CLF1G0035S-100

Broadband RF power GaN HEMT

Rev. 4 — 6 November 2014 Objective data sheet

1. Product profile

1.1 General description

CLF1G0035S-100 is a broadband general purpose 100 W amplifier with first generation GaN HEMT technology from NXP. Frequency of operation is from DC to 3.5 GHz.

Table 1. CW and pulsed RF application information

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 300 mA; V_{DS} = 50 V in a class-AB broadband demo board.

Test signal	f	P_L	G_p	η_D
	(MHz)	(W)	(dB)	(%)
1-Tone CW	500	100	14.2	61.6
	1000	100	11.2	47.9
	1500	100	10.8	46.4
	2000	100	11.7	53.3
1-Tone pulsed [1]	500	100	15.5	67.4
	1000	100	14	52.9
	1500	100	14.3	53.7
	2000	100	13.9	59.5

[1] Pulsed RF; t_p = 50 μs; δ = 1 %.

Table 2. 2-Tone CW application information

Typical 2-Tone performance at T_{case} = 25 °C; I_{Dq} = 500 mA; V_{DS} = 50 V in a class-AB broadband demo board.

Test signal	f	$P_{L(PEP)}$	IMD3
	(MHz)	(W)	(dBc)
2-Tone CW [1]	300	20	–45.5
	1000	20	–39.3
	1500	20	–44
	2000	20	–46.4

[1] 2-Tone CW; Δf = 1 MHz.

1.2 Features and benefits

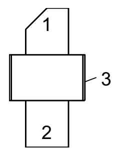
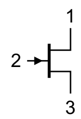
- Frequency of operation is from DC to 3.5 GHz
- 100 W general purpose broadband RF Power GaN HEMT
- Excellent ruggedness (VSWR 10 : 1)
- High voltage operation (50 V)
- Thermally enhanced package

1.3 Applications

- Commercial wireless infrastructure (cellular, WiMAX)
- Industrial, scientific, medical
- Radar
- Jammers
- Broadband general purpose amplifier
- EMC testing
- Public mobile radios
- Defense application

2. Pinning information

Table 3. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	drain		 aaa-003693
2	gate		
3	source [1]		

[1] Connected to flange.

3. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
CLF1G0035S-100	-	earless ceramic package; 2 leads	SOT467B

4. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage		-	150	V
V_{GS}	gate-source voltage		–8	+3	V
I_{GF}	forward gate current	external $R_G = 5\ \Omega$	-	36	mA
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature	measured via IR scan [1]	-	250	°C

[1] Continuous use at maximum temperature will affect the reliability, for details refer to the on-line MTF calculator.

5. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	T_j = 200 °C [1]	1.02	K/W

[1] T_j is measured via IR scan with case temperature of 85 °C and power dissipation of 113 W.

6. Characteristics

Table 7. DC Characteristics

T_{case} = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = –7 V; I_{DS} = 24 mA	150	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 0.1 V; I_{DS} = 24 mA	–2.4	–2	–1.3	V
I_{DSX}	drain cut-off current	V_{DS} = 10 V; V_{GS} = 3 V	-	17.5	-	A
g_{fs}	forward transconductance	V_{DS} = 10 V; V_{GS} = 0 V	-	4.0	-	S

Table 8. RF Characteristics

Test signal: pulsed RF; f = 3 GHz; t_p = 100 μs; δ = 10 %; RF performance at V_{DS} = 50 V; I_{Dq} = 330 mA; T_{case} = 25 °C; unless otherwise specified in a class-AB production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
η_D	drain efficiency	P_L = 100 W	46	53	-	%
G_p	power gain	P_L = 100 W	7.8	12	-	dB
RL_{in}	input return loss	P_L = 100 W	-	–5	–2.5	dB
$P_{droop(pulse)}$	pulse droop power	P_L = 100 W	-	0.04	-	dB
t_r	rise time	P_L = 100 W	-	5	-	ns
t_f	fall time	P_L = 100 W	-	5	-	ns

7. Application information

7.1 Demo circuit

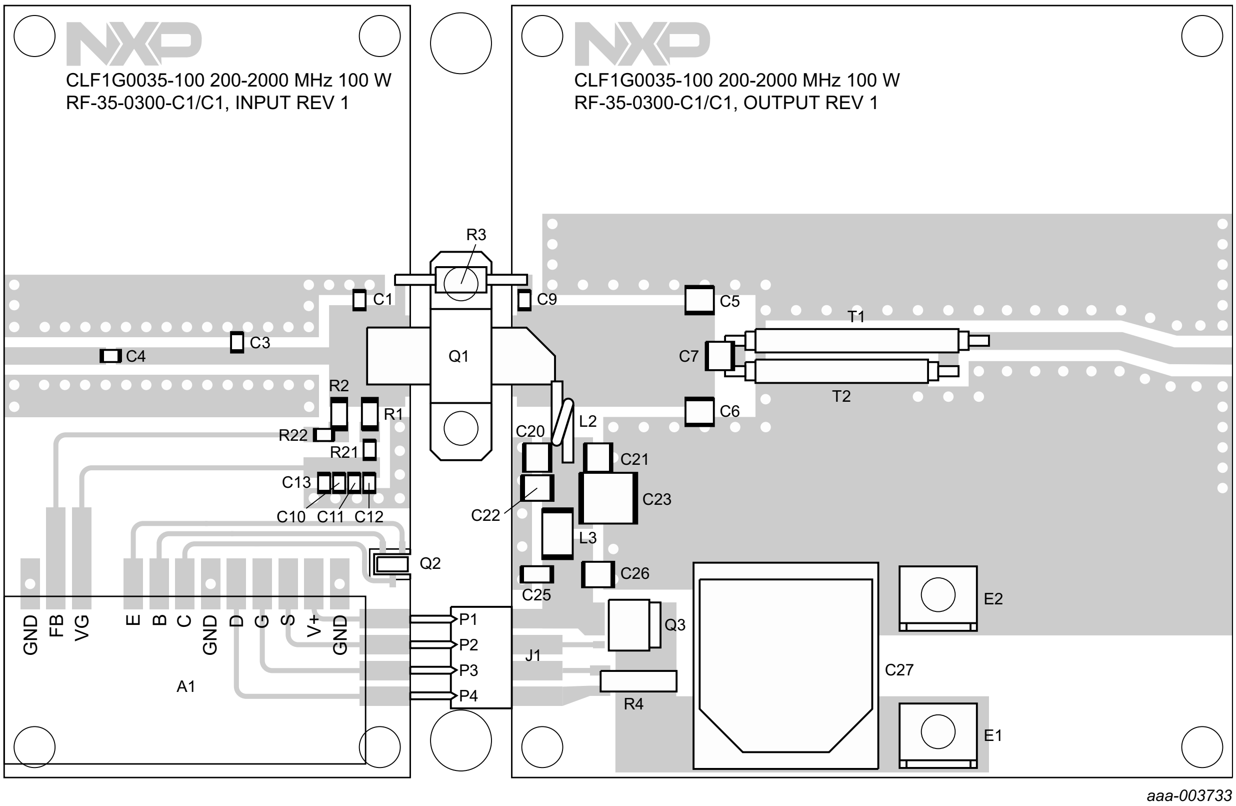


Fig 1. The broadband amplifier (200 MHz to 2100 MHz) demo circuit outline

Table 9. List of components

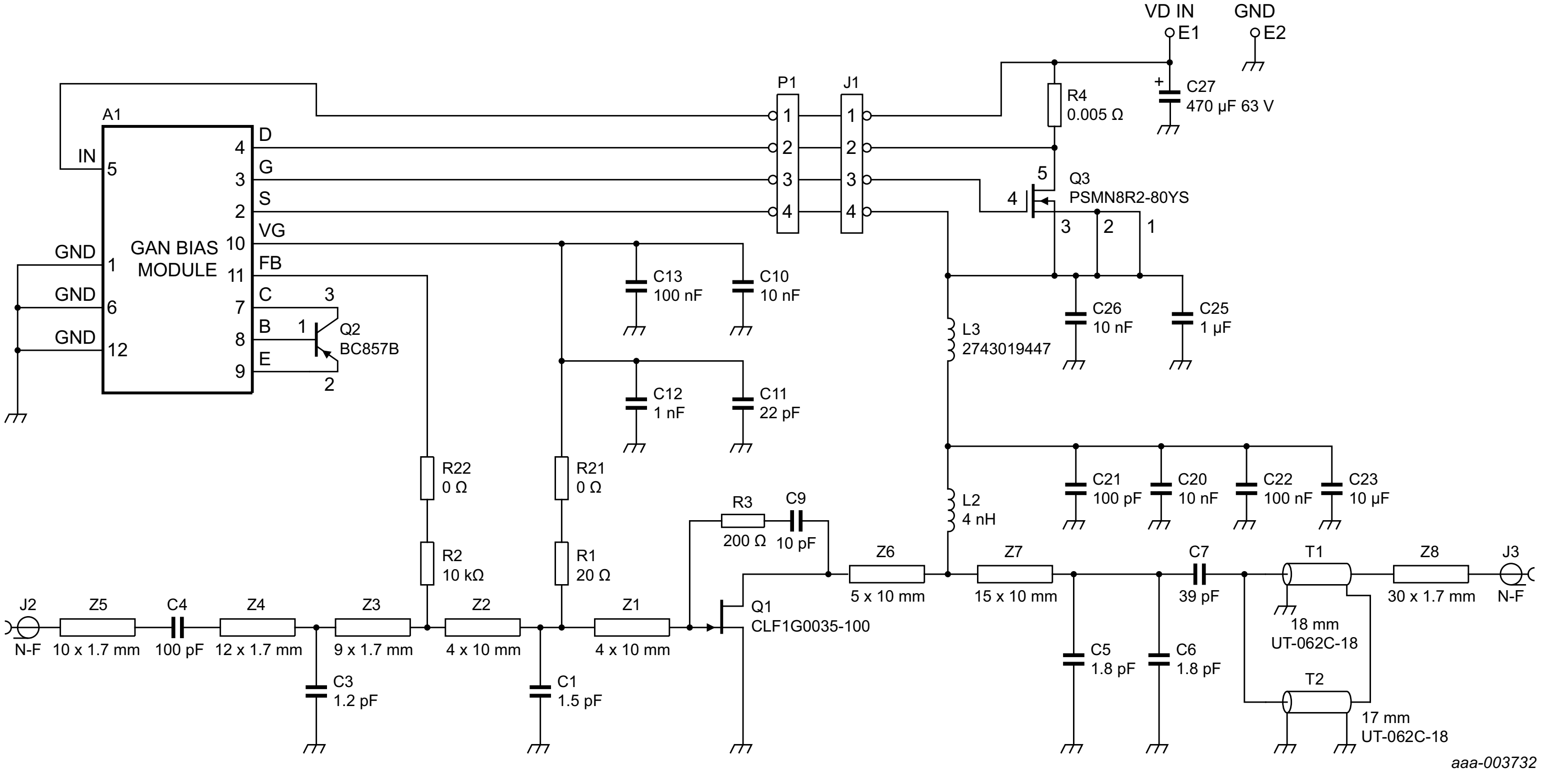
See Figure 1 and Figure 2.

Component	Description	Value	Remarks
A1	GaN bias module v2	-	NXP
C1	multilayer ceramic chip capacitor	3.3 pF	ATC 600F or Passive Plus 0805N
C3	multilayer ceramic chip capacitor	1.5 pF	ATC 600F or Passive Plus 0805N
C4	multilayer ceramic chip capacitor	100 pF	ATC 600F or Passive Plus 0805N
C5, C6	multilayer ceramic chip capacitor	1.8 pF	ATC 800B or Passive Plus 1111N
C7	multilayer ceramic chip capacitor	39 pF	ATC 800B or Passive Plus 1111N
C9	multilayer ceramic chip capacitor	10 nF	ATC 600F or Passive Plus 0805N
C10	multilayer ceramic chip capacitor	10 nF	generic
C11	multilayer ceramic chip capacitor	22 pF	generic
C12	multilayer ceramic chip capacitor	1 nF	generic
C13	multilayer ceramic chip capacitor	100 nF	generic
C20	multilayer ceramic chip capacitor	1 nF	ATC 700B
C21	multilayer ceramic chip capacitor	100 pF	ATC 700B

Table 9. List of components *…continued*

See Figure 1 and Figure 2.

Component	Description	Value	Remarks
C22, C26	multilayer ceramic chip capacitor	10 nF	generic
C23	multilayer ceramic chip capacitor	10 μF	TDK C5750X7S2A106M
C25	multilayer ceramic chip capacitor	1 μF	generic
C27	electrolytic capacitor	470 μF	Panasonic EEE-TK1J471AM
E1, E2	drain voltage connection	-	
J1, P1, P2, P3, P4	1 row, 4-way vertical DC connector header	-	
J2	RF in connector	-	
J3	RF out connector	-	
L2	inductor	14 nH	3 turns, 18 AWG, inner diameter = 2.5 mm
L3	ferrite bead	-	Fair-Rite 2743019447
Q1	transistor	-	NXP CLF1G0035-100
Q2	transistor	-	NXP BC857B
Q3	transistor	-	NXP PSMN8R2-80YS
R1	resistor	20.0 Ω	generic
R2	resistor	10.0 kΩ	generic
R3	resistor	200 Ω	ATC LR12010T0200J
R4	resistor	0.005 Ω	SUSUMU RL7520WT-R005-F
R21, R22	resistor	0 Ω	generic
T1	semi-rigid coax	18 mm	Micro-Coax UT-062C-18
T2	semi-rigid coax	16 mm	Micro-Coax UT-062C-18
Z1, Z2, Z3, Z4, Z5, Z6, Z7, Z8	microstrip lines	-	



See Table 9 for a list of components.

Fig 2. The broadband amplifier (200 MHz to 2100 MHz) demo circuit schematic

7.2 Application test results

Table 10. CW and pulsed RF application information

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 300 mA; V_{DS} = 50 V in a class-AB broadband demo board.

Test signal	f	P_L	G_p	η_D
	(MHz)	(W)	(dB)	(%)
1-Tone CW	500	100	14.2	61.6
	1000	100	11.2	47.9
	1500	100	10.8	46.4
	2000	100	11.7	53.3
1-Tone pulsed [1]	500	100	15.5	67.4
	1000	100	14	52.9
	1500	100	14.3	53.7
	2000	100	13.9	59.5

[1] Pulsed RF; t_p = 50 µs; δ = 1 %.

Table 11. 2-Tone CW application information

Typical 2-Tone performance at T_{case} = 25 °C; I_{Dq} = 500 mA; V_{DS} = 50 V in a class-AB broadband demo board.

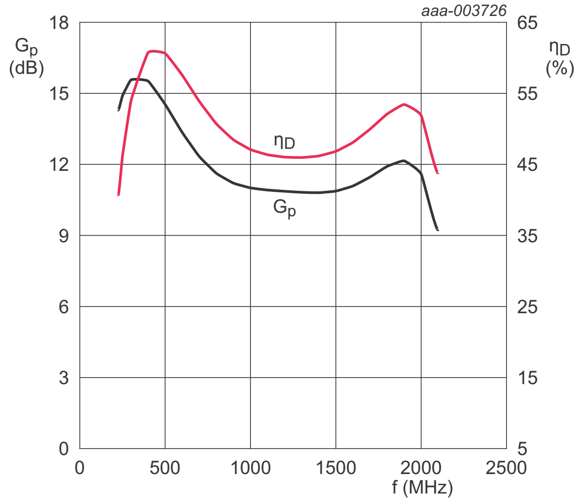
Test signal	f	$P_{L(PEP)}$	IMD3
	(MHz)	(W)	(dBc)
2-Tone CW [1]	300	20	−45.5
	1000	20	−39.3
	1500	20	−44
	2000	20	−46.4

[1] 2-Tone CW; Δf = 1 MHz.

7.3 Graphical data

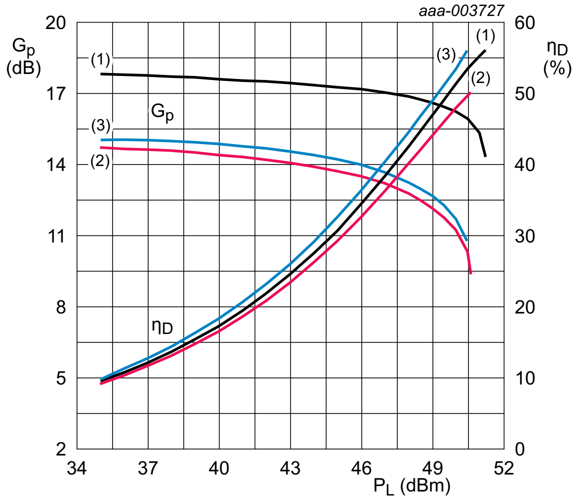
The following figures are measured in a broadband amplifier demo board circuit from 200 MHz to 2100 MHz.

7.3.1 1-Tone CW RF performance



V_{DS} = 50 V; I_{Dq} = 300 mA; P_L = 100 W.

Fig 3. Power gain and drain efficiency as function of frequency; typical values



V_{DS} = 50 V; I_{Dq} = 300 mA.

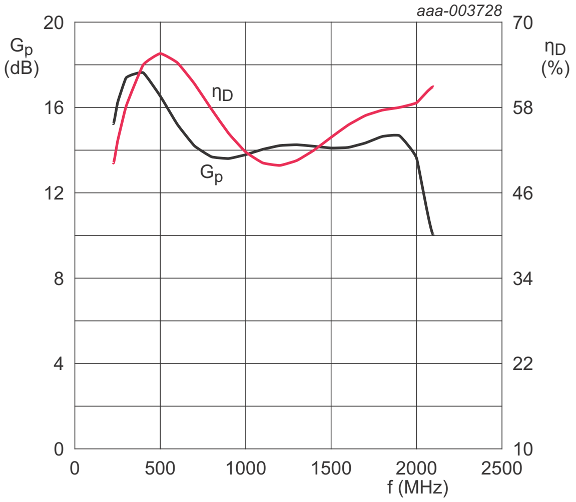
(1) f = 300 MHz

(2) f = 1000 MHz

(3) f = 2000 MHz

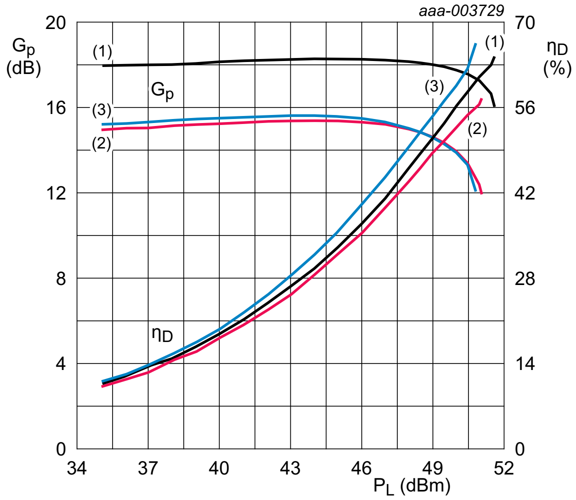
Fig 4. Power gain and drain efficiency as function output power; typical values

7.3.2 1-Tone pulsed RF performance



V_{DS} = 50 V; I_{Dq} = 300 mA; P_L = 100 W; t_p = 50 μs, δ = 1 %.

Fig 5. Power gain and drain efficiency as function of frequency; typical values



V_{DS} = 50 V; I_{Dq} = 300 mA; t_p = 50 μs, δ = 1 %.

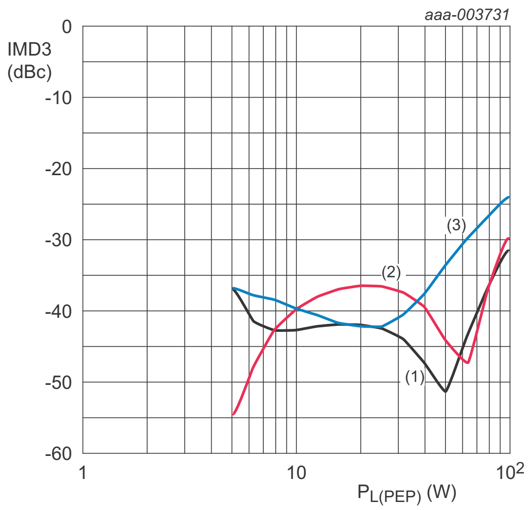
(1) f = 300 MHz

(2) f = 1000 MHz

(3) f = 2000 MHz

Fig 6. Power gain and drain efficiency as function output power; typical values

7.3.3 2-Tone CW performance



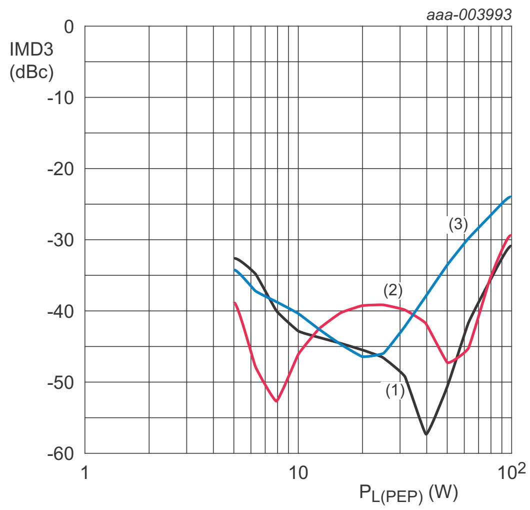
V_{DS} = 50 V; I_{Dq} = 300 mA; Δf = 1 MHz.

(1) f = 300 MHz

(2) f = 1000 MHz

(3) f = 2000 MHz

Fig 7. Third-order intermodulation distortion as a function of peak envelope power load power; typical values



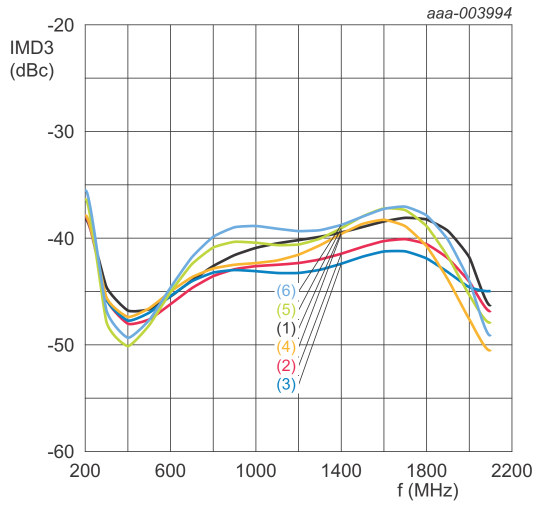
V_{DS} = 50 V; I_{Dq} = 500 mA; Δf = 1 MHz.

(1) f = 300 MHz

(2) f = 1000 MHz

(3) f = 2000 MHz

Fig 8. Third-order intermodulation distortion as a function of peak envelope power load power; typical values



V_{DS} = 50 V; I_{Dq} = 500 mA; $P_{L(PEP)}$ = 20 W.

(1) Δf = 10 kHz

(2) Δf = 30 kHz

(3) Δf = 100 kHz

(4) Δf = 300 kHz

(5) Δf = 1 MHz

(6) Δf = 3 MHz

Fig 9. Third-order intermodulation distortion as a function of frequency and tone spacing; typical values

7.4 Bias module

The bias module information for the GaN HEMT amplifier is described in application note *AN11130*.

8. Test information

8.1 Ruggedness in class-AB operation

The CLF1G0035S-100 is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: V_{DS} = 50 V; P_L = 100 W, f = 3000 MHz.

8.2 Load pull impedance information

The measured load pull impedances are shown below. Impedance reference plane defined at device leads. Measurements performed with NXP test fixtures. Test temperature set at 25 °C with a pulsed CW signal; t_p = 100 μs; δ = 10 %; RF performance at V_{DS} = 50 V; I_{Dq} = 330 mA.

Table 12. Typical impedance

Typical values unless otherwise specified.

f	Z_S	Z_L (maximum $P_{L(M)}$)	Z_L (maximum η_D)
(MHz)	(Ω)	(Ω)	(Ω)
500	6 + 6.5j	5.8 + 1.9j	7.6 + 5j
1000	1.7 + 2j	6 + 0.7j	6.5 + 5.2j
2000	1.2 – 2.8j	4.5 – 0.5j	3.8 + 1.6j
2500	1 – 4.2j	4 – 1.2j	3 + 0j
3000	1.7 – 5.2j	3.8 – 2.5j	3.1 – 1.3j
3500	2.7 – 8.9j	4.2 – 4.8j	3.3 – 3.7j

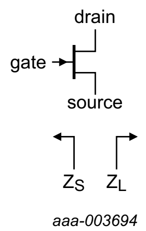


Fig 10. Definition of transistor impedance

Z_S is the measured source pull impedance presented to the device. Z_L is the measured load pull impedance presented to the device.

8.3 Packaged S-parameter data

Table 13. S-parameter

Small signal; V_{DS} = 50 V; I_{Dq} = 330 mA; Z_S = Z_L = 50 Ω

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)
100	0.89132	−156.66	34.068	94.493	0.012475	7.7032	0.52196	−147.24
200	0.89073	−168.26	17.043	82.662	0.012315	−0.83012	0.53166	−156.66
300	0.89427	−172.3	11.153	74.641	0.011818	−5.3714	0.55825	−158.1
400	0.89924	−174.48	8.1416	67.823	0.011142	−8.4181	0.59137	−158.32
500	0.90493	−175.96	6.3028	61.71	0.010348	−10.333	0.62678	−158.56
600	0.91086	−177.14	5.0617	56.145	0.009484	−11.104	0.66181	−159.08
700	0.91671	−178.17	4.1699	51.054	0.008599	−10.584	0.69485	−159.87
800	0.92224	−179.13	3.5016	46.389	0.007737	−8.5461	0.72507	−160.86
900	0.92735	179.94	2.9855	42.108	0.006948	−4.7126	0.75217	−161.98
1000	0.93196	179.04	2.578	38.172	0.006285	1.1721	0.77617	−163.17
1100	0.93606	178.16	2.2506	34.546	0.005806	9.1609	0.79724	−164.39
1200	0.93966	177.28	1.9837	31.195	0.005568	18.833	0.81567	−165.61
1300	0.94281	176.4	1.7635	28.089	0.005606	29.182	0.83174	−166.82
1400	0.94552	175.53	1.5801	25.2	0.005918	38.964	0.84575	−168
1500	0.94785	174.66	1.4259	22.504	0.006469	47.302	0.85796	−169.15
1600	0.94982	173.78	1.2952	19.978	0.00721	53.919	0.86862	−170.26
1700	0.95148	172.9	1.1837	17.603	0.008097	58.951	0.87793	−171.34
1800	0.95285	172.02	1.088	15.361	0.009097	62.687	0.88608	−172.38
1900	0.95397	171.13	1.0053	13.239	0.010189	65.418	0.89322	−173.38
2000	0.95484	170.23	0.93366	11.223	0.011359	67.384	0.89949	−174.36
2100	0.9555	169.32	0.87121	9.2996	0.012601	68.77	0.905	−175.31
2200	0.95595	168.39	0.81661	7.4599	0.013912	69.711	0.90983	−176.23
2300	0.95622	167.44	0.76871	5.6942	0.015292	70.306	0.91408	−177.14
2400	0.9563	166.48	0.7266	3.9939	0.016745	70.629	0.91781	−178.02
2500	0.9562	165.49	0.68949	2.3514	0.018273	70.735	0.92108	−178.88
2600	0.95593	164.48	0.65676	0.7596	0.019885	70.661	0.92394	−179.72
2700	0.95549	163.44	0.62788	−0.788	0.021586	70.439	0.92643	179.44
2800	0.95487	162.36	0.60239	−2.2976	0.023385	70.091	0.92858	178.62
2900	0.95408	161.25	0.57994	−3.775	0.025294	69.632	0.93042	177.81
3000	0.9531	160.1	0.56021	−5.226	0.027321	69.075	0.93198	177
3100	0.95192	158.9	0.54294	−6.656	0.029482	68.427	0.93328	176.2
3200	0.95053	157.65	0.52791	−8.0708	0.03179	67.696	0.93433	175.4
3300	0.94892	156.35	0.51495	−9.4758	0.034261	66.885	0.93514	174.6
3400	0.94706	154.98	0.5039	−10.877	0.036915	65.995	0.93573	173.81
3500	0.94493	153.54	0.49464	−12.28	0.039772	65.028	0.93611	173.01
3600	0.9425	152.02	0.48708	−13.692	0.042855	63.98	0.93627	172.2
3700	0.93974	150.42	0.48113	−15.12	0.046193	62.851	0.93622	171.4

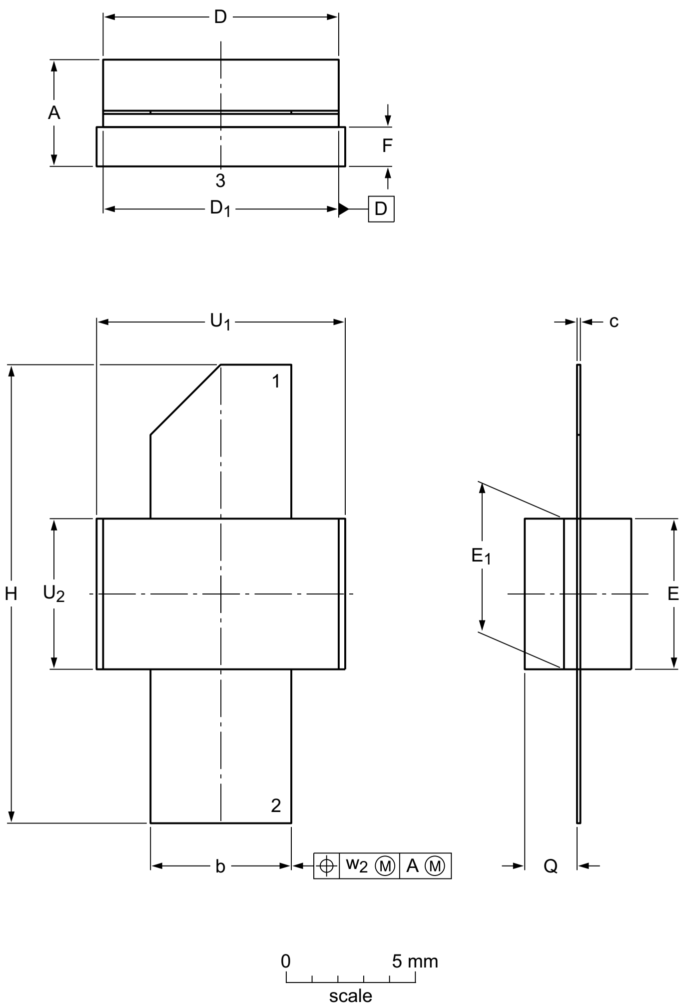
Table 13. S-parameter *…continued*

Small signal; V_{DS} = 50 V; I_{Dq} = 330 mA; Z_S = Z_L = 50 Ω

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)
3800	0.93661	148.72	0.47676	−16.57	0.049816	61.637	0.93596	170.58
3900	0.93304	146.91	0.47391	−18.052	0.053758	60.331	0.93549	169.76
4000	0.92899	144.97	0.47258	−19.574	0.05806	58.928	0.9348	168.93
4100	0.92439	142.9	0.47276	−21.147	0.062766	57.42	0.93389	168.09
4200	0.91915	140.66	0.47446	−22.781	0.067929	55.796	0.93276	167.24
4300	0.91317	138.25	0.47772	−24.491	0.073607	54.046	0.93138	166.37
4400	0.90633	135.63	0.48257	−26.289	0.079867	52.157	0.92976	165.49
4500	0.89849	132.78	0.48907	−28.193	0.086783	50.112	0.9279	164.6
4600	0.88949	129.66	0.49729	−30.221	0.094441	47.895	0.92577	163.69
4700	0.87914	126.23	0.50729	−32.395	0.10293	45.484	0.92339	162.77
4800	0.8672	122.45	0.51914	−34.739	0.11237	42.857	0.92076	161.83
4900	0.85343	118.25	0.53291	−37.279	0.12284	39.988	0.91791	160.88
5000	0.83755	113.57	0.54862	−40.045	0.13448	36.847	0.91488	159.92
5100	0.81926	108.32	0.56627	−43.069	0.14738	33.402	0.91174	158.95
5200	0.79827	102.42	0.58578	−46.386	0.16163	29.62	0.9086	157.98
5300	0.77437	95.758	0.60694	−50.029	0.1773	25.468	0.90565	156.99
5400	0.74749	88.197	0.62942	−54.032	0.19438	20.912	0.90312	156
5500	0.7178	79.599	0.65267	−58.42	0.2128	15.928	0.90132	155
5600	0.68594	69.815	0.67591	−63.21	0.23234	10.5	0.90063	153.96
5700	0.65314	58.706	0.69815	−68.399	0.25267	4.6305	0.90147	152.86
5800	0.62143	46.181	0.71818	−73.964	0.2733	−1.6555	0.90421	151.66
5900	0.59357	32.261	0.73479	−79.853	0.29362	−8.3064	0.90909	150.31
6000	0.57266	17.159	0.7469	−85.99	0.31299	−15.244	0.9161	148.75

9. Package outline

Earless ceramic package; 2 leads **SOT467B**



Dimensions

Unit(1)		A	b	c	D	D_1	E	E_1	F	H	Q	U_1	U_2	w_2
mm	max	4.67	5.59	0.15	9.25	9.27	5.92	5.97	1.65	18.29	2.21	9.78	5.97	
	nom													0.25
	min	3.94	5.33	0.10	9.04	9.02	5.77	5.72	1.40	17.27	1.96	9.53	5.72	
inches	max	0.184	0.22	0.006	0.364	0.365	0.233	0.235	0.065	0.72	0.087	0.385	0.235	
	nom													0.01
	min	0.155	0.21	0.004	0.356	0.355	0.227	0.225	0.055	0.68	0.077	0.375	0.225	

Note
1. millimeter dimensions are derived from the original inch dimensions.

sot467b_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT467B						~~11-08-18~~ 12-05-01

Fig 11. Package outline SOT467B

10. Handling information

10.1 ESD Sensitivity

Table 14. ESD sensitivity

ESD model	Class
Human Body Model (HBM); According JEDEC standard JESD22-A114F	1B [1]

[1] Classification 1B is granted to any part that passes after exposure to an ESD pulse of 500 V, but fails after exposure to an ESD pulse of 1000 V.

11. Abbreviations

Table 15. Abbreviations

Acronym	Description
AWG	American Gauge Wire
CW	Continuous Wave
EMC	ElectroMagnetic Compatibility
ESD	ElectroStatic Discharge
GaN	Gallium Nitride
HEMT	High Electron Mobility Transistor
MTF	Median Time to Failure
VSWR	Voltage Standing-Wave Ratio
WiMAX	Worldwide Interoperability for Microwave Access

12. Revision history

Table 16. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
CLF1G0035S-100 v.4	20141106	Objective data sheet	-	CLF1G0035-100_1G0035S-100 v.3
Modifications:	• The document now describes only the earless version of this product: CLF1G0035S-100.			
CLF1G0035-100_1G0035S-100 v.3	20140926	Objective data sheet	-	CLF1G0035-100_1G0035S-100 v.2
CLF1G0035-100_1G0035S-100 v.2	20130129	Objective data sheet	-	CLF1G0035-100_1G0035S-100 v.1
CLF1G0035-100_1G0035S-100 v.1	20120615	Objective data sheet	-	-

13. Legal information

13.1 Data sheet status

Document status[1][2]	Product status[3]	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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15. Contents

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