LM137QML 負電圧可変型3端子レギュレータ

1 特長

- SMD 5962-99517
- 30 krad(Si)認定済みのTIDが利用可能
- 出力電圧: -37V～-1.2Vの範囲で可変
- -55℃～+150℃の範囲で1.5Aの出力電流を規定
- ライン・レギュレーション: 標準値0.01%/V
- 負荷レギュレーション: 標準値0.3%
- 非常に優れたサーマル・レギュレーション: 0.002%/W
- 77dBのリップル除去
- 非常に優れた熱過渡除去
- 50ppm/℃の温度ドリフト係数
- 電流制限は温度と無関係
- 内部的な熱過負荷保護
- 標準的な3リードのトランジスタ・パッケージ
- 出力の短絡保護

2 アプリケーション

- 多目的電源
- オンカードの電圧レギュレーション
- プログラム可能な電圧電源
- 高精度の電流電源
- 過酷な環境

3 概要

LM137は可変3端子負電圧レギュレータで、-37V～-1.2Vの出力電圧範囲にわたって1.5Aを超える電流を供給できます。これらのレギュレータは適用が非常に簡単で、出力電圧の設定に2つの外付け抵抗、周波数補償に1つの出力コンデンサしか必要としません。優れたレギュレーションを維持し、熱的な過渡変動を低減するよう、回路設計が最適化されています。さらに、LM137シリーズは内部的な電流制限、サーマル・シャットダウン、安全領域補償を搭載しており、過負荷によるブローアウトは事実上発生しません。

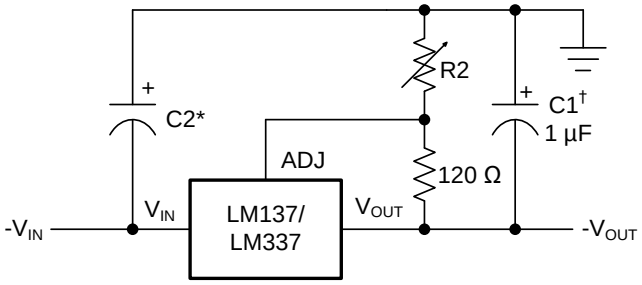
LM137はローカルのオンカード・レギュレーション、プログラム可能な出力電圧のレギュレーション、高精度の電流レギュレーションなど、広範なアプリケーションに役立ちます。LM137は、可変の正電圧レギュレータLM117を補完するために理想的です。

製品情報(1)

型番	SMD番号	パッケージ
LM137K/883		TO-3 (K)
LM137H/883		TO-39 (NDT)
LM137H1PQMLV	5962P9951708VXA 30krad	TO-39 (NDT)
LM137H-MD8		ダイ
LM137KG-MD8		ダイ
LM137KG-MW8		ウェハー

(1) 提供されているすべてのパッケージについては、巻末の注文情報を参照してください。

概略回路図



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English Data Sheet: SNVS313

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4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision E (December 2016) から Revision F に変更 **Page**

- Changed the T0-39 Metal Can Package From: Top View To: Bottom View ... 3

Revision D (February 2015) から Revision E に変更 **Page**

- パッケージ注文情報の付録を更新 ... 1

Revision C (April 2013) から Revision D に変更 **Page**

- 「製品情報」表、「*仕様*」セクション、「*機能説明*」セクション、「*レイアウト*」セクション、「*アプリケーションと実装*」セクション、「*電源に関する推奨事項*」セクション、「*デバイスおよびドキュメントのサポート*」セクション、「*メカニカル、パッケージ、および注文情報*」セクションを追加、更新、または名前を変更 ... 1
- Changed Vout Recovery condition from -4.25 V to -40 V ... 9

Revision B (March 2013) から Revision C に変更 **Page**

- ナショナル セミコンダクターのデータシートのレイアウトをTIフォーマットに変更。 ... 1

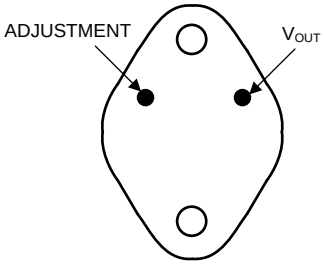
Revision A (December 2010) から Revision B に変更 **Page**

- 「*注文情報*」に新しいLM137H1PQMLVを追加 ... 1
- Added to the HEADER of DC Parameters — Post Radiation Limits 5962P9951701VXA. Added the HEADER and TABLE of DC Parameters — Post Radiation Limits 5962P9951708VXA for *Electrical Characteristics* tables ... 6

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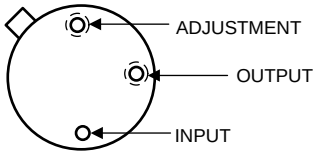
5 Pin Configuration and Functions

TO-3 Metal Can Package
Package K
(Bottom View)



NOTE: Case is Input

T0-39 Metal Can Package
Package NDT
(Bottom View)



NOTE: Case Is Input

Pin Functions

PIN			I/O	DESCRIPTION
NAME	NUMBER			
	K	NDT		
ADJUSTMENT	1	1	O	Adjustment
INPUT	Case	3/Case	I	Input
OUTPUT /V_{OUT}	2	2	O	Output

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6 Specifications

6.1 Absolute Maximum Ratings(1)

			UNIT
Power Dissipation(2)		Internally Limited	
Input-Output Voltage Differential		40	V
Operating Ambient Temperature		$-55 \le T_A \le +125$	°C
Operating Junction Temperature		$-55 \le T_J \le +150$	°C
Storage Temperature		$-65 \le T_A \le +150$	°C
Maximum Junction Temperature		150	°C
Lead Temperature (Soldering, 10 sec.)		300	°C
Maximum Power Dissipation (@25°C)	T0–3	28	W
	T0–39	2.5	W
Package Weight (typical)	T0–3	12,750	mg
	T0–39 Metal Can	955	mg

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. 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), $R_{\theta JA}$ (package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_{Jmax} - T_A)/R_{\theta JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±4000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Manufacturing with less than 500-V HBM is possible with the necessary precautions. Pins listed as ±4000 V may actually have higher performance. Human body model, 100 pF discharged through 1.5 KΩ.

6.3 Recommended Operating Conditions

	MIN	MAX	UNIT
T_A		$-55 \le T_A \le +125$	°C
Input Voltage	−41.25	−4.25	V

6.4 Thermal Information

THERMAL METRIC(1)		TO-3 METAL CAN	TO-39 METAL CAN	UNIT
		2 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	40 (Still Air)	174 (Still Air @ 0.5W)	°C/W
		14 (500 LFM)	64 (500 LFM @ 0.5W)	
$R_{\theta JC}$	Junction-to-case thermal resistance	4	15 (@ 1.0W)	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

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6.5 Quality Conformance Inspection

Table 1. Mil-Std-883, Method 5005 — Group A(1)

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

(1) Group “A” sample only, test at all temps.

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6.6 LM137H 883 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified. V_{IN} = −4.25V, I_L = 8mA, V_{OUT} = V_{Ref} (1) (2)

	PARAMETER	TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
V_{Ref}	Reference Voltage		1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
		V_{IN} = -42 V	1	-1.275	-1.225	V
		V_{IN} = -41.3 V	2, 3	-1.3	-1.2	V
I_Q	Minimum Load Current	V_{OUT} = -1.7 V	1, 2, 3		3.0	mA
		V_{OUT} = -1.7 V, V_{IN} = -11.75 V	1, 2, 3		3.0	mA
		V_{OUT} = -1.7 V, V_{IN} = -42 V	1		5.0	mA
		V_{OUT} = -1.7 V, V_{IN} = -41.3 V	2, 3		5.0	mA
R_{Line}	Line Regulation	-42 V ≤ V_{IN} ≤ -4.25 V	1	-9.0	9.0	mV
		-41.3 V ≤ V_{IN} ≤ -4.25 V	2, 3	-23	23	mV
R_{Load}	Load Regulation	5 mA ≤ I_L ≤ 500 mA, V_{IN} = -6.25 V	1, 2, 3	-25	25	mV
		5mA ≤ I_L ≤ 500 mA, V_{IN} = -14.5 V	1	-25	25	mV
		5mA ≤ I_L ≤ 150 mA, V_{IN} = -40 V	1, 2, 3	-25	25	mV
I_{Adj}	Adjustment Pin Current	I_L = 5 mA	1, 2, 3		100	µA
		V_{IN} = -42 V	1		100	µA
		V_{IN} = -41.3 V	2, 3		100	µA
$\Delta I_{Adj} / V_{Line}$	Adjust Pin Current Change vs. Line Voltage	-42 V ≤ V_{IN} ≤ -4.25 V, I_L = 5 mA	1	-5.0	5.0	µA
		-41.3 V ≤ V_{IN} ≤ -4.25 V, I_L = 5 mA	2, 3	-5.0	5.0	µA
$\Delta I_{Adj} / I_{Load}$	Adjust Pin Current Change vs. Load Current	5 mA ≤ I_L ≤ 500 mA, V_{IN} = -6.5 V	1, 2, 3	-5.0	5.0	µA
V_{Rth}	Thermal Regulation	V_{IN} = -14.5 V, I_L = 500 mA, t = 10 mS	1	-5.0	5.0	mV
		V_{IN} = -14.5 V, I_L = 5 mA, t = 10 mS	1	-5.0	5.0	mV
I_{CL}	Current Limit	V_{IN} = -5 V	1, 2, 3	-1.8	-0.5	A
		V_{IN} = -40 V	1, 2, 3	-0.65	-0.15	A
V_O	Output Voltage		1	-1.28	-1.22	V
			2, 3	-1.3	-1.2	V

(1) V_{IN} = −41.3V at +125°C and −55°C
(2) −41.3V ≤ V_{IN} ≤ −4.25V at +125°C and −55°C

6.7 LM137H 883 Electrical Characteristics AC Parameters

	PARAMETER	TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
R_R	Ripple Rejection Ratio (1)	V_{IN} = -6.25 V, V_{OUT} = V_{Ref}, I_L = 125 mA, e_i = 1V_{RMS}, F = 120 Hz	4,5,6	66		dB

(1) Test at +25°C, ensured but not tested at +125°C and −55°C

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6.8 LM137K 883 Electrical Characteristics DC Parameters

The following conditions apply, unless otherwise specified. V_{IN} = −4.25V, I_L = 8mA, V_{OUT} = V_{Ref} (1) (2)

PARAMETER		TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
V_{Ref}	Reference Voltage		1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
		V_{IN} = -42 V	1	-1.275	-1.225	V
		V_{IN} = -41.3 V	2, 3	-1.3	-1.2	V
I_Q	Minimum Load Current	V_{OUT} = -1.7 V	1, 2, 3		3.0	mA
		V_{OUT} = -1.7 V, V_{IN} = -11.75 V	1, 2, 3		3.0	mA
		V_{OUT} = -1.7 V, V_{IN} = -42 V	1		5.0	mA
		V_{OUT} = -1.7 V, V_{IN} = -41.3 V	2, 3		5.0	mA
R_{Line}	Line Regulation	-42 V ≤ V_{IN} ≤ -4.25 V	1	-9.0	9.0	mV
		-41.3V ≤ V_{IN} ≤ -4.25V	2, 3	-23	23	mV
R_{Load}	Load Regulation	V_{IN} = -6.25 V, 8 mA ≤ I_L ≤ 1.5 A	1, 2, 3	-25	25	mV
		V_{IN} = -14.5 V, 8 mA ≤ I_L ≤ 1.5 A	1	-25	25	mV
		V_{IN} = -40 V, 8 mA ≤ I_L ≤ 300 mA	1	-25	25	mV
		V_{IN} = -40 V, 8 mA ≤ I_L ≤ 250 mA	2, 3	-25	25	mV
I_{Adj}	Adjustment Pin Current		1, 2, 3		100	µA
		V_{IN} = -42 V	1		100	µA
		V_{IN} = -41.3 V	2, 3		100	µA
Δ I_{Adj} / V_{Line}	Adjust Pin Current Change vs. Line Voltage	-42 V ≤ V_{IN} ≤ -4.25 V	1	-5.0	5.0	µA
		-41.3 V ≤ V_{IN} ≤ -4.25 V	2, 3	-5.0	5.0	µA
Δ I_{Adj} / I_{Load}	Adjust Pin Current Change vs. Load Current	8 mA ≤ I_L ≤ 1.5 A, V_{IN} = -6.25 V	1, 2, 3	-5.0	5.0	µA
V_{Rth}	Thermal Regulation	V_{IN} = -14.5 V, I_L = 1.5 mA, t = 10 mS	1	-5.0	5.0	mV
		V_{IN} = -14.5 V, I_L = 8 mA, t = 10 mS	1	-5.0	5.0	mV
I_{CL}	Current Limit	V_{IN} = -5 V	1, 2, 3	-3.5	-1.5	A
		V_{IN} = -40 V	1, 2, 3	-1.2	-0.24	A

(1) V_{IN} = −41.3V at +125°C and −55°C
(2) −41.3V ≤ V_{IN} ≤ −4.25V at +125°C and −55°C

6.9 LM137K 883 Electrical Characteristics AC Parameters

PARAMETER		TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
R_R	Ripple Rejection Ratio (1)	V_{IN} = -6.25 V, V_{OUT} = V_{Ref}, f = 120 Hz, I_L = 0.5 A, e_I = 1V_{RMS}	4,5,6	66		dB

(1) Test at +25°C, ensured but not tested at +125°C and −55°C

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6.10 LM137H RH Electrical Characteristics DC Parameters 5962P9951708VXA

The following conditions apply, unless otherwise specified. (1)

PARAMETER		TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
V_{OUT}	Output Voltage	V_{IN} = -4.25 V, I_L = 5 mA	1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
		V_{IN} = -4.25 V, I_L = 500 mA	1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
		V_{IN} = -41.25 V, I_L = 5 mA	1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
		V_{IN} = -41.25 V, I_L = 50 mA	1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
$V_{R\ Line}$	Line Regulation	V_{IN} = -41.25 V to -4.25 V, I_L = 5 mA	1	-9.0	9.0	mV
			2, 3	-23	23	mV
$V_{R\ Load}$	Load Regulation	V_{IN} = -6.25 V, I_L = 5 mA to 500 mA	1	-12	12	mV
			2, 3	-24	24	mV
		V_{IN} = -41.25 V, I_L = 5 mA to 50 mA	1	-6.0	6.0	mV
			2, 3	-12	12	mV
		V_{IN} = -6.25 V, I_L = 5 mA to 200 mA	1	-6.0	6.0	mV
			2, 3	-12	12	mV
V_{Rth}	Thermal Regulation	V_{IN} = -14.6 V, I_L = 500 mA	1	-5.0	5.0	mV
I_{Adj}	Adjust Pin Current	V_{IN} = -4.25 V, I_L = 5 mA	1, 2, 3	25	100	µA
		V_{IN} = -41.25 V, I_L = 5 mA	1, 2, 3	25	100	µA
$\Delta I_{Adj} / V_{Line}$	Adjust Pin Current Change vs. Line Voltage	V_{IN} = -41.25 V to -4.25 V, I_L = 5 mA	1, 2, 3	-5.0	5.0	µA
$\Delta I_{Adj} / I_{Load}$	Adjust Pin Current Change vs. Load Current	V_{IN} = -6.25 V, I_L = 5 mA to 500 mA	1, 2, 3	-5.0	5.0	µA
I_{OS}	Output Short Circuit Current	V_{IN} = -4.25 V	1, 2, 3	0.5	1.8	A
		V_{IN} = -40 V	1, 2, 3	0.05	0.5	A
V_{OUT} Recovery	Output Voltage Recovery After Output Short Circuit Current	V_{IN} = -4.25 V	1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
		V_{IN} = -40 V	1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
I_Q	Minimum Load Current	V_{IN} = -4.25 V	1, 2, 3	0.2	3.0	mA
		V_{IN} = -14.25 V	1, 2, 3	0.2	3.0	mA
		V_{IN} = -41.25 V	1, 2, 3	1.0	5.0	mA
V_{Start}	Voltage Start-up	V_{IN} = -4.25 V, I_L = 500 mA	1	-1.275	-1.225	V
			2, 3	-1.3	-1.2	V
V_{OUT}	Output Voltage (2)	V_{IN} = -6.25 V, I_L = 5 mA	2	-1.3	-1.2	V

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

(2) Tested at +125°C; correlated to +150°C

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6.11 LM137H RH Electrical Characteristics AC Parameters 5962P9951708VXA

The following conditions apply, unless otherwise specified.(1)

PARAMETER		TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
ΔV_{IN} / ΔV_{OUT}	Ripple Rejection	V_{IN} = -6.25 V, I_L = 125 mA, e_I = 1V_{RMS} at 2400 Hz	9	48		dB
V_{NO}	Output Noise Voltage	V_{IN} = -6.25 V, I_L = 50 mA	9		120	μV_{RMS}
ΔV_{OUT} / ΔV_{IN}	Line Transient Response	V_{IN} = -6.25 V, V_{Pulse} = -1V, I_L = 50 mA	9		80	mV/V
ΔV_O / ΔI_L	Load Transient Response(2)	V_{IN} = -6.25 V, I_L = 50 mA, ΔI_L = 200 mA	9		60	mV

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.
(2) Limit of 0.3mV/mA is equivalent to 60mV

6.12 LM137H RH Electrical Characteristics DC Parameters Drift Values 5962P9951708VXA

The following conditions apply, unless otherwise specified. (1)
Delta calculations performed on QMLV devices at group B, subgroup 5 only.

PARAMETER		TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
V_{OUT}	Output Voltage	V_{IN} = -4.25 V, I_L = 5 mA	1	-0.01	0.01	V
		V_{IN} = -4.25 V, I_L = 500 mA	1	-0.01	0.01	V
		V_{IN} = -41.25 V, I_L = 5 mA	1	-0.01	0.01	V
		V_{IN} = -41.25 V, I_L = 50 mA	1	-0.01	0.01	V
$V_{R\ Line}$	Line Regulation	V_{IN} = -41.25 V to -4.25 V, I_L = 5 mA	1	-4.0	4.0	mV
I_{Adj}	Adjust Pin Current	V_{IN} = -4.25 V, I_L = 5 mA	1	-10	10	µA
		V_{IN} = -41.25 V, I_L = 5 mA	1	-10	10	µA

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

6.13 LM137H RH Electrical Characteristics DC Parameters Post Radiation Limits +25°C 5962P9951708VXA

The following conditions apply, unless otherwise specified.(1)

PARAMETER		TEST CONDITIONS	SUB-GROUPS	MIN	MAX	UNIT
V_{OUT}	Output Voltage	V_{IN} = -41.25 V, I_L = 5 mA	1	-1.30	-1.225	V
		V_{IN} = -41.25 V, I_L = 50 mA	1	-1.30	-1.225	V
$V_{R\ Line}$	Line Regulation	V_{IN} = -41.25 V to -4.25 V, I_L = 5 mA	1	-9.0	+50	mV
I_{Adj}	Adjust Pin Current	V_{IN} = -41.25 V, I_L = 5 mA	1	25	140	µA
ΔI_{Adj} / V_{Line}	Adjust Pin Current Change vs. Line Voltage	V_{IN} = -41.25 V to -4.25 V, I_L = 5 mA	1	-70	+20	µA
V_{OUT} Recovery	Output Voltage Recovery After Output Short Circuit Current	V_{IN} = -40 V	1	-1.30	-1.225	V

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are specified only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

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6.14 Typical Performance Characteristics

(NDT & K Packages)

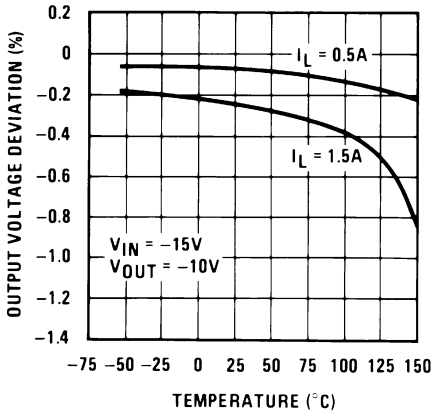


Figure 1. Load Regulation

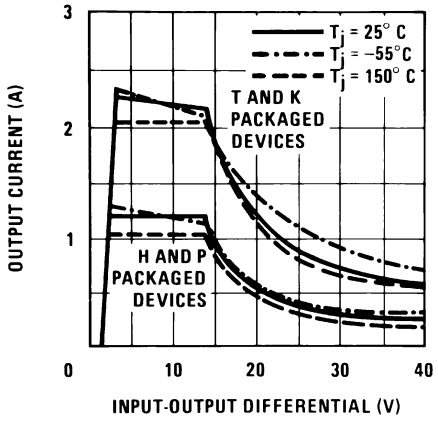


Figure 2. Current Limit

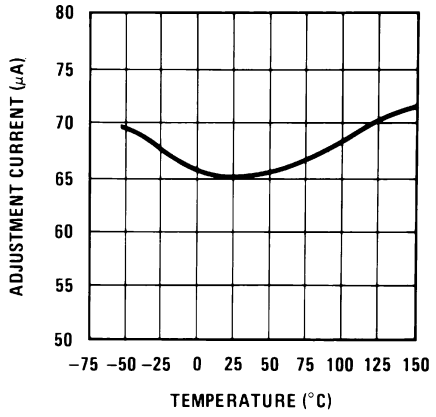


Figure 3. Adjustment Current

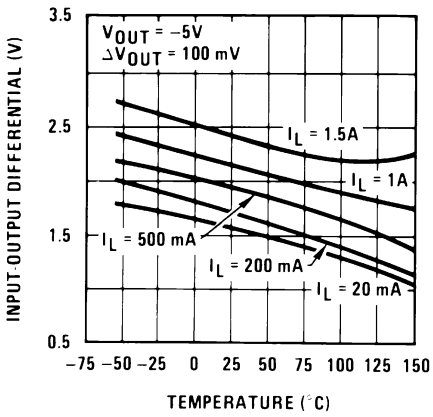


Figure 4. Dropout Voltage

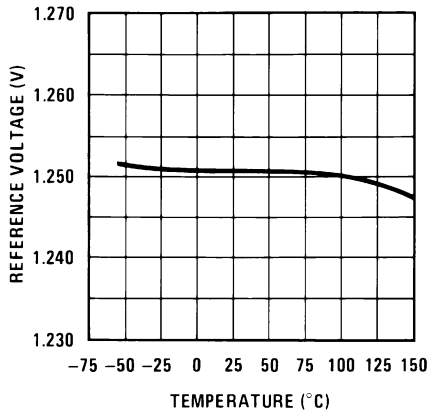


Figure 5. Temperature Stability

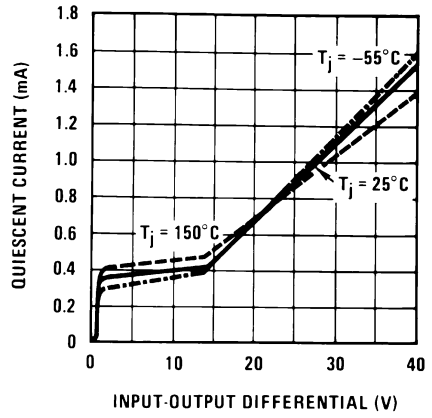


Figure 6. Minimum Operating Current

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Typical Performance Characteristics (continued)

(NDT & K Packages)

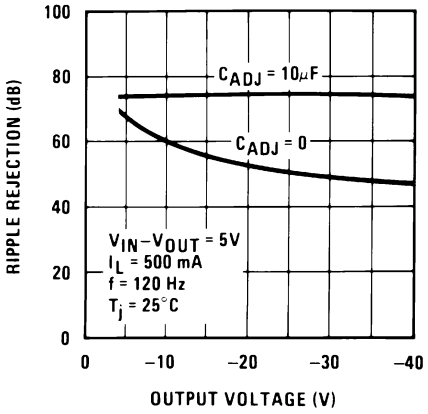


Figure 7. Ripple Rejection

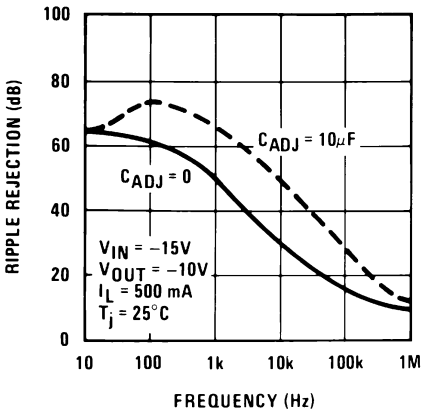


Figure 8. Ripple Rejection

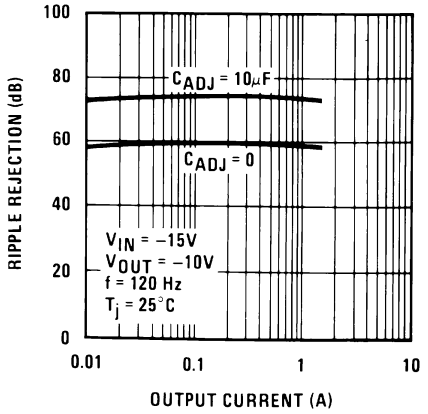


Figure 9. Ripple Rejection

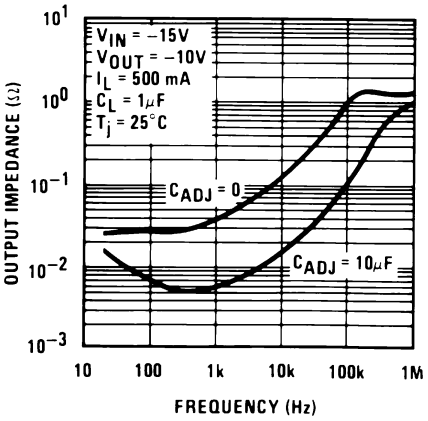


Figure 10. Output Impedance

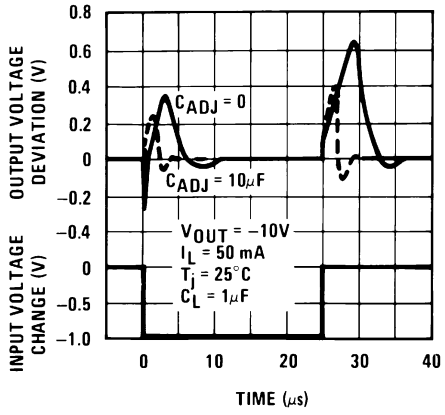


Figure 11. Line Transient Response

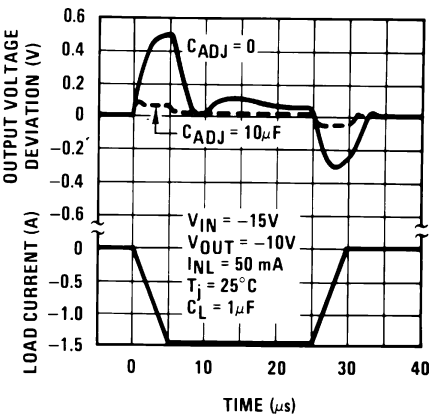


Figure 12. Load Transient Response

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7 Detailed Description

7.1 Functional Block Diagram

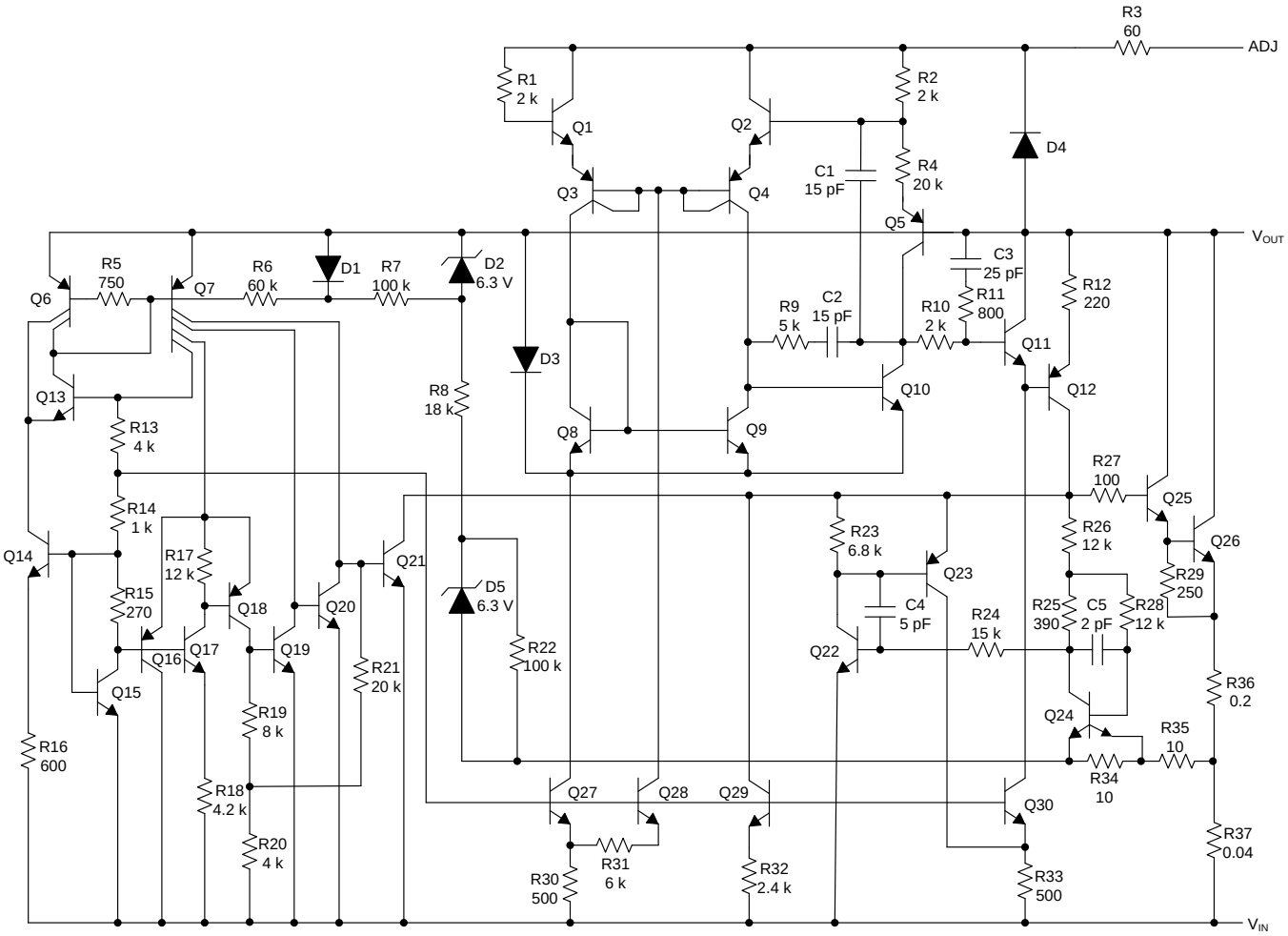


Figure 13. Schematic Diagram

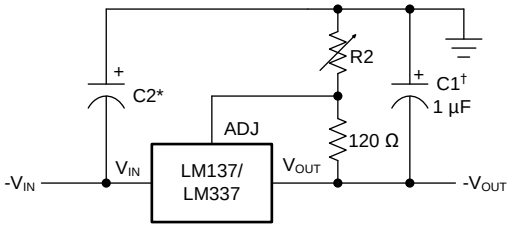
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8 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information and Schematic Diagram



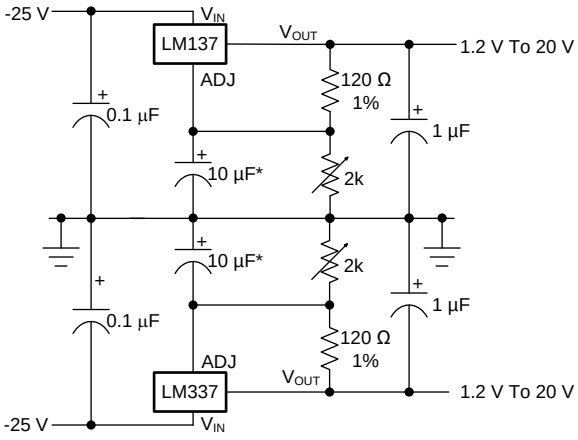
Full output current not available at high input-output voltages

$$-V_{OUT}\ 1.25\left(V1+\frac{R2}{120}\right)+(-I_{ADJ}\ x\ R2)$$

†C1 = 1 µF solid tantalum or 10 µF aluminum electrolytic required for stabilit
*C2 = 1 µF solid tantalum is required only if regulator is more than 4″ from power-supply filter capacitor
Output capacitors in the range of 1µF to 1000 µF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients

Figure 14. Adjustable Negative Voltage Regulator

8.2 Typical Applications



Full output current not available
at high input-output voltages
*The 10 µF capacitors are optional to improve ripple rejection

Figure 15. Adjustable Lab Voltage Regulator

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Typical Applications (continued)

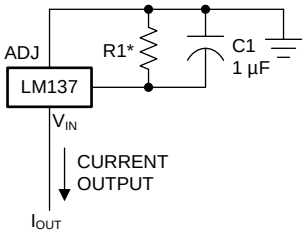
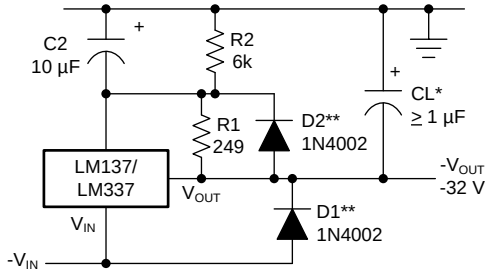


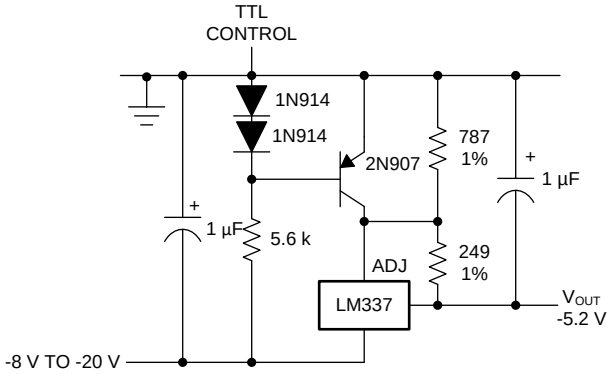
Figure 16. Current Regulator

$$I_{OUT} = \frac{1.250\ V}{R1}$$
$$*0.8\ \Omega \le R1 \le 120\ \Omega \quad (1)$$



*When C_L is larger than 20 µF, D1 protects the LM137 in case the input supply is shorted
**When C2 is larger than 10 µF and $-V_{OUT}$ is larger than −25V, D2 protects the LM137 in case the output is shorted

Figure 17. Negative Regulator with Protection Diodes



*Minimum output ≈ −1.3V when control input is low

Figure 18. −5.2V Regulator with Electronic Shutdown*

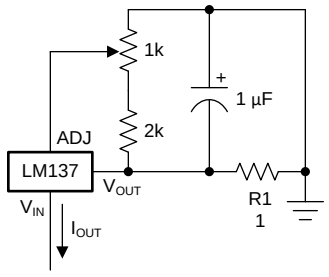


Figure 19. Adjustable Current Regulator

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Typical Applications (continued)

$$I_{OUT} = \left(\frac{1.5\ V}{R1}\right) \pm 15\%\ \text{adjustable} \quad (2)$$

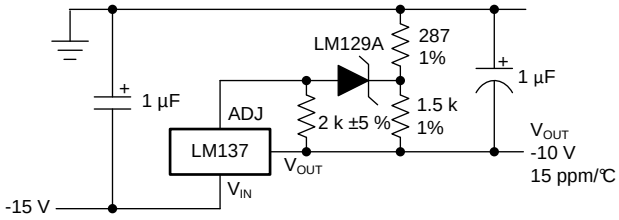
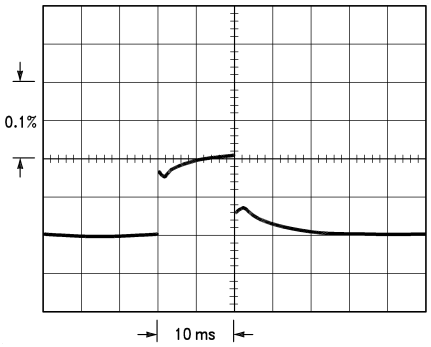


Figure 20. High Stability −10V Regulator

9 Power Supply Recommendations

9.1 Thermal Regulation

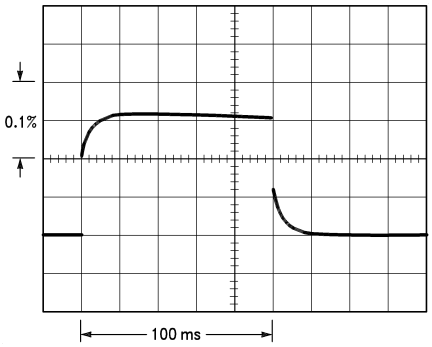
When power is dissipated in an IC, a temperature gradient occurs across the IC chip affecting the individual IC circuit components. With an IC regulator, this gradient can be especially severe since power dissipation is large. Thermal regulation is the effect of these temperature gradients on output voltage (in percentage output change) per Watt of power change in a specified time. Thermal regulation error is independent of electrical regulation or temperature coefficient, and occurs within 5 ms to 50 ms after a change in power dissipation. Thermal regulation depends on IC layout as well as electrical design. The thermal regulation of a voltage regulator is defined as the percentage change of V_{OUT}, per Watt, within the first 10 ms after a step of power is applied. The LM137's specification is 0.02%/W, max.



LM137, V_{OUT} = −10V $V_{IN} - V_{OUT}$ = −40V
Horizontal sensitivity,5 ms/div I_L = 0A → 0.25A → 0A

Figure 21.

In Figure 21, a typical LM137's output drifts only 3 mV (or 0.03% of V_{OUT} = −10V) when a 10W pulse is applied for 10 ms. This performance is thus well inside the specification limit of 0.02%/W × 10W = 0.2% max. When the 10W pulse is ended, the thermal regulation again shows a 3 mV step as the LM137 chip cools off. Note that the load regulation error of about 8 mV (0.08%) is additional to the thermal regulation error. In Figure 22, when the 10W pulse is applied for 100 ms, the output drifts only slightly beyond the drift in the first 10 ms, and the thermal error stays well within 0.1% (10 mV).



LM137, V_{OUT} = −10V $V_{IN} - V_{OUT}$ = −40V
Horizontal sensitivity, 20 ms/div I_L = 0A → 0.25A → 0A

Figure 22.

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10 デバイスおよびドキュメントのサポート

10.1 ドキュメントの更新通知を受け取る方法

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10.2 コミュニティ・リソース

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設計サポート ***TIの設計サポート*** **役に立つ**E2E**フォーラムや、設計サポート・ツールをすばやく見つけることができます。技術サポート用の連絡先情報も参照できます。**

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10.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

11 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

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PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
5962P9951708VXA	Active	Production	TO (NDT) | 3	20 | JEDEC TRAY (5+1)	-	Call TI	Call TI	-55 to 125	LM137H1PQMLV 5962P9951708VXA Q ACO 5962P9951708VXA Q >T
LM137H MD8	Active	Production	DIESALE (Y) | 0	120 | JEDEC TRAY (5+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	
LM137H/883	Active	Production	TO (NDT) | 3	20 | JEDEC TRAY (5+1)	No	Call TI	Level-1-NA-UNLIM	-55 to 125	LM137H/883 Q ACO LM137H/883 Q >T
LM137H1PQMLV	Active	Production	TO (NDT) | 3	20 | JEDEC TRAY (5+1)	No	Call TI	Level-1-NA-UNLIM	-55 to 125	LM137H1PQMLV 5962P9951708VXA Q ACO 5962P9951708VXA Q >T
LM137K/883	Active	Production	TO (K) | 2	50 | TRAY NON-STD	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	(LM120H-15P+, LM137K) /883 Q ACO /883 Q >T
LM137KG MD8	Active	Production	DIESALE (Y) | 0	120 | JEDEC TRAY (5+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	
LM137KG-MW8	Active	Production	WAFERSALE (YS) | 0	1 | NOT REQUIRED	-	Call TI	Level-1-NA-UNLIM	-55 to 125	

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

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

(5) MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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

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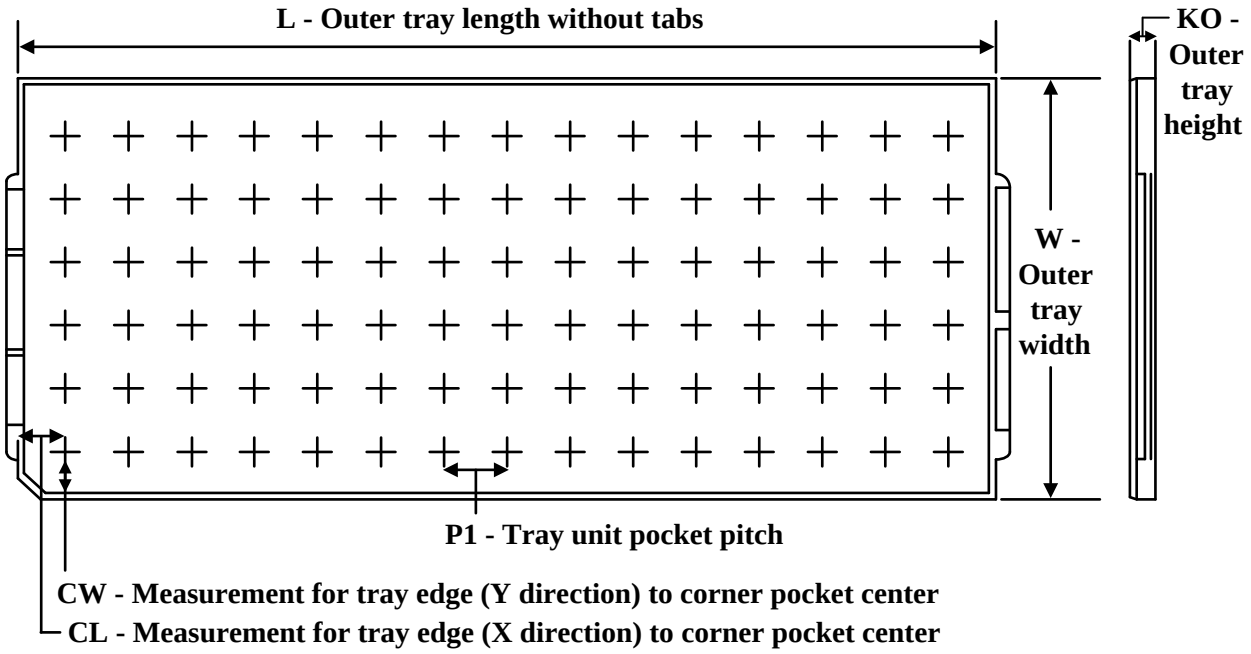
OTHER QUALIFIED VERSIONS OF LM137QML, LM137QML-SP :

- Military : LM137QML
- Space : LM137QML-SP

NOTE: Qualified Version Definitions:

- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TRAY

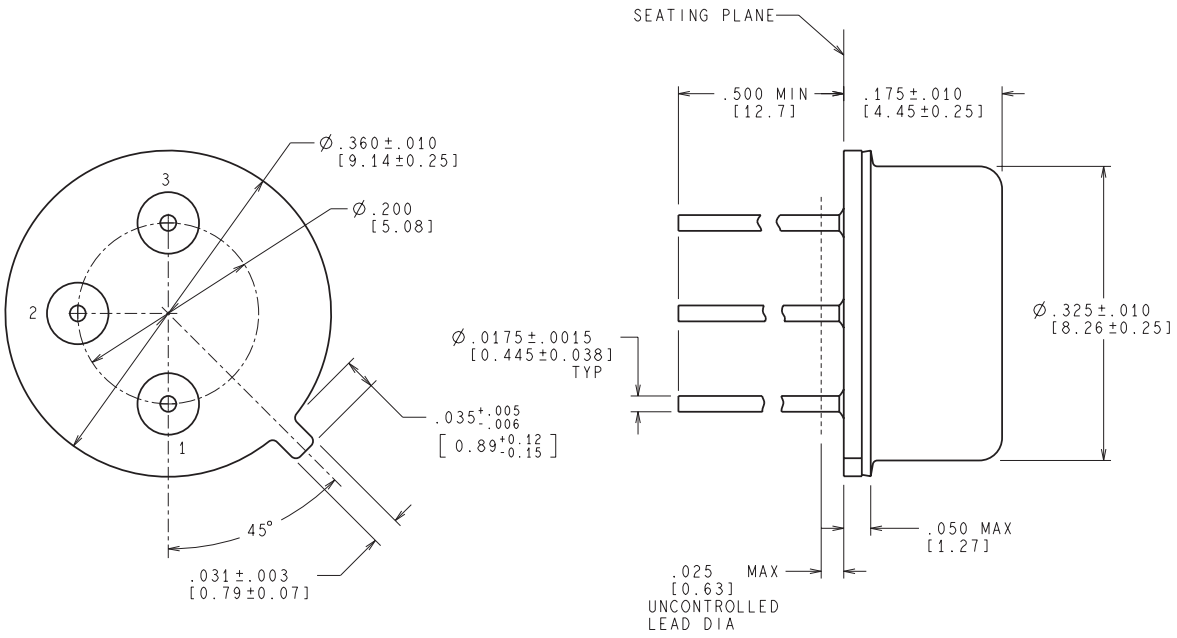


Chamfer on Tray corner indicates Pin 1 orientation of packed units.

*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
5962P9951708VXA	NDT	TO-CAN	3	20	2 X 10	150	126.49	61.98	8890	11.18	12.95	18.54
LM137H/883	NDT	TO-CAN	3	20	2 X 10	150	126.49	61.98	8890	11.18	12.95	18.54
LM137H1PQMLV	NDT	TO-CAN	3	20	2 X 10	150	126.49	61.98	8890	11.18	12.95	18.54
LM137K/883	K	TO-CAN	2	50	9 X 6	NA	292.1	215.9	25654	3.87	22.3	25.4

NDT0003A



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535
CONFIGURATION CONTROL

H03A (Rev D)

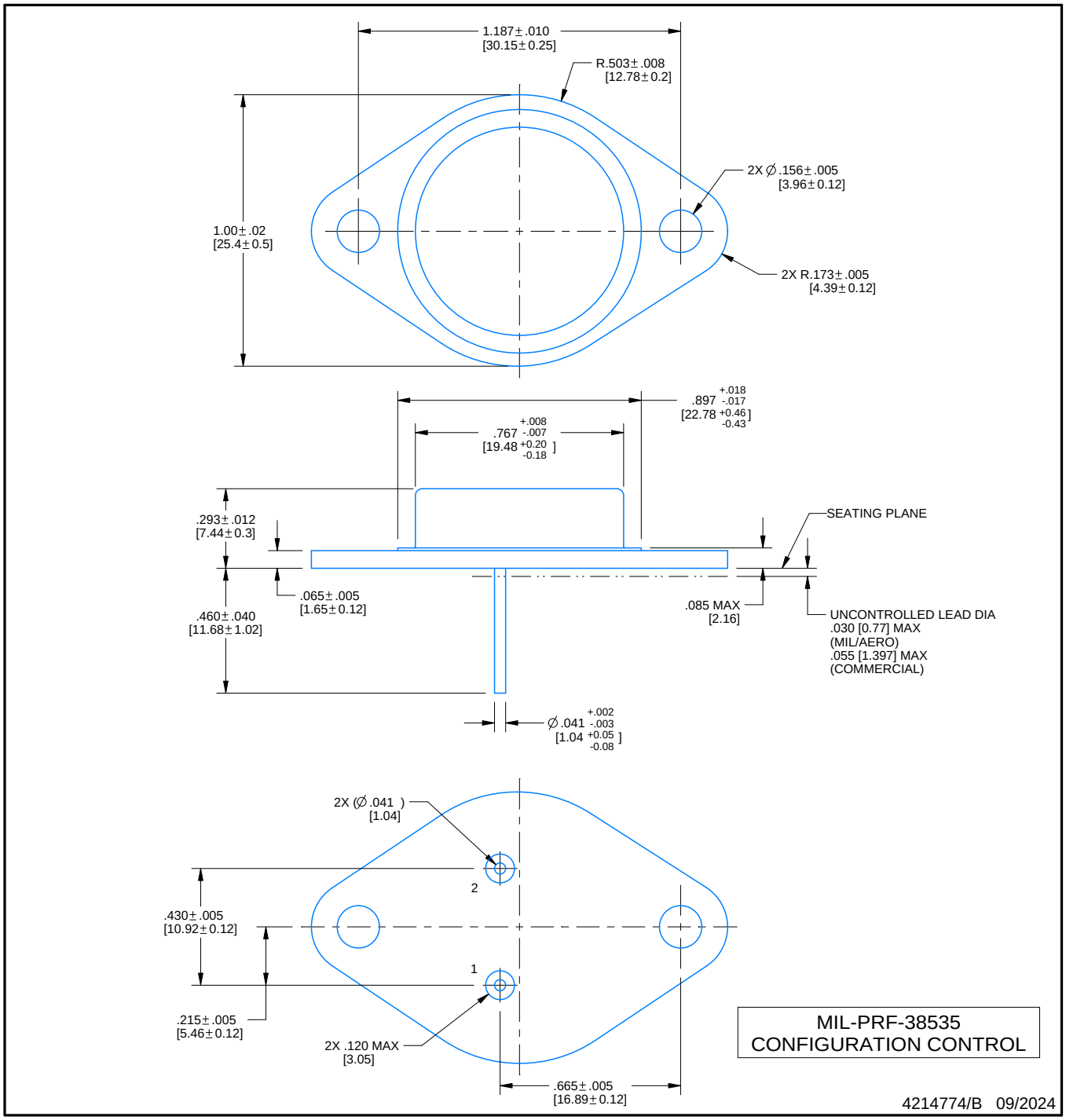
K0002A



PACKAGE OUTLINE

TO-CAN - 7.747 mm max height

TRANSISTOR OUTLINE



NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Leads not to be bent greater than 15°.

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