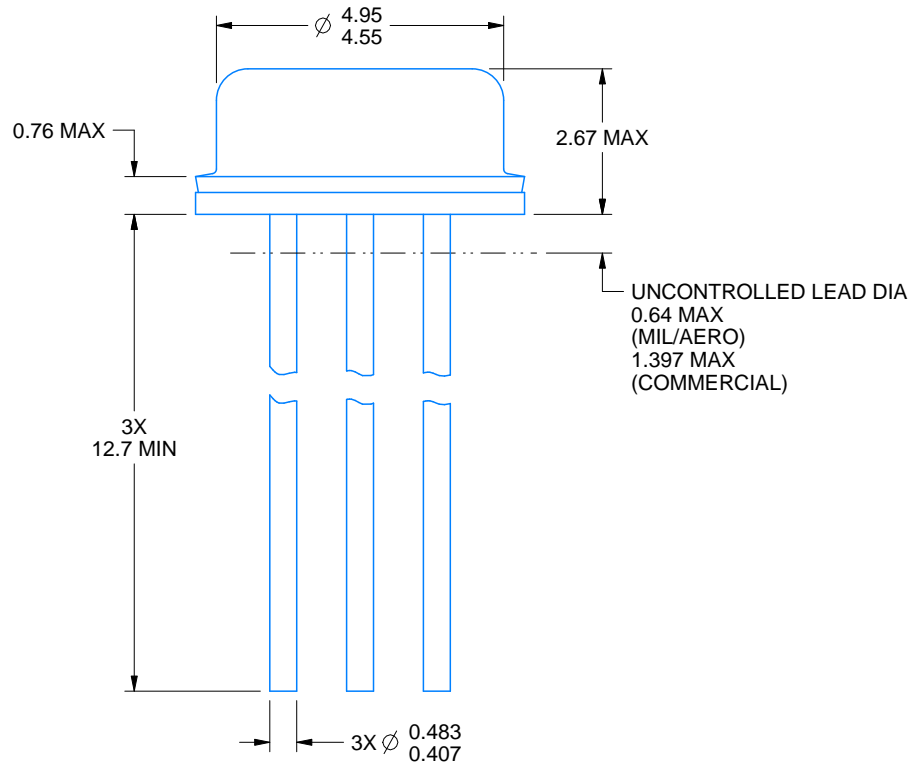
NDV0003H



# PACKAGE OUTLINE

## TO-CAN - 2.67 mm max height

TRANSISTOR OUTLINE



4219876/B 09/2024

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. Reference JEDEC registration TO-46.

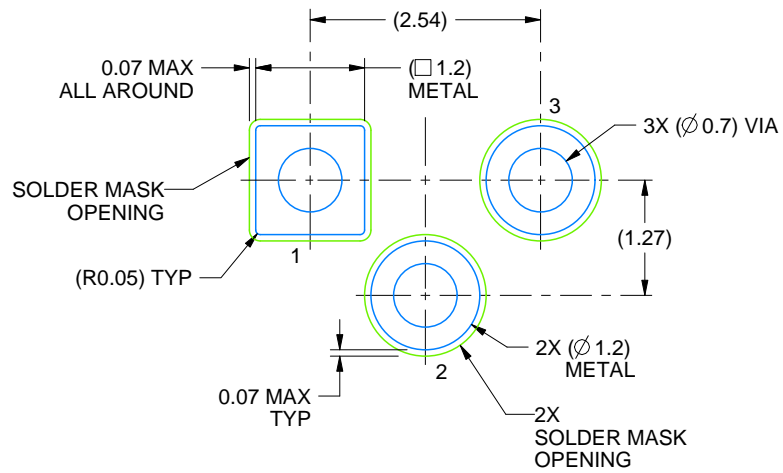


# EXAMPLE BOARD LAYOUT

NDV0003H

TO-CAN - 2.67 mm max height

TRANSISTOR OUTLINE



LAND PATTERN EXAMPLE  
NON-SOLDER MASK DEFINED  
SCALE:12X

4219876/B 09/2024



D0008A

# PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

### NOTES:

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

# EXAMPLE BOARD LAYOUT

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
 EXPOSED METAL SHOWN  
 SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



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

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NOTES: (continued)

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

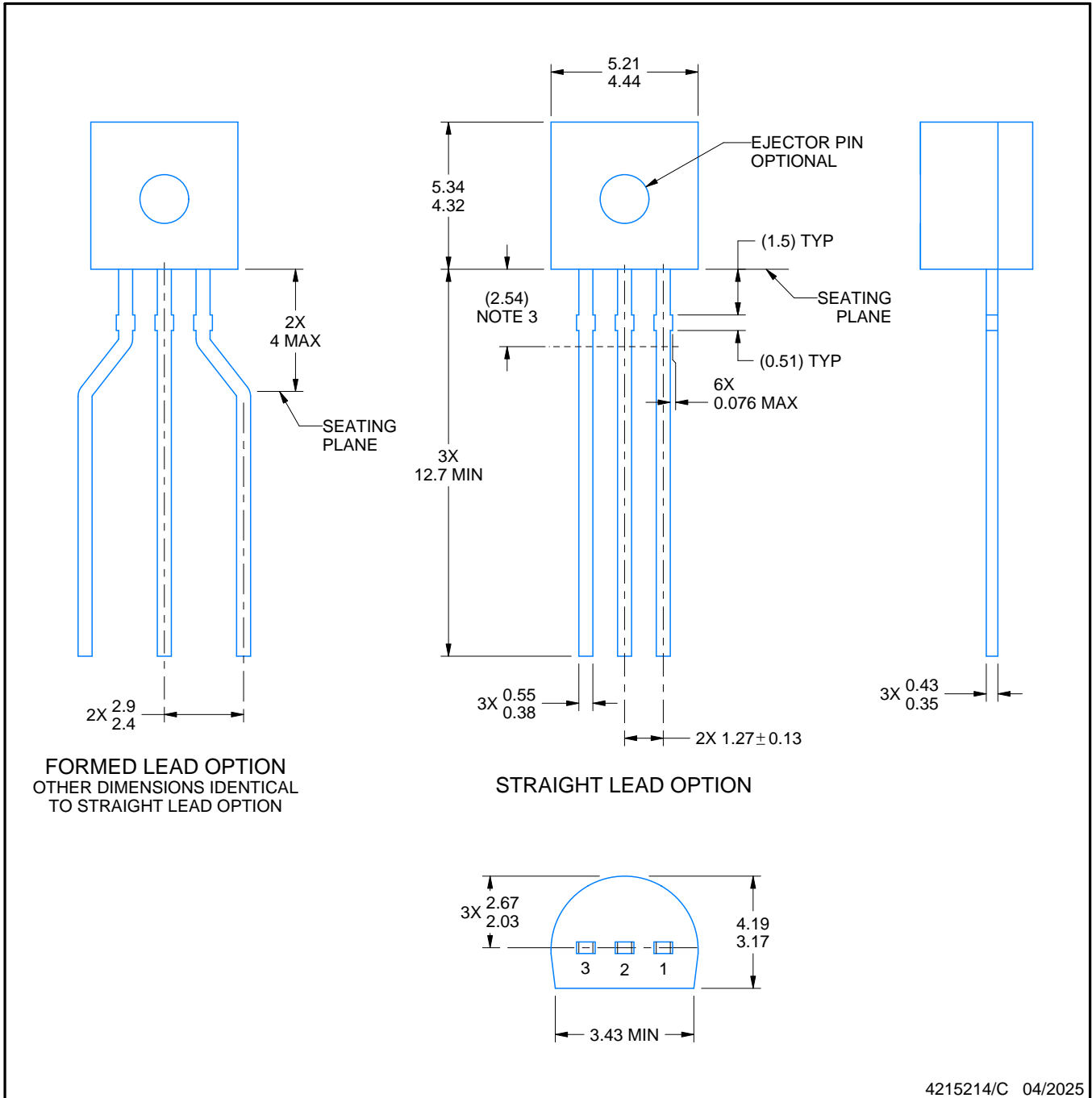
LP0003A



PACKAGE OUTLINE

TO-92 - 5.34 mm max height

TO-92



4215214/C 04/2025

NOTES:

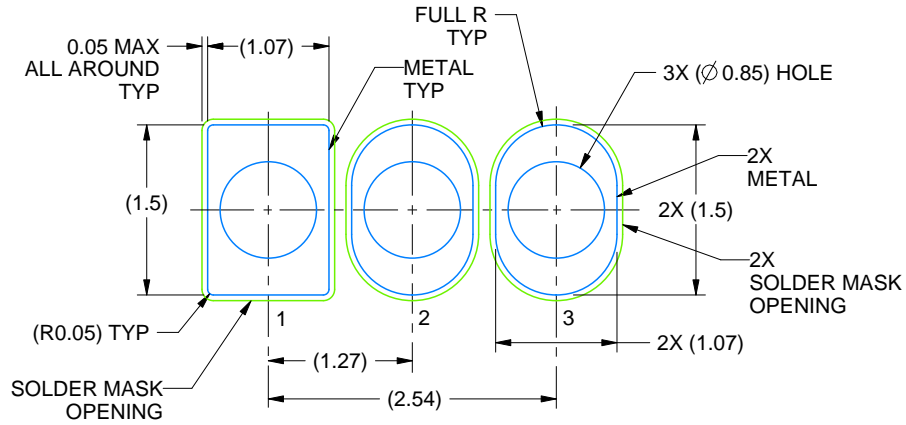
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
  - a. Straight lead option available in bulk pack only.
  - b. Formed lead option available in tape and reel or ammo pack.
  - c. Specific products can be offered in limited combinations of shipping medium and lead options.
  - d. Consult product folder for more information on available options.

# EXAMPLE BOARD LAYOUT

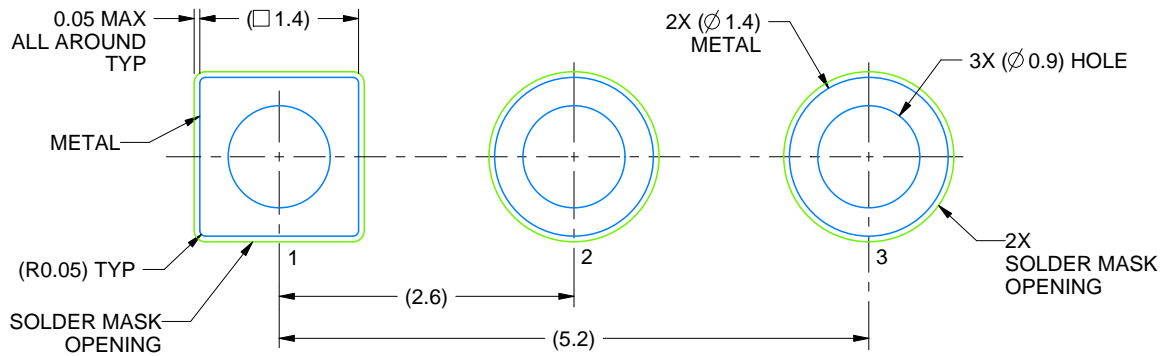
LP0003A

TO-92 - 5.34 mm max height

TO-92



LAND PATTERN EXAMPLE  
STRAIGHT LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X



LAND PATTERN EXAMPLE  
FORMED LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X

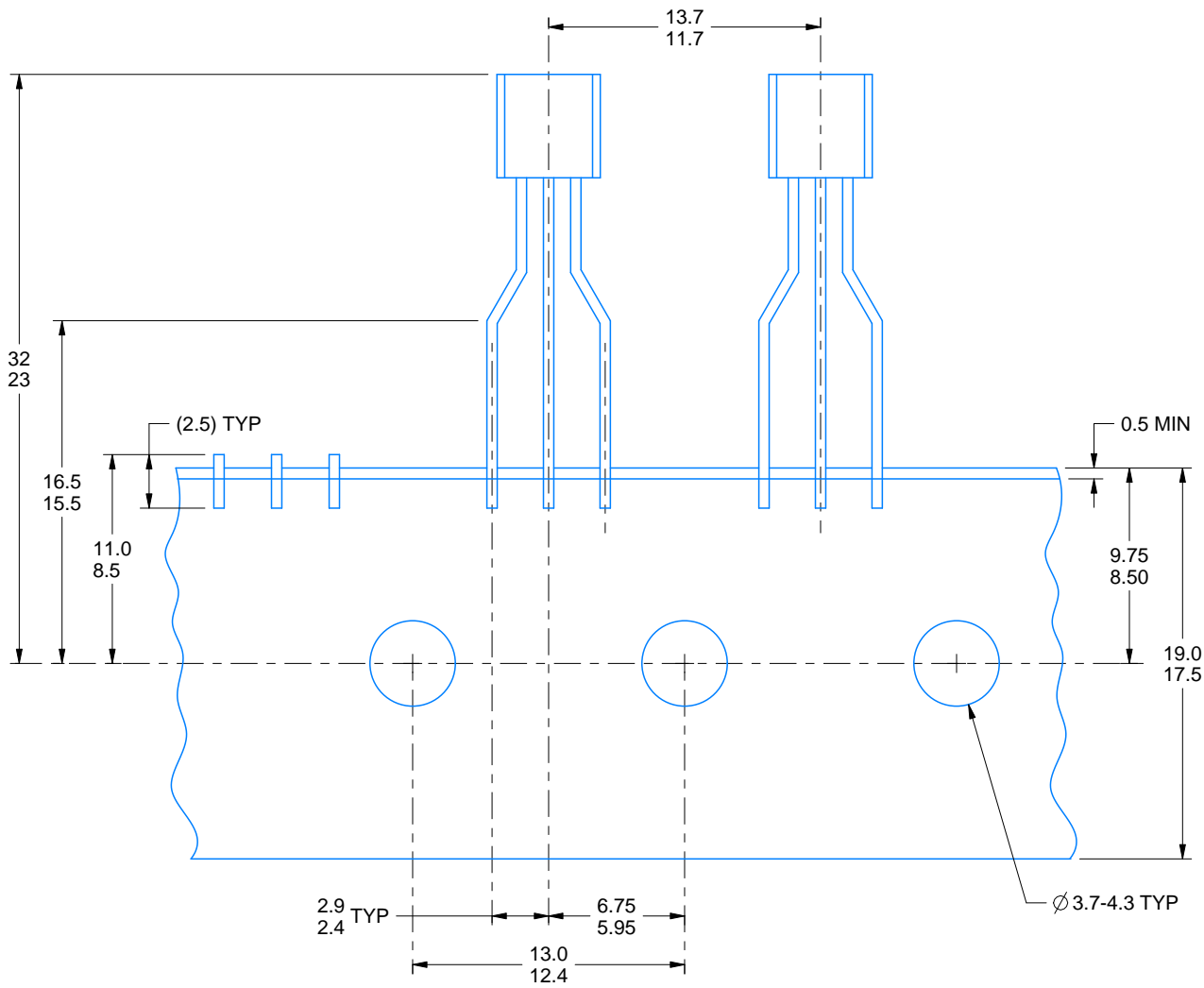
4215214/C 04/2025

**TAPE SPECIFICATIONS**

**LP0003A**

**TO-92 - 5.34 mm max height**

TO-92



FOR FORMED LEAD OPTION PACKAGE

4215214/C 04/2025

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