Voltage Reference – LM4040E-4.1

Precision Micropower Shunt Voltage Reference in bare die form

Rev 1.1
29/07/22

Description

The LM4040E-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 2% accuracy and 150ppm/°C max temperature coefficient. A 73µA 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:

- ±2% (max) output voltage tolerance at 25°C
- 20ppm/°C typical temperature coefficient at 25°C
- Wide operating current range 73µA 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:

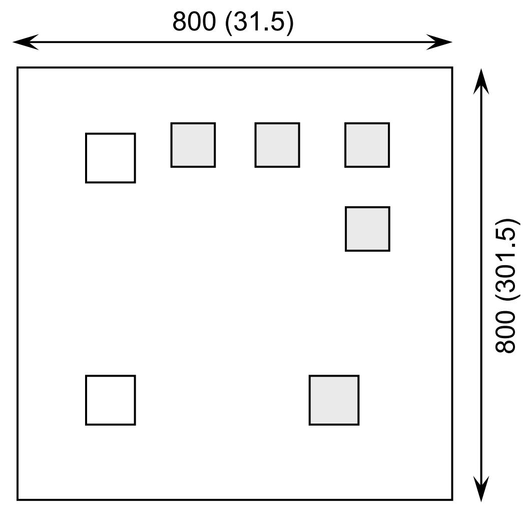
- No suffix - MIL-STD-883 /2010B Visual Inspection
- "**H**" - MIL-STD-883 /2010B Visual Inspection
  + MIL-PRF-38534 Class H LAT
- "**K**" - MIL-STD-883 /2010A Visual Inspection (Space)
  + MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

www.siliconsupplies.com\quality\bare-die-lot-qualification

Die Dimensions in µm (mils)



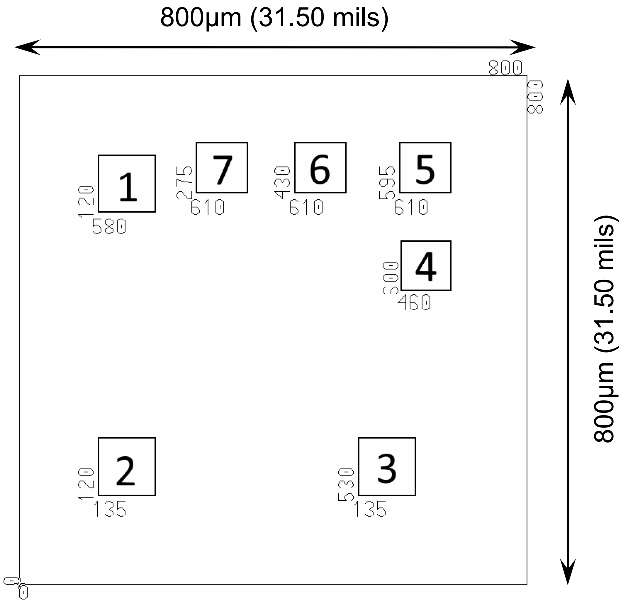
Supply Formats:

- 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

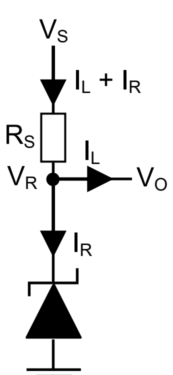
Die Size (Unsawn)	800 x 800 31.5 x 31.5	µm mils
Minimum Bond Pad Size	90 x 90 3.54 x 3.54	µm mils
Die Thickness	260 (±20) 10.24 (±0.8)	µm mils
Top Metal Composition	Al 1%Si 1.4µm	
Back Metal Composition	Ti/Ni/Ag 1.2µm	

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 LM4040E.

R_S determines the current that flows through the load (I_L) and the LM4040E (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 LM4040E 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 LM4040E 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 LM4040E's reverse breakdown voltage, V_R.

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

Absolute Maximum Ratings[1] T_A = 25°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	°C
Storage Temperature	T_{STG}	-65 to 150	°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°C unless otherwise stated

PARAMETER	SYMBOL	MIN	MAX	UNIT
Reverse Current	I_R	0.073	15	mA
Operating Temperature Range	-	-55 to 125		°C

Electrical Characteristics, T_J = 25°C unless otherwise stated

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reverse Breakdown Voltage	V_R	I_R =100μA	-	4.096	-	V
Reverse Breakdown Voltage Tolerance[2]	V_R	I_R =100μA	-	-	±82	mV
		I_R =100μA, T_J = -40 to +85°C	-	-	±122	
		I_R =100μA, T_J = -55 to +125°C	-	-	±143	
Minimum Operating Current	I_{RMIN}	T_J = 25°C	-	50	73	μA
		T_J = -55 to +125°C	-	-	78	
Average Reverse Breakdown Voltage Temperature Coefficient[2]	$\Delta V_R / \Delta T$	I_R =10mA	-	±30	-	ppm /°C
		I_R =1mA	-	±20	-	
		I_R =100μA	-	±20	-	
		I_R =10mA, T_J = -55 to +125°C	-	-	±150	
		I_R =1mA, T_J = -55 to +125°C	-	-	±150	
		I_R =100μA, T_J = -55 to +125°C	-	-	±150	
Breakdown Voltage Change with Operating Current Change[7]	$\Delta V_R / \Delta I_R$	$I_{RMIN} \leq I_R \leq$ 1mA	-	0.5	0.9	mV
		$I_{RMIN} \leq I_R \leq$ 1mA, T_J = -55 to +125°C	-	-	1.5	
		1mA $\leq I_R \leq$ 15mA	-	3	9	
		1mA $\leq I_R \leq$ 15mA, T_J = -55 to +125°C	-	-	13	

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PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reverse Dynamic Impedance	Z_R	I_R = 1mA, f = 120 Hz, I_{AC} = 0.1 I_R	-	0.5	1.3	Ω
Wideband Noise	e_N	I_R =100µA, 10 Hz ≤ f ≤ 10 kHz	-	80	-	μV_{RMS}
Reverse Breakdown Voltage Long Term Stability	ΔV_R	t = 1000 hours T = 25°C ±0.1°C, I_R =100µA	-	120	-	ppm
Thermal Hysteresis	V_{HYST}	ΔT = -40 to 125°C	-	0.08	-	%

2. Reverse Breakdown Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance $\pm[(\Delta V_R/\Delta T)(max\Delta T)(V_R)]$. Where, $\Delta V_R/\Delta T$ is the V_R temperature coefficient, $max\Delta T$ is the maximum difference in temperature from the reference point of 25˚C to T_{MIN} or T_{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˚C after cycling to temperature -40˚C and the 25˚C measurement after cycling to temperature +125˚C.