



**MICROCIRCUIT DATA SHEET**

**MNLM1575-15-X REV 0D1**

Original Creation Date: 08/29/95  
 Last Update Date: 05/22/00  
 Last Major Revision Date: 08/29/95

**SIMPLE SWITCHER(TM) 1A STEP-DOWN VOLTAGE REGULATOR**

**General Description**

The LM1575 regulator is a monolithic integrated circuit that provides all the active functions for a step-down (buck) switching regulator, capable of driving a 1A load with excellent line and load regulation.

Requiring a minimum number of external components, this regulator is simple to use and includes internal frequency compensation and a fixed-frequency oscillator.

The LM1575 offers a high-efficiency replacement for popular three-terminal linear regulators. It substantially reduces the size of the heat sink, and in many cases no heat sink is required.

A standard series of inductors optimized for use with the LM1575 are available from several different manufacturers. This feature greatly simplifies the design of switch-mode power supplies.

Other features include a guaranteed  $\pm 4\%$  tolerance on output voltage within specified input voltage and output load conditions, and  $\pm 10\%$  on the oscillator frequency. External shutdown is included, featuring 50uA (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

**Industry Part Number**

LM1575-15

**NS Part Numbers**

LM1575J-15-QML  
 LM1575K-15-QML  
 LM1575WG-15-QML

**Prime Die**

LM1575-15

**Controlling Document**

SEE FEATURES SECTION

**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**

- Adjustable version output voltage range, 1.23V to 37V  $\pm 4\%$  max over line and load conditions
- Guaranteed 1A output current
- Requires only 4 external components
- 52KHz fixed frequency internal oscillator
- TTL shutdown capability, low power standby mode
- High efficiency
- Uses readily available standard inductors
- Thermal shutdown and current limit protection

CONTROLLING DOCUMENTS:

|                 |                 |
|-----------------|-----------------|
| LM1575J-15-QML  | 5962-9167401QEA |
| LM1575K-15-QML  | 5962-9167401QXA |
| LM1575WG-15-QML | 5962-9167401QZA |

**Applications**

- Simple high-efficiency step-down (buck) regulator
- Efficient pre-regulator for linear regulators
- On-card switching regulators
- Positive to negative converted (Buck-Boost)

**(Absolute Maximum Ratings)**

(Note 1)

|   |  |
|---|--|
| Maximum Supply Voltage                        | 45V  |
| $\overline{\text{ON}}$ /OFF Pin Input Voltage | $-0.3\text{V} \leq V \leq +V_{\text{in}}$  |
| Output Voltage to Ground<br>(Steady State)    | -1V  |
| Power Dissipation<br>(Note 2, 3)              | Internally Limited                         |
| Storage Temperature Range                     | $-65\text{ C} \leq T_a \leq +150\text{ C}$ |
| Lead Temperature<br>(Soldering, 10 seconds)   |  |
| METAL CAN                                     | 300 C                                      |
| CERDIP  | 260 C                                      |
| CERAMIC SOIC                                  | 260 C                                      |
| Maximum Junction Temperature                  | 150 C                                      |
| Thermal Resistance                            |  |
| ThetaJA                                       |  |
| METAL CAN (Still Air)                         | 45 C/W                                     |
| (500LF/Min Air Flow)                          | 10 C/W                                     |
| CERDIP (Still Air)                            | 70 C/W                                     |
| (500LF/Min Air Flow)                          | 33 C/W                                     |
| CERAMIC SOIC (Still Air)                      | 121 C/W                                    |
| (500LF/Min Air Flow)                          | 73 C/W                                     |
| Theta JC<br>(Note 3)                          |  |
| METAL CAN                                     | 3.3 C/W                                    |
| CERDIP  | 2.0 C/W                                    |
| CERAMIC SOIC                                  | 3.0 C/W                                    |
| Package Weight<br>(Typical)                   |  |
| METAL CAN                                     | TBD  |
| CERDIP  | TBD  |
| CERAMIC SOIC                                  | TBD  |
| ESD Tolerance<br>(Note 4)                     | 3000V                                      |

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  $T_{\text{jmax}}$  (maximum junction temperature),  $\Theta_{\text{JA}}$  (package junction to ambient thermal resistance), and  $T_{\text{A}}$  (ambient temperature). The maximum allowable power dissipation at any temperature is  $P_{\text{dmax}} = (T_{\text{jmax}} - T_{\text{A}})/\Theta_{\text{JA}}$  or the number given in the Absolute Maximum Ratings, whichever is lower.

**(Continued)**

- Note 3: 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 of 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 4: Human body model, 1.5k Ohms in series with 100pF.

**Recommended Operating Conditions**

|                   |                     |
|-------------------|---------------------|
| Temperature Range | -55 C ≤ Ta ≤ +125 C |
| Supply Voltage    | 40V                 |

## Electrical Characteristics

### ELECTRICAL CHARACTERISTICS: SYSTEM PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)  
DC:  $V_{in} = 30V$ , and  $I_{load} = 200mA$ .

| SYMBOL | PARAMETER      | CONDITIONS  | NOTES | PIN-NAME | MIN   | MAX   | UNIT | SUB-GROUPS |
|--------|----------------|---|-------|----------|-------|-------|------|------------|
| Vout   | Output Voltage |   | 1     |          | 14.85 | 15.15 | V    | 1          |
|        |                | $0.2A \leq I_{load} \leq 1A$ , $18V \leq V_{in} \leq 40V$ | 1     |          | 14.55 | 15.45 | V    | 1          |
|        |                |   | 1     |          | 14.40 | 15.60 | V    | 2, 3       |

### ELECTRICAL CHARACTERISTICS: DEVICE PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)  
DC:  $V_{in} = 30V$ , and  $I_{load} = 200mA$ .

|       |                           |                                    |   |  |     |     |    |      |
|-------|---------------------------|------------------------------------|---|--|-----|-----|----|------|
| Vsat  | Saturation Voltage        | $I_{out} = 1A$                     | 2 |  |     | 1.2 | V  | 1    |
|       |                           |                                    | 2 |  |     | 1.4 | V  | 2, 3 |
| Icl   | Current Limit             | Peak Current, $t_{ON} \leq 3\mu S$ | 2 |  | 1.7 | 3.0 | A  | 1    |
|       |                           |                                    | 2 |  | 1.3 | 3.2 | A  | 2, 3 |
| Il    | Output Leakage Current    | $V_{in} = 35V$ , Output = 0V       | 4 |  |     | 2   | mA | 1    |
|       |                           | $V_{in} = 35V$ , Output = -1V      | 4 |  |     | 30  | mA | 1    |
| Iq    | Quiescent Current         |                                    | 4 |  |     | 10  | mA | 1    |
|       |                           |                                    | 4 |  |     | 12  | mA | 2, 3 |
| Istby | Standby Quiescent Current | $\overline{ON}/OFF$ Pin = 5V (OFF) |   |  |     | 200 | uA | 1    |
|       |                           |                                    |   |  |     | 500 | uA | 2, 3 |

### AC ELECTRICAL CHARACTERISTICS: DEVICE PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)  
AC:  $V_{in} = 30V$ , and  $I_{load} = 200mA$ .

|    |                      |  |   |  |    |    |     |      |
|----|----------------------|--|---|--|----|----|-----|------|
| fo | Oscillator Frequency |  |   |  | 47 | 58 | KHz | 4    |
|    |                      |  |   |  | 43 | 62 | KHz | 5, 6 |
| Dc | Max Duty Cycle (ON)  |  | 3 |  | 93 |    | %   | 9    |

## Electrical Characteristics

### ELECTRICAL CHARACTERISTICS: ON/OFF CONTROL

(The following conditions apply to all the following parameters, unless otherwise specified.)  
DC:  $V_{in} = 30V$ , and  $I_{load} = 200mA$ .

| SYMBOL | PARAMETER                                 | CONDITIONS                         | NOTES | PIN-NAME | MIN | MAX | UNIT    | SUB-GROUPS |
|--------|---|------------------------------------|-------|----------|-----|-----|---------|------------|
| Vih    | $\overline{ON}/OFF$ Pin Logic Input Level | $V_{out} = 0V$                     |       |          | 2.2 |     | V       | 1          |
| Vih    | $\overline{ON}/OFF$ Pin Logic Input Level | $V_{out} = 0V$                     |       |          | 2.4 |     | V       | 2, 3       |
| Vil    | $\overline{ON}/OFF$ Pin Logic Input Level | $V_{out} = 15V$                    |       |          |     | 1.0 | V       | 1          |
| Vil    | $\overline{ON}/OFF$ Pin Logic Input Level | $V_{out} = 15V$                    |       |          |     | 0.8 | V       | 2, 3       |
| Iih    | $\overline{ON}/OFF$ Pin Input Current     | $\overline{ON}/OFF$ Pin = 5V (OFF) |       |          |     | 30  | $\mu A$ | 1          |
| Iil    | $\overline{ON}/OFF$ Pin Input Current     | $\overline{ON}/OFF$ Pin = 0V (ON)  |       |          |     | 10  | $\mu A$ | 1          |

Note 1: External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance.

Note 2: Output sourcing current. No diode, inductor or capacitor connected to output.

Note 3: Feedback removed from output and connected to 0V.

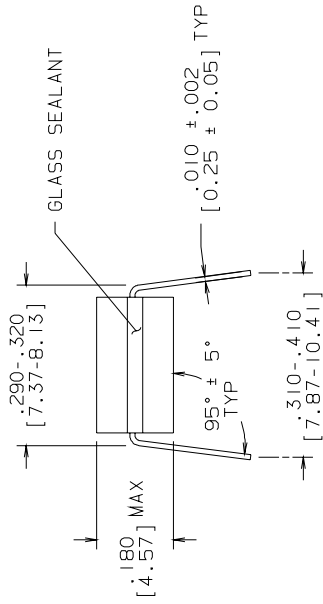
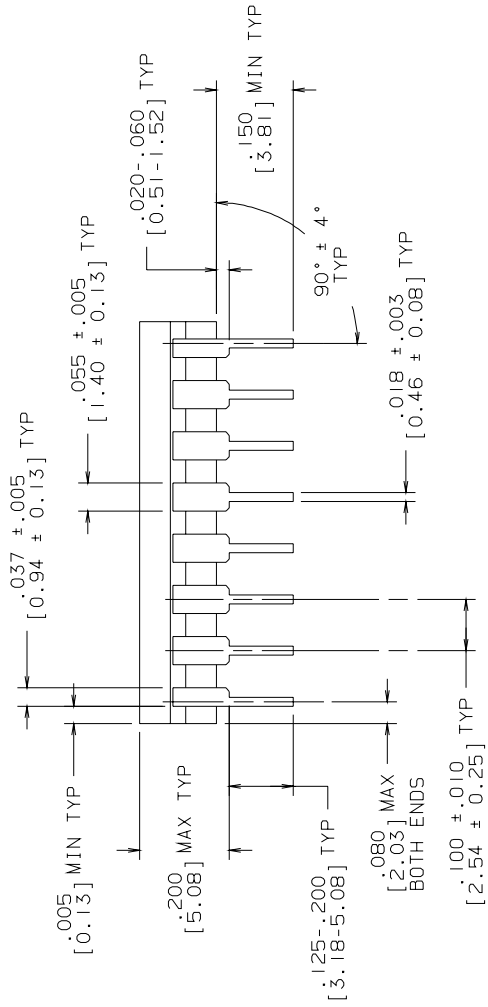
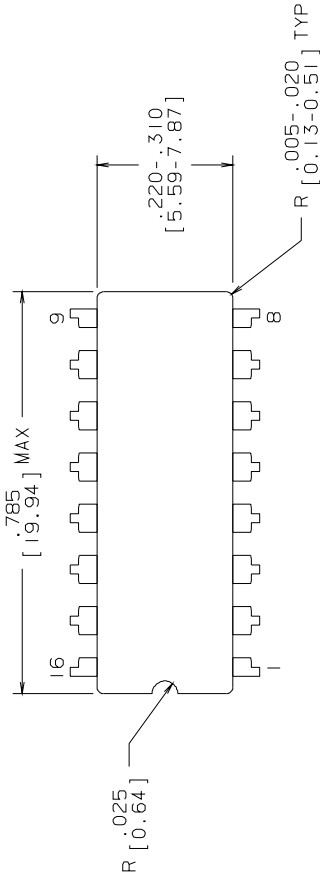
Note 4: Feedback removed from output and connected to 25V to force the output transistor OFF.

## Graphics and Diagrams

| GRAPHICS# | DESCRIPTION   |
|-----------|---|
| 06153HRA2 | METAL CAN (KA), TO-3, 4LD, LOW PROFILE (B/I CKT)    |
| 06265HRB2 | CERDIP (J), 16 LEAD (B/I CKT)                       |
| 06379HRA1 | CERAMIC SOIC (WG), 16 LEAD (B/I CKT)                |
| J16ARL    | CERDIP (J), 16 LEAD (P/P DWG)                       |
| KA04BRA   | METAL CAN (KA), TO-3, 4 LEAD, LOW PROFILE (P/P DWG) |
| P000232A  | METAL CAN (KA), TO-3, 4LD, LOW PROFILE (PINOUT)     |
| P000371A  | CERDIP (J), 16 LEAD (PINOUT)                        |
| P000464A  | CERAMIC SOIC (WG), 16 LEAD (PIN OUT)                |
| WG16ARC   | CERAMIC SOIC (WG), 16 LEAD (P/P DWG)                |

See attached graphics following this page.

| R E V I S I O N S |                                |          |          |
|-------------------|--------------------------------|----------|----------|
| LTR               | DESCRIPTION                    | E. C. N. | DATE     |
| L                 | REVISE PER CURRENT STD; REDRAW | 09996    | 09/15/93 |
|                   |                                |          | TL/      |



MILIAERO  
CONFIGURATION CONTROL

MIL-M-38510  
CONFIGURATION CONTROL

| CONTROLLING DIMENSION: INCH |              |
|-----------------------------|--------------|
| APPROVALS                   | DATE         |
| DRAWN <b>T. LEQUANG</b>     | 09/15/93     |
| DFTG. CHK.                  |              |
| ENGR. CHK.                  |              |
| APPROVAL                    |              |
| PROJECTION<br>              |              |
|                             | INCH [MM]    |
| SCALE<br>N/A                | SIZE<br>B    |
| DRAWING NUMBER<br>MKT-J16A  | REV<br>L     |
| DO NOT SCALE DRAWING        | SHEET 1 OF 1 |

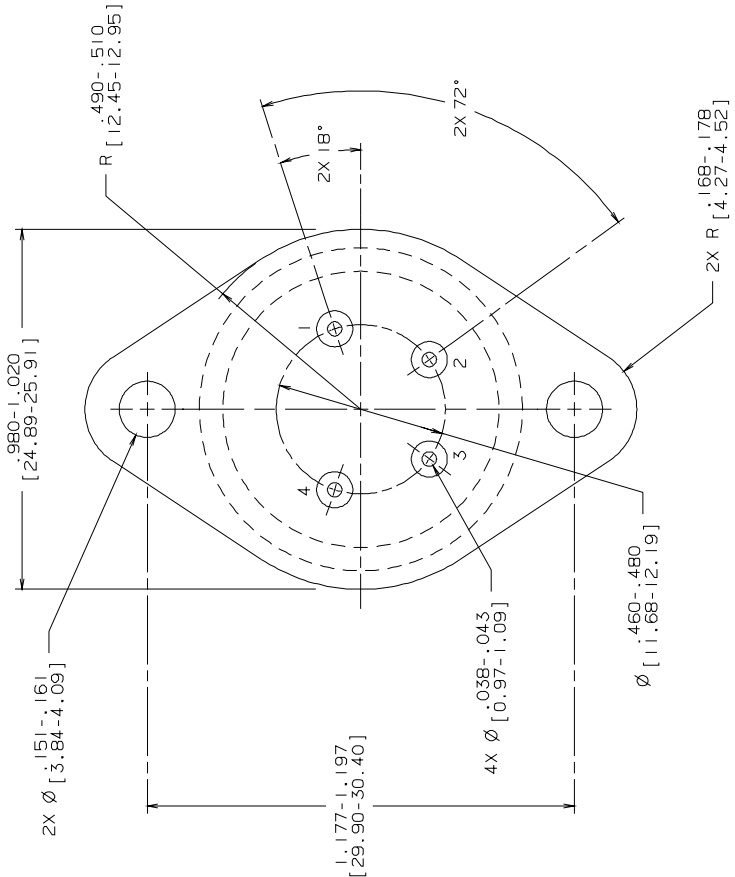
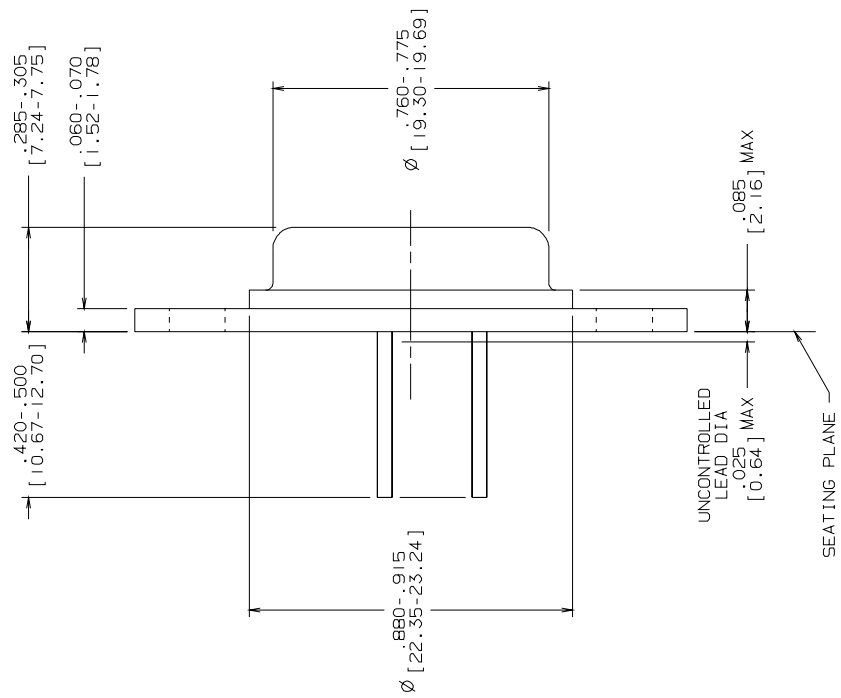
|  |
|--|
| NATIONAL SEMICONDUCTOR CORPORATION<br>2900 Semiconductor Drive, Santa Clara, CA 95052-8090 |
|--|

NOTES: UNLESS OTHERWISE SPECIFIED

- LEAD FINISH TO BE 200 MICROMETERS / 5.08 MICROMETERS MINIMUM SOLDER MEASURED AT THE CREST OF THE MAJOR FLATS.
- JEDEC REGISTRATION MO-036, VARIATION AD, DATED 04/1981.

CERDIP (J),  
16 LEAD

| REVISIONS |                             |        |               |
|-----------|-----------------------------|--------|---------------|
| LTR       | DESCRIPTION                 | E.C.N. | DATE          |
| A         | RELEASE TO DOCUMENT CONTROL | 09260  | 08/14/92 DEG/ |

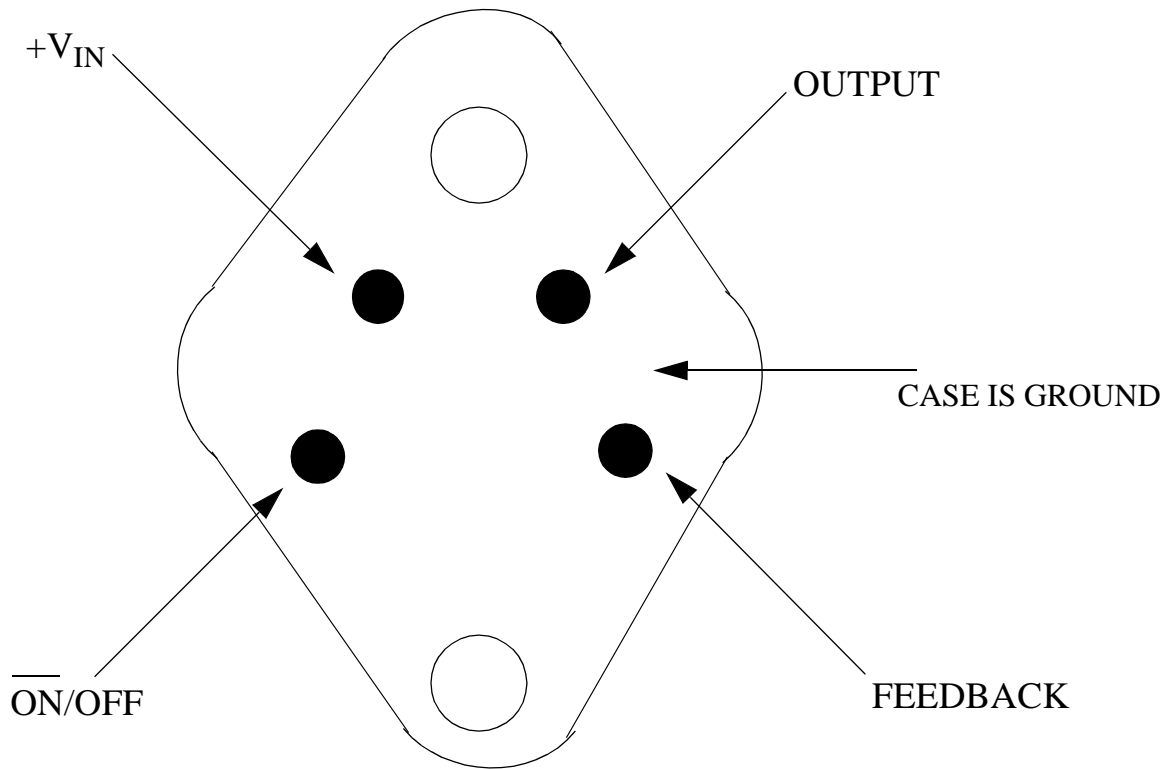


NOTES: UNLESS OTHERWISE SPECIFIED

- STANDARD HEADER TYPE SOLID BASE.
- STANDARD LEAD FINISH:  
Sn/Pb SOLDER OVER 100 MICRONS/  
2.54 MICROMETERS MINIMUM NICKEL PLATED  
ON ALLOY 52.
- LEAD TIPS LOCATED WITHIN ±.080 [2.03]  
OF LEAD POSITION AT BASE.
- REFERENCE ON JEDEC REGISTRATION TO-3,  
PUBLICATION 95, PAGE 98.

| CONTROLLING DIMENSION: INCH  |                |
|--|----------------|
| APPROVALS  | DATE           |
| DRAWN D.E. GRADY   | 10/28/91       |
| DFG: CHK.  |                |
| ENGR. CHK.   |                |
| APPROVAL   |                |
|  |                |
| NATIONAL SEMICONDUCTOR CORPORATION<br>2900 Semiconductor Drive, Santa Clara, CA 95052-8090 |                |
| METAL CAN, TO-3<br>4 LEAD, LOW PROFILE   |                |
| SCALE  | DRAWING NUMBER |
| N/A  | C MKT-KA04B    |
| REV  | A              |
| DO NOT SCALE DRAWING   |                |
| SHEET 1 OF 1   |                |

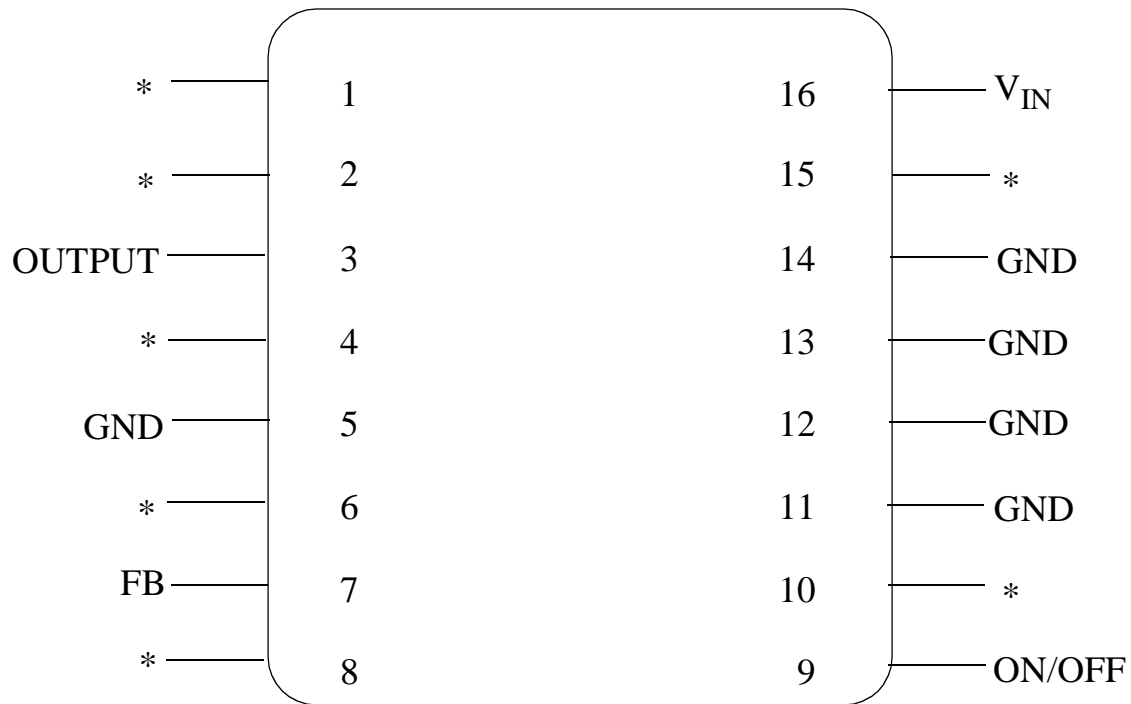
MIL/AERO  
CONFIGURATION CONTROL



LM1575K, LM1575HVK  
4 - LEAD TO-3  
CONNECTION DIAGRAM  
BOTTOM VIEW  
P000232A



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



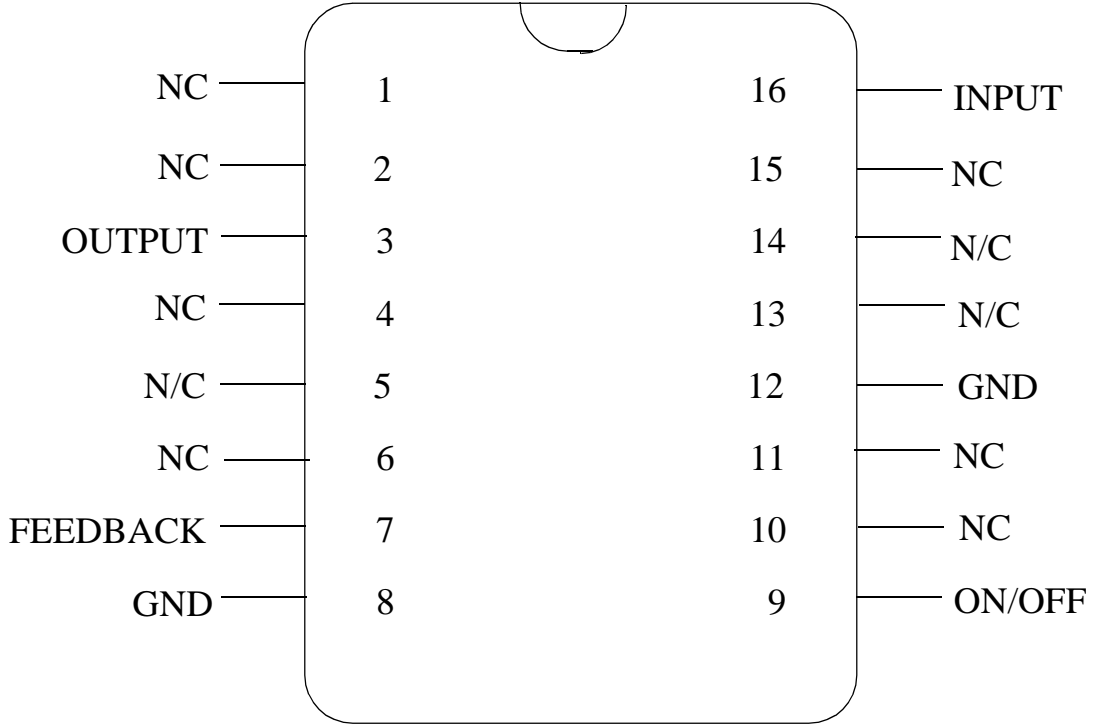
\*No Internal Connection

**LM1575J**  
**16 - LEAD DIP**  
**CONNECTION DIAGRAM**  
**TOP VIEW**  
**P000371A**



National Semiconductor™

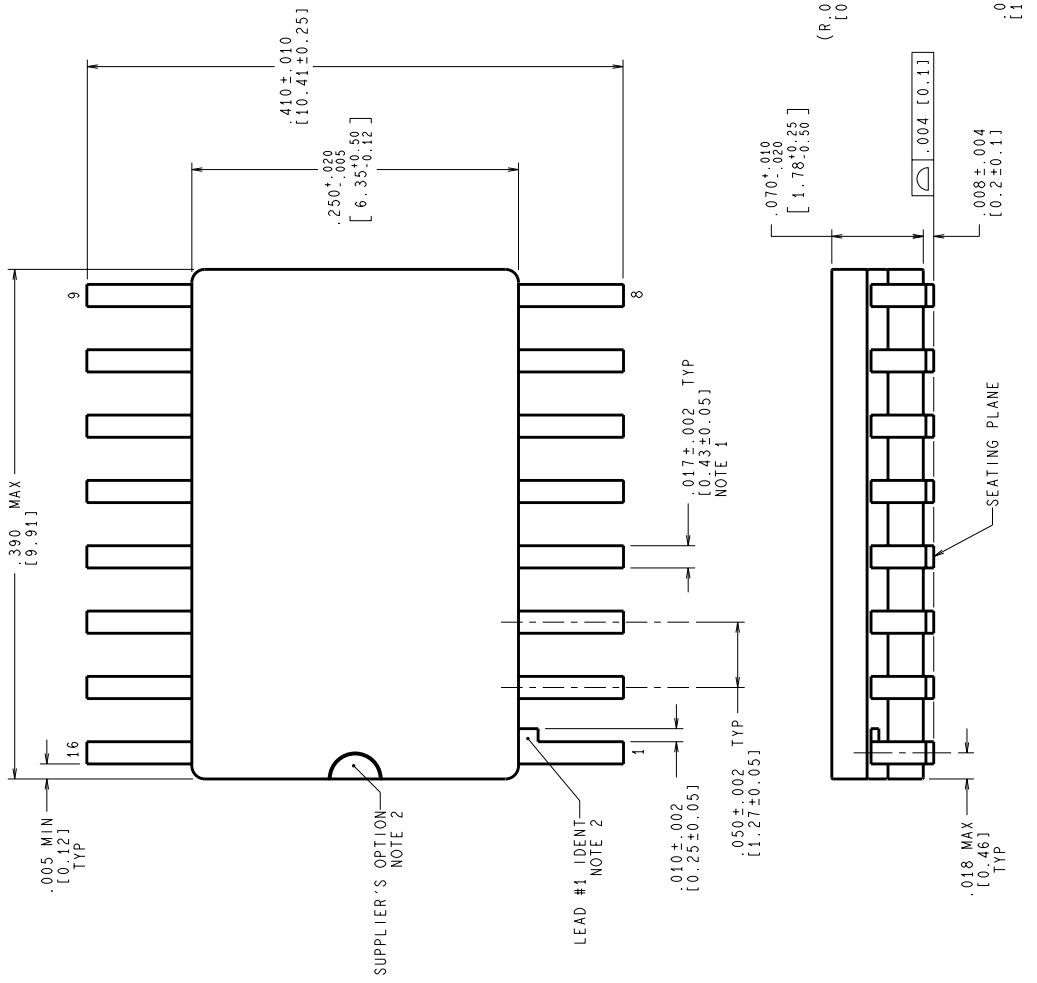
MIL/AEROSPACE OPERATIONS  
 2900 SEMICONDUCTOR DRIVE  
 SANTA CLARA, CA 95050



**LM1575WG**  
**16 - LEAD CERAMIC SOIC**  
**CONNECTION DIAGRAM**  
**TOP VIEW**  
**P000464A**

| REVISIONS |  |        |            |
|-----------|--|--------|------------|
| LTR       | DESCRIPTION  | E.C.N. | DATE       |
| A         | RELEASE TO DOCUMENT CONTROL  | 11376  | 02/29/1996 |
| 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 |
| C         | R.015(0.38) WAS R.006(0.15)  | 11840  | 10/08/1997 |

| APPROVALS   | DATE     | BY/APP'D |
|---|----------|----------|
| DRN: <i>MARYA SUCHY</i>   | 02/29/96 | MS/KH    |
| ENGR. CHK.  |          | MS/KH    |
| PROJECTION  |          |          |
|  |          |          |
| SCALE   | SIZE     | REV      |
| N/A   | C        | C        |
| DO NOT SCALE DRAWING  |          |          |



**MIL-PRF-38535  
CONFIGURATION CONTROL**

CONTROLLING DIMENSION IS INCH  
VALUES IN | ARE MILLIMETERS

- NOTES: UNLESS OTHERWISE SPECIFIED
- LEAD FINISH: SOLDER DIPPED WITH Sn60 OR Sn63 SOLDER CONFORMING TO MIL-PRF-38535 TO A MINIMUM THICKNESS OF 200 MICRONS / 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.
  - LEAD 1 IDENTIFICATION SHALL BE:
    - A NOTCH OR OTHER MARK WITHIN THIS AREA
    - A TAB ON LEAD 1, EITHER SIDE
  - NO JEDEC REGISTRATION AS OF FEBRUARY 1996.

**National Semiconductor**  
2800 Semiconductor Dr., Santa Clara, CA 95052-8000

**CERPACK,  
16 LEAD,  
GULL WING**

SCALE: N/A C (SC) MKT-WG16A REV: C

DO NOT SCALE DRAWING SHEET 1 of 1

**Revision History**

| Rev | ECN #    | Rel Date | Originator    | Changes   |
|-----|----------|----------|---------------|---|
| 0C0 | M0001550 | 05/22/00 | Barbara Lopez | Changed: MNL1575-X-15 Rev. 0B0 to MNL1575-15-X Rev. 0C0. Added power dissipation note for Aluminum Nitride package. Changed nomenclature.   |
| 0D1 | M0003689 | 05/22/00 | Rose Malone   | Update MDS: MNL1575-15-X, Rev. 0C0 to MNL1575-15-X, Rev. 0D1. Added reference to WG package to Main Table, Market Dwg., B/I Ckt., Pin Out to Graphics Section and to Absolute Maximum Ratings Section. Moved Controlling Documents (SMD numbers) to Features Section. Corrected typo in Recommended Operating Conditions Section. |