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MIL-HDBK-6100 30 JULY 1997

## DEPARTMENT OF DEFENSE HANDBOOK

LIST OF CASE OUTLINES<br>AND DIMENSIONS FOR<br>DISCRETE SEMICONDUCTOR DEVICES



## MIL-HDBK-6100

## FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense (DOD).
2. This handbook is for guidance only.
3. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center, Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD1426) appearing at the end of this document or by letter.

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## 1. SCOPE

1.1 Scope. This handbook details dimensioning for popular case outlines used with discrete semiconductor devices specified in MIL-PRF-19500.
2. APPLICABLE DOCUMENTS. This section is not applicable to this handbook.

## 3. GENERAL

3.1 Definitions. The following definitions apply to this handbook.
3.1.1 Seating plane. The reference plane which designates the interface between the package and the surface on which it is mounted.
3.1.2 Body. That part of the package exclusive of electrical terminals, studs, or leads.
3.1.3 Terminal. That part of the package used in making an electrical, mechanical, or thermal connection. Examples of terminals are flexible leads, rigid leads, studs, and cases which serve as electrical connections.
3.1.4 Visual index. A referenced mark, chamfer, notch, tab, flat, extended terminal, or groove which identifies the number one terminal position.

## 4. CASE OUTLINE PRESENTATION

4.1 Outline identification. Outlines included in this handbook are identified by a letter, a dash, then a number-suffix combination. The letter T is used to designate transistor and thyristor outlines and D for diode outlines. Numbers are assigned sequentially within each group to designate a family of outlines. One suffix letter is added to designate one of a family of outlines (e.g., T-1A, T-1B, D-1A, and D-2B).
4.2 Dimensioning symbols. The symbols for dimensioning case outlines are listed below.

| BD | Body diameter. |
| :--- | :--- |
| BL | Body length. |
| BW | Body width. |
| CD | Largest diameter of body (case diameter). |
| CH | Distance from seating plane to top of body (case height). |
| ECT | End cap thickness. |
| F | Overall dimension of flange or hexagon zone including any fillet. |
| $\mathrm{F}_{1}$ | Dimension of a flange or hexagon zone excluding any fillet. |
| FL | Longest dimension between seating plane and center of hole in the lug of a terminal (flag length). |
| FW | Major cross section dimension of a terminal (flag width). |
| HD | Header diameter. |
| HF | Distance across flats dimension of a hexagon (hexagon flats). |
| HR | Curve radii associated with body (header radius). |

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HR2 Curve radii associated with body (header radius).
HT Header thickness.
LC Diameter of the circle upon which the terminal positions are located (lead circle).
LD Diameter of round (wire) terminals (lead diameter).
LL Overall terminal length (lead length).
$L_{1}$ Length of uncontrolled cross section of terminal.
LS Spacing between leads.
MHD Diameter of mounting holes (mounting hole diameter).
MHS Distance between centers of two mounting holes (mounting hole spacing).
OAH Over all height from seating plane.
P Length of controlled zone of body.
PS Linear distance between two terminal centers (pin spacing).
Q Other dimensions.
SD Pitch diameter in accordance with FEDSTDH28 (stud diameter).
SL Overall length of stud.
SU Length of incomplete or undercut threads (stud undercut).
TL Length of visual index (tab length).
TW Width of visual index (tab width).
UD Diameter of thread relief zone (undercut diameter).
C Minor cross section dimension of a terminal.
R Index tab radii.
S Miscellaneous dimensions of terminal flat relative to terminal hole.
NT Diameter of hole in terminal.
$\alpha \quad$ Index datum angle to first terminal position on each pin circle.
B Angular spacing between adjacent terminal positions.
NOTE: Subscript numbers may be included when more than one dimension is specified for a given symbol (e.g. $\mathrm{F}_{1}, \mathrm{HR}_{2}$ ).

|  | Similar to | Figure | Page |
| :--- | :--- | :--- | :--- |
| Outline number | $\underline{\text { JEDEC number }}$ | number number |  |
| T-1A (3-1.5" leads, number 3 connected to case) | TO-205AA (TO-5) | 1 | 5 |
| T-1B (3-1.5" leads, all isolated from case) | TO-205AA (TO-5) | 1 | 5 |
| T-1C (3-.5 leads, number 3 connected to case) | TO-205AD (TO-39) | 1 | 5 |
| T-1D (3-.5" leads, all isolated from case) | TO-205AD (TO-39) | 1 | 5 |
| T-1E (3-.5" leads, number 3 connected to case) | TO-205AF (TO-39) | 1 | 5 |
| T-2A (3-.5" leads, number 3 connected to case) | TO-206AA (TO-18) | 2 | 6 |

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| Outline number | Similar to JEDEC number | Figure number | Page <br> number |
| :---: | :---: | :---: | :---: |
| T-2B (3-.5" leads, number 3 connected to case) | TO-206AB (TO-46) | 2 | 6 |
| T-3A (4-.5" leads, number 4 connected to case) | TO-206AF (TO-72) | 3 | 8 |
| T-4A (40 mil diameter leads) | TO-204AA (TO-3) | 4 | 10 |
| T-4B (50 mil diameter leads) | TO-204AD (TO-3) | 4 | 10 |
| T-4C (60 mil diameter leads) | TO-204AE (TO-3) | 4 | 10 |
| T-5A (30 mil diameter leads) | TO-213AA (TO-66) | 5 | 12 |
| T-6A ( $120^{\circ}$ lead orientation, number 3 connected to case) | TO-210AA (TO-59) | 6 | 14 |
| T-6B (90 ${ }^{\circ}$ lead orientation, all isolated from case) | TO-210AA (TO-59) | 6 | 14 |
| T-6C ( $120^{\circ}$ lead orientation, number 3 isolated from case) | TO-210AA (TO-59) | 6 | 14 |
| T-7A (lead number 3 connected to case) | TO-210AC (TO-61) | 7 | 17 |
| T-7B (all leads isolated from case) | TO-210AC (TO-61) | 7 | 17 |
| D-1A (anode to stud) | DO-203AA(DO-4) | 8 | 19 |
| D-1B (cathode to stud) | DO-203AA(DO-4) | 8 | 19 |
| D-2A (anode to stud) | DO-203AB(DO-5) | 9 | 20 |
| D-2B (cathode to stud) | DO-203AB(DO-5) | 9 | 20 |
| D-3A (20 mil leads) | DO-204AA(DO-7) | 10 | 21 |
| D-3B (20 mil leads) | DO-204AB(DO-14) | 10 | 21 |
| D-3C (20 mil leads) | DO-204AA (DO-35) | 10 | 21 |
| D-3D (30 mil leads) | DO-204AA | 10 | 21 |
| D-3E (40 mil leads) | DO-204AA | 10 | 21 |
| D-4A | DO-205AA (DO-8) | 11 | 22 |
| D-4B | DO-205AB (DO-9) | 11 | 22 |
| D-4C | DO-205AC (DO-30) | 11 | 22 |
| D-4D | DO-205AD | 11 | 22 |
| TO-254 (40 mil diameter leads) | TO-254 | 12 | 24 |
| TO-257 (40 mil diameter leads) | TO-257 | 13 | 25 |
| TO-258 (60 mil diameter leads) | TO-258 | 14 | 26 |
| D-5A | Surface mount | 15 | 27 |
| D-5B | Surface mount | 15 | 27 |
| D-5C | Surface mount | 15 | 27 |
| D-5D | Surface mount | 15 | 27 |
| DO-213AA | Surface mount | 16 | 28 |
| DO-213AB | Surface mount | 16 | 28 |

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| C-3 | Surface mount | 17 | 29 |
| :--- | :--- | :--- | :--- |
| C-4 | Surface mount | 18 | 30 |
| C-6 | Surface mount | 19 | 31 |

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| Symbol | T-1A |  | T-1B |  | T-1C |  | T-1D |  | T-1E |  | Notes |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |  |
| CD | . 305 | .355 | .305 | . 355 | . 305 | . 355 | . 305 | . 355 | . 305 | . 355 |  |
| CH | . 240 | . 260 | . 240 | . 260 | . 240 | . 260 | . 240 | . 260 | . 160 | . 180 |  |
| HD | . 355 | . 370 | . 355 | . 370 | . 355 | . 370 | . 355 | . 370 | . 355 | . 370 |  |
| LC | . 200 TP |  | . 200 TP |  | . 200 TP |  | . 200 TP |  | . 200 TP |  | 6 |
| LD | . 016 | . 021 | . 016 | . 021 | . 016 | . 021 | . 016 | . 021 | . 016 | . 021 | 7 |
| LL | 1.500 | 1.750 | 1.500 | 1.750 | . 500 | . 750 | . 500 | . 750 | . 500 | . 750 | 7 |
| LU | . 016 | . 019 | . 016 | . 019 | . 016 | . 019 | . 016 | . 019 | . 016 | . 019 | 7 |
| L1 |  | . 050 |  | . 050 |  | . 050 |  | . 050 |  | . 050 | 7 |
| L2 | . 250 |  | . 250 |  | . 250 |  | . 250 |  | . 250 |  | 7 |
| TL | . 029 | . 045 | . 029 | . 045 | . 029 | . 045 | . 029 | . 045 | . 029 | . 045 | 3 |
| TW | . 028 | . 034 | . 028 | . 034 | . 028 | . 034 | . 028 | . 034 | . 028 | . 034 | 10 |
| P | . 100 |  | . 100 |  | . 100 |  | . 100 |  | . 100 |  | 5 |
| Q |  | . 040 |  | . 040 |  | . 040 |  | . 040 |  | . 040 | 4 |
| $r$ |  | . 010 |  | . 010 |  | . 010 |  | . 010 |  | . 010 | 11 |
| a | $45^{\circ}$ | TP | $45^{\circ}$ | TP | $45^{\circ}$ | TP |  | TP | $45^{\circ}$ | TP | 6 |
| Notes | 1, 2, | 8, 9 | 1, | , 8 | 1, 2, | 8, 9 |  |  | 1, 2 | 8, 9 |  |

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Symbol CD shall not vary more than $.010(0.25 \mathrm{~mm})$ in zone $P$. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 inch $(1.37 \mathrm{~mm})+.001$ inch $(0.03 \mathrm{~mm})-.000$ inch $(0.00 \mathrm{~mm})$ below seating plane shall be within .007 inch $(0.18 \mathrm{~mm})$ radius of true position (TP) relative to tab. Device may be measured by direct methods or by gauge.
7. Symbol LD applies between $L_{1}$ and $L_{2}$. Dimension LD applies between $L_{2}$ and $L L$ minimum.
8. Lead designation, depending on device type, shall be as follows:

|  |  |  |  |
| :--- | :--- | :--- | :--- |
| $\|$Lead | \|Bipolar | FET | \|Thyristor |
| $\|$number \|transistor |  |  |  |
| 1 | $\mid$ Emitter | Source | Cathode |
| 2 | $\mid$ Base | Gate | Gate |
| 3 | Collector | Drain | Anode |

9. Lead number three is electrically connected to case.
10. Beyond $r$ maximum, TW shall be held for a minimum length of .011 inch $(0.28 \mathrm{~mm})$.
11. Symbol $r$ applied to both inside corners of tab.

FIGURE 1. Physical dimensions of T-1 family. (Similar to TO-5, TO-39)

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| Inches | mm | Inches | mm |
| :--- | :--- | :--- | :--- |
| .007 | 0.18 | .170 | 4.43 |
| .016 | 0.41 | .178 | 4.52 |
| .019 | 0.48 | .195 | 4.95 |
| .021 | 0.53 | .209 | 5.31 |
| .028 | 0.71 | .210 | 5.33 |
| .036 | 0.91 | .230 | 5.84 |
| .040 | 1.02 | .240 | 6.10 |
| .046 | 1.17 | .250 | 6.35 |
| .048 | 1.22 | .260 | 6.60 |
| .050 | 1.27 | .500 | 12.70 |
| .100 | 2.54 | .750 | 19.05 |

FIGURE 2. Physical dimensions of T-2 family. (Similar to TO-18, TO-46)

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NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Symbol CD shall not vary more than .010 inch $(0.25 \mathrm{~mm})$ in zone $P$. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 inch $(1.37 \mathrm{~mm})+.001$ inch $(0.03 \mathrm{~mm})-.000$ inch $(0.00 \mathrm{~mm})$ below seating plane shall be within .007 inch $(0.18 \mathrm{~mm})$ radius of TP relative to tab. Device may be measured by direct methods or by gauge.
7. Symbol LU applies between $L_{1}$ and $L_{2}$. Dimension $L D$ applies between $L_{2}$ and $L L$ minimum.
8. Lead designation, depending on device type, shall be as follows:

| \|Lead |number | Bipolar transistor | FET | \|Thyristor |
| :---: | :---: | :---: | :---: |
|  |  |  |  |
| 1 | Emitter | Gate | Cathode |
| 2 | Base | Source | \| Gate |
| 3 | Collector | Drain | \| Anode |
|  |  |  |  |

9. Lead number three is electrically connected to case.
10. Beyond $r$ maximum, TW shall be held for a minimum length of .011 inch ( 0.28 mm ).
11. Symbol $r$ applied to both inside corners of tab.

FIGURE 2. Physical dimensions of T-2 family (Similar to TO-18, TO-46) - Continued.


| Inches | mm | Inches | mm |
| :--- | :--- | :---: | :---: |
| .007 | 0.18 | .100 | 2.54 |
| .016 | 0.41 | .170 | 4.32 |
| .019 | 0.48 | .178 | 4.52 |
| .021 | 0.53 | .195 | 4.95 |
| .028 | 0.71 | .209 | 5.31 |
| .036 | 0.91 | .210 | 5.33 |
| .040 | 1.02 | .230 | 5.84 |
| .046 | 1.17 | .250 | 6.35 |
| .048 | 1.22 | .500 | 12.70 |
| .050 | 1.27 | .750 | 19.05 |

FIGURE 3. Physical dimensions of T-3 family. (Similar to TO-72)

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NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Symbol CD shall not vary more than .010 inch $(0.25 \mathrm{~mm})$ in zone $P$. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 inch $(1.37 \mathrm{~mm})+.001$ inch $(0.03 \mathrm{~mm})-.000$ inch $(0.00 \mathrm{~mm})$ below seating plane shall be within .007 inch ( 0.18 mm ) radius of TP relative to tab. Device may be measured by direct methods or by gauge.
7. Symbol LU applies between $L_{1}$ and $L_{2}$. Dimension $L D$ applies between $L_{2}$ and $L L$ minimum.
8. Lead designation, depending on device type, shall be as follows:

| \|Lead |number | \|Bipolar |transistor | FET |
| :---: | :---: | :---: |
|  | \| |  |
|  |  |  |
| \| 1 | \|Emitter | Gate |
| \| 2 | \|Base | Source |
| \| 3 | \|Collector | Drain |
| \| 4 | \|Case | Case |
|  |  |  |

9. Lead number three is electrically connected to case.
10. Beyond $r$ maximum, TW shall be held for a minimum length of .011 inch ( 0.28 mm ).
11. Symbol $r$ applied to both inside corners of tab.

FIGURE 3. Physical dimensions of T-3 family (Similar to TO-72) - Continued.


NOTES: (for table on next page)

1. Dimensions are in inches.
2. Metric equivalents are given for general information only
3. These dimensions should be measured at points .050 inch $(1.27 \mathrm{~mm})+.005$ inch $(0.13 \mathrm{~mm})-.000$ inch $(0.00 \mathrm{~mm})$ below seating plane. When gauge is not used, measurement will be made at the seating plane.
4. Two places.
5. The seating plane of the header shall be flat within .001 inch $(0.03 \mathrm{~mm})$ concave to .004 inch $(0.10 \mathrm{~mm})$ convex inside a .930 inch $(23.62 \mathrm{~mm})$ diameter circle on the center of the header and flat within .001 inch $(0.03 \mathrm{~mm})$ concave to .006 inch ( 0.15 mm ) convex overall.
6. Lead diameter shall not exceed twice LD within $L_{1}$.
7. Lead designation, depending on device type, shall be as follows:


FIGURE 4. Physical dimensions of T-4 family. (Similar to TO-3)

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| Symbol | T-4A |  | T-4B |  | T-4C |  | Note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | \| Min | \| Max | \| Min | \| Max | \| Min | \| Max |  |
| CD |  | \| 875 |  | \| 875 |  | \| 875 |  |
| CH | 1.250 | \| 360 | \| 250 | \| 360 | \| 250 | \| 360 |  |
| HR | 1.495 | \| 5.525 | \| 495 | \| . 525 | \| . 495 | \| 525 | 4 |
| $\mathrm{HR}_{1}$ | \| 131 | \| 188 | \| 131 | \| 188 | \| 131 | \| 188 | 4 |
|  |  | \| |  | \| | \| | \| |  |
| HT | \| . 060 | \| 135 | \| 060 | \| 135 | \| . 060 | \| 135 |  |
| LD | \| . 038 | \| . 043 | \| 048 | \| . 053 | \| . 058 | \| . 063 | 4, 6 |
| LL | 1.312 | \| 500 | \| 312 | \| 500 | \| 312 | \| 500 |  |
| $\mathrm{L}_{1}$ | \| | \| . 050 |  | \| . 050 | \| | \| . 050 | 6 |
|  | 1 | , |  | - | । | + |  |
| MHD | \| 151 | \|1.65 | \|1.51 | \|1.65 | \| . 151 | $\mid 1.65$ | 4 |
| MHS | \|1.177 | \|1.197 | \|1.177 | \|1.197 | \|1.177 | \|1.197 |  |
| PS | 1.420 | \| 440 | \| . 420 | \| . 440 | \| . 420 | 1.440 | 3 |
| $\mathrm{PS}_{1}$ | 1.205 | \| 2225 | \| 205 | \| 225 | \| 205 | \| . 225 | 3 |
|  | L | , |  | 1 | 1 | + |  |
| $\mathrm{S}_{1}$ | \| 655 | \| 675 | \| 655 | \| 675 | \| 655 | \| 675 |  |
|  |  | + |  | , | - | , |  |
| Notes | \| 1, 2, 5, 7 |  | 1, 2, 5, 7 |  | \| 1, 2, 5, 7 |  |  |

FIGURE 4. Physical dimensions of T-4 family (Similar to TO-3) - Continued.


| Inches | mm | Inches | mm |
| :---: | :---: | :---: | :---: |
| .028 | 0.71 | .250 | 6.35 |
| .034 | 0.86 | .340 | 8.64 |
| .050 | 1.27 | .350 | 8.89 |
| .075 | 1.91 | .360 | 9.14 |
| .093 | 2.36 | .470 | 11.94 |
| .107 | 2.72 | .500 | 12.70 |
| .115 | 2.92 | .570 | 14.48 |
| .142 | 3.61 | .590 | 14.99 |
| .145 | 3.68 | .620 | 15.75 |
| .152 | 3.86 | .958 | 24.33 |
| .190 | 4.83 | .962 | 24.43 |
| .210 | 5.33 |  |  |

FIGURE 5. Physical dimensions of T-5 family. (Similar to TO-66)

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## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. These dimensions should be measured at points .050 inch ( 1.27 mm ) +.005 inch $(0.13 \mathrm{~mm})-.000$ inch ( 0.00 mm ) below seating plane. When gauge is not used, measurement will be made at the seating plane.
4. Two places.
5. The seating plane of the header shall be flat within .001 inch $(0.03 \mathrm{~mm})$ concave to .004 inch $(0.10 \mathrm{~mm})$ convex inside a .930 inch $(23.62 \mathrm{~mm})$ diameter circle on the center of the header and flat within .001 inch $(0.03 \mathrm{~mm})$ concave to .006 inch ( 0.15 mm ) convex overall.
6. Lead diameter shall not exceed twice LD within $L_{1}$.
7. Lead designation, depending on device type, shall be as follows:

|  |  |  |
| :--- | :--- | :--- |
| $\left\lvert\,$Lead Bipolar FET <br> number \|transistor  <br>    <br> $\mid 1$ Emitter Source <br> $\mid 2$ Base Gate <br> $\mid$ Case Collector Drain $\mathbf{l}\right.$ |  |  |

FIGURE 5. Physical dimensions of T-5 family (Similar to TO-66) - Continued.

| Inches | mm | Inches | mm | Inches | mm |
| :---: | :---: | :---: | :---: | :---: | :---: |
| .040 | 1.02 | .150 | 3.81 | .320 | 8.13 |
| .045 | 1.14 | .155 | 3.94 | .380 | 9.65 |
| .065 | 1.65 | .165 | 4.19 | .400 | 10.16 |
| .070 | 1.78 | .185 | 4.70 | .424 | 10.77 |
| .078 | 1.98 | .189 | 4.80 | .437 | 11.10 |
| .090 | 2.29 | .190 | 4.83 | .455 | 11.56 |
| .110 | 2.79 | .215 | 5.46 | .468 | 11.89 |
| .125 | 3.18 | .250 | 6.35 | .570 | 14.48 |
|  |  | .318 | 8.08 | .763 | 19.38 |

FIGURE 6. Physical dimensions of T-6 family. (Similar to TO-59)

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| Symbol | T-6A |  | T-6B |  | T-6C |  | Note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | \| | |  |  | Max | Min | Max |  |
|  | Min | Max |  |  |  |  |  |
|  | - |  |  |  |  |  |  |
| CD | . 380 |  |  |  |  |  |  |
|  |  | . 437 | . 380 | . 437 | . 380 | . 437 | 9 |
|  |  |  |  |  |  |  |  |
| $\mathrm{CD}_{1}$ | . 318 |  |  |  |  |  |  |
|  |  | . 380 | . 318 | . 380 | . 318 | . 380 |  |
|  |  |  |  |  |  |  |  |
| CH | . 320 |  |  |  |  |  |  |
|  |  | . 468 | . 320 | . 468 | . 320 | . 468 |  |
|  |  |  |  |  |  |  |  |
| HF | . 424 |  |  |  |  |  |  |
|  |  | . 437 | . 424 | . 437 | . 424 | . 437 |  |
|  |  |  |  |  |  |  |  |
| HT | . 090 |  |  |  |  |  |  |
|  |  | . 150 | . 090 | . 150 | . 090 | . 150 |  |
|  |  |  |  |  |  |  |  |
| OAH | . 570 |  |  |  |  |  |  |
|  |  | . 763 | . 570 | . 763 | . 570 | . 763 |  |
|  |  |  |  |  |  |  |  |
| PS | . 185 |  |  |  |  |  |  |
|  |  | . 215 | . 185 | . 215 | \| . 125 | . 165 |  |
|  |  |  |  |  |  |  |  |
| $\mathrm{PS}_{1}$ | . 090 |  |  |  |  |  |  |
|  |  | . 110 | . 090 | . 110 | \| . 090 | . 110 |  |
|  |  |  |  |  |  |  |  |
| SD | .190-32 UNF-2A |  | \|.190-32 UNF-2A |  | \|.190-32 UNF-2A |  |  |
|  |  |  | 6 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| SL | . 400 |  |  |  |  |  |  |  |  |
|  |  | . 455 |  |  | . 400 | . 455 | . 400 | . 455 |  |
|  |  |  |  |  |  |  |  |
| UD | . 155 |  | \| |  |  |  |  |
|  |  | . 189 | \| . 155 | \| 189 | \| . 155 | . 189 |  |
|  |  |  |  |  |  |  |  |
| SU | \| |  |  |  |  |  |  |
|  |  | . 078 | \| | . 078 |  | . 078 |  |
|  | L |  |  |  |  |  |  |
| NT | . 040 |  | \| |  |  |  |  |
|  |  | . 065 | . 040 | \| 065 | . 040 | . 065 |  |
|  |  |  |  |  |  |  |  |
| $\mathrm{NT}_{1}$ | . 045 |  |  |  |  |  |  |
|  |  | . 070 | \| .045 | \| 070 | \| . 045 | . 070 |  |
|  |  |  |  |  |  |  |  |
| $\mathrm{A}_{1}$ | \| |  |  |  |  |  |  |
|  | I | . 250 |  | \| 250 |  | . 250 |  |
|  | 1 |  |  |  | 1 |  |  |
|  | $120^{\circ}$ Nom |  | $90^{\circ} \mathrm{Nom}$ |  | $120^{\circ}$ Nom |  |  |
| B |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Notes | \| |  |  |  |  |  | \| |  |  |
|  | $\begin{aligned} & 1,2,3,4 \\ & 5,7,10,11 \end{aligned}$ |  |  |  | $\begin{aligned} & 1,2,3,4 \\ & 5,8,10 \\ & \hline \end{aligned}$ |  | $\begin{aligned} & 1,2,3,4, \\ & 5,7,10 \end{aligned}$ |  |  |

FIGURE 6. Physical dimensions of T-6 family (Similar to TO-59) - Continued.

## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Terminal three may be flattened and pierced, or hook type.
4. Orientation of terminals in relation to hexagon is not controlled.
5. Chamfer or undercut on one or both ends of hexagon is optional.
6. Threads shall meet the requirements of FED-STD-H28.
7. View 'A' applicable.
8. View 'B' applicable.
9. Symbol $\mathrm{CD}_{1}$ shall not exceed actual HF .
10. Lead designation, depending on device type, shall be as follows:

11. Lead number three is electrically connected to case.

| \| Symbol | T-7A |  | T-7B |  | Note |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |
|  | Min | Max | Min | Max |  |
| CD | \| |  |  |  | 8 |
|  | . 610 | . 687 | \| 610 | . 687 |  |
|  |  |  |  |  |  |
| $C D_{1}$ | . 570 | . 610 | . 570 | . 610 | , |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| CH | . 325 | . 460 | . 325 | . 460 |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| HF | . 667 | . 687 | . 667 | . 687 | 7 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| HT | . 090 | . 150 | . 090 | . 150 | - |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| OAH | . 640 | . 875 | . 640 | . 875 |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| PS | . 340 | . 415 | . 340 | . 415 | 1 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| $\mathrm{PS}_{1}$ |  | . 213 |  | . 213 | \| |
|  | \| . 170 |  | \| 170 |  |  |
|  | 1 |  |  |  |  |
| SD | \|.250-28 UNF-2A |  | \|.250-28 UNF-2A |  | 6 |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| SL | . 422 | . 455 | \| . 422 | . 455 |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| SU | \| | . 090 |  | . 090 |  |
|  | \| |  |  |  |  |
|  | 1 |  |  |  |  |
| NT | . 047 | . 072 | . 047 | . 072 |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| $\mathrm{NT}_{1}$ | . 046 | . 077 | . 046 | . 077 | 1 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| UD | . 220 | . 249 | . 220 | . 249 |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| $\mathrm{A}_{1}$ | \| | . 270 | . 270 |  |  |
|  | \| |  |  |  |  |  |
|  | 1 |  |  |  |  |  |
| Notes | $\begin{aligned} & 1,2,3,4 \\ & 5,9,10 \end{aligned}$ |  | $\begin{aligned} & 1,2,3,4 \\ & 5,9,10 \end{aligned}$ |  | 6 |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |



FIGURE 7. Physical dimensions of T-7 family. (Similar to TO-61)

| Inches | mm | Inches | mm |
| :---: | :---: | :---: | :---: |
| .046 | 1.17 | .325 | 8.26 |
| .047 | 1.19 | .340 | 8.64 |
| .072 | 1.83 | .415 | 10.54 |
| .077 | 1.96 | .422 | 10.72 |
| .090 | 2.29 | .455 | 11.56 |
| .150 | 3.81 | .460 | 11.68 |
| .170 | 4.32 | .570 | 14.48 |
| .213 | 5.41 | .610 | 15.49 |
| .220 | 5.59 | .640 | 16.26 |
| .249 | 6.32 | .667 | 16.94 |
| .250 | 6.35 | .687 | 17.45 |
| .270 | 6.86 | .875 | 22.23 |

## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Terminal three may be flattened and pierced or hook type.
4. Orientation of terminals in relation to hexagon is not controlled.
5. Chamfer or undercut on one or both ends of hexagon is optional.
6. Threads shall meet the requirements of FED-STD-H28.
7. Three places.
8. Symbol CD1 shall not exceed actual HF.
9. Lead designation, depending on device type, shall be as follows:

|  |  |
| :--- | :--- |
| $\left\|\begin{array}{ll}\text { Lead } & \text { Bipolar } \\ \text { number } & \text { transistor } \\ \mid & \mid \\ \hline 1 & \mid \text { Emitter } \\ 2 & \text { Base } \\ 3 & \text { Collector } \\ \hline\end{array}\right\|$ |  |

10. Lead number three is electrically connected to case.

FIGURE 7. Physical dimensions of T-7 family (Similar to TO-61) - Continued.



| Inches | mm | Inches | mm |
| :--- | :--- | :--- | :---: |
| .018 | 0.46 | .265 | 6.73 |
| .060 | 1.52 | .300 | 7.62 |
| .065 | 1.65 | .405 | 10.29 |
| .075 | 1.91 | .422 | 10.72 |
| .078 | 1.98 | .424 | 10.77 |
| .103 | 2.62 | .437 | 11.10 |
| .163 | 4.14 | .453 | 11.51 |
| .175 | 4.45 | .505 | 12.83 |
| .189 | 4.80 | .600 | 15.24 |
| .190 | 4.83 | .800 | 20.32 |
| .250 | 6.35 |  |  |

## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Orientation of terminals in relation to hexagon is not controlled.
4. Chamfer or undercut on one or both ends of hexagon is optional.
5. Threads shall meet the requirements of FED-STD-H28.
6. $\mathrm{CD}_{1}$ shall not exceed HF.

FIGURE 8. Physical dimensions of D-1 family. (Similar to DO-4)


| Inches | mm | \|lnches | mm |
| :--- | :---: | :--- | :---: |
| .030 | 0.76 | $\mid .375$ | 9.53 |
| .080 | 2.03 | $\mid .422$ | 10.72 |
| .090 | 2.29 | $\mid .450$ | 11.43 |
| .115 | 2.92 | $\mid .453$ | 11.51 |
| .140 | 3.56 | $\mid .667$ | 16.94 |
| .175 | 4.45 | $\mid .687$ | 17.45 |
| .200 | 5.08 | $\mid .750$ | 19.05 |
| .220 | 5.59 | $\mid .794$ | 20.17 |
| .249 | 6.32 | $\mid 1.000$ | 25.40 |
| .250 | 6.35 | $\mid$ |  |

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Orientation of terminals in relation to hexagon is not controlled.
4. Chamfer or undercut on one or both ends of hexagon is optional.
5. Threads shall meet the requirements of FED-STD-H28.
6. $\quad \mathrm{CD}_{1}$ shall not exceed HF.

FIGURE 9. Physical dimensions of D-2 family. (Similar to DO-5)


NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Symbol BD shall be measured at the largest diameter.
4. Within $L_{1}$ lead diameter may vary to allow for flash, lead finish build-up, and minor irregularities other than heat slugs.

FIGURE 10. Physical dimensions of D-3 family. (Similar to DO-7, DO-41, DO-35)


| Inches | mm | Inches | mm | Inches | mm | $\mid$ Inches | mm |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| .050 | 1.27 | .310 | 7.87 | .645 | 16.38 | $\mid 1.250$ | 31.75 |
| .063 | 1.60 | .312 | 7.92 | .650 | 16.51 | 1.443 | 36.65 |
| .100 | 2.54 | .350 | 8.89 | .660 | 16.76 | 1.460 | 37.08 |
| .105 | 2.67 | .374 | 9.50 | .735 | 18.67 | 1.647 | 41.83 |
| .110 | 2.79 | .375 | 9.53 | .749 | 19.02 | 1.688 | 42.88 |
| .125 | 3.18 | .395 | 10.03 | .750 | 19.05 | 1.949 | 49.50 |
| .156 | 3.96 | .420 | 10.67 | .755 | 19.18 | $\mid 2.500$ | 63.50 |
| .172 | 4.37 | .425 | 10.80 | .793 | 20.14 | $\mid 3.250$ | 82.55 |
| .187 | 4.75 | .437 | 11.10 | .828 | 21.03 | $\mid 3.50$ | 88.90 |
| .230 | 5.84 | .499 | 12.67 | 1.000 | 25.40 | 3.875 | 98.42 |
| .250 | 6.35 | .500 | 12.70 | 1.031 | 26.19 | 4.185 | 106.30 |
| .265 | 6.73 | .520 | 13.21 | 1.063 | 27.00 | $\mid 5.000$ | 127.00 |
| .270 | 6.86 | .530 | 13.46 | 1.100 | 27.94 | $\mid 5.150$ | 130.81 |
| .300 | 7.62 | .605 | 15.37 | 1.212 | 30.78 | 6.000 | 152.40 |
|  |  | .630 | 16.00 | 1.227 | 31.17 | 9.457 | 240.21 |
|  |  |  |  |  |  | 9.70 | 246.4 |

FIGURE 11. Physical dimensions of D-4 family. (Similar to DO-8, DO-9, DO-30)

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| \| | Variations (all dimensions shown in inches) |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| \| | D-4AA |  | \| | D-4AB |  | \|Note | D-4AC |  | \|Note | D-4AD |  | $\begin{aligned} & \hline \text { I } \\ & \text { _Note } \end{aligned}$ |
| \|Symbol |  |  | \|Note |  |  |  |  |  |  |  |  |  |
| \| |  | \| | \| |  |  | \| |  |  | \| |  |  |  |
| \| | \| Min | Max | 1 | \| Min | \| Max | 1 | \| Min | \| Max | 1 | \| Min | \| Max | \| |
|  | \| |  | \| | \| |  | \| |  |  |  |  |  |  |
| CH | 1 | 12.500 | 14 | 1 | 13.250 | 14 | I | 12.500 | 14 | 1 | 13.50 | 4 |
|  | \| |  |  | \| |  |  |  |  | \| |  |  | \| |
| IFW | 1.437 | 1.650 | 17 | 1.530 | 1.755 | 15 | 1.437 | 1.650 | 17 | 1.735 | 11.000 |  |
|  | , | \| | \| | \| |  | \| |  | \| | \| |  |  | , |
| \| HF | 11.031 | 11.063 | 1 | 11.212 | 11.250 | 1 | 11.031 | \|1.063 | 1 | 11.647 | 11.688 | 1 |
| \| |  |  | , |  |  | \| | , |  | \| | , |  |  |
| \| HT | 1.125 | 1.500 | 15 | 1.250 | 1.630 | 14 | 1.187 | 1.500 | 14 | 1 | 1.630 | 15 |
|  |  |  | \| |  |  | \| |  |  | \| |  |  |  |
| OAL | 13.875 | 15.150 | 1 | 15.000 | 16.000 | 1 | 14.185 | 15.150 | 1 | 19.457 | 19.70 | L |
|  |  | \| | \| |  |  | \| |  | \| | \| |  | \| |  |
| \|S | 1.300 |  | 18 | 1.375 |  | 18 | 1.312 | 1 | 18 | 1.520 | 1 | 8 |
| SD | \|.375-2 | UNF-2A | 19 | 1.750-16 | UNF-2A | 19 | 1.500-20 | UNF-2A | 19 | 1.750-16 | UNF-2A |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{S}_{1}$ | \| 270 | \| | 18 | \| 300 | \| | 18 | \| 270 | \| | 18 | \| 300 |  | 8 |
| + | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|  |  |  | \| |  |  | \| | \| |  | \| |  |  |  |
| \| SL | 1.605 | 1.645 | 1 | 1.793 | 1.828 | L | I | 1.828 | I | 11.00 | 11.100 | 4 |
|  | \| | \| | \| | \| |  | \| | \| |  | , |  |  |  |
| \|SU | 1 | 1.105 | 1 | 1 | 1.156 | 1 | 1.605 | 1.125 | I |  | 1.156 |  |
|  | , |  | \| |  |  | \| |  |  | , |  |  | \| |
| UD | 1.312 | 1.374 | 1 | 1.660 | 1.749 | , | 1.425 | 1.499 | , | 1.660 | 1.750 | L |
|  | , |  | \| | \| |  | \| | \| |  | \| |  |  | \| |
| \|c | 1.050 | 1.110 | 1 | 1.063 | 1.172 | 1 | 1.050 | 1.110 |  | 1.100 | 1.230 |  |
|  | , |  | \| | , |  |  | \| |  | , | \| |  | \| |
| 1 CD | 1 | 11.063 | 14 | , | 11.250 |  | 1 | 11.063 | 14 | 1 | 11.460 | 1 |
|  | \| |  | \| | \| |  | \| | \| |  | \| | \| |  | \| |
| \| $\mathrm{CD}_{1}$ | I | \|1.227 | \| | \| | \|1.443 | \| | \| | \|1.227 | \| | \| | $\mid 1.949$ | \| |
|  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|  |  |  | \| |  |  | \| | \| |  | \| |  |  | \| |
| NT | 1.250 | 1.310 | 1 | 1.265 | 1.350 | 1 | 1.250 | 1.310 | 1 | 1.395 | 1.420 | L |
| \| Note | \| | 1, 2, 5, 7 | 1 |  | 1, 2, 5, 7 | । | 1, 2, 5, 7 |  |  | \| | 1,2,5 |  |

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are for general information only.
3. Dimensioning and tolerancing in accordance with ANSI Y14.5M-1982.
4. The body of the device with the exception of the hexagon and flexible lead extensions lies within cylinder defined by $\mathrm{CD}_{1}$ and $\mathrm{CH}, \mathrm{CD}_{1}$ not to exceed actual HF.
5. Chamfer or undercut on one or both ends of hexagonal base is optional.
6. Flexible lead.
7. Contour and orientation of terminal lug are optional. Square or radius on end of terminal is optional.
8. Minimum flat.
9. Symbol SD is pitch diameter of coated threads, reference: Unified screw threads, ANSI B1.1-1982.

FIGURE 11. Physical dimensions of D-4 family (Similar to DO-8, DO-9, DO-30) - Continued.

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| Inches | mm | Inches | mm |
| :---: | :---: | :--- | :--- |
| .035 | 0.89 | .535 | 13.59 |
| .040 | 1.02 | .545 | 13.84 |
| .045 | 1.14 | .665 | 16.89 |
| .050 | 1.27 | .685 | 17.40 |
| .139 | 3.53 | .790 | 20.07 |
| .149 | 3.78 | .800 | 20.32 |
| .150 | 3.81 | 1.195 | 30.35 |
| .249 | 6.32 | 1.235 | 31.37 |
| .260 | 6.60 |  |  |

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimensioning and tolerancing in accordance with ANSI Y14.5M-1982.
4. Methods used for electrical isolation of the terminals feedthroughs shall employ materials that contain a minimum of 90 percent $\mathrm{AL}_{2} \mathrm{O}_{3}$ (ceramic).

FIGURE 12. Physical dimensions of TO-254.

$\left.\begin{array}{ll|ll}\text { Inches } & \mathrm{mm} & \text { Inches } & \mathrm{mm} \\ .025 & 0.64 & & .410\end{array}\right) 10.41$

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Methods used for electrical isolation of the terminals feedthroughs shall employ materials that contain a minimum of 90 percent $\mathrm{AL}_{2} \mathrm{O}_{3}$ (ceramic).

FIGURE 13. Physical dimensions of TO-257.


| Inches mm |  |  | $\mid$ Inches mm |  |
| :--- | :--- | :--- | :--- | :---: |
| .035 | 0.89 | .530 | 13.46 |  |
| .045 | 1.14 | .550 | 13.97 |  |
| .055 | 1.40 | .685 | 17.40 |  |
| .065 | 1.65 | .695 | 17.65 |  |
| .155 | 3.94 | .697 | 17.70 |  |
| .165 | 4.19 | .707 | 17.96 |  |
| .200 | 5.08 | .750 | 19.05 |  |
| .240 | 6.10 | .815 | 20.70 |  |
| .270 | 6.86 | .835 | 21.21 |  |
| .500 | 12.70 |  |  |  |

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Methods used for electrical isolation of the terminals feedthroughs shall employ materials that contain a minimum of 90 percent $\mathrm{AL}_{2} \mathrm{O}_{3}$ (ceramic).

FIGURE 14. Physical dimensions of TO-258.


NOTES:

1. Dimensions are in inches.
2. Metric equivalents are for general information only.
3. Dimensions are pre-solder dip.
4. Minimum clearance of glass body to mounting surface on all orientations.

FIGURE 15. Physical dimensions of D5 surface mount family, square end surface mount.


| \| Symbol | Dimensions |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | \| |  |  |  | \| |  |  |  |
|  | DO-213AA |  |  |  | DO-213AB |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | \| Inches |  | \| Millimeters |  | Inches |  | \| Millimeters |  |
|  | Min | Max | Min | Max | \| Min | Max |  | Max |
|  |  |  |  |  |  |  |  |  |
| BL | 1.130 | 1.146 | 3.30 | 3.70 | 1.189 | 1.205 | 4.80 | 5.20 |
|  | \| |  |  |  |  |  |  |  |
| \| BD | 1.063 | 1.067 | 1.60 | 11.70 | 1.094 | 1.105 | 2.39 | 2.66 |
| E ECT | 1.016 | 1.022 | 0.41 | 10.55 | 1.016 | 1.022 | 0.41 | 10.55 |
| \|S | . .001 min |  | 0.03 min |  | 1.001 min |  | 0.03 min |  |

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimensions are pre-solder dip.
4. Minimum clearance of glass body to mounting surface on all orientations.

FIGURE 16. Physical dimensions of DO-213 family, round end surface mount.


| Inches | mm | Inches mm |  |
| :---: | :---: | :---: | :---: |
| .016 | 0.41 | .071 | 1.80 |
| .017 | 0.43 | .078 | 1.98 |
| .023 | 0.58 | .085 | 2.16 |
| .024 | 0.61 | .105 | 2.67 |
| .036 | 0.91 | .115 | 2.92 |
| .046 | 1.17 | .125 | 3.18 |
| .054 | 1.37 |  |  |

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

FIGURE 17. Physical dimensions, surface mount C-3.

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NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The coplanarity deviation of all terminal contact points, as defined by the device seating plane, shall not exceed .006 inch $(0.15 \mathrm{~mm})$ for solder dipped leadless chip carriers.

FIGURE 18. Physical dimensions of surface mount C-4.


NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The coplanarity deviation of all terminal contact points, as defined by the device seating plane, shall not exceed .006 inch ( 0.15 mm ) for solder dipped leadless chip carriers.

FIGURE 19. Physical dimensions of surface mount C-6.

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5. Notes. Not applicable.

## CONCLUDING MATERIAL

| Custodians: | Preparing activity: |
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| Army - CR | DLA-CC |
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| Air Force -17 |  |
| NASA-NA |  |
| Review activities: |  |
| Army - AR, MI, SM |  |
| Navy - AS, CG, MC, OS, SH |  |
| Air Force -19, 85, 99 | (Project 5961-1914) |

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