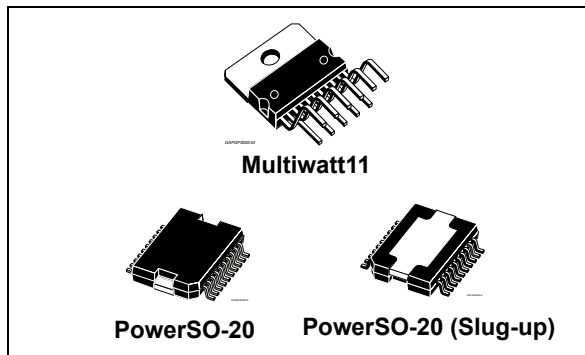


## 35 W bridge car radio amplifier with low voltage operation

Datasheet - production data



- Protections:
  - Short circuit (to GND, to  $V_S$ , across the load)
  - Very inductive loads
  - Chip over temperature
  - Load dump
  - Open GND
  - ESD

### Description

The TDA7391LV is a bridge class AB audio power amplifier specially intended for car radio high power applications.

The high power capability together with the possibility to operate either in differential input mode or single ended input mode makes it suitable for boosters and high end car radio equipment. The exclusive fully complementary output stage and the internal fixed gain configuration drop the external component count.

The on board clipping detector allows easy implementation of gain compression systems.

It is moreover compliant to the most recent OEM specifications for low voltage operation (so called 'start-stop' battery profile during engine stop), helping car manufacturers to reduce the overall emissions and thus contributing to environment protection.

### Features

- High power capability:
  - 40 W/ 4  $\Omega$  max
  - 45 W/ 3.2  $\Omega$  max
  - 32 W/ 3.2  $\Omega$  @  $V_S = 14.4$  V,  $f = 1$  kHz, THD = 10 %
  - 26 W/ 4  $\Omega$  @  $V_S = 14.4$  V,  $f = 1$  kHz, THD = 10%
- Differential inputs (either single ended or differential input signal is accepted)
- Minimum external component count:
  - No bootstrap capacitors
  - No boucherot cells
  - Internally fixed gain (30 dB)
  - No SVR capacitor
- Standby function (CMOS compatible)
- Capable to operate to 6 V (e.g. "start-stop")

Table 1. Device summary

Order code	Package	Packing
TDA7391LV	Multiwatt11	Tube
TDA7391LVDP	PowerSO-20	Tube
TDA7391LVDPDTR		Tape and reel
TDA7391LVDPDU	PowerSO-20 (Slug-up)	Tube
TDA7391LVDPDUTR		Tape and reel

# Contents

- 1      Block diagram, test and application circuit ..... 5**
  - 1.1    Block diagram ..... 5
  - 1.2    Test and application circuit ..... 5
  
- 2      Pins description ..... 6**
  
- 3      Electrical specifications ..... 8**
  - 3.1    Absolute maximum ratings ..... 8
  - 3.2    Thermal data ..... 8
  - 3.3    Electrical characteristics ..... 8
  - 3.4    Low voltage operation (“start stop”) ..... 10
  - 3.5    Electrical characteristics curves ..... 11
  
- 4      Package information ..... 13**
  
- 5      Revision history ..... 16**

## List of tables

Table 1.	Device summary . . . . .	1
Table 2.	Pins function . . . . .	6
Table 3.	Absolute maximum ratings . . . . .	8
Table 4.	Thermal data . . . . .	8
Table 5.	Electrical characteristics . . . . .	8
Table 6.	Document revision history . . . . .	16

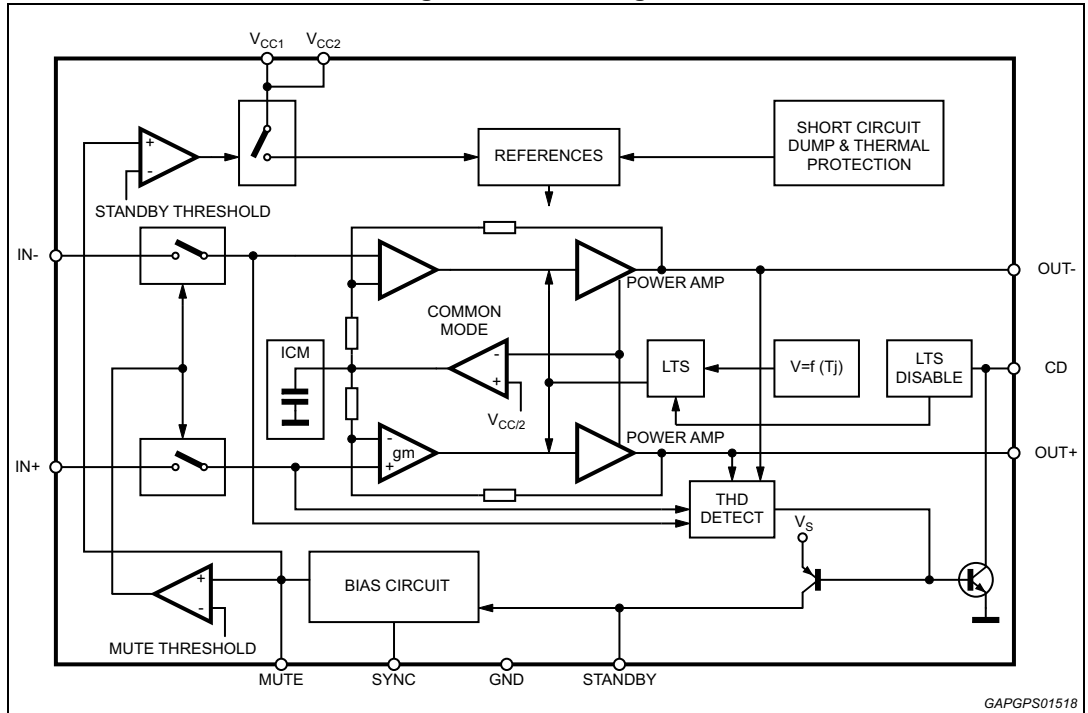
## List of figures

Figure 1.	Block diagram . . . . .	5
Figure 2.	Test and application circuit . . . . .	5
Figure 3.	Multiwatt11 pins connection (top view) . . . . .	6
Figure 4.	PowerSO-20 pins connection (top view) . . . . .	6
Figure 5.	Worst case battery cranking curve sample 1 . . . . .	10
Figure 6.	Worst case battery cranking curve sample 2 . . . . .	10
Figure 7.	Quiescent current vs. supply voltage . . . . .	11
Figure 8.	Output power vs. supply voltage (@ $R_L = 4\Omega$ ) . . . . .	11
Figure 9.	Distortion vs. frequency (@ $R_L = 4\Omega$ ) . . . . .	11
Figure 10.	Output power vs. supply voltage (@ $R_L = 3.2\Omega$ ) . . . . .	11
Figure 11.	Distortion vs. frequency (@ $R_L = 3.2\Omega$ ) . . . . .	11
Figure 12.	Supply voltage rejection vs. frequency . . . . .	11
Figure 13.	Common mode rejection vs. frequency . . . . .	12
Figure 14.	Total power dissipation and efficiency vs. output power (@ $R_L = 4\Omega$ ) . . . . .	12
Figure 15.	Power bandwidth . . . . .	12
Figure 16.	Multiwatt11 (vertical) mechanical data and package dimensions . . . . .	13
Figure 17.	PowerSO20 mechanical data and package dimensions . . . . .	14
Figure 18.	PowerSO20 (Slug-up) mechanical data and package dimensions . . . . .	15

# 1 Block diagram, test and application circuit

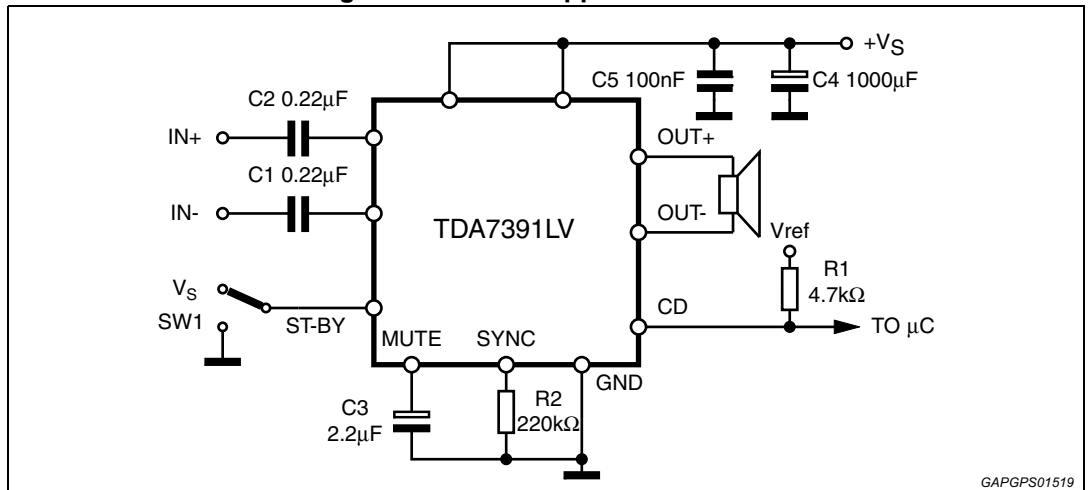
## 1.1 Block diagram

Figure 1. Block diagram



## 1.2 Test and application circuit

Figure 2. Test and application circuit



## 2 Pins description

Figure 3. Multiwatt11 pins connection (top view)

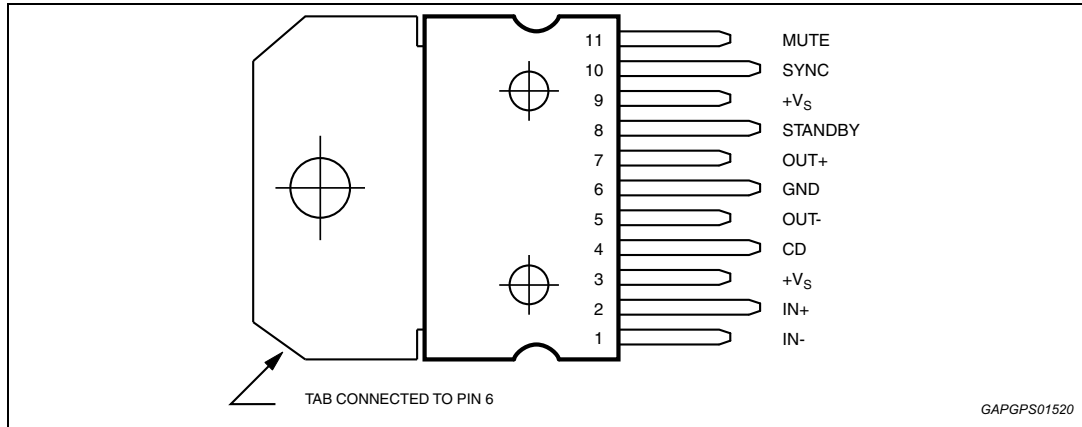


Figure 4. PowerSO-20 pins connection (top view)

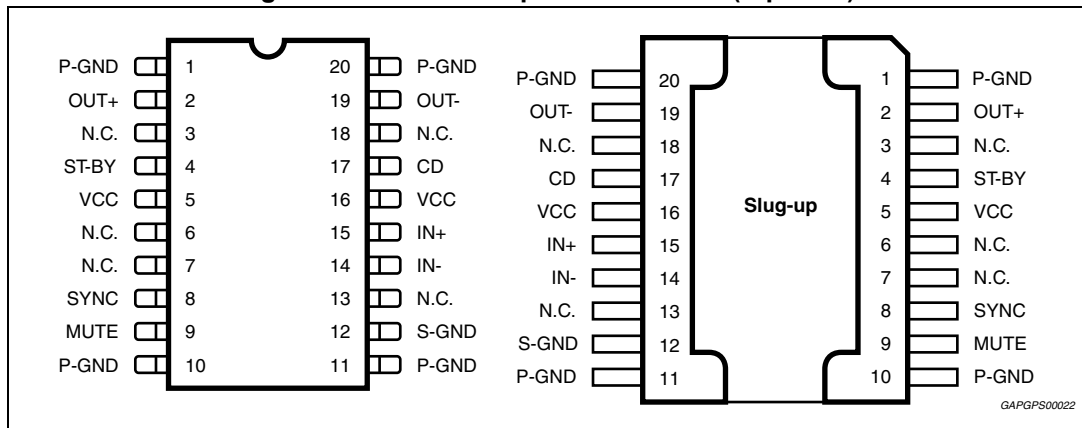


Table 2. Pins function

Multiwatt11 Pin #	PowerSO-20 Pin #	Name	Description
1, 2	14, 15	INPUTS	The input stage is a high impedance type also capable of operation in single ended mode with one input capacitively coupled to the signal GND. The impedance seen by the inverting and non inverting input pins must be matched.
3, 9	5, 16	+Vs	Supply voltage.
4	17	CD	The TDA7391LV is equipped with a diagnostic circuitry able to detect the clipping in the Output Signal (distortion = 10%). The CD pin (open collector) gives out low level signal during clipping.

Table 2. Pins function (continued)

Multiwatt11 Pin #	PowerSO-20 Pin #	Name	Description
5, 7	2, 19	OUTPUTS	The output stage is a bridge type able to drive loads as low as $3.2\Omega$ . It consists of two class AB fully complementary PNP/NPN stages fully protected. A rail to rail output voltage swing is achieved without need of bootstrap capacitors. No external compensation is necessary.
6	1, 10, 11, 20	GND	Power ground.
	12	S-GND	Signal ground.
8	4	STANDBY	The device features a standby function which shuts down all the internal bias supplies when the standby pin is low. In standby mode the amplifier sinks a small current (in the range of few $\mu\text{A}$ ). When the standby pin is high the IC becomes fully operational.
10	8	SYNC	A resistor ( $R_2$ ) between pin 8 and GND set the charging current of capacitor $C_3$ (pin 9). The suggested values of $C_3$ and $R_2$ define the correct timing in order to switch on/off the amplifier without any pop noise.
11	9	MUTE	The pin is connected to a capacitor ( $C_3$ ) tied to GND to set the mute/standby time. An automatic mute during turn on/off is provided to prevent noisy transients.

### 3 Electrical specifications

#### 3.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_S$	DC supply voltage	28	V
$V_{OP}$	Operating supply voltage	18	V
$V_{PEAK}$	Peak supply voltage (t = 50 ms)	50	V
$I_O$	Output peak current repetitive (f > 10 Hz)	4.5	A
	Output peak current non repetitive	6	A
$P_{tot}$	Power dissipation ( $T_{case} = 85\text{ °C}$ )	43	W
$T_{stg}, T_j$	Storage and junction temperature	-40 to 150	°C

#### 3.2 Thermal data

Table 4. Thermal data

Symbol	Parameter	Multiwatt	PowerSO	Unit
$R_{th\ j-case}$	Thermal resistance junction-to-case Max.	1.8	2	°C/W

#### 3.3 Electrical characteristics

$V_S = 14.4\text{ V}$ ;  $R_L = 4\ \Omega$ ,  $f = 1\text{ kHz}$ ,  $T_{amb} = 25\text{ °C}$ , unless otherwise specified.

Table 5. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_S$	Supply voltage range	-	6	-	18	V
$I_q$	Total quiescent current	-	-	60	150	mA
$V_{OS}$	Output offset voltage	-	-	-	120	mV
$I_{SB}$	Standby current	$V_{ST-BY} = 1.5\text{ V}$	-	-	50	μA
$I_{SBin}$	Standby input bias current	$V_{ST-BY} = 5\text{ V}$	-	-	10	μA
$V_{SBon}$	Standby on threshold voltage	-	-	-	1.5	V
$V_{SBoff}$	Standby off threshold voltage	-	3.5	-	-	V
$ATT_{ST-BY}$	Standby attenuation	-	-	90	-	dB
$I_{M\ in}$	Mute input bias current	( $V_{MUTE} = 5\text{ V}$ )	-	-	10	μA
$A_M$	Mute attenuation	-	-	90	-	dB



Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
P <sub>O</sub>	Output power	THD = 10 %	20	26	-	W
		THD = 1 %	-	21	-	W
		THD = 10 %; R <sub>L</sub> = 3.2 Ω	-	32	-	W
P <sub>O MAX</sub>	Max. output power <sup>(1)</sup>	V <sub>S</sub> = 14.4 V; R <sub>L</sub> = 3.2 Ω	-	45	-	W
THD	Total harmonic distortion	-	-	0.06	-	%
		P <sub>O</sub> = 0.1 to 15 W	-	0.03	-	%
G <sub>V</sub>	Voltage gain	-	29.5	30	30.5	dB
f <sub>H</sub>	High frequency roll-off	P <sub>O</sub> = 1 W; -3 dB	75	-	-	kHz
R <sub>IN</sub>	Input Impedance	Differential	36	60	-	kΩ
		Single ended	30	55	-	kΩ
E <sub>IN</sub>	Input noise voltage	R <sub>g</sub> = 0 Ω; f = 22 Hz to 22 kHz	-	4	-	mV
CMRR	Input common mode rejection	f = 1 kHz; V <sub>IN</sub> = 1 V <sub>rms</sub>	-	65	-	dB
SVR	Supply voltage rejection	R <sub>g</sub> = 0 Ω; V <sub>r</sub> = 1 V <sub>rms</sub>	-	60	-	dB
CDL	Clipping detection level	-	5	10	15	%
T <sub>sd</sub>	Absolute thermal shutdown junction temperature	-	-	160	-	°C

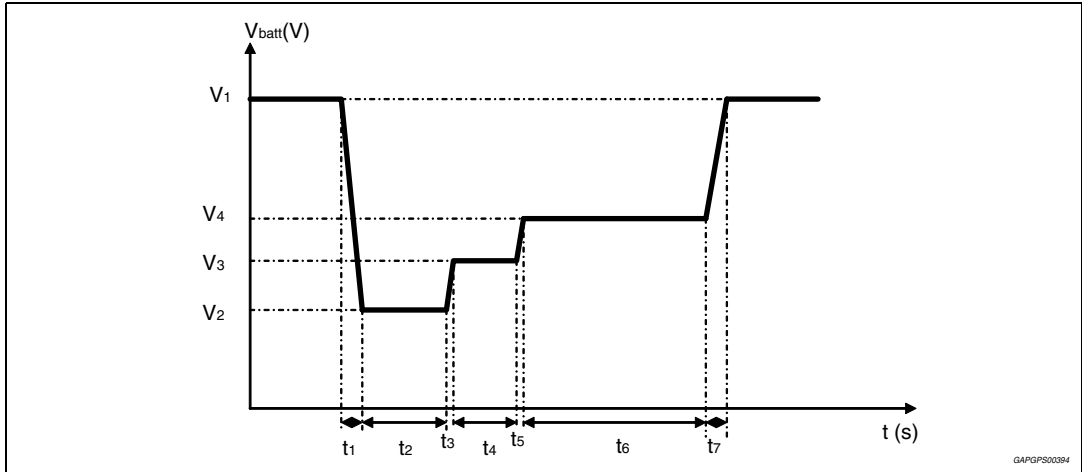
1. Saturated square wave output.

### 3.4 Low voltage operation (“start stop”)

The most recent OEM specification are requiring automatic stop of car engine at traffic light, in order to reduce emissions of polluting substances. The TDA7391LV allows a continuous operation when battery falls down to 6/7 V during such conditions. The maximum system power will be reduced accordingly.

Worst case battery cranking curves are shown below, indicating the shape and durations of allowed battery transitions.

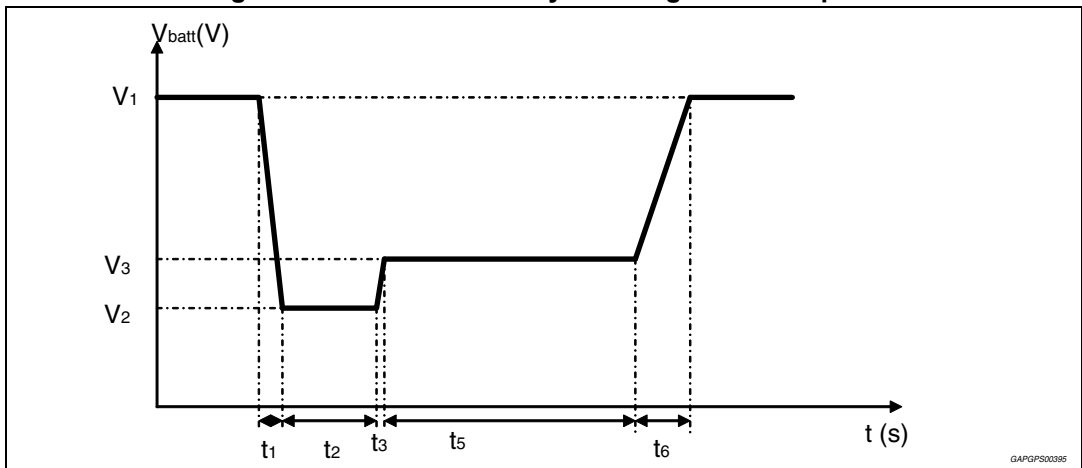
**Figure 5. Worts case battery cranking curve sample 1**



V1 = 12 V; V2 = 6 V; V3 = 7 V; V4 = 8 V

t1 = 2 ms; t2 = 50 ms; t3 = 5 ms; t4 = 300 ms; t5 = 10 ms; t6 = 1 s; t7 = 2 ms

**Figure 6. Worst case battery cranking curve sample 2**



V1 = 12 V; V2 = 6 V; V3 = 7 V

t1 = 2 ms; t2 = 5 ms; t3 = 15 ms; t5 = 1 s; t6 = 50 ms

### 3.5 Electrical characteristics curves

Figure 7. Quiescent current vs. supply voltage

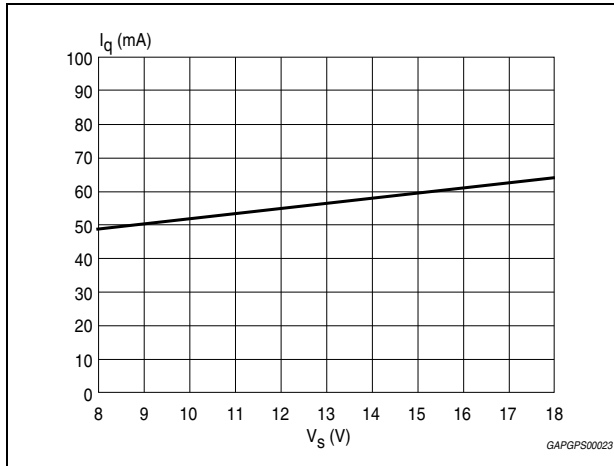


Figure 8. Output power vs. supply voltage (@ $R_L = 4\Omega$ )

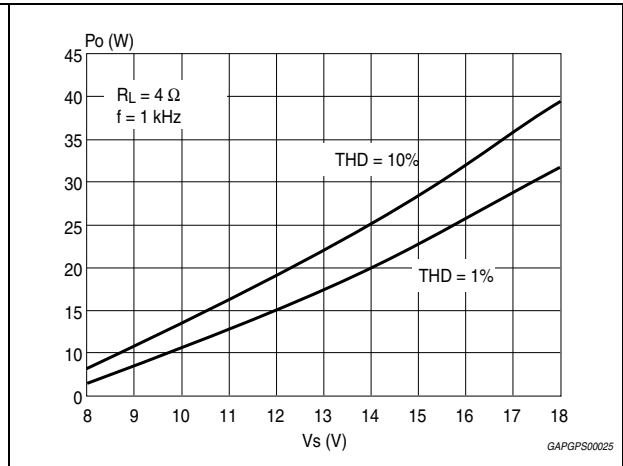


Figure 9. Distortion vs. frequency (@  $R_L = 4\Omega$ )

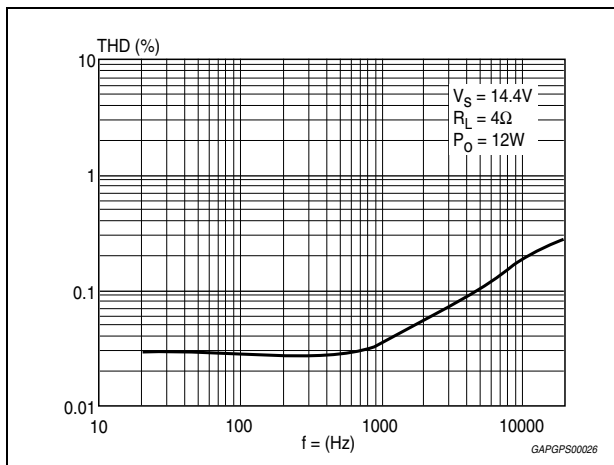


Figure 10. Output power vs. supply voltage (@ $R_L = 3.2\Omega$ )

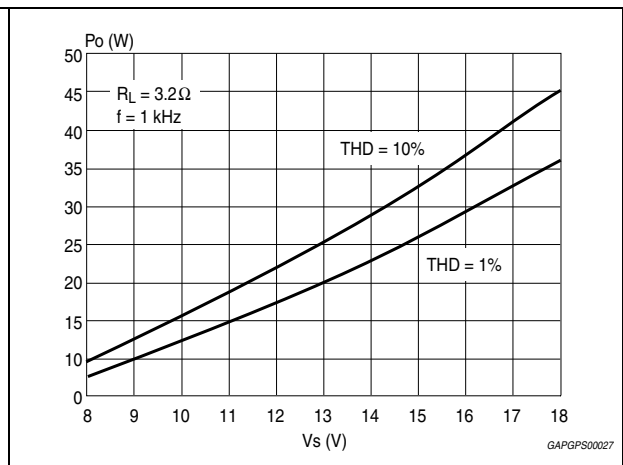


Figure 11. Distortion vs. frequency (@  $R_L = 3.2\Omega$ )

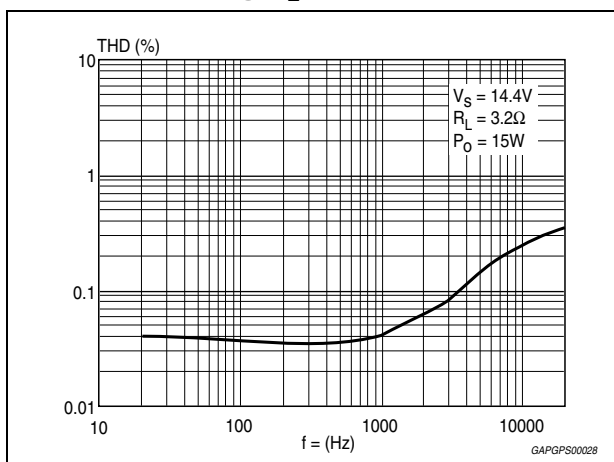


Figure 12. Supply voltage rejection vs. frequency

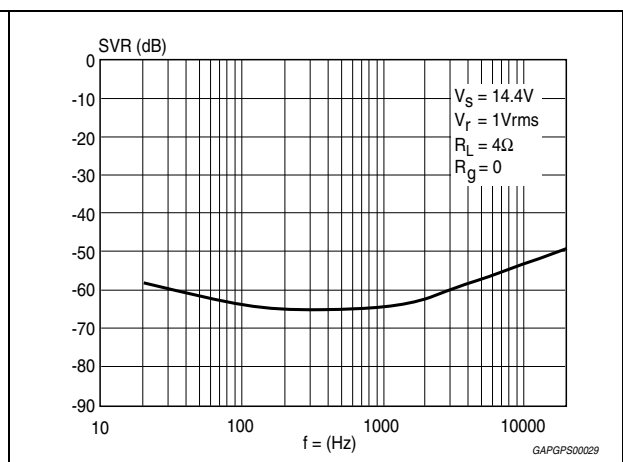


Figure 13. Common mode rejection vs. frequency

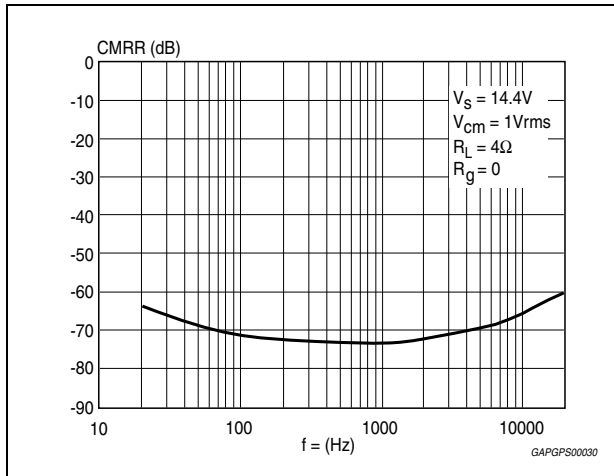


Figure 14. Total power dissipation and efficiency vs. output power (@ $R_L = 4 \Omega$ )

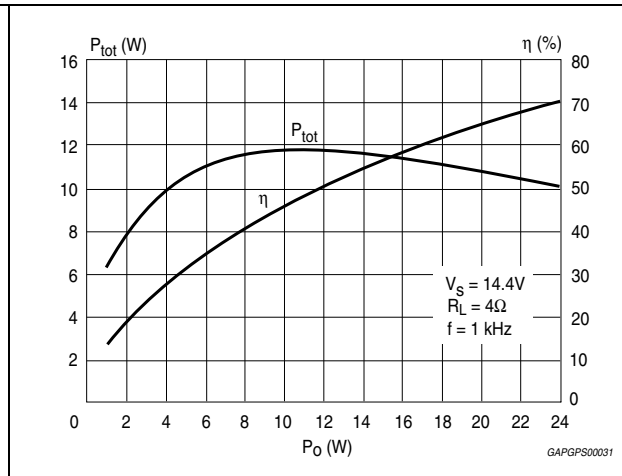
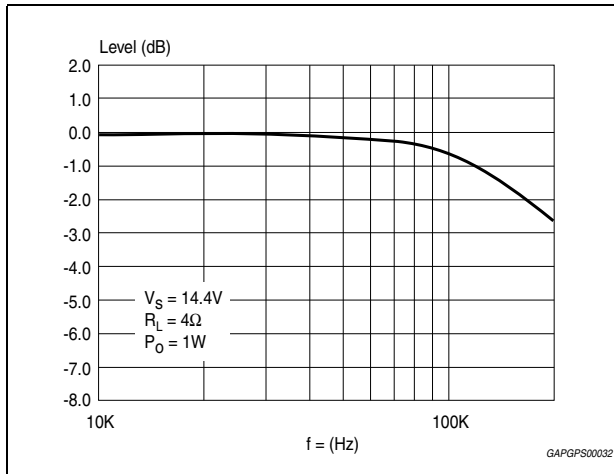


Figure 15. Power bandwidth



# 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com).

ECOPACK® is an ST trademark.

**Figure 16. Multiwatt11 (vertical) mechanical data and package dimensions**

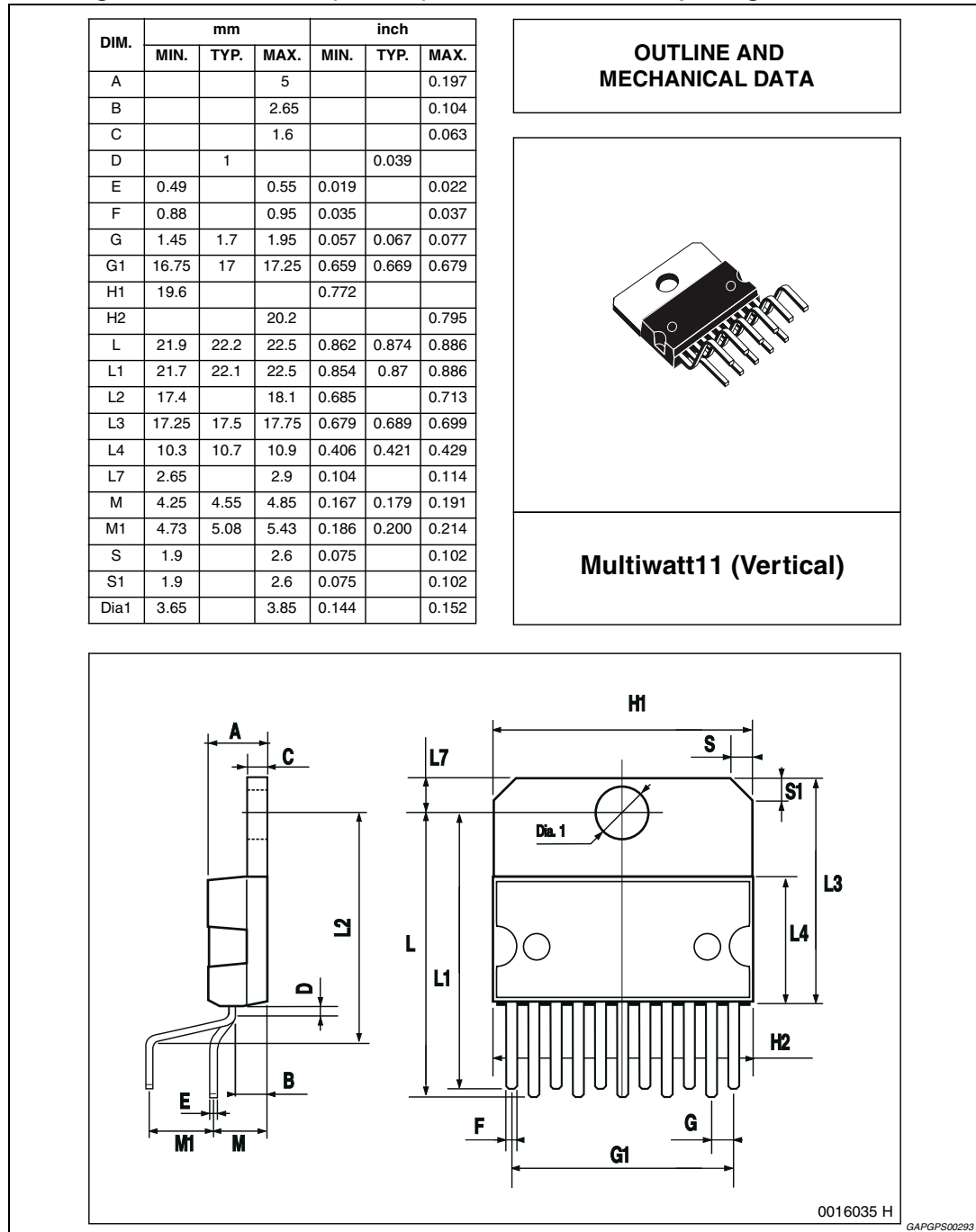


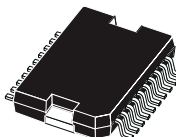
Figure 17. PowerSO20 mechanical data and package dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A1			3.6			0.142
a1	0.1		0.3	0.004		0.012
a2			3.3			0.130
a3	0		0.1	0.000		0.004
b	0.4		0.53	0.016		0.021
c	0.23		0.32	0.009		0.013
D (1)	15.8		16	0.622		0.630
D1 (2)	9.4		9.8	0.370		0.386
E	13.9		14.5	0.547		0.570
e		1.27			0.050	
e3		11.43			0.450	
E1 (1)	10.9		11.1	0.429		0.437
E2			2.9			0.114
E3	5.8		6.2	0.228		0.244
G	0		0.1	0.000		0.004
H	15.5		15.9	0.610		0.626
h			1.1			0.043
L	0.8		1.1	0.031		0.043
N	8° (Typ.)					
S	8° (Max.)					
T		10			0.394	

- (1) "D and E1" do not include mold flash or protrusions.
- Mold flash or protrusions shall not exceed 0.15mm (0.006")
- Critical dimensions: "E", "G" and "a3".
- (2) For subcontractors, the limit is the one quoted in jedec MO-166

**OUTLINE AND MECHANICAL DATA**

Weight: 1.9gr



**JEDEC MO-166**

**PowerSO20**

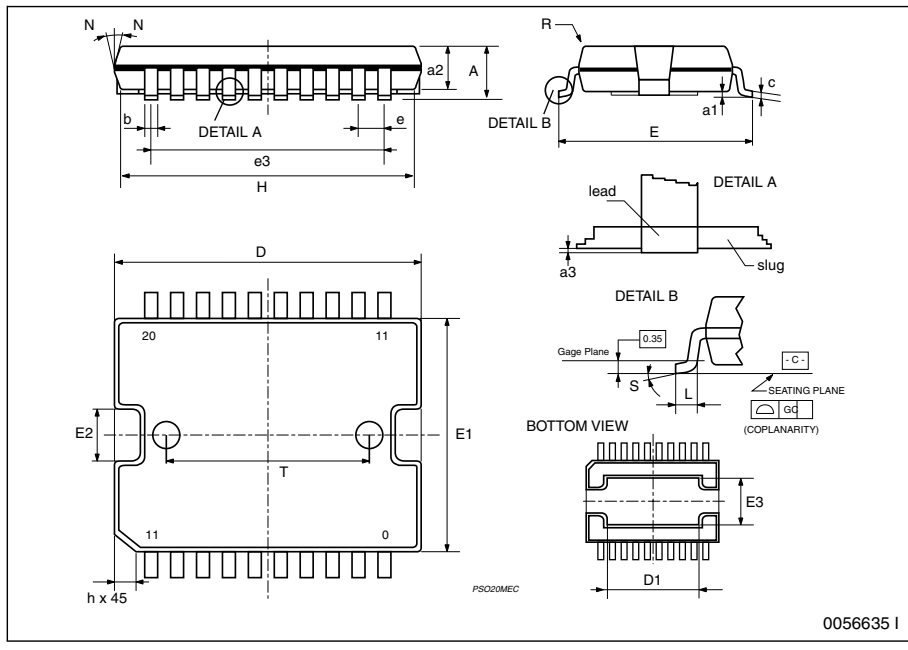
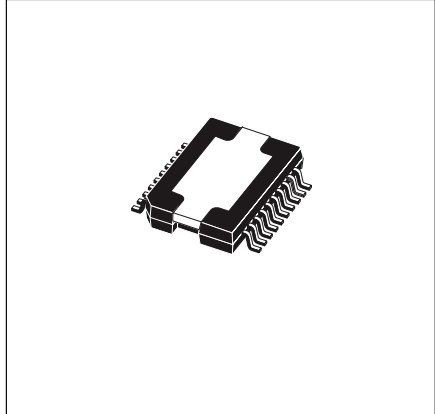


Figure 18. PowerSO20 (Slug-up) mechanical data and package dimensions

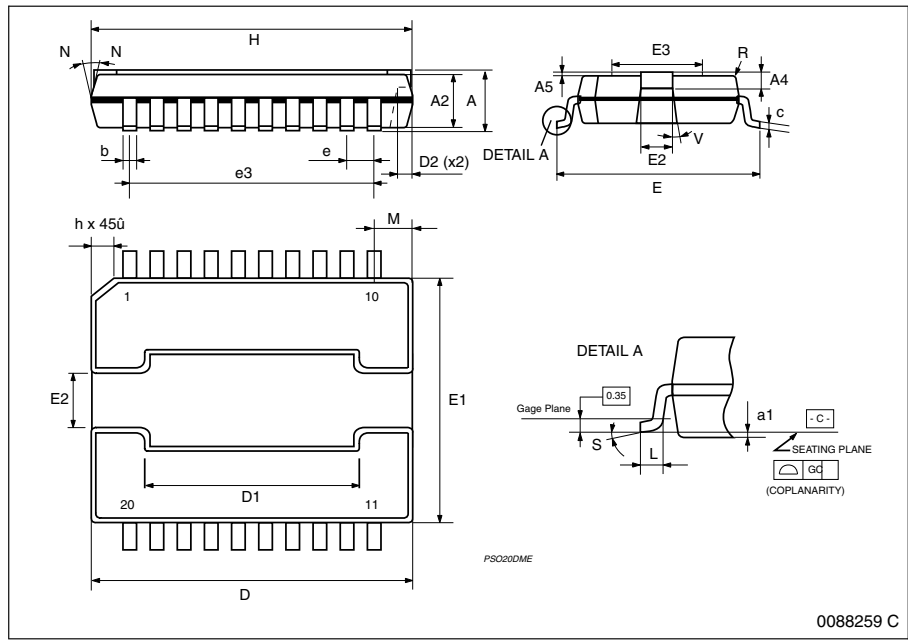
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	3.25		3.5	0.128		0.138
A2	3	3.15	3.3	0.118	0.124	0.130
A4	0.8		1	0.031		0.039
A5	0.15	0.2	0.25	0.006	0.008	0.010
a1	0.030		-0.040	0.0012		-0.0016
b	0.4		0.53	0.016		0.021
c	0.23		0.32	0.009		0.012
D (1)	15.8		16	0.622		0.630
D1	9.4		9.8	0.370		0.385
D2		1			0.039	
E	13.9		14.5	0.547		0.570
E1 (1)	10.9		11.1	0.429		0.437
E2			2.9			0.114
E3	5.8		6.2	0.228		0.244
e	1.12	1.27	1.42	0.044	0.050	0.056
e3		11.43			0.450	
G	0		0.1	0		0.004
H	15.5		15.9	0.61		0.625
h			1.1			0.043
L	0.8		1.1	0.031		0.043
N	10° (max)					
R		0.6			0.024	
S	0° (min.) 8° (max.)					
V	5° (min.) 7° (max.)					

OUTLINE AND MECHANICAL DATA



PowerSO20 (Slug-up)

(1) "D and E1" do not include mold flash or protrusions.  
 - Mold flash or protrusions shall not exceed 0.15mm (0.006")  
 - Critical dimensions: "E", "a1", "e" and "G".



## 5 Revision history

Table 6. Document revision history

Date	Revision	Changes
29-Mar-2012	1	Initial release.
18-Sep-2013	2	Updated: <i>Features on page 1;</i> <i>Figure 1: Block diagram on page 5;</i> <i>Table 2: Pins function.</i> Updated Disclaimer.



**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.**

**ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.**

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.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

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

[www.st.com](http://www.st.com)

