

## LM4132 SOT-23 Precision Low Dropout Voltage Reference

Check for Samples: [LM4132](#)

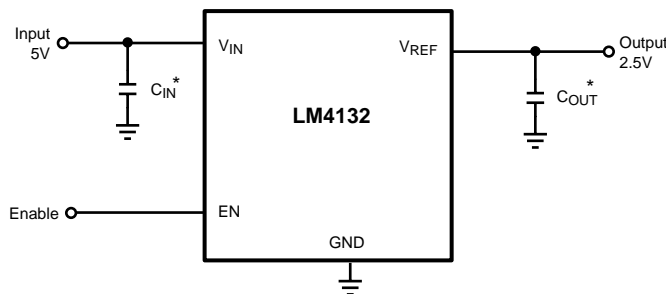
### FEATURES

- 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

### Typical Application Circuit



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

### 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 breakthrough 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.

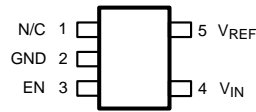
The LM4132 is available in five grades (A, B, C, D and E) for greater flexibility. The best grade devices (A) have an initial accuracy of 0.05% with a specified temperature coefficient of 10ppm/°C or less, while the lowest grade parts (E) have an initial accuracy of 0.5% and a tempco of 30ppm/°C.



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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 <sub>IN</sub>	Input supply
5	V <sub>REF</sub>	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<sup>(1)(2)</sup>

Maximum Voltage on any input	-0.3 to 6V
Output short circuit duration	Indefinite
Power Dissipation (T <sub>A</sub> = 25°C) <sup>(3)</sup>	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 <sup>(4)</sup>	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<sub>JMAX</sub> (maximum junction temperature), θ<sub>J-A</sub> (junction to ambient thermal resistance) and T<sub>A</sub> (ambient temperature). The maximum power dissipation at any temperature is: P<sub>DissMAX</sub> = (T<sub>JMAX</sub> - T<sub>A</sub>) / θ<sub>J-A</sub> up to the value listed in the Absolute Maximum Ratings. θ<sub>J-A</sub> for SOT23-5 is 220°C/W, T<sub>JMAX</sub> = 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 <sub>IN</sub>
Maximum Load Current	20mA
Junction Temperature Range (T <sub>J</sub> )	-40°C to +125°C

## Electrical Characteristics

### LM4132-1.8 (V<sub>OUT</sub> = 1.8V)

Limits in standard type are for T<sub>J</sub> = 25°C only, and limits in boldface type apply over the junction temperature (T<sub>J</sub>) range of -40°C to +125°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<sub>J</sub> = 25°C, and are provided for reference purposes only. Unless otherwise specified V<sub>IN</sub> = 5V and I<sub>LOAD</sub> = 0

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V <sub>REF</sub>	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 <sub>REF</sub> / °C (Note 6)	Temperature Coefficient					ppm / °C
	LM4132A-1.8	0°C ≤ T <sub>J</sub> ≤ +85°C			<b>10</b>	
		-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132B-1.8	-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132C-1.8				<b>20</b>	
	LM4132D-1.8				<b>20</b>	
LM4132E-1.8				<b>30</b>		
I <sub>Q</sub>	Supply Current			60	<b>100</b>	μA
I <sub>Q,SD</sub>	Supply Current in Shutdown	EN = 0V		3	<b>7</b>	μA
ΔV <sub>REF</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>REF</sub> + 400mV ≤ V <sub>IN</sub> ≤ 5.5V		30		ppm / V
ΔV <sub>REF</sub> /ΔI <sub>LOAD</sub>	Load Regulation	0mA ≤ I <sub>LOAD</sub> ≤ 20mA		25	<b>120</b>	ppm / mA
ΔV <sub>REF</sub>	Long Term Stability <sup>(3)</sup>	1000 Hrs		50		ppm
	Thermal Hysteresis <sup>(4)</sup>	-40°C ≤ T <sub>J</sub> ≤ +125°C		75		
V <sub>IN</sub> - V <sub>REF</sub>	Dropout Voltage <sup>(5)</sup>	I <sub>LOAD</sub> = 10mA		230	<b>400</b>	mV
V <sub>N</sub>	Output Noise Voltage	0.1 Hz to 10 Hz		170		μV <sub>PP</sub>
I <sub>SC</sub>	Short Circuit Current				<b>75</b>	mA
V <sub>IL</sub>	Enable Pin Maximum Low Input Level				<b>35</b>	%V <sub>IN</sub>
V <sub>IH</sub>	Enable Pin Minimum High Input Level		<b>65</b>			%V <sub>IN</sub>

- (1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at 25°C and represent the most likely parametric norm.
- (3) Long term stability is V<sub>REF</sub> @25°C measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in +25°C output voltage before and after cycling the device from (-40°C to 125°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					ppm / $^\circ C$
	LM4132A-2.0	$0^\circ C \leq T_J \leq +85^\circ C$			<b>10</b>	
		$-40^\circ C \leq T_J \leq +125^\circ C$			<b>20</b>	
	LM4132B-2.0	$-40^\circ C \leq T_J \leq +125^\circ C$			<b>20</b>	
	LM4132C-2.0				<b>20</b>	
	LM4132D-2.0				<b>20</b>	
LM4132E-2.0				<b>30</b>		
$I_Q$	Supply Current		60	<b>100</b>	$\mu A$	
$I_{Q\_SD}$	Supply Current in Shutdown	EN = 0V		3	<b>7</b>	$\mu A$
$\Delta V_{REF}/\Delta V_{IN}$	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	<b>120</b>	ppm / mA
$\Delta V_{REF}$	Long Term Stability <sup>(3)</sup>	1000 Hrs		50		ppm
	Thermal Hysteresis <sup>(4)</sup>	$-40^\circ C \leq T_J \leq +125^\circ C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage <sup>(5)</sup>	$I_{LOAD} = 10mA$		175	<b>400</b>	mV
$V_N$	Output Noise Voltage	0.1 Hz to 10 Hz		190		$\mu V_{PP}$
$I_{SC}$	Short Circuit Current				<b>75</b>	mA
$V_{IL}$	Enable Pin Maximum Low Input Level				<b>35</b>	$\%V_{IN}$
$V_{IH}$	Enable Pin Minimum High Input Level		<b>65</b>			$\%V_{IN}$

- (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<sub>OUT</sub> = 2.5V)

Limits in standard type are for T<sub>J</sub> = 25°C only, and limits in boldface type apply over the junction temperature (T<sub>J</sub>) range of -40°C to +125°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<sub>J</sub> = 25°C, and are provided for reference purposes only. Unless otherwise specified V<sub>IN</sub> = 5V and I<sub>LOAD</sub> = 0

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V <sub>REF</sub>	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 <sub>REF</sub> / °C (Note 6)	Temperature Coefficient					ppm / °C
	LM4132A-2.5	0°C ≤ T <sub>J</sub> ≤ +85°C			<b>10</b>	
		-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132B-2.5	-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132C-2.5				<b>20</b>	
	LM4132D-2.5				<b>20</b>	
LM4132E-2.5				<b>30</b>		
I <sub>Q</sub>	Supply Current			60	<b>100</b>	μA
I <sub>Q,SD</sub>	Supply Current in Shutdown	EN = 0V		3	<b>7</b>	μA
ΔV <sub>REF</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>REF</sub> + 400mV ≤ V <sub>IN</sub> ≤ 5.5V		50		ppm / V
ΔV <sub>REF</sub> /ΔI <sub>LOAD</sub>	Load Regulation	0mA ≤ I <sub>LOAD</sub> ≤ 20mA		25	<b>120</b>	ppm / mA
ΔV <sub>REF</sub>	Long Term Stability <sup>(3)</sup>	1000 Hrs		50		ppm
	Thermal Hysteresis <sup>(4)</sup>	-40°C ≤ T <sub>J</sub> ≤ +125°C		75		
V <sub>IN</sub> - V <sub>REF</sub>	Dropout Voltage <sup>(5)</sup>	I <sub>LOAD</sub> = 10mA		175	<b>400</b>	mV
V <sub>N</sub>	Output Noise Voltage	0.1 Hz to 10 Hz		240		μV <sub>PP</sub>
I <sub>SC</sub>	Short Circuit Current				<b>75</b>	mA
V <sub>IL</sub>	Enable Pin Maximum Low Input Level				<b>35</b>	%V <sub>IN</sub>
V <sub>IH</sub>	Enable Pin Minimum High Input Level		<b>65</b>			%V <sub>IN</sub>

- (1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at 25°C and represent the most likely parametric norm.
- (3) Long term stability is V<sub>REF</sub> @25°C measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in +25°C output voltage before and after cycling the device from (-40°C to 125°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<sub>OUT</sub> = 3.0V)

Limits in standard type are for T<sub>J</sub> = 25°C only, and limits in boldface type apply over the junction temperature (T<sub>J</sub>) range of -40°C to +125°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<sub>J</sub> = 25°C, and are provided for reference purposes only. Unless otherwise specified V<sub>IN</sub> = 5V and I<sub>LOAD</sub> = 0

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V <sub>REF</sub>	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 <sub>REF</sub> / °C (Note 6)	Temperature Coefficient					ppm / °C
	LM4132A-3.0	0°C ≤ T <sub>J</sub> ≤ +85°C			<b>10</b>	
		-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132B-3.0	-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132C-3.0				<b>20</b>	
	LM4132D-3.0				<b>20</b>	
LM4132E-3.0				<b>30</b>		
I <sub>Q</sub>	Supply Current			60	<b>100</b>	μA
I <sub>Q,SD</sub>	Supply Current in Shutdown	EN = 0V		3	<b>7</b>	μA
ΔV <sub>REF</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>REF</sub> + 400mV ≤ V <sub>IN</sub> ≤ 5.5V		70		ppm / V
ΔV <sub>REF</sub> /ΔI <sub>LOAD</sub>	Load Regulation	0mA ≤ I <sub>LOAD</sub> ≤ 20mA		25	<b>120</b>	ppm / mA
ΔV <sub>REF</sub>	Long Term Stability <sup>(3)</sup>	1000 Hrs		50		ppm
	Thermal Hysteresis <sup>(4)</sup>	-40°C ≤ T <sub>J</sub> ≤ +125°C		75		
V <sub>IN</sub> - V <sub>REF</sub>	Dropout Voltage <sup>(5)</sup>	I <sub>LOAD</sub> = 10mA		175	<b>400</b>	mV
V <sub>N</sub>	Output Noise Voltage	0.1 Hz to 10 Hz		285		μV <sub>PP</sub>
I <sub>SC</sub>	Short Circuit Current				<b>75</b>	mA
V <sub>IL</sub>	Enable Pin Maximum Low Input Level				<b>35</b>	%V <sub>IN</sub>
V <sub>IH</sub>	Enable Pin Minimum High Input Level		<b>65</b>			%V <sub>IN</sub>

- (1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at 25°C and represent the most likely parametric norm.
- (3) Long term stability is V<sub>REF</sub> @25°C measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in +25°C output voltage before and after cycling the device from (-40°C to 125°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<sub>OUT</sub> = 3.3V)

Limits in standard type are for T<sub>J</sub> = 25°C only, and limits in boldface type apply over the junction temperature (T<sub>J</sub>) range of -40°C to +125°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<sub>J</sub> = 25°C, and are provided for reference purposes only. Unless otherwise specified V<sub>IN</sub> = 5V and I<sub>LOAD</sub> = 0

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Unit
V <sub>REF</sub>	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 <sub>REF</sub> / °C (Note 6)	Temperature Coefficient					ppm / °C
	LM4132A-3.3	0°C ≤ T <sub>J</sub> ≤ +85°C			<b>10</b>	
		-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132B-3.3	-40°C ≤ T <sub>J</sub> ≤ +125°C			<b>20</b>	
	LM4132C-3.3				<b>20</b>	
	LM4132D-3.3				<b>20</b>	
LM4132E-3.3				<b>30</b>		
I <sub>Q</sub>	Supply Current			60	<b>100</b>	μA
I <sub>Q,SD</sub>	Supply Current in Shutdown	EN = 0V		3	<b>7</b>	μA
ΔV <sub>REF</sub> /ΔV <sub>IN</sub>	Line Regulation	V <sub>REF</sub> + 400mV ≤ V <sub>IN</sub> ≤ 5.5V		85		ppm / V
ΔV <sub>REF</sub> /ΔI <sub>LOAD</sub>	Load Regulation	0mA ≤ I <sub>LOAD</sub> ≤ 20mA		25	<b>120</b>	ppm / mA
ΔV <sub>REF</sub>	Long Term Stability <sup>(3)</sup>	1000 Hrs		50		ppm
	Thermal Hysteresis <sup>(4)</sup>	-40°C ≤ T <sub>J</sub> ≤ +125°C		75		
V <sub>IN</sub> - V <sub>REF</sub>	Dropout Voltage <sup>(5)</sup>	I <sub>LOAD</sub> = 10mA		175	<b>400</b>	mV
V <sub>N</sub>	Output Noise Voltage	0.1 Hz to 10 Hz		310		μV <sub>PP</sub>
I <sub>SC</sub>	Short Circuit Current				<b>75</b>	mA
V <sub>IL</sub>	Enable Pin Maximum Low Input Level				<b>35</b>	%V <sub>IN</sub>
V <sub>IH</sub>	Enable Pin Minimum High Input Level		<b>65</b>			%V <sub>IN</sub>

- (1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are specified through correlation using Statistical Quality Control.
- (2) Typical numbers are at 25°C and represent the most likely parametric norm.
- (3) Long term stability is V<sub>REF</sub> @25°C measured during 1000 hrs.
- (4) Thermal hysteresis is defined as the change in +25°C output voltage before and after cycling the device from (-40°C to 125°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					ppm / $^\circ C$
	LM4132A-4.1	$0^\circ C \leq T_J \leq +85^\circ C$			<b>10</b>	
		$-40^\circ C \leq T_J \leq +125^\circ C$			<b>20</b>	
	LM4132B-4.1	$-40^\circ C \leq T_J \leq +125^\circ C$			<b>20</b>	
	LM4132C-4.1				<b>20</b>	
	LM4132D-4.1				<b>20</b>	
LM4132E-4.1				<b>30</b>		
$I_Q$	Supply Current			60	<b>100</b>	$\mu A$
$I_{Q\_SD}$	Supply Current in Shutdown	EN = 0V		3	<b>7</b>	$\mu A$
$\Delta V_{REF} / \Delta V_{IN}$	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	<b>120</b>	ppm / mA
$\Delta V_{REF}$	Long Term Stability <sup>(3)</sup>	1000 Hrs		50		ppm
	Thermal Hysteresis <sup>(4)</sup>	$-40^\circ C \leq T_J \leq +125^\circ C$		75		
$V_{IN} - V_{REF}$	Dropout Voltage <sup>(5)</sup>	$I_{LOAD} = 10mA$		175	<b>400</b>	mV
$V_N$	Output Noise Voltage	0.1 Hz to 10 Hz		350		$\mu V_{PP}$
$I_{SC}$	Short Circuit Current				<b>75</b>	mA
$V_{IL}$	Enable Pin Maximum Low Input Level				<b>35</b>	$\%V_{IN}$
$V_{IH}$	Enable Pin Minimum High Input Level		<b>65</b>			$\%V_{IN}$

- (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

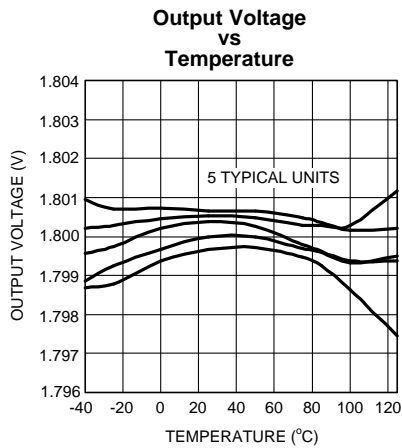


Figure 1.

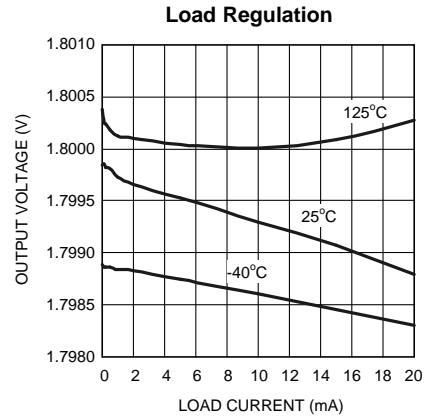


Figure 2.

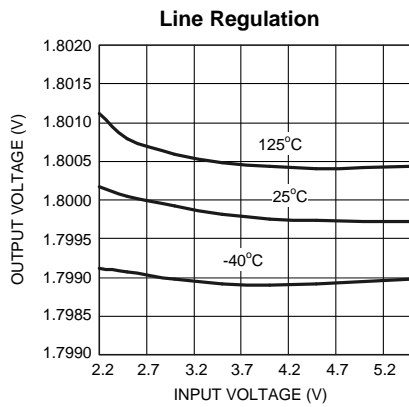


Figure 3.

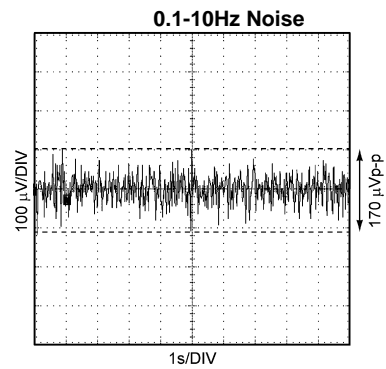


Figure 4.

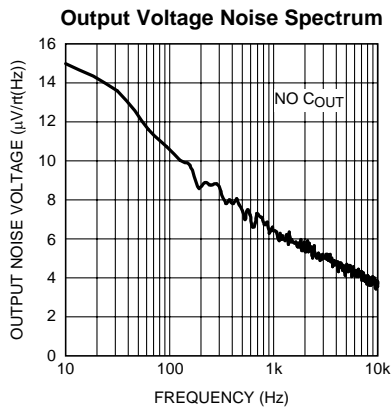


Figure 5.

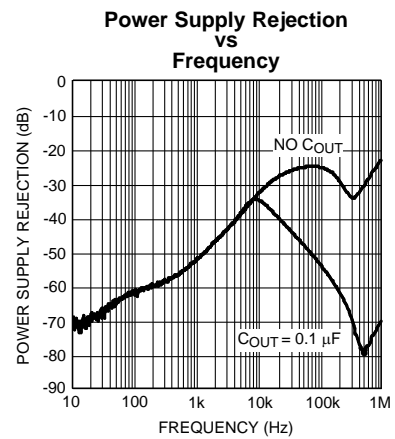
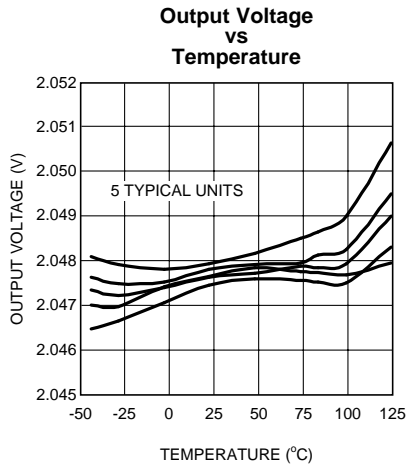
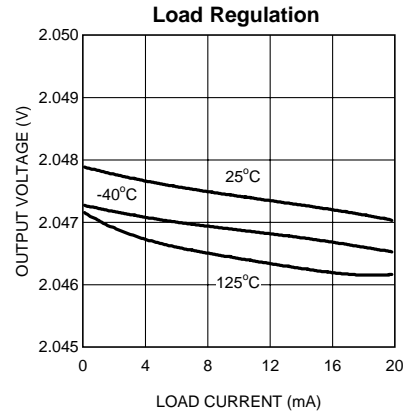


Figure 6.

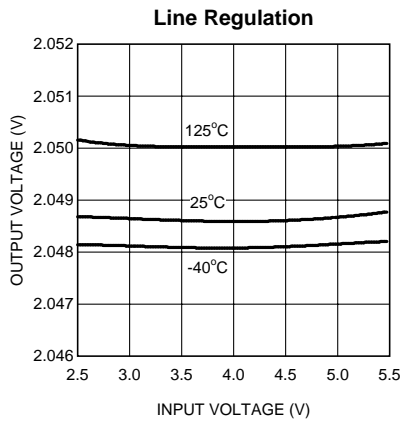
**Typical Performance Characteristics for 2.048V**



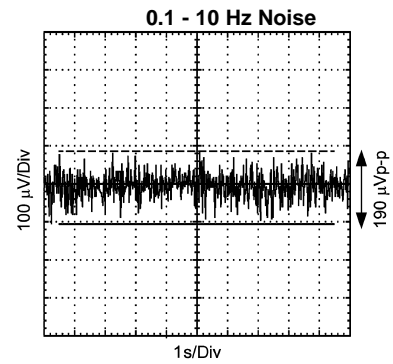
**Figure 7.**



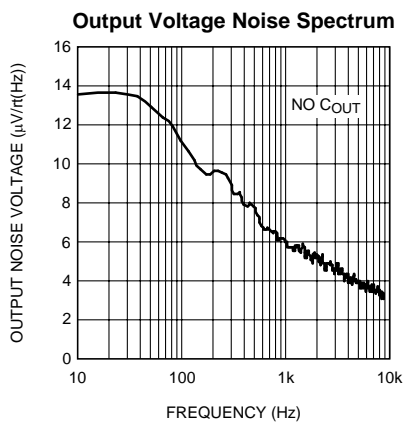
**Figure 8.**



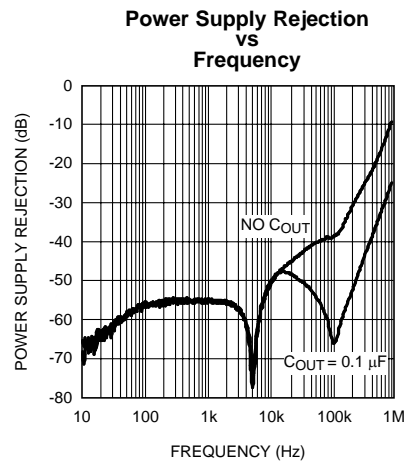
**Figure 9.**



**Figure 10.**



**Figure 11.**



**Figure 12.**

Typical Performance Characteristics for 2.5V

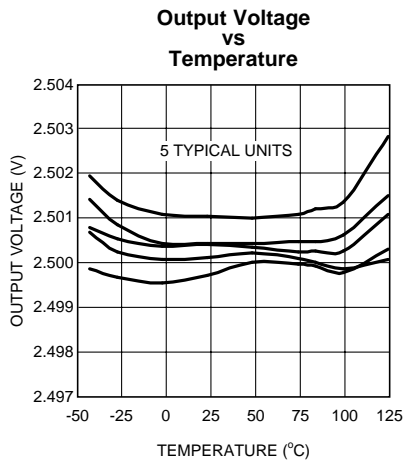


Figure 13.

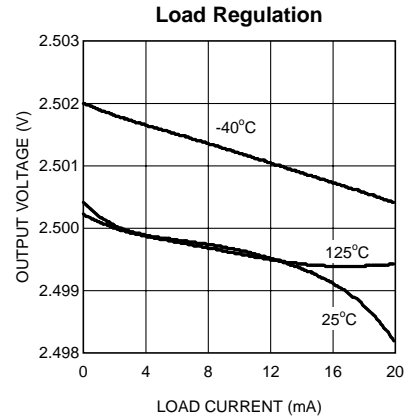


Figure 14.

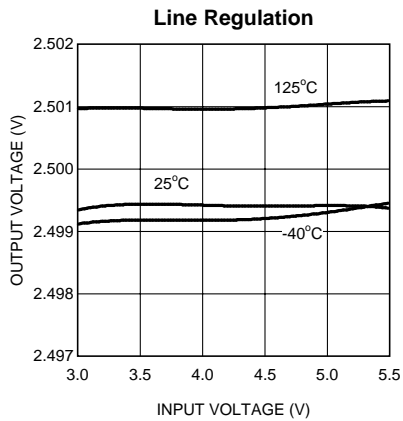


Figure 15.

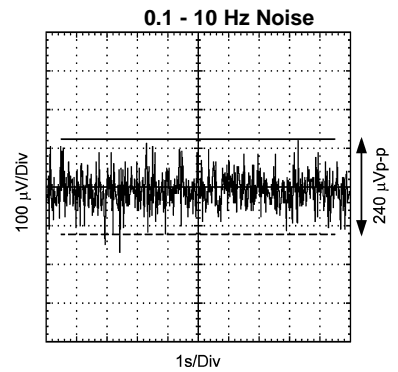


Figure 16.

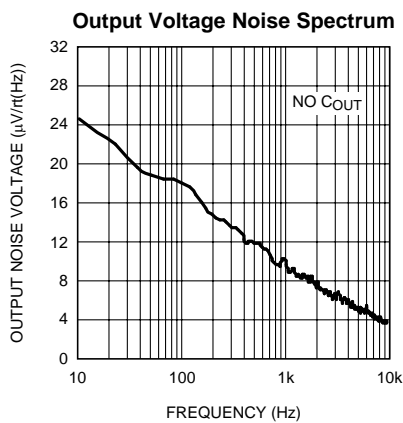


Figure 17.

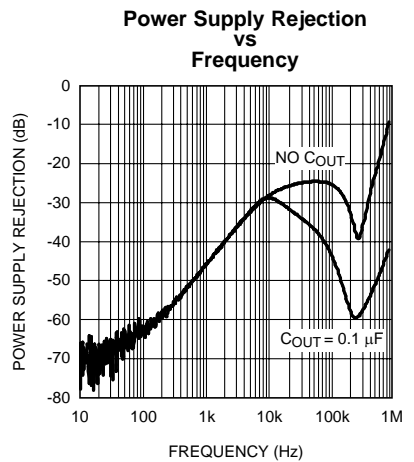


Figure 18.

Typical Performance Characteristics for 3.0V

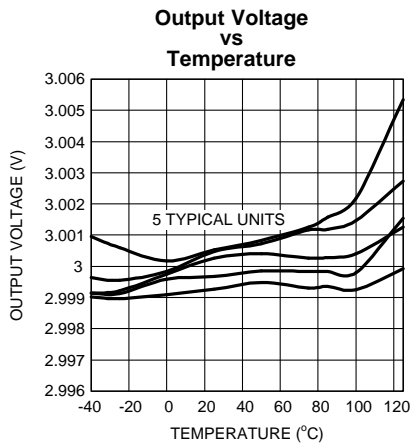


Figure 19.

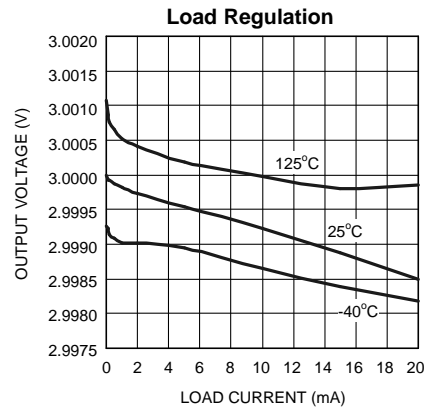


Figure 20.

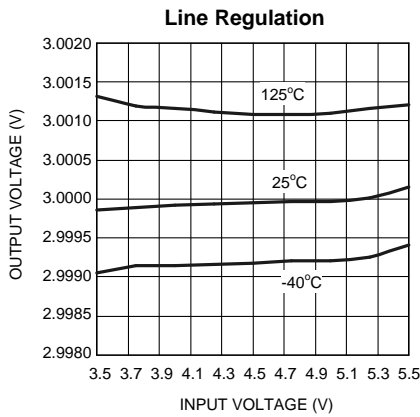


Figure 21.

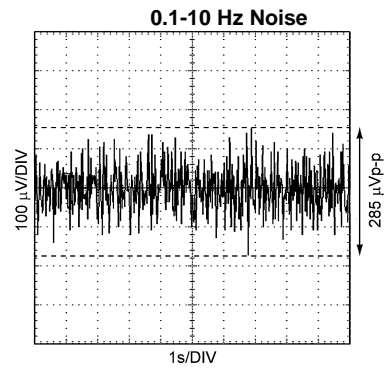


Figure 22.

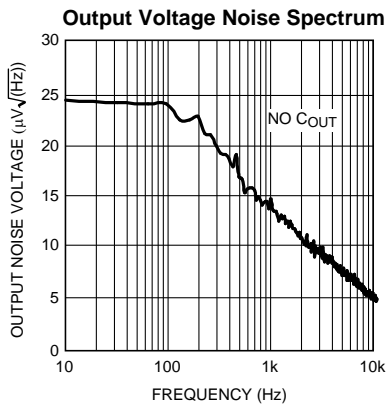


Figure 23.

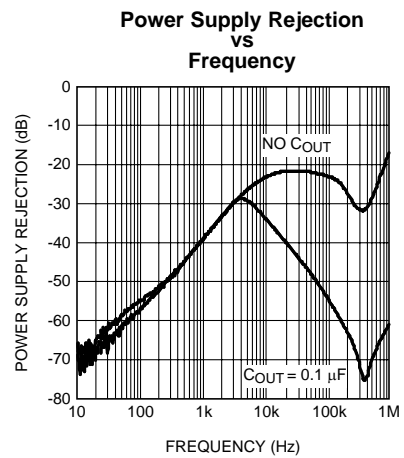


Figure 24.

### Typical Performance Characteristics for 3.3V

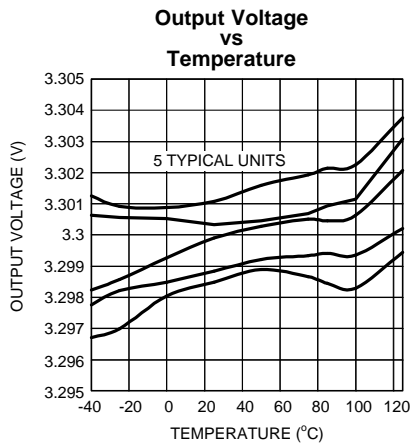


Figure 25.

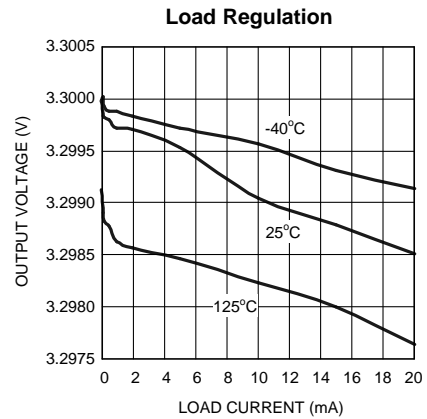


Figure 26.

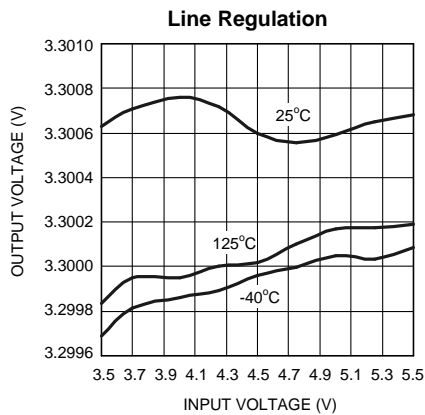


Figure 27.

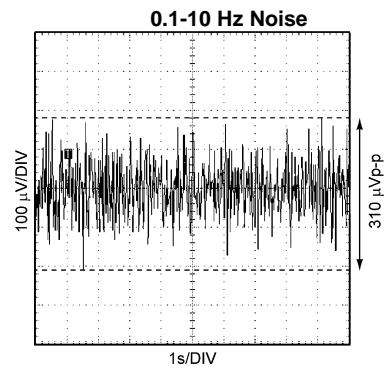


Figure 28.

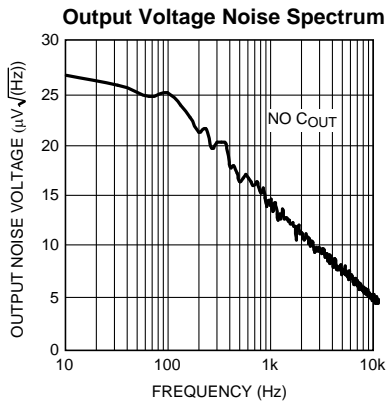


Figure 29.

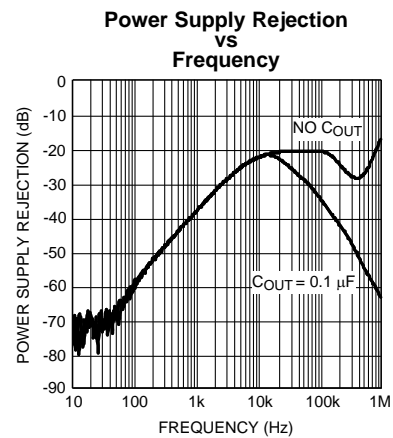


Figure 30.

**Typical Performance Characteristics for 4.096V**

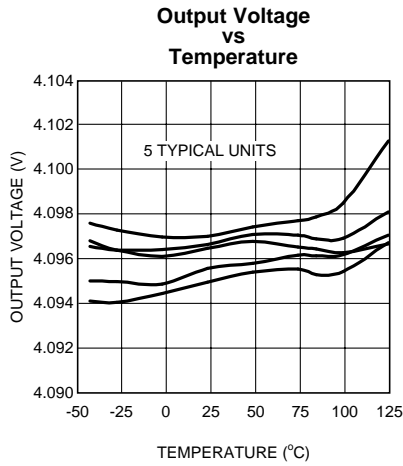


Figure 31.

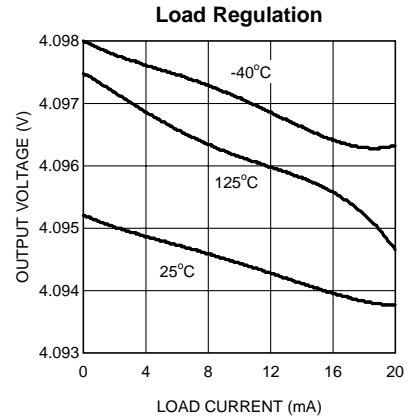


Figure 32.

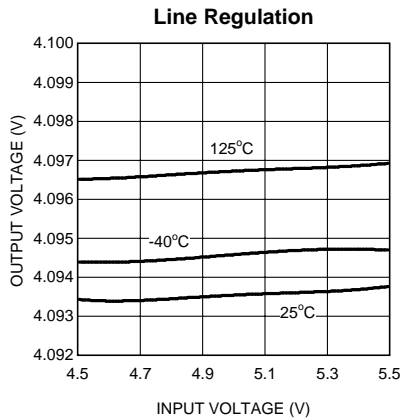


Figure 33.

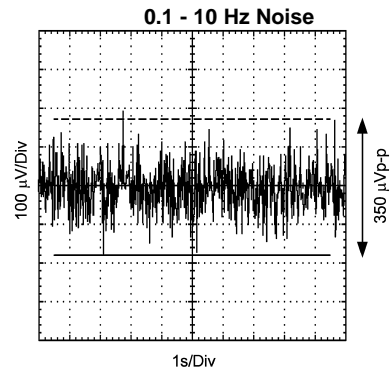


Figure 34.

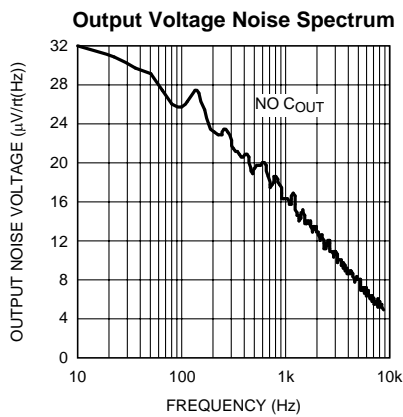


Figure 35.

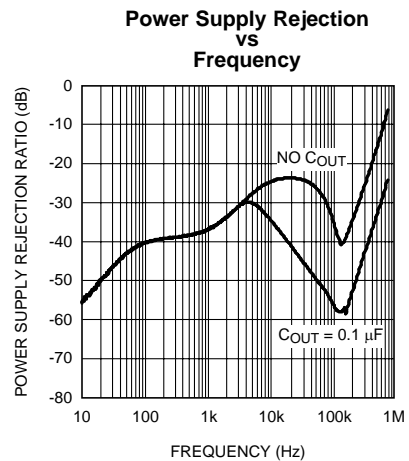


Figure 36.

Typical Performance Characteristics

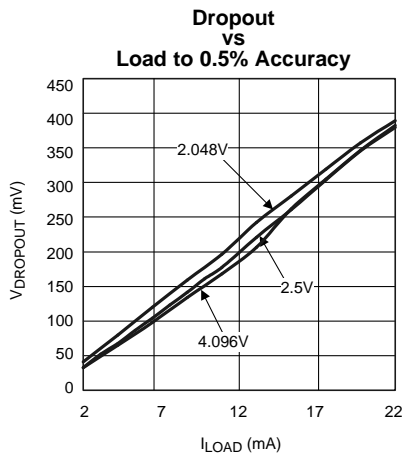


Figure 37.

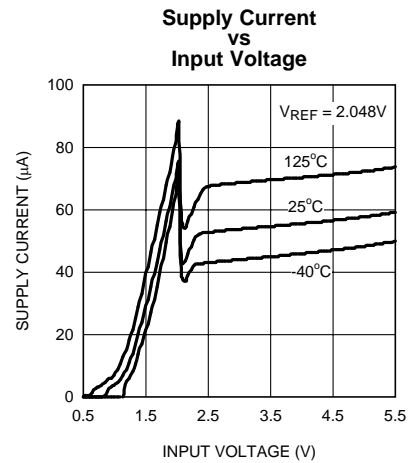


Figure 38.

Enable Threshold Voltage and Hysteresis

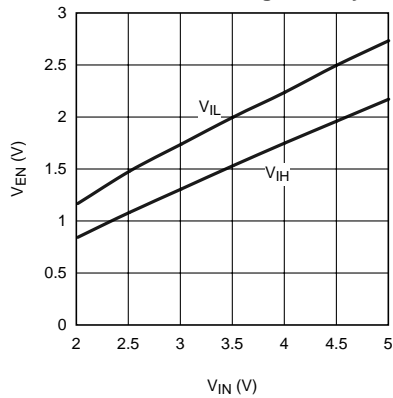


Figure 39.

Shutdown Iq vs Temperature

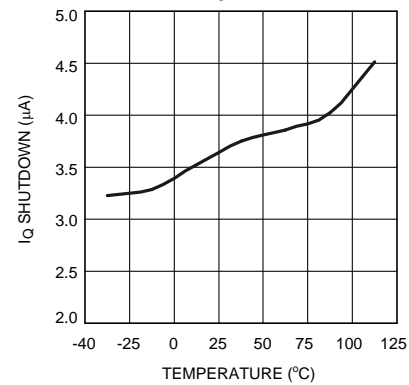


Figure 40.

Typical Long Term Stability

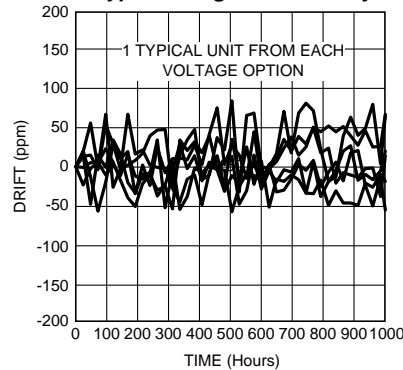


Figure 41.

Ground Current vs Load Current

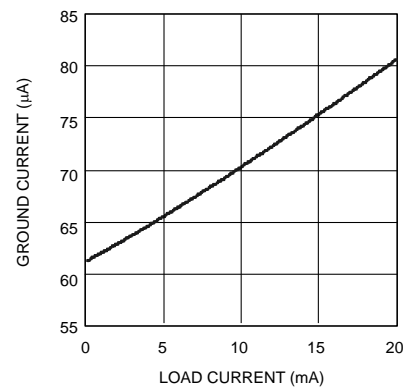
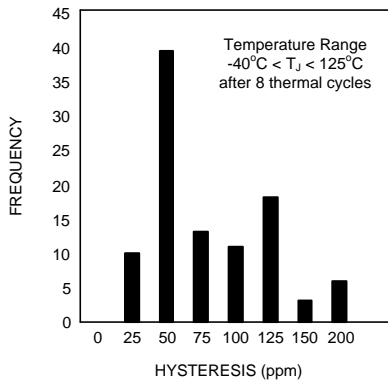


Figure 42.

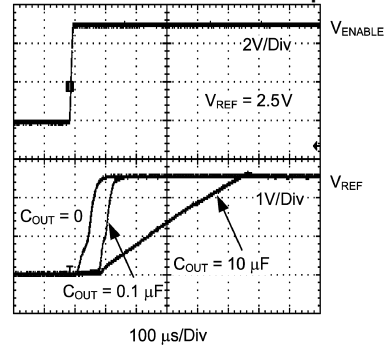
**Typical Performance Characteristics (continued)**

**Typical Thermal Hysteresis**



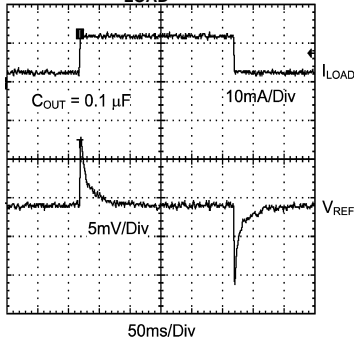
**Figure 43.**

**Turn-On Transient Response**



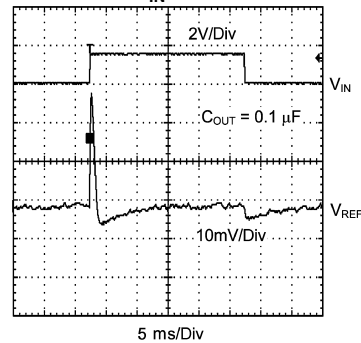
**Figure 44.**

**Load Transient Response**  
**I<sub>LOAD</sub> = 0 to 10mA**



**Figure 45.**

**Line Transient Response**  
**V<sub>IN</sub> = 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

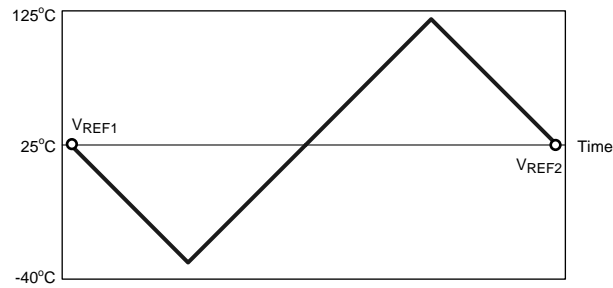
The LM4132 features indefinite short circuit protection. This protection limits the output current to  $75\text{mA}$  when the output is shorted to ground.

### 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  $10\text{ms}$ ) under brown out conditions and low temperatures ( $-40^\circ\text{C}$ ).

### THERMAL HYSTERESIS

Thermal hysteresis is defined as the change in output voltage at  $25^\circ\text{C}$  after some deviation from  $25^\circ\text{C}$ . 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:

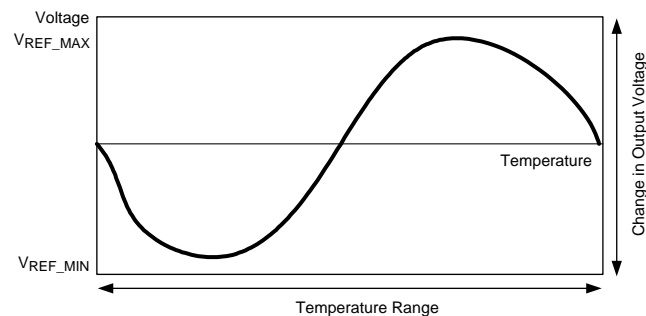
$$V_{\text{HYS}} = \frac{|V_{\text{REF1}} - V_{\text{REF2}}|}{V_{\text{REF}}} \times 10^6 \text{ ppm}$$

Where

- $V_{\text{HYS}}$  = Thermal hysteresis expressed in ppm
- $V_{\text{REF}}$  = Nominal preset output voltage
- $V_{\text{REF1}} = V_{\text{REF}}$  before temperature fluctuation
- $V_{\text{REF2}} = V_{\text{REF}}$  after temperature fluctuation.
- The LM4132 features a low thermal hysteresis of 75 ppm (typical) from  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  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  $V_{\text{REF}}$  vs Temperature Profile**

Temperature coefficient may be expressed analytically as the following:

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

$T_D$  = Temperature drift

$V_{\text{REF}}$  = Nominal preset output voltage

$V_{\text{REF\_MIN}}$  = Minimum output voltage over operating temperature range

$V_{\text{REF\_MAX}}$  = Maximum output voltage over operating temperature range

$\Delta T$  = 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

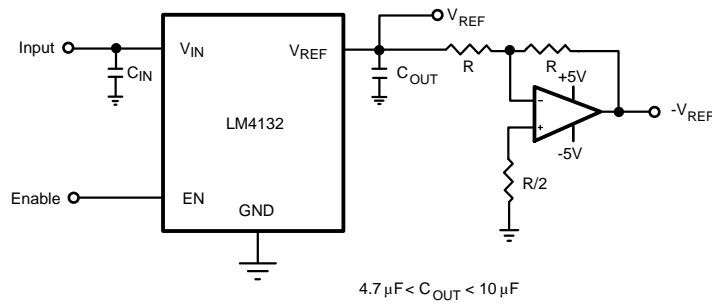


Figure 49. Voltage Reference with Complimentary Output

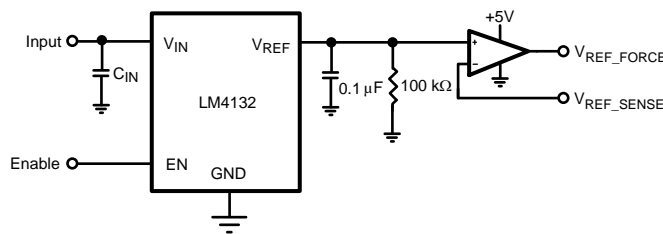


Figure 50. Precision Voltage Reference with Force and Sense Output

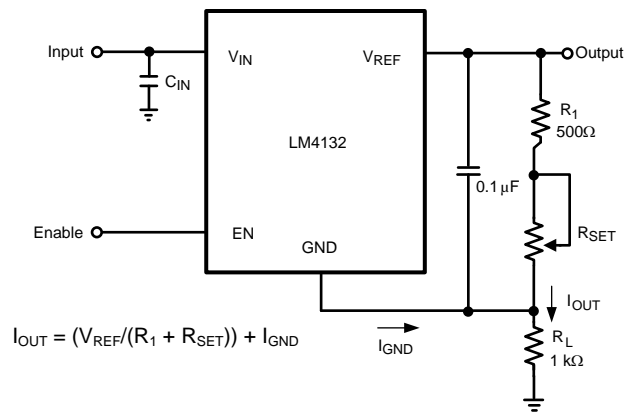


Figure 51. Programmable Current Source

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**REVISION HISTORY**

<b>Changes from Revision B (April 2013) to Revision C</b>	<b>Page</b>
• Changed layout of National Data Sheet to TI format .....	<a href="#">20</a>

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**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
LM4132AMF-4.1	NRND	SOT-23	DBV	5	1000	TBD	Call TI	Call TI	-40 to 125	R4FA	
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	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	<a href="#">Samples</a>
LM4132BMF-4.1	NRND	SOT-23	DBV	5	1000	TBD	Call TI	Call TI	-40 to 125	R4FB	
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
LM4132CMF-4.1	NRND	SOT-23	DBV	5	1000	TBD	Call TI	Call TI	-40 to 125	R4FC	
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>



Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>
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	<a href="#">Samples</a>

(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.

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

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**TAPE AND REEL INFORMATION**

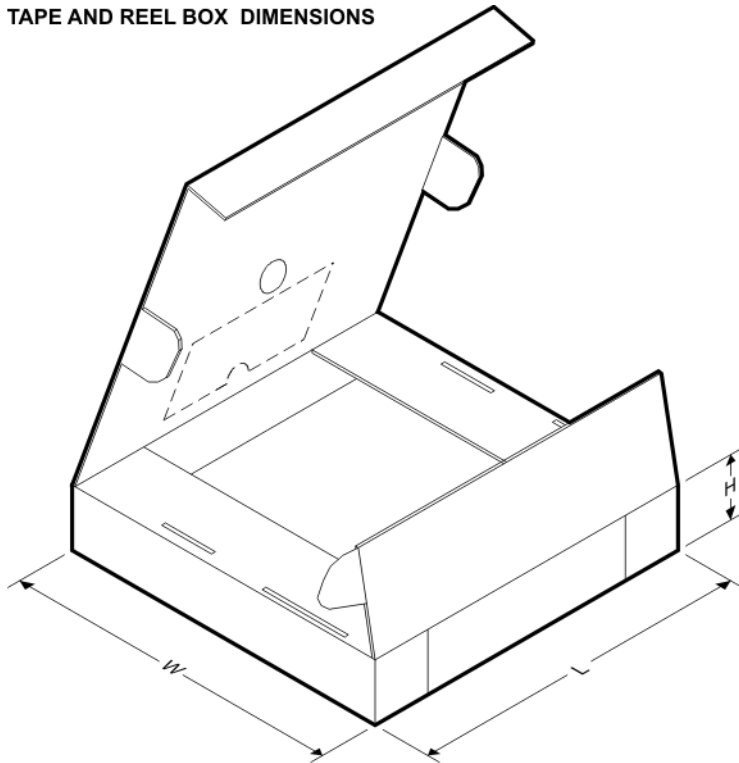
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
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

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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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