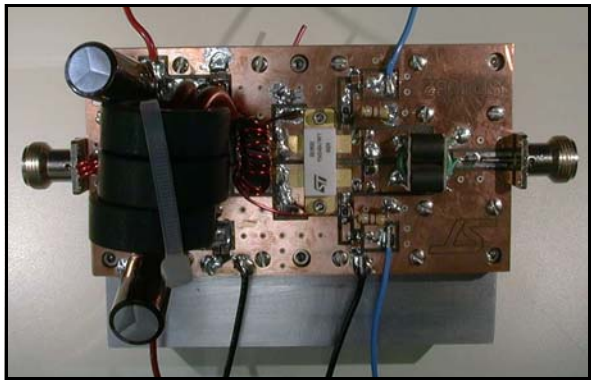
DB-3932-30

Evaluation board using 1x SD3932 for HF transmitters

Features

- Excellent thermal stability
- Frequency: 2 - 30 MHz
- Supply voltage: 100 V
- Output power: 400 W
- Input power 4 W max.
- Efficiency: 62 % - 68 %
- IMD at 400 WPEP < -25 dBc
- Load mismatch: 3:1 all phases



Description

The DB-3932-30 is a 400 W / 100 V RF broadband power amplifier intended for linear or nonlinear operation over the band 2 to 30 MHz using 1xSD3932 gold metallized N-channel MOS field-effect transistor.

Table 1. Device summary

Order code
DB-3932-30

Contents

1 Electrical data

1.1 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
P_{IN}	Input power	6	W
P_{OUT}	Output power	500	W
V_{DD}	Drain supply voltage	100	V
V_{GG}	Gate biasing voltage	4	V
I_{DD}	Drain current	8	A
P_{DISS}	Power dissipation	400	W

2 Electrical characteristics

T_A = +25 °C, V_{DD} = 100V, I_{DQ} = 2 x 100mA

Table 3. Electrical specification

Symbol	Test conditions	Min	Typ	Max	Unit
Freq	Frequency range	2		30	MHz
P_{OUT}		400			W
Gain	P_{OUT} = 400 W		22.5 ± 1.2		dB
ND	P_{OUT} = 400 W		62 - 68		%
H2	2^{ND} Harmonic @ P_{OUT} = 400 W		-40 / -50		dBc
H3	3^{RD} Harmonic @ P_{OUT} = 400 W		-16 / -21		dBc
IMD	4 tones - 1 kHz spacing / 25 W per tone			-25	dBc

3 Schematic and components part list

Figure 1. Components part list

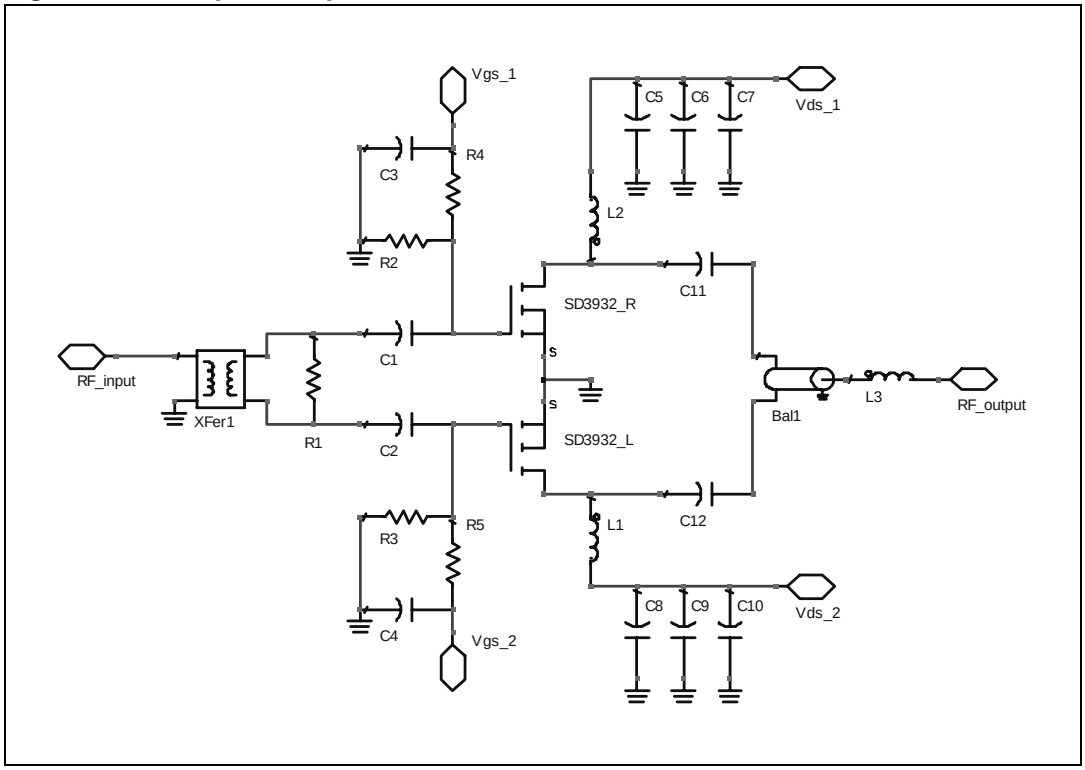


Table 4. Bill of materials

Component ID	Description	Value	Case size	Manufacturer	Part code
XFer1	9:1 transformer			Communication concepts	RF400-9
R1	Resistor	5 Ω		Venkel	
R2, R3	Resistor	470 Ω	carbon		471
R4,R5	Resistor	510 Ω		Venkel	511
C1,C2,C3,C4	Capacitor	39000 pF	100B	ATC	393M
C5, C8	Capacitor	1200 pF	100B	ATC	122M
C6, C9	Capacitor	39000 pF	100B	ATC	393M
C7,C10	Capacitor	100 uF			
C11, C12	Capacitor	39000 pF	100B	ATC	393M
L1,L2	SPLIT CHOKE	39 uH/side		7 turns wound on toroid 5943000601	
L3	Inductor			3 turns 5/16 inch dia	
Bal1	BALUN	50 Ω		two turns thru 3 toroids 2943802702B	151

Table 4. Bill of materials (continued)

Component ID	Description	Value	Case size	Manufacturer	Part code
torroid	toroid			ferrite	5943000601
torroid	toroid			ferrite	2943802702B
RF in, RF out	N conn	50 Ω		SV Microwave	5050-0037
SD3932	DMOS			STMicroelectronics	SD3932
Board	FR-4 THk = 0.100" 1OZ Cu Both Sides				

4 Circuit layout

Figure 2. Circuit layout / photomaster

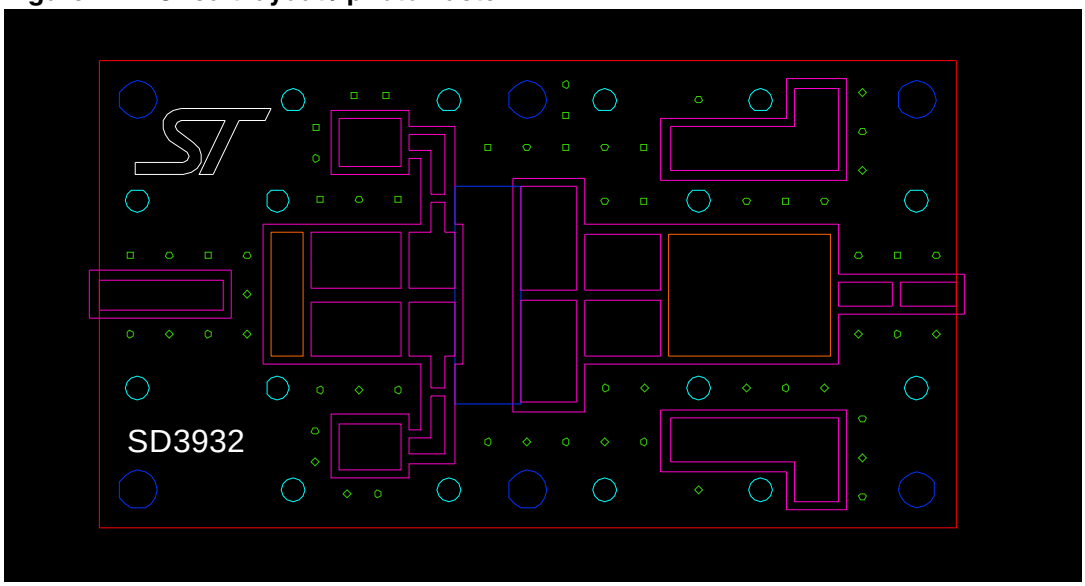


Figure 3. Photo circuit layout / input transformer

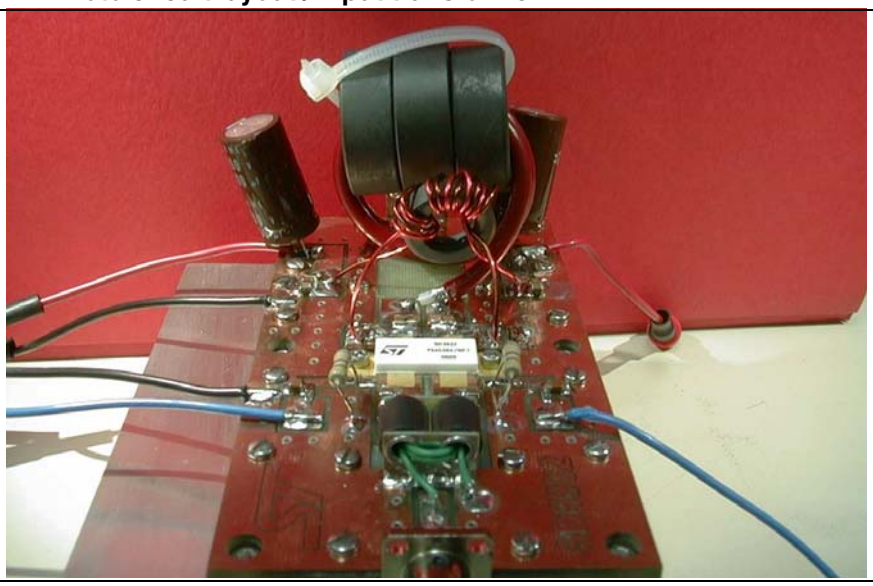


Figure 4. Photo circuit layout / output transformer

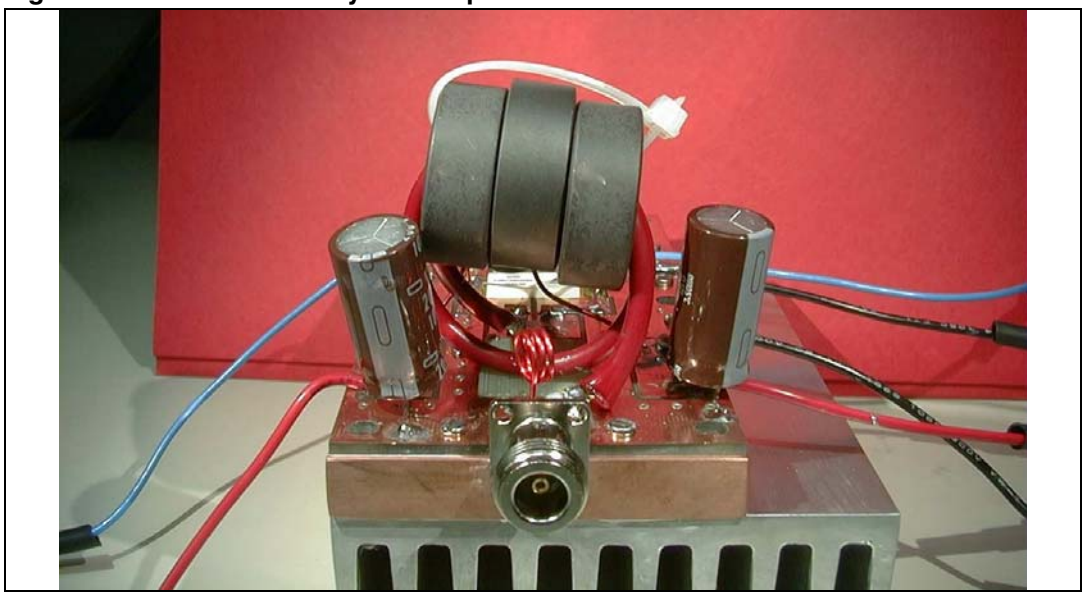
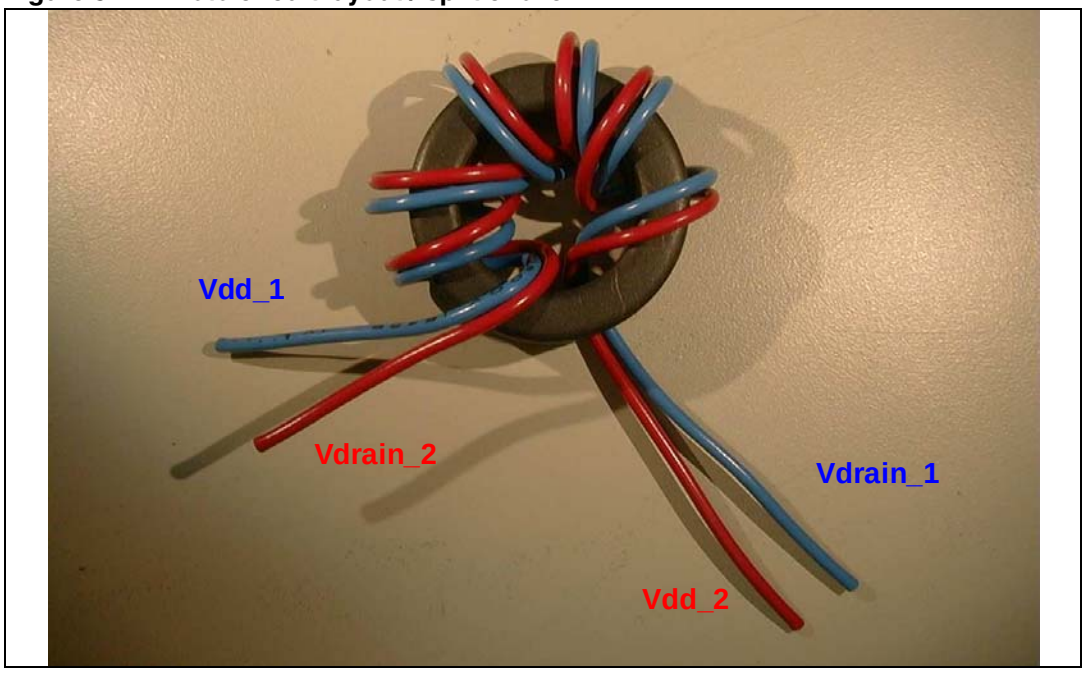


Figure 5. Photo circuit layout / split choke



5 Broadband

5.1 Broadband Zdl impedance

Figure 6. Broadband Zdl impedance

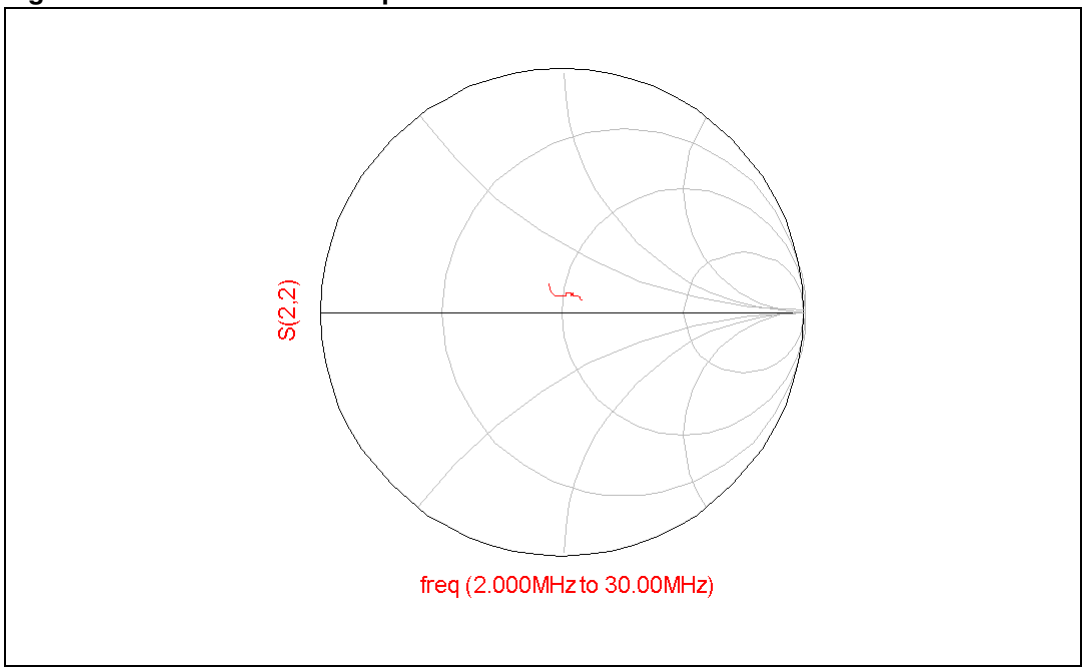


Table 5. Broadband Zdl impedance

freq	R	jX
2 .000 MHz	43.369	9.91 7
3 .000 MHz	45.089	7.85 9
4 .000 MHz	45.956	7.03 6
5 .000 MHz	46.521	6.58 4
6 .000 MHz	47.043	6.46 9
7 .000 MHz	47.372	6.47 6
8 .000 MHz	47.772	6.65 1
9 .000 MHz	48.299	6.47 4
10.00 MHz	48.482	6.46 9
11.00 MHz	48.948	6.75 0
12.00 MHz	49.284	6.91 4
13.00 MHz	49.694	7.08 1
14.00 MHz	50.105	7.25 2
15.00 MHz	50.515	7.39 6
16.00 MHz	50.953	7.54 4

Table 5. Broadband Zdl impedance (continued)

freq	R	jX
17.00 MHz	51.420	7.68 4
18.00 MHz	51.916	7.77 0
19.00 MHz	52.405	7.81 9
20.00 MHz	52.893	7.83 0
21.00 MHz	53.321	7.82 5
22.00 MHz	53.816	7.99 6
23.00 MHz	54.467	7.95 2
24.00 MHz	55.052	7.75 2
25.00 MHz	55.419	7.71 3
26.00 MHz	56.174	7.62 4
27.00 MHz	56.925	7.30 1
28.00 MHz	57.630	6.75 1
29.00 MHz	58.212	5.98 8
30.00 MHz	58.618	5.05 1

5.2 Broadband Zs impedance

Figure 7. Broadband Zs impedance

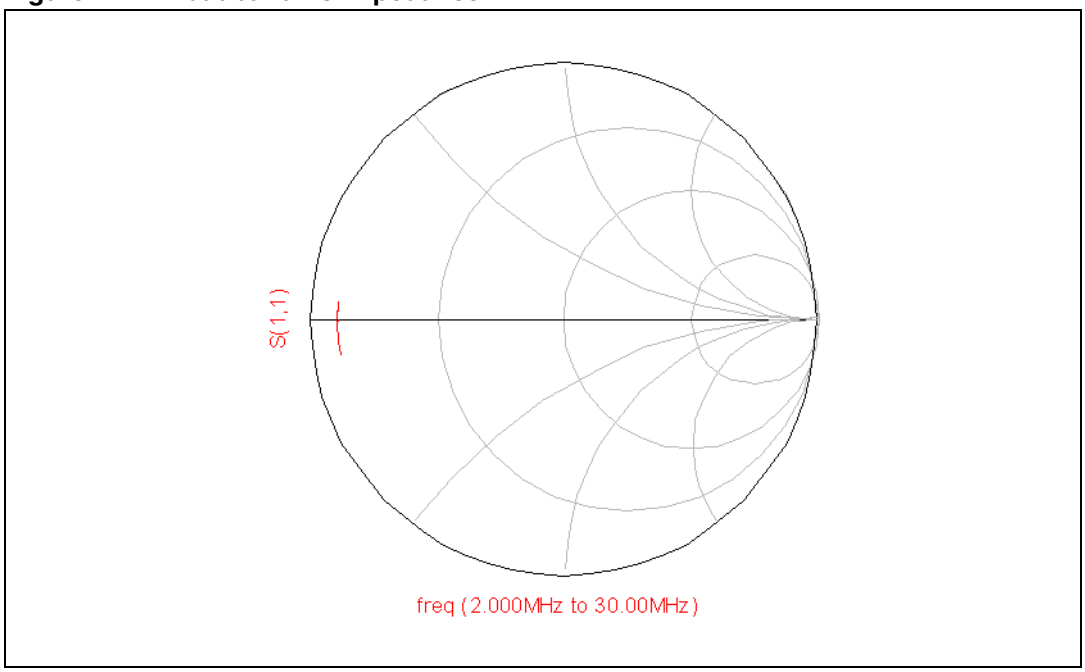


Table 6. Broadband Zs impedance

freq	R	jX
2.000 MHz	2.721	-3.873
3.000 MHz	2.712	-2.444
4.000 MHz	2.706	-1.720
5.000 MHz	2.641	-1.280
6.000 MHz	2.740	-0.871
7.000 MHz	2.664	-0.628
8.000 MHz	2.636	-0.369
9.000 MHz	2.776	-0.292
10.00 MHz	2.737	0.065
11.00 MHz	2.729	0.131
12.00 MHz	2.720	0.275
13.00 MHz	2.746	0.395
14.00 MHz	2.746	0.492
15.00 MHz	2.746	0.624
16.00 MHz	2.726	0.732
17.00 MHz	2.755	0.829
18.00 MHz	2.747	0.891

Table 6. Broadband Zs impedance (continued)

freq	R	jX
19.00 MHz	2.742	1.012
20.00 MHz	2.767	1.112
21.00 MHz	2.778	1.216
22.00 MHz	2.768	1.282
23.00 MHz	2.754	1.389
24.00 MHz	2.777	1.466
25.00 MHz	2.784	1.515
26.00 MHz	2.803	1.649
27.00 MHz	2.806	1.691
28.00 MHz	2.800	1.783
29.00 MHz	2.809	1.882
30.00 MHz	2.843	1.982

6 Typical performance

Figure 8. Gain and drain efficiency versus frequency

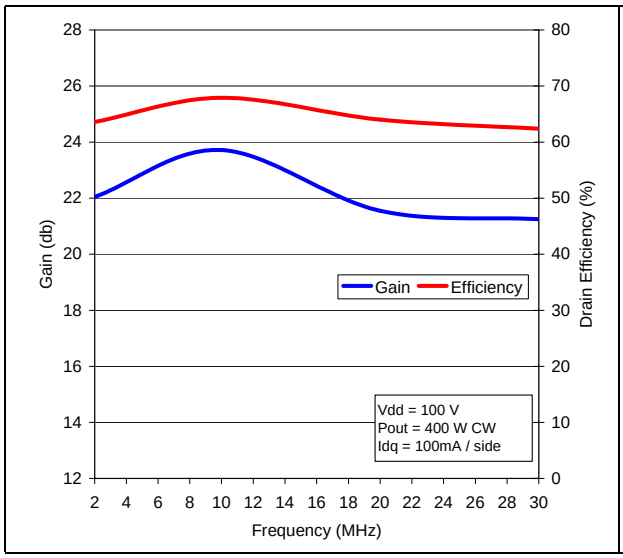


Figure 9. Output power vs input power & frequency

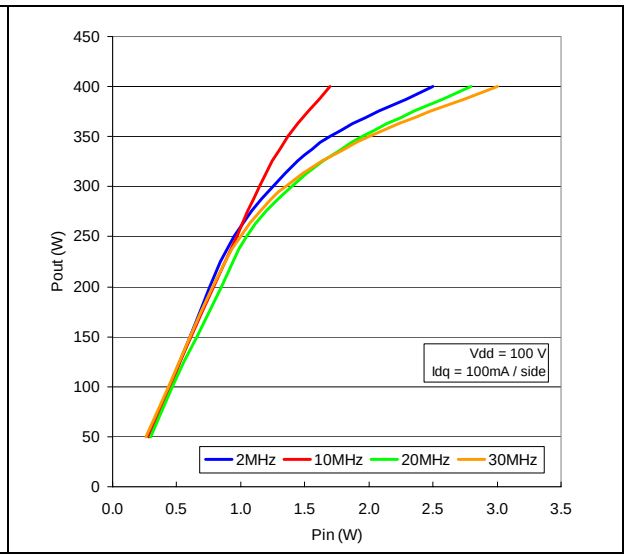


Figure 10. Drain efficiency versus Pout & frequency

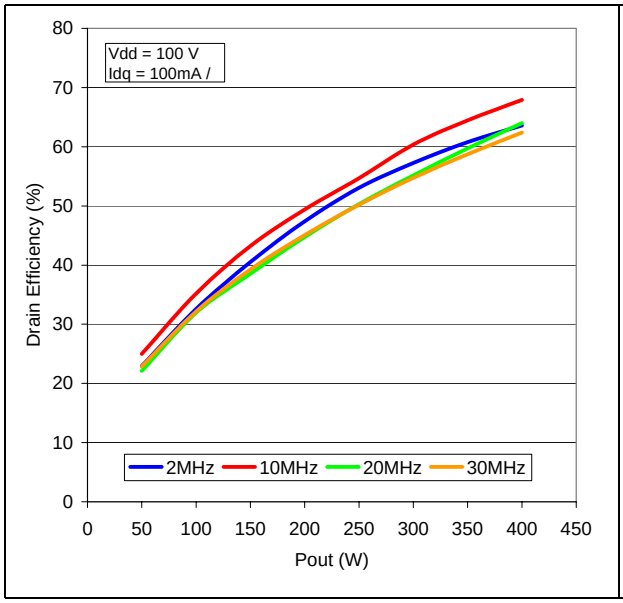


Figure 11. Harmonics level vs frequency

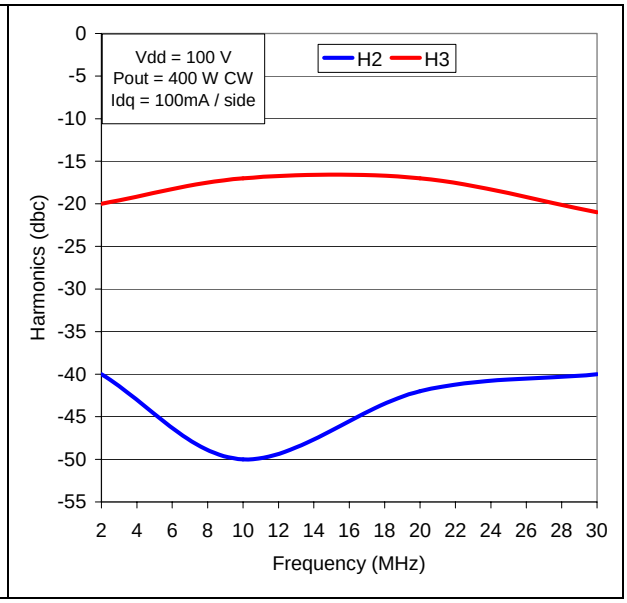
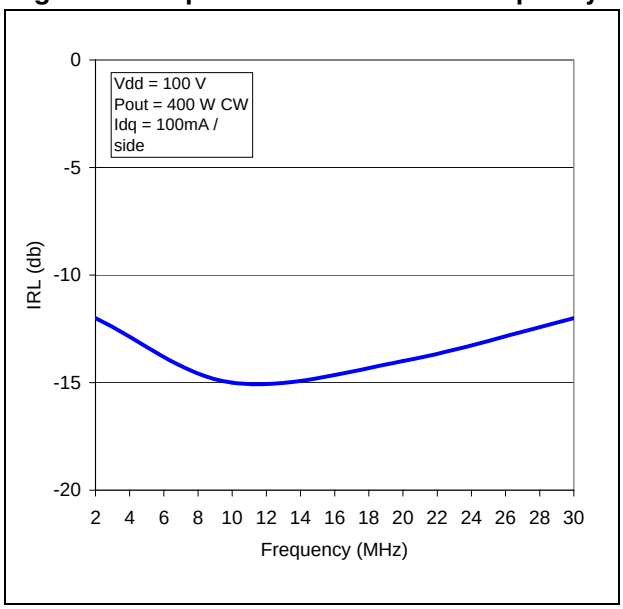


Figure 12. Input return loss versus frequency



7 Four tone

Figure 13. Four tones IMD_30MHz_100W(avg)

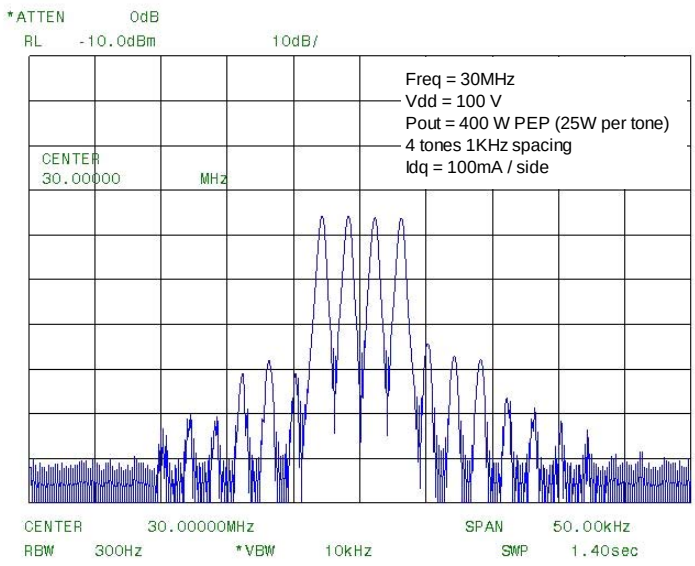


Figure 14. Four tones IMD_20MHz_100W(avg)

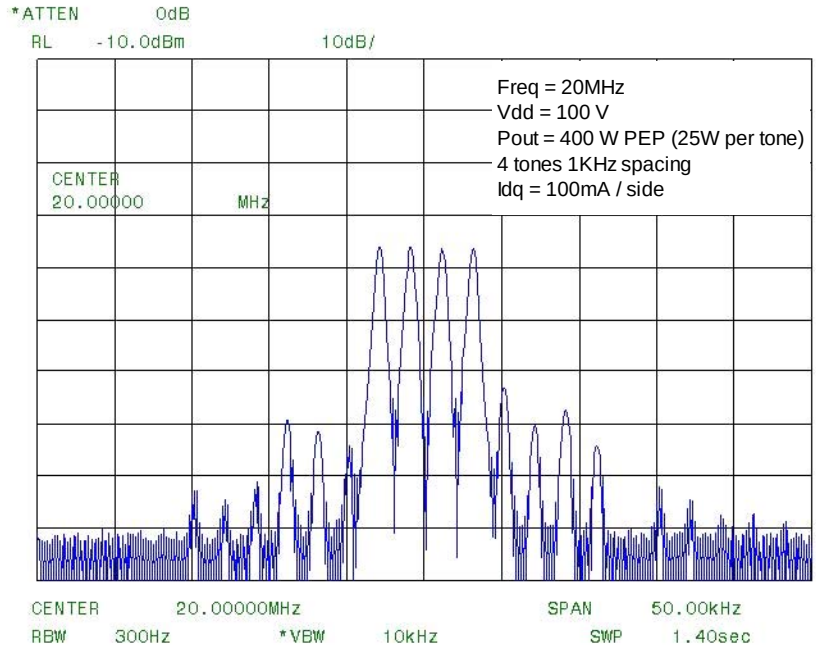


Figure 15. Four tones IMD_10MHz_100W(avg)

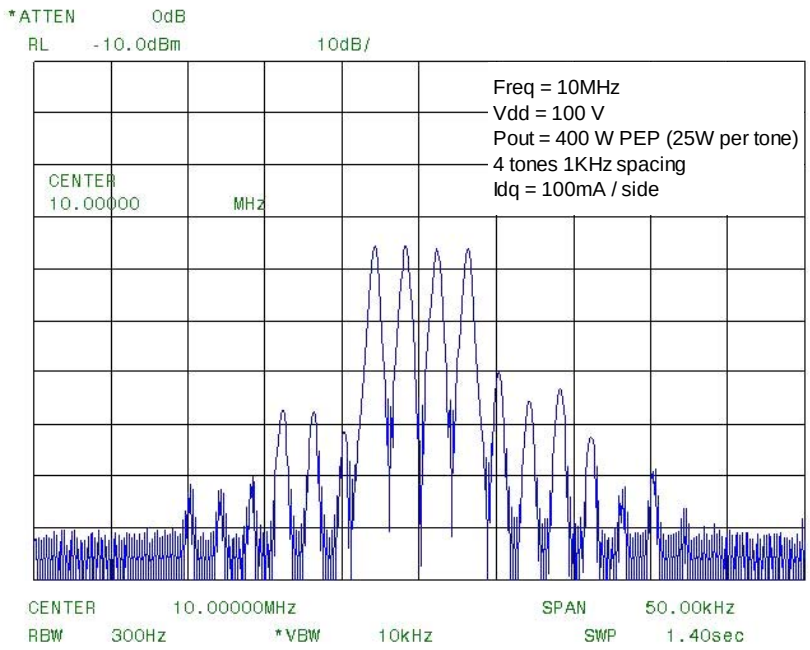
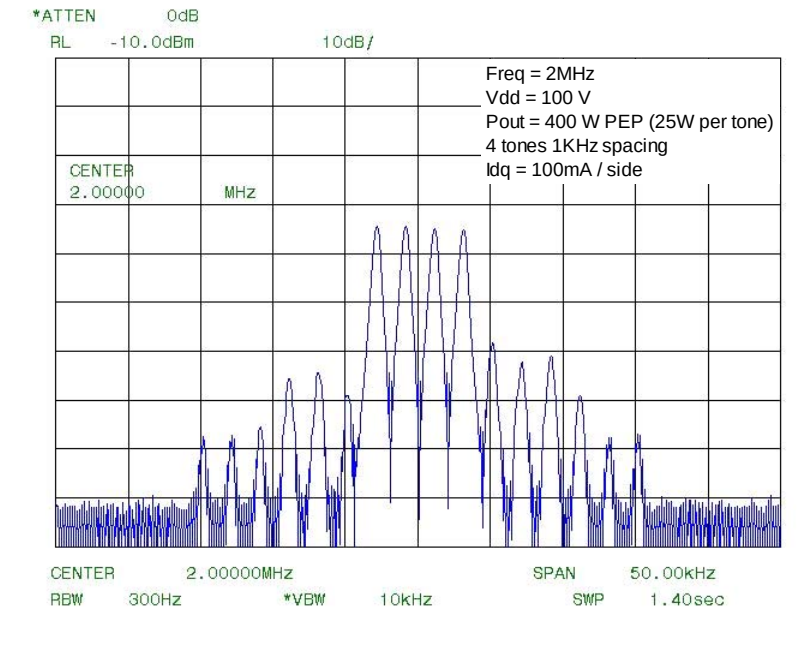


Figure 16. Four tones IMD_2MHz_100W (avg)



8 SD3932 mounting recommendations

8.1 Mounting recommendations

- Ensure holes in heatsinks are free from burrs;
- Minimum depth of tapped holes in heatsinks is 6 mm;
- Use 4-40 UNC-2A cheese-head screws with a flat washer to spread the joint pressure;
- The minimum flatness of the mounting area is 0.02 mm;
- Mounting area roughness should be less than 0.5 µm (micro);
- Avoid, as much as possible, use of flux or flux solutions because flux can penetrate even when hermetically sealed ceramic-capped transistors. Tin and wash the printed-circuit board BEFORE mounting the power transistors, then solder the transistor leads without using flux;
- Transistor leads may be tinned by dipping them full-length into a solder bath at a temperature of about 230 °C. No flux should be used during tinning;
- Recommended heatsink compounds : WPSII (silicon free) from Austerlitz Electronics, 340 from Dow Corning etc.

8.2 Mounting sequence

- Apply a thin layer of evenly distributed heatsink compound to the flange;
- Position the device with flat washers in place;
- Tighten the screws until finger tight (0.05 Nm);
- Further tighten the screws until the specified torque is reached;
- For M174, M177 & M244 type of packages, torque should be minimum 0.6 Nm and 0.75 Nm max.

Table 7. DMOS packages - list of materials

Package type	Description	Flange	Leadframe	Ceramic insulator	Plating		Torque (Nm)	
					Leads	Flange	Min	Max
M174	0.500 DIA 4L NON HERM W/FLANGE	Cu	ALLOY 42 (Fe58 / Ni42)	BeO (99.5% min)	Au (100 µ min) over Ni (100 µ min / 350 µ max)	Ni(100 µ min) + Pd (10 µ min)	0.6	0.75
M174 (Moly disk)	0.500 DIA 4L NON HERM W/FLANGE (MOLY DISK)	Cu-Mo-Cu	ALLOY 42 (Fe58 / Ni42)	BeO (99.5% min)	Au (100 µ min) over Ni (100 µ min / 350 µ max)	Ni(100 µ min) + Pd (10 µ min)	0.6	0.75
M177	0.550 DIA 4L NON HERM W/FLANGE	Cu-Mo-Cu	ALLOY 42 (Fe58 / Ni42)	BeO (99.5% min)	Au (60 µ min) over Ni (100 µ min / 350 µ max)	Au (100 µ min) over Ni (100 µ min / 350 µ max)	0.6	0.75
M244	2x 0.400x0.425 WIDE 2L LAP N/H FLANGE	W (85%) - Cu (15%)	ALLOY 42 (Fe58 / Ni42)	BeO(99.5 % min)	Au (60 µ min) over Ni (100 µ min / 350 µ max)	Au (60 µ min) over Ni (100 µ min / 350 µ max)	0.6	0.75

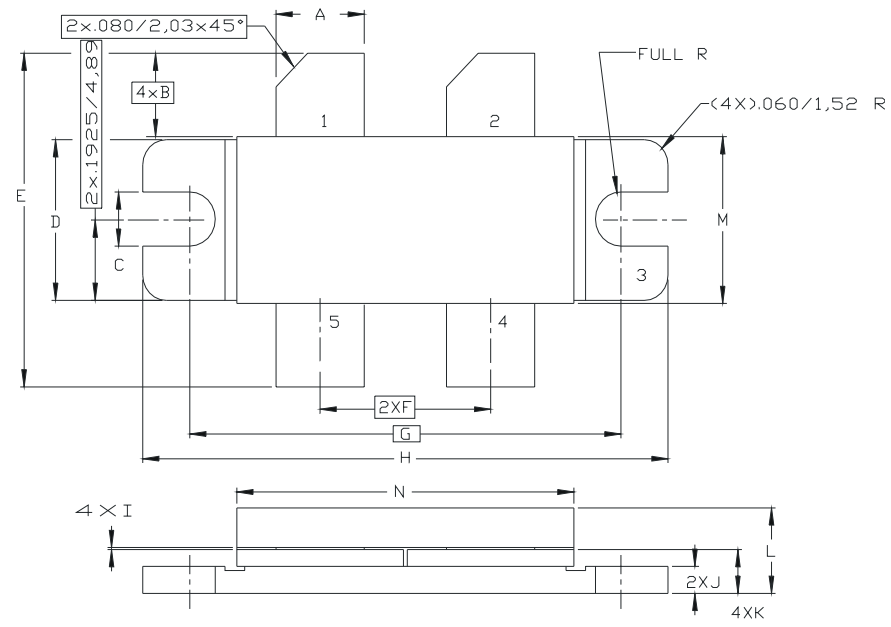
9 Package mechanical data - SD3932

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

Table 8. M244 (.400 x .860 4/L BAL N/HERM W/FLG) mechanical data

Dim.	mm.			Inch		
	Min	Typ	Max	Min	Typ	Max
A	5.59		5.84	0.220		0.230
B		5.08			0.200	
C	3.02		3.28	0.119		0.129
D	9.65		9.91	0.380		0.390
E	19.81		20.82	0.780		0.820
F	10.92		11.18	0.430		0.440
G		27.94			1.100	
H	33.91		34.16	1.335		1.345
I	0.10		0.15	0.004		0.006
J	1.52		1.78	0.060		0.070
K	2.59		2.84	0.102		0.112
L	4.83		5.84	0.190		0.230
M	10.03		10.34	0.395		0.407
N	21.59		22.10	0.850		0.870

Figure 17. Package dimensions



Controlling Dimension: Inches

1020876B

10 Revision history

Table 9. Document revision history

Date	Revision	Changes
07-Dec-2007	1	Initial release

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST’s terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST’S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER’S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com