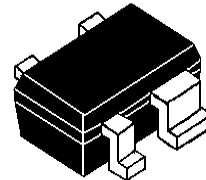




# START540

## NPN Silicon RF Transistor

- LOW NOISE FIGURE:  $NF_{min} = 0.9\text{dB}$   
@ 1.8GHz, 5mA, 2V
- HIGH OUTPUT  $IP_3 = 24\text{dBm}$   
@ 1.8GHz, 20mA, 2V
- GOOD RUGGEDNESS  $BV_{ceo} = 4.5\text{V}$
- TRANSITION FREQUENCY 45GHz
- ULTRA MINIATURE SOT343 PACKAGE



SOT343 (SC70)

**ORDER CODE**  
START540TR

**BRANDING**  
540

### DESCRIPTION

The START540 is a member of the START family that provide the market with the state of the art of RF silicon process. Manufactured in the third generation of ST proprietary bipolar process, it offers the highest linearity with excellent Noise Figure for 4.5V breakdown voltage( $BV_{ceo}$ ). It reaches performance level only achieved with GaAs products before.

### APPLICATIONS

- LNA FOR GSM/DCS, DECT, PDC, PCS, PCN, CDMA, W-CDMA
- GENERAL PURPOSE 500MHZ-5GHZ

### ABSOLUTE MAXIMUM RATINGS

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	40	mA
$I_b$	Base current	4	mA
$P_{tot}$	Total dissipation, $T_s = 101$	180	mW
$T_{stg}$	Storage temperature	-65 to 150	°C
$T_j$	Max. operating junction temperature	150	°C

### ABSOLUTE MAXIMUM RATINGS

$R_{thjs}$	Thermal Resistance Junction soldering point	270	°C/W
------------	---	-----	------

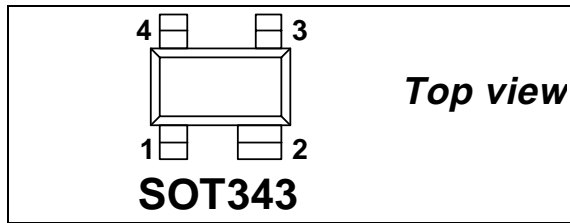
## START540

### ELECTRICAL CHARACTERISTICS (T<sub>j</sub>=25 °C, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I <sub>obo</sub>	Collector cutoff current	V <sub>cb</sub> = 5V, I <sub>e</sub> = 0A			150	nA
I <sub>ebo</sub>	Emitter-base cutoff current	V <sub>eb</sub> = 1.5V, I <sub>c</sub> = 0A			15	μA
H <sub>fe</sub>	DC current gain	I <sub>c</sub> = 20mA, V <sub>ce</sub> = 3V	100	160		
NF <sub>min</sub>	Minimum noise figure	I <sub>c</sub> = 5mA, V <sub>ce</sub> = 2V, f = 1.8GHz, Z <sub>s</sub> = Z <sub>sopt</sub>		0.9		dB
G <sub>a</sub>	NF <sub>min</sub> associated gain	I <sub>c</sub> = 5mA, V <sub>ce</sub> = 2V, f = 1.8GHz		16		dB
S <sub>21</sub>   <sup>2</sup>	Insertion power gain	I <sub>c</sub> = 20mA, V <sub>ce</sub> = 2V, f = 1.8GHz		19.5		dB
G <sub>ms</sub> <sup>(1)</sup>	Maximum stable gain	I <sub>c</sub> = 20mA, V <sub>ce</sub> = 2V, f = 1.8GHz		22.7		dB
P <sub>-1dB</sub>	1dB compression point	I <sub>c</sub> = 20mA, V <sub>ce</sub> = 2V, f = 1.8GHz		13		dBm
OIP <sub>3</sub>	Output third order intercept point	I <sub>c</sub> = 20mA, V <sub>ce</sub> = 2V, f = 1.8GHz		24		dBm

Note(1): G<sub>ms</sub> = |S<sub>21</sub> / S<sub>12</sub>|

### PINOUT



### PIN CONNECTION

Pin No.	Description
1	BASE
3	COLLECTOR
2,4	EMITTER

**COMMON EMITTER S-PARAMETERS (  $V_{CE} = 2V, I_C = 20mA$  )**

f	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.1	0.699	-21.6	42.32	164.0	0.009	88.9	0.942	-12.2
0.5	0.545	-89.7	27.82	119.9	0.027	58.1	0.642	-50.6
0.9	0.480	-130.0	18.42	98.1	0.036	48.1	0.431	-70.6
1	0.476	-137.4	16.86	94.0	0.038	47.2	0.397	-74.7
1.5	0.483	-166.9	11.63	76.9	0.048	41.6	0.272	-96.2
1.8	0.494	179.6	9.63	68.2	0.052	38.8	0.220	-110.7
2	0.503	172.2	8.49	63.1	0.055	36.7	0.193	-123.3
2.5	0.513	157.6	6.46	53.6	0.061	31.7	0.148	-154.4
3	0.533	147.8	5.34	45.9	0.069	26.7	0.142	-171.4
3.5	0.551	139.6	4.54	36.6	0.077	21.2	0.153	177.9
4	0.559	133.8	3.87	28.3	0.085	13.7	0.154	162.7

**COMMON EMITTER S-PARAMETERS (  $V_{CE} = 2V, I_C = 5mA$  )**

f	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.5	0.816	-50.5	14.56	140.8	0.038	65.8	0.879	-30.3
0.9	0.715	-84.6	11.92	118.2	0.058	48.4	0.720	-49.0
1	0.695	-92.5	11.32	113.2	0.061	45.0	0.685	-53.1
1.5	0.620	-128.0	8.64	91.5	0.075	30.9	0.515	-71.9
1.8	0.589	-145.6	7.39	80.9	0.080	23.8	0.425	-81.8
2	0.581	-156.1	6.66	74.5	0.080	19.3	0.374	-88.4
2.5	0.570	-167.6	5.87	8.0	0.082	14.8	0.316	-96.8
3	0.572	167.6	4.37	51.7	0.085	5.7	0.225	-166.8
3.5	0.585	155.3	3.74	40.4	0.090	1.1	0.208	-128.4
4	0.592	146.1	3.20	30.6	0.094	-5.0	0.184	-141.2

**COMMON EMITTER NOISE-PARAMETERS (  $V_{CE} = 2V, I_C = 5mA$  )**

f	F <sub>min</sub>	Γ <sub>opt</sub>		R <sub>n</sub>	r <sub>n</sub>	S <sub>21</sub>   <sup>2</sup>	F <sub>50</sub>
		MAG	ANG				
1.8	0.91	0.39	100.8	6.4	0.128	17.38	1.12
2	0.96	0.48	115.2	6.38	0.127	16.47	1.22
2.5	1.01	0.48	136.8	5.94	0.118	14.35	1.34
3	1.14	0.46	163	5.6	0.112	12.82	1.38
3.5	1.3	0.39	-160	5.2	0.104	11.46	1.42
4	1.4	0.32	-122.4	5	0.1	10.12	1.66

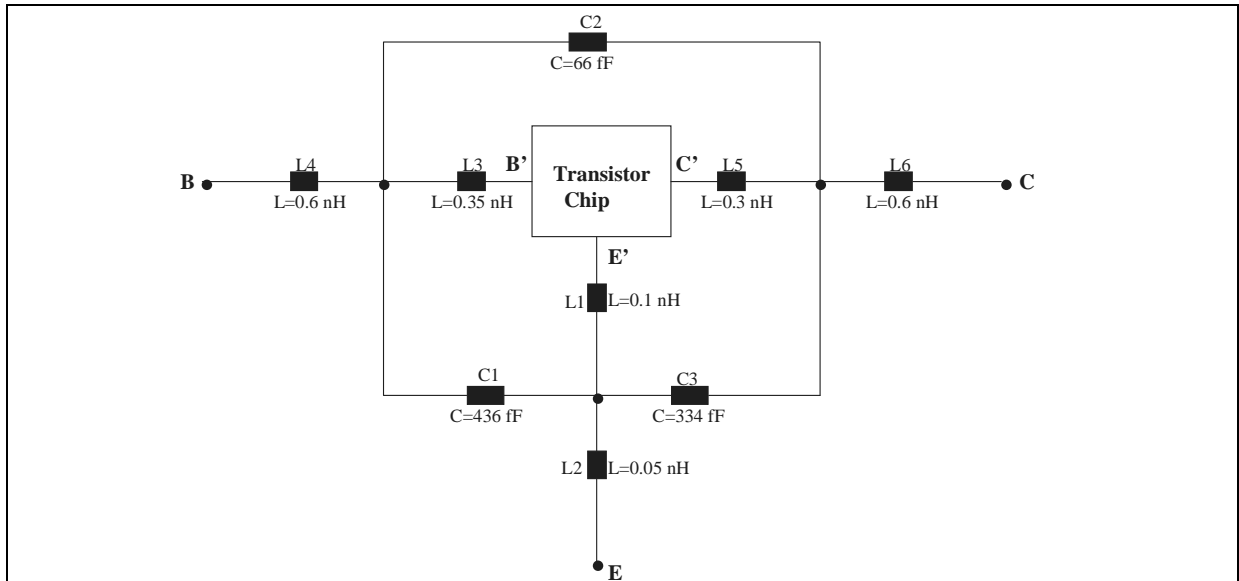
## START540

### SPICE PARAMETERS (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax)

#### TRANSISTOR CHIP DATA

Symbol	Value	Symbol	Value	Symbol	Value
TMEAS	27.0	FC	0.66	XJBC	0.53
IS	1.00E-16	EG	1.12	XTI	3.76
ISE	1.58E-11	NF	1	BF	320
NR	1	NE	3.27	VAF	70
ISC	1.55E-15	BR	9.52	VAR	2.3
IKF	$\{0.217*((T(^{\circ}C)+273.15)/300.15)^{-1.63}\}$	NC	1.495	TF	3.0E-12
TR	7E-10	PTF	32.0	VTF	27.9
XTF	9.84	ITF	0.498	MJE	0.497
RB	10.8	RBM	2.94	MJC	0.292
RC	3.77	RE	0.42	MJS	0.245
CJE	421E-15	VJE	1.03	IKR	8.32E-3
CJC	160E-15	VJC	0.6	XTB	-0.54
CJS	112E-15	VJS	0.4		

#### PACKAGE EQUIVALENT CIRCUIT



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.

#### FOR MORE ACCURACY SIMULATION IN SATURATION REGION :

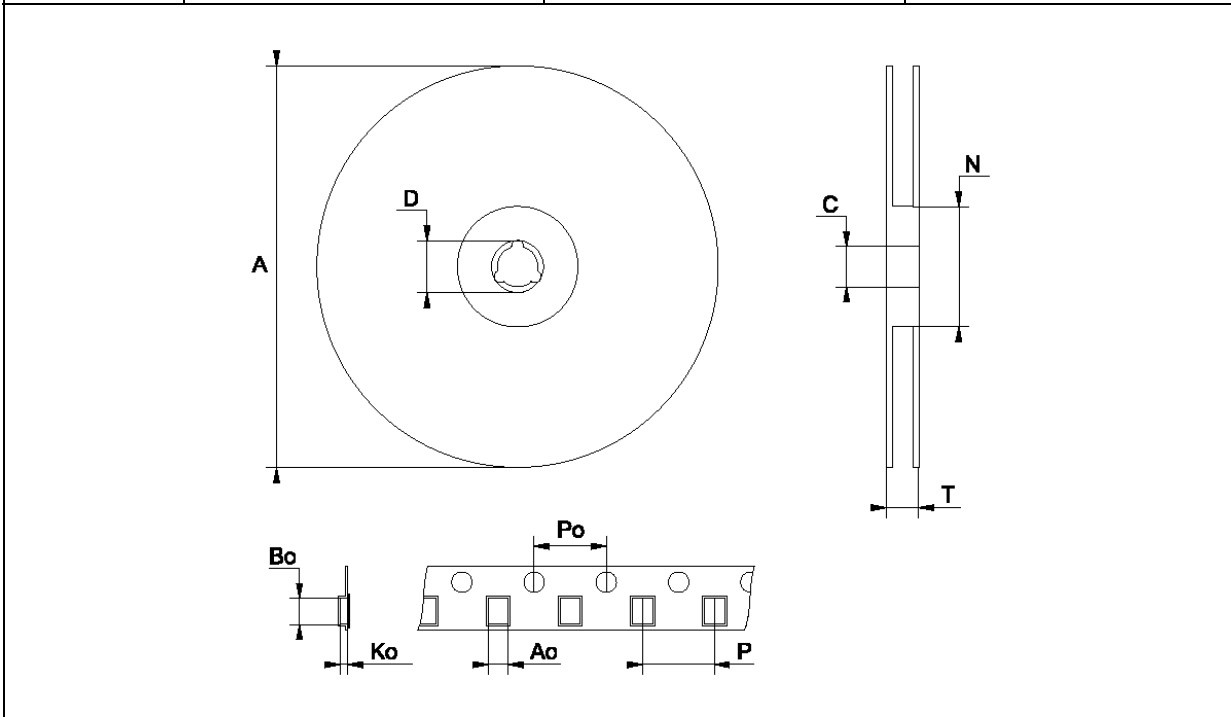
Adding the 5 Spice parameters showed in Table A and using **ST Spice Library** (available on request) you can achieve a more accuracy simulation in the saturation region. ST Spice library is compatible with following simulators: ELDO MENTOR (any version), SPECTRE CADENCE (any version), ADS (version 2001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

**Table A Table A (Spice Parameters extracted in saturation region)**

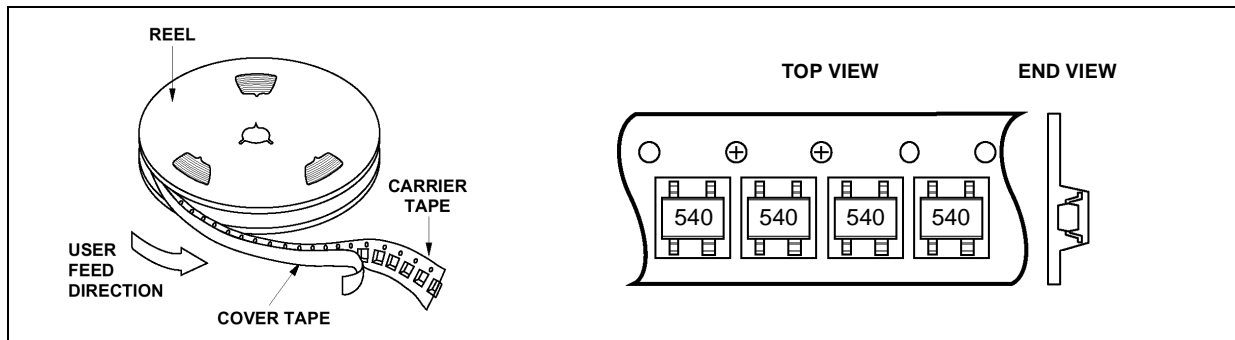
RW	Vjj	ENP	VRP	RP
1.173	0.8	2.085	$\{4.12*((TEMPER+273.15)/300.15)^{0.303}\}$	1.00E-6

TAPE & REEL DIMENSIONS

	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	

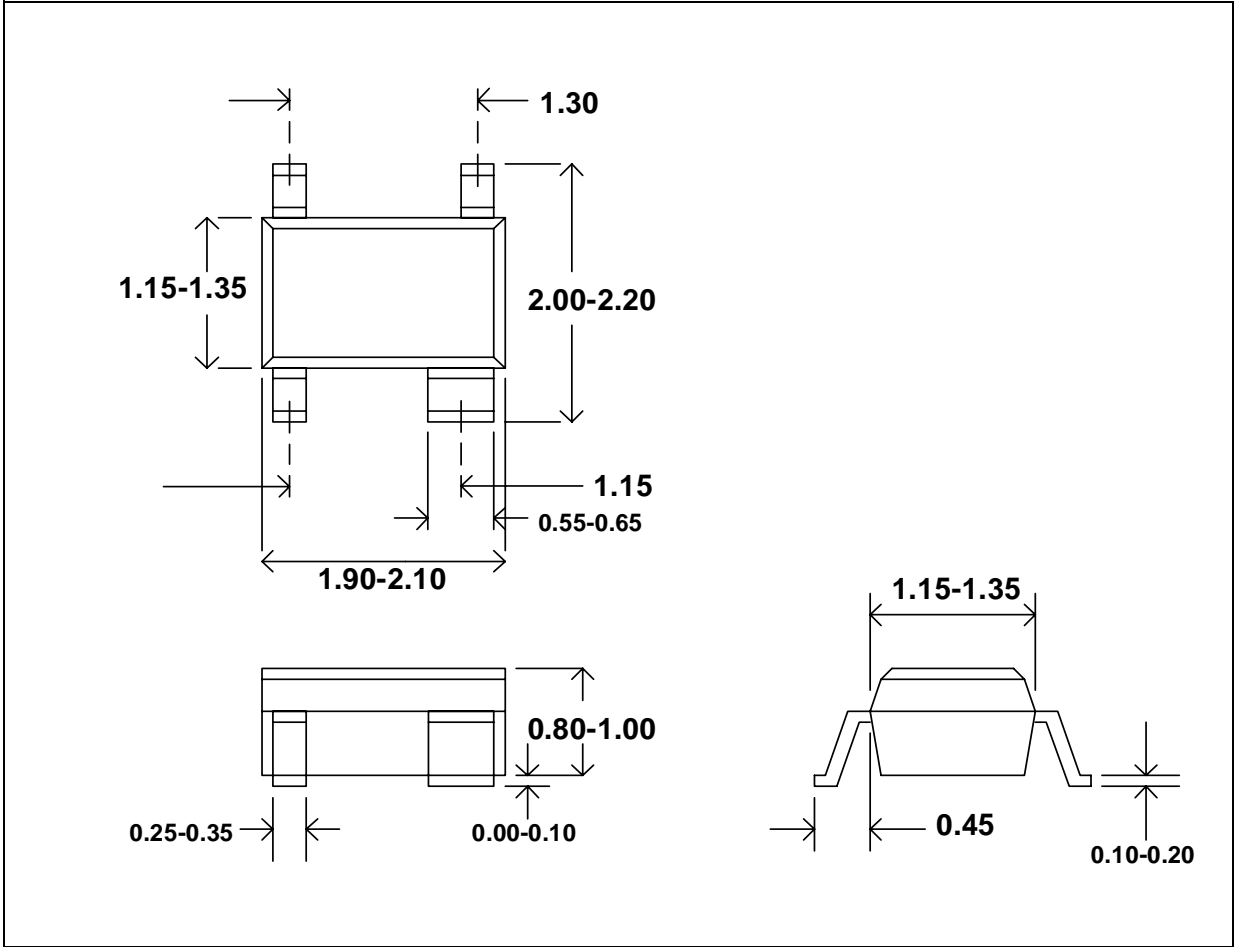


DEVICE ORIENTATION



**START540**

**PACKAGE DIMENSIONS SOT343 (SC-70 4 leads)**



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is registered trademark of STMicroelectronics  
© 2002 STMicroelectronics - All Rights Reserved

All other names are the property of their respective owners.

STMicroelectronics GROUP OF COMPANIES  
Australia - Brazil - Canada - China - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -  
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - U.S.A.  
<http://www.st.com>