National Semiconductor

# MICROCIRCUIT DATA SHEET

## MRLM137-X-RH REV 2A0

Original Creation Date: 09/21/00
Last Update Date: 07/14/04
Last Major Revision Date: 07/07/04

# 3-TERMINAL VOLTAGE REGULATOR, -37 VOLTS ≤ VO ≤ -1.25 VOLTS AT 0.5A GUARANTEED TO 30k rd(Si) TESTED TO MIL-STD-883, METHOD 1019

## General Description

The LM137H is an adjustable 3-terminal negative voltage regulator capable of supplying in excess of -0.5A over an output voltage range of -1.2V to -37V. This regulator is exceptionally easy to apply, requiring only 2 external resistors to set the output voltage and 1 output capacitor for frequency compensation. The circuit design has been optimized for excellent regulation and low thermal transients. Futher, the LM137H features internal current limiting, thermal shutdown and safe-area compensation, making it virtually blowout-proof against overloads.

The LM137H serve a wide variety of applications including local on-card regulation, programmable-output voltage regulation or precision current regulation. The LM137H is an ideal complement to the LM117H adjustable positive regulator.

## Industry Part Number

LM137

## Prime Die

LM137

## Controlling Document

SEE FEATURES SECTION

## NS Part Numbers

LM137HPQML
LM137HPQMLV
LM137WG-QMLV
LM137WGPQML
LM137WGPQMLV

## Processing

MIL-STD-883, Method 5004

## Quality Conformance Inspection

MIL-STD-883, Method 5005

| Subgrp | 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 |

## Features

- Output voltage adjustable from -1.2V to -37V
- 0.5A output current guaranteed, -55 C to +150 C
- Line regulation typically 0.01%/V
- Load regulation typically 0.3%
- Excellent thermal regulation, 0.002%/W
- 50 ppm/ C temperature coefficient
- Temperature-independent current limit
- Internal thermal overload protection
- Stantard 3-lead transistor package
- Output short circuit protected
- CONTROLLING DOCUMENTS:

  LM137HPQML 5962P9951701QXA
  LM137HPQMLV 5962P9951701VXA
  LM137WG-QMLV 5962-9951701VZA
  LM137WGPQML 5962P9951701QZA
  LM137WGPQMLV 5962P9951701VZA

# (Absolute Maximum Ratings)

(Note 1)

| | |
|---|---|
| Power Dissipation | Internally Limited |
| Input-Output Voltage Differential | 40V |
| Operatuing Junction Temperature | -55 C ≤ Ta ≤ +150 C |
| Maximum Junction Temperature (Note 2) | 150 C |
| Maximum Power Dissipation (@ 25 C) | 2.5 Watts |
| Minimum Input Voltage | -41.25V |
| Storage Temperature | -65 C ≤ Ta ≤ +150 C |
| Lead Temperature (Soldering, 10 seconds) | 300 C |
| Thermal Resistance | |
| ThetaJA | |
| Metal Can | |
| (Still Air @ 0.5W) | 140 C/W |
| (500LF/Min Air Flow @ 0.5W) | 64 C/W |
| CERAMIC SOIC | |
| (Still Air @ 0.5W) | 108 C/W |
| (500LF/Min Air Flow @ 0.5W) | 65 C/W |
| ThetaJC | |
| Metal Can (@ 1.0W) | 15 C/W |
| CERAMIC SOIC (@ 1.0W) (Note 3, 4) | 2.7 C/W |
| Package Weight (Typical) | |
| Metal Can | 955mg |
| CERAMIC SOIC | 370mg |
| ESD Rating (Note 3) | 4000V |

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Rating 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 Tjmax (maximum junction temperature), ThetaJA (package junction to ambient thermal resistance), and TA (ambient temperature). The maximum allowable power dissipation at any temperature is Pdmax = (Tjmax - TA) /ThetaJA or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 3: For the CERAMIC SOIC device to function properly, the "Output" and "Output/Sense" pins must be connected on the users printed circuit board.

*(Continued)*

Note 4: The package material for these devices allows much improved heat transfer over our standard ceramic packages. In order to take full advantage of this improved heat transfer, heat sinking must be provided between the package base (directly beneath the die), and either metal traces on, or thermal vias through, the printed circuit board. Without this additional heat sinking, device power dissipation must be calculated using junction-to-ambient, rather than junction -to-case, thermal resistance. It must not be assumed that the device leads will provide substantial heat transfer out the package, since the thermal resistance of the leadframe material is very poor, relative to the material of the package base. The stated junction-to-case thermal resistance is for the package material only, and does not account for the additional thermal resistance between the package base and the printed circuit board. The user must determine the value of the additional thermal resistance and must combine this with the stated value for the package, to calculate the total allowed power dissipation for the device.

Note 5: Human body model, 1.5K Ohms in series with 100pF.

## Recommended Operating Conditions

| | |
|---|---|
| Ta | -55 C $\leq$ Ta $\leq$ +125 C |
| Input Voltage Range | -41.25V to -4.25V |

# Electrical Characteristics

## DC PARAMETERS: (SEE NOTE 3)

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|---|---|---|---|---|---|---|---|---|
| Vout | Output Voltage | Vin = -4.25V, Il = 5mA | 3 | | -1.275 | -1.225 | V | 1 |
| | | | 3 | | -1.3 | -1.2 | V | 2, 3 |
| | | Vin = -4.25V, Il = 500mA | 3 | | -1.275 | -1.225 | V | 1 |
| | | | 3 | | -1.3 | -1.2 | V | 2, 3 |
| | | Vin = -41.25V, Il = 5mA | 3 | | -1.275 | -1.225 | V | 1 |
| | | | 3 | | -1.3 | -1.2 | V | 2, 3 |
| | | Vin = -41.25V, Il = 50mA | 3 | | -1.275 | -1.225 | V | 1 |
| | | | 3 | | -1.3 | -1.2 | V | 2, 3 |
| Vrline | Line Regulation | Vin = -41.25V to -4.25V, Il = 5mA | 3 | | -9 | 9 | mV | 1 |
| | | | 3 | | -23 | 23 | mV | 2, 3 |
| Vrload | Load Regulation | Vin = -6.25V, Il = 5mA to 500mA | 3 | | -12 | 12 | mV | 1 |
| | | | 3 | | -24 | 24 | mV | 2, 3 |
| | | Vin = -41.25V, Il = 5mA to 50mA | 3 | | -6 | 6 | mV | 1 |
| | | | 3 | | -12 | 12 | mV | 2, 3 |
| | | Vin = -6.25V, Il = 5mA to 200mA | 3 | | -6 | 6 | mV | 1 |
| | | | 3 | | -12 | 12 | mV | 2, 3 |
| Vrth | Thermal Regulation | Vin = -14.6V, Il = 500mA | 3 | | -5 | 5 | mV | 1 |
| Iadj | Adjust Pin Current | Vin = -4.25V, Il = 5mA | 3 | | 25 | 100 | uA | 1, 2, 3 |
| | | Vin = -41.25V, Il = 5mA | 3 | | 25 | 100 | uA | 1, 2, 3 |
| Delta Iadj(line) | Adjust Pin Current Change vs. Line Voltage | Vin = -41.25V to -4.25V, Il = 5mA | 3 | | -5 | 5 | uA | 1, 2, 3 |
| Delta Iadj(load) | Adjust Pin Current Change vs. Load Current | Vin = -6.25V, Il = 5mA to 500mA | 3 | | -5 | 5 | uA | 1, 2, 3 |
| Ios | Output Short Circuit Current | Vin = -4.25V | 3 | | 0.5 | 1.8 | A | 1, 2, 3 |
| | | Vin = -40V | 3 | | 0.05 | 0.5 | A | 1, 2, 3 |
| Vout (Recovery) | Output Voltage Recovery After Output Short Circuit Current | Vin = -4.25V | 3 | | -1.275 | -1.225 | V | 1 |
| | | | 3 | | -1.3 | -1.2 | V | 2, 3 |
| | | Vin = -40V | 3 | | -1.275 | -1.225 | V | 1 |
| | | | 3 | | -1.3 | -1.2 | V | 2, 3 |

# Electrical Characteristics

## DC PARAMETERS: (SEE NOTE 3) (Continued)

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|---|---|---|---|---|---|---|---|---|
| Iq | Minimum Load Current | Vin = -4.25V | 3 | | 0.2 | 3 | mA | 1, 2, 3 |
| | | Vin = -14.25V | 3 | | 0.2 | 3 | mA | 1, 2, 3 |
| | | Vin = -41.25V | 3 | | 1 | 5 | mA | 1, 2, 3 |
| Vstart | Voltage Start-up | Vin = -4.25V, Il = 500mA | 3 | | -1.275 | -1.225 | V | 1 |
| | | | 3 | | -1.3 | -1.2 | V | 2, 3 |
| Vout | Output Voltage | Vin = -6.25V, Il = 5mA | 1, 3 | | -1.3 | -1.2 | V | 2 |

## AC PARAMETERS: (SEE NOTE 3)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Delta Vin/Delta Vout | Ripple Rejection | Vin = -6.25V, Il = 125mA, ei = 1Vrms at 2400Hz | 3 | | 48 | | dB | 9 |
| Vno | Output Noise Voltage | Vin = -6.25V, Il = 50mA | 3 | | | 120 | uVrms | 9 |
| Delta Vout/Delta Vin | Line Transient Response | Vin = -6.25V, Vpulse = -1V, Il = 50mA | 3 | | | 80 | mV/V | 9 |
| Delta Vout/Delta Il | Load Transient Response | Vin = -6.25V, Il = 50mA, Delta Il = 200mA | 2, 3 | | | 60 | mV | 9 |

## DC PARAMETERS: DRIFT VALUES (See NOTE 3)

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: "Delta calculations performed on JAN S and QMLV devices at group B, subgroup 5 only".

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vout | Output Voltage | Vin = -4.25V, Il = 5mA | 3 | | -0.01 | 0.01 | V | 1 |
| | | Vin = -4.25V, Il = 500mA | 3 | | -0.01 | 0.01 | V | 1 |
| | | Vin = -41.25V, Il = 5mA | 3 | | -0.01 | 0.01 | V | 1 |
| | | Vin = -41.25V, Il = 50mA | 3 | | -0.01 | 0.01 | V | 1 |
| Vrline | Line Regulation | Vin = 41.25V to -4.25V, Il = 5mA | 3 | | -4 | 4 | mV | 1 |
| Iadj | Adjust Pin Current | Vin = -4.25V, Il = 5mA | 3 | | -10 | 10 | uA | 1 |
| | | Vin = -41.25V, Il = 5mA | 3 | | -10 | 10 | uA | 1 |

## DC PARAMETERS: POST RADIATION LIMITS +25 C (See NOTE 3)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Delta Iadj (line) | Adjust Pin Current Change vs. Line Voltage | Vin = -41.25V to -4.25V, Il = 5mA | 3 | | -20 | 20 | uA | 1 |

Note 1: Tested at +125 C; correlated to 150 C.
Note 2: Limit of 0.3mV/mA is equivalent to 60mV.

*(Continued)*

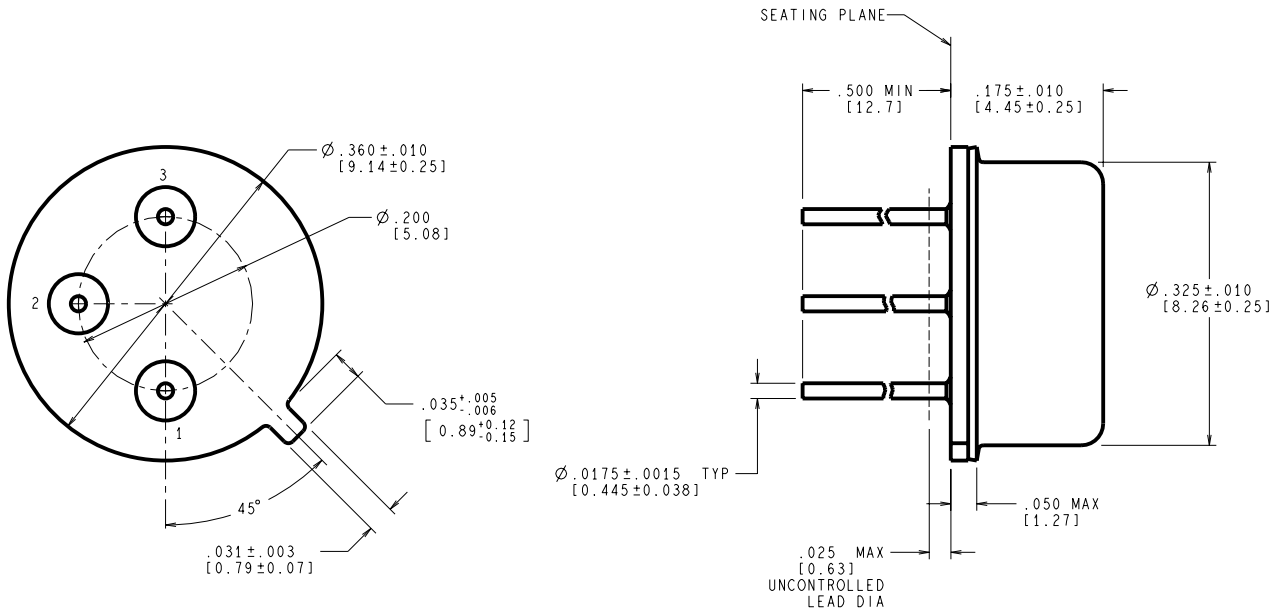
Note 3: Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, Method 1019.5, Condition A.

# Graphics and Diagrams

| GRAPHICS# | DESCRIPTION |
|---|---|
| 05192HRC1 | METAL CAN (H), TO-39, 3LD, .200 DIA P.C. (P/P DWG) |
| 06367HRA1 | CERAMIC SOIC (WG), 16 LEAD (B/I CKT) |
| H03ARD | METAL CAN (H), TO-39, 3LD, .200 DIA P.C. (P/P DWG) |
| P000199A | METAL CAN (H), TO-39, 3LD, .200 DIA P.C.  (PINOUT) |
| P000463A | CERAMIC SOIC (WG), 16 LEAD (PINOUT) |
| WG16ARC | CERAMIC SOIC (WG), 16 LEAD (P/P DWG) |

**See attached graphics following this page.**

| REVISIONS | | | | |
|---|---|---|---|---|
| LTR | DESCRIPTION | E.C.N. | DATE | BY/APP'D |
| C | REVISE & REDRAW PER NEW STANDARD | 10403 | 05/24/94 | TL/GM |
| D | UPDATE MILAERO STAMP; Ø.325 WAS Ø.326; REVISE TOLERANCES | 10798 | 02/28/95 | TL/ |




CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS

NOTES: UNLESS OTHERWISE SPECIFIED

1. LEADS TO BE LOCATED WITHIN .010 IN/ 0.25 mm OF THEIR TRUE POSITIONS RELATIVE TO A MAXIMUM WIDTH TAB.
2. STANDARD METAL CAN TYPE: SOLID BASE, KOVAR.
3. APPLIES TO MIL-AERO AND LINEAR PRODUCTS.
4. REFERENCE JEDEC REGISTRATION TO-39, JEDEC PUBLICATION No. 95.

MIL-I-38535
CONFIGURATION CONTROL

| APPROVALS | DATE |
|---|---|
| DRAWN T. LEQUANG | 05/24/94 |
| DFTG. CHK. | |
| ENGR. CHK. | |

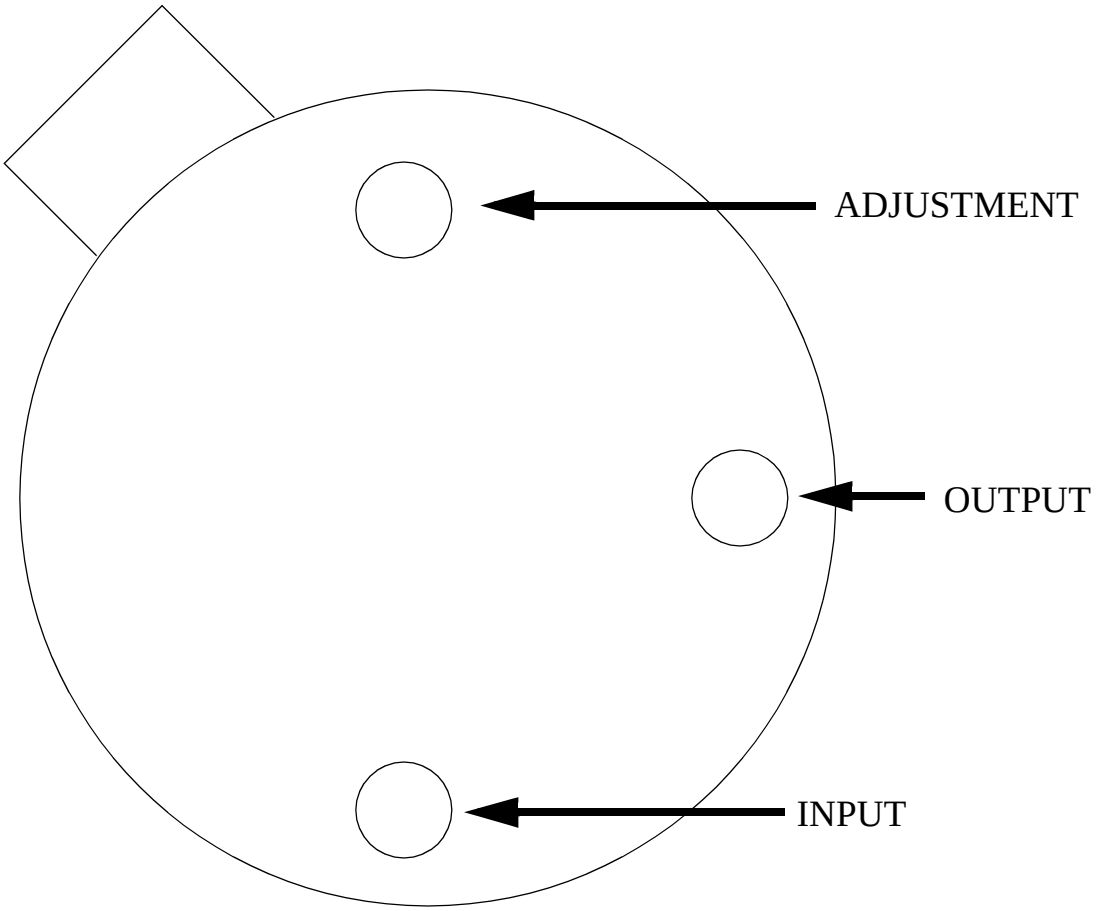
National Semiconductor
2900 Semiconductor dr, Santa Clara, CA 95052-8090

# METAL CAN, TO-39, 3 LEAD, .200 DIA P.C.

PROJECTION
INCH [MM]

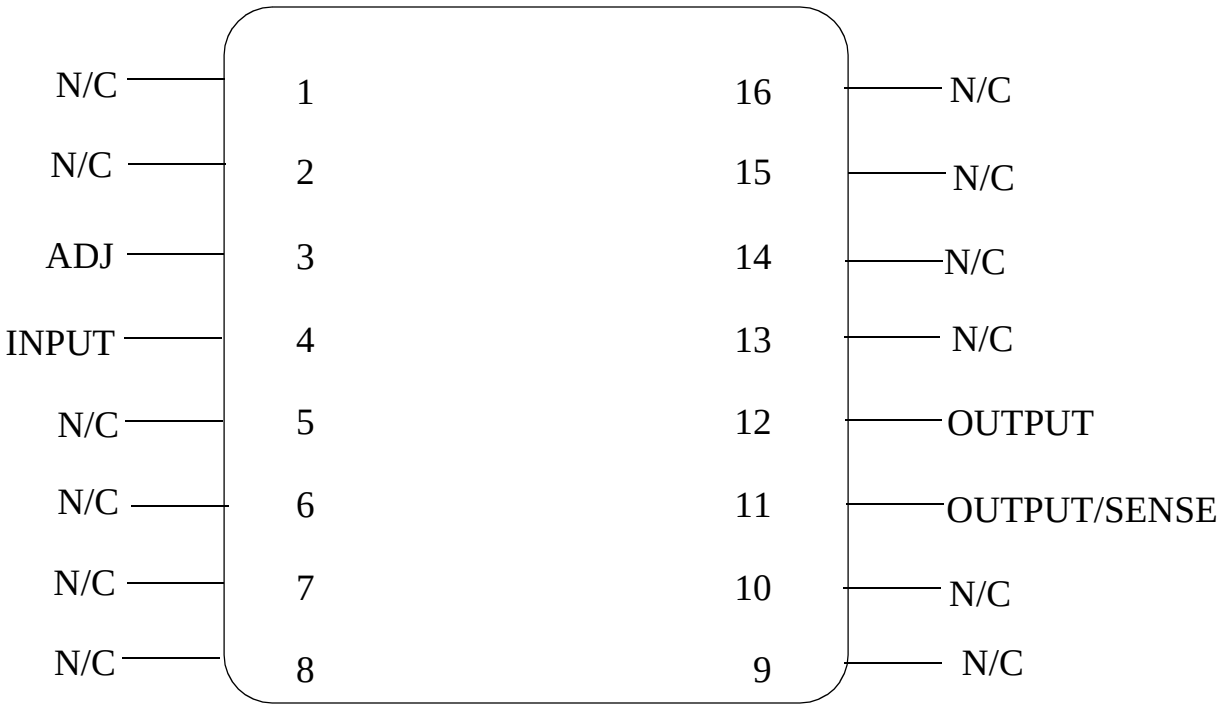
| SCALE | SIZE | DRAWING NUMBER | REV |
|---|---|---|---|
| N/A | C | MKT-H03A | D |

DO NOT SCALE DRAWING | SHEET 1 of 1




# LM137H, LM137HVH
# 3 - LEAD TO-39
# CONNECTION DIAGRAM
# BOTTOM VIEW
# P000199A

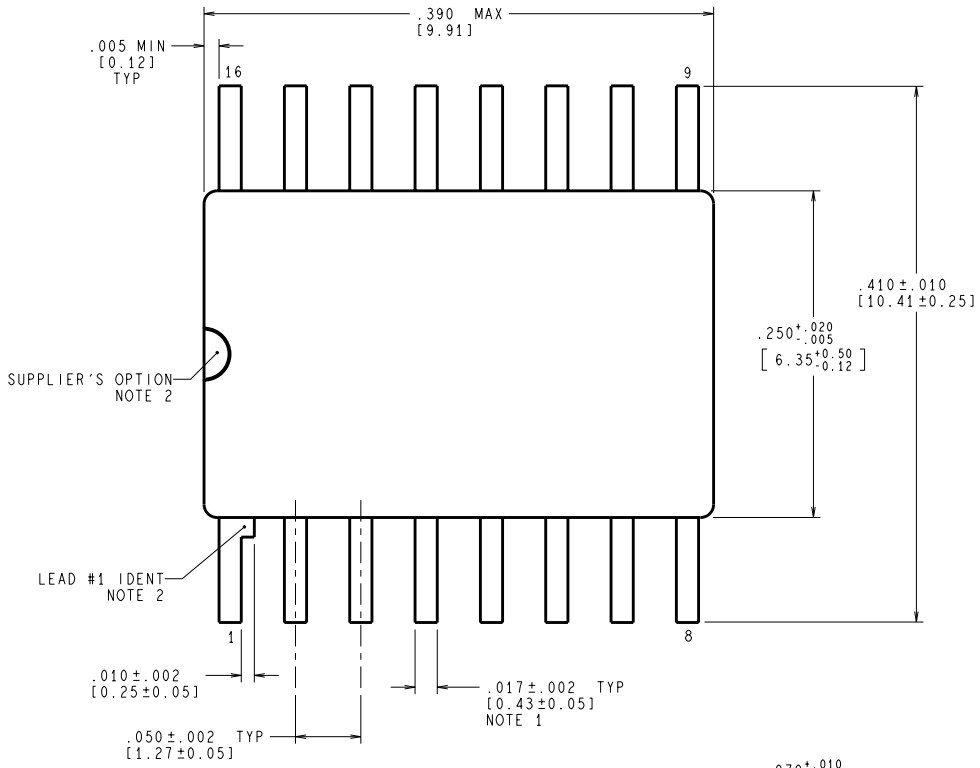
National Semiconductor™
MIL/AEROSPACE OPERATIONS
2900 SEMICONDUCTOR DRIVE
SANTA CLARA, CA 95050

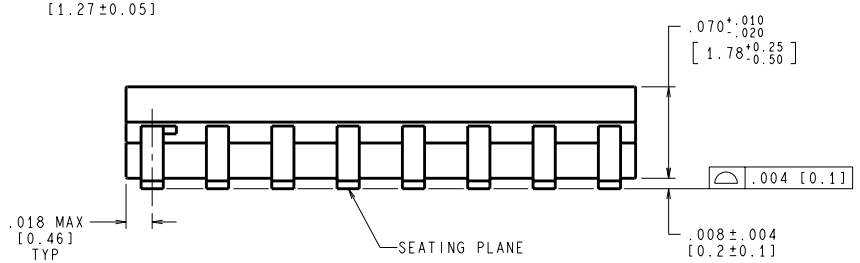


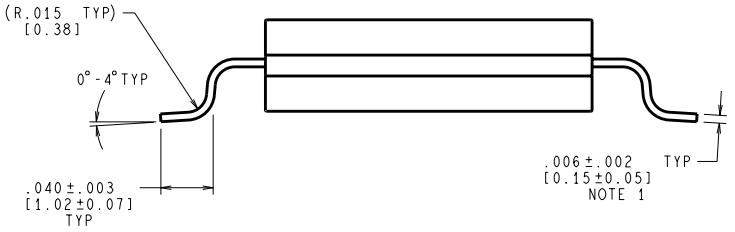

# LM137WG
# 16 - LEAD CERAMIC SOIC
# CONNECTION DIAGRAM
# TOP VIEW
# P000463A

National Semiconductor™
MIL/AEROSPACE OPERATIONS
2900 SEMICONDUCTOR DRIVE
SANTA CLARA, CA 95050

| REVISIONS | | | | |
|---|---|---|---|---|
| LTR | DESCRIPTION | E.C.N. | DATE | BY/APP'D |
| A | RELEASE TO DOCUMENT CONTROL | 11376 | 02/29/1996 | MS/KH |
| B | LD PITCH TOL WAS ±.005; CHANGE LD RADIUS TO REF DIM; REMOVE THE OTHER R.006±.002; DIM .040±.003 WAS .037±.003 | 11443 | 04/19/1996 | MS/KH |
| C | R .015[0.38] WAS R .006[0.15] | 11840 | 10/08/1997 | TL/ |




NOTES: UNLESS OTHERWISE SPECIFIED

1. LEAD FINISH: SOLDER DIPPED WITH Sn60 OR Sn63 SOLDER CONFORMING TO MIL-PRF-38535 TO A MINIMUM THICKNESS OF 200 MICROINCHES/ 5.08 MICROMETERS. SOLDER MAY BE APPLIED OVER LEAD BASIS METAL OR Sn PLATE. MAXIMUM LIMIT MAY BE INCREASED BY .003 IN/ 0.08mm AFTER LEAD FINISH APPLIED.
2. LEAD 1 IDENTIFICATION SHALL BE:
   a) A NOTCH OR OTHER MARK WITHIN THIS AREA
   b) A TAB ON LEAD 1, EITHER SIDE
3. NO JEDEC REGISTRATION AS OF FEBRUARY 1996.

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535
CONFIGURATION CONTROL

| APPROVALS | DATE |
|---|---|
| DRAWN: MARTA SUCHY | 02/29/96 |
| DFTG. CHK. | |
| ENGR. CHK. | |

National Semiconductor
2900 Semiconductor dr, Santa Clara, CA 95052-8090

# CERPACK, 16 LEAD, GULL WING

PROJECTION
INCH [MM]

| SCALE | SIZE | DRAWING NUMBER | REV |
|---|---|---|---|
| N/A | C | (SC)MKT-WG16A | C |

DO NOT SCALE DRAWING | SHEET 1 of 1

# Revision History

| Rev | ECN # | Rel Date | Originator | Changes |
|---|---|---|---|---|
| 0A0 | M0003761 | 03/15/02 | Rose Malone | Initial MDS Release: MRLM137-X-RH, Rev. 0A0. Replaced MRLM137-H-RH, Rev. 2A0 |
| 1A0 | M0003966 | 07/14/04 | Rose Malone | Archive/Obsolete MDS: MRLM137-X-RH, Rev. 0A0. No longer able to produce Rad Hard Product. |
| 2A0 | M0004398 | 07/14/04 | Rose Malone | De-Archive MDS: MRLM137-X-RH, Rev. 1A0. Releasing MDS at Revision 2A0. |

# National Semiconductor was acquired by Texas Instruments.

http://www.ti.com/corp/docs/investor_relations/pr_09_23_2011_national_semiconductor.html

This file is the datasheet for the following electronic components:

LM137H/883 - http://www.ti.com/product/lm137h/883?HQS=TI-null-null-dscatalog-df-pf-null-wwe

LM137K/883 - http://www.ti.com/product/lm137k/883?HQS=TI-null-null-dscatalog-df-pf-null-wwe

LM137AH/883 - http://www.ti.com/product/lm137ah/883?HQS=TI-null-null-dscatalog-df-pf-null-wwe

5962P9951701VZA - http://www.ti.com/product/5962p9951701vza?HQS=TI-null-null-dscatalog-df-pf-null-wwe

JM38510/11803BXA - http://www.ti.com/product/jm38510/11803bxa?HQS=TI-null-null-dscatalog-df-pf-null-wwe

5962P9951701VXA - http://www.ti.com/product/5962p9951701vxa?HQS=TI-null-null-dscatalog-df-pf-null-wwe

7703403YA - http://www.ti.com/product/7703403ya?HQS=TI-null-null-dscatalog-df-pf-null-wwe

LM137KG MWA - http://www.ti.com/product/lm137kg mwa?HQS=TI-null-null-dscatalog-df-pf-null-wwe

JM38510/11804SYA - http://www.ti.com/product/jm38510/11804sya?HQS=TI-null-null-dscatalog-df-pf-null-wwe

5962-9951701VZA - http://www.ti.com/product/5962-9951701vza?HQS=TI-null-null-dscatalog-df-pf-null-wwe

LM137H MDS - http://www.ti.com/product/lm137h mds?HQS=TI-null-null-dscatalog-df-pf-null-wwe

7703403XA - http://www.ti.com/product/7703403xa?HQS=TI-null-null-dscatalog-df-pf-null-wwe

LM137KG MDA - http://www.ti.com/product/lm137kg mda?HQS=TI-null-null-dscatalog-df-pf-null-wwe

5962P9951702VYA - http://www.ti.com/product/5962p9951702vya?HQS=TI-null-null-dscatalog-df-pf-null-wwe

JM38510/11803SXA - http://www.ti.com/product/jm38510/11803sxa?HQS=TI-null-null-dscatalog-df-pf-null-wwe

LM137WG/883 - http://www.ti.com/product/lm137wg/883?HQS=TI-null-null-dscatalog-df-pf-null-wwe

LM137H - http://www.ti.com/product/lm137h?HQS=TI-null-null-dscatalog-df-pf-null-wwe

JM38510/11804BYA - http://www.ti.com/product/jm38510/11804bya?HQS=TI-null-null-dscatalog-df-pf-null-wwe