

# Transistors

## silicon low/medium power switching transistors

book 1 parts 1 and 2

| Type No.                     | Outline | Drawing reference | V <sub>CB0</sub><br>(V) | V <sub>CEO</sub><br>(V) | Maximum Ratings         |                            |                        | T <sub>j</sub><br>(°C) | P <sub>tot</sub><br>at 25°C<br>(mW) | hFE  |      | f <sub>t</sub><br>(MHz) | V <sub>CE(sat)</sub> |      | I <sub>C</sub> at I <sub>B</sub> |   | Special Features                |                                  |                           |
|------------------------------|---------|-------------------|-------------------------|-------------------------|-------------------------|----------------------------|------------------------|------------------------|-------------------------------------|------|------|-------------------------|----------------------|------|----------------------------------|---|---------------------------------|----------------------------------|---------------------------|
|                              |         |                   |                         |                         | I <sub>CM</sub><br>(mA) | I <sub>C(AV)</sub><br>(mA) | I <sub>C</sub><br>(mA) |                        |                                     | min. | max. |                         | min.                 | max. | I <sub>C</sub><br>(mA)           | I <sub>B</sub><br>(mA)  | t <sub>on</sub><br>max.<br>(ns) | t <sub>off</sub><br>max.<br>(ns) | at I <sub>C</sub><br>(mA) |
| <b>N-P-N SWITCHING TYPES</b> |         |                   |                         |                         |                         |                            |                        |                        |                                     |      |      |                         |                      |      |                                  |   |                                 |                                  |                           |
| BSS38                        | TO-92   | BB1               | 120                     | 100                     | 250                     | 100                        | 150                    | 300                    | 20                                  | —    | 4.0  | 60                      | 0.7                  | 4    | 0.4                              | —   | 1000                            | 15                               |                           |
| BSW41A                       | TO-18   | AT1               | 40                      | 25                      | 500                     | 300                        | 200                    | 350                    | 30                                  | —    | 10   | 150                     | 0.7                  | 500  | 35                               | 50  | 110                             | 300                              |                           |
| BSX19                        | TO-18   | AT1               | 40                      | 15                      | 500                     | —                          | 200                    | 360                    | 20                                  | 60   | 10   | 400                     | 0.3                  | 10   | 0.6                              | 12  | 15                              | 10                               |                           |
| BSX20                        |         |                   |                         |                         |                         |                            |                        |                        | 40                                  | 120  | 10   | 500                     | 0.3                  | 10   | 0.3                              | 12  | 18                              | 10                               |                           |
| BSX21                        | TO-18   | AT1               | 120                     | 80                      | 250                     | 100                        | 175                    | 300                    | 20                                  | —    | 4.0  | 60                      | 0.7                  | 4    | 0.4                              | Numerical indicator tube driver                                   |                                 |                                  |                           |
| BSY95A                       | TO-18   | AT1               | 20                      | 15                      | 200                     | 100                        | 175                    | 300                    | 50                                  | 200  | 10   | 200                     | 0.35                 | 10   | 0.2                              | t <sub>s</sub> < 50ns at 10mA                                     |                                 |                                  |                           |
| 2N2369                       | TO-18   | AT1               | 40                      | 15                      | 500                     | —                          | 200                    | 360                    | 40                                  | 120  | 10   | 500                     | 0.25                 | 10   | 1.0                              | 12  | 18                              | 10                               |                           |
| 2N2369A                      |         |                   |                         |                         |                         |                            |                        |                        | 40                                  | 120  | 10   | 500                     | 0.20                 | 10   | 1.0                              |   |                                 |                                  |                           |
| BFX34                        | TO-39   | AV3               | 120                     | 60                      | 5A                      | 2A                         | 200                    | 870                    | 40                                  | 150  | 2A   | 70                      | 1.0                  | 5A   | 500                              | 600   | 1200                            | 5A                               |                           |
| BSV64                        | TO-39   | AV3               | 100                     | 60                      | 5.0A                    | 2.0A                       | 200                    | 870                    | 40                                  | —    | 2A   | 100*                    | 1.0                  | 5A   | 500                              | 600   | 1200                            | 5A                               |                           |
| BSW66                        | TO-39   | AV3               | 100                     | 100                     | 2.0A                    | 1.0A                       | 200                    | 800                    | 40                                  | —    | 100  | 80*                     | 0.4                  | 500  | 50                               | For relays and other highly inductive load switching applications |                                 |                                  |                           |
| BSW67                        |         |                   | 120                     | 120                     |                         |                            |                        |                        |                                     |      |      | 0.4                     | 500                  | 50   |                                  |   |                                 |                                  |                           |
| BSW68                        |         |                   | 150                     | 150                     |                         |                            |                        |                        |                                     |      |      | 0.5                     | 500                  | 50   |                                  |   |                                 |                                  |                           |
| BSX59                        | TO-39   | AV3               | 70                      | 45                      | —                       | 1.0A                       | 200                    | 800                    | 25                                  | —    | 500  | 250                     | 0.3                  | 150  | 15                               | 35  | 60                              | 500                              |                           |
| BSX61                        |         |                   |                         |                         |                         |                            |                        |                        | 25                                  | —    | 500  | 250                     | 0.5                  | 150  | 15                               | 50  | 100                             | 500                              |                           |
| <b>P-N-P SWITCHING TYPES</b> |         |                   |                         |                         |                         |                            |                        |                        |                                     |      |      |                         |                      |      |                                  |   |                                 |                                  |                           |
| BSS68                        | TO-92   | BB1               | -110                    | -100                    | —                       | 100                        | 150                    | 300                    | 30                                  | —    | 25   | 50                      | -0.25                | 25   | 2.5                              | intended for anode switching of numerical indicator tubes         |                                 |                                  |                           |
| 2N2904                       | TO-39   | AV3               | -60                     | -40                     | —                       | 600                        | 200                    | 600                    | 40                                  | 120  | 150  | 200                     | -0.4                 | 150  | 15                               | 45  | 100                             | 150                              |                           |
| 2N2904A                      |         |                   | -60                     | -60                     |                         |                            |                        |                        |                                     |      |      |                         |                      |      |                                  |   |                                 |                                  |                           |
| 2N2905                       | TO-39   | AV3               | -60                     | -40                     | —                       | 600                        | 200                    | 600                    | 100                                 | 300  | 150  | 200                     | -0.4                 | 150  | 15                               | 45  | 100                             | 150                              |                           |
| 2N2905A                      |         |                   | -60                     | -60                     |                         |                            |                        |                        |                                     |      |      |                         |                      |      |                                  |   |                                 |                                  |                           |
| 2N2906                       | TO-18   | AT1               | -60                     | -40                     | —                       | 600                        | 200                    | 400                    | 40                                  | 120  | 150  | 200                     | -0.4                 | 150  | 15                               | 45  | 100                             | 150                              |                           |
| 2N2906A                      |         |                   | -60                     | -60                     |                         |                            |                        |                        |                                     |      |      |                         |                      |      |                                  |   |                                 |                                  |                           |
| 2N2907                       | TO-18   | AT1               | -60                     | -40                     | —                       | 600                        | 200                    | 400                    | 100                                 | 300  | 150  | 200                     | -0.4                 | 150  | 15                               | 45  | 100                             | 150                              |                           |
| 2N2907A                      |         |                   | -60                     | -60                     |                         |                            |                        |                        |                                     |      |      |                         |                      |      |                                  |   |                                 |                                  |                           |

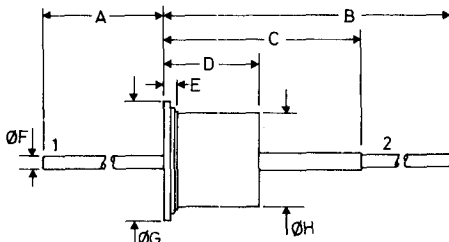
\*Typical

# OUTLINES and DIMENSIONS (millimetres)

**A**

B.S.3934 SO-16

DO-1  
DO-2  
DO-3

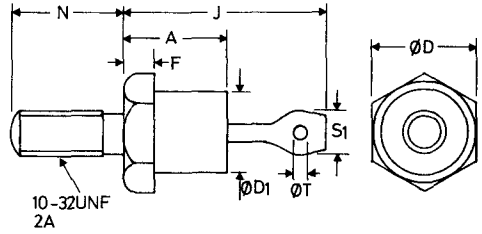


|    | 1    | 2    | A    | B    | C    | D    | E    | ØF   | ØG   | ØH   |
|----|------|------|------|------|------|------|------|------|------|------|
|    | min. | min. | min. | min. | min. | max. | max. | max. | max. | max. |
| A1 | a    | k    | 35   | 51   | 17   | 7.7  | 1.6  | 1.1  | 9.6  | 7.1  |
| A2 | k    | a    | 35   | 49   | 17   | 8.5  | 1.9  | 1.1  | 9.7  | 7.1  |
| A3 | k    | a    | 35   | 51   | 17   | 7.7  | 1.6  | 1.1  | 9.6  | 7.1  |

**B**

B.S.3934 SO-10

DO-4



A 10.3 max.  
ØD 11.1 max.  
ØD1 9.3 max.  
F 3.2

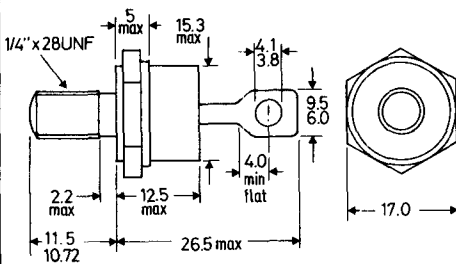
J 20.3 max.  
N 11.5 max.  
S1 4.8 max.  
ØT 1.6 min.

|    | Stud | Eyelet |
|----|------|--------|
| B1 | k    | a      |
| B2 | a    | k      |

**C**

B.S.3934 SO-13

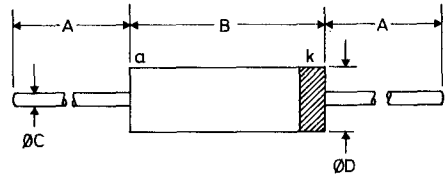
DO-5



|    | Stud | Eyelet |
|----|------|--------|
| C1 | k    | a      |
| C2 | a    | k      |

**D**

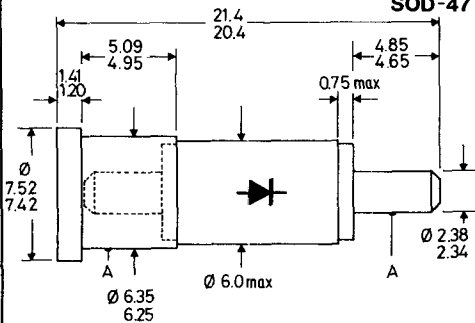
DO-7  
DO-14  
DO-15



|    |       | A    | B    | ØC   | ØD   |
|----|-------|------|------|------|------|
|    |       | min. | max. | nom. | max. |
| D1 | DO-7  | 25.4 | 7.6  | 0.52 | 2.5  |
| D2 | DO-14 | 25.4 | 7.6  | 0.5  | 3.3  |
| D3 | DO-15 | 25.4 | 6.4  | 0.8  | 3.2  |

**E**

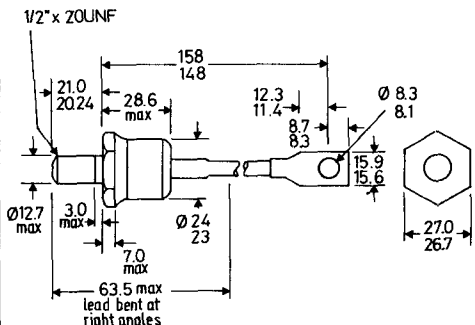
DO-22  
SOD-47



A = concentricity tolerance = ± 0.20

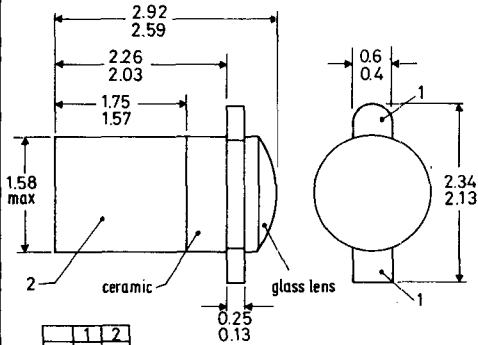
**F**

DO-30



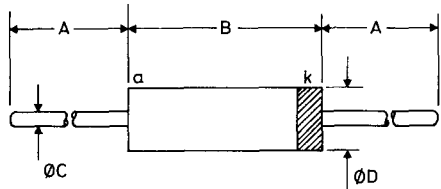
BZW86 Blue sleeve - anode to eyelet  
BZW86R Red sleeve - anode to stud

These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

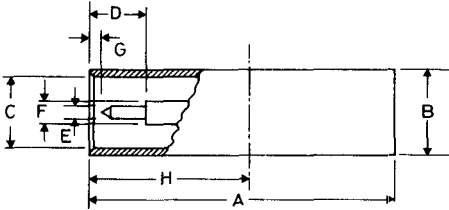
**G****DO-31**

|    |   |   |
|----|---|---|
|    | 1 | 2 |
| G1 | k | a |
| G2 | e | c |

For LED's the overall length = 3.60/2.97

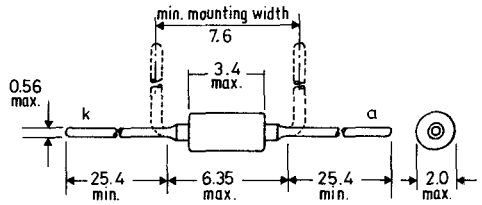
**H****DO-35**

| A    | B    | ØC   | ØD   |
|------|------|------|------|
| min. | max. | max. | max. |
| 25.4 | 4.25 | 0.56 | 1.85 |

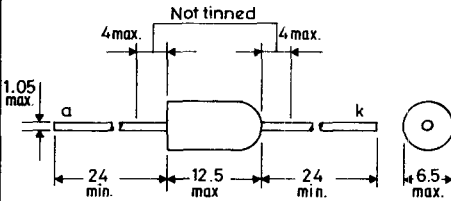
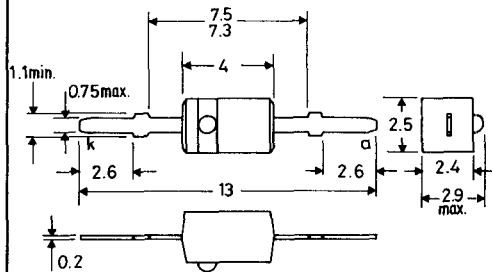
**J****DO-37  
SOD-49**

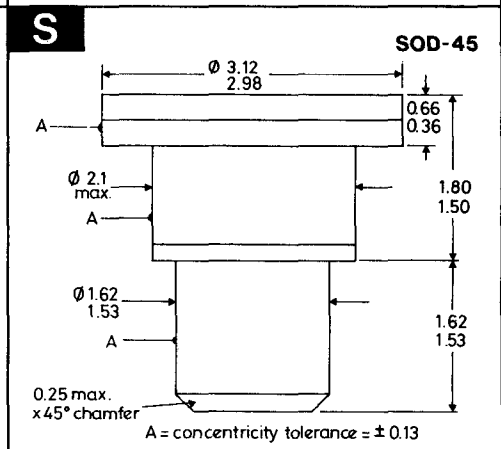
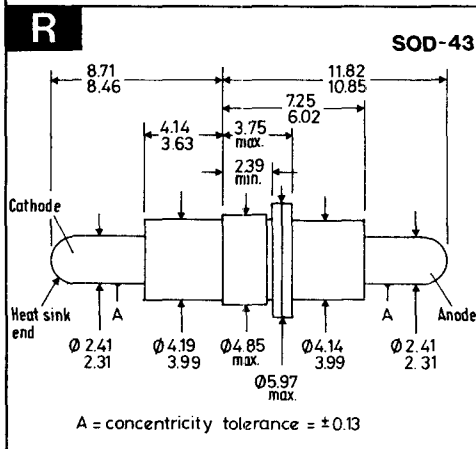
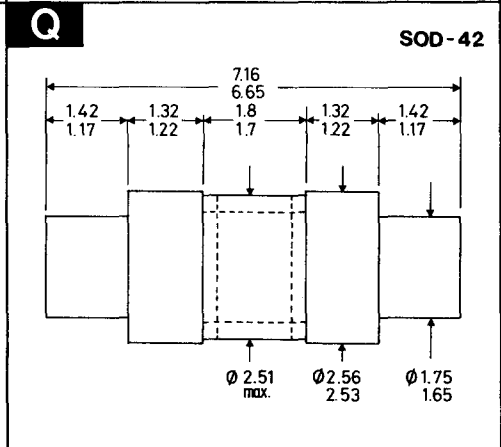
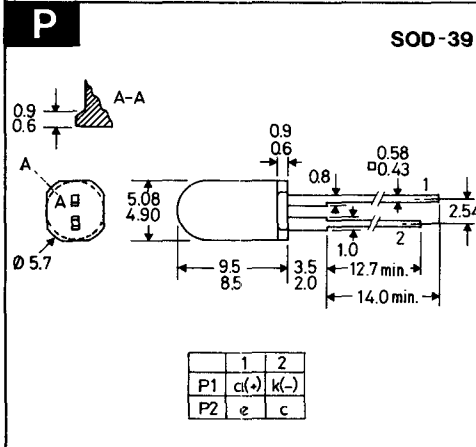
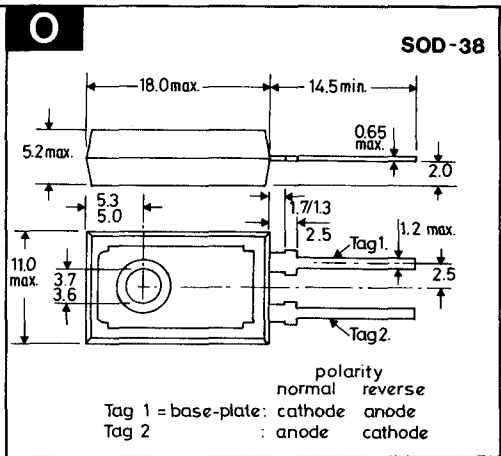
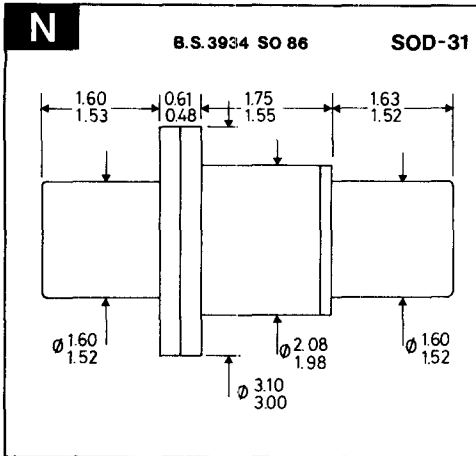
|     |             |    |            |
|-----|-------------|----|------------|
| A   | 19.43/18.67 | ØE | 0.84/0.79  |
| ØB* | 5.59/5.49   | ØF | 1.57/1.52  |
| ØC  | 4.80/4.72   | G  | 0.71/0.15  |
| D   | 3.73 min.   | H  | 10.32 nom. |

\*These tolerances apply only over H

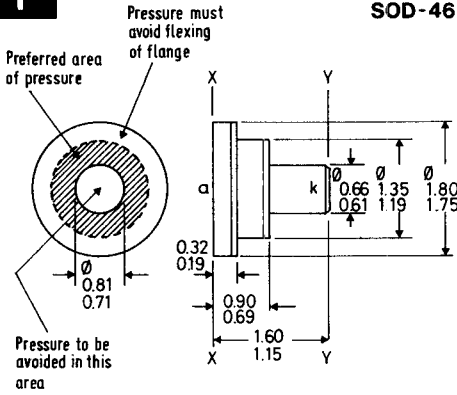
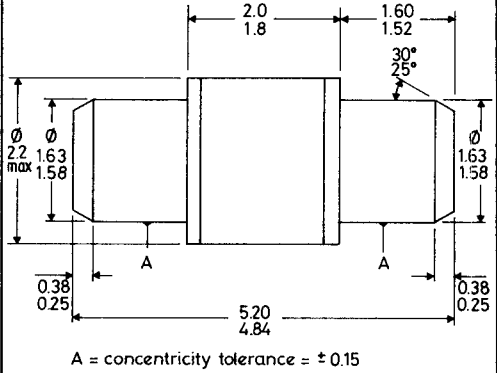
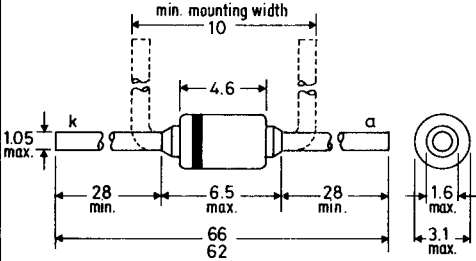
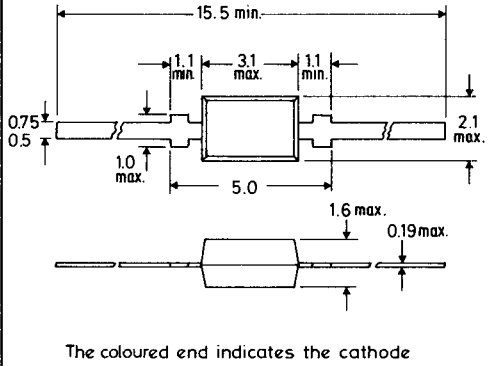
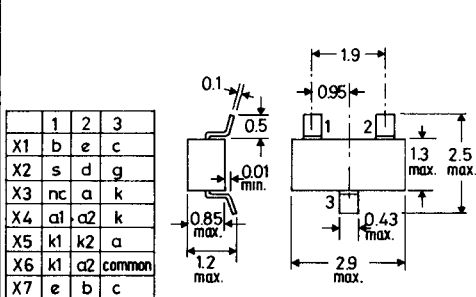
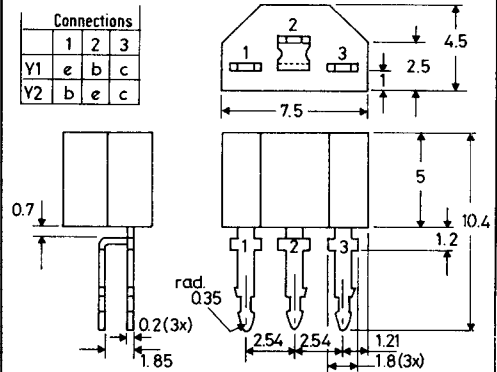
**K****SOD-17**

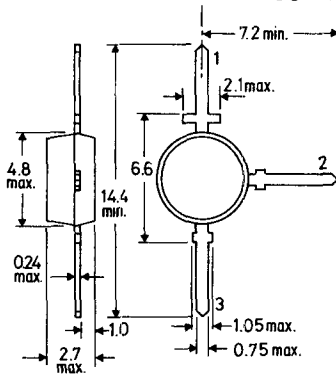
Cathode indicated by the broad band of colour code

**L****SOD-18****M****SOD-23**

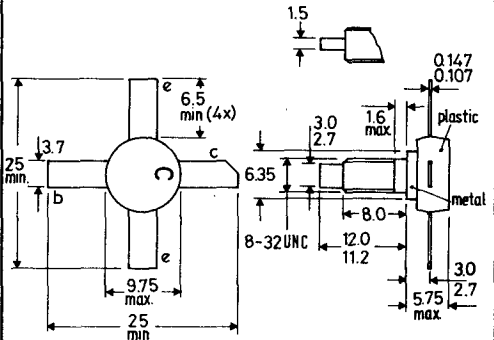
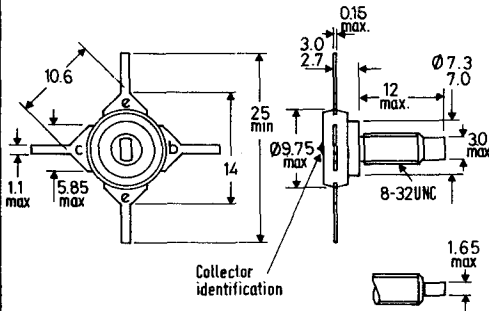
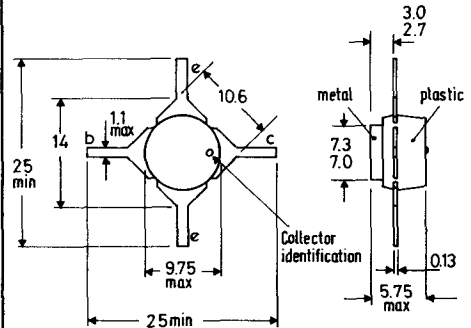
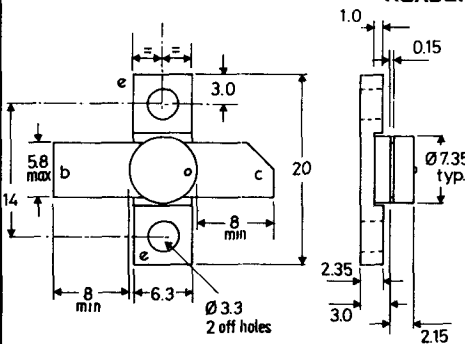
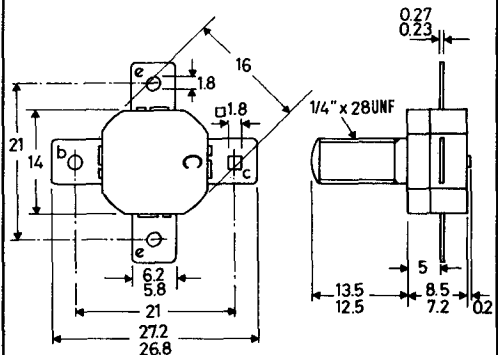


These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

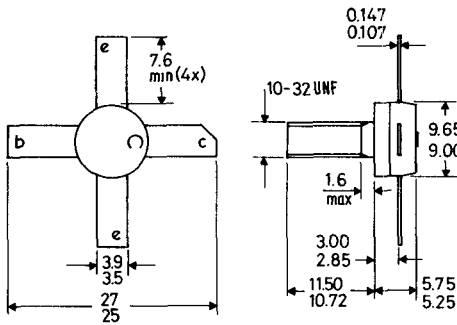
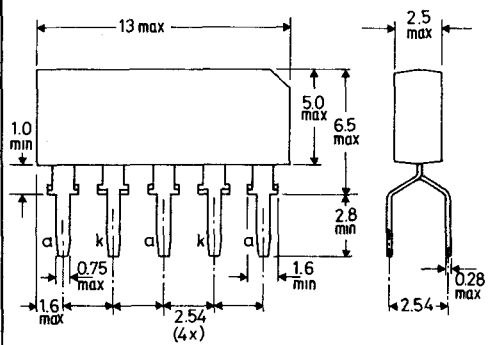
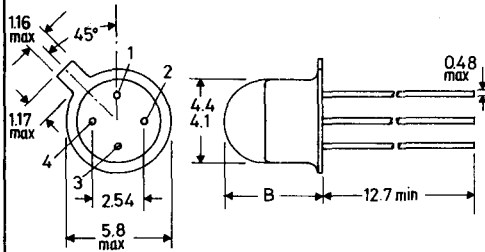
**T****SOD-46****U****SOD-50****V****SOD-51****W****SOD-52****X****SOT-23****Y****SOT-25**

**Z****SOT-37**

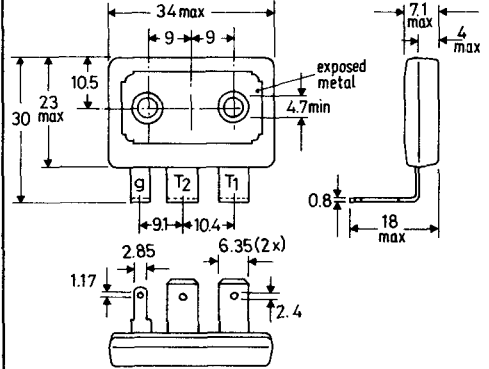
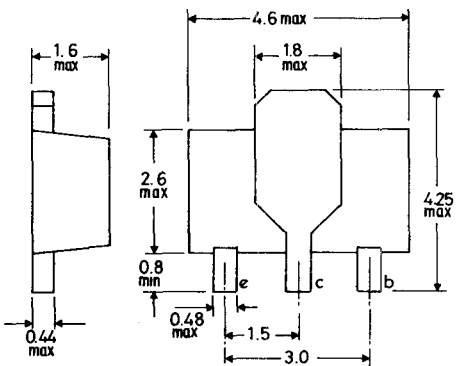
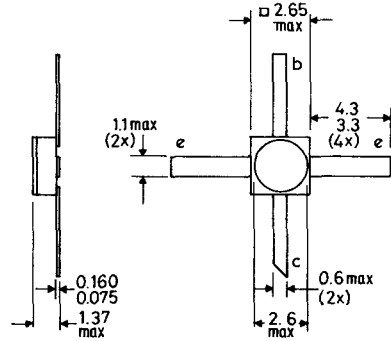
|    |   |   |   |
|----|---|---|---|
|    | 1 | 2 | 3 |
| Z1 | c | b | e |
| Z2 | c | e | b |

**AC****SOT-48/2****AD****SOT-48/3****AE****SOT-48/4****AF****SOT-48  
HEADER****AG****SOT-55**

These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

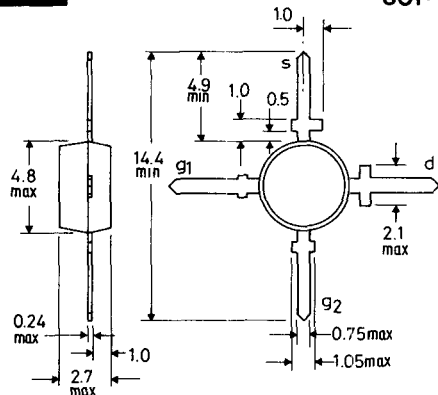
**AH****SOT-56****AJ****SOT-60****AK****SOT-70**

|     | 1  | 2  | 3   | 4  | B max |
|-----|----|----|-----|----|-------|
| AK1 | a  | -  | k   | -  | 5.08  |
| AK2 | e  | b  | c   | -  | 4.5   |
| AK3 | Vp | IP | GND | OP | 5.08  |

**AL****SOT-80****AM****SOT-89****AN****SOT-100**

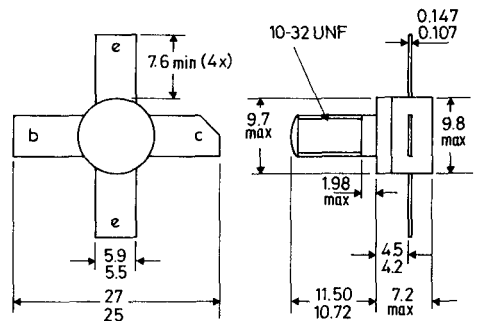
# AO

SOT-103



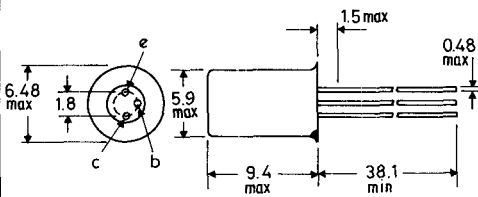
# AP

SOT-105



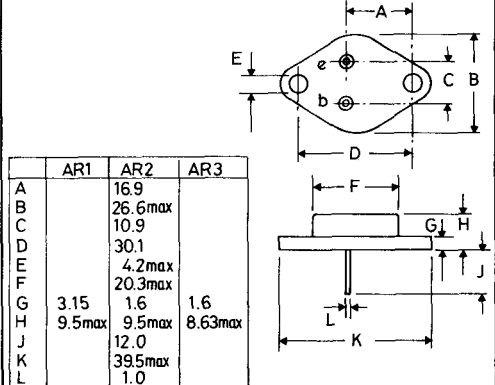
# AQ

B.S.3934 SO-21/SB3-10 TO-1



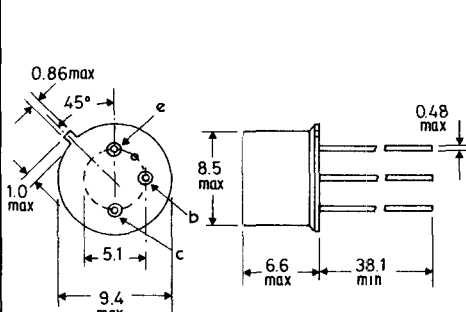
# AR

B.S.3934 SO-5B/SB2-2 TO-3



# AS

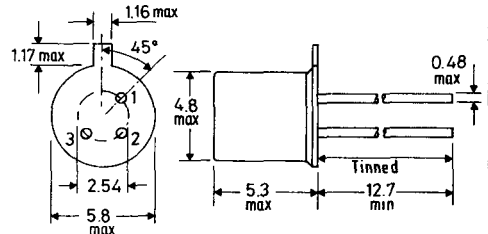
B.S.3934 SO-3/SB3-3B TO-5



AS1: collector connected to case  
AS2: base connected to case

# AT

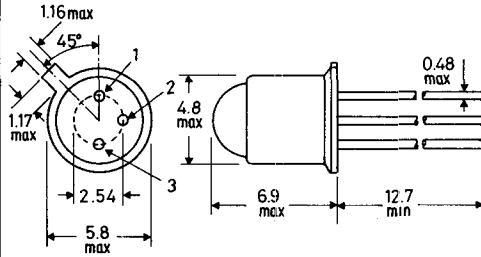
B.S.3934 SO-12A/SB3-6A TO-18



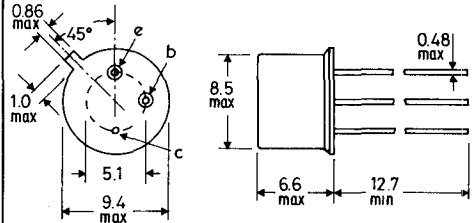
|     | 1 | 2 | 3        |
|-----|---|---|----------|
| AT1 | e | b | c + env. |
| AT2 | s | d | g + env. |
| AT3 | d | g | s + env. |
| AT4 | k | - | a        |
| AT5 | a | - | k        |
| AT6 | k | - | a        |

These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.



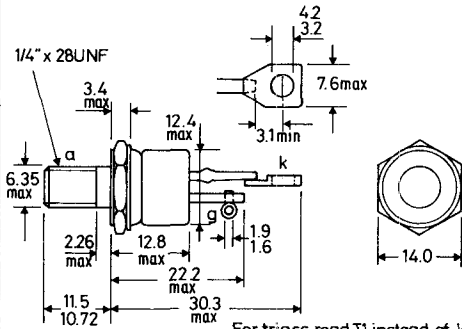
**AU****TO-18**  
(with lens)

|     |   |   |        |
|-----|---|---|--------|
|     | 1 | 2 | 3      |
| AU1 | a | a | k      |
| AU2 | e | b | c+case |
| AU3 | k | - | a      |

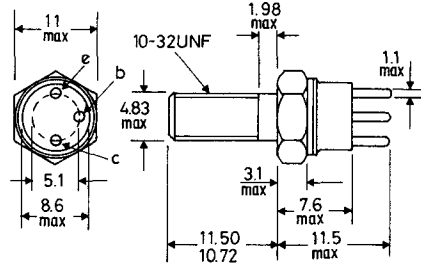
**AV****B.S.3934 SO-3/SB3-3A TO-39**

AV1: b+case  
 AV2: case isolated  
 AV3: c+case  
 AV4: e.cathode  
       b.gate  
       c.anode+case

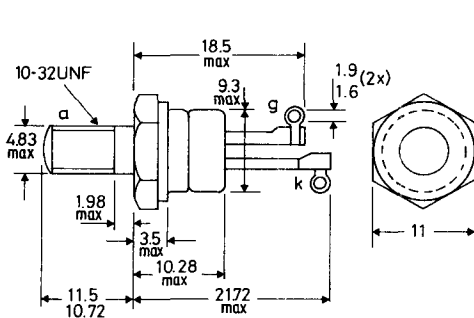
AV5: e.b. cell connections  
 c. metal case  
 AV6: red spot indicates  
       +ve connection

**AW****B.S.3932 SO-36 TO-48**

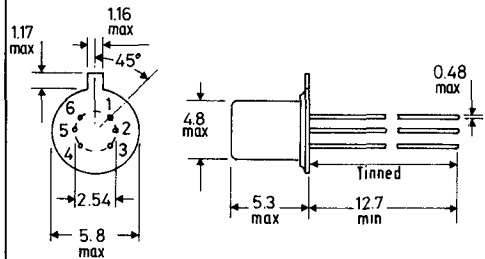
For triacs read T1 instead of k  
 T2 instead of a

**AX****TO-60**

Emitter connected to envelope

**AY****B.S.3934 SO-35A TO-64**

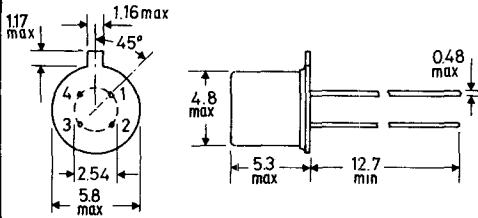
For triacs read T1 instead of k  
 T2 instead of a

**AZ****TO-71**

|     |    |    |    |    |    |    |
|-----|----|----|----|----|----|----|
| Pin | 1  | 2  | 3  | 4  | 5  | 6  |
| AZ1 | e1 | e2 | c2 | b2 | b1 | c1 |
| AZ2 | s1 | d1 | g1 | s2 | d2 | g2 |

**BA**

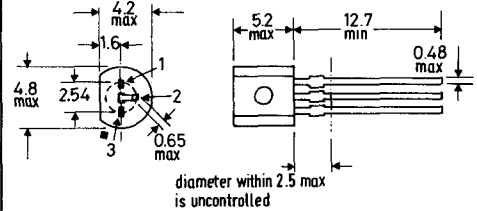
B.S.3934 SO-12A/SB4-3 TO-72



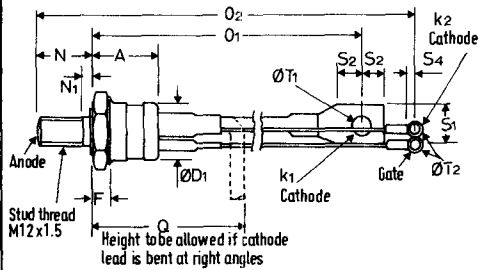
|     | 1 | 2  | 3  | 4               |
|-----|---|----|----|-----------------|
| BA1 | b | e  | c  | s+envelope      |
| BA2 | e | b  | c  | s+envelope      |
| BA3 | s | d  | g  | screen+envelope |
| BA4 | d | g  | g  | s+b+envelope    |
| BA5 | d | s  | g  | b+envelope      |
| BA6 | k | gk | ga | a               |

**BB**TO-92  
variant

| Pin | 1 | 2 | 3 |
|-----|---|---|---|
| BB1 | e | b | c |
| BB2 | b | e | c |
| BB3 | d | s | g |
| BB4 | g | a | k |
| BB5 | b | c | e |

**BC**

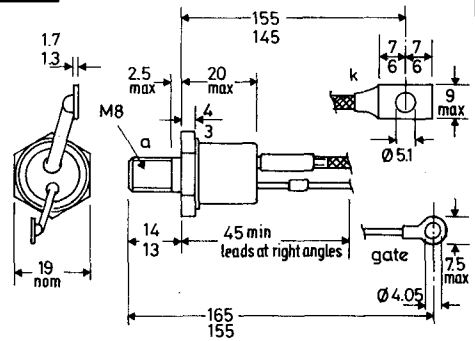
B.S.3934 SO-30C TO-94



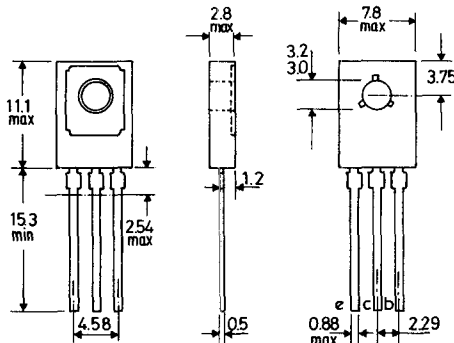
|     |         |    |         |     |         |
|-----|---------|----|---------|-----|---------|
| A   | 28.5max | O1 | 158 max | S4  | 3.8 min |
| ØD1 | 24.1max | O2 | 190max  | ØT1 | 8.3max  |
| F   | 8.9max  | Q  | 63.5max | ØT2 | 4.2max  |
| N   | 21.0max | S1 | 16.5max |     |         |
| N1  | 3.0max  | S2 | 9.6min  |     |         |

**BD**

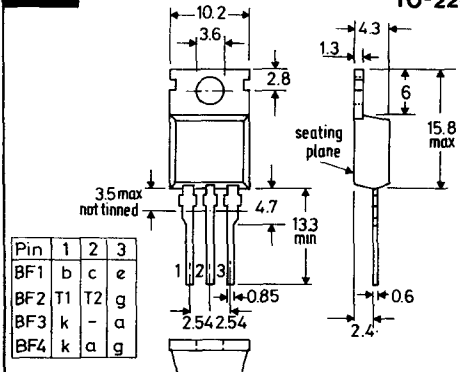
TO-103

For triacs read T1 instead of k  
T2 instead of a**BE**

TO-126

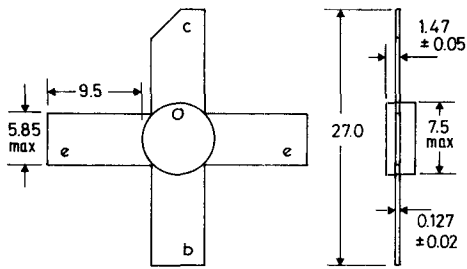
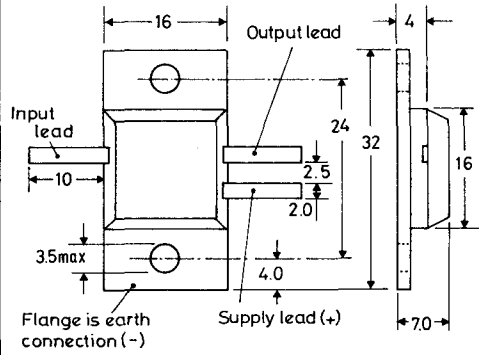
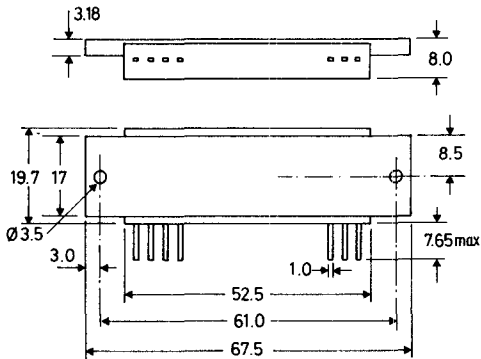
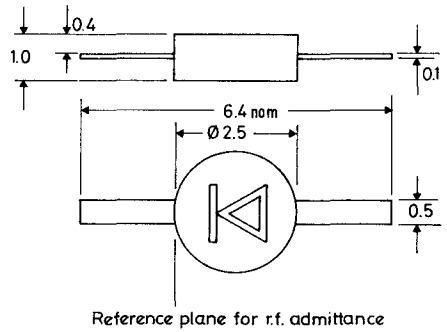
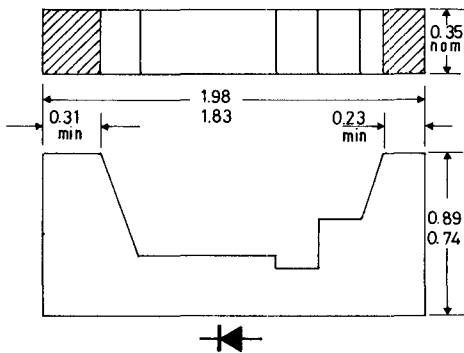
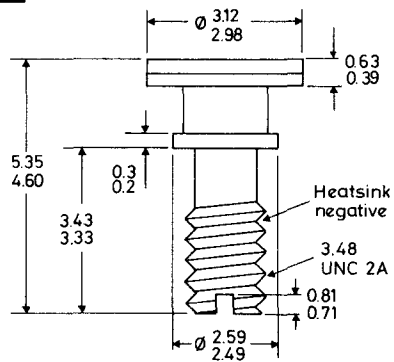
**BF**

TO-220



| Pin | 1  | 2  | 3 |
|-----|----|----|---|
| BF1 | b  | c  | e |
| BF2 | T1 | T2 | g |
| BF3 | k  | -  | a |
| BF4 | k  | a  | g |

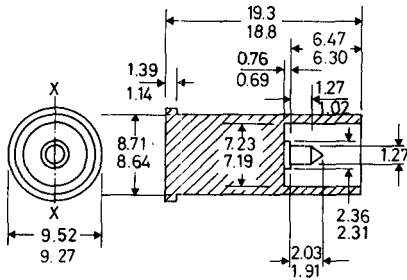
These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

**BG****BH****BJ****BK****BL****BM**

# BN

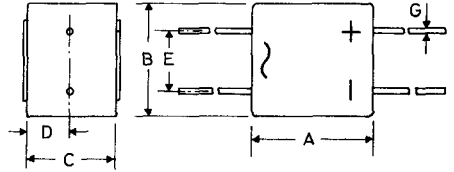
B.S.3934

SO-26

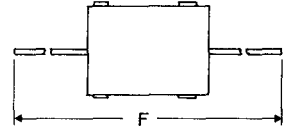


(All dimensions max.)

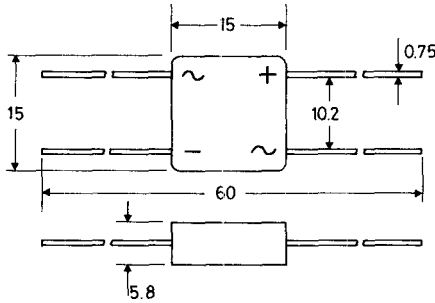
# BO



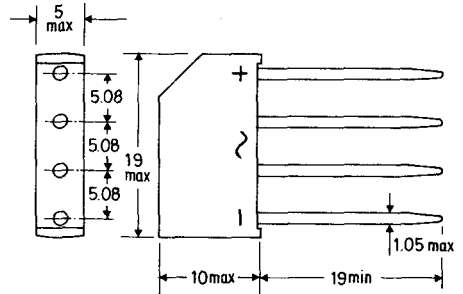
|   | BO1  | BO2 | BO3 |
|---|------|-----|-----|
| A | 12   | 20  | 12  |
| B | 10   | 19  | 10  |
| C | 8    | 15  | 8   |
| D | 4    | 7.5 | 4   |
| E | 5    | 10  | 5   |
| F | 58   | 60  | 48  |
| G | 0.75 | 1.0 | 1.1 |



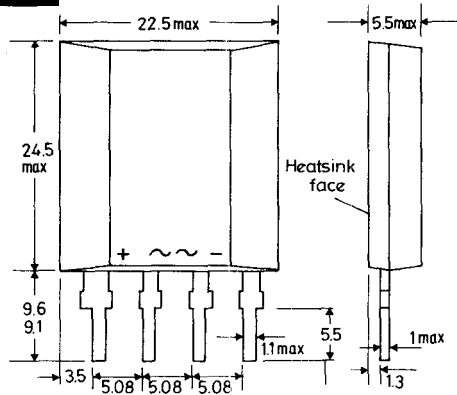
# BP



# BQ

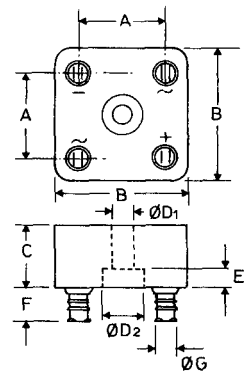


# BR



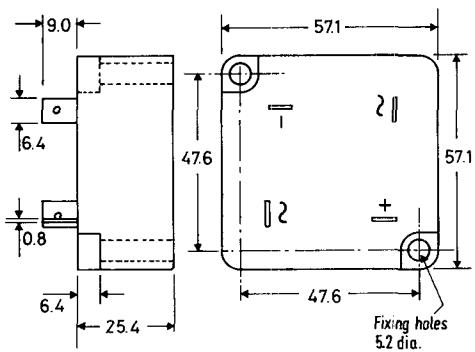
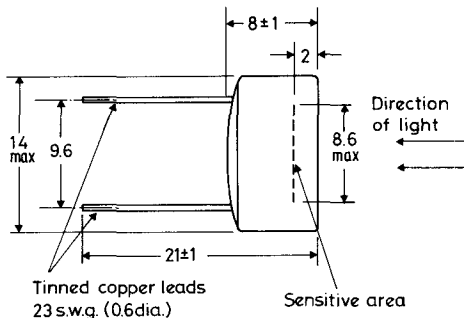
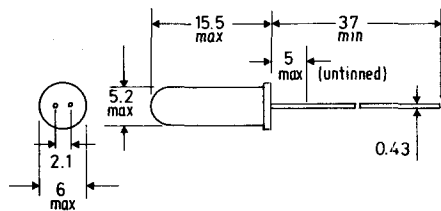
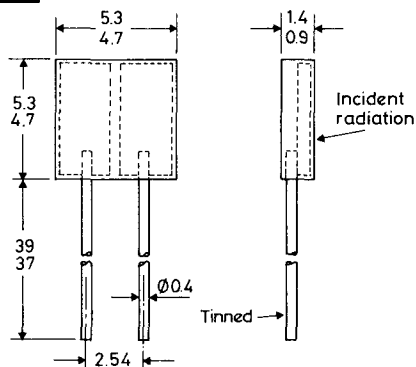
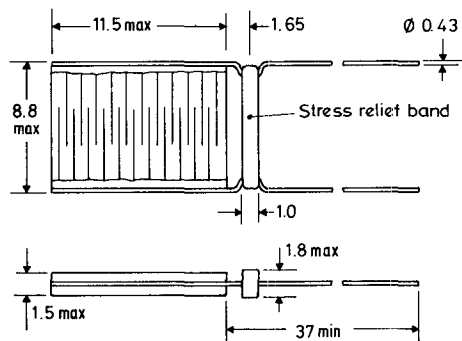
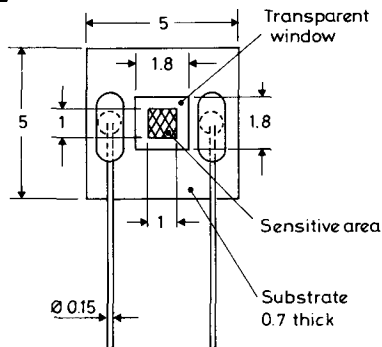
# BS

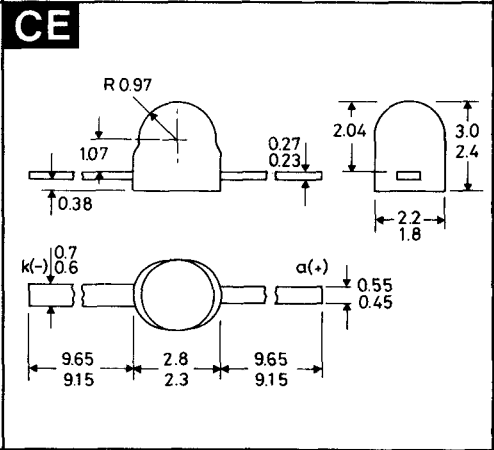
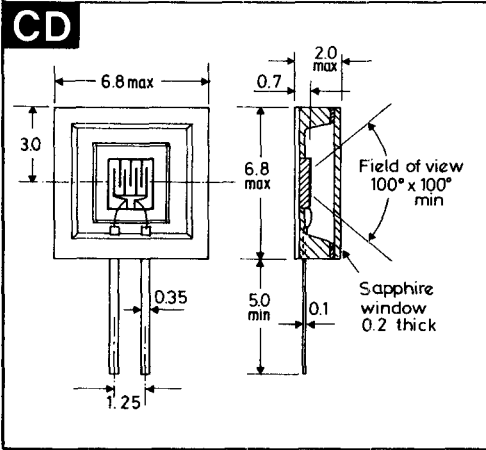
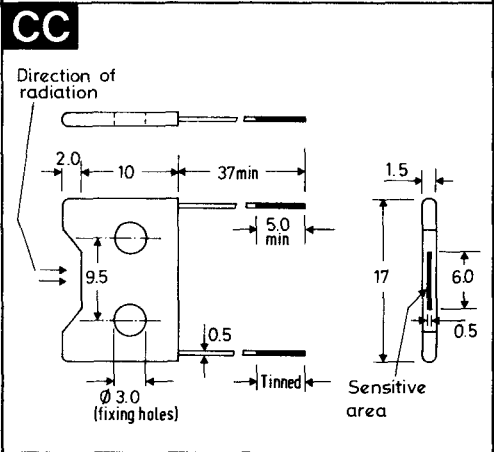
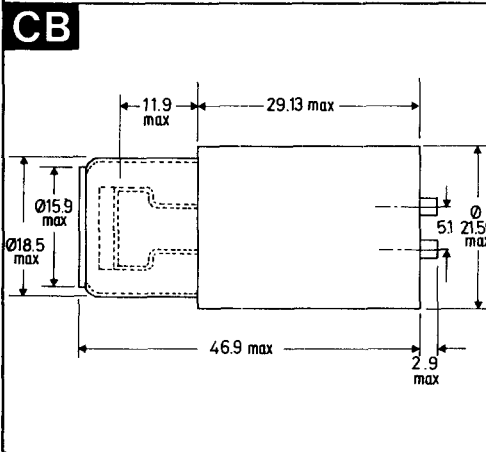
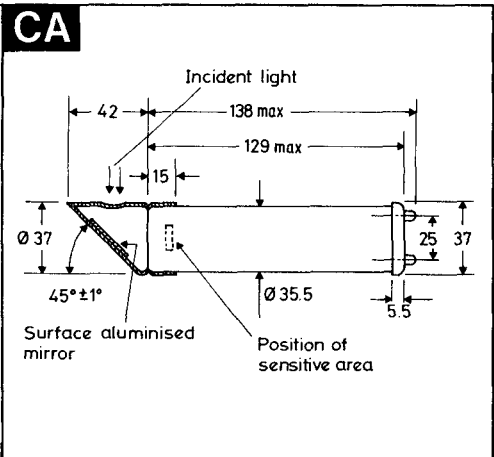
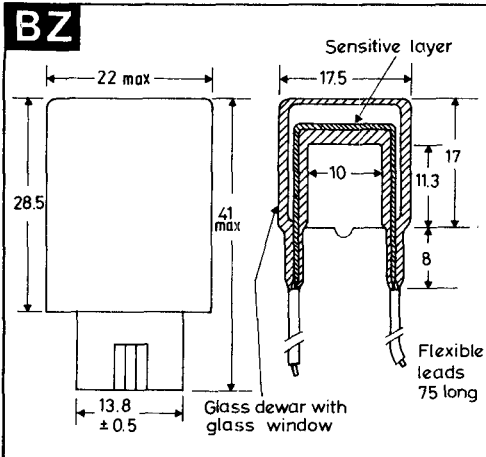
B.S.3934 SO-67



|     | BS1  | BS2  |
|-----|------|------|
|     | typ. | max. |
| A   | 23   | 21   |
| B   | 35   | 34.6 |
| C   | 17   | 15.2 |
| ØD1 | 5    | 5.05 |
| ØD2 | 11   | 11   |
| E   | 5    | 3.7  |
| F   | 9    | 9    |
| ØG  | 4.8  | 4.8  |

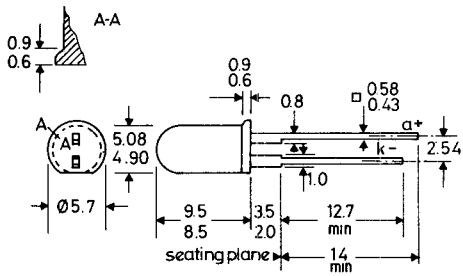
These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

**BT****BU****BV****BW****BX****BY**

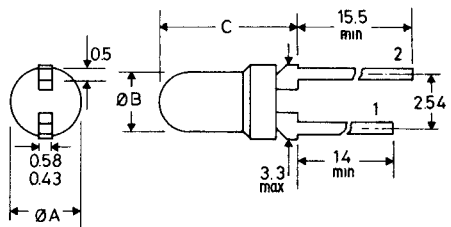


These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.

# CF

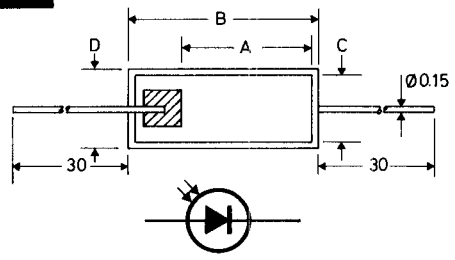


# CG



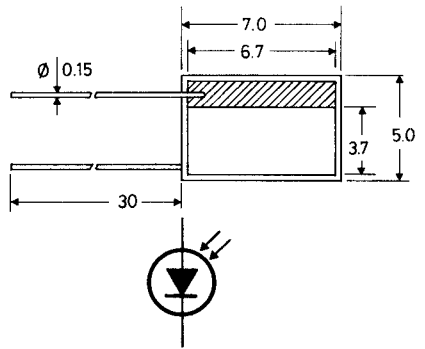
|     | 1    | 2    | ØA       | ØB        | C       |
|-----|------|------|----------|-----------|---------|
| CG1 | k(-) | a(+) | 3.0-3.17 | 2.4-2.6   | 5.8-6.3 |
| CG2 | a(+) | k(-) | 3.0-3.17 | 2.4-2.6   | 5.8-6.3 |
| CG3 | k(-) | a(+) | 3.3 max  | 2.65-3.17 | 4.8-6.3 |

# CH

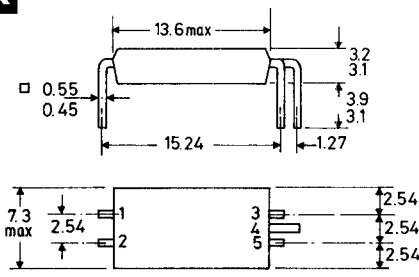


|   | CH1  | CH2  |
|---|------|------|
| A | 2.2  | 3.5  |
| B | 3.35 | 4.55 |
| C | 0.95 | 1.85 |
| D | 1.25 | 2.15 |

# CJ

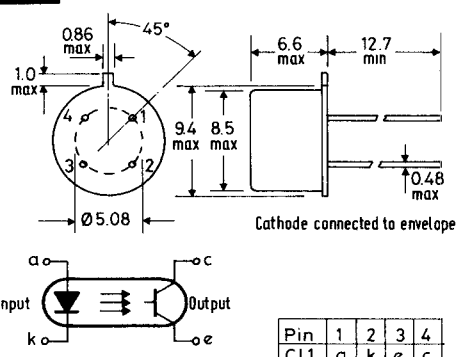


# CK



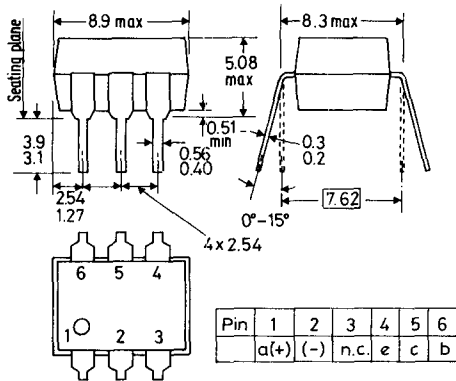
| Pin | 1 | 2 | 3 | 4       | 5 |
|-----|---|---|---|---------|---|
| CK1 | a | k | b | c       | e |
| CK2 | k | a | e | omitted | c |

# CL

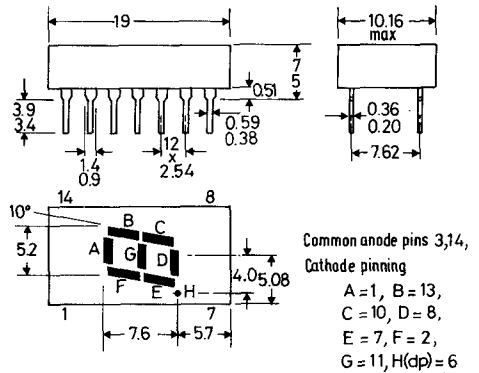


| Pin | 1 | 2 | 3 | 4 |
|-----|---|---|---|---|
| CL1 | a | k | e | c |
| CL2 | e | c | a | k |

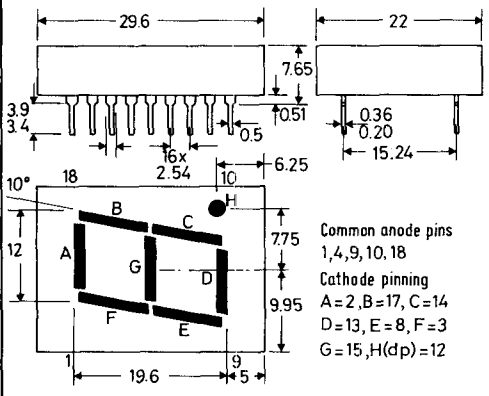
# CM



# CN



# CO



*These drawings give limited information for quick reference purposes. For equipment design more complete information should be obtained from individual data sheets in the Technical Handbook or from standard B.S. or JEDEC outline drawings.*