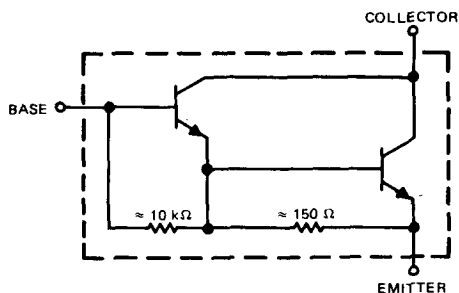


# TYPES TIP140, TIP141, TIP142 N-P-N DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

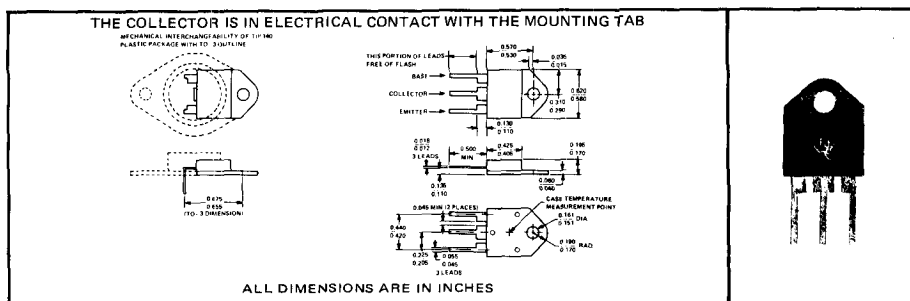
DESIGNED FOR COMPLEMENTARY USE WITH TIP145, TIP146, TIP147

- 125 W at 25°C Case Temperature
- Min  $h_{FE}$  of 1000 at 4 V, 5 A
- 10-A Rated Collector Current
- 100-mJ Reverse Energy Rating

device schematic



mechanical data



absolute maximum ratings at 25°C case temperature (unless otherwise noted)

|                                                                                    | TIP140              | TIP141         | TIP142         |
|------------------------------------------------------------------------------------|---------------------|----------------|----------------|
| Collector-Base Voltage                                                             | 60 V                | 80 V           | 100 V          |
| Collector-Emitter Voltage (See Note 1)                                             | 60 V                | 80 V           | 100 V          |
| Emitter-Base Voltage                                                               | 5 V                 | 5 V            | 5 V            |
| Continuous Collector Current                                                       | 10 A                | 10 A           | 10 A           |
| Peak Collector Current (See Note 2)                                                | 15 A                | 15 A           | 15 A           |
| Continuous Base Current                                                            | 0.5 A               | 0.5 A          | 0.5 A          |
| Safe Operating Areas at (or below) 25°C Case Temperature                           | See Figures 7 and 8 |                |                |
| Continuous Device Dissipation at (or below) 25°C Case Temperature (See Note 3)     | 125 W               | 125 W          | 125 W          |
| Continuous Device Dissipation at (or below) 25°C Free-Air Temperature (See Note 4) | 3.5 W               | 3.5 W          | 3.5 W          |
| Unclamped Inductive Load Energy (See Note 5)                                       | 100 mJ              | 100 mJ         | 100 mJ         |
| Operating Collector Junction Temperature Range                                     | -65°C to 150°C      | -65°C to 150°C | -65°C to 150°C |
| Storage Temperature Range                                                          | -65°C to 150°C      | -65°C to 150°C | -65°C to 150°C |
| Lead Temperature 1/8 Inch from Case for 10 Seconds                                 | 260°C               | 260°C          | 260°C          |

- NOTES: 1. These values apply when the base-emitter diode is open-circuited.  
 2. This value applies for  $t_w \leq 0.3$  ms, duty cycle  $\leq 10\%$ .  
 3. Derate linearly to 150°C case temperature at the rate of 1 W/°C or refer to Dissipation Derating Curve, Figure 9.  
 4. Derate linearly to 150°C free-air temperature at the rate of 28 mW/°C or refer to Dissipation Derating Curve, Figure 10.  
 5. This rating is based on the capability of the transistors to operate safely in the circuit of Figure 2.  $L = 100$  mH,  $R_{BB2} = 100 \Omega$ ,  $V_{BB2} = 0$  V,  $R_S = 0.1 \Omega$ ,  $V_{CC} = 20$  V. Energy  $\approx 1C^2L/2$ .

# TYPES TIP140, TIP141, TIP142

## N-P-N DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

electrical characteristics at 25°C case temperature

| PARAMETER                                          | TEST CONDITIONS                                                   | TIP140 |     | TIP141 |     | TIP142 |     | UNIT |
|----------------------------------------------------|-------------------------------------------------------------------|--------|-----|--------|-----|--------|-----|------|
|                                                    |                                                                   | MIN    | MAX | MIN    | MAX | MIN    | MAX |      |
| $V_{(BR)CEO}$ Collector-Emitter Breakdown Voltage  | $I_C = 30 \text{ mA}$ , $I_B = 0$ , See Note 6                    | 60     |     | 80     |     | 100    |     | V    |
| $I_{CEO}$ Collector Cutoff Current                 | $V_{CE} = 30 \text{ V}$ , $I_B = 0$                               | 2      |     |        |     |        |     | mA   |
|                                                    | $V_{CE} = 40 \text{ V}$ , $I_B = 0$                               |        |     | 2      |     |        |     |      |
|                                                    | $V_{CE} = 50 \text{ V}$ , $I_B = 0$                               |        |     |        |     | 2      |     |      |
| $I_{CBO}$ Collector Cutoff Current                 | $V_{CB} = 60 \text{ V}$ , $I_E = 0$                               | 1      |     |        |     |        |     | mA   |
|                                                    | $V_{CB} = 80 \text{ V}$ , $I_E = 0$                               |        |     | 1      |     |        |     |      |
|                                                    | $V_{CB} = 100 \text{ V}$ , $I_E = 0$                              |        |     |        |     | 1      |     |      |
| $I_{EBO}$ Emitter Cutoff Current                   | $V_{EB} = 5 \text{ V}$ , $I_C = 0$                                | 2      |     | 2      |     | 2      |     | mA   |
| $h_{FE}$ Static Forward Current Transfer Ratio     | $V_{CE} = 4 \text{ V}$ , $I_C = 5 \text{ A}$                      | 1000   |     | 1000   |     | 1000   |     |      |
|                                                    | $V_{CE} = 4 \text{ V}$ , $I_C = 10 \text{ A}$                     | 500    |     | 500    |     | 500    |     |      |
| $V_{BE}$ Base-Emitter Voltage                      | $V_{CE} = 4 \text{ V}$ , $I_C = 10 \text{ A}$ , See Notes 6 and 7 | 3      |     | 3      |     | 3      |     | V    |
| $V_{CE(sat)}$ Collector-Emitter Saturation Voltage | $I_B = 10 \text{ mA}$ , $I_C = 5 \text{ A}$                       | 2      |     | 2      |     | 2      |     | V    |
|                                                    | $I_B = 40 \text{ mA}$ , $I_C = 10 \text{ A}$                      | 3      |     | 3      |     | 3      |     |      |

NOTES: 6. These parameters must be measured using pulse techniques.  $t_w = 300 \mu\text{s}$ , duty cycle  $\leq 2\%$ .

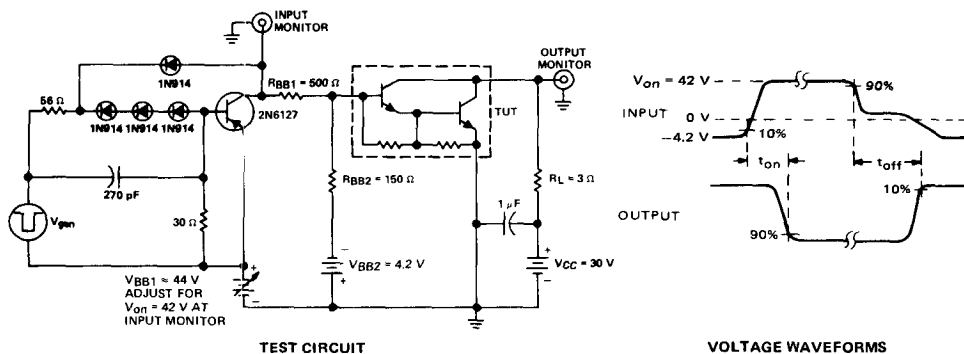
7. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts and located within 0.125 inch from the device body.

switching characteristics at 25°C case temperature

| PARAMETER               | TEST CONDITIONS†                                                                                                                                      | TYP | UNIT          |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------|
| $t_{on}$ Turn-On Time   | $I_C = 10 \text{ A}$ , $I_{B(1)} = 40 \text{ mA}$ , $I_{B(2)} = -40 \text{ mA}$ ,<br>$V_{BE(off)} = -4.2 \text{ V}$ , $R_L = 3 \Omega$ , See Figure 1 | 0.9 | $\mu\text{s}$ |
| $t_{off}$ Turn-Off Time |                                                                                                                                                       | 11  |               |

† Voltage and current values shown are nominal; exact values vary slightly with transistor parameters.

### PARAMETER MEASUREMENT INFORMATION



NOTES: A.  $V_{gen}$  is a  $-30\text{-V}$  pulse (from 0 V) into a  $50\text{-}\Omega$  termination.

B. The  $V_{gen}$  waveform is supplied by a generator with the following characteristics:  $t_r \leq 15 \text{ ns}$ ,  $t_f \leq 15 \text{ ns}$ ,  $Z_{out} = 50 \Omega$ ,  $t_w = 20 \mu\text{s}$ , duty cycle  $\leq 2\%$ .

C. Waveforms are monitored on an oscilloscope with the following characteristics:  $t_r \leq 15 \text{ ns}$ ,  $R_{in} \geq 10 \text{ M}\Omega$ ,  $C_{in} \leq 11.5 \text{ pF}$ .

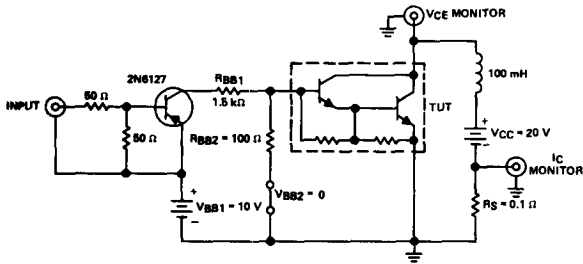
D. Resistors must be noninductive types.

E. The d-c power supplies may require additional bypassing in order to minimize ringing.

FIGURE 1

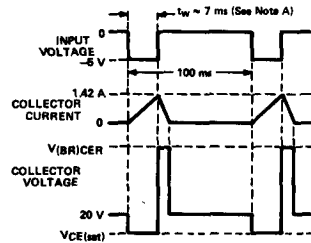
# TYPES TIP140, TIP141, TIP142 N-P-N DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

## INDUCTIVE LOAD SWITCHING



TEST CIRCUIT

NOTE A: Input pulse width is increased until  $I_{CM} = 1.42$  A.



VOLTAGE AND CURRENT WAVEFORMS

FIGURE 2

## TYPICAL CHARACTERISTICS

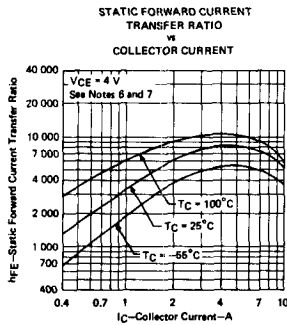


FIGURE 3

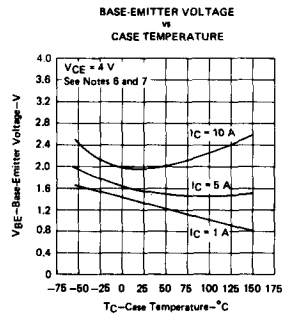


FIGURE 4

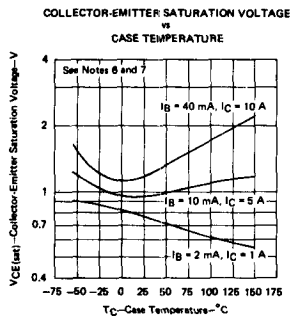


FIGURE 5

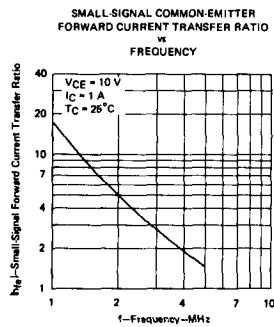


FIGURE 6

NOTES: 6. These parameters must be measured using pulse techniques.  $t_W = 300 \mu s$ , duty cycle  $\leq 2\%$ .

7. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts and located within 0.125 inch from the device body.

# TYPES TIP140, TIP141, TIP142

## N-P-N DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

### MAXIMUM SAFE OPERATING AREAS

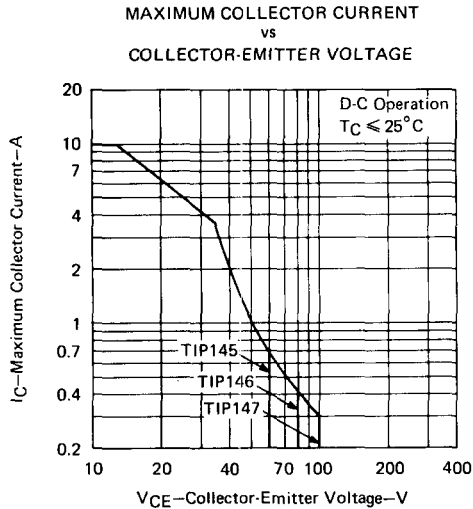


FIGURE 7

NOTE 8: Above this point the safe operating area has not been defined.

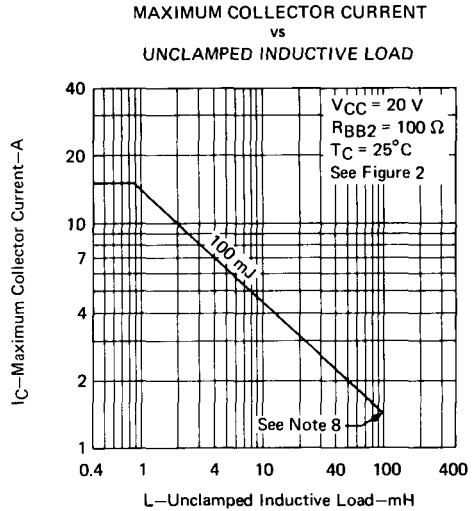


FIGURE 8

### THERMAL INFORMATION

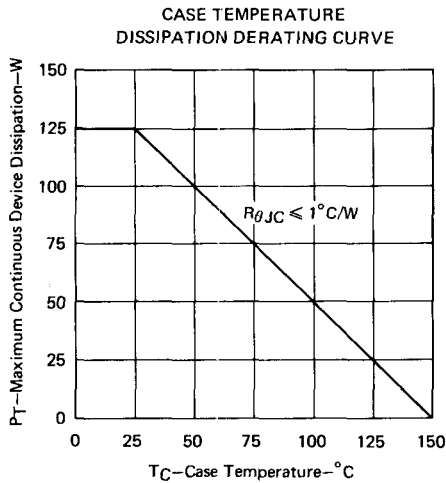


FIGURE 9

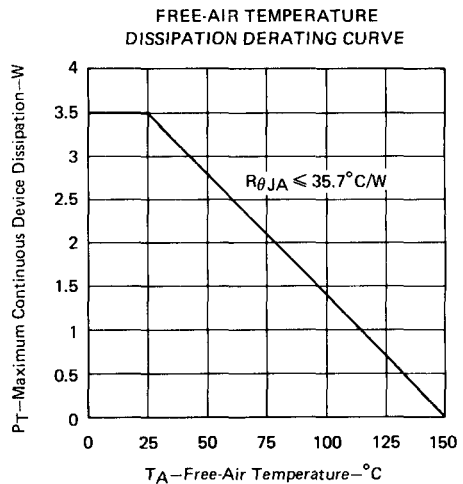


FIGURE 10

| Type<br>type |          | $P_{tot} @$<br>$T_C = 25\text{ }^{\circ}\text{C}$<br>(100 $^{\circ}\text{C}$ )<br>W | $V_{CEO}$<br>min | $I_{CD}$<br>max<br>A | min  | $h_{FE}$<br>max | @ | $I_C$<br>A |
|--------------|----------|-------------------------------------------------------------------------------------|------------------|----------------------|------|-----------------|---|------------|
| NPN          | PNP      |                                                                                     |                  |                      |      |                 |   |            |
| TIP 35 B     | TIP 36 B | 90                                                                                  | 80               | 25                   | 25   | 100             |   | 1,5        |
| TIP 35 C     | TIP 36 C | 90                                                                                  | 100              | 25                   | 25   | 100             |   | 1,5        |
| TIP 41       | TIP 42   | 65                                                                                  | 40               | 6                    | 15   | 75              |   | 3          |
| TIP 41 A     | TIP 42 A | 65                                                                                  | 60               | 6                    | 15   | 75              |   | 3          |
| TIP 41 B     | TIP 42 B | 65                                                                                  | 80               | 6                    | 15   | 75              |   | 3          |
| TIP 41 C     | TIP 42 C | 65                                                                                  | 100              | 6                    | 15   | 75              |   | 3          |
| TIP 3055     | TIP 5530 | 90                                                                                  | 70               | 15                   | 20   |                 |   | 4          |
| BD 633       | BD 634   | 30                                                                                  | 45               | 2                    | 25   |                 |   | 1          |
| BD 635       | BD 636   | 30                                                                                  | 60               | 2                    | 25   |                 |   | 1          |
| BD 637       | BD 638   | 30                                                                                  | 80               | 2                    | 25   |                 |   | 1          |
| BD 733       | BD 734   | 40                                                                                  | 32               | 4                    | 50   |                 |   | 2          |
| BD 735       | BD 736   | 40                                                                                  | 32               | 4                    | 50   |                 |   | 2          |
| BD 737       | BD 738   | 40                                                                                  | 45               | 4                    | 40   |                 |   | 2          |
| TIP 110      | TIP 115  | 50                                                                                  | 60               | 2                    | 1000 |                 |   | 1          |
| TIP 111      | TIP 116  | 50                                                                                  | 80               | 2                    | 1000 |                 |   | 1          |
| TIP 112      | TIP 117  | 50                                                                                  | 100              | 2                    | 1000 |                 |   | 1          |
| TIP 120      | TIP 125  | 65                                                                                  | 60               | 5                    | 1000 |                 |   | 3          |
| TIP 121      | TIP 126  | 65                                                                                  | 80               | 5                    | 1000 |                 |   | 3          |
| TIP 122      | TIP 127  | 65                                                                                  | 100              | 5                    | 1000 |                 |   | 3          |
| TIP 140      | TIP 145  | 125                                                                                 | 60               | 10                   | 1000 |                 |   | 5          |
| TIP 141      | TIP 146  | 125                                                                                 | 80               | 10                   | 1000 |                 |   | 5          |
| TIP 142      | TIP 147  | 125                                                                                 | 100              | 10                   | 1000 |                 |   | 5          |

| Type<br>type | $T_A = 25\text{ }^{\circ}\text{C}$<br>(100 $^{\circ}\text{C}$ )<br>W | $P_{tot} @$<br>$T_C = 25\text{ }^{\circ}\text{C}$<br>(100 $^{\circ}\text{C}$ )<br>W | $V_{CEO}$<br>min<br>V | $I_{CD}$<br>max<br>A | min | $h_{FE}$<br>max | (a) | $I_C$<br>A |
|--------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------|----------------------|-----|-----------------|-----|------------|
| 2N 4915      | 4                                                                    | 87,5                                                                                | 80                    | 5                    | 25  | 100             |     | 2,5        |
| 2N 4998      | 2                                                                    | (20)                                                                                | 80                    | 2                    | 30  | 90              |     | 1          |
| 2N 5000      | 2                                                                    | (20)                                                                                | 80                    | 2                    | 70  | 200             |     | 1          |
| 2N 5002      |                                                                      | (33,3)                                                                              | 80                    | 5                    | 30  | 90              |     | 2,5        |
| 2N 5004      |                                                                      | (33,3)                                                                              | 80                    | 5                    | 70  | 200             |     | 2,5        |
| 2N 5038      | 5                                                                    | 140                                                                                 | 90                    | 20                   | 20  | 100             |     | 12         |
| 2N 5039      | 5                                                                    | 140                                                                                 | 75                    | 20                   | 20  | 100             |     | 10         |
| 2N 5148      | 1                                                                    | (4)                                                                                 | 80                    | 2                    | 30  | 90              |     | 1          |
| 2N 5150      | 1                                                                    | (4)                                                                                 | 80                    | 2                    | 70  | 200             |     | 1          |
| 2N 5152      |                                                                      | (6,7)                                                                               | 80                    | 2                    | 30  | 90              |     | 2,5        |
| 2N 5154      |                                                                      | (6,7)                                                                               | 80                    | 2                    | 70  | 200             |     | 2,5        |
| 2N 5301      | 5                                                                    | 200                                                                                 | 40                    | 20                   | 40  | 60              |     | 1          |
| 2N 5302      | 5                                                                    | 200                                                                                 | 60                    | 20                   | 40  | 60              |     | 1          |
| 2N 5303      | 5                                                                    | 200                                                                                 | 80                    | 20                   | 40  | 60              |     | 1          |

| f <sub>T</sub><br>min<br>MHz | I <sub>CES</sub><br>(I <sub>CEO</sub> )<br>μA | @ | V <sub>CE</sub><br>V | Gehäuse<br>package         | Anwendungen<br>applications, remarks                                                           |
|------------------------------|-----------------------------------------------|---|----------------------|----------------------------|------------------------------------------------------------------------------------------------|
| 3                            | 700                                           |   | 80                   | TO-3P                      | Verstärker, Schalter, komplementär zu TIP 36 B<br>amplifier, switch, complementary to TIP 36 B |
| 3                            | 700                                           |   | 100                  | TO-66P                     | Verstärker, Schalter, komplementär zu TIP 36 C<br>amplifier, switch, complementary to TIP 36 C |
| 3                            | 400                                           |   | 40                   | TO-66P                     | Verstärker, Schalter, komplementär zu TIP 42<br>amplifier, switch, complementary to TIP 42     |
| 3                            | 400                                           |   | 60                   | TO-66P                     | Verstärker, Schalter, komplementär zu TIP 42 A<br>amplifier, switch, complementary to TIP 42 A |
| 3                            | 400                                           |   | 80                   | TO-66P                     | Verstärker, Schalter, komplementär zu TIP 42 B<br>amplifier, switch, complementary to TIP 42 B |
| 3                            | 400                                           |   | 100                  | TO-66P                     | Verstärker, Schalter, komplementär zu TIP 42 C<br>amplifier, switch, complementary to TIP 42 C |
|                              |                                               |   |                      | TO-3P                      |                                                                                                |
|                              |                                               |   |                      | TO-66<br>TO-66<br>TO-66    | Komplementär<br>Endstufen<br>for complementary output stages                                   |
|                              |                                               |   |                      | TO-66P<br>TO-66P<br>TO-66P | Darlington                                                                                     |
|                              |                                               |   |                      | TO-66P<br>TO-66P<br>TO-66P | Verstärker, Schalter<br>amplifier, switch      Darlington                                      |
|                              |                                               |   |                      | TO-3P<br>TO-3P<br>TO-3P    | Darlington                                                                                     |
| f <sub>T</sub><br>min<br>MHz | I <sub>CES</sub><br>(I <sub>CEO</sub> )<br>μA | @ | V <sub>VE</sub><br>V | Gehäuse<br>package         | Anwendungen, Bemerkungen<br>applications, remarks                                              |
| 4                            | (1000)                                        |   | 80                   | TO-3                       | Verstärker, Schalter<br>amplifier, switch                                                      |
| 50                           | (0,05)                                        |   | 40                   | TO-59                      | Für Computeranwendung                                                                          |
| 60                           | (0,05)                                        |   | 40                   | TO-59                      | komplementär zu 2N 4999, 2N 5001, 2N 5003, 2N 5005                                             |
| 60                           | (0,05)                                        |   | 40                   | TO-59                      | computer application                                                                           |
| 70                           | (0,05)                                        |   | 40                   | TO-59                      | complementary to 2N 4999, 2N 5001, 2N 5003, 2N 5005                                            |
| 60                           | 50                                            |   | 140                  | TO-3                       | Verstärker und schnelle Schalter                                                               |
| 60                           | 50                                            |   | 110                  | TO-3                       | amplifier and high-speed switch                                                                |
| 50                           | (0,05)                                        |   | 40                   | TO-39                      | Für Computeranwendung                                                                          |
| 60                           | (0,05)                                        |   | 40                   | TO-39                      | komplementär zu 2N 5147, 2N 5149, 2N 5151, 2N 5153                                             |
| 60                           | (0,05)                                        |   | 40                   | TO-39                      | computer application                                                                           |
| 70                           | (0,05)                                        |   | 40                   | TO-39                      | complementary to 2N 5147, 2N 5149, 2N 5151, 2N 5153                                            |
| 4                            | (5)                                           |   | 40                   | TO-3                       | Verstärker, Schalter                                                                           |
| 4                            | (5)                                           |   | 60                   | TO-3                       | amplifier, switch                                                                              |
| 4                            | (5)                                           |   | 80                   | TO-3                       |                                                                                                |