

# MM3905 (SILICON)

# MM3906

## PNP SILICON ANNULAR TRANSISTORS

... designed for general purpose switching and amplifier applications.  
Direct replacement for plastic 2N3905 and 2N3906.

- Hermetic Low Profile TO-52 Metal Package for High Reliability
- High Voltage Ratings –  $BV_{CEO} = 40$  Volts (Min)
- Current Gain Specified from  $100 \mu A$  to  $100 mA$
- Complete Switching and Amplifier Specifications

## PNP SILICON SWITCHING AND AMPLIFIER TRANSISTORS

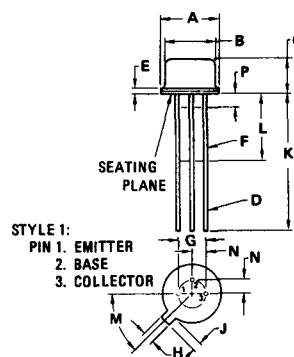


### MAXIMUM RATINGS

| Rating                                                                    | Symbol         | Value       | Unit                 |
|---------------------------------------------------------------------------|----------------|-------------|----------------------|
| Collector-Emitter Voltage                                                 | $V_{CEO}$      | 40          | Vdc                  |
| Collector-Base Voltage                                                    | $V_{CB}$       | 40          | Vdc                  |
| Emitter-Base Voltage                                                      | $V_{EB}$       | 5.0         | Vdc                  |
| Collector Current – Continuous                                            | $I_C$          | 200         | mA dc                |
| Total Power Dissipation @ $T_A = 25^\circ C$<br>Derate above $25^\circ C$ | $P_D$          | 360<br>2.06 | mW<br>mW/ $^\circ C$ |
| Operating and Storage Junction<br>Temperature Range                       | $T_J, T_{stg}$ | -55 to +200 | $^\circ C$           |

### THERMAL CHARACTERISTICS

| Characteristic                             | Symbol          | Max | Unit         |
|--------------------------------------------|-----------------|-----|--------------|
| Thermal Resistance, Junction to<br>Ambient | $R_{\theta JA}$ | 490 | $^\circ C/W$ |



| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 5.31        | 5.84  | 0.209     | 0.230 |
| B   | 4.52        | 4.95  | 0.178     | 0.195 |
| C   | 2.92        | 3.81  | 0.115     | 0.150 |
| D   | —           | 0.533 | —         | 0.021 |
| E   | —           | 0.762 | —         | 0.030 |
| F   | 0.406       | 0.483 | 0.016     | 0.019 |
| G   | 2.54 BSC    | —     | 0.100 BSC | —     |
| H   | 0.914       | 1.17  | 0.036     | 0.046 |
| J   | 0.711       | 1.22  | 0.028     | 0.048 |
| K   | 12.70       | —     | 0.500     | —     |
| L   | 6.35        | —     | 0.250     | —     |
| M   | 45° BSC     | —     | 45° BSC   | —     |
| N   | 1.27 BSC    | —     | 0.050 BSC | —     |
| P   | —           | 1.27  | —         | 0.050 |

All JEDEC dimensions and notes apply

CASE 27-02  
TO-52

# MM3905, MM3906 (continued)

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic                                                                             | Fig. No. | Symbol            | Min | Max | Unit |
|--------------------------------------------------------------------------------------------|----------|-------------------|-----|-----|------|
| <b>OFF CHARACTERISTICS</b>                                                                 |          |                   |     |     |      |
| Collector-Base Breakdown Voltage<br>(I <sub>C</sub> = 10 µAdc, I <sub>E</sub> = 0)         | -        | BV <sub>CBO</sub> | 40  | -   | Vdc  |
| Collector-Emitter Breakdown Voltage (1)<br>(I <sub>C</sub> = 1.0 mAdc, I <sub>B</sub> = 0) | -        | BV <sub>CEO</sub> | 40  | -   | Vdc  |
| Emitter-Base Breakdown Voltage<br>(I <sub>E</sub> = 10 µAdc, I <sub>C</sub> = 0)           | -        | BV <sub>EBO</sub> | 5.0 | -   | Vdc  |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 30 Vdc, V <sub>BE(off)</sub> = 3.0 Vdc)     | -        | I <sub>CEV</sub>  | -   | 50  | nAdc |
| Base Cutoff Current<br>(V <sub>CE</sub> = 30 Vdc, V <sub>BE(off)</sub> = 3.0 Vdc)          | -        | I <sub>BEV</sub>  | -   | 50  | nAdc |

## ON CHARACTERISTICS (1)

|                                                                                                                                                        |                  |        |                      |           |              |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------|----------------------|-----------|--------------|-----|
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 1.0 Vdc)                                                                              | MM3905<br>MM3906 | 15     | h <sub>FE</sub>      | 30<br>60  | -            | -   |
| (I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 1.0 Vdc)                                                                                                 | MM3905<br>MM3906 |        |                      | 40<br>80  | -            |     |
| (I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 1.0 Vdc)                                                                                                  | MM3905<br>MM3906 |        |                      | 50<br>100 | 150<br>300   |     |
| (I <sub>C</sub> = 50 mAdc, V <sub>CE</sub> = 1.0 Vdc)                                                                                                  | MM3905<br>MM3906 |        |                      | 30<br>60  | -            |     |
| (I <sub>C</sub> = 100 mAdc, V <sub>CE</sub> = 1.0 Vdc)                                                                                                 | MM3905<br>MM3906 |        |                      | 10<br>15  | -            |     |
| Collector-Emitter Saturation Voltage<br>(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc)<br>(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc) |                  | 16, 17 | V <sub>CE(sat)</sub> | -<br>-    | 0.25<br>0.4  | Vdc |
| Base-Emitter Saturation Voltage<br>(I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc)<br>(I <sub>C</sub> = 50 mAdc, I <sub>B</sub> = 5.0 mAdc)      |                  | 17     | V <sub>BE(sat)</sub> | 0.65<br>- | 0.85<br>0.95 | Vdc |

## SMALL-SIGNAL CHARACTERISTICS

|                                                                                                                              |                  |       |                 |                                                |                                               |        |
|------------------------------------------------------------------------------------------------------------------------------|------------------|-------|-----------------|------------------------------------------------|-----------------------------------------------|--------|
| Current-Gain-Bandwidth Product (1)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz)                      | MM3905<br>MM3906 | -     | f <sub>T</sub>  | 200<br>250                                     | -                                             | MHz    |
| Output Capacitance<br>(V <sub>CB</sub> = 5.0 Vdc, I <sub>E</sub> = 0, f = 100 kHz)                                           |                  | 3     | C <sub>ob</sub> | -                                              | 5.0                                           | pF     |
| Input Capacitance<br>(V <sub>BE</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 100 kHz)                                            |                  | 3     | C <sub>ib</sub> | -                                              | 10                                            | pF     |
| Input Impedance<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)                                        | MM3905<br>MM3906 | 13    | h <sub>ie</sub> | 0.5<br>2.0                                     | 8.0<br>12                                     | k ohms |
| Voltage Feedback Ratio<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)                                 | MM3905<br>MM3906 | 14    | h <sub>re</sub> | 0.1 × 10 <sup>-4</sup><br>1 × 10 <sup>-4</sup> | 5 × 10 <sup>-4</sup><br>10 × 10 <sup>-4</sup> | -      |
| Small-Signal Current Gain<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)                              | MM3905<br>MM3906 | 11    | h <sub>fe</sub> | 50<br>100                                      | 200<br>400                                    | -      |
| Output Admittance<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)                                      | MM3905<br>MM3906 | 12    | h <sub>oe</sub> | 1.0<br>3.0                                     | 40<br>60                                      | µmhos  |
| Noise Figure<br>(I <sub>C</sub> = 100 µAdc, V <sub>CE</sub> = 5.0 Vdc, R <sub>S</sub> = 1.0 k ohm,<br>f = 10 Hz to 15.7 kHz) | MM3905<br>MM3906 | 9, 10 | NF              | -<br>-                                         | 5.0<br>4.0                                    | dB     |

## SWITCHING CHARACTERISTICS

|                                                                                                                                    |                  |         |                |        |            |    |
|------------------------------------------------------------------------------------------------------------------------------------|------------------|---------|----------------|--------|------------|----|
| Delay Time<br>(V <sub>CC</sub> = 3.0 Vdc, V <sub>BE(off)</sub> = 0.5 Vdc,<br>I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = 1.0 mAdc) |                  | 1, 5    | t <sub>d</sub> | -      | 35         | ns |
| Rise Time                                                                                                                          |                  | 1, 5, 6 | t <sub>r</sub> | -      | 35         | ns |
| Storage Time<br>(V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mAdc,<br>I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mAdc)             | MM3905<br>MM3906 | 2, 7    | t <sub>s</sub> | -<br>- | 200<br>225 | ns |
| Fall Time                                                                                                                          | MM3905<br>MM3906 | 2, 8    | t <sub>f</sub> | -<br>- | 60<br>75   | ns |

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2.0%.

FIGURE 1 - DELAY AND RISE TIME  
EQUIVALENT TEST CIRCUIT

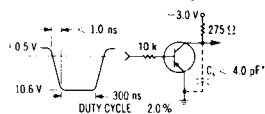
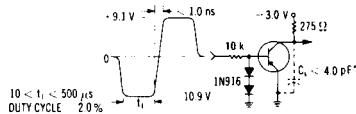


FIGURE 2 - STORAGE AND FALL TIME  
EQUIVALENT TEST CIRCUIT



\*Total shunt capacitance of test jig and connectors

# TRANSIENT CHARACTERISTICS

$-T_J = 25^\circ\text{C} \dots T_J = 125^\circ\text{C}$

FIGURE 3 – CAPACITANCE

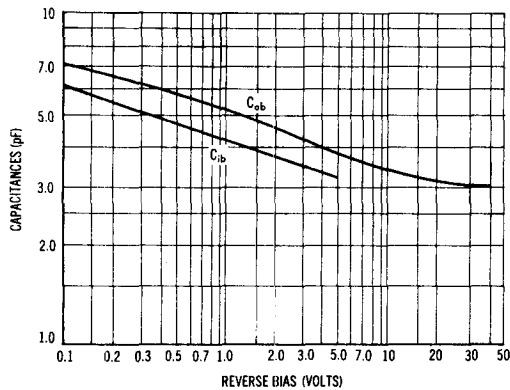


FIGURE 4 – CHARGE DATA

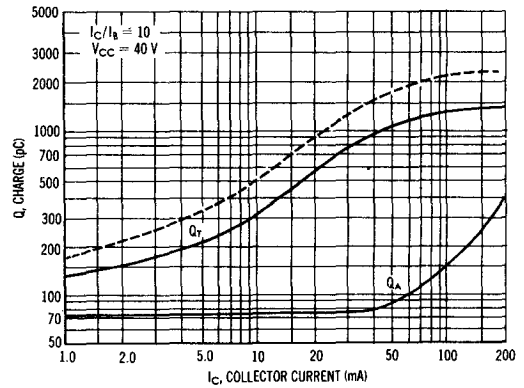


FIGURE 5 – TURN-ON TIME

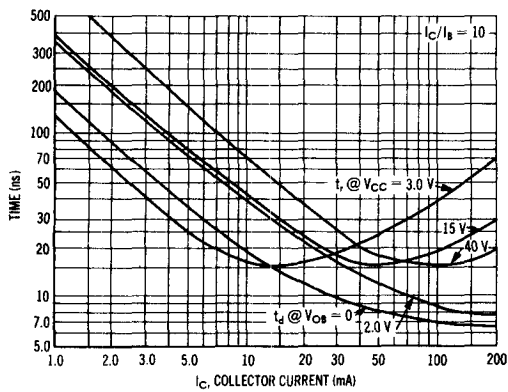


FIGURE 6 – RISE TIME

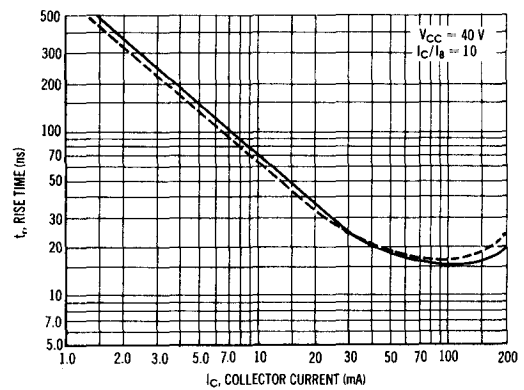


FIGURE 7 – STORAGE TIME

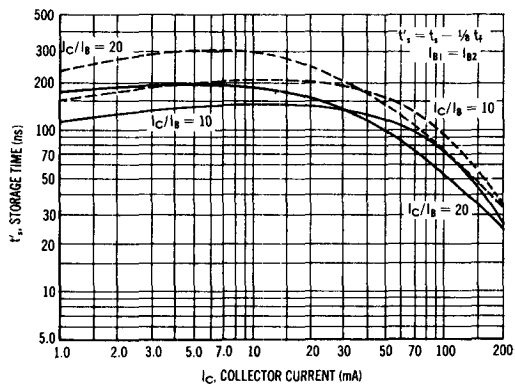
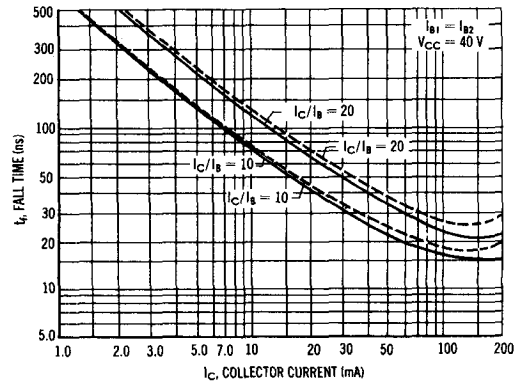


FIGURE 8 – FALL TIME



# AUDIO SMALL SIGNAL CHARACTERISTICS

## NOISE FIGURE VARIATIONS

$V_{CE} = 5.0 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$

FIGURE 9

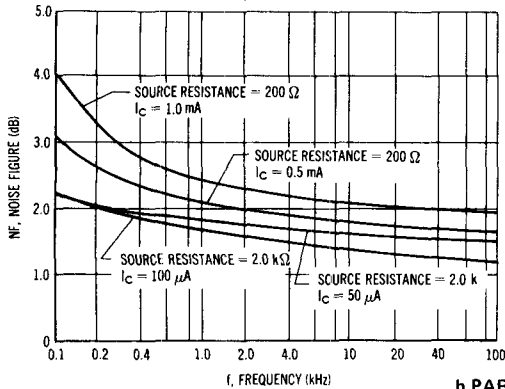
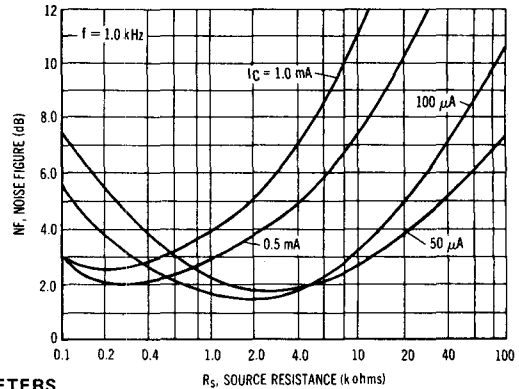


FIGURE 10



## h PARAMETERS

( $V_{CE} = 10 \text{ Vdc}$ ,  $f = 1.0 \text{ kHz}$ ,  $T_A = 25^\circ\text{C}$ )

FIGURE 11 – CURRENT GAIN

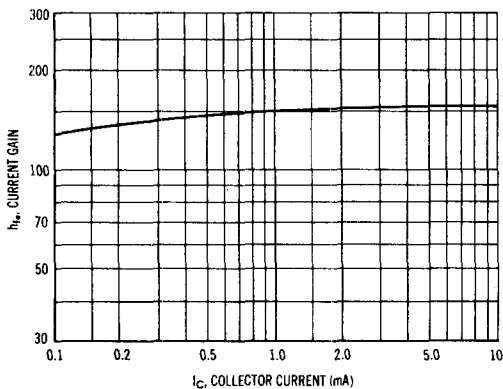


FIGURE 12 – OUTPUT ADMITTANCE

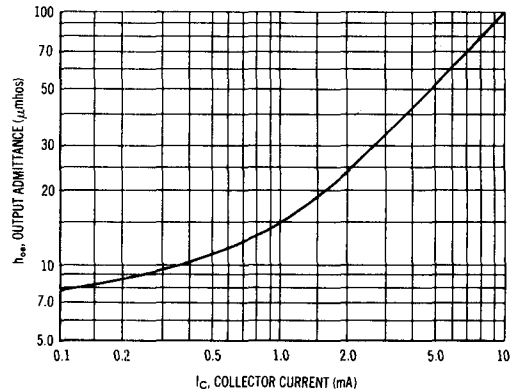


FIGURE 13 – INPUT IMPEDANCE

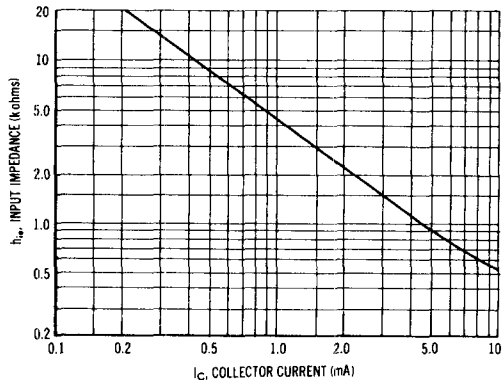
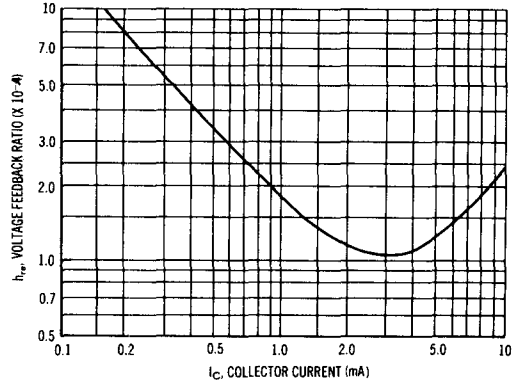


FIGURE 14 – VOLTAGE FEEDBACK RATIO



## STATIC CHARACTERISTICS

FIGURE 15 – NORMALIZED CURRENT GAIN

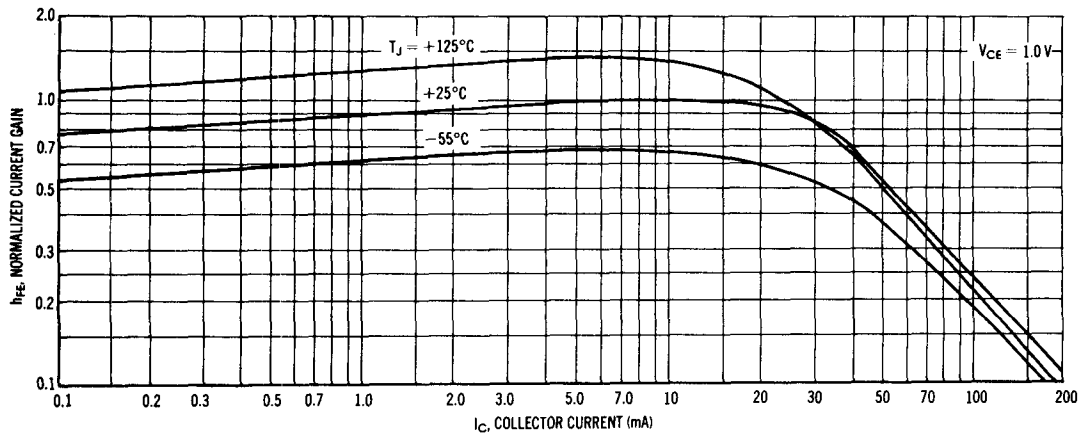


FIGURE 16 – COLLECTOR SATURATION REGION

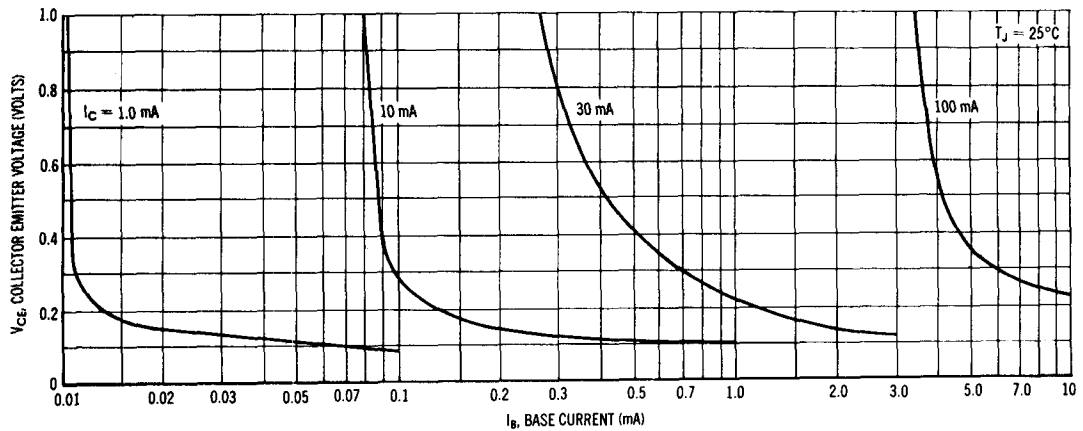


FIGURE 17 – "ON" VOLTAGES

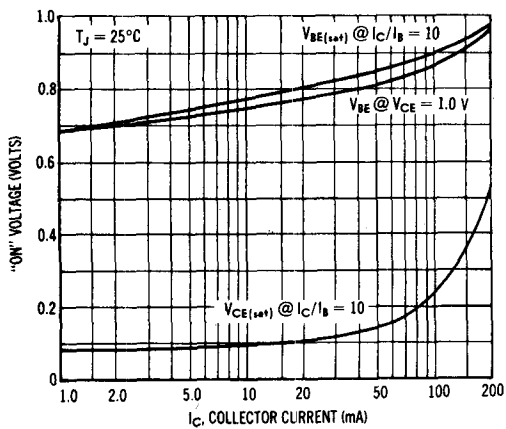


FIGURE 18 – TEMPERATURE COEFFICIENTS

