LM4030 SOT-23 Ultra-High Precision Shunt Voltage Reference

Check for Samples: LM4030

FEATURES

- **High Output Voltage Accuracy 0.05%**
- **Low Temperature Coefficient 10 ppm/°C**
- **Extended Temperature Operation -40-125°C**
- **Excellent Thermal Hysteresis, 75ppm**
- **Excellent Long-Term Stability, 40ppm**
- **High Immunity to Board Stress Effects**
- **Capable of Handling 50 mA Transients**
- **Voltage Options 2.5V, 4.096V**
- **SOT-23 Package**

APPLICATIONS

- **Data Acquisition/Signal path**
- **Test and Measurement**
- **Automotive & Industrial**
- **Communications**
- **Instrumentation**
- **Power Management**

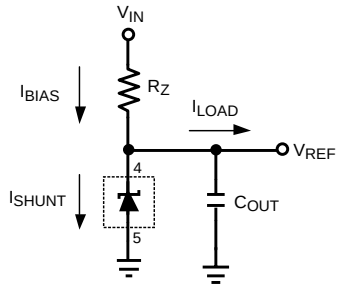
DESCRIPTION

The LM4030 is an ultra-high precision shunt voltage reference, having exceptionally high initial accuracy (0.05%) and temperature stability (10ppm/°C). The LM4030 is available with fixed voltage options of 2.5V and 4.096V. Despite the tiny SOT-23 package, the LM4030 exhibits excellent thermal hysteresis (75ppm) and long-term stability (40ppm) as well as immunity to board stress effects.

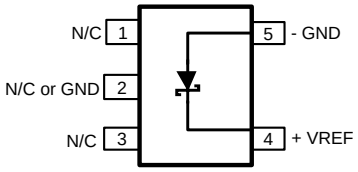
The LM4030 is designed to operate without an external capacitor, but any capacitor up to 10µF may be used. The LM4030 can be powered off as little as 120µA (max) but is capable of shunting up to 30mA continuously. As with any shunt reference, the LM4030 can be powered off of virtually any supply and is a simple way to generate a highly accurate system reference.

The LM4030 is available in three grades (A, B, and C). The best grade devices (A) have an initial accuracy of 0.05% with ensured temperature coefficient of 10 ppm/°C or less, while the lowest grade parts (C) have an initial accuracy of 0.15% and a temperature coefficient of 30 ppm/°C.

Typical Application Circuit



Connection Diagram



SOT-23 Package
(Top View)

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PIN DESCRIPTIONS

Pin #	Name	Function
1	N/C	No connect pin, leave floating
2	GND, N/C	Ground or no connect
3	N/C	No connect pin, leave floating
4	VREF	Reference voltsge
5	GND	Ground



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 (1)(2)

Maximum Voltage on any input	-0.3 to 6V
Power Dissipation (T_A = 25°C) (3)	350mW
Storage Temperature Range	−65°C to 150°C
Lead Temperature (soldering, 10sec)	260°C
Vapor Phase (60 sec)	215°C
Infrared (15sec)	220°C
ESD Susceptibility (4) Human Body Model	2kV

(1) Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. Operating Ratings indicate conditions for which the device is intended to be functional, but do not ensure specific performance limits. For ensured specifications, see Electrical Characteristics.

(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.

(3) Without PCB copper enhancements. The maximum power dissipation must be de-rated at elevated temperatures and is limited by T_{JMAX} (maximum junction temperature), θ_{J-A} (junction to ambient thermal resistance) and T_A (ambient temperature). The maximum power dissipation at any temperature is: $P_{DissMAX} = (T_{JMAX} - T_A) / \theta_{J-A}$ up to the value listed in the Absolute Maximum Ratings. θ_{J-A} for SOT-23 package is 220°C/W, T_{JMAX} = 125°C.

(4) The human body model is a 100 pF capacitor discharged through a 1.5 kΩ resistor into each pin.

Operating Ratings

Maximum Continuous Shunt Current	30mA
Maximum Shunt Current (<1s)	50mA
Junction Temperature Range (T_J)	−40°C to +125°C

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Electrical Characteristics
LM4030-2.5 (V_{OUT} = 2.5V)

Limits in standard type are for T_J = 25°C only, and limits in boldface type apply over the junction temperature (T_J) range of -40°C to +125°C. Minimum and Maximum limits are ensured through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Reverse Breakdown Voltage	I_{SHUNT} = 120µA		2.5		V
	Reverse Breakdown Voltage Tolerance (I_{SHUNT} = 120µA)					
	LM4030A-2.5	(A Grade - 0.05%)	-0.05		0.05	%
	LM4030B-2.5	(B Grade - 0.10%)	-0.10		0.10	%
	LM4030C-2.5	(C Grade - 0.15%)	-0.15		0.15	%
I_{RMIN}	Minimum Operating Current				**120**	µA
TC	Temperature Coefficient (3)					
	LM4030A-2.5	0°C ≤ T_J ≤ + 85°C			**10**	ppm / °C
		-40°C ≤ T_J ≤ +125°C			**20**	ppm / °C
	LM4030B-2.5	-40°C ≤ T_J ≤ +125°C			**20**	ppm / °C
	LM4030C-2.5	-40°C ≤ T_J ≤ +125°C			**30**	ppm / °C
$\Delta V_{REF}/\Delta I_{SHUNT}$	Reverse Breakdown Voltage Change with Current	160µA ≤ I_{SHUNT} ≤ 30mA		25	**110**	ppm / mA
ΔV_{REF}	Long Term Stability (4)	1000 Hrs, T_A = 30°C		40		ppm
V_{HYST}	Thermal Hysteresis (5)	-40°C ≤ T_J ≤ +125°C		75		ppm
V_N	Output Noise Voltage (6)	0.1 Hz to 10 Hz		105		μV_{PP}

(1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlation using Statistical Quality Control.
(2) Typical numbers are at 25°C and represent the most likely parametric norm.
(3) Temperature coefficient is measured by the "Box" method; i.e., the maximum ΔV_{REF} is divided by the maximum ΔT.
(4) Long term stability is V_{REF} @25°C measured during 1000 hrs. This measurement is taken for I_R = 500 µA.
(5) Thermal hysteresis is defined as the change in +25°C output voltage before and after cycling the device from (-40°C to 125°C) eight times.
(6) Low frequency peak-to-peak noise measured using first-order 0.1 Hz HPF and second-order 10 Hz LPF.

Electrical Characteristics
LM4030-4.096 (V_{OUT} = 4.096V)

Limits in standard type are for T_J = 25°C only, and limits in boldface type apply over the junction temperature (T_J) range of -40°C to +125°C. Minimum and Maximum limits are ensured through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Reverse Breakdown Voltage	I_{SHUNT} = 130µA		4.096		V
	Reverse Breakdown Voltage Tolerance (I_{SHUNT} = 130µA)					
	LM4030A-4.096	(A Grade - 0.05%)	-0.05		0.05	%
	LM4030B-4.096	(B Grade - 0.10%)	-0.10		0.10	%
	LM4030C-4.096	(C Grade - 0.15%)	-0.15		0.15	%
I_{RMIN}	Minimum Operating Current				**130**	µA
TC	Temperature Coefficient (3)					
	LM4030A-4.096	0°C ≤ T_J ≤ + 85°C			**10**	ppm / °C
		-40°C ≤ T_J ≤ +125°C			**20**	ppm / °C
	LM4030B-4.096	-40°C ≤ T_J ≤ +125°C			**20**	ppm / °C
	LM4030C-4.096	-40°C ≤ T_J ≤ +125°C			**30**	ppm / °C
$\Delta V_{REF}/\Delta I_{LOAD}$	Reverse Breakdown Voltage Change with Current	160µA ≤ I_{SHUNT} ≤ 30mA		15	**95**	ppm / mA

(1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlation using Statistical Quality Control.
(2) Typical numbers are at 25°C and represent the most likely parametric norm.
(3) Temperature coefficient is measured by the "Box" method; i.e., the maximum ΔV_{REF} is divided by the maximum ΔT.

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Electrical Characteristics
LM4030-4.096 (V_{OUT} = 4.096V) (continued)

Limits in standard type are for T_J = 25°C only, and limits in boldface type apply over the junction temperature (T_J) range of -40°C to +125°C. Minimum and Maximum limits are ensured through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
ΔV_{REF}	Long Term Stability (4)	1000 Hrs, T_A = 30°C		40		ppm
V_{HYST}	Thermal Hysteresis (5)	-40°C ≤ T_J ≤ +125°C		75		ppm
V_N	Output Noise Voltage (6)	0.1 Hz to 10 Hz		165		μV_{PP}

(4) Long term stability is V_{REF} @25°C measured during 1000 hrs. This measurement is taken for I_R = 500 µA.
(5) Thermal hysteresis is defined as the change in +25°C output voltage before and after cycling the device from (-40°C to 125°C) eight times.
(6) Low frequency peak-to-peak noise measured using first-order 0.1 Hz HPF and second-order 10 Hz LPF.

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Typical Performance Characteristics for 2.5V

Output Voltage vs Temperature

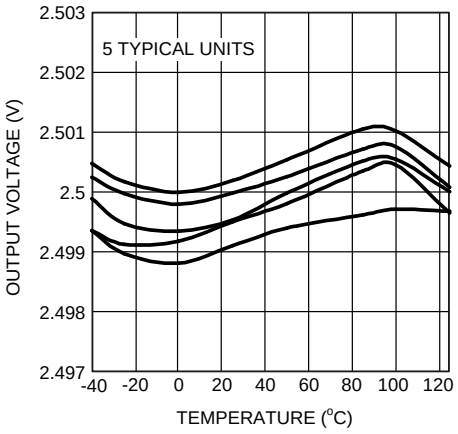


Figure 1.

0.1 - 10 Hz Peak-to-Peak Noise

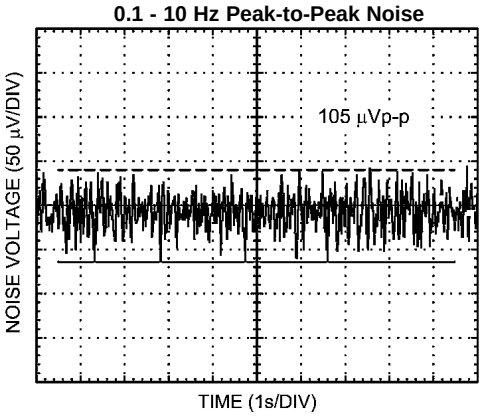


Figure 2.

Start Up - 120 µA

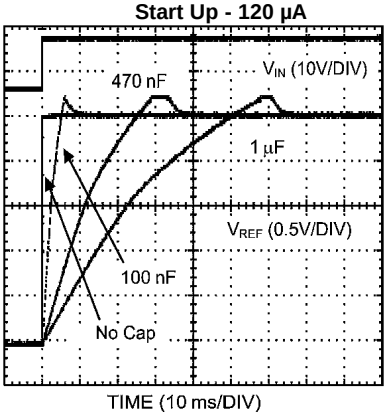


Figure 3.

Start Up - 50 mA

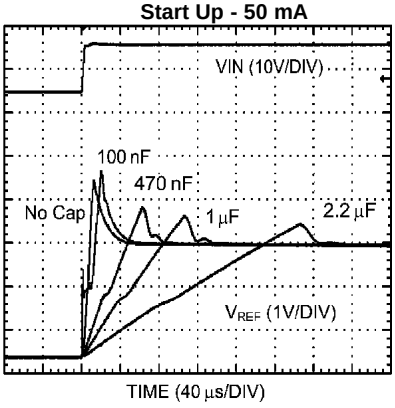


Figure 4.

Reverse Breakdown Voltage Change with Current

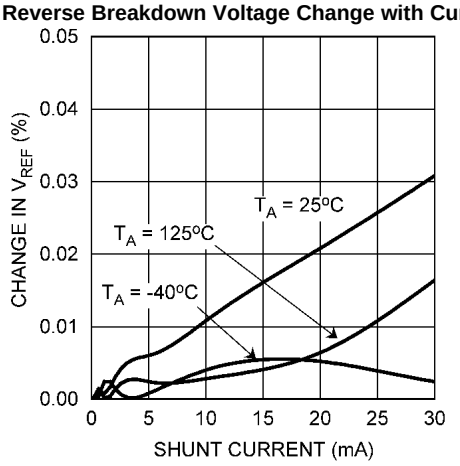


Figure 5.

Reverse Dynamic Impedance vs Frequency

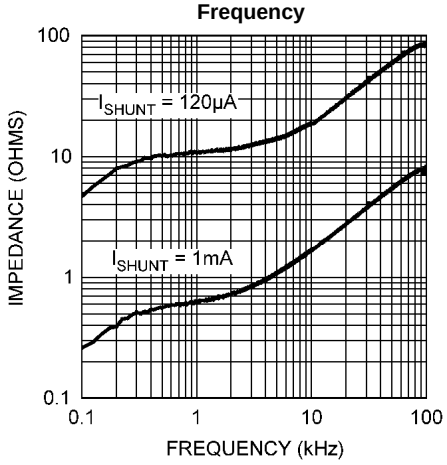


Figure 6.

Typical Performance Characteristics for 4.096V

Output Voltage vs Temperature

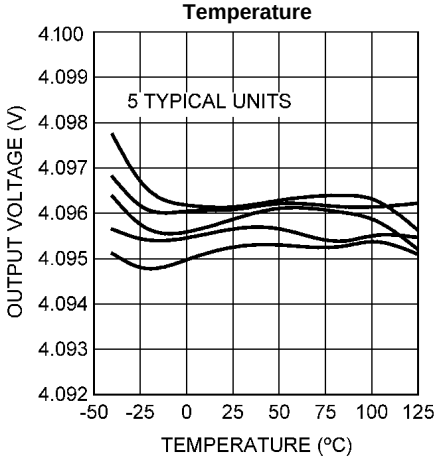


Figure 7.

0.1 - 10 Hz Peak-to-Peak Noise

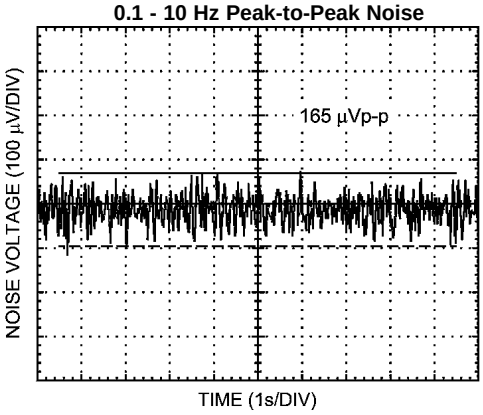


Figure 8.

Start Up - 130 µA

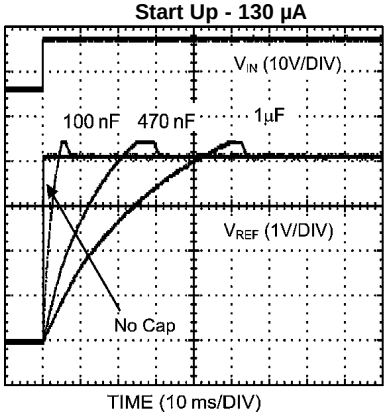


Figure 9.

Start Up - 50 mA

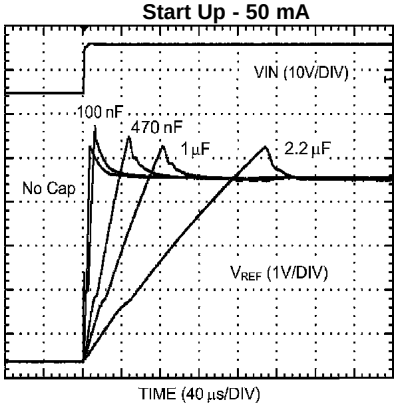


Figure 10.

Reverse Breakdown Voltage Change with Current

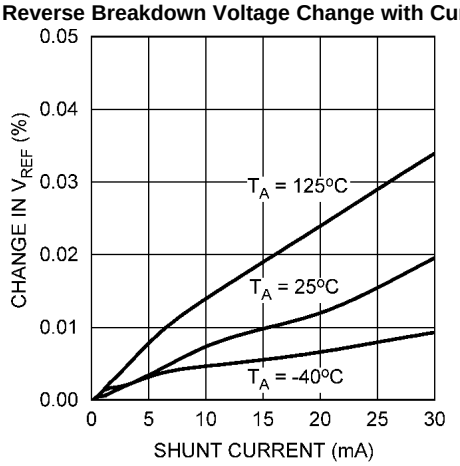


Figure 11.

Reverse Dynamic Impedance vs Frequency

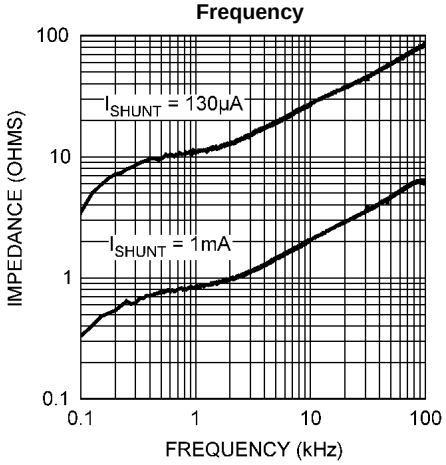


Figure 12.

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Typical Performance Characteristics

Forward Characteristic

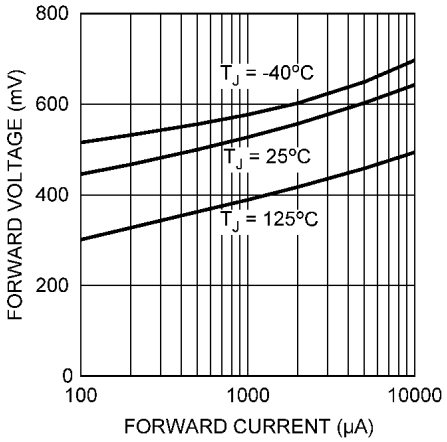


Figure 13.

Load Transient Response

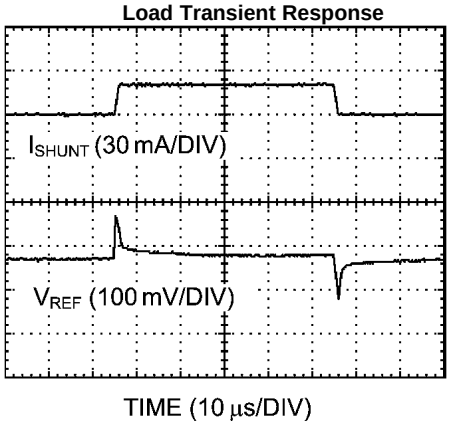


Figure 14.

Minimum Operating Current

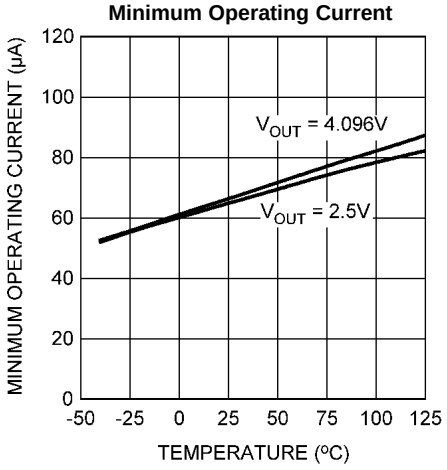


Figure 15.

Noise Spectrum

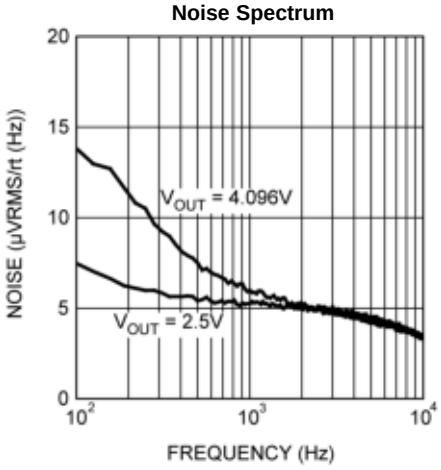


Figure 16.

Thermal Hysteresis Distribution

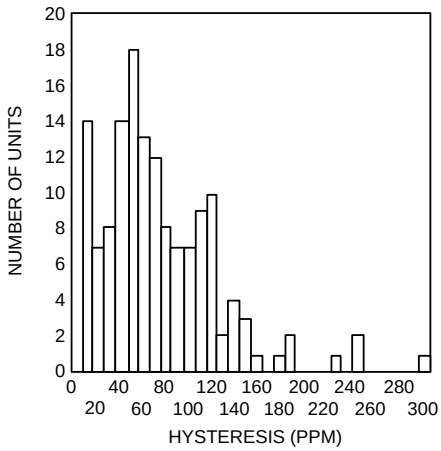


Figure 17.

Output Voltage vs Thermal Cycle (-40°C to 125°C)

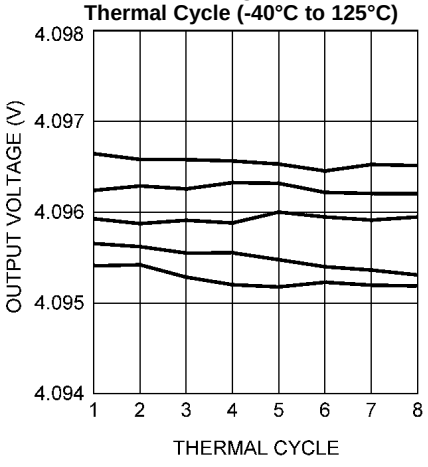


Figure 18.

Typical Performance Characteristics (continued)

Long Term Stability (T_A = 25°C)

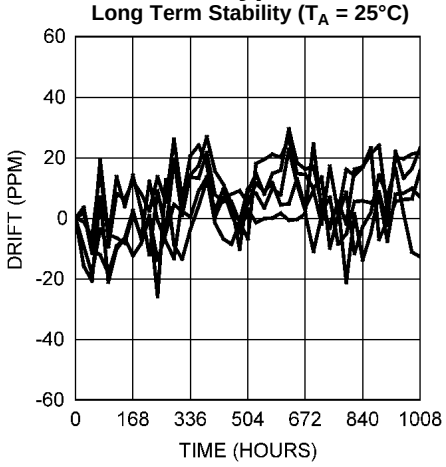


Figure 19.

Long Term Stability (T_A =125°C)

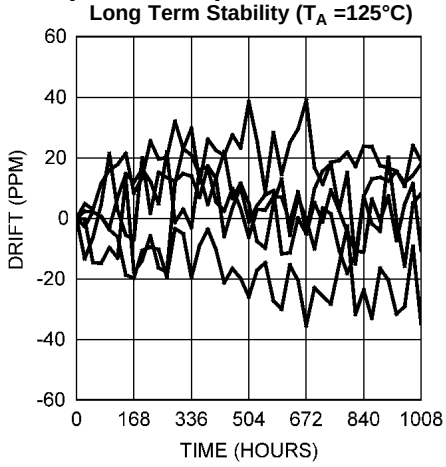


Figure 20.

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APPLICATION INFORMATION

THEORY OF OPERATION

The LM4030 is an ultra-high precision shunt voltage reference, having exceptionally high initial accuracy (0.05%) and temperature stability (10ppm/°C). The LM4030 is available with fixed voltage options of 2.5V and 4.096V. Despite the tiny SOT-23 package, the LM4030 exhibits excellent thermal hysteresis (75ppm) and long-term stability (25ppm). The LM4030 is designed to operate without an external capacitor, but any capacitor up to 10 µF may be used. The LM4030 can be powered off as little as 120 µA (max) but is capable of shunting up to 30 mA continuously. The typical application circuit for the LM4030 is shown in Figure 21.

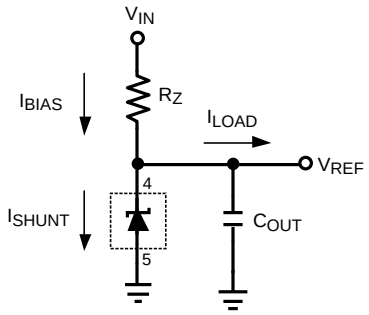


Figure 21. Typical Application Circuit

COMPONENT SELECTION

A resistor must be chosen to set the maximum operating current for the LM4030 (R_Z in Figure 21). The value of the resistor can be calculated using the following equation:

$$R_Z = (V_{IN} - V_{REF})/(I_{MIN_OPERATING} + I_{LOAD_MAX}) \quad (1)$$

R_Z is chosen such that the total current flowing through R_Z is greater than the maximum load current plus the minimum operating current of the reference itself. This ensures that the reference is never starved for current. Running the LM4030 at higher currents is advantageous for reducing noise. The reverse dynamic impedance of the V_{REF} node scales inversely with the shunted current (see Figure 22) leading to higher rejection of noise emanating from the input supply and from EMI (electro-magnetic interferrence).

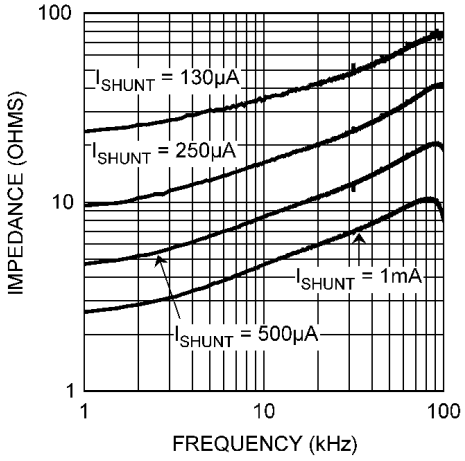


Figure 22. Reverse Dynamic Impedance vs I_{OUT}

The LM4030 is designed to operate with or without a bypass capacitor (C_{OUT} in Figure 21) and is stable with capacitors of up to 10 µF. The use of a bypass capacitor can improve transient response and reduce broadband noise. Additionally, a bypass capacitor will counter the rising reverse dynamic impedance at higher frequencies improving noise immunity (see Figure 23).

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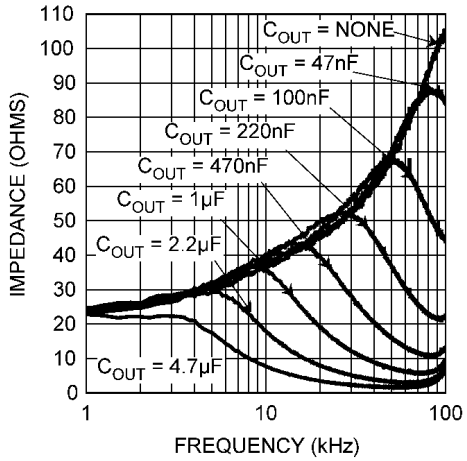


Figure 23. Reverse Dynamic Impedance vs C_{OUT}

As with other regulators, an external capacitor reduces the amplitude of the V_{REF} transient when a sudden change in loading takes place. The capacitor should be placed as close to the part as possible to reduce the effects of unwanted board parasitics.

THERMAL HYSTERESIS

Thermal hysteresis is the defined as the change in output voltage at 25°C after some deviation from 25°C. This is to say that thermal hysteresis is the difference in output voltage between two points in a given temperature profile. An illustrative temperature profile is shown in Figure 24.

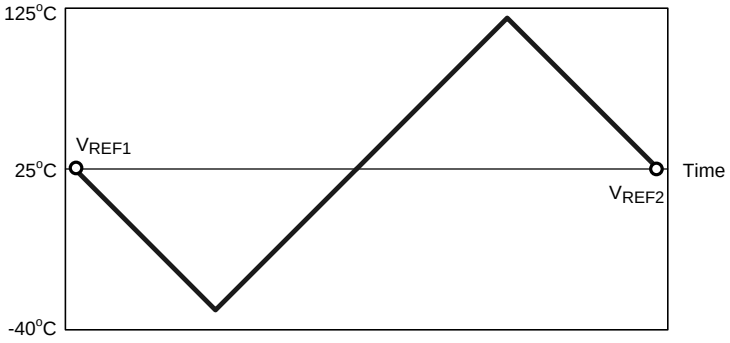


Figure 24. Illustrative Temperature Profile

This may be expressed analytically as the following:

$$V_{HYS} = \frac{|V_{REF1} - V_{REF2}|}{V_{REF}} \times 10^6 \text{ ppm} \quad (2)$$

where

- V_{HYS} = Thermal hysteresis expressed in ppm
- V_{REF} = Nominal preset output voltage
- V_{REF1} = V_{REF} before temperature fluctuation
- V_{REF2} = V_{REF} after temperature fluctuation

The LM4030 features a low thermal hysteresis of 75 ppm (typical) from -40°C to 125°C after 8 temperature cycles.

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TEMPERATURE COEFFICIENT

Temperature drift is defined as the maximum deviation in output voltage over the temperature range. This deviation over temperature may be illustrated as shown in Figure 25.

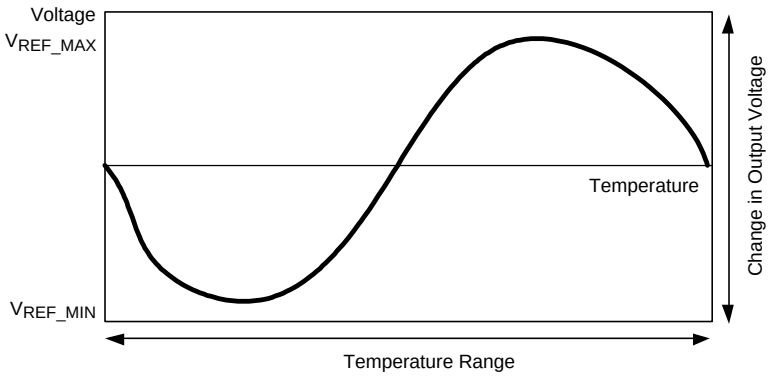


Figure 25. Illustrative V_{REF} vs Temperature Profile

Temperature coefficient may be expressed analytically as the following:

$$T_D = \frac{(V_{REF_MAX} - V_{REF_MIN})}{V_{REF} \times \Delta T} \times 10^6 \text{ ppm} \quad (3)$$

where

- T_D = Temperature drift
- V_{REF} = Nominal preset output voltage
- V_{REF_MIN} = Minimum output voltage over operating temperature range
- V_{REF_MAX} = Maximum output voltage over operating temperature range
- ΔT = Operating temperature range

The LM4030 features a low temperature drift of 10ppm (max) to 30ppm (max), depending on the grade.

DYNAMIC OFFSET CANCELLATION AND LONG TERM STABILITY

Aside from initial accuracy and drift performance, other specifications such as thermal hysteresis and long-term stability can affect the accuracy of a voltage reference, especially over the lifetime of the application. The reference voltage can also shift due to board stress once the part is mounted onto the PCB and during subsequent thermal cycles. Generally, these shifts in VREF arise due to offsets between matched devices within the regulation loop. Both passive and active devices naturally experience drift over time and stress and temperature gradients across the silicon die also generate offset. The LM4030 incorporates a dynamic offset cancellation scheme which compensates for offsets developing within the regulation loop. This gives the LM4030 excellent long-term stability (40 ppm typical) and thermal hysteresis performance (75ppm typical), as well as substantial immunity to PCB stress effects, despite being packaged in a tiny SOT-23.

EXPRESSION OF ELECTRICAL CHARACTERISTICS

Electrical characteristics are typically expressed in mV, ppm, or a percentage of the nominal value. Depending on the application, one expression may be more useful than the other. To convert one quantity to the other one may apply the following:

ppm to mV error in output voltage:

$$\frac{V_{REF} \times ppm_{ERROR}}{10^3} = V_{ERROR} \quad (4)$$

where

- V_{REF} is in volts (V) and V_{ERROR} is in milli-volts (mV)

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Bit error (1 bit) to voltage error (mV):

$$\frac{V_{REF}}{2^n} \times 10^3 = V_{ERROR} \quad (5)$$

V_{REF} is in volts (V), V_{ERROR} is in milli-volts (mV), and n is the number of bits.

mV to ppm error in output voltage:

$$\frac{V_{ERROR}}{V_{REF}} \times 10^3 = ppm_{ERROR} \quad (6)$$

where

- V_{REF} is in volts (V) and V_{ERROR} is in milli-volts (mV)

Voltage error (mV) to percentage error (percent):

$$\frac{V_{ERROR}}{V_{REF}} \times 0.1 = Percent_Error \quad (7)$$

where

- V_{REF} is in volts (V) and V_{ERROR} is in milli-volts (mV)

PRINTED CIRCUIT BOARD and LAYOUT CONSIDERATIONS

The LM4030 has a very small change in reverse voltage with current (25ppm/mA typical) so large variations in load current (up to 50mA) should not appreciably shift VREF. Parasitic resistance between the LM4030 and the load introduces a voltage drop proportional to load current and should be minimized. The LM4030 should be placed as close to the load it is driving as the layout will allow. The location of R_Z is not important, but C_{OUT} should be as close to the LM4030 as possible so added ESR does not degrade the transient performance.

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REVISION HISTORY

Changes from Revision A (April 2013) to Revision B	Page
• Changed layout of National Data Sheet to TI format	12

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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)
LM4030AMF-2.5/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JA
LM4030AMF-2.5/NOPB.A	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JA
LM4030AMF-4.096/NO.A	Active	Production	SOT-23 (DBV) | 5	1000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KA
LM4030AMF-4.096/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KA
LM4030AMFX-2.5/NO.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JA
LM4030AMFX-2.5/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JA
LM4030BMF-2.5/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JB
LM4030BMF-2.5/NOPB.A	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JB
LM4030BMF-4.096/NO.A	Active	Production	SOT-23 (DBV) | 5	1000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KB
LM4030BMF-4.096/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KB
LM4030BMFX-2.5/NO.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JB
LM4030BMFX-2.5/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JB
LM4030BMFX4.096/NO.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KB
LM4030BMFX4.096/NO.B	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	-	Call TI	Call TI	-40 to 125	
LM4030BMFX4.096/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KB
LM4030CMF-2.5/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JC
LM4030CMF-2.5/NOPB.A	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JC
LM4030CMF-2.5/NOPB.B	Active	Production	SOT-23 (DBV) | 5	1000 | SMALL T&R	-	Call TI	Call TI	-40 to 125	
LM4030CMF-4.096/NO.A	Active	Production	SOT-23 (DBV) | 5	1000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KC
LM4030CMF-4.096/NOPB	Active	Production	SOT-23 (DBV) | 5	1000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KC
LM4030CMFX-2.5/NO.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JC
LM4030CMFX-2.5/NO.B	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	-	Call TI	Call TI	-40 to 125	
LM4030CMFX-2.5/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5JC
LM4030CMFX4.096/NO.A	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KC
LM4030CMFX4.096/NOPB	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	R5KC

(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.

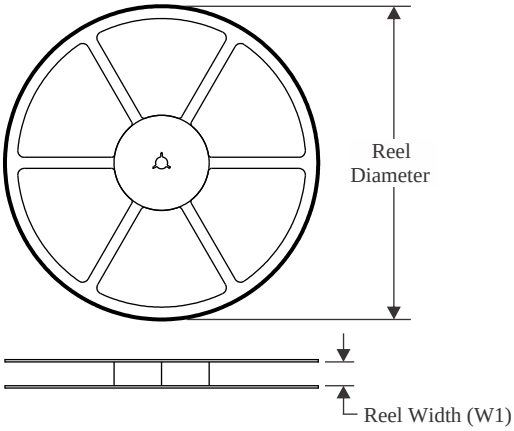
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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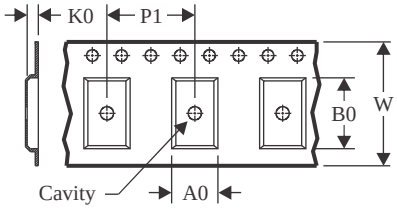
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TAPE AND REEL INFORMATION

REEL DIMENSIONS

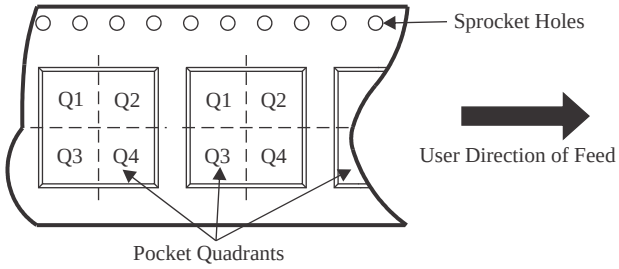


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

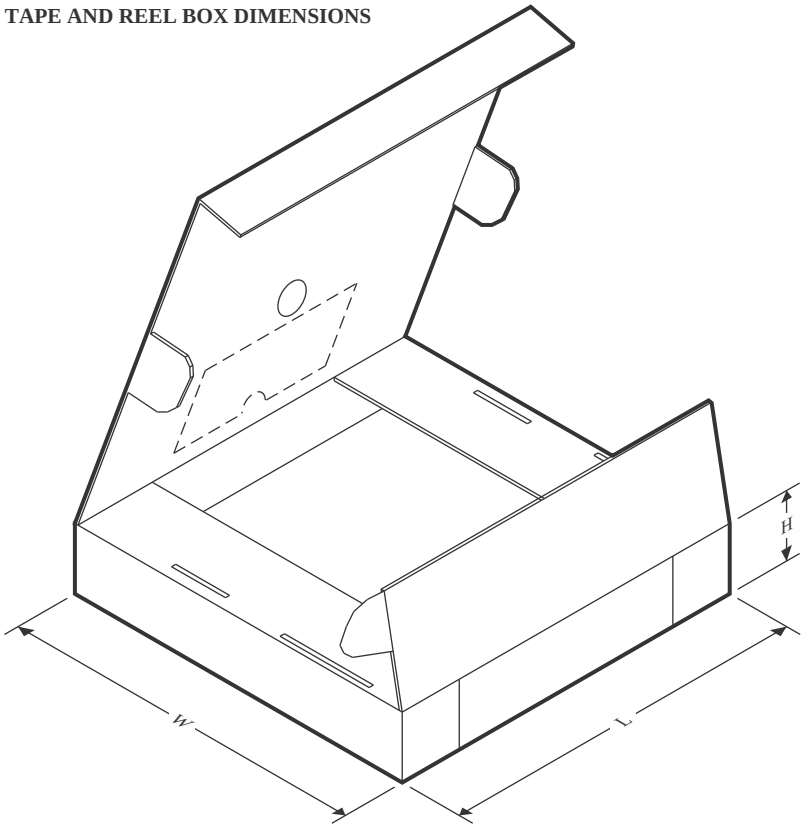
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LM4030AMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030AMF-4.096/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030AMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030BMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030BMF-4.096/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030BMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030BMFX4.096/ NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030CMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030CMF-4.096/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030CMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4030CMFX4.096/ NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

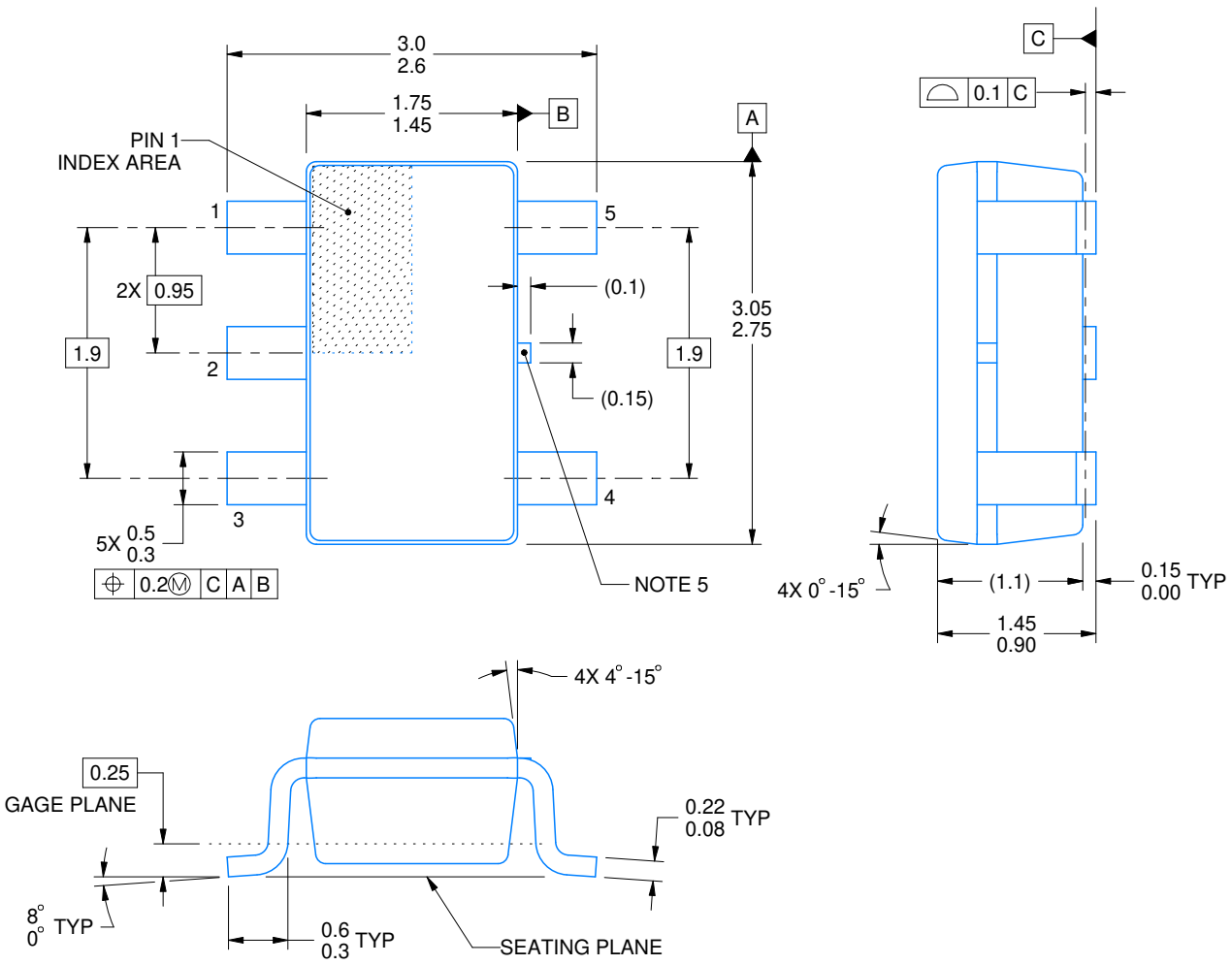
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM4030AMF-2.5/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LM4030AMF-4.096/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LM4030AMFX-2.5/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0
LM4030BMF-2.5/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LM4030BMF-4.096/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LM4030BMFX-2.5/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0
LM4030BMFX4.096/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0
LM4030CMF-2.5/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LM4030CMF-4.096/NOPB	SOT-23	DBV	5	1000	208.0	191.0	35.0
LM4030CMFX-2.5/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0
LM4030CMFX4.096/NOPB	SOT-23	DBV	5	3000	208.0	191.0	35.0

PACKAGE OUTLINE

DBV0005A

SOT-23 - 1.45 mm max height

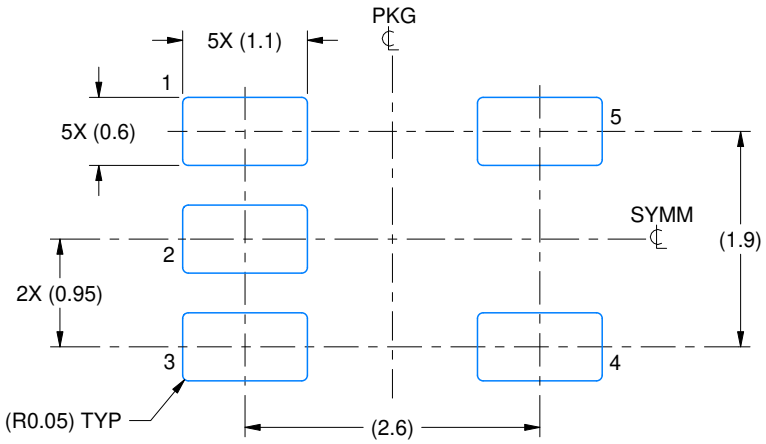
SMALL OUTLINE TRANSISTOR



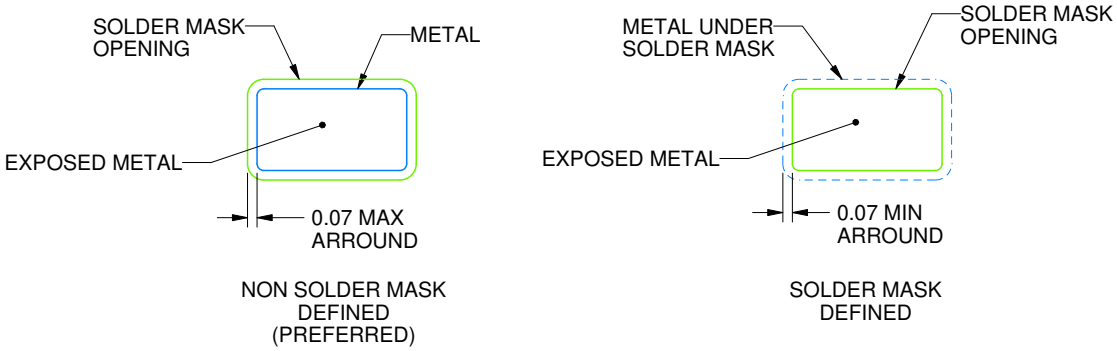
4214839/K 08/2024

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. Refernce JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

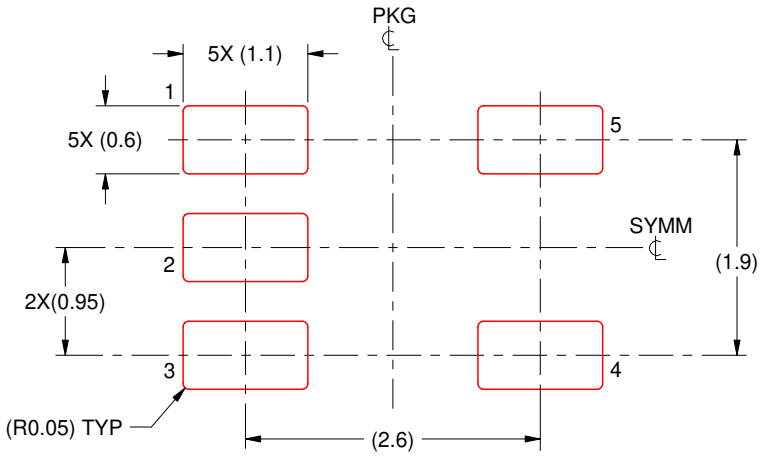


SOLDER MASK DETAILS

4214839/K 08/2024

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.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214839/K 08/2024

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.

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