



# Voltage Reference – LM4040B-4.1

Precision Micropower Shunt Voltage Reference in bare die form

Rev 1.1  
29/07/22

## Description

The LM4040B-4.1 is a high precision, two-terminal shunt mode, bandgap voltage reference with fixed reverse breakdown voltage of 4.096V. The device is ideal for space-critical high reliability applications with initial 0.2% accuracy and 100ppm/°C max temperature coefficient. A 68µA to 15mA shunt current capability with low dynamic impedance ensures stable reverse breakdown voltage accuracy over a wide current range and operating temperature. No external stabilizing capacitors are required.

## Features:

- ±0.2% (max) output voltage tolerance at 25°C
- 20ppm/°C typical temperature coefficient at 25°C
- Wide operating current range 68µA to 15mA
- No output capacitor required
- Tolerates capacitive load
- Bandgap reference corrects temperature drift
- Specified over military temperature range.

## Ordering Information

The following part suffixes apply:

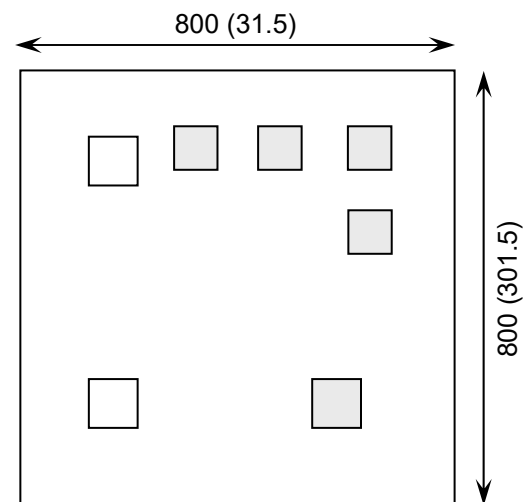
- No suffix - MIL-STD-883 /2010B Visual Inspection
- "H" - MIL-STD-883 /2010B Visual Inspection  
+ MIL-PRF-38534 Class H LAT
- "K" - MIL-STD-883 /2010A Visual Inspection (Space)  
+ MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

[www.siliconsupplies.com/quality/bare-die-lot-qualification](http://www.siliconsupplies.com/quality/bare-die-lot-qualification)

## Die Dimensions in µm (mils)



## Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness <=> 280µm(11 Mils) – On request
- In Metal or Ceramic package – On request

## Mechanical Specification

Die Size (Unsawn)	800 x 800 31.5 x 31.5	µm mils
Minimum Bond Pad Size	90 x 90 3.54 x 3.54	µm mils
Die Thickness	260 (±20) 10.24 (±0.8)	µm mils
Top Metal Composition	Al 1%Si 1.4µm	
Back Metal Composition	Ti/Ni/Ag 1.2µm	

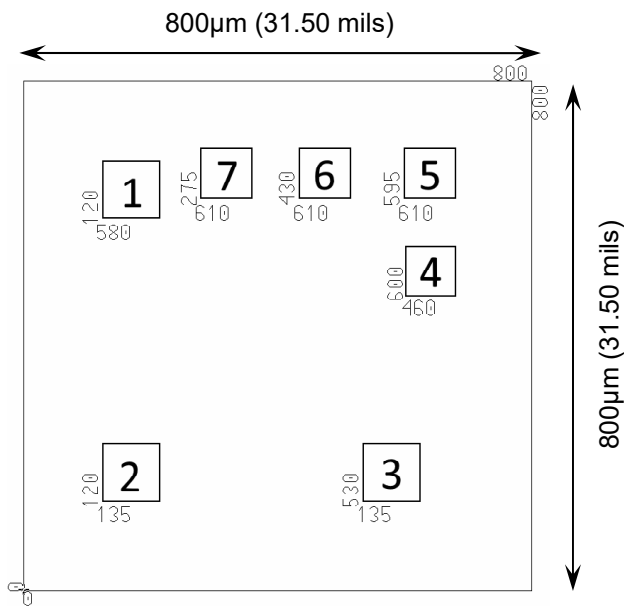




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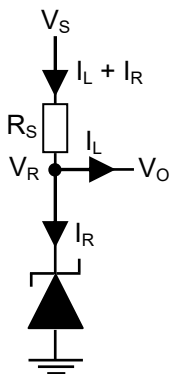
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## Pad Layout and Functions



PAD	FUNCTION	COORDINATES (µm)	
		X	Y
1	CATHODE +	120	580
2	ANODE –	120	135
3	NO CONNECT	530	135
4	NO CONNECT	600	480
5	NO CONNECT	595	610
6	NO CONNECT	430	610
7	NO CONNECT	275	610
CONNECT CHIP BACK TO GND			

## Typical Application



An external series resistor ( $R_S$ ) is connected between the supply voltage,  $V_S$ , and the LM4040B.

$R_S$  determines the current that flows through the load ( $I_L$ ) and the LM4040B ( $I_R$ ). Since load current and supply voltage may vary,  $R_S$  should be small enough to supply at least the minimum acceptable  $I_R$  to the LM4040B even when the supply voltage is at its minimum and the load current is at its maximum value. When the supply voltage is at its maximum and  $I_L$  is at its minimum,  $R_S$  should be large enough so that the current flowing through the LM4040B is less than 15mA.

$R_S$  is determined by the supply voltage, ( $V_S$ ), the load and operating current, ( $I_L$  and  $I_R$ ), and the LM4040B's reverse breakdown voltage,  $V_R$ .

$$R_S = \frac{V_S - V_R}{I_L + I_R}$$





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## Absolute Maximum Ratings<sup>1</sup> $T_A = 25^\circ\text{C}$ unless otherwise stated

PARAMETER	SYMBOL	VALUE	UNIT
Reverse Current	$I_R$	25	mA
Forward Current	$I_F$	10	mA
Operating Temperature Range	$T_J$	-55 to +150	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	-65 to 150	$^\circ\text{C}$

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

## Recommended Operating Conditions $T_J = 25^\circ\text{C}$ unless otherwise stated

PARAMETER	SYMBOL	MIN	MAX	UNIT
Reverse Current	$I_R$	0.068	15	mA
Operating Temperature Range	-	-55 to 125		$^\circ\text{C}$

## Electrical Characteristics, $T_J = 25^\circ\text{C}$ unless otherwise stated

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reverse Breakdown Voltage	$V_R$	$I_R = 100\mu\text{A}$	-	4.096	-	V
Reverse Breakdown Voltage Tolerance <sup>2</sup>	$V_R$	$I_R = 100\mu\text{A}$	-	-	$\pm 8.2$	mV
		$I_R = 100\mu\text{A}, T_J = -40$ to $+85^\circ\text{C}$	-	-	$\pm 35$	
		$I_R = 100\mu\text{A}, T_J = -55$ to $+125^\circ\text{C}$	-	-	$\pm 49$	
Minimum Operating Current	$I_{RMIN}$	$T_J = 25^\circ\text{C}$	-	50	68	$\mu\text{A}$
		$T_J = -55$ to $+125^\circ\text{C}$	-	-	73	
Average Reverse Breakdown Voltage Temperature Coefficient <sup>2</sup>	$\Delta V_R / \Delta T$	$I_R = 10\text{mA}$	-	$\pm 30$	-	ppm / $^\circ\text{C}$
		$I_R = 1\text{mA}$	-	$\pm 20$	-	
		$I_R = 100\mu\text{A}$	-	$\pm 20$	-	
		$I_R = 10\text{mA}, T_J = -55$ to $+125^\circ\text{C}$	-	-	$\pm 100$	
		$I_R = 1\text{mA}, T_J = -55$ to $+125^\circ\text{C}$	-	-	$\pm 100$	
		$I_R = 100\mu\text{A}, T_J = -55$ to $+125^\circ\text{C}$	-	-	$\pm 100$	
Breakdown Voltage Change with Operating Current Change <sup>7</sup>	$\Delta V_R / \Delta I_R$	$I_{RMIN} \leq I_R \leq 1\text{mA}$	-	0.5	0.9	mV
		$I_{RMIN} \leq I_R \leq 1\text{mA}, T_J = -55$ to $+125^\circ\text{C}$	-	-	1.2	
		$1\text{mA} \leq I_R \leq 15\text{mA}$	-	3	7	
		$1\text{mA} \leq I_R \leq 15\text{mA}, T_J = -55$ to $+125^\circ\text{C}$	-	-	10	





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## Electrical Characteristics, $T_J = 25^\circ\text{C}$ unless otherwise stated

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reverse Dynamic Impedance	$Z_R$	$I_R = 1\text{mA}$ , $f = 120\text{ Hz}$ , $I_{AC} = 0.1 I_R$	-	0.5	1	$\Omega$
Wideband Noise	$e_N$	$I_R = 100\mu\text{A}$ , $10\text{ Hz} \leq f \leq 10\text{ kHz}$	-	80	-	$\mu\text{V}_{\text{RMS}}$
Reverse Breakdown Voltage Long Term Stability	$\Delta V_R$	$t = 1000\text{ hours}$ $T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$ , $I_R = 100\mu\text{A}$	-	120	-	ppm
Thermal Hysteresis	$V_{\text{HYST}}$	$\Delta T = -40\text{ to }125^\circ\text{C}$	-	0.08	-	%

2. Reverse Breakdown Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\text{max}\Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\text{max}\Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. 3. Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately. Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $+125^\circ\text{C}$ .

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