CLF1G0035-100; CLF1G0035S-100

Broadband RF power GaN HEMT

Rev. 2 — 29 January 2013 Objective data sheet

1. Product profile

1.1 General description

CLF1G0035-100 and CLF1G0035S-100 are broadband general purpose 100 W amplifiers 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 (MHz)	P_L (W)	G_p (dB)	η_D (%)
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 (MHz)	$P_{L(PEP)}$ (W)	IMD3 (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

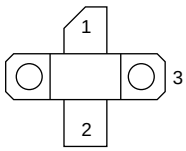
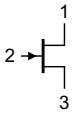
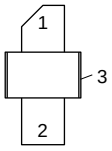
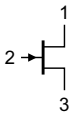
- Excellent ruggedness (VSWR 10 : 1)
- High voltage operation (50 V)
- Thermally enhanced package

1.3 Applications

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

2. Pinning information

Table 3. Pinning

Pin	Description		Simplified outline	Graphic symbol
CLF1G0035-100 (SOT467C)				
1	drain			
2	gate			
3	source	[1]		aaa-003693
CLF1G0035S-100 (SOT467B)				
1	drain			
2	gate			
3	source	[1]		aaa-003693

[1] Connected to flange.

3. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
CLF1G0035-100	-	flanged ceramic package; 2 mounting holes; 2 leads	SOT467C
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 Ω	-	36	mA
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature	measured via IR scan	-	250	°C

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	-	A
g_{fs}	forward transconductance	V_{DS} = 10 V; V_{GS} = 0 V	-	3.9	-	S

Table 8. RF Characteristics

Test signal: pulsed RF; 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
f	frequency		3	-	3.5	GHz
η_D	drain efficiency	P_L = 100 W	-	47	-	%
G_p	power gain	P_L = 100 W	-	10	-	dB
RL_{in}	input return loss	P_L = 100 W	-	–6	-	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

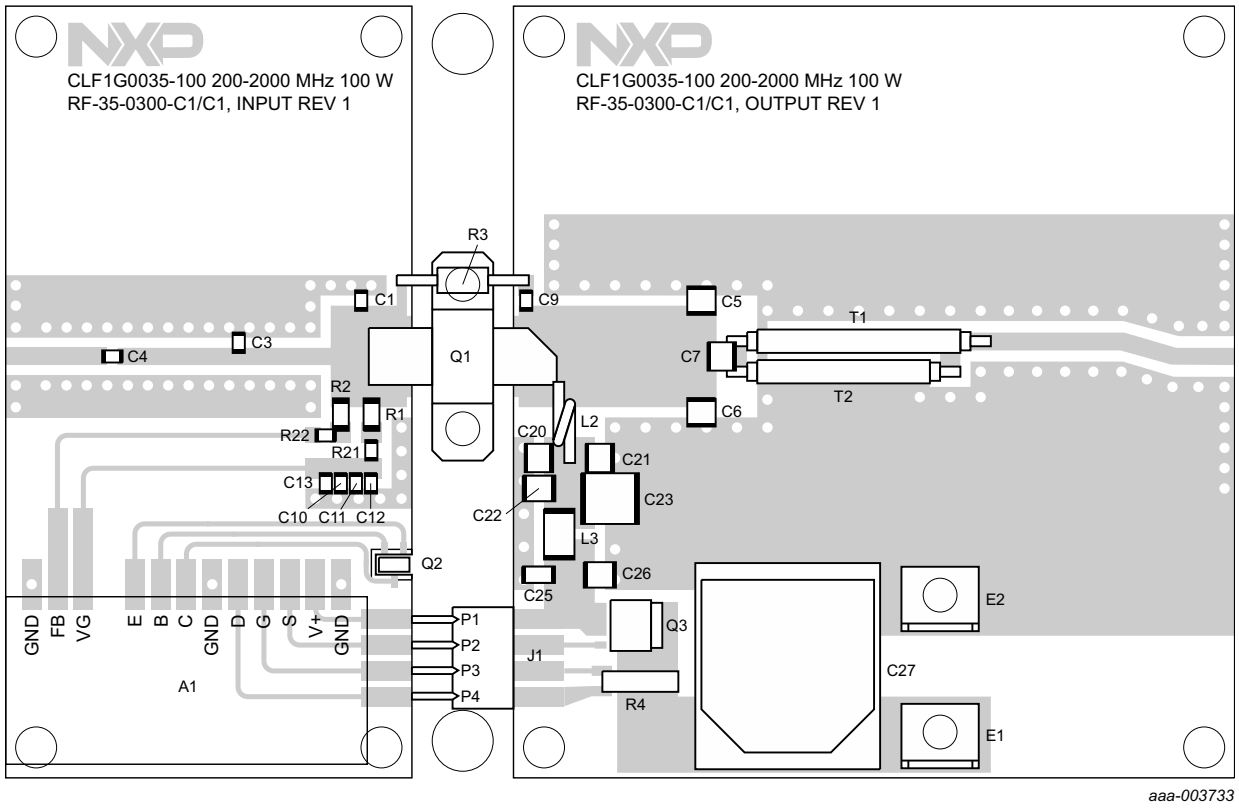


Fig 1. The broadband amplifier (200 MHz to 2100 MHz) demo circuit outline

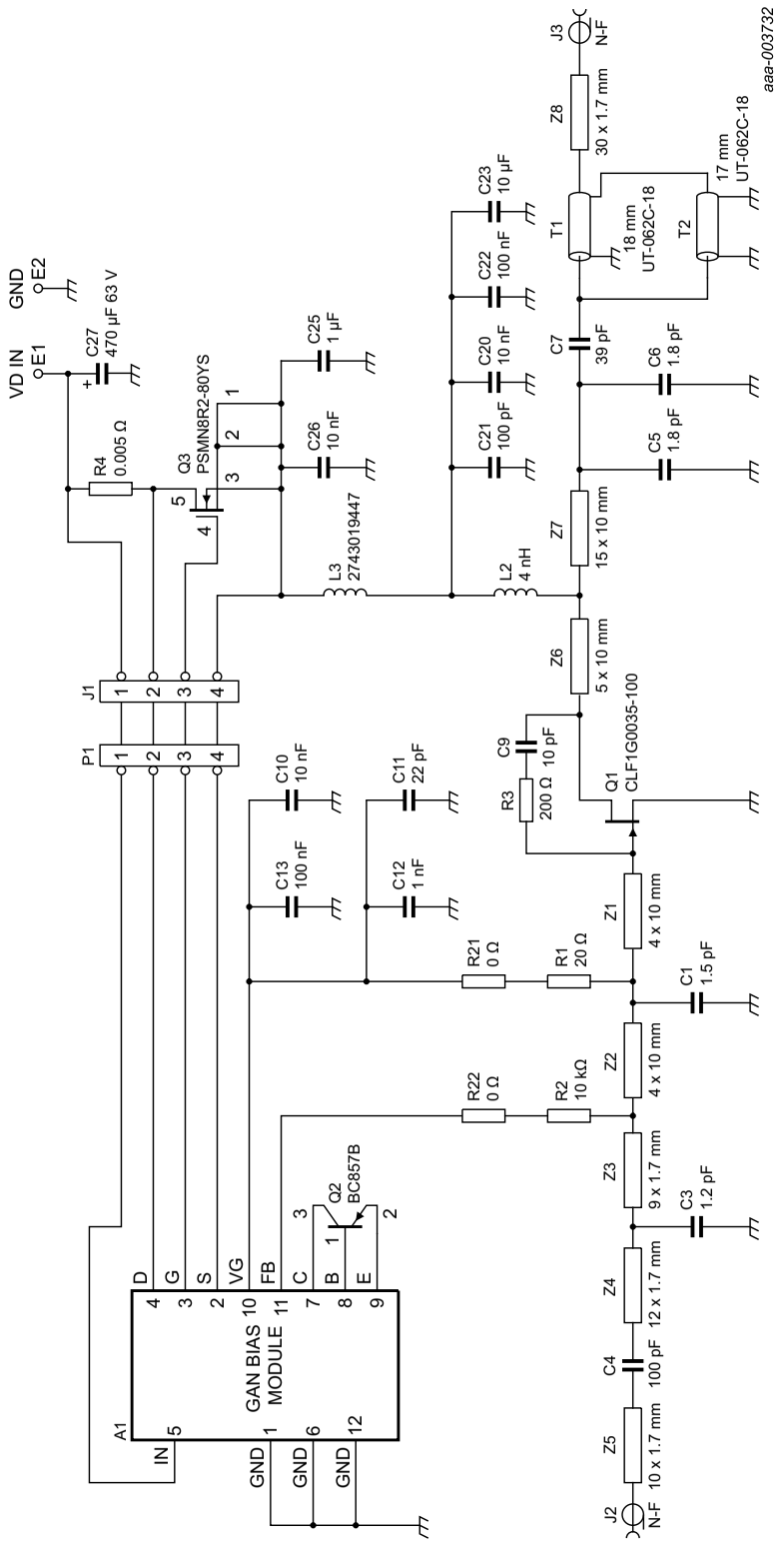
Table 9. List of components

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, PassivePlus 0805N
C3	multilayer ceramic chip capacitor	1.5 pF	ATC 600F, PassivePlus 0805N
C4	multilayer ceramic chip capacitor	100 pF	ATC 600F, PassivePlus 0805N
C5, C6	multilayer ceramic chip capacitor	1.8 pF	ATC 800B, PassivePlus 1111N
C7	multilayer ceramic chip capacitor	39 pF	ATC 800B, PassivePlus 1111N
C9	multilayer ceramic chip capacitor	10 nF	ATC 600F, PassivePlus 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 (MHz)	P_L (W)	G_p (dB)	η_D (%)
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.

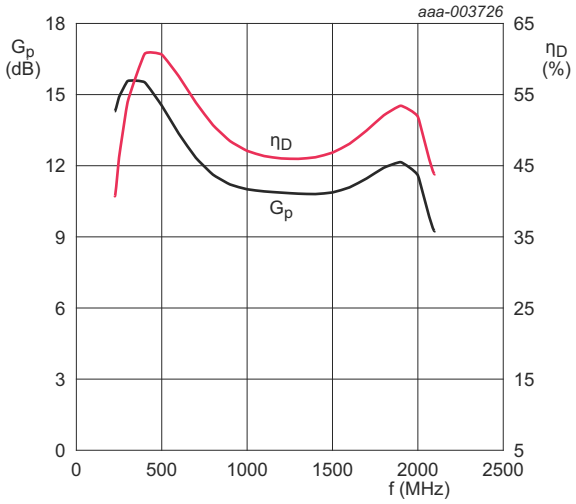
Test signal	f (MHz)	$P_{L(PEP)}$ (W)	IMD3 (dBc)
2-Tone CW [1]	300	20	–45.5
	1000	20	–39.3
	1500	20	–44
	2000	20	–46.4

[1] 2-Tone CW; Δf = 1 MHz.

7.3 Graphical data

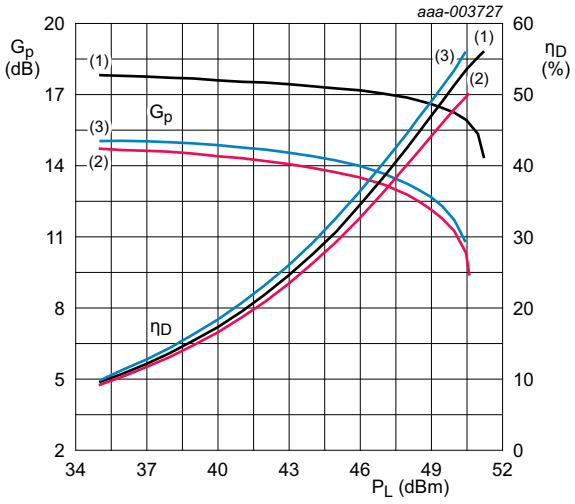
The following figures are measured in a broadband amplifier demo board circuit from 200 MHz to 2100 MHz.

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.

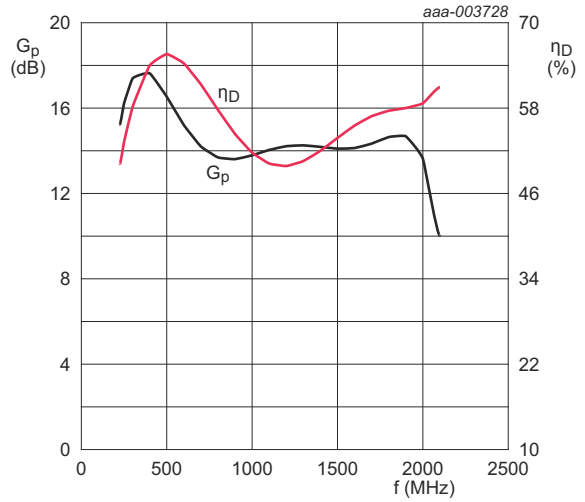
(1) f = 300 MHz

(2) f = 1000 MHz

(3) f = 2000 MHz

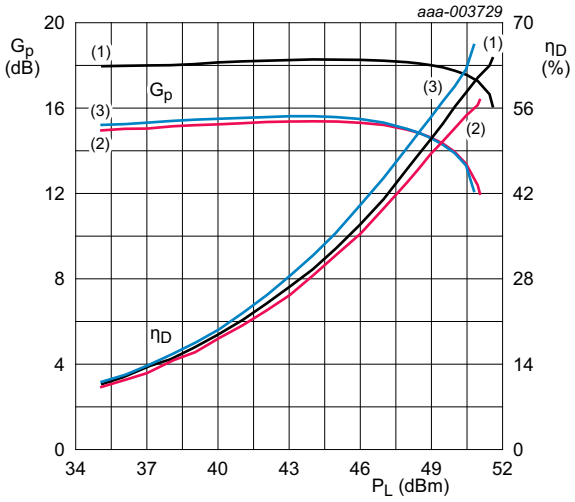
Fig 4. Power gain and drain efficiency as function output power; typical values

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 %.

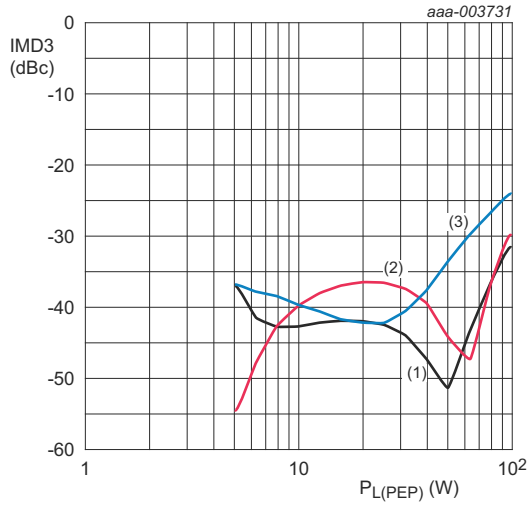
(1) f = 300 MHz

(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



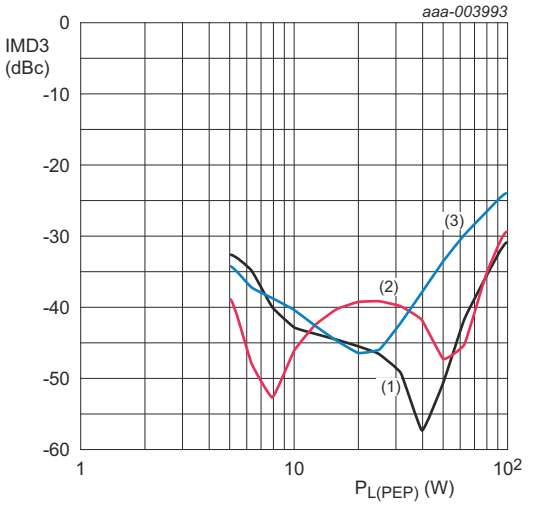
V_{DS} = 50 V; I_{Dq} = 300 mA; Δf = 1 MHz.

(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



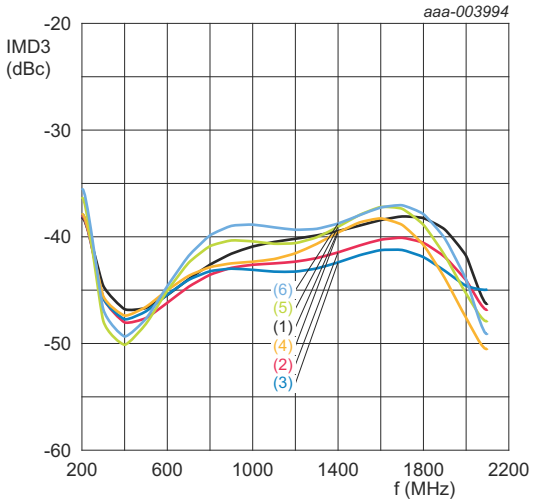
V_{DS} = 50 V; I_{Dq} = 500 mA; Δf = 1 MHz.

(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 CLF1G0035-100 and CLF1G0035S-100 are 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

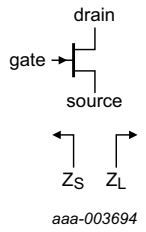


Fig 10. Definition of transistor impedance

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

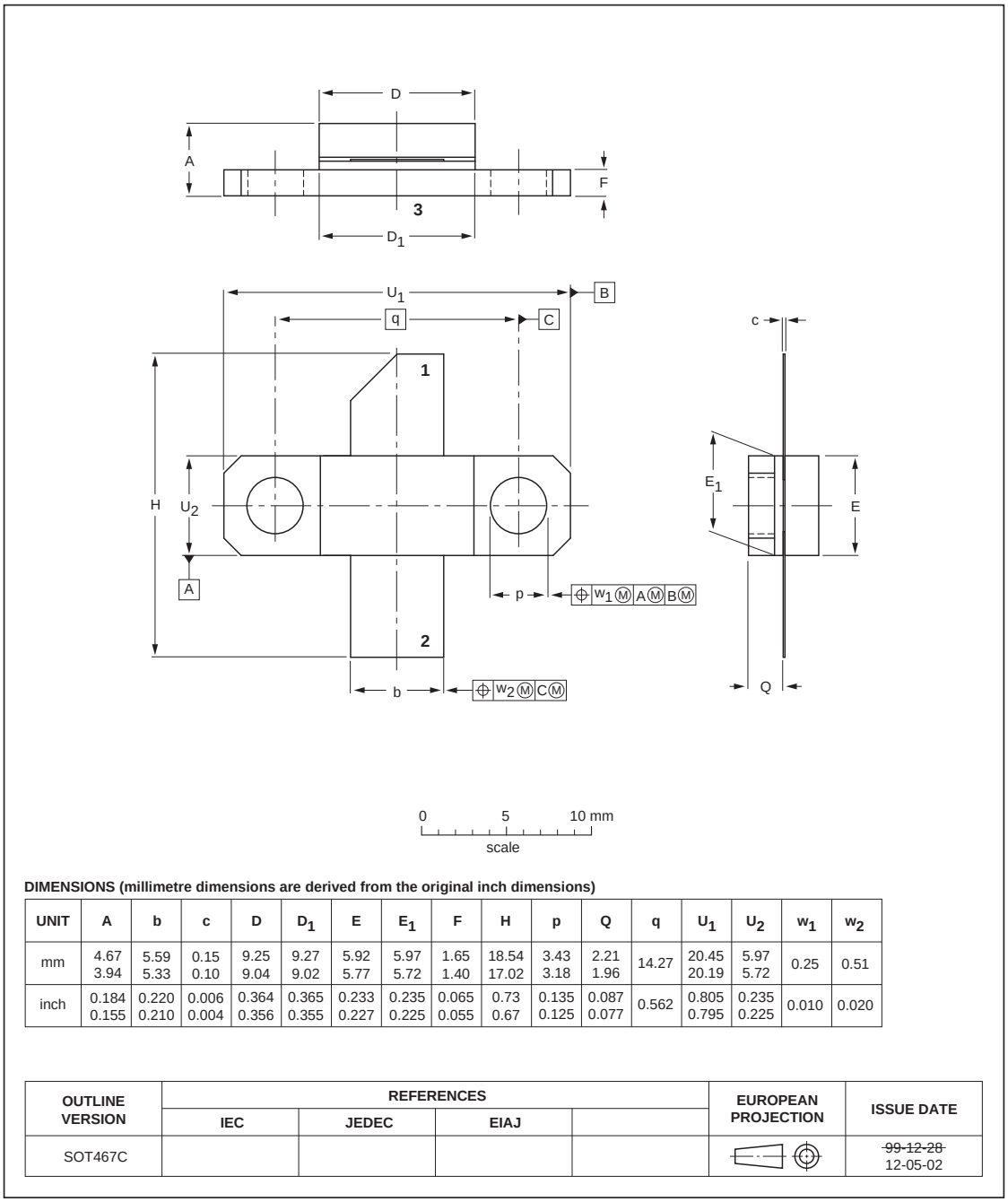
Table 13. S-parameter *...continued*

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

Flanged ceramic package; 2 mounting holes; 2 leads **SOT467C**



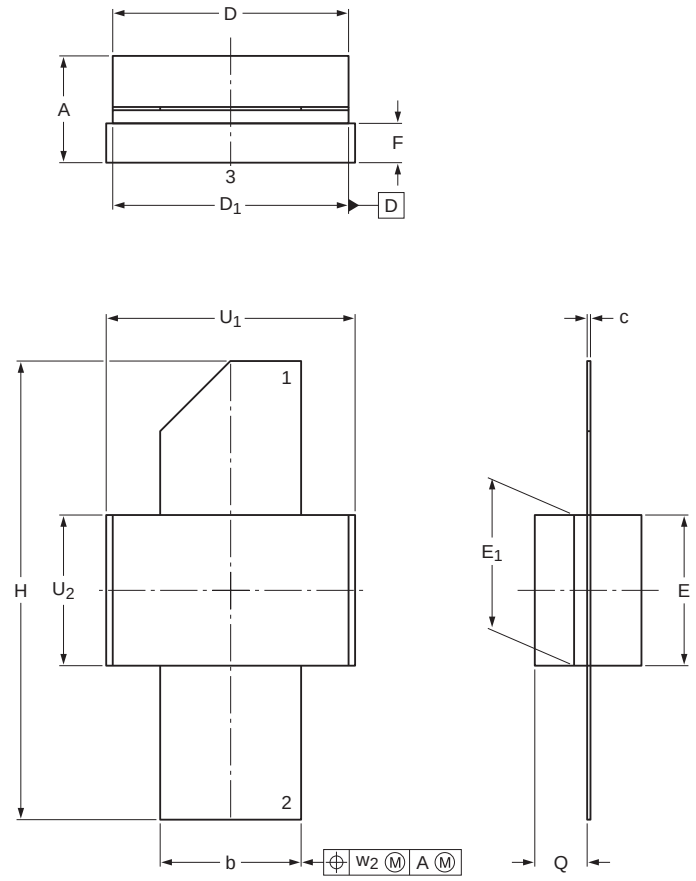
DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	c	D	D_1	E	E_1	F	H	p	Q	q	U_1	U_2	w_1	w_2
mm	4.67 3.94	5.59 5.33	0.15 0.10	9.25 9.04	9.27 9.02	5.92 5.77	5.97 5.72	1.65 1.40	18.54 17.02	3.43 3.18	2.21 1.96	14.27	20.45 20.19	5.97 5.72	0.25	0.51
inch	0.184 0.155	0.220 0.210	0.006 0.004	0.364 0.356	0.365 0.355	0.233 0.227	0.235 0.225	0.065 0.055	0.73 0.67	0.135 0.125	0.087 0.077	0.562	0.805 0.795	0.235 0.225	0.010	0.020

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT467C						~~99-12-28~~ 12-05-02

Fig 11. Package outline SOT467C

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	0.25
	nom													
	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	0.01
	nom													
	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 12. 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
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
CLF1G0035-100_1G0035S-100 v.2	20130129	Objective data sheet	-	CLF1G0035-100_ 1G0035S-100 v.1
Modifications:	• Table 7 on page 3: table has been updated. • Section 7 on page 4: layout has been changed. • Table 9 on page 4: row 1, remark has been changed. • Section 8 on page 11: layout has been changed. • Section 8.1 on page 11: section has been updated.			
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.

13.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

13.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific NXP Semiconductors product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NXP Semiconductors accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

13.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

14. Contact information

For more information, please visit: **http://www.nxp.com**

For sales office addresses, please send an email to: **salesaddresses@nxp.com**

15. Contents

For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 29 January 2013
Document identifier: CLF1G0035-100_1G0035S-100