LM185-1.2QML

LM185-1.2QML Micropower Voltage Reference Diode

Literature Number: SNVS384

National Semiconductor

October 2005

LM185-1.2QML
Micropower Voltage Reference Diode

General Description

The LM185-1.2 is a micropower 2-terminal band-gap voltage regulator diodes. Operating over a 10µA to 20mA current range, it features exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to provide tight voltage tolerance. Since the LM185-1.2 band-gap reference uses only transistors and resistors, low noise and good long term stability result.

Careful design of the LM185-1.2 has made the device exceptionally tolerant of capacitive loading, making it easy to use in almost any reference application. The wide dynamic operating range allows its use with widely varying supplies with excellent regulation.

The extremely low power drain of the LM185-1.2 makes it useful for micropower circuitry. This voltage reference can be used to make portable meters, regulators or general purpose analog circuitry with battery life approaching shelf life.

Further, the wide operating current allows it to replace older references with a tighter tolerance part.

Features

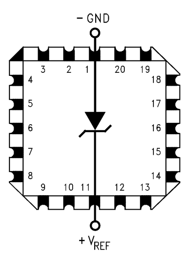
- Operating current of 10µA to 20mA
- 1Ω maximum dynamic impedance (typical)
- Low temperature coefficient
- Low voltage reference - 1.235V

Ordering Information

NS Part Number	JAN Part Number	NS Package Number	Package Description
LM185E-1.2/883	5962–87594012A	E20A	20LD LCC
LM185H-1.2-SMD	5962–8759401XA	H02A	2 LD T0–46
LM185H-1.2-QV	5962–8759401VXA	H02A	2 LD T0–46
LM185WG-1.2/883	5962–8759401YA	WG10A	10LD Ceramic SOIC
LM185BYH-1.2-SMD	5962–8759405XA	H02A	2 LD T0–46
LM185WG-1.2-QV	5962–8759401VYA	WG10A	10LD Ceramic SOIC

Connection Diagrams

Hermetic Leadless Chip Carrier (E)



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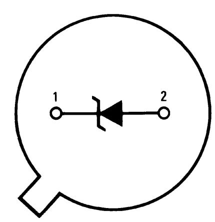
See NS Package Number E20A

TO-46
Metal Can Package (H)



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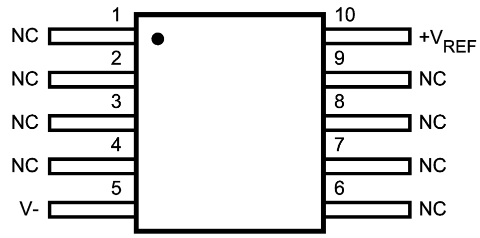
Bottom View
See NS Package Number H02A

 DS201561

Connection Diagrams (Continued)

Ceramic SOIC (WG)



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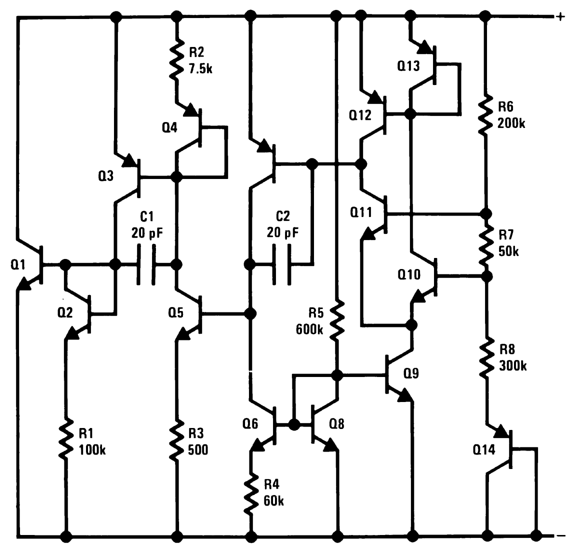
See NS Package Number WG10A

Schematic Diagram



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Absolute Maximum Ratings (Note 1)

Reverse Current	30mA
Forward Current	10mA
Operating Temperature Range	$-55^{\circ}C \leq T_A \leq +125^{\circ}C$
Maximum Junction Temperature (T_{Jmax}) (Note 2)	+150˚C
Storage Temperature	$-55^{\circ}C \leq T_A \leq +150^{\circ}C$
Lead Temperature (Soldering 10 Seconds)	
Ceramic SOIC	260˚C
TO-46 package	300˚C
20LD LCC package	300˚C
Thermal Resistance	
θ_{JA}	
Metal Can (Still Air)	300˚C/W
Metal Can (500LF / Min Air Flow)	139˚C/W
20LD LCC (Still Air)	100˚C/W
20LD LCC (500LF / Min Air Flow)	73˚C/W
Ceramic SOIC (Still Air)	194˚C/W
Ceramic SOIC (500LF / Min Air Flow)	128˚C/W
θ_{JC}	
Metal Can	57˚C/W
20LD LCC	25˚C/W
Ceramic SOIC	23˚C/W
Package Weight (Typical)	
Metal Can	TBD
20LD LCC	TBD
Ceramic SOIC	210mg
ESD Tolerance (Note 3)	4KV

Quality Conformance Inspection

Mil-Std-883, Method 5005 - Group A

Subgroup	Description	Temp ˚C
1	Static tests at	25
2	Static tests at	125
3	Static tests at	-55
4	Dynamic tests at	25
5	Dynamic tests at	125
6	Dynamic tests at	-55
7	Functional tests at	25
8A	Functional tests at	125
8B	Functional tests at	-55
9	Switching tests at	25
10	Switching tests at	125
11	Switching tests at	-55
12	Settling time at	25
13	Settling time at	125
14	Settling time at	-55

LM185–1.2 Electrical Characteristics

DC Parameters

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
V_{Ref}	Reverse Breakdown Voltage	I_R = 10μA		1.223	1.247	V	1
		I_R = 20μA		1.205	1.26	V	2, 3
		I_R = 1mA		1.223	1.247	V	1
				1.205	1.26	V	2, 3
		I_R = 20mA		1.223	1.247	V	1
				1.205	1.26	V	2, 3
$\Delta V_{Ref} / \Delta I_R$	Reverse Breakdown Voltage Change with Current	10μA ≤ I_R ≤ 1mA		-1.0	1.0	mV	1
		20μA ≤ I_R ≤ 1mA		-1.5	1.5	mV	2, 3
		1mA ≤ I_R ≤ 20mA		-10.0	10.0	mV	1
				-20.0	20.0	mV	2, 3
V_F	Forward Bias Voltage	I_F = 2mA		-1.0	-0.4	V	1

DC Drift Parameters

Delta calculations performed on QMLV devices at group B , subgroup 5, unless otherwise specified on the IPI.

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
V_R	Reverse Breakdown Voltage	I_R = 10μA		-0.01	0.01	V	1
		I_R = 20mA		-0.01	0.01	V	1

LM185BY–1.2 Electrical Characteristics

DC Parameters

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
V_{Ref}	Reverse Breakdown Voltage	I_R = 10μA		1.223	1.247	V	1
		I_R = 20μA		1.205	1.26	V	2, 3
		I_R = 1mA		1.223	1.247	V	1
				1.205	1.26	V	2, 3
		I_R = 20mA		1.223	1.247	V	1
				1.205	1.26	V	2, 3
$\Delta V_{Ref} / \Delta I_R$	Reverse Breakdown Voltage Change with Current	10μA ≤ I_R ≤ 1mA		-1.0	1.0	mV	1
		20μA ≤ I_R ≤ 1mA		-1.5	1.5	mV	2, 3
		1mA ≤ I_R ≤ 20mA		-10.0	10.0	mV	1
				-20.0	20.0	mV	2, 3
V_F	Forward Bias Voltage	I_F = 2mA		-1.0	-0.4	V	1
T_C	Temperature Coefficient		(Note 4)		50	PPM/˚C	2, 3

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

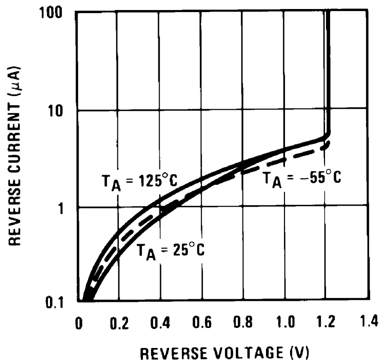
Note 2: The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 3: Human body model, 1.5KΩ in series with 100pF.

Note 4: The average temperature coefficient is defined as the maximum deviation of reference voltage, at all measured temperatures between the operating T_{Min} & T_{Max}, divided by ($T_{Max} - T_{Min}$). The measured temperatures ($T_{Measured}$) are –55˚C, 25˚C, & 125˚C or $\Delta V_{Ref} / (T_{Max} - T_{Min})$

Typical Performance Characteristics

Reverse Characteristics



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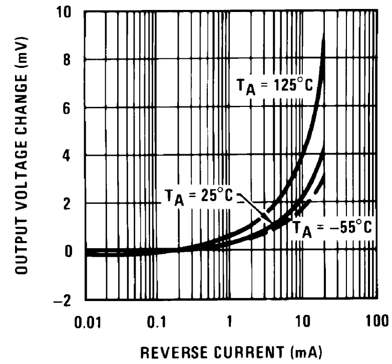
Reverse Characteristics



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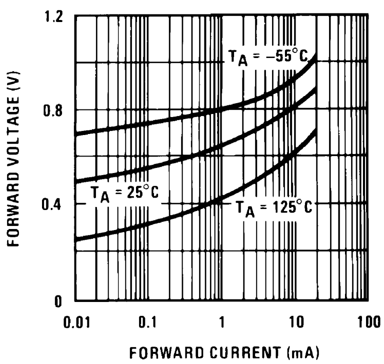
Forward Characteristics



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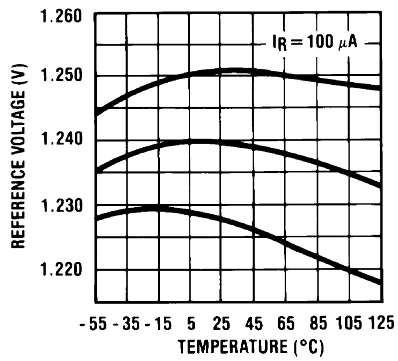
Temperature Drift of 3 Representative Units



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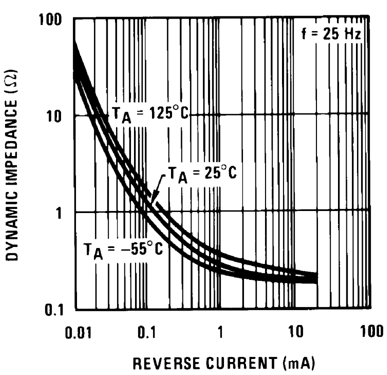
Reverse Dynamic Impedance



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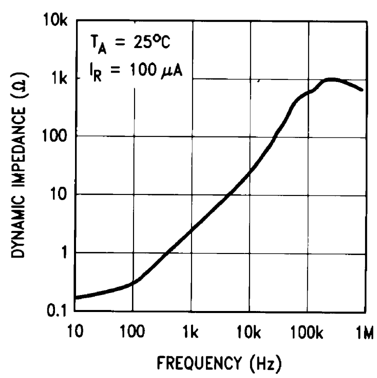
Reverse Dynamic Impedance



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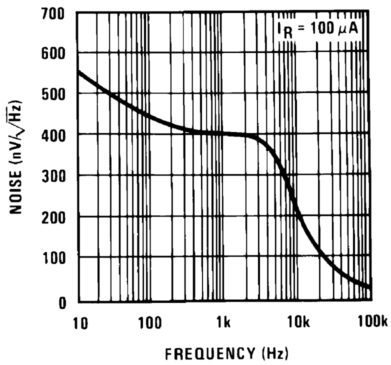
Typical Performance Characteristics (Continued)

Noise Voltage



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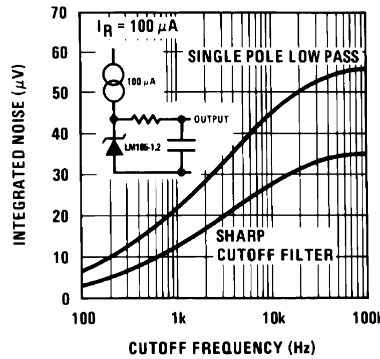
Filtered Output Noise



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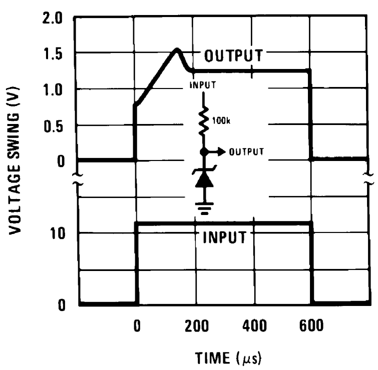
Response Time



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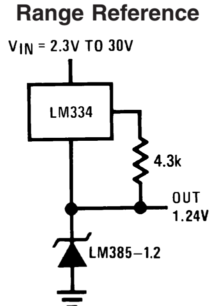
Typical Applications

Wide Input Range Reference



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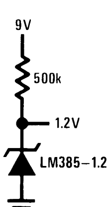
Micropower Reference from 9V Battery



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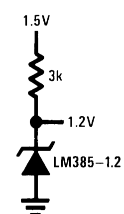
Reference from 1.5V Battery



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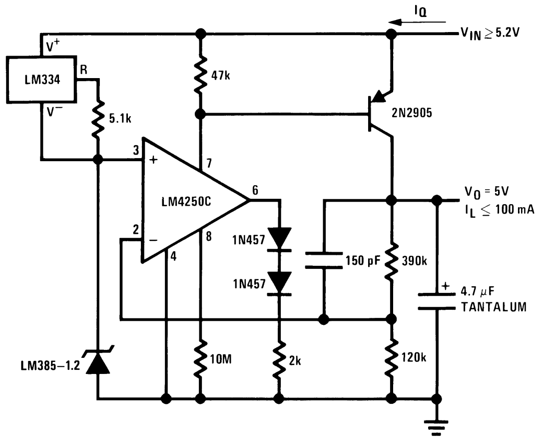
Typical Applications (Continued)

Micropower* 5V Regulator



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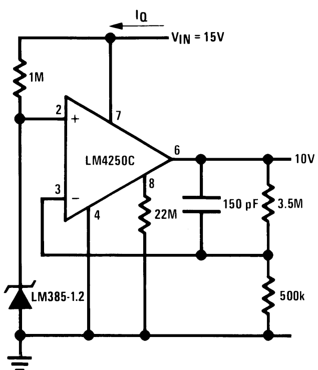
*$I_Q \simeq 30\mu A$

Micropower* 10V Reference



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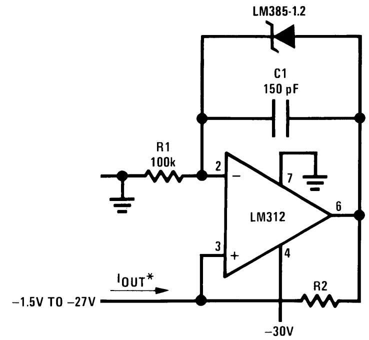
*$I_Q \simeq 20\mu A$ standby current

Precision 1μA to 1mA Current Sources



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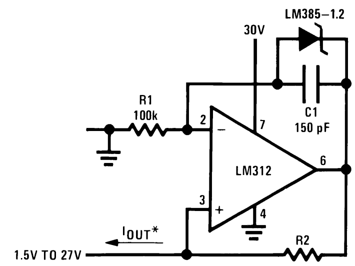
$$*I_{OUT} = \frac{1.23V}{R2}$$



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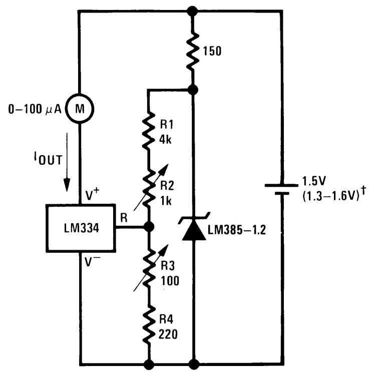
Typical Applications (Continued)

METER THERMOMETERS

0˚C–100˚C Thermometer



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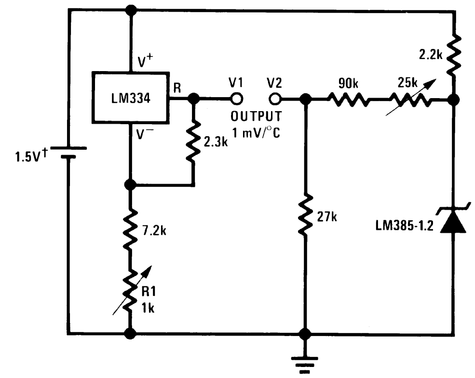
Calibration

1. Short LM385-1.2, adjust R3 for I_{OUT}= temp at 1µA/˚K
2. Remove short, adjust R2 for correct reading in centigrade

†I_Q at 1.3V≃500µA

I_Q at 1.6V≃2.4mA

Centigrade Thermometer



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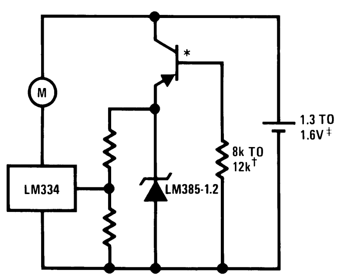
Calibration

1. Adjust R1 so that V1 = temp at 1mV/˚K
2. Adjust V2 to 273.2mV

†I_Q for 1.3V to 1.6V battery voltage = 50µA to 150µA

Lower Power Thermometer



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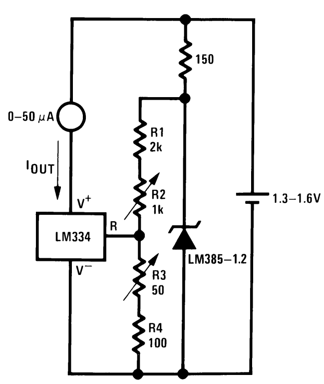
*2N3638 or 2N2907 select for inverse H_{FE} ≃ 5

†Select for operation at 1.3V

‡I_Q ≃ 600µA to 900µA

0˚F–50˚F Thermometer



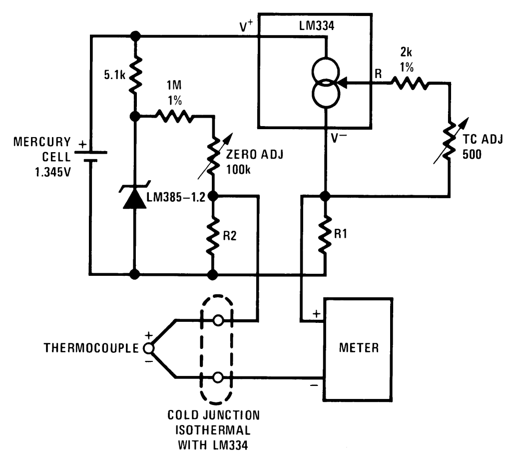
20156130

Calibration

1. Short LM385-1.2, adjust R3 for I_{OUT}= temp at 1.8µA/˚K
2. Remove short, adjust R2 for correct reading in ˚F

Typical supply current 50µA

Micropower Thermocouple Cold Junction Compensator



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Adjustment Procedure

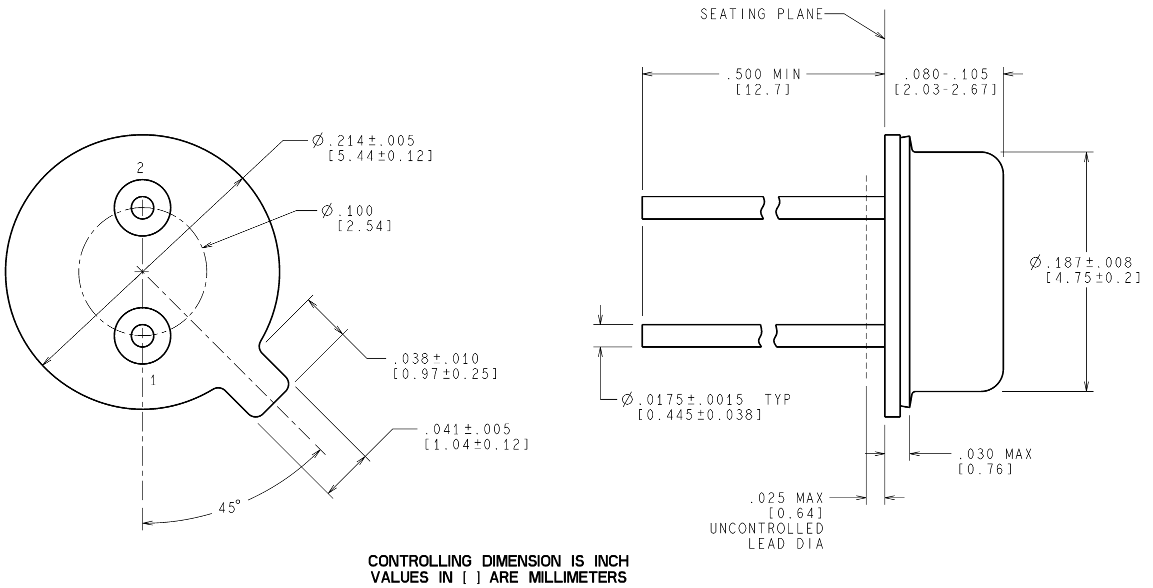
1. Adjust TC ADJ pot until voltage across R1 equals Kelvin temperature multiplied by the thermocouple Seebeck coefficient.
2. Adjust zero ADJ pot until voltage across R2 equals the thermocouple Seebeck coefficient multiplied by 273.2.

Thermocouple Type	Seebeck Coefficient (µV/˚C)	R1 (Ω)	R2 (Ω)	Voltage Across R1 @ 25˚C (mV)	Voltage Across R2 (mV)
J	52.3	523	1.24k	15.60	14.32
T	42.8	432	1k	12.77	11.78
K	40.8	412	953Ω	12.17	11.17
S	6.4	63.4	150Ω	1.908	1.766

Revision History Section

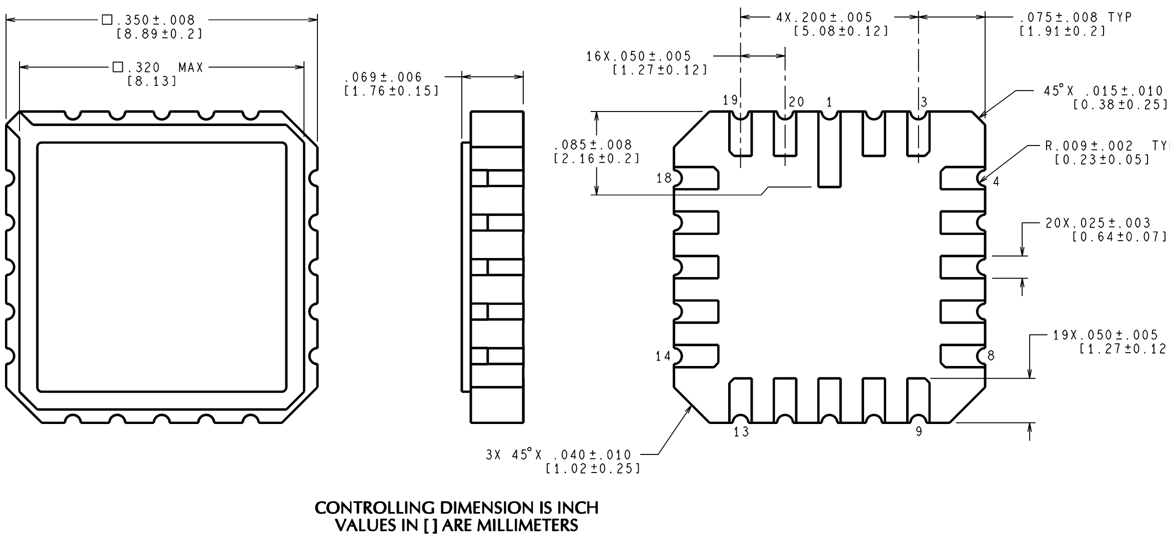
Released	Revision	Section	Originator	Changes
10/07/05	A	New Release, Corporate format	L. Lytle	2 MDS data sheets converted into one Corp. data sheet format. MNLM185-1.2-X Rev 2A3 and MNLM185BY-1.2-X Rev 0B0 data sheets will be archived.

Physical Dimensions inches (millimeters) unless otherwise noted



H02A (Rev F)

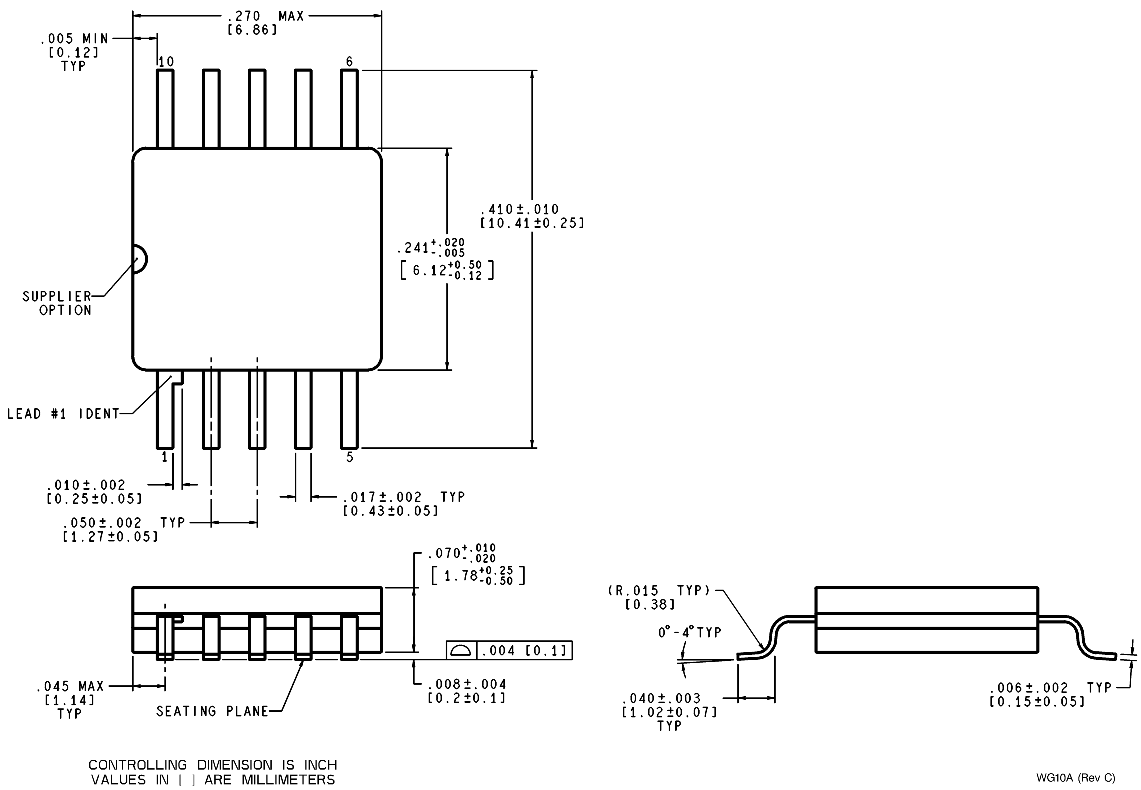
TO-46 Metal Can Package (H)
NS Package Number H02A



E20A (Rev F)

Leadless Chip Carrier Package (E)
NS Package Number E20A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Ceramic SOIC Package (WG)
NS Package Number WG10A

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