



# 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 3<sup>rd</sup> generation bipolar process, it offers the highest power, gain and efficiency in SOT-343 for given breakdown voltage (BV<sub>ceo</sub>). Suitable for a wide range of applications up to 5 GHz, it shows a performance level achieved before with GaAs products only.

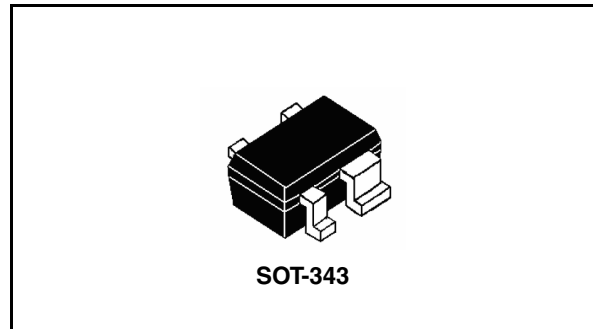


Table 1. Device summary

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 ( $t_J = 25\text{ }^\circ\text{C}$ , 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	$\mu\text{A}$
$I_{EBO}$	Emitter-base cutoff current	$V_{EB} = 1.5\text{ V}$ , $I_C = 0\text{ A}$			120	$\mu\text{A}$
$h_{FE}$	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)	$\eta$ (%)
Class-AB ( $I_{cq} = 5\text{ mA}$ )	1.9	3.6	26	$\leq 12$	typ. 68

### 3 Pin connections

Figure 1. Pin out

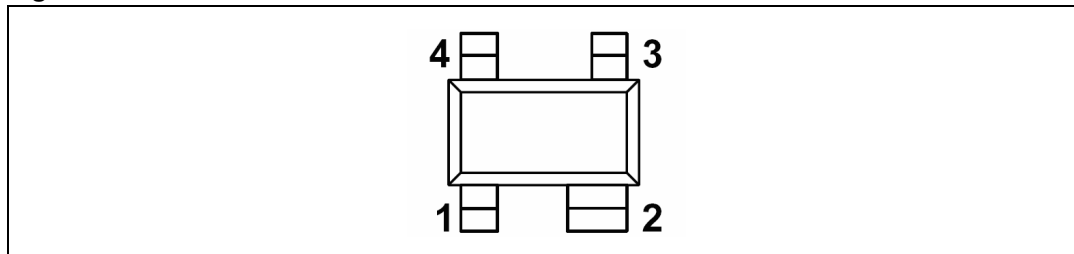


Table 6. Pin description

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**

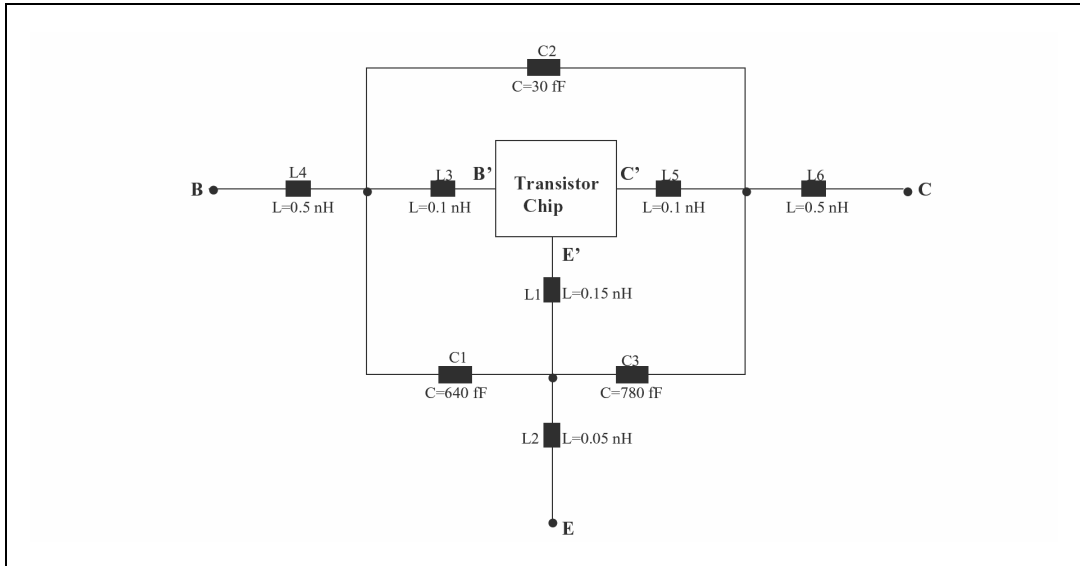
Symbol	Value
TMEAS	27.0
IS	3.27E-16
ISE	13.08E-12
NR	1
ISC	7.89E-15
IKF	{3.948*((T(oC)+273.15)/ 300.15)^(-1.7)}
TR	7E-10
XTF	16.3
RB	2.58
RC	0.597
CJE	3048E-15
CJC	930E-15
CJS	510E-15
FC	0.81
EG	1.12
NF	1
NE	3.2
BR	9.75
NC	1.5
PTF	38
ITF	5.01
RBM	0.83
RE	0.066
VJE	1.09
VJC	0.695
VJS	0.507
XJBC	0.51
XTI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

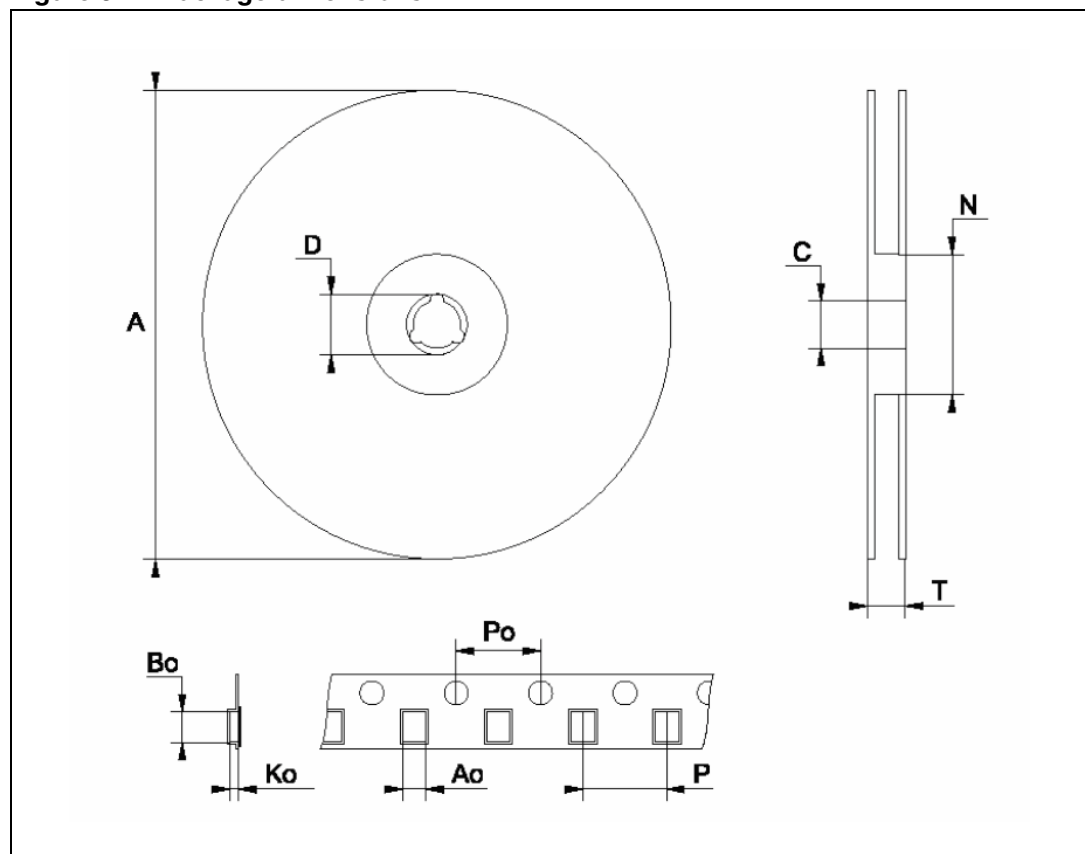


Figure 4. Device orientation

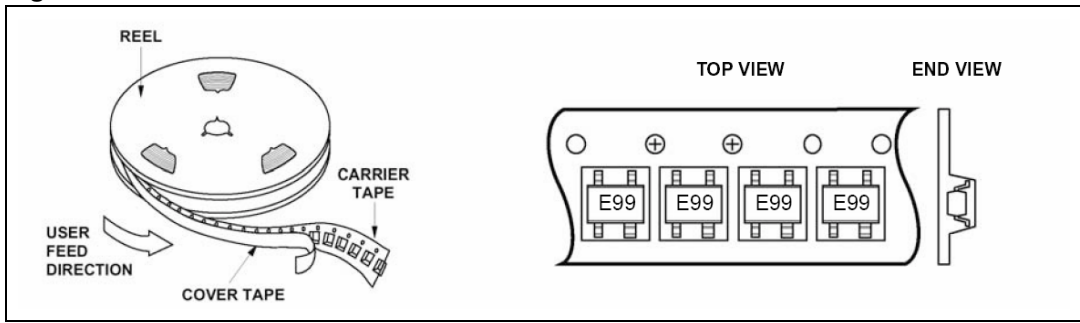
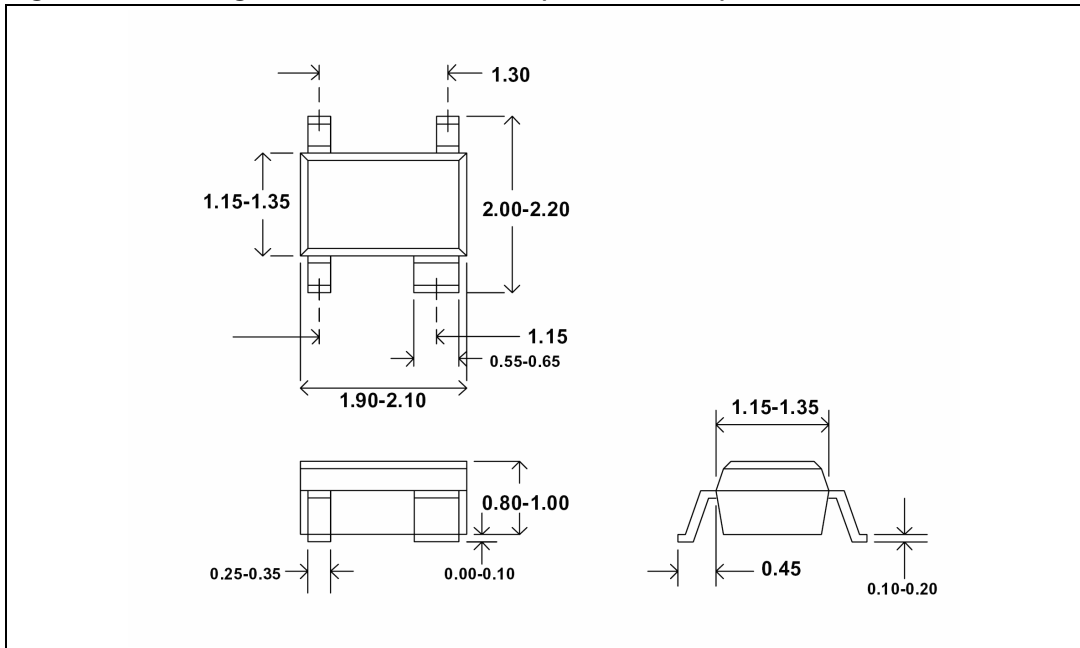


Figure 5. Package dimensions SOT-343 (SC-70 4 leads)



## 8 Revision history

Table 11. Document revision history

Date	Revision	Changes
21-Feb-2008	1	Initial release

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