



START499ETR

NPN RF silicon transistor

Features

- High efficiency
- High gain
- Linear and non linear operation
- Transition frequency 42 GHz
- Ultra miniature SOT-343 (SC70) lead free package

Applications

- PA for dect or PHS
- PA stage for wireless LAN and Bluetooth™ @ 2.5 GHz
- UHF-VHF pre power amplifier

Description

START499ETR is a product of the START family that provide the market with a Si state-of-art RF process. Manufactured in ST 3rd generation bipolar process, it offers the highest power, gain and efficiency in SOT-343 for given breakdown voltage (BV_{ceo}). Suitable for a wide range of applications up to 5 GHz, it shows a performance level achieved before with GaAs products only.

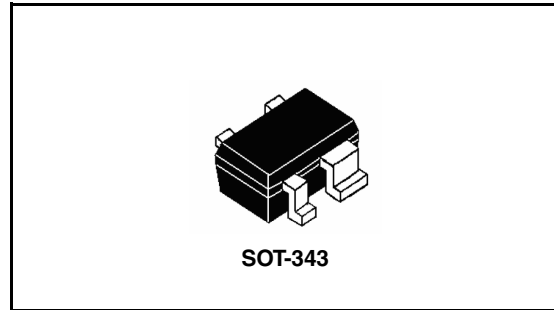


Table 1. Device summary

| Part number | Marking | Package | Packaging |
|-------------|---------|---------|---------------|
| START499ETR | E99 | SOT-343 | Tape and reel |

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1 Electrical data

1.1 Maximum ratings

Table 2. Absolute maximum ratings ($T_C = +25^\circ\text{C}$)

| Symbol | Parameter | Value | Unit |
|-----------|---|------------|------------------|
| V_{CEO} | Collector emitter voltage | 4.5 | V |
| V_{CBO} | Collector base voltage | 15 | V |
| V_{EBO} | Emitter base voltage | 1.5 | V |
| I_C | Collector current | 600 | mA |
| I_B | Base current | 32 | mA |
| P_{TOT} | Total dissipation at $T_S = 60^\circ\text{C}$ | 600 | mW |
| T_{STG} | Storage temperature | -65 to 150 | $^\circ\text{C}$ |
| T_J | Max. operating junction temperature | 150 | $^\circ\text{C}$ |

1.2 Thermal data

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|------------|------------------------------------|-------|---------------------------|
| R_{thJC} | Junction - case thermal resistance | 150 | $^\circ\text{C}/\text{W}$ |

2 Electrical characteristics

Table 4. Electrical characteristics ($t_J = 25\text{ °C}$, unless otherwise specified)

| Symbol | Parameter | Test conditions | Min | Typ | Max | Unit |
|------------|------------------------------------|---|-----|------|-----|---------------|
| I_{CBO} | Collector cutoff current | $V_{CB} = 5\text{ V}$, $I_E = 0\text{ A}$ | | | 1.2 | μA |
| I_{EBO} | Emitter-base cutoff current | $V_{EB} = 1.5\text{ V}$, $I_C = 0\text{ A}$ | | | 120 | μA |
| h_{FE} | DC current gain | $I_C = 160\text{ mA}$, $V_{CE} = 4\text{ V}$ | | 160 | | |
| G | Power gain | $I_C = 200\text{ mA}$, $V_{CE} = 3\text{ V}$, $f = 1.8\text{ GHz}$ | | 15 | | dB |
| P_{-1dB} | 1dB compression point | $I_C = 200\text{ mA}$, $V_{CE} = 3\text{ V}$, $f = 1.8\text{ GHz}$ | | 23.5 | | dBm |
| IP3 | Output third order intercept point | $I_C = 200\text{ mA}$, $V_{CE} = 3\text{ V}$, $f = 1.8\text{ GHz}$ | | 33.5 | | dBm |
| NF | Noise figure | $I_C = 200\text{ mA}$, $V_{CE} = 3\text{ V}$, $f = 1.8\text{ GHz}$ | | 3.3 | | dB |

Table 5. Quick reference data

| Mode of operation | f (GHz) | V_{CE} (V) | P_L (dBm) | G_P (dB) | η (%) |
|-------------------------------------|---------|--------------|-------------|------------|------------|
| Class-AB ($I_{CQ} = 5\text{ mA}$) | 1.9 | 3.6 | 26 | ≤ 12 | typ. 68 |

3 Pin connections

Figure 1. Pin out

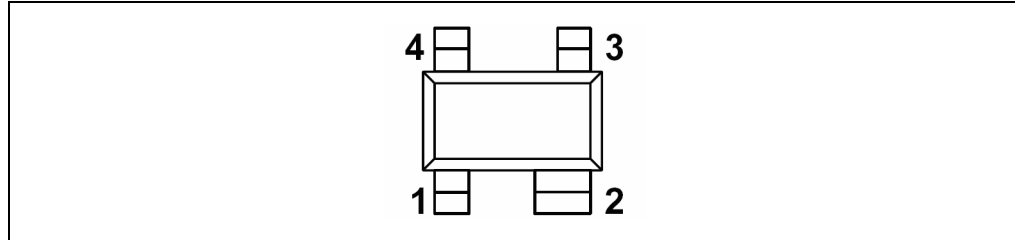


Table 6. Pin description

| Pin number | Description |
|------------|-------------|
| 1 | Base |
| 3 | Collector |
| 2,4 | Emitter |

4 Spice parameters

(Gummel-poon model, Berkley-SPICE 2G.6 syntax)

Table 7. Transistor chip data

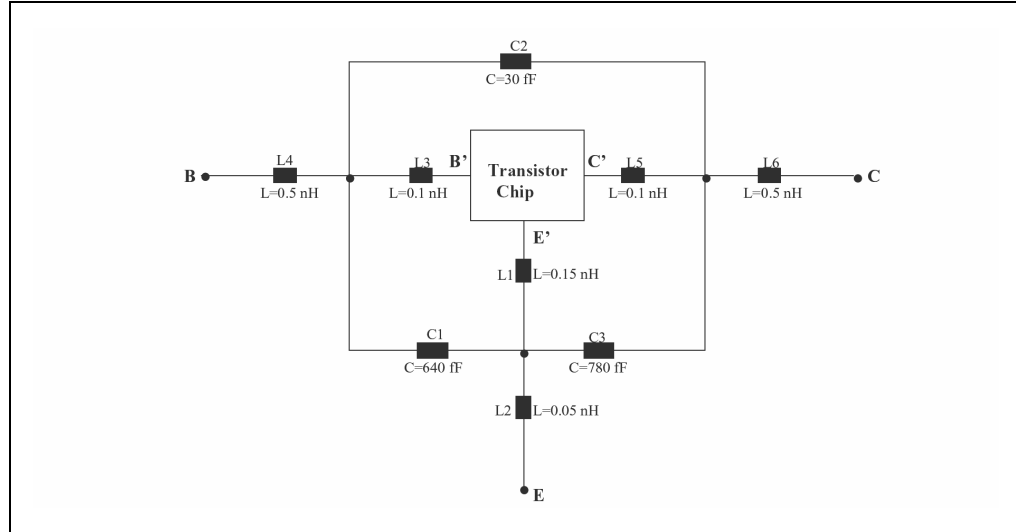
| Symbol | Value |
|--------|--|
| TMEAS | 27.0 |
| IS | 3.27E-16 |
| ISE | 13.08E-12 |
| NR | 1 |
| ISC | 7.89E-15 |
| IKF | $\{3.948*((T(oC)+273.15)/300.15)^{-1.7}\}$ |
| TR | 7E-10 |
| XTF | 16.3 |
| RB | 2.58 |
| RC | 0.597 |
| CJE | 3048E-15 |
| CJC | 930E-15 |
| CJS | 510E-15 |
| FC | 0.81 |
| EG | 1.12 |
| NF | 1 |
| NE | 3.2 |
| BR | 9.75 |
| NC | 1.5 |
| PTF | 38 |
| ITF | 5.01 |
| RBM | 0.83 |
| RE | 0.066 |
| VJE | 1.09 |
| VJC | 0.695 |
| VJS | 0.507 |
| XJBC | 0.51 |
| XTI | 3.68 |
| BF | 332 |
| VAF | 70 |
| VAR | 2.1 |

Table 7. Transistor chip data (continued)

| Symbol | Value |
|--------|---------|
| TF | 3.4E-12 |
| VTF | 29.7 |
| MJE | 0.341 |
| MJC | 0.312 |
| MJS | 0.297 |
| IKR | 57.3E-3 |
| XTB | -0.82 |

5 Package equivalent circuit

Figure 2. Package equivalent circuit



Note: In order to avoid high complexity of the package equivalent circuit, the two emitter leads of SOT-343 package are combined in one electrical connection.

5.1 For more accuracy simulation in saturation region:

Adding the 5 spice parameters showed in [Table 8](#) and using ST spice library (available on request) you can achieve a more accuracy simulation in the saturation region. ST spice library is compatible with following simulators: ELDO MENTOR (any version), SPECTRE CADENCE (any version), ADS (version 2001 only).

Table 8. Spice parameters extracted in saturation region

| RW | Vjj | ENP | VRP | RP |
|-------|-------|-------|--|---------|
| 1.034 | 0.755 | 2.235 | $\{7.2*((TEMPER+273.15)/300.15)^{(0.125)}\}$ | 0.33E-6 |

6 Common emitter S-parameters

$V_{CE} = 2 \text{ V}$, $I_C = 200 \text{ mA}$

Table 9. Common emitter S-parameters

| Freq (MHz) | $ S_{11} $ | $S_{11}\angle\Phi$ | $ S_{21} $ | $S_{21}\angle\Phi$ | $ S_{12} $ | $S_{12}\angle\Phi$ | $ S_{22} $ | $S_{22}\angle\Phi$ |
|------------|------------|--------------------|------------|--------------------|------------|--------------------|------------|--------------------|
| 0.1 | 0.669 | -158 | 65.164 | 124 | 0.008 | 47 | 0.635 | -107 |
| 0.5 | 0.778 | -179 | 15.773 | 105 | 0.013 | 81 | 0.589 | -164 |
| 0.9 | 0.781 | 174 | 8.622 | 107 | 0.021 | 119 | 0.600 | -174 |
| 1 | 0.780 | 173 | 7.535 | 109 | 0.021 | 134 | 0.598 | -176 |
| 1.5 | 0.782 | 167 | 5.203 | 120 | 0.061 | 160 | 0.600 | 180 |
| 1.8 | 0.764 | 162 | 4.229 | 122 | 0.062 | 171 | 0.605 | 177 |
| 2 | 0.765 | 159 | 3.896 | 125 | 0.090 | 173 | 0.600 | 176 |
| 2.5 | 0.725 | 153 | 3.150 | 131 | 0.132 | 179 | 0.590 | 174 |
| 3 | 0.687 | 148 | 2.364 | 138 | 0.152 | 170 | 0.575 | 171 |
| 3.5 | 0.662 | 142 | 1.806 | 152 | 0.211 | 161 | 0.569 | 167 |
| 4 | 0.677 | 139 | 1.558 | 165 | 0.263 | 154 | 0.586 | 162 |

7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

Table 10. SOT-343 mechanical data

| Dim. | mm. | | |
|------|------------------------|------|------------------------|
| | Min | Typ | Max |
| A | 178.5 | 179 | 179.5 |
| C | 12.8 | 13.0 | 13.5 |
| D | 20.2 | | |
| N | 54.5 | 55 | 55.5 |
| T | | | 14.4 |
| Ao | | 2.25 | |
| Bo | | 2.7 | |
| Ko | | 1.2 | |
| Po | 3.8 (cumulative 10 Po) | 4.0 | 4.2 (cumulative 10 Po) |
| P | | 4.0 | |

Figure 3. Package dimensions

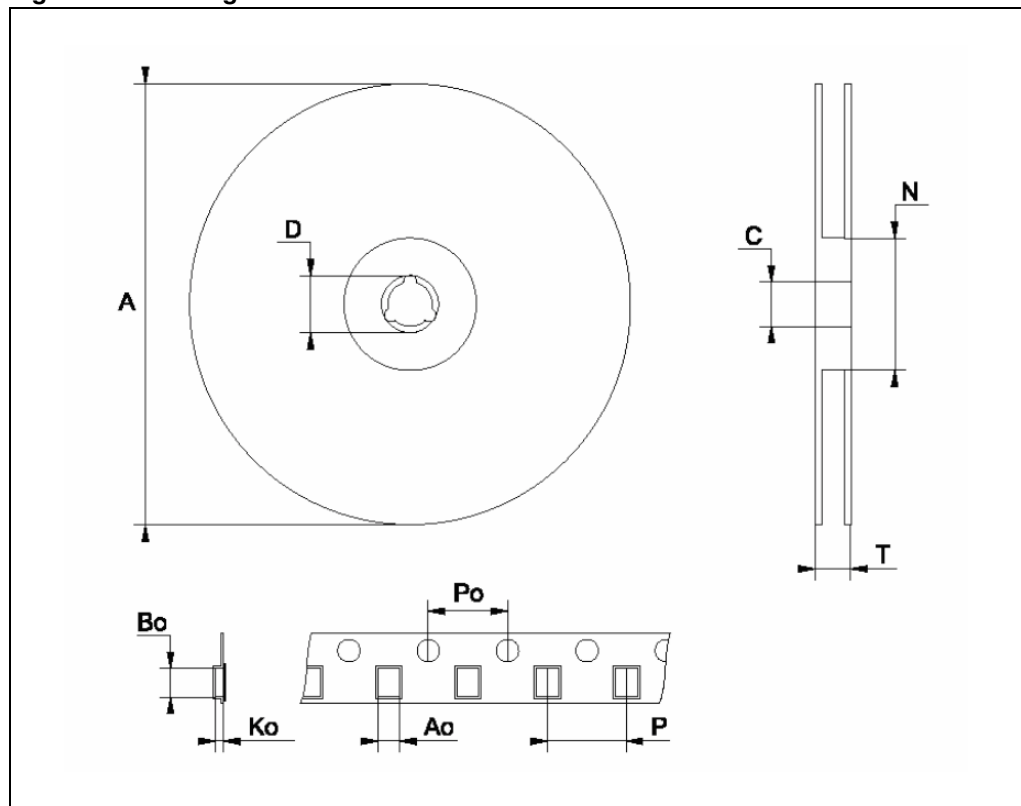


Figure 4. Device orientation

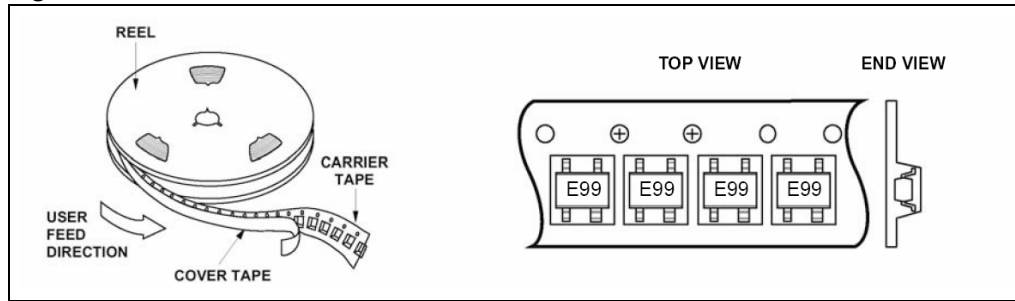
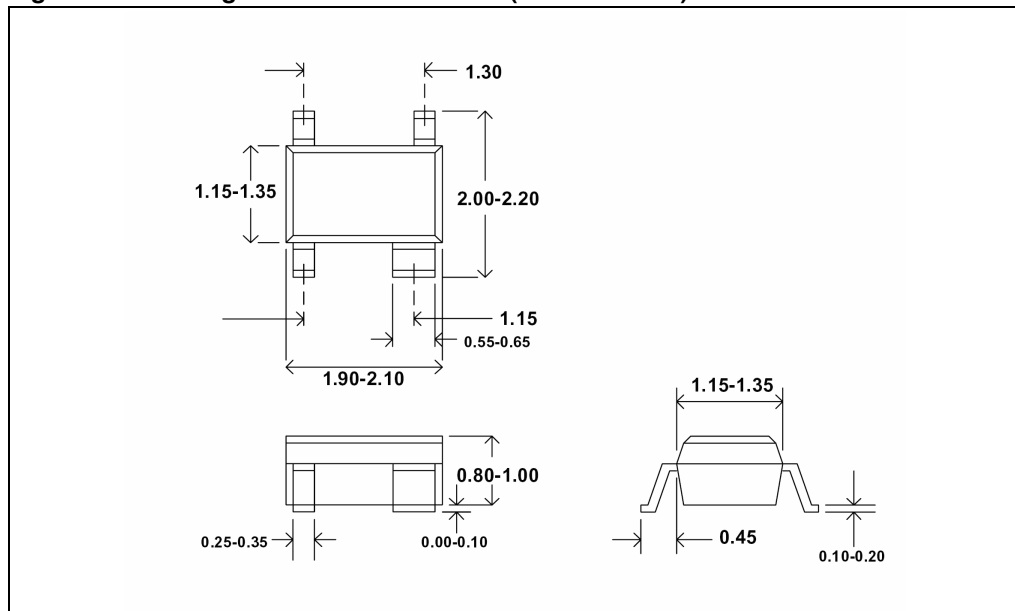


Figure 5. Package dimensions SOT-343 (SC-70 4 leads)



8 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|-------------|----------|-----------------|
| 21-Feb-2008 | 1 | Initial release |

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