

DATA SHEET

BFE520 NPN wideband differential transistor

Preliminary specification
File under Discrete Semiconductors, SC14

1995 Sep 04

NPN wideband differential transistor

BFE520

FEATURES

- Small size
- High power gain at low bias current and voltage
- Temperature matched
- Balanced configuration
- h_{FE} matched
- Continues to operate at $V_{CE} < 1$ V.

APPLICATIONS

- Single balanced mixers
- Balanced amplifiers
- Balanced oscillators.

DESCRIPTION

Emitter coupled dual NPN silicon RF transistor in a surface mount SOT353 (S-mini) package. The transistor is primarily intended for applications in the RF front end as a balanced mixer, a differential amplifier in analog and digital cellular phones, and in cordless phones, pagers and satellite TV-tuners.

PINNING

PIN	SYMBOL	DESCRIPTION
1	b_1	base 1
2	e	emitter
3	b_2	base 2
4	c_2	collector 2
5	c_1	collector 1

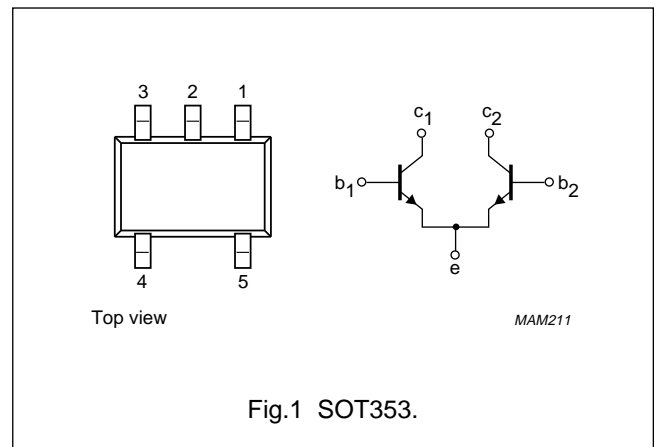


Fig.1 SOT353.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Any single transistor						
C_{re}	feedback capacitance C_{BC}	$I_e = 0$; $V_{CB} = 3$ V; $f = 1$ MHz	–	0.35	0.4	pF
MSG/G_{max}	maximum power gain	$I_C = 20$ mA; $V_{CE} = 3$ V; $f = 900$ MHz	–	16	–	dB
		$I_C = 20$ mA; $V_{CE} = 3$ V; $f = 2$ GHz	–	9	–	dB
F	noise figure	$I_C = 5$ mA; $V_{CE} = 3$ V; $f = 900$ MHz; $\Gamma_S = \Gamma_{opt}$	–	1.1	1.6	dB
		$I_C = 5$ mA; $V_{CE} = 3$ V; $f = 2$ GHz; $\Gamma_S = \Gamma_{opt}$	–	1.9	–	dB
h_{FE}	DC current gain	$I_C = 20$ mA; $V_{CE} = 3$ V	60	120	250	
$R_{th\ j-s}$	thermal resistance from junction to soldering point	single loaded	–	–	230	K/W
		double loaded	–	–	115	K/W

NPN wideband differential transistor

BFE520

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Any single transistor					
V _{CBO}	collector-base voltage	open emitter	–	20	V
V _{CES}	collector-emitter voltage	base-emitter shorted	–	15	V
V _{EBO}	emitter-base voltage	open collector	–	2.5	V
I _C	DC collector current		–	70	mA
P _{tot}	total power dissipation	up to T _s = 118 °C; note 1	–	1	W
T _{stg}	storage temperature		–65	+175	°C
T _j	junction temperature		–	175	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
R _{th j-s}	thermal resistance from junction to soldering point; note 1	single loaded	230	K/W
		double loaded	115	K/W

Note to the Limiting values and Thermal characteristics1. T_s is the temperature at the soldering point of the collector pin.

NPN wideband differential transistor

BFE520

CHARACTERISTICS

 $T_j = 25\text{ °C}$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC characteristics of any single transistor						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5\ \mu\text{A}; I_E = 0$	–	–	20	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 10\ \mu\text{A}; I_B = 0$	–	–	15	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 2.5\ \mu\text{A}; I_C = 0$	–	–	2.5	V
I_{CBO}	collector-base leakage current	$I_E = 0; V_{CB} = 6\ \text{V}$	–	–	50	nA
h_{FE}	DC current gain	$I_C = 20\ \text{mA}; V_{CE} = 6\ \text{V}$	60	120	250	
AC characteristics of any single transistor						
f_T	transition frequency	$I_C = 20\ \text{mA}; V_{CE} = 3\ \text{V};$ $f = 1\ \text{GHz}$	–	9	–	GHz
C_c	collector capacitance	$I_E = i_e = 0; V_{CB} = 3\ \text{V}; f = 1\ \text{MHz}$	–	0.4	0.45	pF
C_{re}	feedback capacitance	$I_C = 0; V_{CB} = 3\ \text{V}; f = 1\ \text{MHz}$	–	0.35	0.4	pF
MSG/G_{max}	maximum power gain; note 1	$I_C = 20\ \text{mA}; V_{CE} = 3\ \text{V};$ $f = 900\ \text{MHz}; T_{amb} = 25\text{ °C}$	–	16	–	dB
		$I_C = 20\ \text{mA}; V_{CE} = 3\ \text{V};$ $f = 2\ \text{GHz}; T_{amb} = 25\text{ °C}$	–	9	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 20\ \text{mA}; V_{CE} = 3\ \text{V};$ $f = 900\ \text{MHz}; T_{amb} = 25\text{ °C}$	13	14	–	dB
F	noise figure	$I_C = 5\ \text{mA}; V_{CE} = 3\ \text{V};$ $f = 900\ \text{MHz}; \Gamma_S = \Gamma_{opt}$	–	1.1	1.6	dB
		$I_C = 5\ \text{mA}; V_{CE} = 3\ \text{V};$ $f = 2\ \text{GHz}; \Gamma_S = \Gamma_{opt}$	–	1.9	–	dB

Note

1. Maximum gain of the differential amplifier is higher because of internal emitter connection (see Fig.2).

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APPLICATION INFORMATION

SPICE parameters for any single BFE520 crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.016	fA
2	BF	220.1	–
3	NF	1.000	–
4	VAF	48.06	V
5	IKF	510.0	mA
6	ISE	283.0	fA
7	NE	2.035	–
8	BR	100.7	–
9	NR	0.988	–
10	VAR	1.692	V
11	IKR	2.352	mA
12	ISC	24.48	aA
13	NC	1.022	–
14	RB	10.00	Ω
15	IRB	1.000	μ A
16	RBM	10.00	Ω
17	RE	775.3	m Ω
18	RC	2.210	Ω
19 ⁽¹⁾	XTB	0.000	–
20 ⁽¹⁾	EG	1.110	eV
21 ⁽¹⁾	XTI	3.000	–
22	CJE	1.245	pF
23	VJE	600.0	mV
24	MJE	0.258	–
25	TF	8.616	ps
26	XTF	6.788	–
27	VTF	1.414	V
28	ITF	110.3	mA
29	PTF	45.01	deg
30	CJC	447.6	fF
31	VJC	189.2	mV
32	MJC	0.071	–
33	XCJC	0.130	–
34	TR	543.7	ps
35 ⁽¹⁾	CJS	0.000	F
36 ⁽¹⁾	VJS	750.0	mV
37 ⁽¹⁾	MJS	0.000	–
38	FC	0.780	–

Note

1. These parameters have not been extracted, the default values are shown.

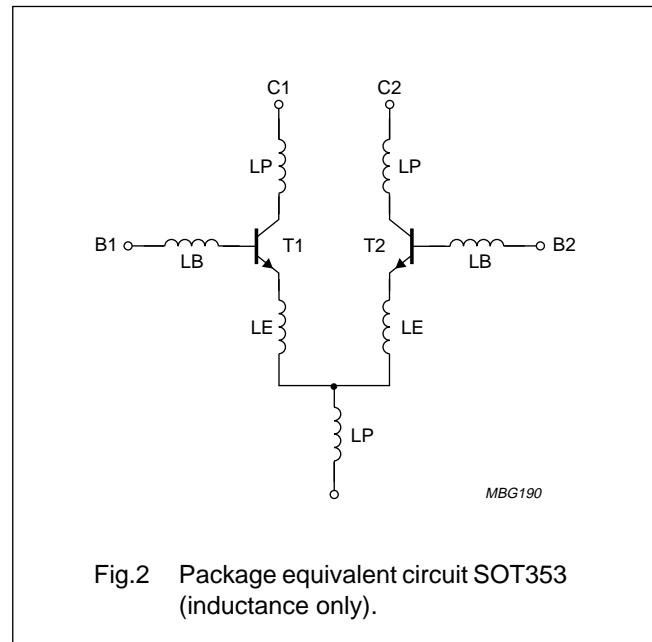
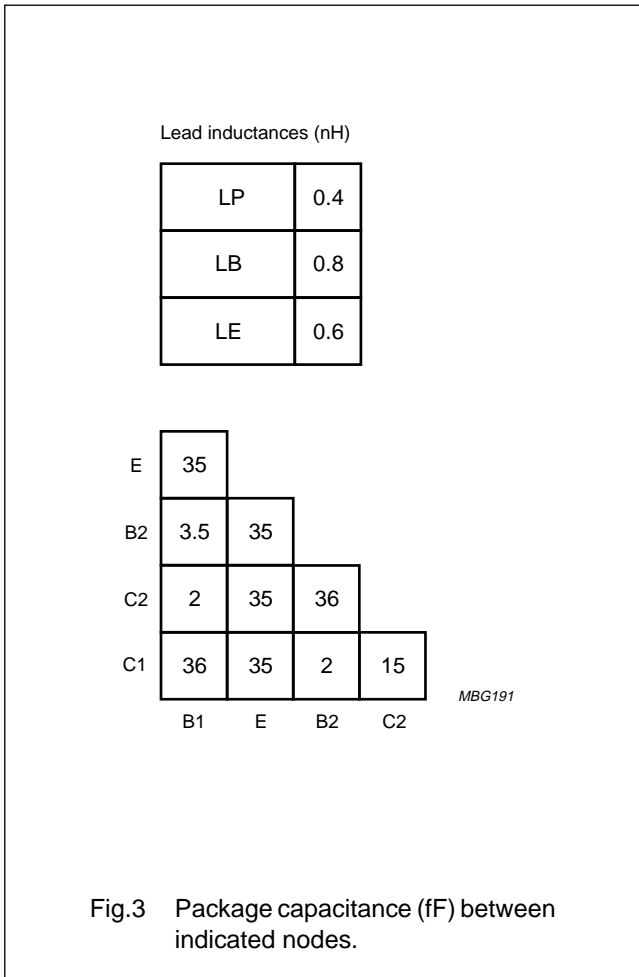


Fig.2 Package equivalent circuit SOT353 (inductance only).

NPN wideband differential transistor

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Typical application circuit

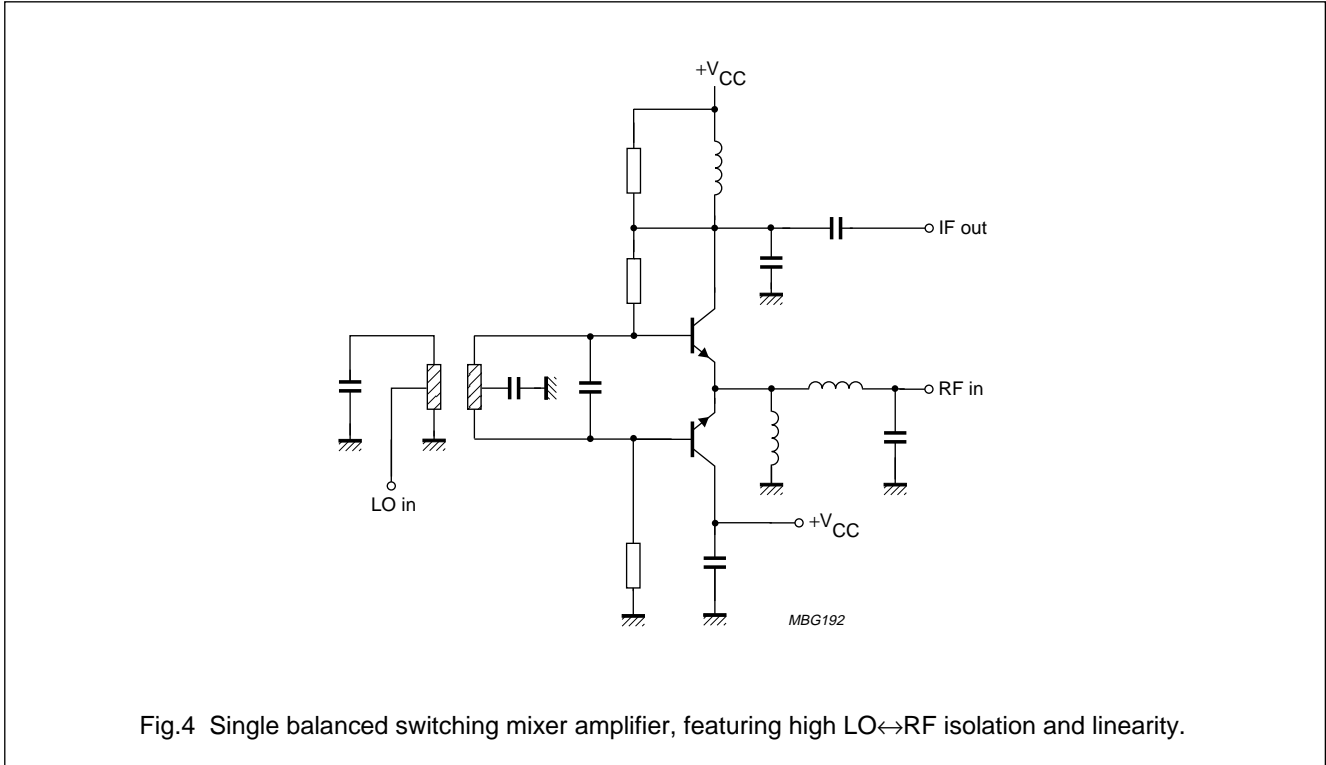
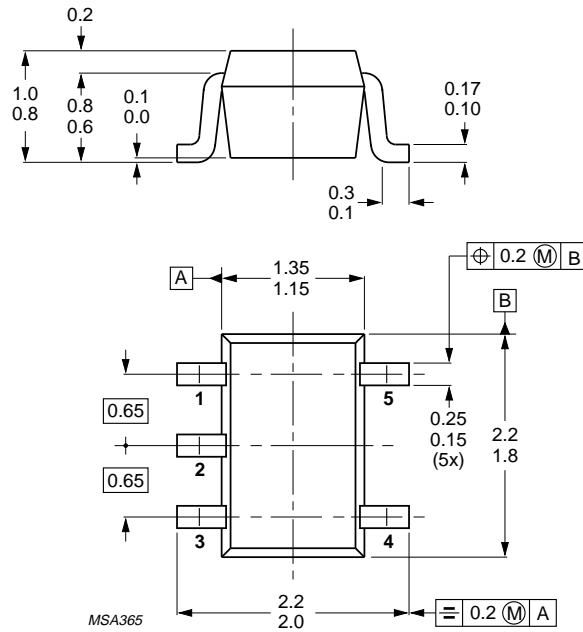


Fig.4 Single balanced switching mixer amplifier, featuring high LO↔RF isolation and linearity.

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BF E520

PACKAGE OUTLINE



Dimensions in mm.

Fig.5 SOT353.

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DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Short-form specification	The data in this specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

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