CLF1G0035-100P; CLF1G0035S-100P

Broadband RF power GaN HEMT

Rev. 2 — 20 June 2013 Objective data sheet

1. Product profile

1.1 General description

The CLF1G0035-100P and CLF1G0035S-100P are 100 W general purpose broadband GaN HEMTs usable from DC to 3.5 GHz.

Table 1. CW and pulsed RF application information

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 330 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	2500	100	12.8	51
	2600	100	12.7	52.4
	2700	100	12.3	50
	2800	100	11.7	49
	2900	100	11.5	49
	3000	100	10.5	47
1-Tone pulsed [1]	2500	100	14.2	52
	2600	100	14.4	54.4
	2700	100	14.1	52.5
	2800	100	13.7	51.5
	2900	100	13.6	51.8
	3000	100	12.7	50.1

[1] Pulsed RF; t_p = 100 µs; δ = 10 %.

Table 2. 2-Tone CW application information

Typical 2-Tone performance at T_{case} = 25 °C; I_{Dq} = 330 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]	2500	20	–41.6
	2600	20	–43
	2700	20	–41.5
	2800	20	–41.3
	2900	20	–41.3
	3000	20	–40

[1] 2-Tone CW; Δf = 100 kHz.

1.2 Features and benefits

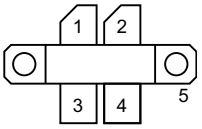
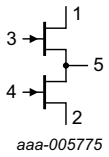
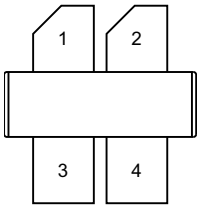
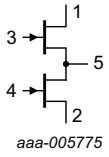
- Frequency of operation is from DC to 3.5 GHz
- 100 W general purpose broadband RF Power GaN HEMT
- Excellent ruggedness (VSWR = 10 : 1)
- High voltage operation (50 V)
- Thermally enhanced package

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
CLF1G0035-100P (SOT1228A)				
1	drain1			
2	drain2			
3	gate1			
4	gate2			
5	source	[1]		
CLF1G0035S-100P (SOT1228B)				
1	drain1			
2	drain2			
3	gate1			
4	gate2			
5	source	[1]		

[1] Connected to flange.

3. Ordering information

Table 4. Ordering information

Type number	Package		
	Name	Description	Version
CLF1G0035-100P	-	flanged ceramic package; 2 mounting holes; 4 leads	SOT1228A
CLF1G0035S-100P	-	earless flanged ceramic package; 4 leads	SOT1228B

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 108.6 W.

6. Characteristics

Table 7. DC characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = –7 V; I_{DS} = 12 mA	150	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 0.1 V; I_{DS} = 12 mA	–2.4	–2	–1.6	V
I_{DSX}	drain cut-off current	V_{DS} = 10 V; V_{GS} = 3 V	-	8.8	-	A
g_{fs}	forward transconductance	V_{DS} = 10 V; V_{GS} = 0 V	-	1.8	-	S

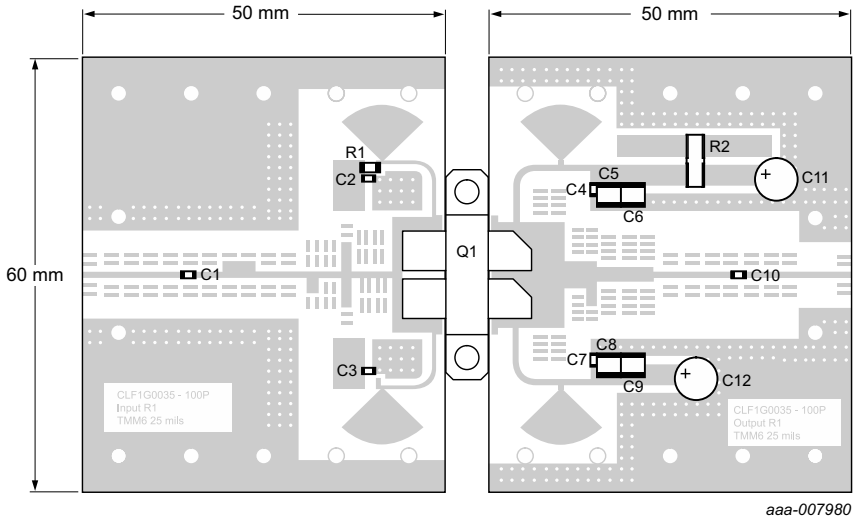
Table 8. RF characteristics

Test signal: pulsed RF; f = 3000 MHz; 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	-	50	-	%
G_p	power gain	P_L = 100 W	-	14	-	dB
RL_{in}	input return loss	P_L = 100 W	-	–6	-	dB
$P_{droop(pulse)}$	pulse droop power	P_L = 100 W	-	0.2	-	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



Printed-Circuit Board (PCB) material: TMM6, ε_r = 6.0, thickness = 0.635 mm, 28.35 grams copper on each side.

See Table 9 for list of components.

Fig 1. The broadband amplifier (2500 MHz to 3000 MHz) demo circuit outline

Table 9. List of components

See Figure 1.

Component	Description	Value	Remarks
C1, C10	multilayer ceramic chip capacitor	20 pF	ATC800A
C2, C3,C4, C7	multilayer ceramic chip capacitor	1 nF	ATC700A
C5, C8	multilayer ceramic chip capacitor	4.7 μF, 50 V	
C6, C9	multilayer ceramic chip capacitor	10 μF, 50 V	
C11, C12	electrolytic capacitor	220 μF, 50 V	
Q1	transistor	-	CLF1G0035-100P
R1	resistor	4.7 Ω	
R2	resistor	0.01 Ω	LVK25R01, 2W, 1 % tolerance

7.2 Application test results

Table 10. CW and pulsed RF application information

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 330 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	2500	100	12.8	51
	2600	100	12.7	52.4
	2700	100	12.3	50
	2800	100	11.7	49
	2900	100	11.5	49
	3000	100	10.5	47
1-Tone pulsed [1]	2500	100	14.2	52
	2600	100	14.4	54.4
	2700	100	14.1	52.5
	2800	100	13.7	51.5
	2900	100	13.6	51.8
	3000	100	12.7	50.1

[1] Pulsed RF; t_p = 100 µs; δ = 10 %.

Table 11. 2-Tone CW application information

Typical 2-Tone performance at T_{case} = 25 °C; I_{Dq} = 330 mA; V_{DS} = 50 V in a class-AB broadband demo board.

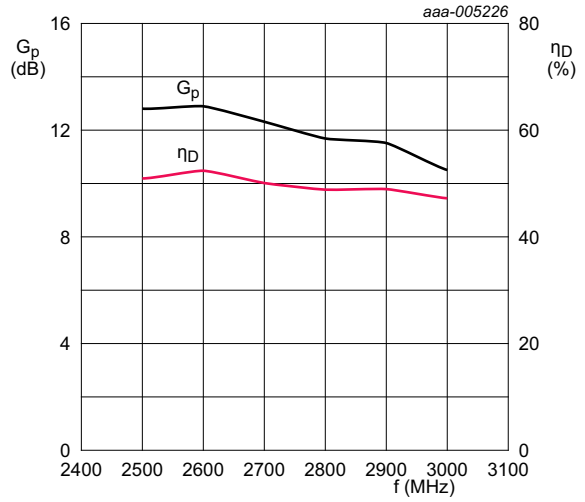
Test signal	f (MHz)	$P_{L(PEP)}$ (W)	IMD3 (dBc)
2-Tone CW [1]	2500	20	–41.6
	2600	20	–43
	2700	20	–41.5
	2800	20	–41.3
	2900	20	–41.3
	3000	20	–40

[1] 2-Tone CW; Δf = 100 kHz.

7.3 Graphical data

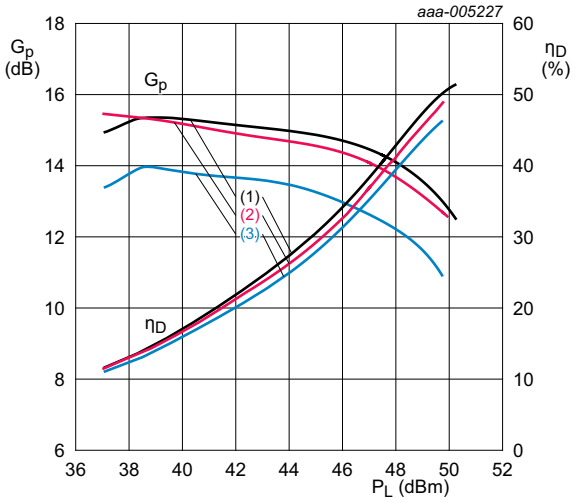
The following figures are measured in a broadband amplifier demo board from 2500 MHz to 3000 MHz.

7.3.1 1-Tone CW RF performance



V_{DS} = 50 V; I_{Dq} = 330 mA; P_L = 100 W.

Fig 2. Power gain and drain efficiency as function of frequency; typical values



V_{DS} = 50 V; I_{Dq} = 330 mA.

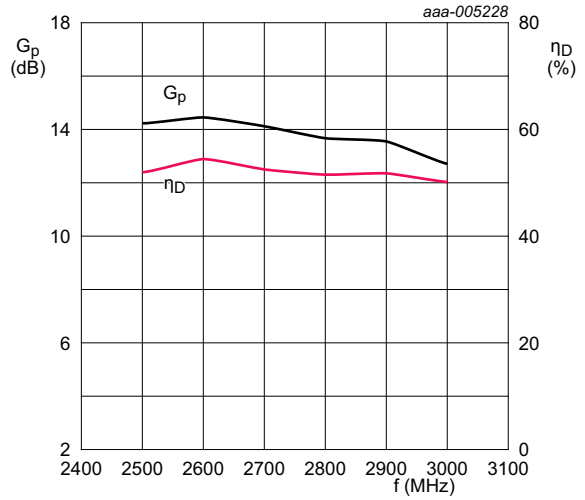
(1) f = 2500 MHz

(2) f = 2700 MHz

(3) f = 3000 MHz

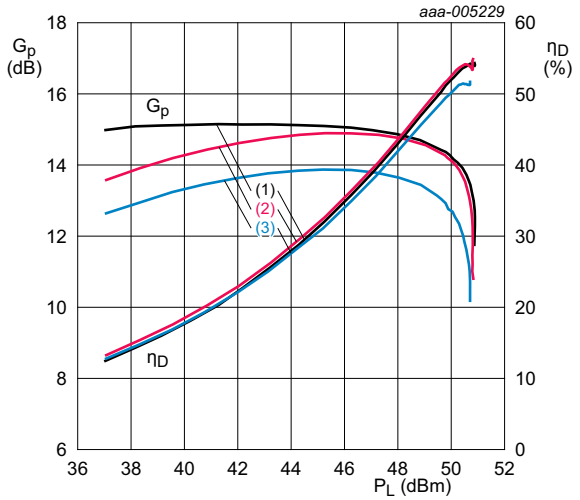
Fig 3. Power gain and drain efficiency as a function of output power; typical values

7.3.2 1-Tone pulsed RF performance



V_{DS} = 50 V; I_{Dq} = 330 mA; P_L = 100 W.

Fig 4. Power gain and drain efficiency as function of frequency; typical values



V_{DS} = 50 V; I_{Dq} = 330 mA.

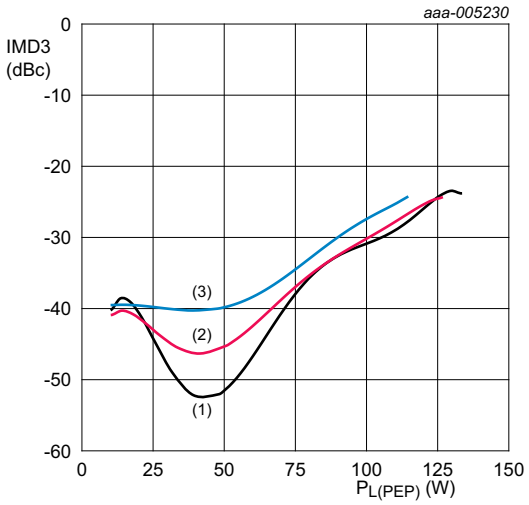
(1) f = 2500 MHz

(2) f = 2700 MHz

(3) f = 3000 MHz

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

7.3.3 2-Tone CW performance



Δf = 100 kHz; V_{DS} = 50 V; I_{Dq} = 330 mA.

(1) f = 2500 MHz

(2) f = 2700 MHz

(3) f = 3000 MHz

Fig 6. Third-order intermodulation distortion as a function of peak envelope power load power; typical values

8. Test information

8.1 Ruggedness in class-AB operation

The CLF1G0035-100P and CLF1G0035S-100P 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 (CW), f = 2500 MHz.

8.2 Load pull impedance information

Table 12. Typical impedance

Measured load-pull data half device. Typical values unless otherwise specified. I_{Dq} = 150 mA; V_{DS} = 50 V. Z_S and Z_L defined in Figure 7.

f	Z_S [1]	Z_L (maximum $P_{L(M)}$) [2]	Z_L (maximum η_D) [2]
MHz	Ω	Ω	Ω
500	6.4 + 4j	9.7 + 7j	10 + 5j
1000	1.9 + 2.2j	9.1 + 12.4j	10 + 6j
2000	1.9 – 2.9j	5 + 4.1j	6.6 + 1.4j
2500	2.1 – 6.3j	3.6 + 0.75j	4.5 – 0.4j
3000	2.5 – 9j	3.9 – 1.2j	5.8 – 1.8j
3500	2.9 – 14j	6.6 – 2j	5.8 – 3j

[1] measured at gate1 and gate2

[2] measured at drain1 and drain2

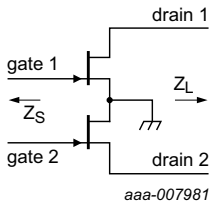


Fig 7. Definition of transistor impedance

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 data half device

Small signal; typical values unless otherwise specified; V_{DS} = 50 V; I_{Dq} = 150 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)
500	0.82686	−168.9	9.6028	67.238	0.01482	−9.5809	0.48482	−133.17
600	0.82717	−171.62	7.7589	61.123	0.013844	−12.463	0.52053	−136.01
700	0.82892	−173.81	6.4386	55.547	0.01282	−14.415	0.55589	−138.65
800	0.83183	−175.69	5.4524	50.412	0.011783	−15.413	0.58964	−141.17
900	0.83572	−177.39	4.6934	45.655	0.010764	−15.358	0.62126	−143.61
1000	0.84047	−178.98	4.096	41.233	0.0097946	−14.091	0.65063	−145.96
1100	0.84604	179.5	3.618	37.11	0.008907	−11.409	0.67787	−148.22
1200	0.85244	178	3.2306	33.257	0.0081421	−7.0907	0.70319	−150.39
1300	0.8597	176.51	2.9136	29.648	0.0075495	−0.99281	0.72687	−152.47
1400	0.86785	175.01	2.6525	26.259	0.0071873	6.7932	0.74919	−154.47
1500	0.87697	173.47	2.4362	23.07	0.0071125	15.766	0.77044	−156.39
1600	0.88715	171.88	2.2569	20.062	0.0073641	25.034	0.79086	−158.24
1700	0.89848	170.23	2.1083	17.22	0.007952	33.645	0.81069	−160.04
1800	0.90446	168.57	1.972	14.461	0.0088014	40.908	0.8252	−161.7
1900	0.90172	166.97	1.839	11.713	0.0098257	46.58	0.83233	−163.2
2000	0.89927	165.33	1.7253	9.0465	0.011062	50.849	0.83898	−164.63
2100	0.89713	163.64	1.6281	6.4503	0.012486	53.942	0.84528	−166
2200	0.89532	161.88	1.5454	3.9129	0.014088	56.092	0.85135	−167.32
2300	0.89386	160.04	1.4755	1.4231	0.015869	57.498	0.85727	−168.6
2400	0.89277	158.1	1.4171	−1.0309	0.01784	58.314	0.86313	−169.84
2500	0.89205	156.03	1.3692	−3.4611	0.020023	58.659	0.86899	−171.05
2600	0.89096	153.83	1.3297	−5.8933	0.022423	58.605	0.87436	−172.23
2700	0.88445	151.58	1.2888	−8.4222	0.024891	58.132	0.87579	−173.35
2800	0.87762	149.17	1.2551	−10.982	0.027588	57.364	0.87715	−174.44
2900	0.87039	146.59	1.2281	−13.588	0.030547	56.329	0.87847	−175.5
3000	0.86268	143.8	1.2076	−16.259	0.033808	55.045	0.8798	−176.54
3100	0.85434	140.75	1.1934	−19.013	0.037423	53.519	0.88118	−177.56
3200	0.84525	137.4	1.1855	−21.877	0.041451	51.748	0.88265	−178.56
3300	0.83522	133.68	1.1839	−24.877	0.045967	49.721	0.88425	−179.53
3400	0.82403	129.52	1.1889	−28.05	0.051058	47.418	0.88607	179.52
3500	0.80856	125.24	1.1872	−31.326	0.056194	44.92	0.88556	178.56
3600	0.79077	120.6	1.1867	−34.765	0.061705	42.174	0.88468	177.6
3700	0.77106	115.45	1.1896	−38.412	0.067742	39.146	0.88406	176.66
3800	0.74926	109.7	1.1956	−42.297	0.074348	35.812	0.88382	175.74
3900	0.72527	103.23	1.2044	−46.449	0.081559	32.146	0.88412	174.82
4000	0.69912	95.917	1.2152	−50.902	0.089394	28.121	0.88516	173.9
4100	0.67108	87.595	1.2274	−55.686	0.097849	23.71	0.88717	172.98

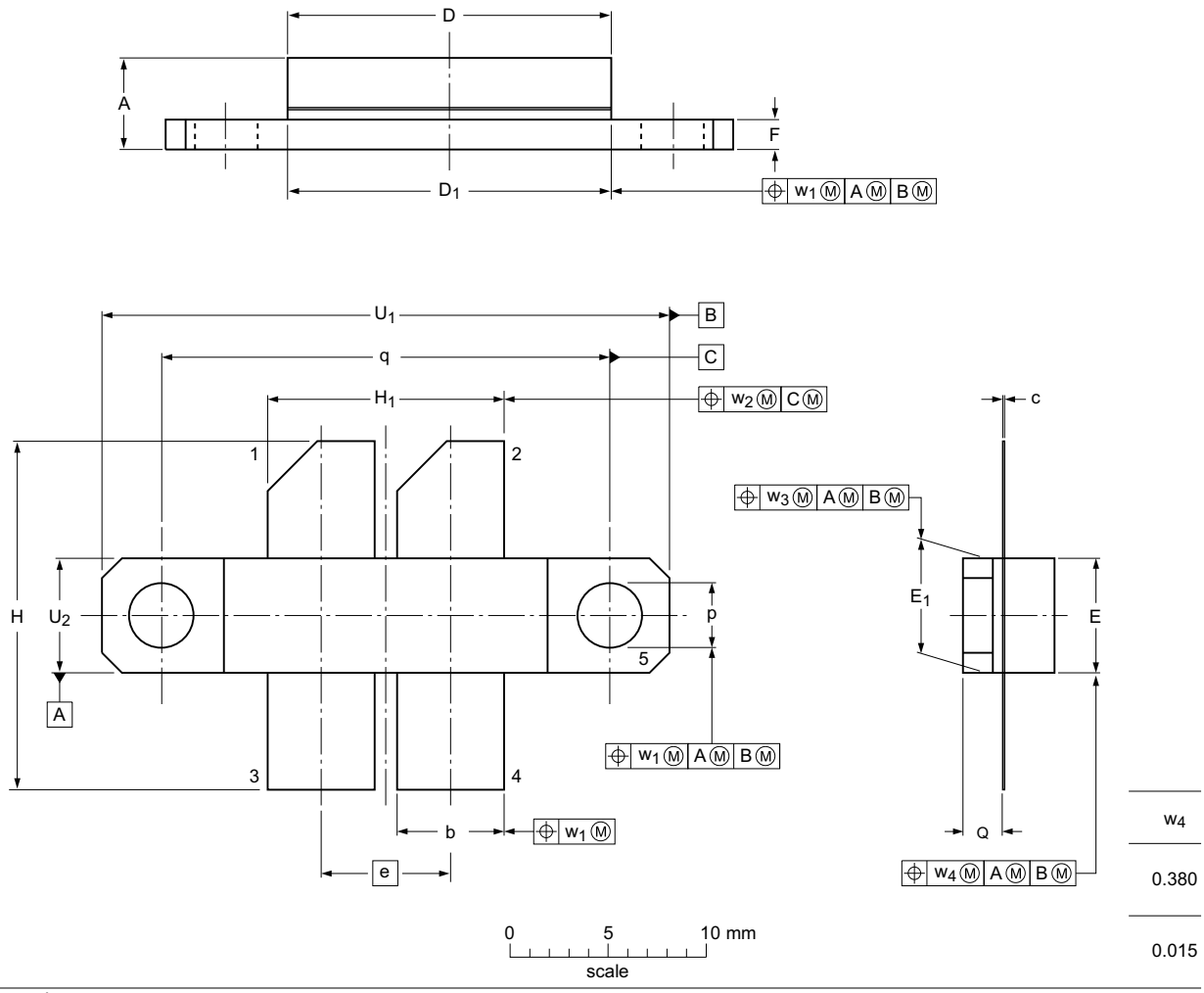
Table 13. S-parameter data half device *...continued*

Small signal; typical values unless otherwise specified; V_{DS} = 50 V; I_{Dq} = 150 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)
4200	0.64183	78.092	1.24	−60.826	0.10688	18.891	0.89042	172.03
4300	0.6126	67.228	1.2515	−66.34	0.11639	13.65	0.89516	171.03
4400	0.58534	54.856	1.2604	−72.231	0.12622	7.9864	0.90159	169.95
4500	0.5628	40.93	1.2649	−78.48	0.13615	1.9193	0.90984	168.75
4600	0.54816	25.608	1.2633	−85.047	0.14588	−4.5074	0.91983	167.38
4700	0.54433	9.3292	1.2542	−91.862	0.15511	−11.224	0.9313	165.79
4800	0.55279	−7.214	1.2369	−98.835	0.16356	−18.138	0.94381	163.95
4900	0.57293	−23.266	1.2115	−105.86	0.17103	−25.144	0.95677	161.82
5000	0.60219	−38.234	1.1791	−112.84	0.17745	−32.138	0.96962	159.39
5100	0.63534	−51.341	1.1406	−119.47	0.18272	−38.825	0.9807	156.67
5200	0.66527	−61.779	1.0972	−125.31	0.18683	−44.756	0.98704	153.74
5300	0.69493	−71.079	1.0544	−130.96	0.1906	−50.53	0.99214	150.52
5400	0.72195	−78.947	1.0134	−136.23	0.19423	−55.963	0.99508	147.04
5500	0.74577	−85.567	0.97537	−141.15	0.19795	−61.088	0.99579	143.28
5600	0.76759	−91.49	0.94075	−146	0.20193	−66.161	0.99532	139.15
5700	0.78744	−96.798	0.90986	−150.8	0.20632	−71.236	0.99371	134.58
5800	0.80548	−101.57	0.88283	−155.64	0.21125	−76.374	0.99093	129.47
5900	0.82197	−105.86	0.85961	−160.58	0.21682	−81.647	0.98694	123.72
6000	0.83722	−109.72	0.84	−165.71	0.22309	−87.14	0.98164	117.18

9. Package outline

Flanged LDMOST ceramic package; 2 mounting holes; 4 leads **SOT1228A**



	w4
	0.380
	0.015

Dimensions

Unit[1]		A	b	c	D	D_1	e	E	E_1	F	H	H_1	p	Q[2]	q	U_1	U_2	w_1	w_2	w_3
mm	max	5.2	5.59	0.15	16.66	16.69		5.92	5.97	1.65	18.29	12.19	3.43	2.21		29.08	5.97			
	nom						6.60								22.86			0.25	0.51	0.125
	min	4.5	5.33	0.08	16.36	16.33		5.77	5.72	1.40	17.27	11.94	3.18	1.96		28.83	5.72			
inches	max	0.205	0.220	0.006	0.656	0.657		0.233	0.235	0.065	0.720	0.480	0.135	0.087		1.145	0.235			
	nom						0.26								0.900			0.01	0.02	0.005
	min	0.177	0.210	0.003	0.644	0.643		0.227	0.225	0.055	0.680	0.470	0.125	0.077		1.135	0.225			

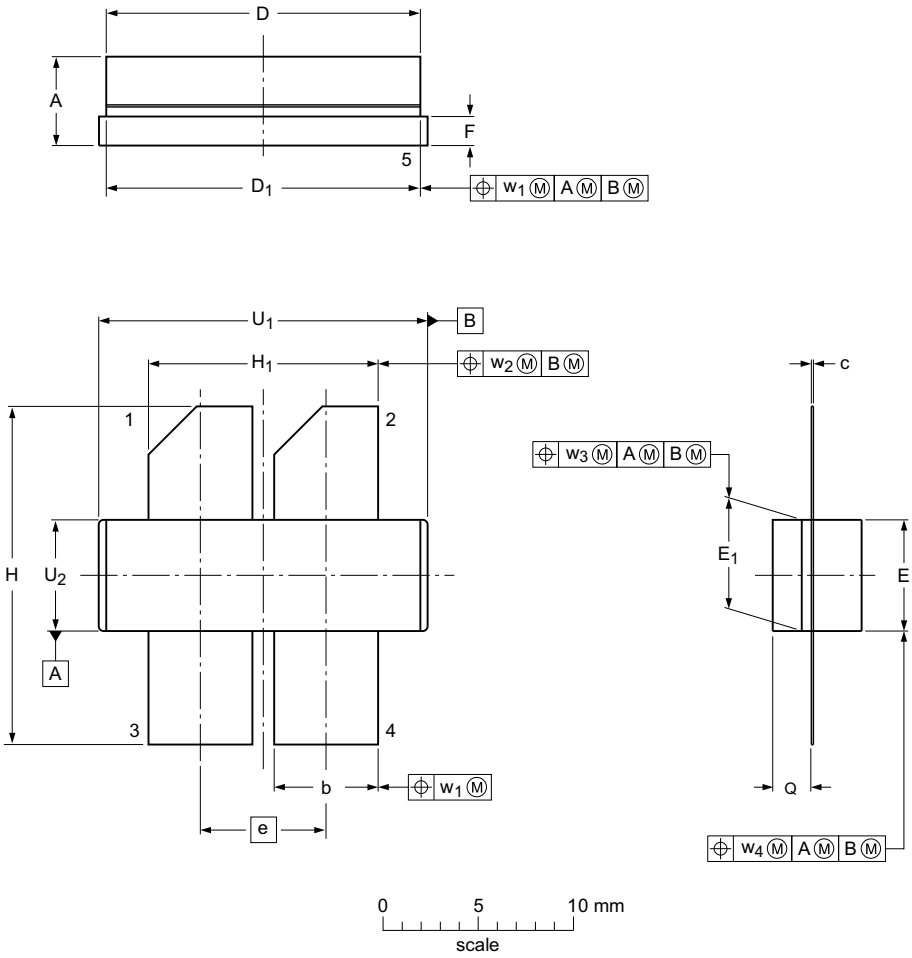
Note
1. Millimeter dimensions are derived from the original inch dimensions.
2. Dimension is measured 0.030 inch (0.76 mm) from body.

sot1228a_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1228A						~~12-06-11~~ 13-05-16

Fig 8. Package outline SOT1228A

Earless flanged LDMOST ceramic package; 4 leads **SOT1228B**



Dimensions

Unit[1]		A	b	c	D	D_1	e	E	E_1	F	H	H_1	Q[2]	U_1	U_2	w_1	w_2	w_3	w_4
mm	max	5.2	5.59	0.15	16.66	16.69		5.92	5.97	1.65	18.29	12.19	2.21	17.40	5.97				
	nom						6.60									0.25	0.51	0.125	0.38
	min	4.5	5.33	0.08	16.36	16.33		5.77	5.72	1.40	17.27	11.94	1.96	17.15	5.72				
inches	max	0.205	0.220	0.006	0.656	0.657		0.233	0.235	0.065	0.720	0.480	0.087	0.685	0.235				
	nom						0.26									0.01	0.02	0.005	0.01
	min	0.177	0.210	0.003	0.644	0.643		0.227	0.225	0.055	0.680	0.470	0.077	0.675	0.225				

Note
1. Millimeter dimensions are derived from the original inch dimensions.
2. Dimension is measured 0.030 inch (0.76 mm) from body.

sot1228b_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1228B						~~13-05-15~~ 13-05-23

Fig 9. Package outline SOT1228B

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
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
CLF1G0035-100P_1G0035S-100P v.2	20130620	Objective data sheet	-	CLF1G0035-100P_1G0035S-100P v.1
Modifications:	• Table 6 on page 3: table has been updated. • Table 7 on page 3: table has been updated. • Table 8 on page 3: table has been updated. • Section 7 on page 4: section has been updated. • Section 8 on page 8: section has been added.			
CLF1G0035-100P_1G0035S-100P v.1	20121210	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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