

# BF1217WR

N-channel dual gate MOSFET

Rev. 2 — 20 June 2011

Product data sheet

## 1. Product profile

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### 1.1 General description

Enhancement type N-channel field-effect transistor with source and substrate interconnected. Integrated diodes between gates and source protect against excessive input voltage surges. The BF1217WR is encapsulated in the SOT343R plastic package.

#### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

### 1.2 Features and benefits

- Excellent low frequency noise performance
- Superior cross modulation performance during AGC
- High forward transfer admittance
- High forward transfer admittance to input capacitance ratio

### 1.3 Applications

- Gain controlled low noise amplifiers for VHF and UHF applications with 5 V supply voltage
  - ◆ digital and analog television tuners
  - ◆ professional communication equipment



**1.4 Quick reference data**

**Table 1. Quick reference data**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	DC	-	-	6	V
$I_D$	drain current	DC	-	-	30	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 107\text{ }^\circ\text{C}$	[1]	-	180	mW
$ y_{fs} $	forward transfer admittance	$f = 100\text{ MHz}; T_j = 25\text{ }^\circ\text{C}; I_D = 18\text{ mA}$	23	27	38	mS
$C_{iss(G1)}$	input capacitance at gate1	$f = 100\text{ MHz}$	[2]	-	2.5	pF
$C_{rss}$	reverse transfer capacitance	$f = 100\text{ MHz}$	[2]	-	20	fF
NF	noise figure	$f = 400\text{ MHz}; Y_S = Y_{S(opt)}$	-	1.0	-	dB
		$f = 800\text{ MHz}; Y_S = Y_{S(opt)}$	-	1.5	-	dB
Xmod	cross modulation	input level for $k = 1\%$ at 40 dB AGC; $f_w = 50\text{ MHz}; f_{unw} = 60\text{ MHz}$	[3]	105	107	-
$T_j$	junction temperature		-	-	150	$^\circ\text{C}$

[1]  $T_{sp}$  is the temperature at the soldering point of the source lead.

[2] Calculated from S-parameters.

[3] Measured in [Figure 17](#) test circuit.

**2. Pinning information**

**Table 2. Discrete pinning**

Pin	Description	Simplified outline	Graphic symbol
1	source		
2	drain		
3	gate 2		
4	gate 1		

**3. Ordering information**

**Table 3. Ordering information**

Type number	Package		Version
	Name	Description	
BF1217WR	-	plastic surface-mounted package; reverse pinning; 4 leads	SOT343R

## 4. Marking

**Table 4. Marking**

Type number	Marking	Description
BF1217WR	VA%	% = p : made in Hong Kong
		% = t : made in Malaysia
		% = w : made in China

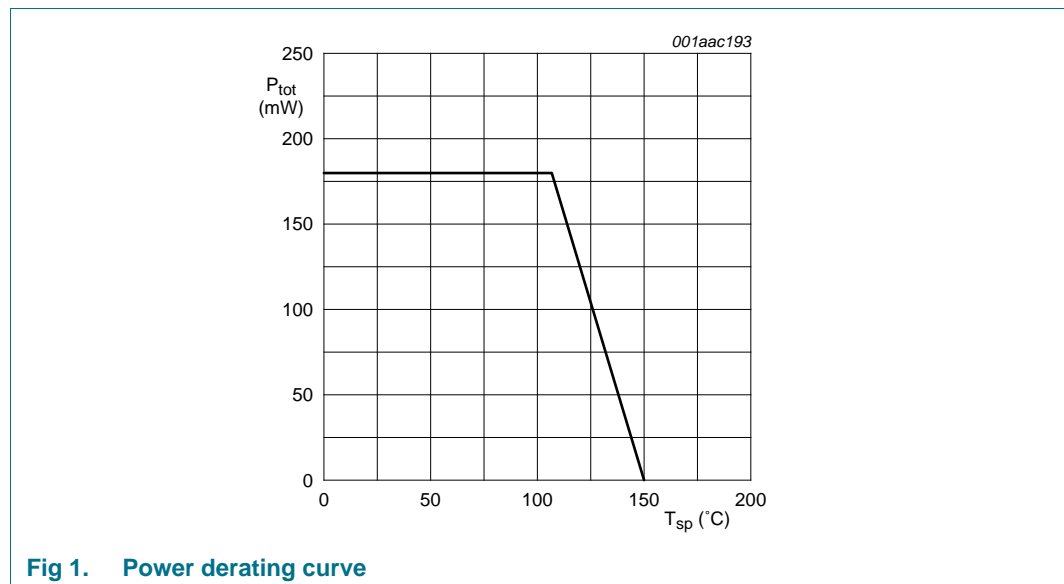
## 5. Limiting values

**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
<b>Per MOSFET</b>					
$V_{DS}$	drain-source voltage	DC	-	6	V
$I_D$	drain current	DC	-	30	mA
$I_{G1}$	gate1 current		-	±10	mA
$I_{G2}$	gate2 current		-	±10	mA
$P_{tot}$	total power dissipation	$T_{sp} \leq 107\text{ °C}$ [1]	-	180	mW
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	150	°C

[1]  $T_{sp}$  is the temperature at the soldering point of the source lead.



**Fig 1. Power derating curve**

## 6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point		240	K/W

## 7. Static characteristics

Table 7. Static characteristics

$T_j = 25\text{ }^\circ\text{C}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per MOSFET; unless otherwise specified</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{G1-S} = V_{G2-S} = 0\text{ V}$ ; $I_D = 10\text{ }\mu\text{A}$	6	-	-	V
$V_{(BR)G1-SS}$	gate1-source breakdown voltage	$V_{G2-S} = V_{DS} = 0\text{ V}$ ; $I_{G1-S} = 10\text{ mA}$	6	-	10	V
$V_{(BR)G2-SS}$	gate2-source breakdown voltage	$V_{G1-S} = V_{DS} = 0\text{ V}$ ; $I_{G2-S} = 10\text{ mA}$	6	-	10	V
$V_{F(S-G1)}$	forward source-gate1 voltage	$V_{G2-S} = V_{DS} = 0\text{ V}$ ; $I_{S-G1} = 10\text{ mA}$	0.5	-	1.5	V
$V_{F(S-G2)}$	forward source-gate2 voltage	$V_{G1-S} = V_{DS} = 0\text{ V}$ ; $I_{S-G2} = 10\text{ mA}$	0.5	-	1.5	V
$V_{G1-S(th)}$	gate1-source threshold voltage	$V_{DS} = 5\text{ V}$ ; $V_{G2-S} = 4\text{ V}$ ; $I_D = 100\text{ }\mu\text{A}$	0.3	-	1.0	V
$V_{G2-S(th)}$	gate2-source threshold voltage	$V_{DS} = 5\text{ V}$ ; $V_{G1-S} = 5\text{ V}$ ; $I_D = 100\text{ }\mu\text{A}$	0.4	-	1.0	V
$I_{DS}$	drain-source current	$V_{G2-S} = 4\text{ V}$ ; $V_{DS} = 5\text{ V}$ ; $R_{G1} = 82\text{ k}\Omega$	[1]	-	24	mA
$I_{G1-S}$	gate1 cut-off current	$V_{G2-S} = 0\text{ V}$ ; $V_{DS} = 0\text{ V}$ ; $V_{G1-S} = 5\text{ V}$	-	-	50	nA
$I_{G2-S}$	gate2 cut-off current	$V_{G2-S} = 4\text{ V}$ ; $V_{DS} = 0\text{ V}$ ; $V_{G1-S} = 0\text{ V}$	-	-	20	nA

[1]  $R_{G1}$  connects gate1 to  $V_{GG} = 5\text{ V}$ . See [Figure 17](#).

## 8. Dynamic characteristics

**Table 8. Dynamic characteristics**

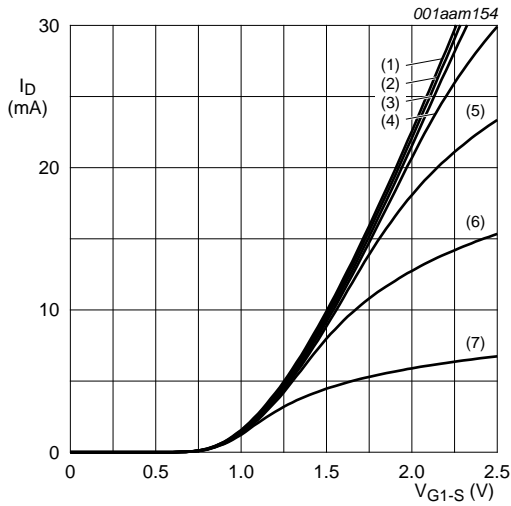
Common source;  $T_{amb} = 25\text{ °C}$ ;  $V_{G2-S} = 4\text{ V}$ ;  $V_{DS} = 5\text{ V}$ ;  $I_D = 18\text{ mA}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$ y_{fs} $	forward transfer admittance	$f = 100\text{ MHz}$ ; $T_j = 25\text{ °C}$	23	27	38	mS
$C_{iss(G1)}$	input capacitance at gate1	$f = 100\text{ MHz}$	[1]	-	2.5	pF
$C_{iss(G2)}$	input capacitance at gate2	$f = 100\text{ MHz}$	[1]	-	1.0	pF
$C_{oss}$	output capacitance	$f = 100\text{ MHz}$	[1]	-	0.8	pF
$C_{rss}$	reverse transfer capacitance	$f = 100\text{ MHz}$	[1]	-	20	fF
$G_{tr}$	transducer power gain	$B_S = B_{S(opt)}$ ; $B_L = B_{L(opt)}$	[1]			
		$f = 200\text{ MHz}$ ; $G_S = 2\text{ mS}$ ; $G_L = 0.5\text{ mS}$	-	34	-	dB
		$f = 400\text{ MHz}$ ; $G_S = 2\text{ mS}$ ; $G_L = 1\text{ mS}$	-	30	-	dB
		$f = 800\text{ MHz}$ ; $G_S = 3.3\text{ mS}$ ; $G_L = 1\text{ mS}$	-	26	-	dB
NF	noise figure	$f = 400\text{ MHz}$ ; $Y_S = Y_{S(opt)}$	-	1.0	-	dB
		$f = 800\text{ MHz}$ ; $Y_S = Y_{S(opt)}$	-	1.5	-	dB
Xmod	cross modulation	input level for $k = 1\%$ ; $f_w = 50\text{ MHz}$ ; $f_{unw} = 60\text{ MHz}$	[2]			
		at 0 dB AGC	90	104	-	dB $\mu$ V
		at 10 dB AGC	-	100	-	dB $\mu$ V
		at 20 dB AGC	-	104	-	dB $\mu$ V
		at 40 dB AGC	105	107	-	dB $\mu$ V

[1] Calculated from S-parameters.

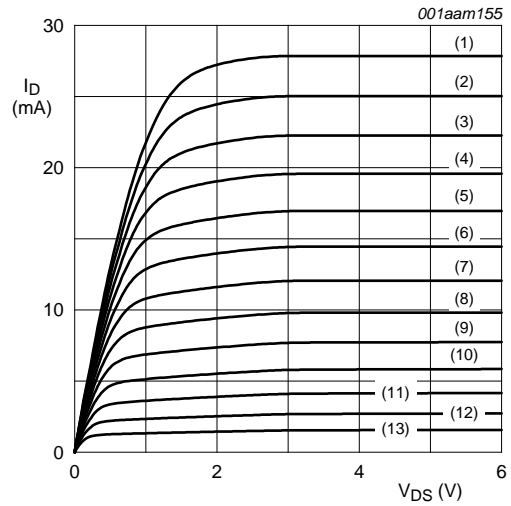
[2] Measured in [Figure 17](#) test circuit.

8.1 Graphs



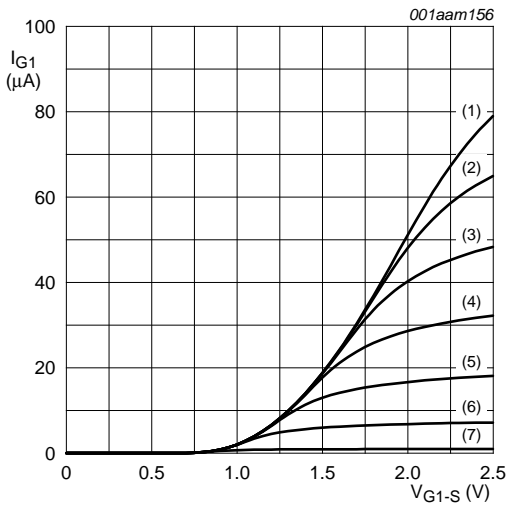
- (1)  $V_{G2-S} = 4.0\text{ V}$
  - (2)  $V_{G2-S} = 3.5\text{ V}$
  - (3)  $V_{G2-S} = 3.0\text{ V}$
  - (4)  $V_{G2-S} = 2.5\text{ V}$
  - (5)  $V_{G2-S} = 2.0\text{ V}$
  - (6)  $V_{G2-S} = 1.5\text{ V}$
  - (7)  $V_{G2-S} = 1.0\text{ V}$
- $V_{DS} = 5\text{ V}; T_j = 25\text{ }^\circ\text{C}.$

Fig 2. Transfer characteristics; typical values



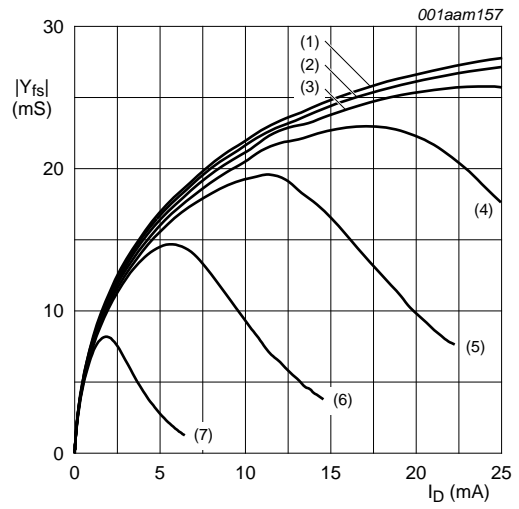
- (1)  $V_{G1-S} = 2.2\text{ V}$
  - (2)  $V_{G1-S} = 2.1\text{ V}$
  - (3)  $V_{G1-S} = 2.0\text{ V}$
  - (4)  $V_{G1-S} = 1.9\text{ V}$
  - (5)  $V_{G1-S} = 1.8\text{ V}$
  - (6)  $V_{G1-S} = 1.7\text{ V}$
  - (7)  $V_{G1-S} = 1.6\text{ V}$
  - (8)  $V_{G1-S} = 1.5\text{ V}$
  - (9)  $V_{G1-S} = 1.4\text{ V}$
  - (10)  $V_{G1-S} = 1.3\text{ V}$
  - (11)  $V_{G1-S} = 1.2\text{ V}$
  - (12)  $V_{G1-S} = 1.1\text{ V}$
  - (13)  $V_{G1-S} = 1.0\text{ V}$
- $V_{G2-S} = 4\text{ V}; T_j = 25\text{ }^\circ\text{C}.$

Fig 3. Output characteristics; typical values



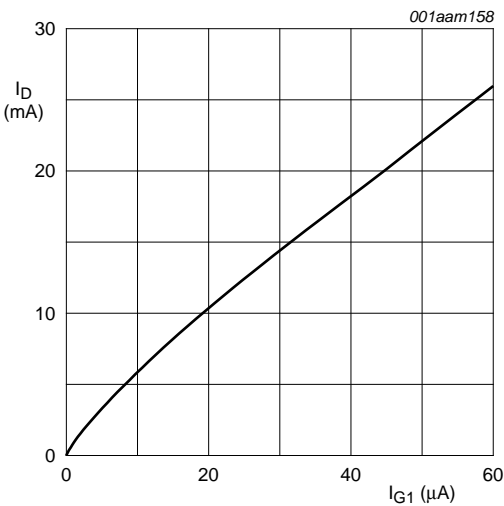
- (1)  $V_{G2-S} = 4.0\text{ V}$
  - (2)  $V_{G2-S} = 3.5\text{ V}$
  - (3)  $V_{G2-S} = 3.0\text{ V}$
  - (4)  $V_{G2-S} = 2.5\text{ V}$
  - (5)  $V_{G2-S} = 2.0\text{ V}$
  - (6)  $V_{G2-S} = 1.5\text{ V}$
  - (7)  $V_{G2-S} = 1.0\text{ V}$
- $V_{DS} = 5\text{ V}; T_j = 25\text{ }^\circ\text{C}.$

Fig 4. Gate1 current as a function of gate1 voltage; typical values



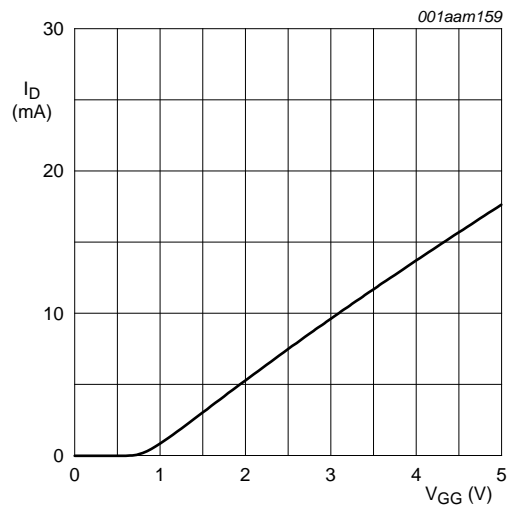
- (1)  $V_{G2-S} = 4.0\text{ V}$
  - (2)  $V_{G2-S} = 3.5\text{ V}$
  - (3)  $V_{G2-S} = 3.0\text{ V}$
  - (4)  $V_{G2-S} = 2.5\text{ V}$
  - (5)  $V_{G2-S} = 2.0\text{ V}$
  - (6)  $V_{G2-S} = 1.5\text{ V}$
  - (7)  $V_{G2-S} = 1.0\text{ V}$
- $V_{DS} = 5\text{ V}; T_j = 25\text{ }^\circ\text{C}.$

Fig 5. Forward transfer admittance as a function of drain current; typical values



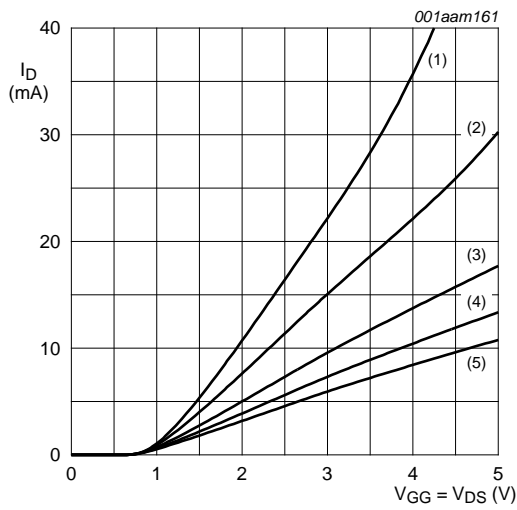
$V_{DS} = 5\text{ V}; V_{G2-S} = 4\text{ V}; T_j = 25\text{ }^\circ\text{C}.$

Fig 6. Drain current as a function of gate1 current; typical values



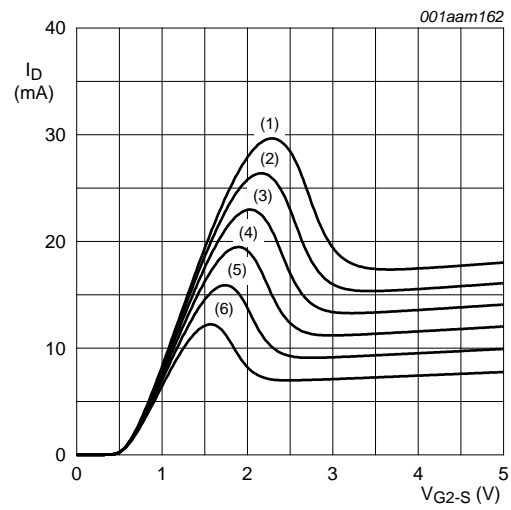
$V_{DS} = 5\text{ V}; V_{G2-S} = 4\text{ V}; R_{G1} = 82\text{ k}\Omega; T_j = 25\text{ }^\circ\text{C}.$

Fig 7. Drain current as a function of gate1 supply voltage ( $V_{GG}$ ); typical values



- (1)  $R_{G1} = 20\text{ k}\Omega$
  - (2)  $R_{G1} = 40\text{ k}\Omega$
  - (3)  $R_{G1} = 80\text{ k}\Omega$
  - (4)  $R_{G1} = 120\text{ k}\Omega$
  - (5)  $R_{G1} = 160\text{ k}\Omega$
- $V_{G2-S} = 4\text{ V}; T_j = 25\text{ }^\circ\text{C}.$

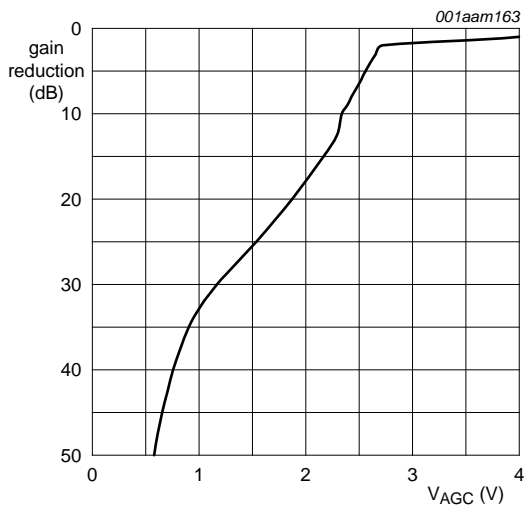
**Fig 8. Drain current as a function of  $V_{DS}$  and  $V_{GG}$ ; typical values**



- (1)  $V_{GG} = 5.0\text{ V}$
  - (2)  $V_{GG} = 4.5\text{ V}$
  - (3)  $V_{GG} = 4.0\text{ V}$
  - (4)  $V_{GG} = 3.5\text{ V}$
  - (5)  $V_{GG} = 3.0\text{ V}$
  - (6)  $V_{GG} = 2.5\text{ V}$
- $T_j = 25\text{ }^\circ\text{C}; R_{G1} = 82\text{ k}\Omega$  (connected to  $V_{GG}$ ).

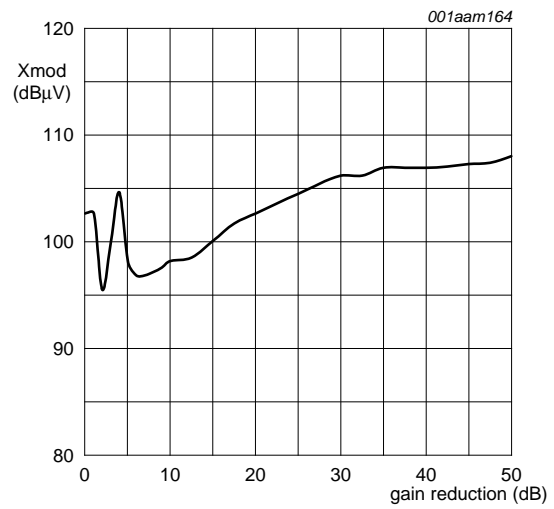
**Fig 9. Drain current as a function of gate2 voltage; typical values**





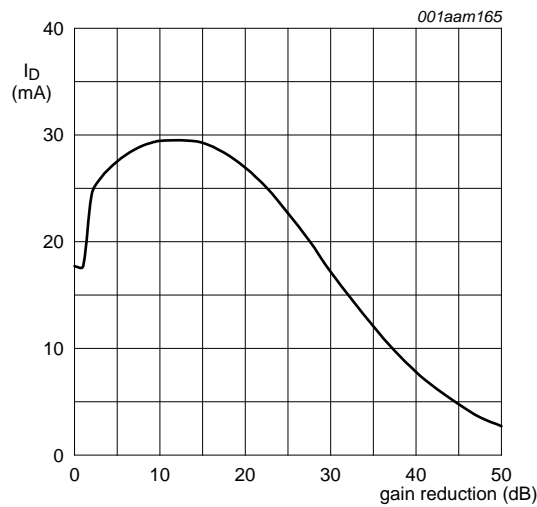
$V_{DS} = 5\text{ V}; V_{GG} = 5\text{ V}; I_{D(nom)} = 19\text{ mA}; R_{G1} = 82\text{ k}\Omega;$   
 $f = 50\text{ MHz}; T_j = 25\text{ }^\circ\text{C};$  see [Figure 17](#).

**Fig 10. Typical gain reduction as a function of the AGC voltage; typical values**



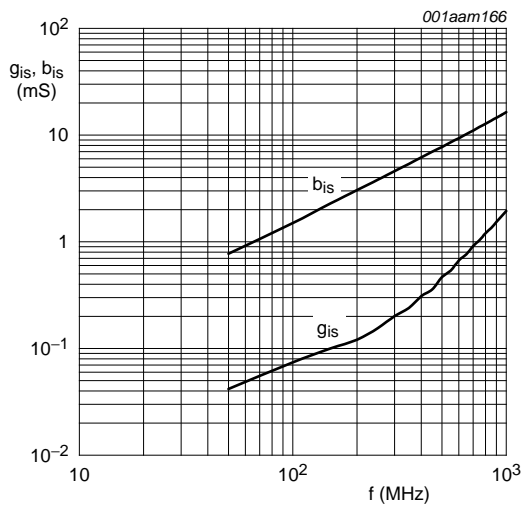
$V_{DS} = 5\text{ V}; V_{GG} = 5\text{ V}; V_{G2-S(nom)} = 4\text{ V}; R_{G1} = 82\text{ k}\Omega;$   
 $f_w = 50\text{ MHz}; f_{unw} = 60\text{ MHz}; I_{D(nom)} = 19\text{ mA}; T_j = 25\text{ }^\circ\text{C};$   
 see [Figure 17](#).

**Fig 11. Unwanted voltage for 1% cross modulation as a function of gain reduction; typical values**



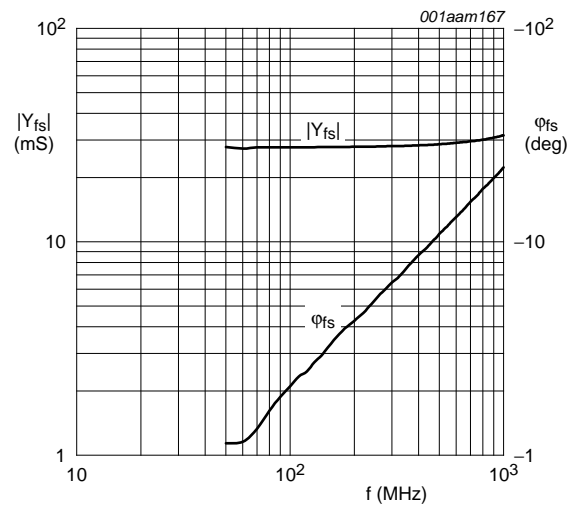
$V_{DS} = 5\text{ V}; V_{GG} = 5\text{ V}; V_{G2-S(nom)} = 4\text{ V}; R_{G1} = 82\text{ k}\Omega; f_w = 50\text{ MHz}; I_{D(nom)} = 19\text{ mA}; T_j = 25\text{ }^\circ\text{C};$  see [Figure 17](#).

**Fig 12. Typical drain current as a function of gain reduction; typical values**



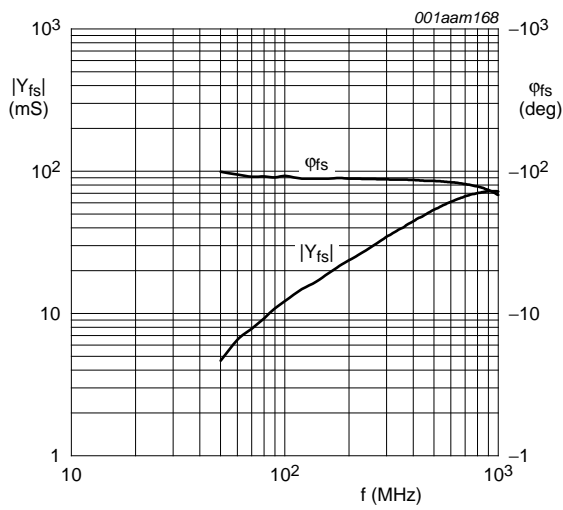
$V_{DS} = 5\text{ V}; V_{G2-S} = 4\text{ V}; I_D = 19\text{ mA}$ .

**Fig 13. Input admittance as a function of frequency; typical values**



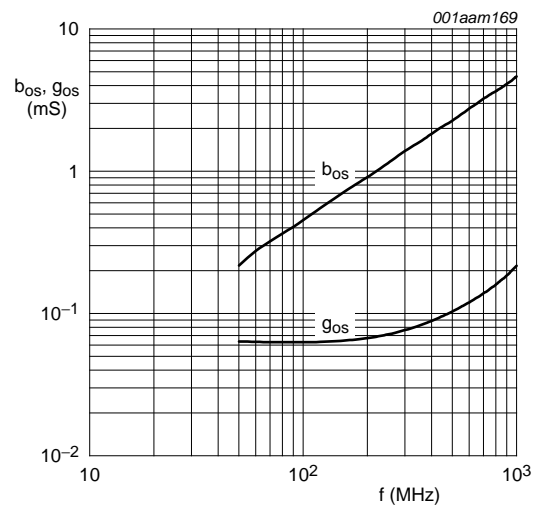
$V_{DS} = 5\text{ V}; V_{G2-S} = 4\text{ V}; I_D = 19\text{ mA}$ .

**Fig 14. Forward transfer admittance and phase as a function of frequency; typical values**



$V_{DS} = 5\text{ V}; V_{G2-S} = 4\text{ V}; I_D = 19\text{ mA}$ .

**Fig 15. Reverse transfer admittance and phase as a function of frequency; typical values**



$V_{DS} = 5\text{ V}; V_{G2-S} = 4\text{ V}; I_D = 19\text{ mA}$ .

**Fig 16. Output admittance as a function of frequency; typical values**

## 8.2 Scattering parameters

**Table 9. Scattering parameters**

$V_{DS} = 5\text{ V}$ ;  $V_{G2-S} = 4\text{ V}$ ;  $I_D = 19\text{ mA}$ ;  $T_{amb} = 25\text{ °C}$ ;  $Z_0 = 50\text{ }\Omega$ ; typical values.

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)
40	0.9960	-3.50	2.77	177.20	0.00034	82.80	0.9945	-1.00
50	0.9957	-4.46	2.76	176.02	0.00046	82.50	0.9944	-1.28
100	0.9935	-8.66	2.74	172.19	0.00121	81.86	0.9938	-2.69
200	0.9880	-17.55	2.73	164.42	0.00231	80.28	0.9927	-5.39
300	0.9805	-26.17	2.69	156.64	0.00331	75.66	0.9909	-8.17
400	0.9712	-34.58	2.64	149.07	0.00414	71.21	0.9896	-10.79
500	0.9589	-42.78	2.58	141.74	0.00482	67.42	0.9872	-13.30
600	0.9451	-50.61	2.52	134.58	0.00526	64.33	0.9850	-16.08
700	0.9309	-58.23	2.45	127.49	0.00549	61.90	0.9836	-18.74
800	0.9166	-65.68	2.37	120.79	0.00551	60.77	0.9818	-21.05
900	0.9034	-72.70	2.29	114.37	0.00536	60.73	0.9796	-23.59
1000	0.8894	-79.30	2.22	107.90	0.00505	62.45	0.9781	-26.44

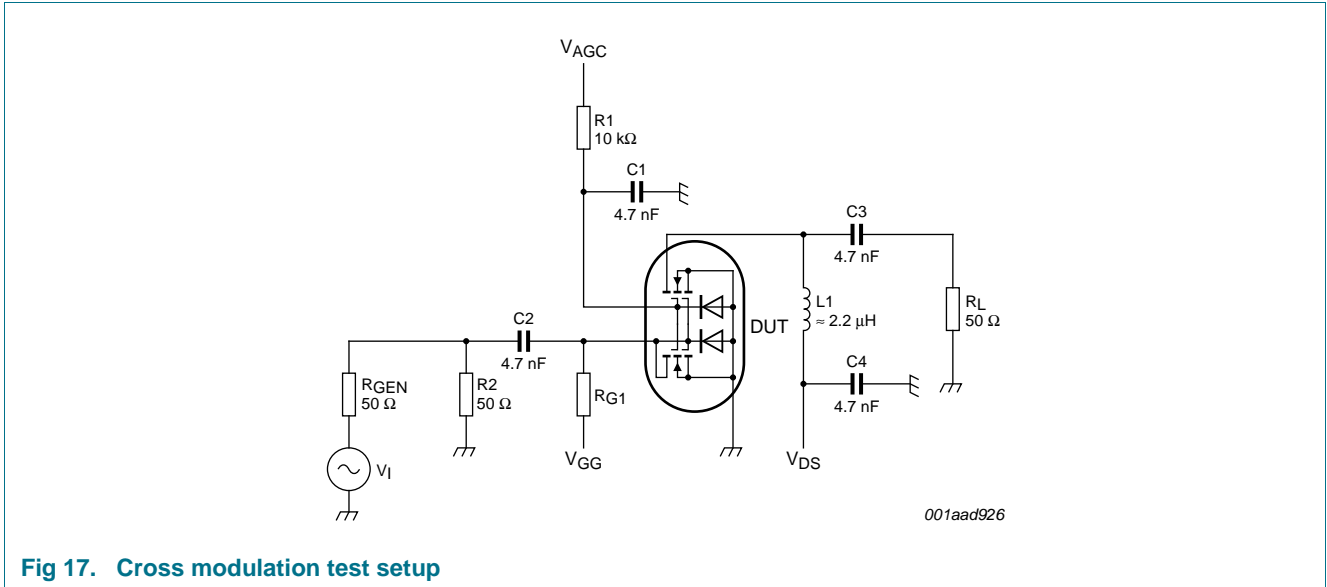
## 8.3 Noise data

**Table 10. Noise data**

$V_{DS} = 5\text{ V}$ ;  $V_{G2-S} = 4\text{ V}$ ;  $I_D = 19\text{ mA}$ ;  $T_{amb} = 25\text{ °C}$ ; typical values.

f (MHz)	NF <sub>min</sub> (dB)	$\Gamma_{opt}$		r <sub>n</sub> (ratio)
		(ratio)	(deg)	
400	1.0	0.798	29.5	0.907
800	1.5	0.703	57.7	0.749

**9. Test information**



**Fig 17. Cross modulation test setup**

10. Package outline

Plastic surface-mounted package; reverse pinning; 4 leads

SOT343R

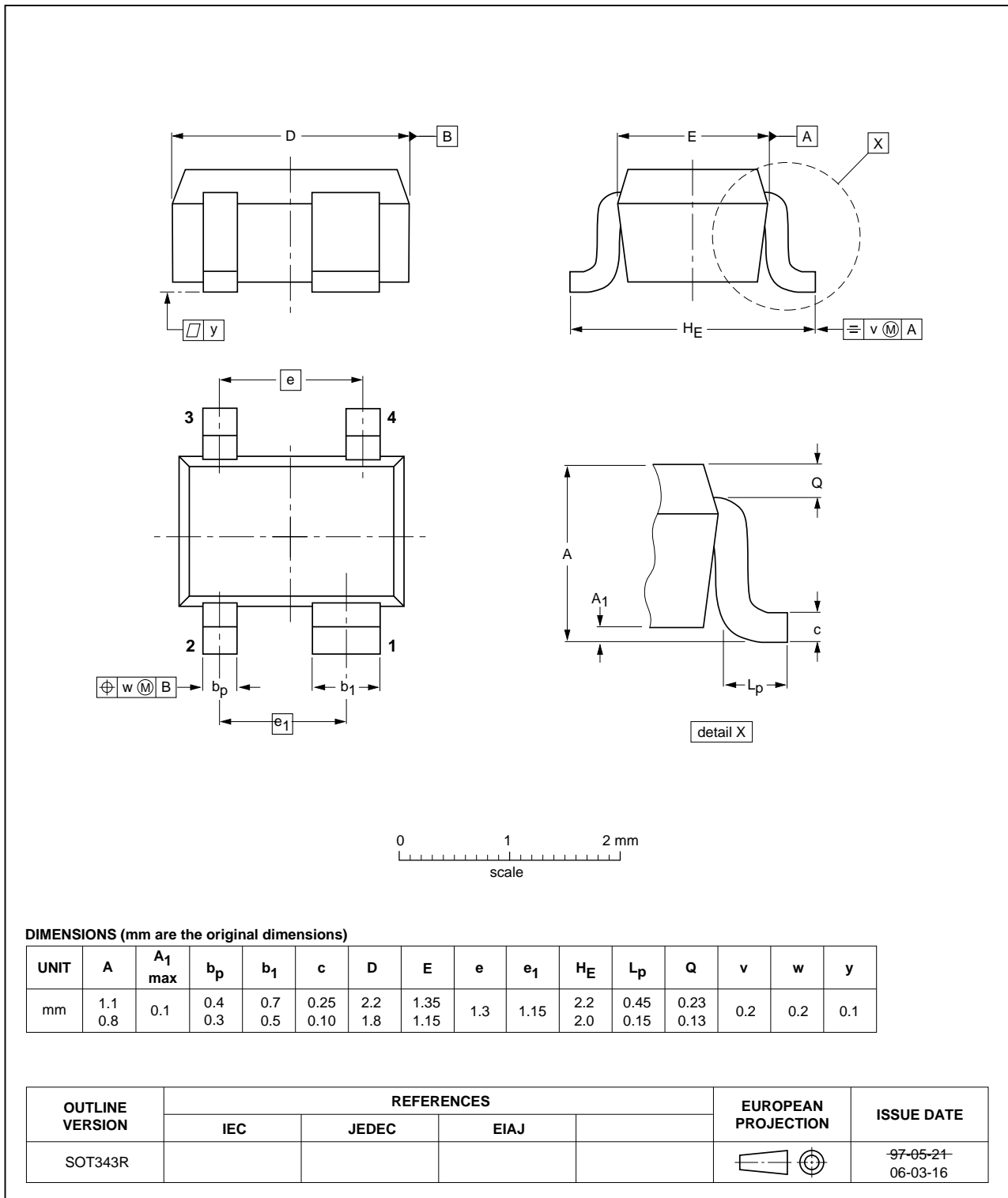


Fig 18. Package outline SOT343

## 11. Abbreviations

Table 11. Abbreviations

Acronym	Description
AGC	Automatic Gain Control
DC	Direct Current
MOSFET	Metal-Oxide-Semiconductor Field-Effect Transistor
UHF	Ultra High Frequency
VHF	Very High Frequency

## 12. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BF1217WR v.2	20110620	Product data sheet	-	BF1217WR v.1
Modifications:	• Package outline corrected.			
BF1217WR v.1	20100803	Product data sheet	-	-

## 13. Legal information

### 13.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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Date of release: 20 June 2011

Document identifier: BF1217WR