

LM4132 SOT-23 Precision Low Dropout Voltage Reference

Check for Samples: [LM4132](#)

FEATURES

- Output Initial Voltage Accuracy 0.05%
- Low Temperature Coefficient 10ppm/°C
- Low Supply Current, 60µA
- Enable Pin Allowing a 3µA Shutdown Mode
- 20mA Output Current
- Voltage Options 1.8V, 2.048V, 2.5V, 3.0V, 3.3V, 4.096V
- Custom Voltage Options Available (1.8V to 4.096V)
- V_{IN} Range of $V_{REF} + 400\text{mV}$ to 5.5V @ 10mA
- Stable with Low ESR Ceramic Capacitors
- SOT23-5 Package

APPLICATIONS

- Instrumentation & Process Control
- Test Equipment
- Data Acquisition Systems
- Base Stations
- Servo Systems
- Portable, Battery Powered Equipment
- Automotive & Industrial
- Precision Regulators
- Battery Chargers
- Communications
- Medical Equipment

DESCRIPTION

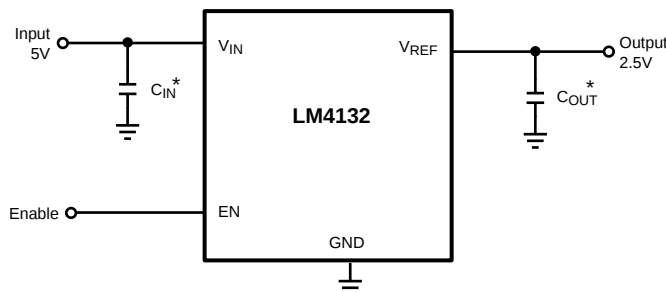
The LM4132 family of precision voltage references performs comparable to the best laser-trimmed bipolar references, but in cost effective CMOS technology. The key to this break through is the use of EEPROM registers for correction of curvature, tempco, and accuracy on a CMOS bandgap architecture that allows package level programming to overcome assembly shift. The shifts in voltage accuracy and tempco during assembly of die into plastic packages limit the accuracy of references trimmed with laser techniques.

Unlike other LDO references, the LM4132 is capable of delivering up to 20mA and does not require an output capacitor or buffer amplifier. These advantages and the SOT23 packaging are important for space-critical applications.

Series references provide lower power consumption than shunt references, since they do not have to idle the maximum possible load current under no load conditions. This advantage, the low quiescent current (60µA), and the low dropout voltage (400mV) make the LM4132 ideal for battery-powered solutions.

The LM4132 is available in five grades (A, B, C, D and E) for greater flexibility. The best grade devices (A) have an initial accuracy of 0.05% with a specified temperature coefficient of 10ppm/°C or less, while the lowest grade parts (E) have an initial accuracy of 0.5% and a tempco of 30ppm/°C.

Typical Application Circuit



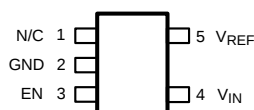
*Note: The capacitor C_{IN} is required and the capacitor C_{OUT} is optional.



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Connection Diagram



(Top View)
See Package Number DBV0005A

PIN DESCRIPTIONS

Pin #	Name	Function
1	N/C	No connect pin, leave floating
2	GND	Ground
3	EN	Enable pin
4	V _{IN}	Input supply
5	V _{REF}	Reference output



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
Output short circuit duration	Indefinite
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. For 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_{JA} (junction to ambient thermal resistance) and T_A (ambient temperature). The maximum power dissipation at any temperature is: $P_{DISSMAX} = (T_{JMAX} - T_A) / \theta_{JA}$ up to the value listed in the Absolute Maximum Ratings. θ_{JA} for SOT23-5 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 Input Supply Voltage	5.5V
Maximum Enable Input Voltage	V _{IN}
Maximum Load Current	20mA
Junction Temperature Range (T _J)	-40°C to +125°C

Electrical Characteristics

LM4132-1.8 ($V_{OUT} = 1.8V$)

Limits in standard type are for $T_J = 25^{\circ}C$ only, and limits in boldface type apply over the junction temperature (T_J) range of $-40^{\circ}C$ to $+125^{\circ}C$ unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at $T_J = 25^{\circ}C$, and are provided for reference purposes only. Unless otherwise specified $V_{IN} = 5V$ and $I_{LOAD} = 0$

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Output Voltage Initial Accuracy					
	LM4132A-1.8	(A Grade - 0.05%)	-0.05		0.05	%
	LM4132B-1.8	(B Grade - 0.1%)	-0.1		0.1	
	LM4132C-1.8	(C Grade - 0.2%)	-0.2		0.2	
	LM4132D-1.8	(D Grade - 0.4%)	-0.4		0.4	
	LM4132E-1.8	(E Grade - 0.5%)	-0.5		0.5	
$TCV_{REF} / ^{\circ}C$ (Note 6)	Temperature Coefficient					
	LM4132A-1.8	$0^{\circ}C \leq T_J \leq +85^{\circ}C$			10	ppm / $^{\circ}C$
		$-40^{\circ}C \leq T_J \leq +125^{\circ}C$			20	
	LM4132B-1.8	$-40^{\circ}C \leq T_J \leq +125^{\circ}C$			20	
	LM4132C-1.8				20	
	LM4132D-1.8				20	
	LM4132E-1.8				30	
I_Q	Supply Current			60	100	μA
I_{Q_SD}	Supply Current in Shutdown	EN = 0V		3	7	μA
$\Delta V_{REF}/\Delta V_{IN}$	Line Regulation	$V_{REF} + 400mV \leq V_{IN} \leq 5.5V$		30		ppm / V
$\Delta V_{REF}/\Delta I_{LOAD}$	Load Regulation	$0mA \leq I_{LOAD} \leq 20mA$		25	120	ppm / mA
ΔV_{REF}	Long Term Stability ⁽³⁾	1000 Hrs		50		ppm
	Thermal Hysteresis ⁽⁴⁾	$-40^{\circ}C \leq T_J \leq +125^{\circ}C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage ⁽⁵⁾	$I_{LOAD} = 10mA$		230	400	mV
V_N	Output Noise Voltage	0.1 Hz to 10 Hz		170		μV_{PP}
I_{SC}	Short Circuit Current				75	mA
V_{IL}	Enable Pin Maximum Low Input Level				35	% V_{IN}
V_{IH}	Enable Pin Minimum High Input Level		65			% V_{IN}

- (1) Limits are 100% production tested at $25^{\circ}C$. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at $25^{\circ}C$ and represent the most likely parametric norm.
- (3) Long term stability is V_{REF} @ $25^{\circ}C$ measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in $+25^{\circ}C$ output voltage before and after cycling the device from $(-40^{\circ}C$ to $125^{\circ}C)$.
- (5) Dropout voltage is defined as the minimum input to output differential at which the output voltage drops by 0.5% below the value measured with a 5V input.

Electrical Characteristics

LM4132-2.0 ($V_{OUT} = 2.048V$)

Limits in standard type are for $T_J = 25^\circ C$ only, and limits in boldface type apply over the junction temperature (T_J) range of $-40^\circ C$ to $+125^\circ C$ unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at $T_J = 25^\circ C$, and are provided for reference purposes only. Unless otherwise specified $V_{IN} = 5V$ and $I_{LOAD} = 0$

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Output Voltage Initial Accuracy					
	LM4132A-2.0	(A Grade - 0.05%)	-0.05		0.05	%
	LM4132B-2.0	(B Grade - 0.1%)	-0.1		0.1	
	LM4132C-2.0	(C Grade - 0.2%)	-0.2		0.2	
	LM4132D-2.0	(D Grade - 0.4%)	-0.4		0.4	
	LM4132E-2.0	(E Grade - 0.5%)	-0.5		0.5	
$TCV_{REF} / ^\circ C$ (Note 6)	Temperature Coefficient					
	LM4132A-2.0	$0^\circ C \leq T_J \leq +85^\circ C$			10	ppm / $^\circ C$
		$-40^\circ C \leq T_J \leq +125^\circ C$			20	
	LM4132B-2.0	$-40^\circ C \leq T_J \leq +125^\circ C$			20	
	LM4132C-2.0				20	
	LM4132D-2.0				20	
	LM4132E-2.0				30	
I_Q	Supply Current			60	100	μA
I_{Q_SD}	Supply Current in Shutdown	EN = 0V		3	7	μA
$\Delta V_{REF}/\Delta V_{IN}$	Line Regulation	$V_{REF} + 400mV \leq V_{IN} \leq 5.5V$		30		ppm / V
$\Delta V_{REF}/\Delta I_{LOAD}$	Load Regulation	$0mA \leq I_{LOAD} \leq 20mA$		25	120	ppm / mA
ΔV_{REF}	Long Term Stability ⁽³⁾	1000 Hrs		50		ppm
	Thermal Hysteresis ⁽⁴⁾	$-40^\circ C \leq T_J \leq +125^\circ C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage ⁽⁵⁾	$I_{LOAD} = 10mA$		175	400	mV
V_N	Output Noise Voltage	0.1 Hz to 10 Hz		190		μV_{PP}
I_{SC}	Short Circuit Current				75	mA
V_{IL}	Enable Pin Maximum Low Input Level				35	% V_{IN}
V_{IH}	Enable Pin Minimum High Input Level		65			% V_{IN}

- (1) Limits are 100% production tested at $25^\circ C$. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at $25^\circ C$ and represent the most likely parametric norm.
- (3) Long term stability is V_{REF} @ $25^\circ C$ measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in $+25^\circ C$ output voltage before and after cycling the device from $(-40^\circ C$ to $125^\circ C)$.
- (5) Dropout voltage is defined as the minimum input to output differential at which the output voltage drops by 0.5% below the value measured with a 5V input.

Electrical Characteristics

LM4132-2.5 ($V_{OUT} = 2.5V$)

Limits in standard type are for $T_J = 25^{\circ}C$ only, and limits in boldface type apply over the junction temperature (T_J) range of $-40^{\circ}C$ to $+125^{\circ}C$ unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at $T_J = 25^{\circ}C$, and are provided for reference purposes only. Unless otherwise specified $V_{IN} = 5V$ and $I_{LOAD} = 0$

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Output Voltage Initial Accuracy					
	LM4132A-2.5	(A Grade - 0.05%)	-0.05		0.05	%
	LM4132B-2.5	(B Grade - 0.1%)	-0.1		0.1	
	LM4132C-2.5	(C Grade - 0.2%)	-0.2		0.2	
	LM4132D-2.5	(D Grade - 0.4%)	-0.4		0.4	
	LM4132E-2.5	(E Grade - 0.5%)	-0.5		0.5	
$TCV_{REF} / ^{\circ}C$ (Note 6)	Temperature Coefficient					
	LM4132A-2.5	$0^{\circ}C \leq T_J \leq +85^{\circ}C$			10	ppm / $^{\circ}C$
		$-40^{\circ}C \leq T_J \leq +125^{\circ}C$			20	
	LM4132B-2.5	$-40^{\circ}C \leq T_J \leq +125^{\circ}C$			20	
	LM4132C-2.5				20	
	LM4132D-2.5				20	
	LM4132E-2.5				30	
I_Q	Supply Current			60	100	μA
I_{Q_SD}	Supply Current in Shutdown	$EN = 0V$		3	7	μA
$\Delta V_{REF}/\Delta V_{IN}$	Line Regulation	$V_{REF} + 400mV \leq V_{IN} \leq 5.5V$		50		ppm / V
$\Delta V_{REF}/\Delta I_{LOAD}$	Load Regulation	$0mA \leq I_{LOAD} \leq 20mA$		25	120	ppm / mA
ΔV_{REF}	Long Term Stability ⁽³⁾	1000 Hrs		50		ppm
	Thermal Hysteresis ⁽⁴⁾	$-40^{\circ}C \leq T_J \leq +125^{\circ}C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage ⁽⁵⁾	$I_{LOAD} = 10mA$		175	400	mV
V_N	Output Noise Voltage	0.1 Hz to 10 Hz		240		μV_{PP}
I_{SC}	Short Circuit Current				75	mA
V_{IL}	Enable Pin Maximum Low Input Level				35	$\%V_{IN}$
V_{IH}	Enable Pin Minimum High Input Level		65			$\%V_{IN}$

(1) Limits are 100% production tested at $25^{\circ}C$. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.

(2) Typical numbers are at $25^{\circ}C$ and represent the most likely parametric norm.

(3) Long term stability is V_{REF} @ $25^{\circ}C$ measured during 1000 hrs.

(4) Thermal hysteresis is defined as the change in $+25^{\circ}C$ output voltage before and after cycling the device from $(-40^{\circ}C$ to $125^{\circ}C)$.

(5) Dropout voltage is defined as the minimum input to output differential at which the output voltage drops by 0.5% below the value measured with a 5V input.

Electrical Characteristics

LM4132-3.0 ($V_{OUT} = 3.0V$)

Limits in standard type are for $T_J = 25^\circ C$ only, and limits in boldface type apply over the junction temperature (T_J) range of $-40^\circ C$ to $+125^\circ C$ unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at $T_J = 25^\circ C$, and are provided for reference purposes only. Unless otherwise specified $V_{IN} = 5V$ and $I_{LOAD} = 0$

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Output Voltage Initial Accuracy					
	LM4132A-3.0	(A Grade - 0.05%)	-0.05		0.05	%
	LM4132B-3.0	(B Grade - 0.1%)	-0.1		0.1	
	LM4132C-3.0	(C Grade - 0.2%)	-0.2		0.2	
	LM4132D-3.0	(D Grade - 0.4%)	-0.4		0.4	
	LM4132E-3.0	(E Grade - 0.5%)	-0.5		0.5	
$TCV_{REF} / ^\circ C$ (Note 6)	Temperature Coefficient					
	LM4132A-3.0	$0^\circ C \leq T_J \leq +85^\circ C$			10	ppm / $^\circ C$
		$-40^\circ C \leq T_J \leq +125^\circ C$			20	
	LM4132B-3.0	$-40^\circ C \leq T_J \leq +125^\circ C$			20	
	LM4132C-3.0				20	
	LM4132D-3.0				20	
	LM4132E-3.0				30	
I_Q	Supply Current			60	100	μA
I_{Q_SD}	Supply Current in Shutdown	$EN = 0V$		3	7	μA
$\Delta V_{REF} / \Delta V_{IN}$	Line Regulation	$V_{REF} + 400mV \leq V_{IN} \leq 5.5V$		70		ppm / V
$\Delta V_{REF} / \Delta I_{LOAD}$	Load Regulation	$0mA \leq I_{LOAD} \leq 20mA$		25	120	ppm / mA
ΔV_{REF}	Long Term Stability ⁽³⁾	1000 Hrs		50		ppm
	Thermal Hysteresis ⁽⁴⁾	$-40^\circ C \leq T_J \leq +125^\circ C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage ⁽⁵⁾	$I_{LOAD} = 10mA$		175	400	mV
V_N	Output Noise Voltage	0.1 Hz to 10 Hz		285		μV_{PP}
I_{SC}	Short Circuit Current				75	mA
V_{IL}	Enable Pin Maximum Low Input Level				35	% V_{IN}
V_{IH}	Enable Pin Minimum High Input Level		65			% V_{IN}

- (1) Limits are 100% production tested at $25^\circ C$. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at $25^\circ C$ and represent the most likely parametric norm.
- (3) Long term stability is V_{REF} @ $25^\circ C$ measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in $+25^\circ C$ output voltage before and after cycling the device from $(-40^\circ C$ to $125^\circ C)$.
- (5) Dropout voltage is defined as the minimum input to output differential at which the output voltage drops by 0.5% below the value measured with a 5V input.

Electrical Characteristics

LM4132-3.3 ($V_{OUT} = 3.3V$)

Limits in standard type are for $T_J = 25^{\circ}C$ only, and limits in boldface type apply over the junction temperature (T_J) range of $-40^{\circ}C$ to $+125^{\circ}C$ unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at $T_J = 25^{\circ}C$, and are provided for reference purposes only. Unless otherwise specified $V_{IN} = 5V$ and $I_{LOAD} = 0$

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Output Voltage Initial Accuracy					
	LM4132A-3.3	(A Grade - 0.05%)	-0.05		0.05	%
	LM4132B-3.3	(B Grade - 0.1%)	-0.1		0.1	
	LM4132C-3.3	(C Grade - 0.2%)	-0.2		0.2	
	LM4132D-3.3	(D Grade - 0.4%)	-0.4		0.4	
	LM4132E-3.3	(E Grade - 0.5%)	-0.5		0.5	
$TCV_{REF} / ^{\circ}C$ (Note 6)	Temperature Coefficient					
	LM4132A-3.3	$0^{\circ}C \leq T_J \leq +85^{\circ}C$			10	ppm / $^{\circ}C$
		$-40^{\circ}C \leq T_J \leq +125^{\circ}C$			20	
	LM4132B-3.3	$-40^{\circ}C \leq T_J \leq +125^{\circ}C$			20	
	LM4132C-3.3				20	
	LM4132D-3.3				20	
	LM4132E-3.3				30	
I_Q	Supply Current			60	100	μA
I_{Q_SD}	Supply Current in Shutdown	EN = 0V		3	7	μA
$\Delta V_{REF}/\Delta V_{IN}$	Line Regulation	$V_{REF} + 400mV \leq V_{IN} \leq 5.5V$		85		ppm / V
$\Delta V_{REF}/\Delta I_{LOAD}$	Load Regulation	$0mA \leq I_{LOAD} \leq 20mA$		25	120	ppm / mA
ΔV_{REF}	Long Term Stability ⁽³⁾	1000 Hrs		50		ppm
	Thermal Hysteresis ⁽⁴⁾	$-40^{\circ}C \leq T_J \leq +125^{\circ}C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage ⁽⁵⁾	$I_{LOAD} = 10mA$		175	400	mV
V_N	Output Noise Voltage	0.1 Hz to 10 Hz		310		μV_{PP}
I_{SC}	Short Circuit Current				75	mA
V_{IL}	Enable Pin Maximum Low Input Level				35	% V_{IN}
V_{IH}	Enable Pin Minimum High Input Level		65			% V_{IN}

- (1) Limits are 100% production tested at $25^{\circ}C$. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at $25^{\circ}C$ and represent the most likely parametric norm.
- (3) Long term stability is V_{REF} @ $25^{\circ}C$ measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in $+25^{\circ}C$ output voltage before and after cycling the device from $(-40^{\circ}C$ to $125^{\circ}C)$.
- (5) Dropout voltage is defined as the minimum input to output differential at which the output voltage drops by 0.5% below the value measured with a 5V input.

Electrical Characteristics

LM4132-4.1 ($V_{OUT} = 4.096V$)

Limits in standard type are for $T_J = 25^\circ C$ only, and limits in boldface type apply over the junction temperature (T_J) range of $-40^\circ C$ to $+125^\circ C$ unless otherwise specified. Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at $T_J = 25^\circ C$, and are provided for reference purposes only. Unless otherwise specified $V_{IN} = 5V$ and $I_{LOAD} = 0$

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V_{REF}	Output Voltage Initial Accuracy					
	LM4132A-4.1	(A Grade - 0.05%)	-0.05		0.05	%
	LM4132B-4.1	(B Grade - 0.1%)	-0.1		0.1	
	LM4132C-4.1	(C Grade - 0.2%)	-0.2		0.2	
	LM4132D-4.1	(D Grade - 0.4%)	-0.4		0.4	
	LM4132E-4.1	(E Grade - 0.5%)	-0.5		0.5	
$TCV_{REF} / ^\circ C$ (Note 6)	Temperature Coefficient					
	LM4132A-4.1	$0^\circ C \leq T_J \leq +85^\circ C$			10	ppm / $^\circ C$
		$-40^\circ C \leq T_J \leq +125^\circ C$			20	
	LM4132B-4.1	$-40^\circ C \leq T_J \leq +125^\circ C$			20	
	LM4132C-4.1				20	
	LM4132D-4.1				20	
	LM4132E-4.1				30	
I_Q	Supply Current			60	100	μA
I_{Q_SD}	Supply Current in Shutdown	EN = 0V		3	7	μA
$\Delta V_{REF}/\Delta V_{IN}$	Line Regulation	$V_{REF} + 400mV \leq V_{IN} \leq 5.5V$		100		ppm / V
$\Delta V_{REF}/\Delta I_{LOAD}$	Load Regulation	$0mA \leq I_{LOAD} \leq 20mA$		25	120	ppm / mA
ΔV_{REF}	Long Term Stability ⁽³⁾	1000 Hrs		50		ppm
	Thermal Hysteresis ⁽⁴⁾	$-40^\circ C \leq T_J \leq +125^\circ C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage ⁽⁵⁾	$I_{LOAD} = 10mA$		175	400	mV
V_N	Output Noise Voltage	0.1 Hz to 10 Hz		350		μV_{PP}
I_{SC}	Short Circuit Current				75	mA
V_{IL}	Enable Pin Maximum Low Input Level				35	% V_{IN}
V_{IH}	Enable Pin Minimum High Input Level		65			% V_{IN}

- (1) Limits are 100% production tested at $25^\circ C$. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at $25^\circ C$ and represent the most likely parametric norm.
- (3) Long term stability is V_{REF} @ $25^\circ C$ measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in $+25^\circ C$ output voltage before and after cycling the device from $(-40^\circ C$ to $125^\circ C)$.
- (5) Dropout voltage is defined as the minimum input to output differential at which the output voltage drops by 0.5% below the value measured with a 5V input.

Typical Performance Characteristics for 1.8V

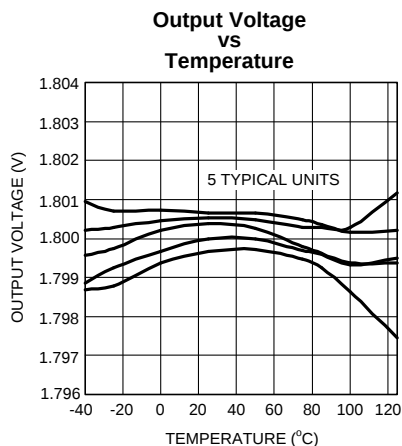


Figure 1.

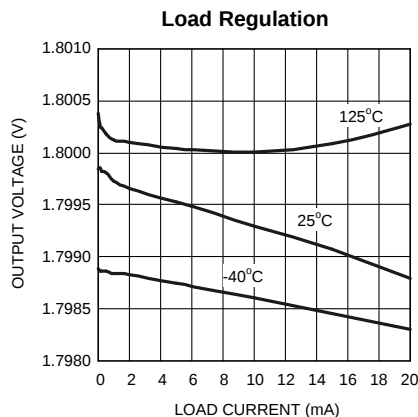


Figure 2.

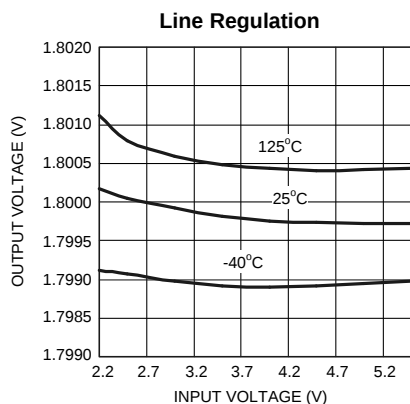


Figure 3.

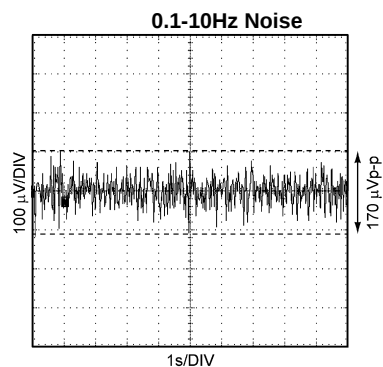


Figure 4.

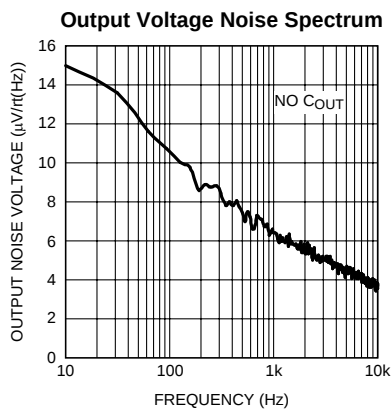


Figure 5.

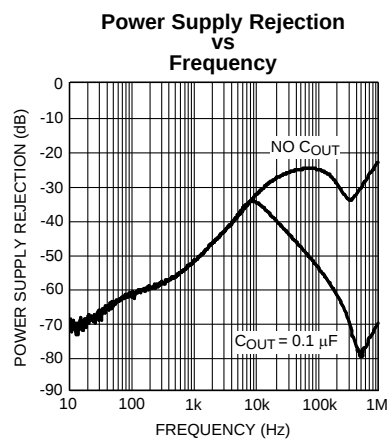


Figure 6.

Typical Performance Characteristics for 2.048V

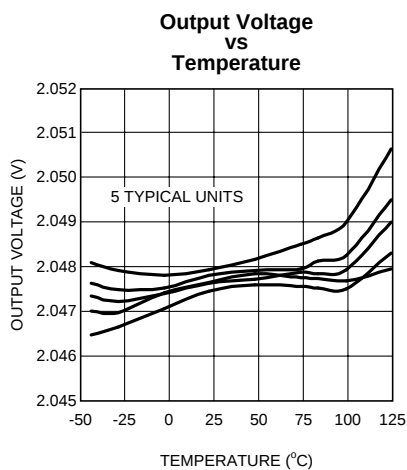


Figure 7.

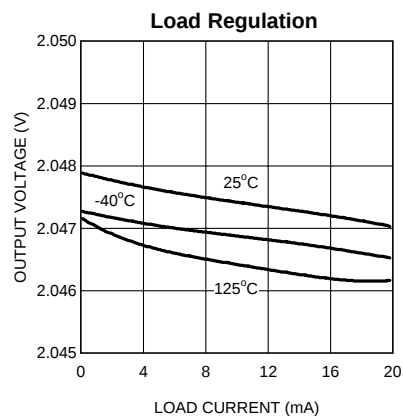


Figure 8.

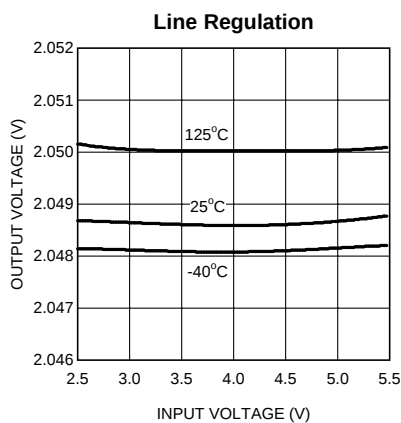


Figure 9.

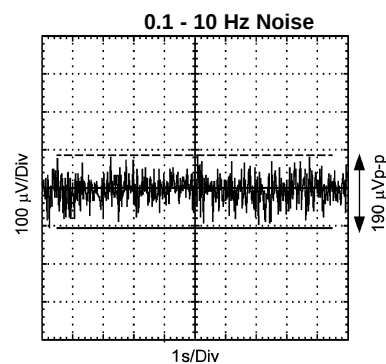


Figure 10.

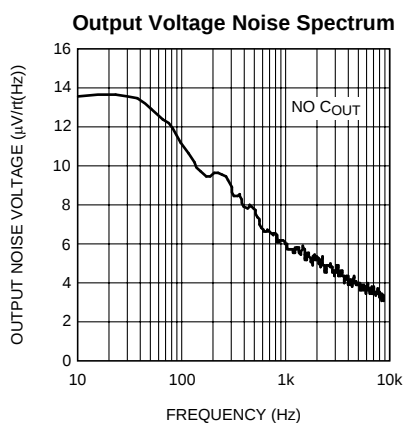


Figure 11.

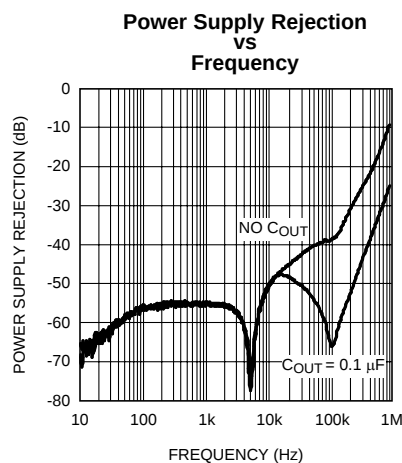


Figure 12.

Typical Performance Characteristics for 2.5V

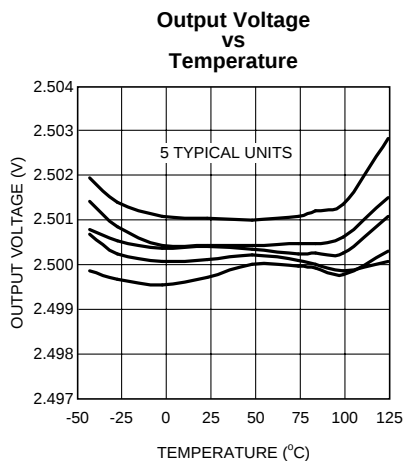


Figure 13.

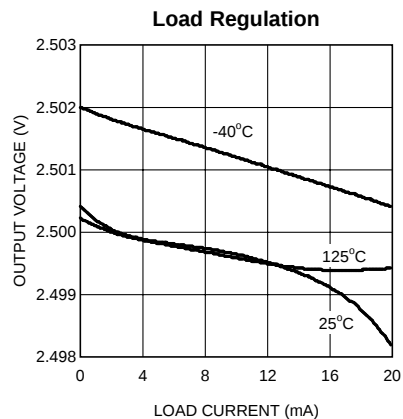


Figure 14.

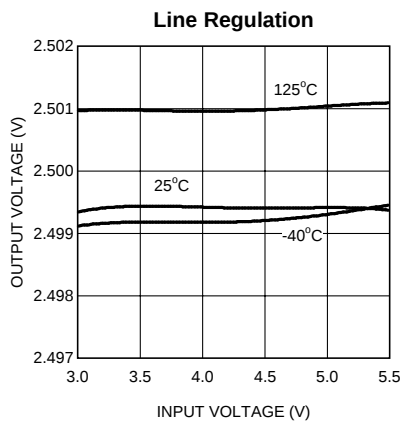


Figure 15.

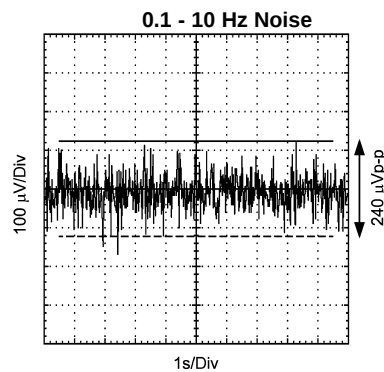


Figure 16.

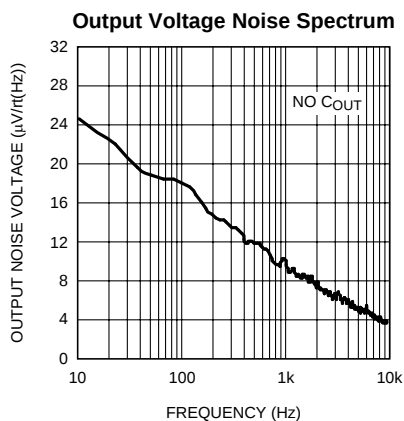


Figure 17.

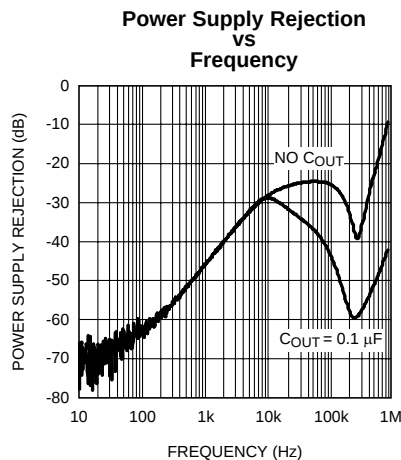


Figure 18.

Typical Performance Characteristics for 3.0V

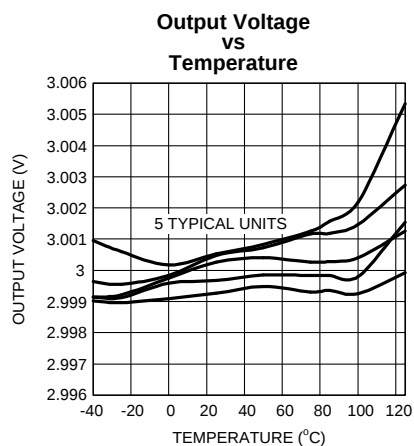


Figure 19.

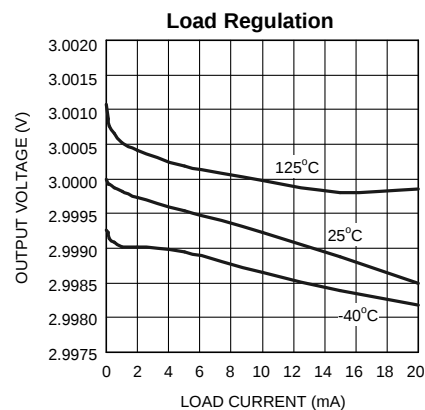


Figure 20.

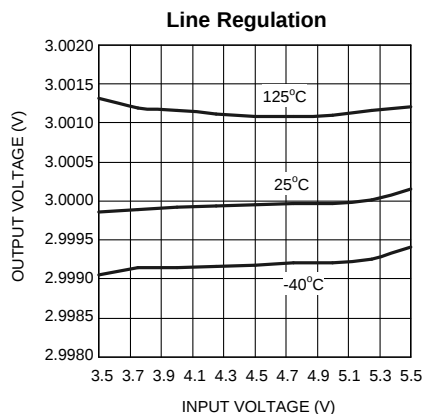


Figure 21.

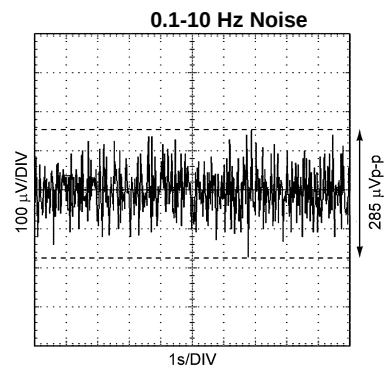


Figure 22.

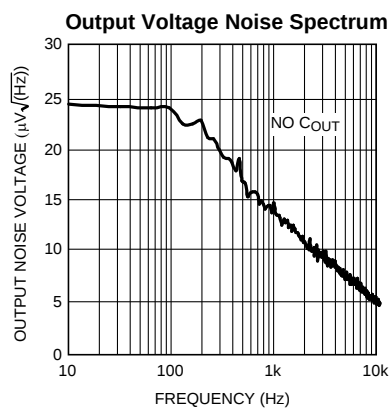


Figure 23.

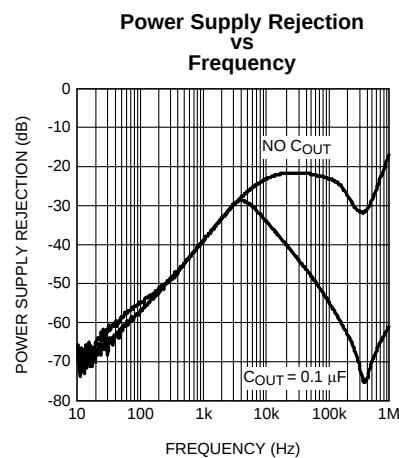


Figure 24.

Typical Performance Characteristics for 3.3V

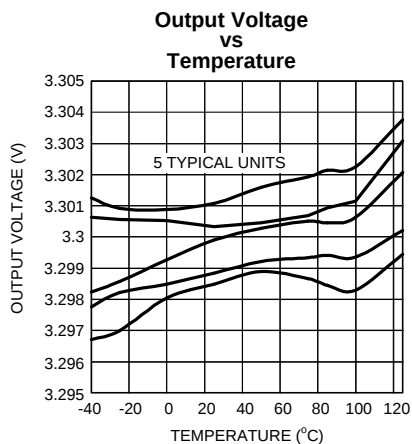


Figure 25.

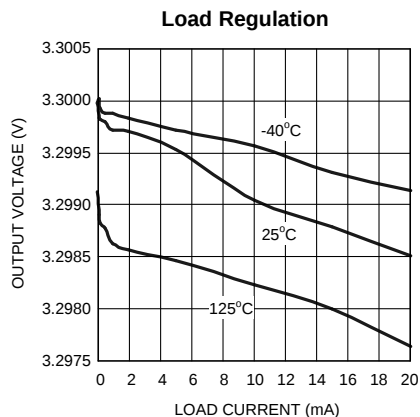


Figure 26.

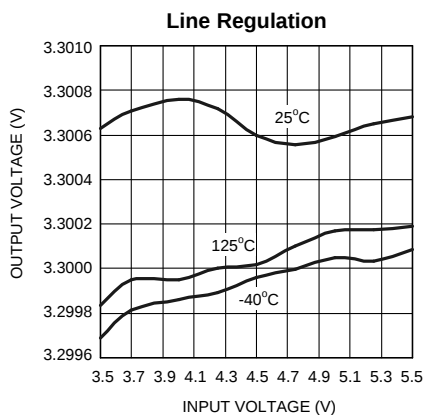


Figure 27.

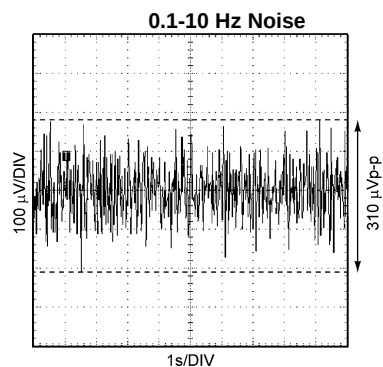


Figure 28.

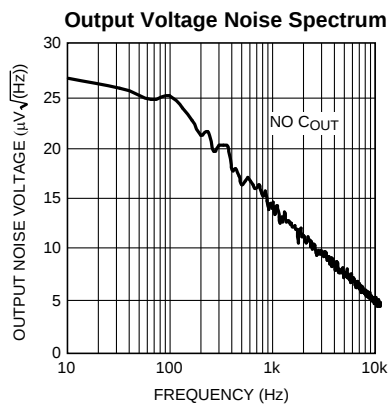


Figure 29.

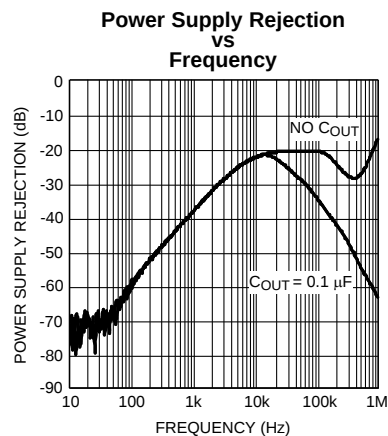


Figure 30.

Typical Performance Characteristics for 4.096V

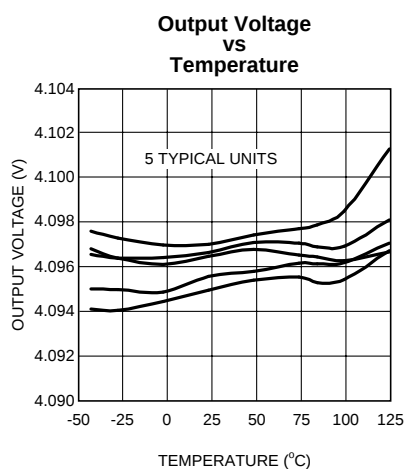


Figure 31.

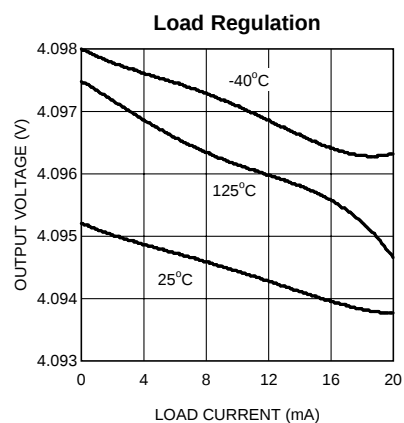


Figure 32.

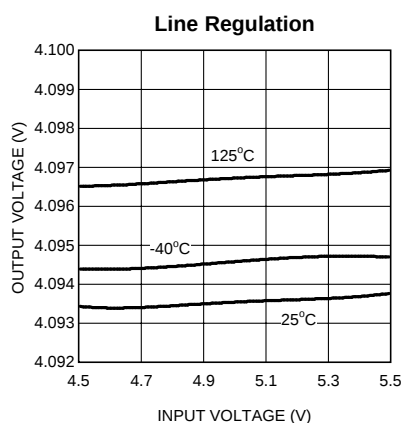


Figure 33.

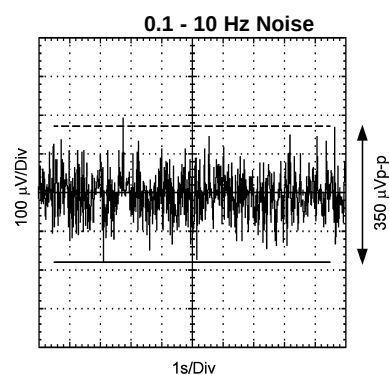


Figure 34.

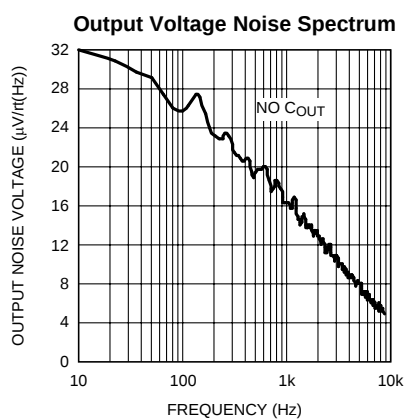


Figure 35.

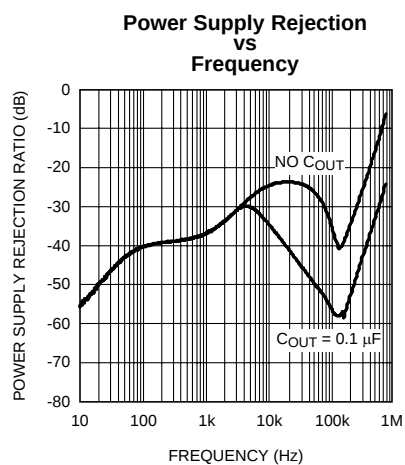


Figure 36.

Typical Performance Characteristics

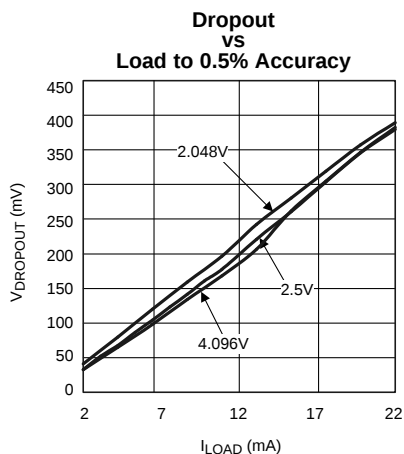


Figure 37.

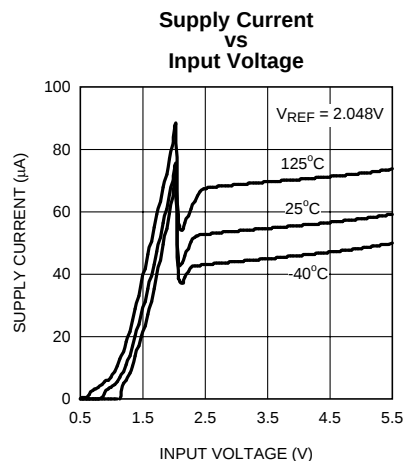


Figure 38.

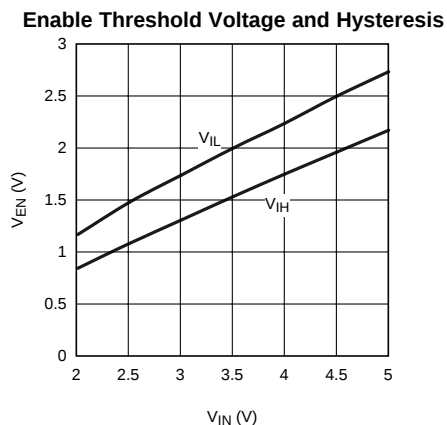


Figure 39.

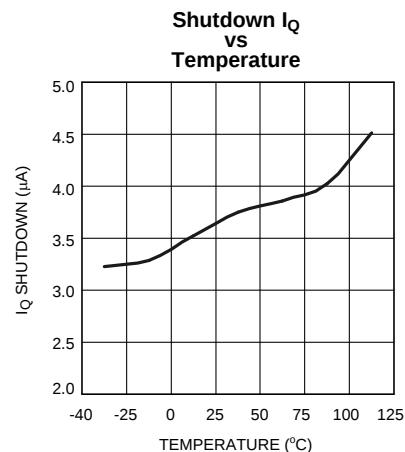


Figure 40.

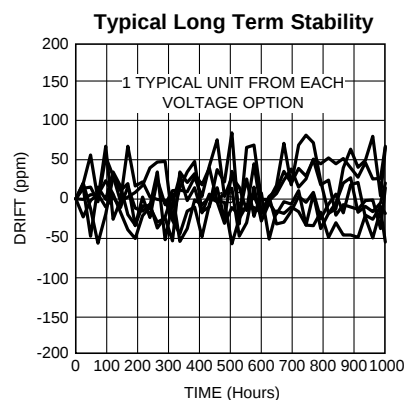


Figure 41.

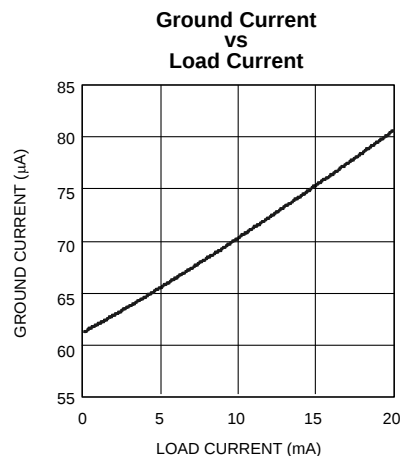


Figure 42.

Typical Performance Characteristics (continued)

Typical Thermal Hysteresis

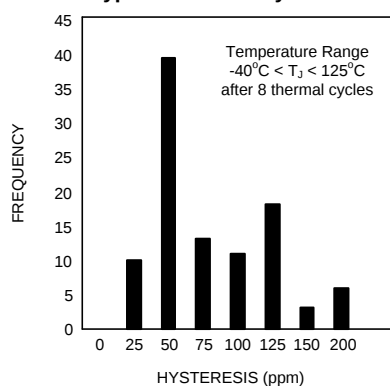


Figure 43.

Turn-On Transient Response

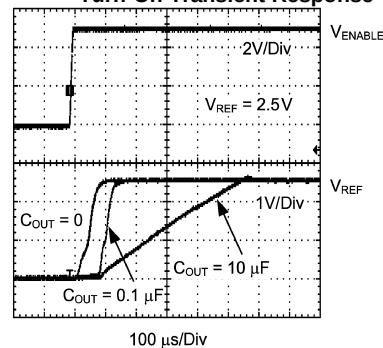


Figure 44.

Load Transient Response I_{LOAD} = 0 to 10mA

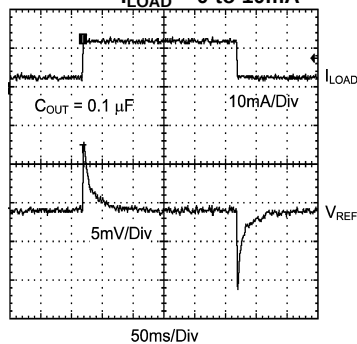


Figure 45.

Line Transient Response V_{IN} = 4V to 5.5V

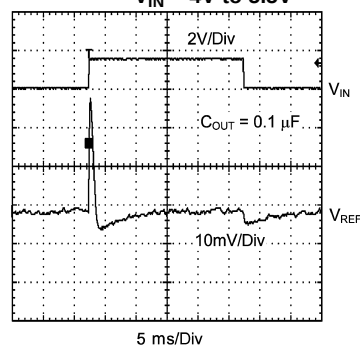


Figure 46.

APPLICATION INFORMATION

THEORY OF OPERATION

The foundation of any voltage reference is the band-gap circuit. While the reference in the LM4132 is developed from the gate-source voltage of transistors in the IC, principles of the band-gap circuit are easily understood using a bipolar example. For a detailed analysis of the bipolar band-gap circuit, please refer to Application Note AN-56.

SUPPLY AND ENABLE VOLTAGES

To ensure proper operation, V_{EN} and V_{IN} must be within a specified range. An acceptable range of input voltages is:

$$V_{IN} > V_{REF} + 400\text{mV} \quad (I_{LOAD} \leq 10\text{mA}) \quad (1)$$

The enable pin uses an internal pull-up current source ($I_{PULL_UP} \approx 2\mu\text{A}$) that may be left floating or triggered by an external source. If the part is not enabled by an external source, it may be connected to V_{IN} . An acceptable range of enable voltages is given by the enable transfer characteristics. See the Electrical Characteristics section and Enable Transfer Characteristics figure for more detail. Note, the part will not operate correctly for $V_{EN} > V_{IN}$.

COMPONENT SELECTION

A small ceramic (X5R or X7R) capacitor on the input must be used to ensure stable operation. The value of C_{IN} must be sized according to the output capacitor value. The value of C_{IN} must satisfy the relationship $C_{IN} \geq C_{OUT}$. When no output capacitor is used, C_{IN} must have a minimum value of $0.1\mu\text{F}$. Noise on the power-supply input may affect the output noise. Larger input capacitor values (typically $4.7\mu\text{F}$ to $22\mu\text{F}$) may help reduce noise on the output and significantly reduce overshoot during startup. Use of an additional optional bypass capacitor between the input and ground may help further reduce noise on the output. With an input capacitor, the LM4132 will drive any combination of resistance and capacitance up to $V_{REF}/20\text{mA}$ and $10\mu\text{F}$ respectively.

The LM4132 is designed to operate with or without an output capacitor and is stable with capacitive loads up to $10\mu\text{F}$. Connecting a capacitor between the output and ground will significantly improve the load transient response when switching from a light load to a heavy load. The output capacitor should not be made arbitrarily large because it will effect the turn-on time as well as line and load transients.

While a variety of capacitor chemistry types may be used, it is typically advisable to use low esr ceramic capacitors. Such capacitors provide a low impedance to high frequency signals, effectively bypassing them to ground. Bypass capacitors should be mounted close to the part. Mounting bypass capacitors close to the part will help reduce the parasitic trace components thereby improving performance.

SHORT CIRCUITED OUTPUT

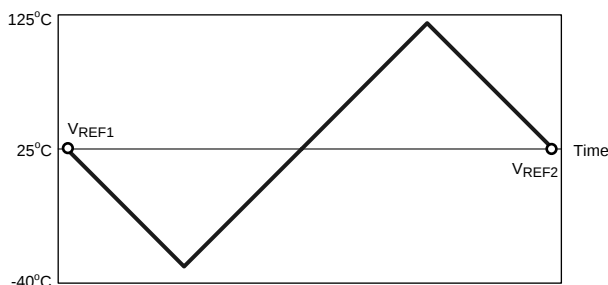
The LM4132 features indefinite short circuit protection. This protection limits the output current to 75mA when the output is shorted to ground.

TURN ON TIME

Turn on time is defined as the time taken for the output voltage to rise to 90% of the preset value. The turn on time depends on the load. The turn on time is typically $33.2\mu\text{s}$ when driving a $1\mu\text{F}$ load and $78.8\mu\text{s}$ when driving a $10\mu\text{F}$ load. Some users may experience an extended turn on time (up to 10ms) under brown out conditions and low temperatures (-40°C).

THERMAL HYSTERESIS

Thermal hysteresis is 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 47](#).

**Figure 47. Illustrative Temperature Profile**

This may be expressed analytically as the following:

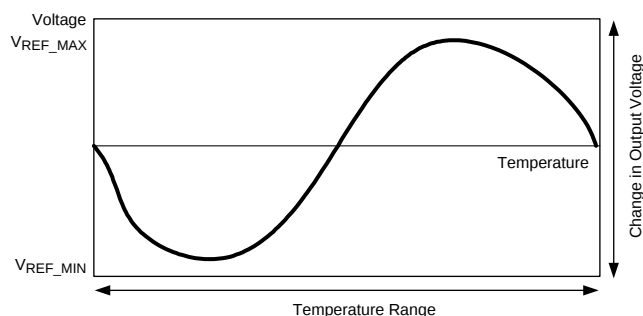
$$V_{HYS} = \frac{|V_{REF1} - V_{REF2}|}{V_{REF}} \times 10^6 \text{ ppm}$$

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 LM4132 features a low thermal hysteresis of 75 ppm (typical) from -40°C to 125°C after 8 temperature cycles. (2)

TEMPERATURE COEFFICIENT

Temperature drift is defined as the maximum deviation in output voltage over the operating temperature range. This deviation over temperature may be illustrated as shown in [Figure 48](#).

**Figure 48. Illustrative V_{REF} vs Temperature Profile**

Temperature coefficient may be expressed analytically as the following:

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

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 LM4132 features a low temperature drift of 10ppm (max) to 30ppm (max), depending on the grade.

LONG TERM STABILITY

Long-term stability refers to the fluctuation in output voltage over a long period of time (1000 hours). The LM4132 features a typical long-term stability of 50ppm over 1000 hours. The measurements are made using 5 units of each voltage option, at a nominal input voltage (5V), with no load, at room temperature.

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:

$$\frac{V_{REF} \times \text{ppm}_{ERROR}}{10^3} = V_{ERROR}$$

Where

- V_{REF} is in volts (V) and V_{ERROR} is in milli-volts (mV). (4)

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:

$$\frac{V_{ERROR}}{V_{REF}} \times 10^3 = \text{ppm}_{ERROR}$$

Where

- V_{REF} is in volts (V) and V_{ERROR} is in milli-volts (mV). (6)

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

$$\frac{V_{ERROR}}{V_{REF}} \times 0.1 = \text{Percent_Error}$$

Where

- V_{REF} is in volts (V) and V_{ERROR} is in milli-volts (mV). (7)

PRINTED CIRCUIT BOARD and LAYOUT CONSIDERATIONS

References in SOT packages are generally less prone to PC board mounting than devices in Small Outline (SOIC) packages. To minimize the mechanical stress due to PC board mounting that can cause the output voltage to shift from its initial value, mount the reference on a low flex area of the PC board, such as near the edge or a corner.

The part may be isolated mechanically by cutting a U shape slot on the PCB for mounting the device. This approach also provides some thermal isolation from the rest of the circuit.

Bypass capacitors must be mounted close to the part. Mounting bypass capacitors close to the part will reduce the parasitic trace components thereby improving performance.

Typical Application Circuits

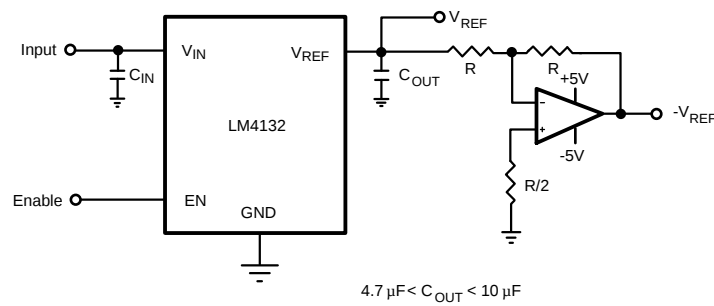


Figure 49. Voltage Reference with Complimentary Output

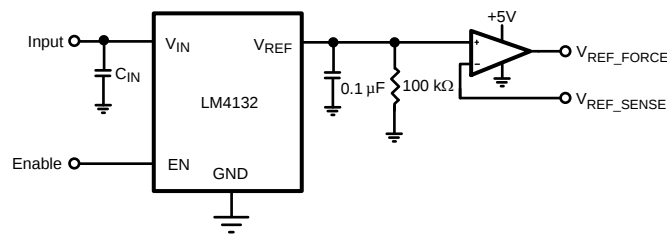


Figure 50. Precision Voltage Reference with Force and Sense Output

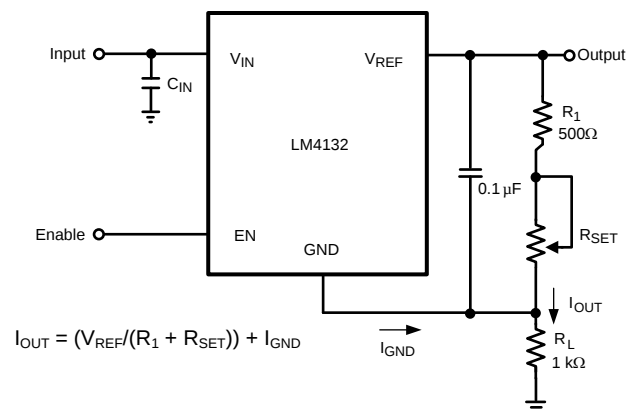


Figure 51. Programmable Current Source

REVISION HISTORY

Changes from Revision B (April 2013) to Revision C	Page
• Changed layout of National Data Sheet to TI format	20

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM4132AMF-1.8/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AA	Samples
LM4132AMF-2.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BA	Samples
LM4132AMF-2.5/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CA	Samples
LM4132AMF-3.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DA	Samples
LM4132AMF-3.3/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EA	Samples
LM4132AMF-4.1	ACTIVE	SOT-23	DBV	5	1000	TBD	Call TI	Call TI	-40 to 125	R4FA	Samples
LM4132AMF-4.1/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FA	Samples
LM4132AMFX-1.8/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AA	Samples
LM4132AMFX-2.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BA	Samples
LM4132AMFX-2.5/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CA	Samples
LM4132AMFX-3.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DA	Samples
LM4132AMFX-3.3/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EA	Samples
LM4132AMFX-4.1/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FA	Samples
LM4132BMF-1.8/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AB	Samples
LM4132BMF-2.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BB	Samples
LM4132BMF-2.5/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CB	Samples
LM4132BMF-3.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DB	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM4132BMF-3.3/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EB	Samples
LM4132BMF-4.1	ACTIVE	SOT-23	DBV	5	1000	TBD	Call TI	Call TI	-40 to 125	R4FB	Samples
LM4132BMF-4.1/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FB	Samples
LM4132BMFX-1.8/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AB	Samples
LM4132BMFX-2.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BB	Samples
LM4132BMFX-2.5/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CB	Samples
LM4132BMFX-3.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DB	Samples
LM4132BMFX-3.3/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EB	Samples
LM4132BMFX-4.1/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FB	Samples
LM4132CMF-1.8/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AC	Samples
LM4132CMF-2.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BC	Samples
LM4132CMF-2.5/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CC	Samples
LM4132CMF-3.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DC	Samples
LM4132CMF-3.3/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EC	Samples
LM4132CMF-4.1	ACTIVE	SOT-23	DBV	5	1000	TBD	Call TI	Call TI	-40 to 125	R4FC	Samples
LM4132CMF-4.1/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FC	Samples
LM4132CMFX-1.8/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AC	Samples
LM4132CMFX-2.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BC	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM4132CMFX-2.5/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CC	Samples
LM4132CMFX-3.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DC	Samples
LM4132CMFX-3.3/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EC	Samples
LM4132CMFX-4.1/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FC	Samples
LM4132DMF-1.8/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AD	Samples
LM4132DMF-2.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BD	Samples
LM4132DMF-2.5/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CD	Samples
LM4132DMF-3.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DD	Samples
LM4132DMF-3.3/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4ED	Samples
LM4132DMF-4.1/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FD	Samples
LM4132DMFX-1.8/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AD	Samples
LM4132DMFX-2.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BD	Samples
LM4132DMFX-2.5/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CD	Samples
LM4132DMFX-3.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DD	Samples
LM4132DMFX-3.3/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4ED	Samples
LM4132DMFX-4.1/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FD	Samples
LM4132EMF-1.8/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AE	Samples
LM4132EMF-2.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BE	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM4132EMF-2.5/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CE	Samples
LM4132EMF-3.0/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DE	Samples
LM4132EMF-3.3/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EE	Samples
LM4132EMF-4.1/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FE	Samples
LM4132EMFX-1.8/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4AE	Samples
LM4132EMFX-2.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4BE	Samples
LM4132EMFX-2.5/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4CE	Samples
LM4132EMFX-3.0/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4DE	Samples
LM4132EMFX-3.3/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4EE	Samples
LM4132EMFX-4.1/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	R4FE	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

⁽⁴⁾ There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "--" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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TAPE AND REEL INFORMATION

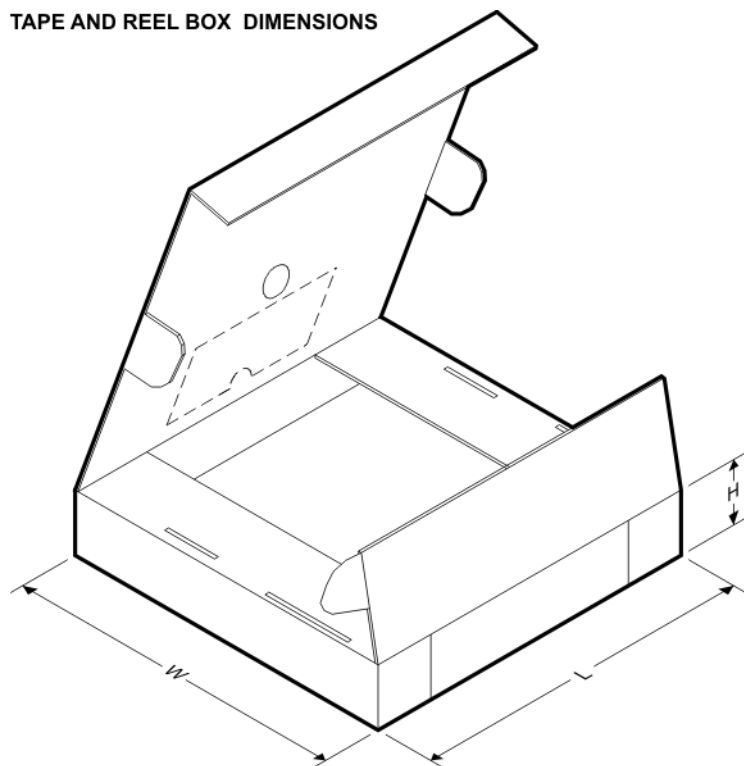

*All dimensions are nominal

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
LM4132AMF-1.8/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMF-2.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMF-3.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMF-3.3/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMF-4.1	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMF-4.1/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMFX-1.8/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMFX-2.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMFX-3.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMFX-3.3/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132AMFX-4.1/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMF-1.8/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMF-2.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMF-3.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMF-3.3/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

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
LM4132BMF-4.1	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMF-4.1/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMFX-1.8/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMFX-2.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMFX-3.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMFX-3.3/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132BMFX-4.1/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMF-1.8/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMF-2.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMF-3.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMF-3.3/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMF-4.1	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMF-4.1/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMFX-1.8/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMFX-2.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMFX-3.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMFX-3.3/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132CMFX-4.1/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMF-1.8/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMF-2.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMF-3.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMF-3.3/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMF-4.1/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMFX-1.8/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMFX-2.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMFX-3.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMFX-3.3/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132DMFX-4.1/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMF-1.8/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMF-2.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMF-2.5/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMF-3.0/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMF-3.3/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMF-4.1/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMFX-1.8/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMFX-2.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMFX-2.5/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMFX-3.0/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

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
LM4132EMFX-3.3/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LM4132EMFX-4.1/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

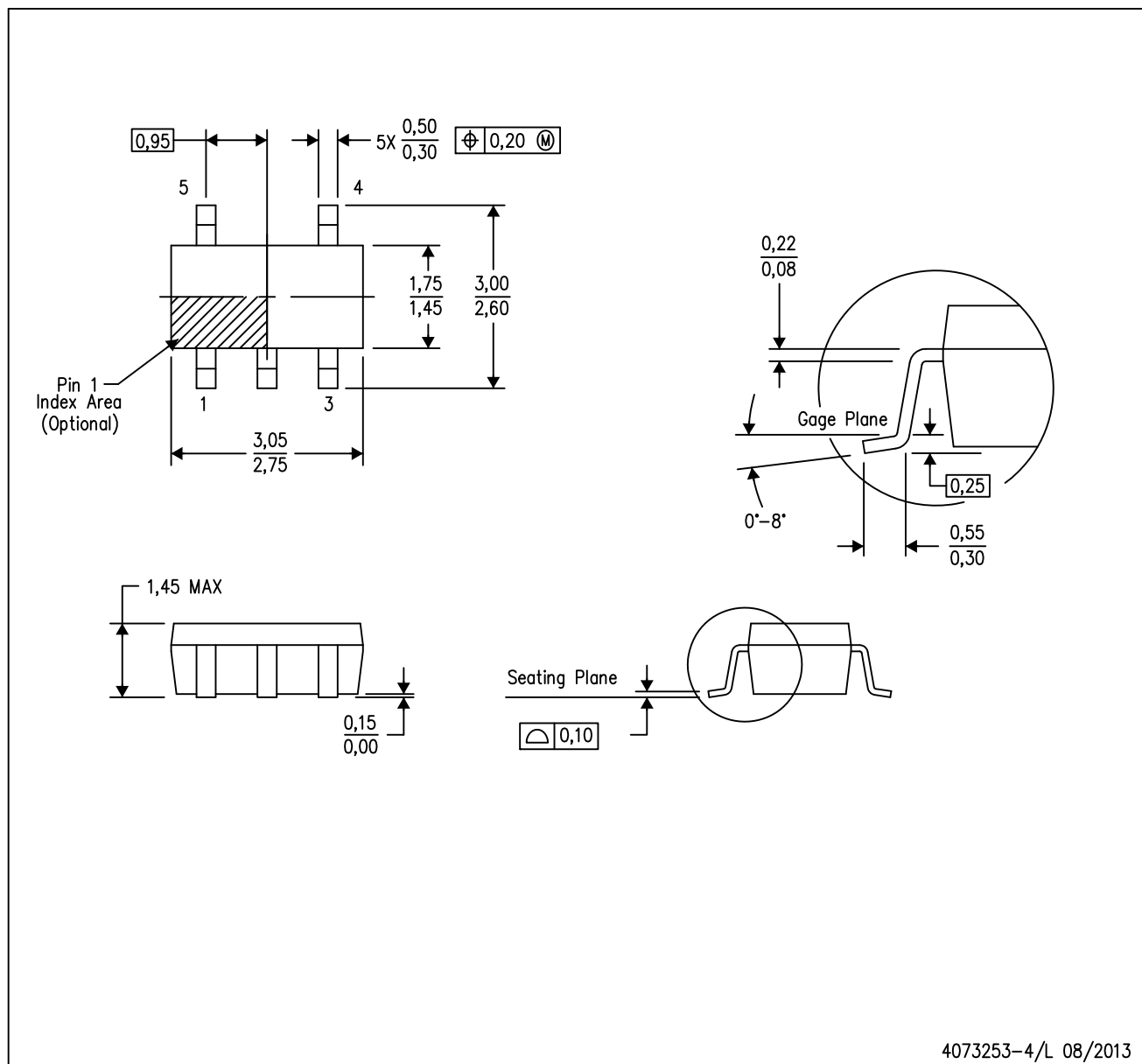
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM4132AMF-1.8/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132AMF-2.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132AMF-2.5/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132AMF-3.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132AMF-3.3/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132AMF-4.1	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132AMF-4.1/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132AMFX-1.8/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132AMFX-2.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132AMFX-2.5/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132AMFX-3.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132AMFX-3.3/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132AMFX-4.1/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132BMF-1.8/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132BMF-2.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM4132BMF-2.5/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132BMF-3.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132BMF-3.3/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132BMF-4.1	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132BMF-4.1/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132BMFX-1.8/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132BMFX-2.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132BMFX-2.5/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132BMFX-3.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132BMFX-3.3/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132BMFX-4.1/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132CMF-1.8/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132CMF-2.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132CMF-2.5/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132CMF-3.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132CMF-3.3/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132CMF-4.1	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132CMF-4.1/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132CMFX-1.8/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132CMFX-2.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132CMFX-2.5/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132CMFX-3.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132CMFX-3.3/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132CMFX-4.1/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132DMF-1.8/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132DMF-2.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132DMF-2.5/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132DMF-3.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132DMF-3.3/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132DMF-4.1/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132DMFX-1.8/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132DMFX-2.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132DMFX-2.5/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132DMFX-3.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132DMFX-3.3/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132DMFX-4.1/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132EMF-1.8/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132EMF-2.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132EMF-2.5/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132EMF-3.0/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132EMF-3.3/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132EMF-4.1/NOPB	SOT-23	DBV	5	1000	210.0	185.0	35.0
LM4132EMFX-1.8/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132EMFX-2.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM4132EMFX-2.5/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132EMFX-3.0/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132EMFX-3.3/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0
LM4132EMFX-4.1/NOPB	SOT-23	DBV	5	3000	210.0	185.0	35.0

DBV (R-PDSO-G5)

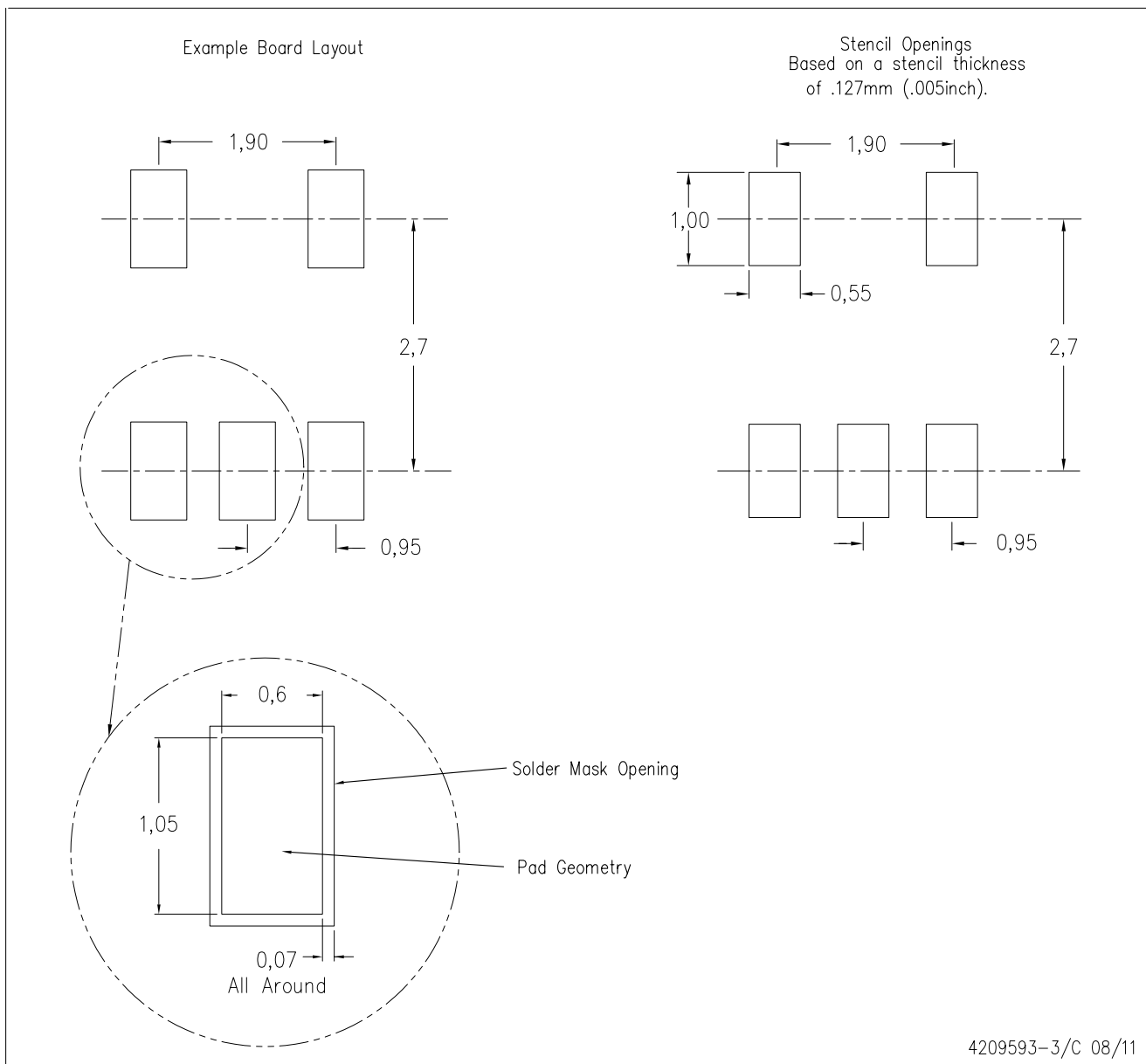
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

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