

**NPN Silicon Germanium RF Transistor\***

- For high power amplifiers
- Ideal for low phase noise oscillators
- Maxim. available Gain  $G_{ma} = 21$  dB at 1.8 GHz  
Noise figure  $F = 0.8$  dB at 1.8 GHz
- Gold metallization for high reliability
- 70 GHz  $f_T$ - Silicon Germanium technology
- Pb-free (RoHS compliant) package<sup>1)</sup>
- Qualified according AEC Q101



\* Short term description



**ESD (Electrostatic discharge) sensitive device, observe handling precaution!**

Type	Marking	Pin Configuration						Package
BFP650	R5s	1=B	2=E	3=C	4=E	-	-	SOT343

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CEO}$		V
$T_A > 0$ °C		4	
$T_A \leq 0$ °C		3.7	
Collector-emitter voltage	$V_{CES}$	13	
Collector-base voltage	$V_{CBO}$	13	
Emitter-base voltage	$V_{EBO}$	1.2	
Collector current	$I_C$	150	mA
Base current	$I_B$	10	
Total power dissipation <sup>2)</sup>	$P_{tot}$	500	mW
$T_S \leq 75$ °C			
Junction temperature	$T_j$	150	°C
Ambient temperature	$T_A$	-65 ... 150	
Storage temperature	$T_{stg}$	-65 ... 150	

<sup>1)</sup>Pb-containing package may be available upon special request

<sup>2)</sup> $T_S$  is measured on the collector lead at the soldering point to the pcb

**Thermal Resistance**

Parameter	Symbol	Value	Unit
Junction - soldering point <sup>1)</sup>	$R_{thJS}$	≤ 140	K/W

**Electrical Characteristics** at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**DC Characteristics**

Collector-emitter breakdown voltage $I_C = 3 \text{ mA}$ , $I_B = 0$	$V_{(BR)CEO}$	4	4.5	-	V
Collector-emitter cutoff current $V_{CE} = 13 \text{ V}$ , $V_{BE} = 0$	$I_{CES}$	-	-	100	$\mu\text{A}$
Collector-base cutoff current $V_{CB} = 5 \text{ V}$ , $I_E = 0$	$I_{CBO}$	-	-	100	nA
Emitter-base cutoff current $V_{EB} = 0.5 \text{ V}$ , $I_C = 0$	$I_{EBO}$	-	-	10	$\mu\text{A}$
DC current gain $I_C = 80 \text{ mA}$ , $V_{CE} = 3 \text{ V}$ , pulse measured	$h_{FE}$	110	180	270	-

<sup>1)</sup>For calculation of  $R_{thJA}$  please refer to Application Note Thermal Resistance

**Electrical Characteristics at  $T_A = 25^\circ\text{C}$ , unless otherwise specified**

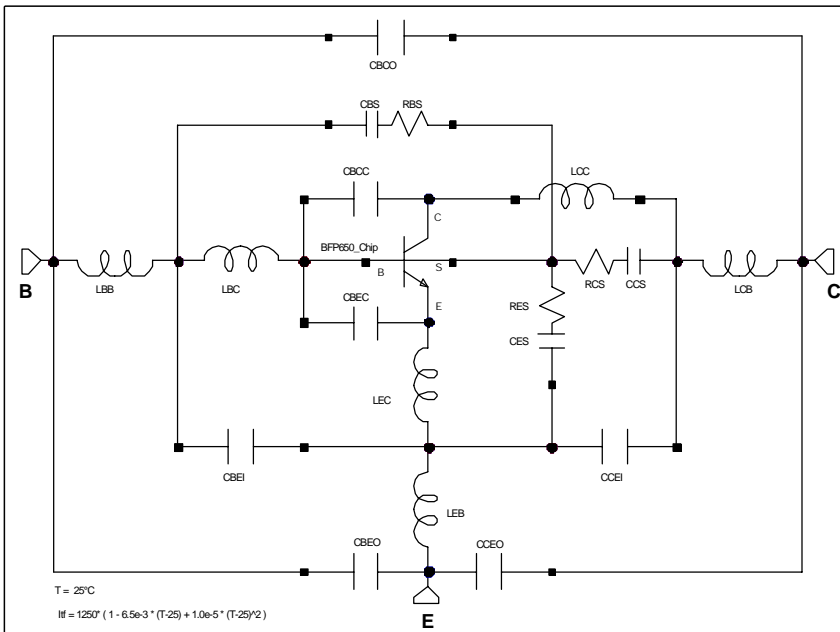
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>AC Characteristics (verified by random sampling)</b>					
Transition frequency $I_C = 80\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 1\text{ GHz}$	$f_T$	28	37	-	GHz
Collector-base capacitance $V_{CB} = 3\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , emitter grounded	$C_{cb}$	-	0.26	0.4	pF
Collector emitter capacitance $V_{CE} = 3\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , base grounded	$C_{ce}$	-	0.45	-	
Emitter-base capacitance $V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$ , $V_{CB} = 0$ , collector grounded	$C_{eb}$	-	1.1	-	
Noise figure $I_C = 10\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 1.8\text{ GHz}$ , $Z_S = Z_{Sopt}$ $I_C = 10\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $f = 6\text{ GHz}$ , $Z_S = Z_{Sopt}$	$F$	-	0.8	-	dB
		-	1.9	-	
Power gain, maximum available <sup>1)</sup> $I_C = 80\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ , $f = 1.8\text{ GHz}$ $f = 6\text{ GHz}$	$G_{ma}$	-	21.5	-	
		-	10.5	-	
Transducer gain $I_C = 80\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$ $f = 6\text{ GHz}$	$ S_{21e} ^2$	15	17.5	-	dB
		-	6	-	
Third order intercept point at output <sup>2)</sup> $V_{CE} = 3\text{ V}$ , $I_C = 80\text{ mA}$ , $f = 1.8\text{ GHz}$ , $Z_S = Z_L = 50\ \Omega$	$IP_3$	-	29.5	-	dBm
1dB Compression point at output $I_C = 80\text{ mA}$ , $V_{CE} = 3\text{ V}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 1.8\text{ GHz}$	$P_{-1dB}$	-	18	-	

<sup>1</sup> $G_{ma} = |S_{21e} / S_{12e}| (k - (k^2 - 1)^{1/2})$ 
<sup>2</sup> $IP_3$  value depends on termination of all intermodulation frequency components.  
Termination used for this measurement is  $50\ \Omega$  from 0.1 MHz to 6 GHz

**SPICE Parameter (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax):**
**Transistor Chip Data:**

IS =	0.61	fA	BF =	450	-	NF =	1.025	-
VAF =	1000	V	IKF =	0.47	A	ISE =	62	fA
NE =	2	-	BR =	42	-	NR =	1	-
VAR =	2	V	IKR =	18	mA	ISC =	700	fA
NC =	1.8	-	RB =	1.036	$\Omega$	IRB =	4.548	mA
RBM =	0.895	$\Omega$	RE =	0.2	-	RC =	1.006	$\Omega$
CJE =	682.5	fF	VJE =	0.8	V	MJE =	0.3	-
TF =	1.9	ps	XTF =	10	-	VTF =	1.5	V
ITF =	1.25	A	PTF =	0	deg	CJC =	204.6	fF
VJC =	0.6	V	MJC =	0.5	-	XCJC =	1	-
TR =	0.2	ns	CJS =	294.9	fF	VJS =	0.6	V
MJS =	0.27	-	XTB =	-1.42	-	EG =	1.078	eV
XTI =	3	-	FC =	0.8	-	TNOM =	298	K
AF =	2	-	KF =	2.441E-11	-			
TITF1 =	-0.0065	-	TITF2 =	1.0E-5	-			

All parameters are ready to use, no scaling is necessary.

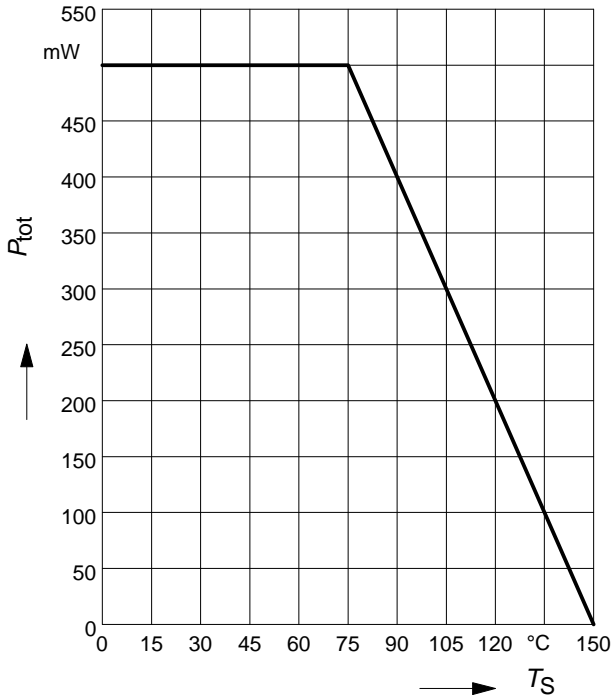
**Package Equivalent Circuit:**


LBC =	50	pH
LCC =	50	pH
LEC =	4	pH
LBB =	554.6	pH
LCB =	606.9	pH
LEB =	138.7	pH
CBEC =	327.6	fF
CBCC =	171.4	fF
CES =	490	fF
CBS =	120	fF
CCS =	135	fF
CBCO =	7.5	fF
CCEO =	112.6	fF
CBEI =	121.5	fF
CCEI =	5.7	fF
CBEI =	6.9	$\Omega$
RBS =	710	$\Omega$
RCS =	710	$\Omega$
RES =	140	$\Omega$

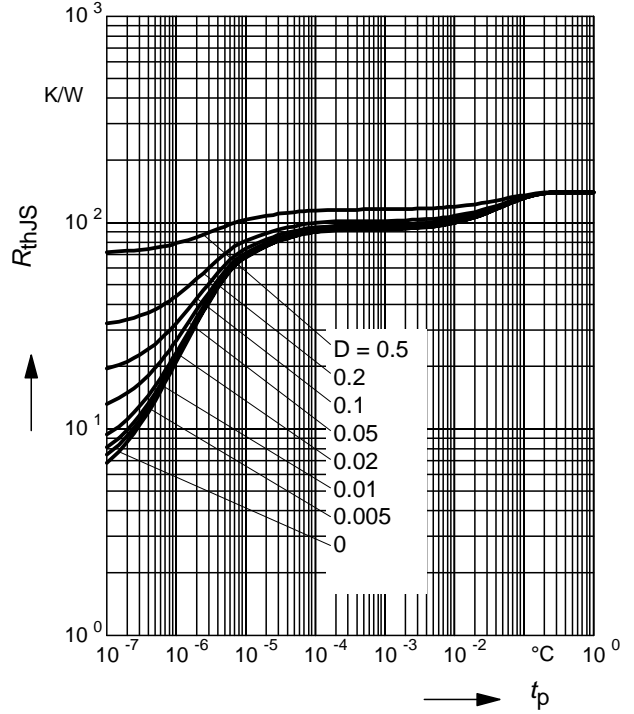
For examples and ready to use parameters please contact your local Infineon Technologies distributor or sales office to obtain a Infineon Technologies CD-ROM or see Internet: <http://www.infineon.com>

Valid up to 6GHz

**Total power dissipation  $P_{tot} = f(T_S)$**

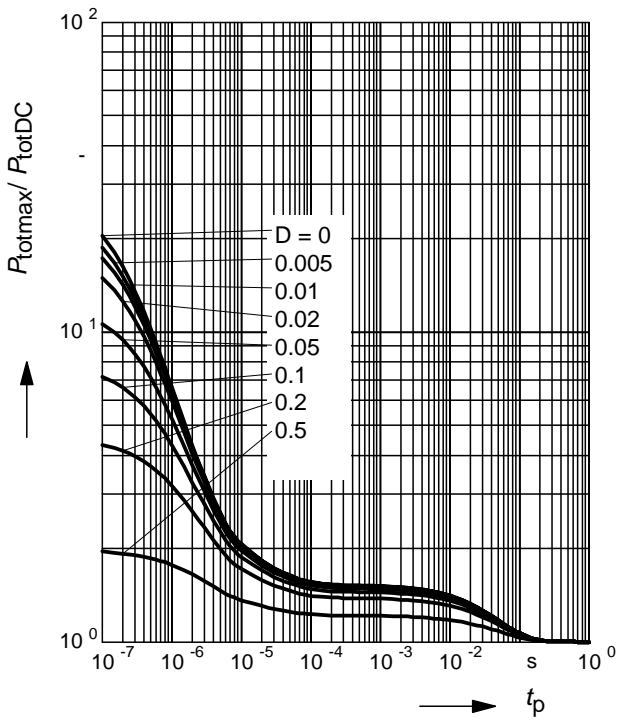


**Permissible Pulse Load  $R_{thJS} = f(t_p)$**



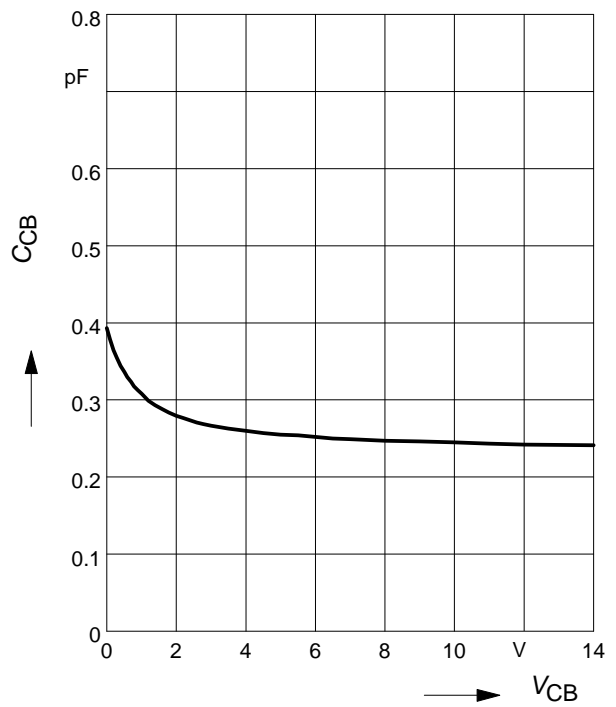
**Permissible Pulse Load**

$P_{totmax}/P_{totDC} = f(t_p)$



**Collector-base capacitance  $C_{cb} = f(V_{CB})$**

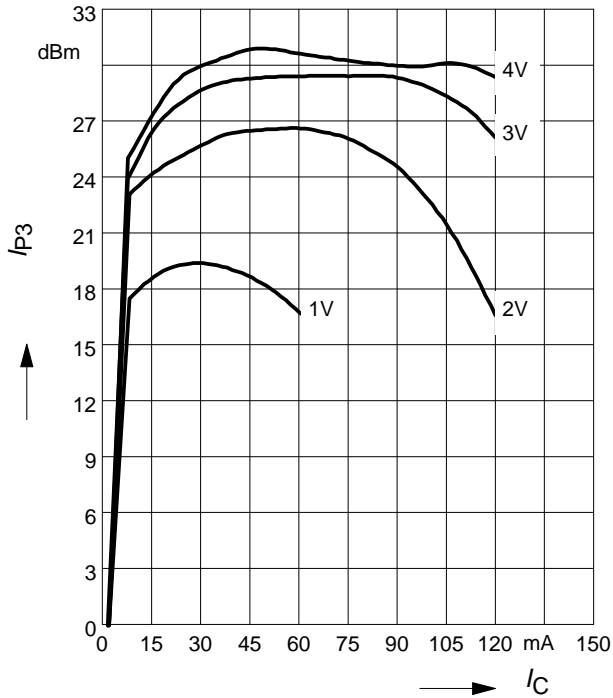
$f = 1\text{MHz}$



**Third order Intercept Point  $IP_3=f(I_C)$**

(Output,  $Z_S=Z_L=50\Omega$ )

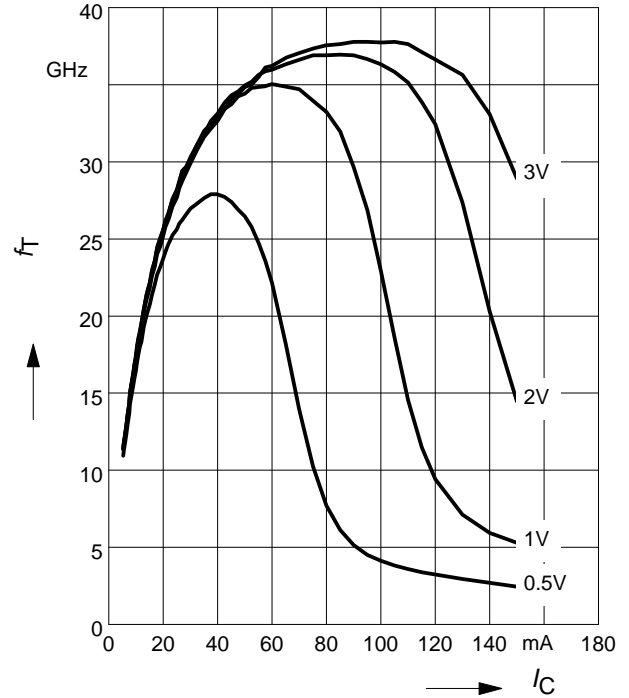
$V_{CE}$  = parameter,  $f = 1.8\text{ GHz}$



**Transition frequency  $f_T=f(I_C)$**

$f = 1\text{ GHz}$

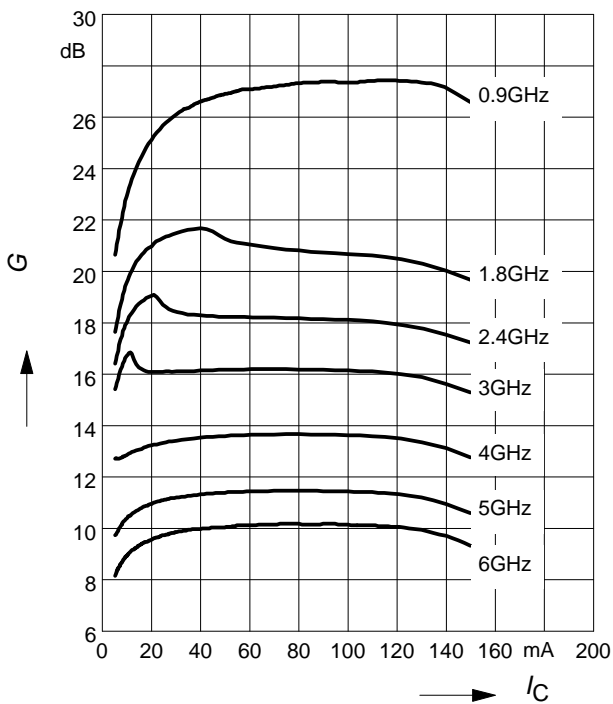
$V_{CE}$  = parameter



**Power gain  $G_{ma}, G_{ms} = f(I_C)$**

$V_{CE} = 3\text{ V}$

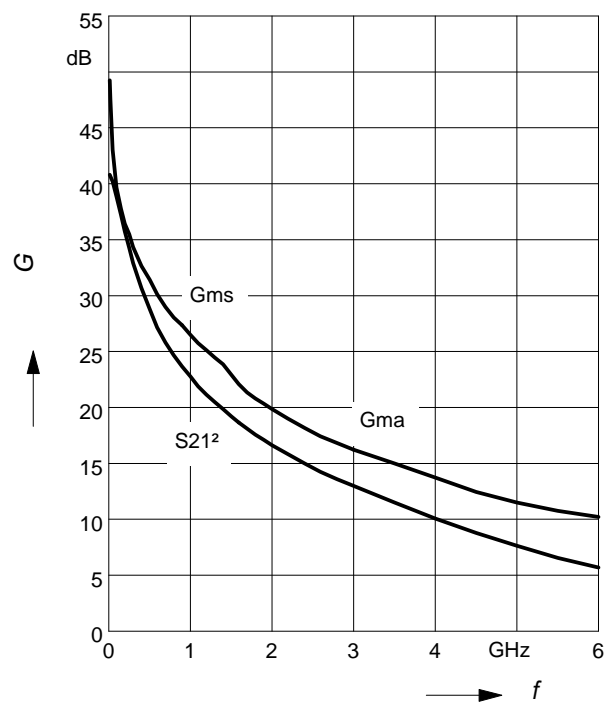
$f$  = parameter



**Power Gain  $G_{ma}, G_{ms} = f(f)$**

$|S_{21}|^2 = f(f)$

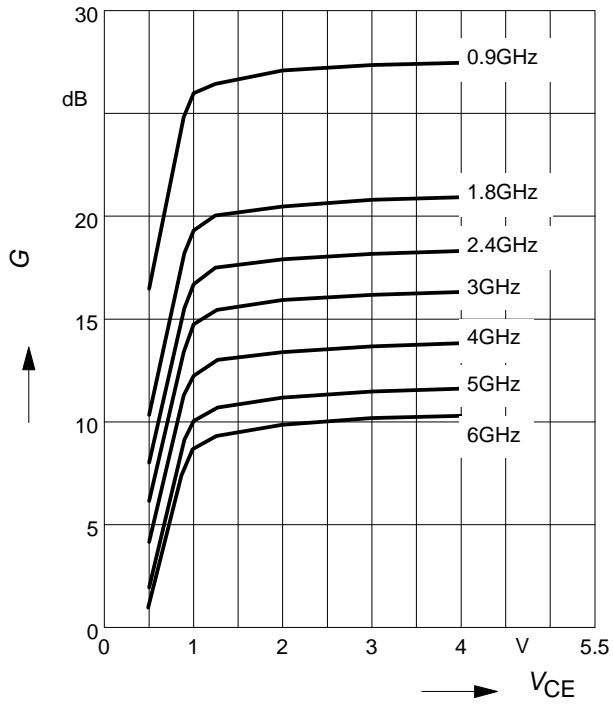
$V_{CE} = 3\text{ V}, I_C = 80\text{ mA}$



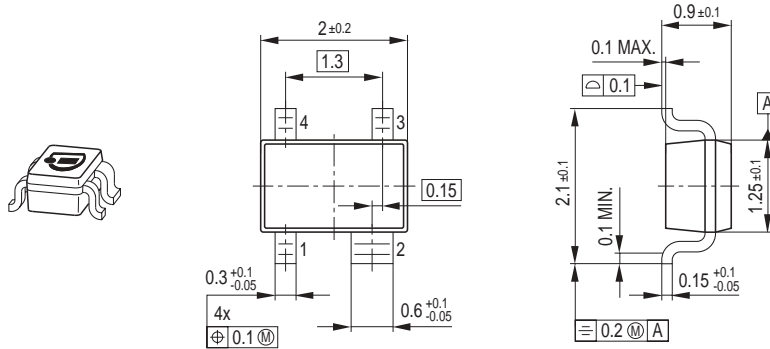
Power gain  $G_{ma}$ ,  $G_{ms} = f(V_{CE})$

$I_C = 80mA$

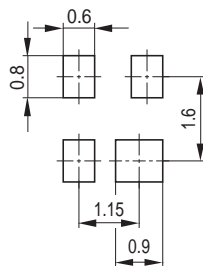
$f =$  parameter



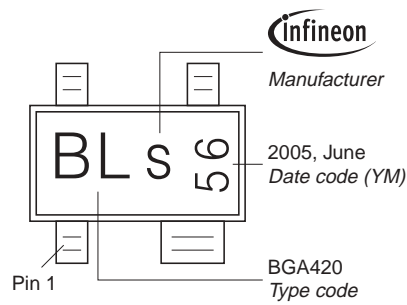
Package Outline



Foot Print

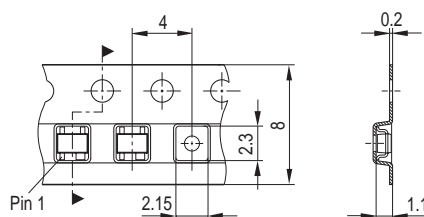


Marking Layout (Example)



Standard Packing

Reel  $\varnothing$ 180 mm = 3.000 Pieces/Reel  
 Reel  $\varnothing$ 330 mm = 10.000 Pieces/Reel





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