



Micro Commercial Components



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## MMST3904

### NPN Small Signal Transistors

### Features

- Epitaxial Planar Die Construction
- Complementary PNP Type available (MMST3906)
- Ultra-small surface mount package
- Marking : K2N
- Lead Free Finish/RoHS Compliant ("P" Suffix designates RoHS Compliant. See ordering information)
- Epoxy meets UL 94 V-0 flammability rating
- Moisture Sensitivity Level 1
- Halogen free available upon request by adding suffix "-HF"

### Maximum Ratings

| Symbol    | Rating                                      | Rating      | Unit |
|-----------|---------------------------------------------|-------------|------|
| $V_{CEO}$ | Collector-Emitter Voltage                   | 40          | V    |
| $V_{CBO}$ | Collector-Base Voltage                      | 60          | V    |
| $V_{EBO}$ | Emitter-Base Voltage                        | 6.0         | V    |
| $I_C$     | Collector Current-Continuous <sup>(1)</sup> | 200         | mA   |
| $P_C$     | Power dissipation <sup>(1)</sup>            | 200         | mW   |
| $T_J$     | Junction Temperature                        | -55 to +150 | °C   |
| $T_{STG}$ | Storage Temperature                         | -55 to +150 | °C   |

### Electrical Characteristics @ 25°C Unless Otherwise Specified

| Symbol | Parameter | Min | Max | Units |
|--------|-----------|-----|-----|-------|
|--------|-----------|-----|-----|-------|

#### OFF CHARACTERISTICS <sup>(2)</sup>

|               |                                                                            |     |     |      |
|---------------|----------------------------------------------------------------------------|-----|-----|------|
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage<br>( $I_C=1.0mA$ , $I_B=0$ )           | 40  | --- | Vdc  |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage<br>( $I_C=10uA$ , $I_E=0$ )               | 60  | --- | Vdc  |
| $V_{(BR)EBO}$ | Collector-Emitter Breakdown Voltage<br>( $I_C=10uA$ , $I_C=0$ )            | 5.0 | --- | Vdc  |
| $I_{CEX}$     | Collector-Base Cutoff Current<br>( $V_{CE}=30Vdc$ , $V_{EB(OFF)}=3.0Vdc$ ) | --- | 50  | nAdc |
| $I_{BL}$      | Emitter-Base Cutoff Current<br>( $V_{CE}=30Vdc$ , $V_{EB(OFF)}=3.0Vdc$ )   | --- | 50  | nAdc |

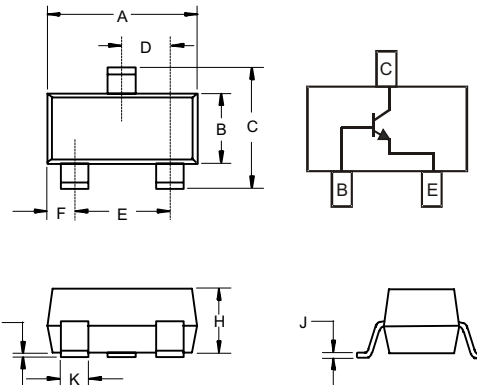
#### ON CHARACTERISTICS <sup>(2)</sup>

|               |                                                                                                                                                                                                        |                             |              |     |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------|-----|
| $h_{FE}$      | DC Current Gain<br>( $I_C=100uA$ , $V_{CE}=1.0Vdc$ )<br>( $I_C=1.0mA$ , $V_{CE}=1.0Vdc$ )<br>( $I_C=10mA$ , $V_{CE}=1.0Vdc$ )<br>( $I_C=50mA$ , $V_{CE}=1.0Vdc$ )<br>( $I_C=500mA$ , $V_{CE}=1.0Vdc$ ) | 40<br>70<br>100<br>60<br>30 | ---          | --- |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage<br>( $I_C=10mA$ , $I_B=1.0mA$ )<br>( $I_C=50mA$ , $I_B=5.0mA$ )                                                                                                   | ---                         | 0.25<br>0.30 | Vdc |
| $V_{BE(sat)}$ | Base-Emitter Saturation Voltage<br>( $I_C=10mA$ , $I_B=1.0mA$ )<br>( $I_C=50mA$ , $I_B=5.0mA$ )                                                                                                        | 0.65<br>---                 | 0.85<br>0.95 | Vdc |

Note: 1. Valid provided that terminals are kept at ambient temperature.

2. Pulse test: Pulse width<300us, duty cycle<2%

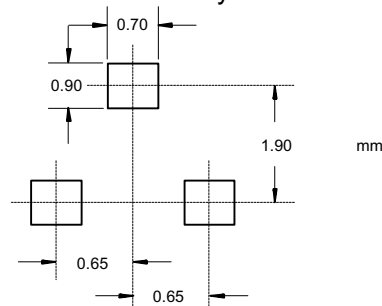
### SOT-323



#### DIMENSIONS

| DIM | INCHES       |      | MM          |      | NOTE |
|-----|--------------|------|-------------|------|------|
|     | MIN          | MAX  | MIN         | MAX  |      |
| A   | .071         | .087 | 1.80        | 2.20 |      |
| B   | .045         | .053 | 1.15        | 1.35 |      |
| C   | .079         | .087 | 2.00        | 2.20 |      |
| D   | .026 Nominal |      | 0.65Nominal |      |      |
| E   | .047         | .055 | 1.20        | 1.40 |      |
| F   | .012         | .016 | .30         | .40  |      |
| G   | .000         | .004 | .000        | .100 |      |
| H   | .035         | .039 | .90         | 1.00 |      |
| J   | .004         | .010 | .100        | .250 |      |
| K   | .012         | .016 | .30         | .40  |      |

#### Suggested Solder Pad Layout



**SMALL SIGNAL CHARACTERISTICS**

|                  |                                                                                                        |                                                              |     |     |                    |
|------------------|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|-----|-----|--------------------|
| C <sub>obo</sub> | Output Capacitance<br>(V <sub>CB</sub> =5.0Vdc, f=1.0MHz, I <sub>E</sub> =0)                           |                                                              | --- | 4.0 | pF                 |
| C <sub>ibo</sub> | Input Capacitance<br>(V <sub>EB</sub> =0.5Vdc, f=1.0MHz, I <sub>C</sub> =0)                            |                                                              | --- | 8.0 | pF                 |
| h <sub>ie</sub>  | Input Impedance                                                                                        | V <sub>CE</sub> =10Vdc, I <sub>C</sub> =1.0mAdc,<br>f=1.0KHz | 1.0 | 10  | kohms              |
| h <sub>re</sub>  | Voltage Feedback Ratio                                                                                 |                                                              | 0.5 | 8.0 | X 10 <sup>-4</sup> |
| h <sub>fe</sub>  | Small Signal Current Gain                                                                              |                                                              | 100 | 400 | ---                |
| h <sub>oe</sub>  | Output Admittance                                                                                      |                                                              | 1.0 | 40  | uS                 |
| f <sub>T</sub>   | Current Gain-Bandwidth Product<br>(V <sub>CE</sub> =20Vdc, I <sub>C</sub> =10mAdc, f=100MHz)           |                                                              | 300 | --- | NHz                |
| NF               | Noise Figure<br>(V <sub>CE</sub> =5.0Vdc, I <sub>C</sub> =100uAdc, R <sub>C</sub> =1.0KOHMS, f=1.0KHz) |                                                              | --- | 5.0 | dB                 |

**SWITCHING CHARACTERISTICS**

|    |            |                                                                             |     |    |    |
|----|------------|-----------------------------------------------------------------------------|-----|----|----|
| td | Delay Time | $V_{CC}=3.0Vdc$ , $I_C=100\mu A$ ,<br>$V_{BE(off)}=0.5Vdc$ , $I_{B1}=1.0mA$ | --- | 35 | ns |
| tr | Rise Time  |                                                                             | --- | 35 | ns |

## Ordering Information :

| Device         | Packing               |
|----------------|-----------------------|
| Part Number-TP | Tape&Reel; 3Kpcs/Reel |

Note : Adding "-HF" suffix for halogen free, eg. Part Number-TP-HF

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