LM140QML Three Terminal Positive Regulators

Check for Samples: LM140QML

FEATURES

- **Complete Specifications at 1.0A and 0.5A Loads**
- **No External Components**
- **Internal Thermal Overload Protection**
- **Internal Short Circuit Current-Limiting**
- **Output Transistor Safe-Area Compensation**

DESCRIPTION

The monolithic 3-terminal positive voltage regulators employ internal current-limiting, thermal shutdown and safe-area compensation, making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 0.5A output current. They are intended as fixed voltage regulators in a wide range of applications including local (on-card) regulation for elimination of noise and distribution problems associated with single-point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents.

Considerable effort was expended to make the entire series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply.

Connection Diagram
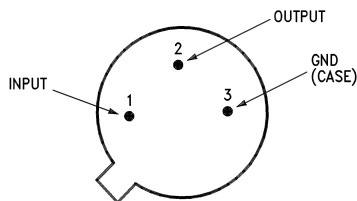
Figure 1. Steel Metal Can TO-39 Package (NDT)
Bottom View
See Package Number NDT0003A
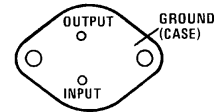
Figure 2. TO-3 Metal Can (K)
Bottom View
See Package Number K0002C

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.

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Absolute Maximum Ratings[1]

DC Input Voltage			35V
Internal Power Dissipation [2]			Internally Limited
Maximum Junction Temperature ($T_{Jmax)}$)			150°C
Storage Temperature Range			-65°C ≤ T_A ≤ +150°C
Operating Temperature Range			-55°C ≤ T_A ≤ +125°C
Lead Temperature (Soldering 10 seconds)			300°C
Thermal Resistance	θ_{JA}	T0−39 (Still Air)	232°C/W
		T0−39 (500 LF/Min Air Flow)	77°C/W
		T0−3 (Still Air)	35°C/W
		T0−3 (500 LF/Min Air Flow)	TBD
	θ_{JC}	T0−39	15°C/W
		T0−3	4°C/W
ESD Susceptibility [3]			2KV

(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 specify specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
(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.
(3) Human body model, 100pF discharged through 1.5KΩ

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

Product Folder Links: *LM140QML*

LM140H–5.0 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.
DC: V_I = 10V, I_L =350mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_O	Output Voltage	V_I = 35V, I_L = 5mA		4.75	5.75	V	1
				4.80	5.20	V	1
		V_I = 8V		4.70	5.30	V	1, 2, 3
		V_I = 8V, I_L = 5mA		4.70	5.30	V	1, 2, 3
		V_I = 20V, I_L = 5mA		4.70	5.30	V	1, 2, 3
		V_I = 20V		4.70	5.30	V	1, 2, 3
R_{Line}	Line Regulation	7V ≤ V_I ≤ 25V, I_L = 200mA		-50	50	mV	1
		8V ≤ V_I ≤ 25V, I_L = 200mA		-50	50	mV	2, 3
		8V ≤ V_I ≤ 20V, I_L = 200mA		-25	25	mV	1
				-40	40	mV	2, 3
R_{Load}	Load Regulation	5mA ≤ I_L ≤ 500mA		-50	50	mV	1
				-100	100	mV	2, 3
		5mA ≤ I_L ≤ 200mA		-25	25	mV	1
				-50	50	mV	2, 3
I_Q	Quiescent Current				7.0	mA	1, 2, 3
ΔI_Q	Quiescent Current Change	8V ≤ V_I ≤ 25V, I_L = 200mA		-0.8	0.8	mA	1, 2, 3
		5mA ≤ I_L ≤ 350mA		-0.5	0.5	mA	1, 2, 3
I_{Pk}	Peak Current	V_I - V_O = 7V	See [1]	0.4	2.0	A	1, 2, 3
V_{DO}	Dropout Voltage		See [2]		2.5	V	1
I_{OS}	Short Circuit Current	V_I = 35V			1.0	A	1, 2, 3

(1) V_O is set to 90% V_{Ref}
(2) $V_{DO} = V_I - V_O$ when V_O is 95% of V_{Ref}.

LM140H–5.0 Electrical Characteristics AC Parameters

The following conditions apply, unless otherwise specified.
AC: V_I = 10V, I_L =350mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	I_L = 125mA, e_I = 1V_{RMS}, f = 2.4KHz, V_I = 10V		62		dB	4, 5, 6

LM140H–12 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.

DC: V_I = 19V, I_L =350mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_O	Output Voltage	V_I = 35V, I_L = 5mA		11.4	12.6	V	1
				11.5	12.5	V	1
		V_I = 15.5V		11.4	12.6	V	1, 2, 3
		V_I = 15.5V, I_L = 5mA		11.4	12.6	V	1, 2, 3
		V_I = 27V, I_L = 5mA		11.4	12.6	V	1, 2, 3
		V_I = 27V		11.4	12.6	V	1, 2, 3
R_{Line}	Line Regulation	14.5V ≤ V_I ≤ 30V, I_L = 200mA		-60	60	mV	1
		15.0V ≤ V_I ≤ 30V, I_L = 200mA		-120	120	mV	2, 3
		16V ≤ V_I ≤ 25V, I_L = 200mA		-30	30	mV	1
				-60	60	mV	2, 3
R_{Load}	Load Regulation	5mA ≤ I_L ≤ 500mA		-120	120	mV	1
				-240	240	mV	2, 3
		5mA ≤ I_L ≤ 200mA		-60	60	mV	1
				-120	120	mV	2, 3
I_Q	Quiescent Current				7.0	mA	1, 2, 3
ΔI_Q	Quiescent Current Change	14.5V ≤ V_I ≤ 30V, I_L = 200mA		-0.8	0.8	mA	1, 2, 3
		5mA ≤ I_L ≤ 350mA		-0.5	0.5	mA	1, 2, 3
I_{Pk}	Peak Current	V_I - V_O = 7V	See [1]	0.4	2.0	A	1, 2, 3
V_{DO}	Dropout Voltage		See [2]		2.5	V	1
I_{OS}	Short Circuit Current	V_I = 35V			1.0	A	1, 2, 3

(1) V_O is set to 90% V_{Ref}

(2) $V_{DO} = V_I − V_O$ when V_O is 95% of V_{Ref}.

LM140H–12 Electrical Characteristics AC Parameters

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	V_I = 17V, I_L = 125mA, e_I = 1V_{RMS}, f = 2.4KHz		55		dB	4, 5, 6

Product Folder Links: LM140QML

LM140H–15 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.
DC: V_I = 23V, I_L =350mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_O	Output Voltage	$V_I = 35V$, $I_L = 5mA$		14.25	15.75	V	1
				14.40	15.60	V	1
		$V_I = 18.5V$		14.25	15.75	V	1, 2, 3
		$V_I = 18.5V$, $I_L = 5mA$		14.25	15.75	V	1, 2, 3
		$V_I = 30V$, $I_L = 5mA$		14.25	15.75	V	1, 2, 3
		$V_I = 30V$		14.25	15.75	V	1, 2, 3
R_{Line}	Line Regulation	$17.5V \leq V_I \leq 30V$, $I_L = 200mA$		-60	60	mV	1
		$18.5V \leq V_I \leq 30V$, $I_L = 200mA$		-120	120	mV	2, 3
		$20V \leq V_I \leq 30V$, $I_L = 200mA$		-30	30	mV	1
				-60	60	mV	2, 3
R_{Load}	Load Regulation	$5mA \leq I_L \leq 500mA$		-150	150	mV	1
				-300	300	mV	2, 3
		$5mA \leq I_L \leq 200mA$		-75	75	mV	1
				-150	150	mV	2, 3
I_Q	Quiescent Current				7.0	mA	1, 2, 3
ΔI_Q	Quiescent Current Change	$17.5V \leq V_I \leq 30V$, $I_L = 200mA$		-0.8	0.8	mA	1, 2, 3
		$5mA \leq I_L \leq 350mA$		-0.5	0.5	mA	1, 2, 3
I_{Pk}	Peak Current	$V_I - V_O = 7V$	See[1]	0.4	2.0	A	1, 2, 3
V_{DO}	Dropout Voltage		See[2]		2.5	V	1
I_{OS}	Short Circuit Current	$V_I = 35V$			1.0	A	1, 2, 3

(1) V_O is set to 90% V_{Ref}
(2) $V_{DO} = V_I - V_O$ when V_O is 95% of V_{Ref}.

LM140H–15 Electrical Characteristics AC Parameters

The following conditions apply, unless otherwise specified.
AC: V_I = 23V, I_L =350mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	$V_I=20V$, $I_L=125mA$, $e_I=1V_{RMS}$, $f = 2.4KHz$		54		dB	4, 5, 6

Product Folder Links: *LM140QML*

LM140K–5.0 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.
DC: V_I = 10V, I_L = 5mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
I_Q	Quiescent Current	I_L = 1A			6.0	mA	1
					7.0	mA	2, 3
ΔQ	Quiescent Current Change	I_L = 1A, 8V ≤ V_I ≤ 20mA		-0.8	0.8	mA	1
		I_L ≤ 500mA, 8V ≤ V_I ≤ 25V		-0.8	0.8	mA	1, 2, 3
		5mA, ≤ I_L ≤ 1.0A		-0.5	0.5	mA	1, 2, 3
V_O	Output Voltage			4.80	5.20	V	1
		V_I = 8V		4.75	5.25	V	1, 2, 3
		V_I = 8V, I_L = 1A		4.75	5.25	V	1, 2, 3
		V_I = 20V		4.75	5.25	V	1, 2, 3
		V_I = 20V, I_L = 1A		4.75	5.25	V	1, 2, 3
R_{Line}	Line Regulation	I_L = 500mA, 7V ≤ V_I ≤ 25V		-50	50	mV	1, 2, 3
		I_L = 1A, 7.3V ≤ V_I ≤ 20V		-50	50	mV	1
		I_L = 1A, 8.0V ≤ V_I ≤ 20V		-50	50	mV	2, 3
		I_L = 1A, 8V ≤ V_I ≤ 12V		-25	25	mV	1, 2, 3
R_{Load}	Load Regulation	5mA ≤ I_L ≤ 1.5A		-50	50	mV	1
		5mA ≤ I_L ≤ 1.0A		-50	50	mV	2, 3
		250mA ≤ I_L ≤ 750mA		-25	25	mV	1
I_{OS}	Current Limit			-4.0	-0.02	A	1
		V_I = 35V		-2.0	-0.02	A	1

LM140K–5.0 Electrical Characteristics AC Parameters

The following conditions apply, unless otherwise specified.
AC: V_I = 10V, I_L = 5mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	f = 120Hz, I_L = 350mA, e_I = 1V_{RMS}		68		dB	4

LM140K–12 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.
DC: V_I = 19V, I_L = 5mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
I_Q	Quiescent Current	I_L = 1A			6.0	mA	1
					7.0	mA	2, 3
ΔI_Q	Quiescent Current Change	I_L = 1A, 15.5V ≤ V_I ≤ 27V		-0.8	0.8	mA	1
		I_L = 500mA 15V ≤ V_I ≤ 30V		-0.8	0.8	mA	1, 2, 3
		5mA ≤ I_L ≤ 1A		-0.5	0.5	mA	1, 2, 3
V_O	Output Voltage			11.5	12.5	V	1
		V_I = 15.5V		11.4	12.6	V	1, 2, 3
		V_I = 15.5V, I_L = 1A		11.4	12.6	V	1, 2, 3
		V_I = 27V		11.4	12.6	V	1, 2, 3
		V_I = 27V, I_L = 1A		11.4	12.6	V	1, 2, 3
R_{Line}	Line Regulation	I_L = 500mA, 14.5V ≤ V_I ≤ 25V		-120	120	mV	1, 2, 3
		I_L = 1A, 14.6V ≤ V_I ≤ 27V		-120	120	mV	1
		I_L = 1A, 15.0V ≤ V_I ≤ 27V		-120	120	mV	2, 3
		I_L = 1A, 16V ≤ V_I ≤ 22V		-60	60	mV	1, 2, 3
R_{Load}	Load Regulation	5mA ≤ I_L ≤ 1.5A		-120	120	mV	1
		5mA ≤ I_L ≤ 1.0A		-120	120	mV	2, 3
		250mA ≤ I_L ≤ 750mA		-60	60	mV	1
I_{OS}	Current Limit	V_I = 17V		-3.5	-0.02	A	1
		V_I = 35V		-2.0	-0.02	A	1

LM140K–12 Electrical Characteristics AC Parameters

The following conditions apply, unless otherwise specified.
AC: V_I = 19V, I_L = 5mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	f = 120Hz, I_L = 350mA, e_I = 1V_{RMS}		61		dB	4

Product Folder Links: *LM140QML*

LM140QML

LM140K–15 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified.
DC: V_I = 23V, I_L = 5mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
I_Q	Quiescent Current	I_L = 1A			6.0	mA	1
					7.0	mA	2, 3
ΔI_Q	Quiescent Current Change	I_L = 1A, 18.5V ≤ V_I ≤ 30V		-0.8	0.8	mA	1
		I_L = 500mA, 18.5V ≤ V_I ≤ 30V		-0.8	0.8	mA	2, 3
		5mA ≤ I_L ≤ 1A		-0.5	0.5	mA	1, 2, 3
V_O	Output Voltage			14.4	15.6	V	1
		V_I = 18.5V		14.25	15.75	V	1, 2, 3
		V_I = 18.5V, I_L = 1A		14.25	15.75	V	1, 2, 3
		V_I = 30V		14.25	15.75	V	1, 2, 3
		V_I = 30V, I_L = 1A		14.25	15.75	V	1, 2, 3
R_{Line}	Line Regulation	I_L = 500mA, 17.5V ≤ V_I ≤ 30V		-150	150	mV	1
		I_L = 500mA, 18.5V ≤ V_I ≤ 30V		-150	150	mV	2, 3
		I_L = 1A, 17.7V ≤ V_I ≤ 30V		-75	75	mV	1
		I_L = 1A, 20V ≤ V_I ≤ 26V		-75	75	mV	1, 2, 3
R_{Load}	Load Regulation	5mA ≤ I_L ≤ 1.5A		-150	150	mV	1
		5mA ≤ I_L ≤ 1.0A		-150	150	mV	2, 3
		250mA ≤ I_L ≤ 750mA		-75	75	mV	1
I_{OS}	Current Limit	V_I = 20V		-3.5	-0.02	A	1
		V_I =35V		-2.0	-0.02	A	1

LM140K–15 Electrical Characteristics AC Parameters

The following conditions apply, unless otherwise specified.
AC: V_I = 23V, I_L = 5mA

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	f = 120Hz, I_L = 350mA, e_I = 1V_{RMS}		60		dB	4

REVISION HISTORY SECTION

Released	Revision	Section	Originator	Changes
02/21/06	A	New Release, Corporate format	L. Lytle	6 MDS data sheets converted into one Corp. data sheet format. The drift tables were eliminated from the 883 section since it did not apply. MDS data sheets MNLM140-05H Rev 0B0, MNLM140-05-K Rev. 0C0, MNLM140-12H Rev 0A0, MNLM140-12K Rev 0B0, MNLM140-15H Rev 0A0, and MNLM140-15K Rev 0B0 will be archived.
05/02/13	B			Changed layout of National Data Sheet to TI format.

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
LM140H-12/883	ACTIVE	TO	NDT	3	20	TBD	Call TI	Call TI	-55 to 125	LM140H-12/883 Q ACO LM140H-12/883 Q >T	Samples
LM140H-15/883	ACTIVE	TO	NDT	3	20	TBD	Call TI	Call TI	-55 to 125	LM140H-15/883 Q ACO LM140H-15/883 Q >T	Samples
LM140H-5.0/883	ACTIVE	TO	NDT	3	20	TBD	Call TI	Call TI	-55 to 125	LM140H-5.0/883 Q ACO LM140H-5.0/883 Q >T	Samples
LM140K-12/883	ACTIVE	TO	K	2	50	TBD	Call TI	Call TI	-55 to 125	LM140K-12 /883 Q ACO /883 Q >T	Samples
LM140KG-12 MD8	ACTIVE	DIESALE	Y	0	221	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	-55 to 125		Samples
LM140KG-5 MD8	ACTIVE	DIESALE	Y	0	221	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	-55 to 125		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.

(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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NDT0003A
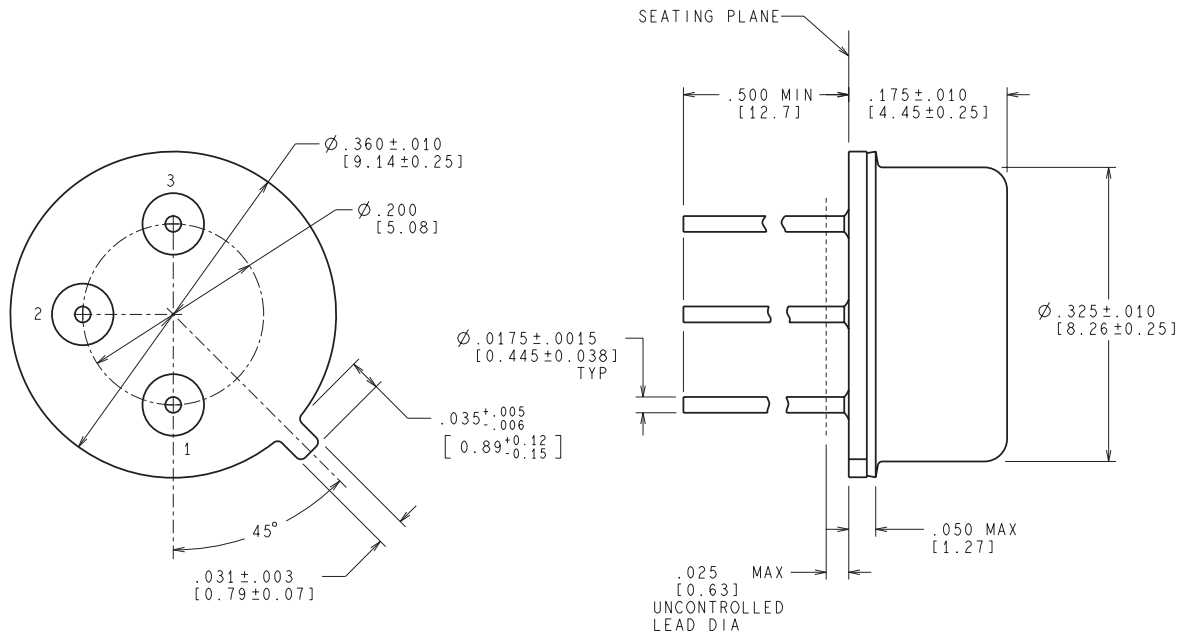
SEATING PLANE

.500 MIN
[12.7]

.175±.010
[4.45±0.25]

Ø .360±.010
[9.14±0.25]

Ø .200
[5.08]

Ø .0175±.0015
[0.445±0.038]
TYP

.035$^{+.005}_{-.006}$
$[0.89^{+0.12}_{-0.15}]$

Ø .325±.010
[8.26±0.25]

45°

.031±.003
[0.79±0.07]

.050 MAX
[1.27]

.025 MAX
[0.63]
UNCONTROLLED
LEAD DIA

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535
CONFIGURATION CONTROL

H03A (Rev D)

TEXAS
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K0002C

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535
CONFIGURATION CONTROL

K02C (Rev E)

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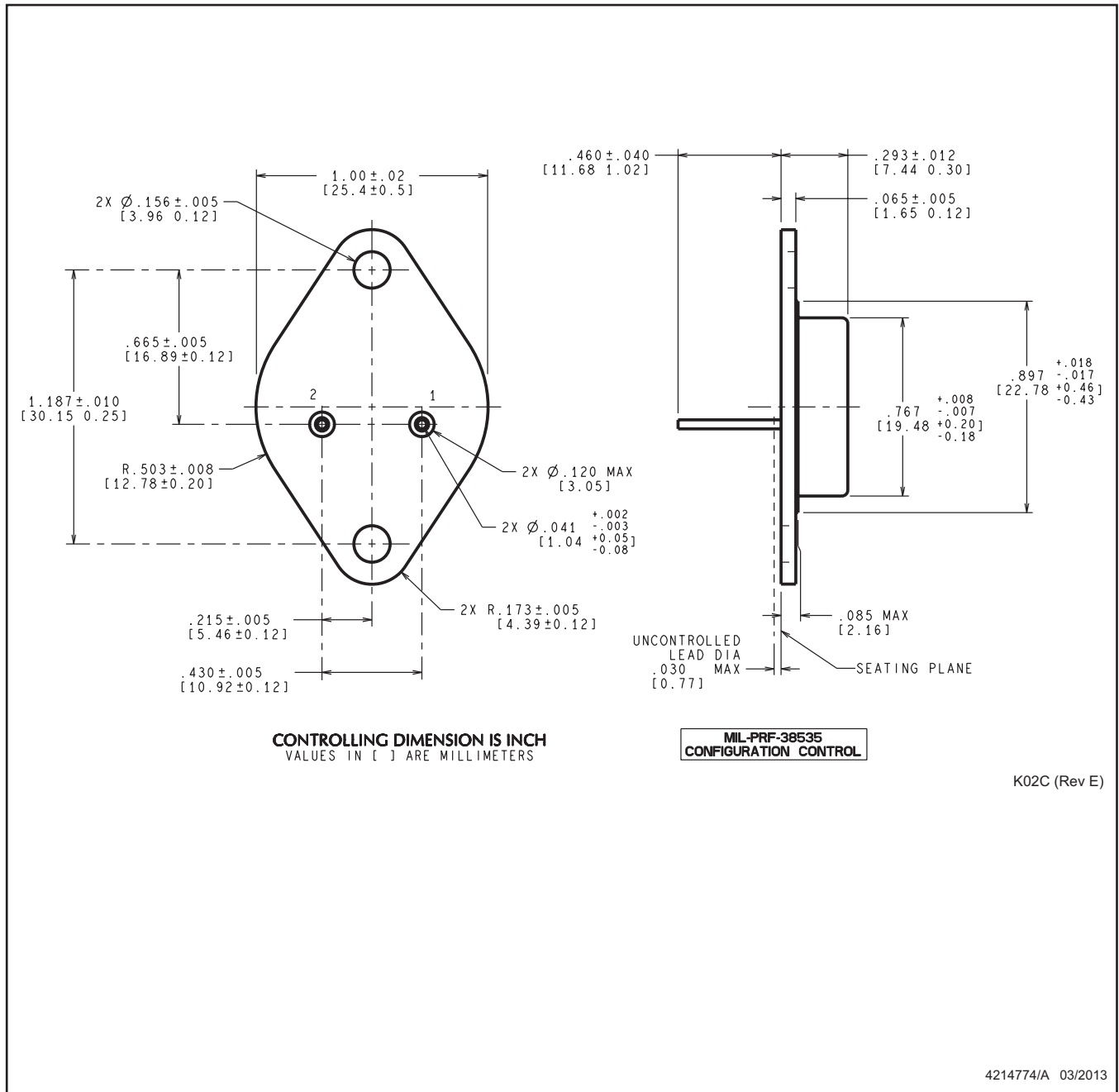
NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

2. This drawing is subject to change without notice.

3. Leads not to be bent greater than 15º

TEXAS
INSTRUMENTS
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IMPORTANT NOTICE

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
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