35 W bridge car radio amplifier with low voltage operation

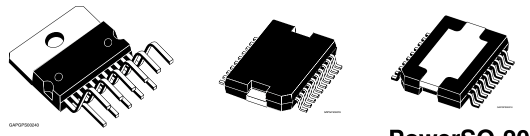
Datasheet — production data

Features

- High power capability:
  - 40 W/ 4 Ω max
  - 45 W/ 3.2 Ω max
  - 32 W/ 3.2 Ω @V_S = 14.4 V, f = 1 kHz, THD = 10 %
  - 26 W/ 4 Ω @ 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)
- Programmable turn-on/off delay
- Capable to operate to 6 V (e.g. “start-stop”)

Protections

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



Multiwatt11 **PowerSO-20** **PowerSO-20 (Slug-up)**

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

Table 1. Device summary

Order code	Package	Packing
TDA7391LV	Multiwatt11	Tube
TDA7391LVPD	PowerSO-20	Tube
TDA7391LVPDTR		Tape and reel
TDA7391LVPDU	PowerSO-20 (Slug-up	Tube
TDA7391LVPDUTR		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

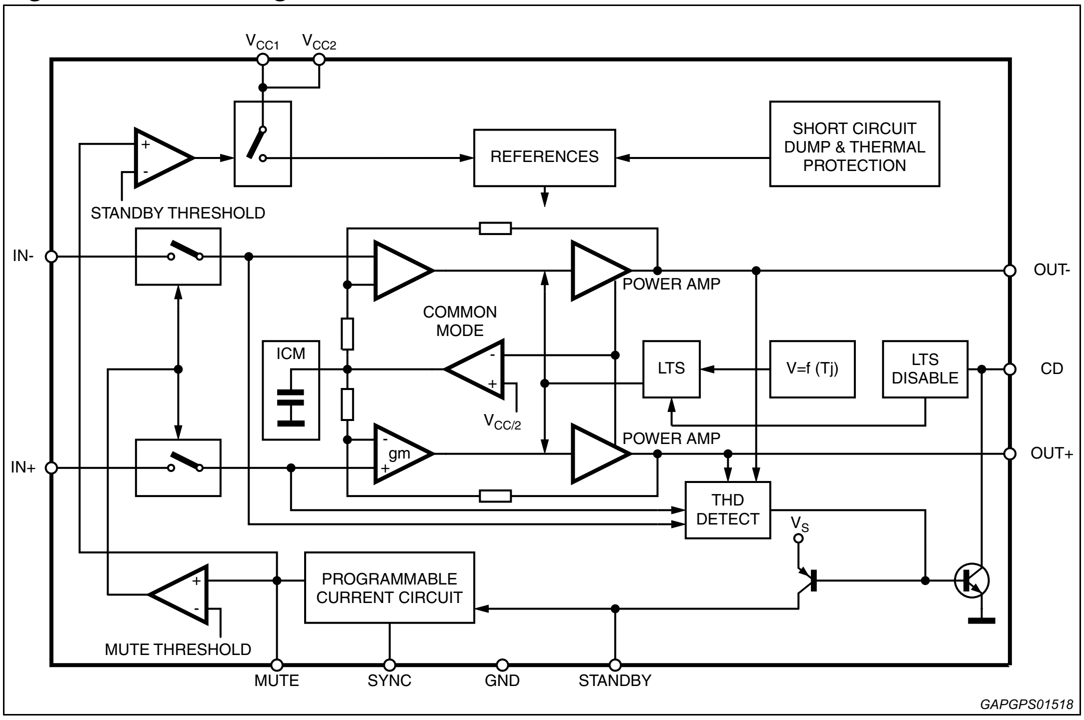
List of figures

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. Worts 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 = 4Ω) 11
Figure 9. Distortion vs. frequency (@ R_L = 4Ω) 11
Figure 10. Output power vs. supply voltage (@R_L = 3.2 Ω) 11
Figure 11. Distortion vs. frequency (@ R_L = 3.2 Ω) 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 Ω) 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

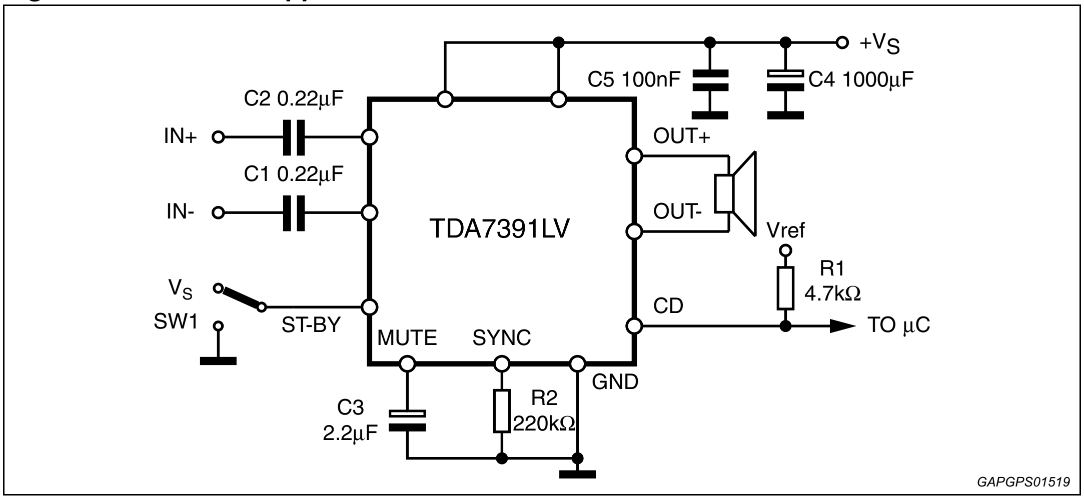
1.1 Block diagram

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)

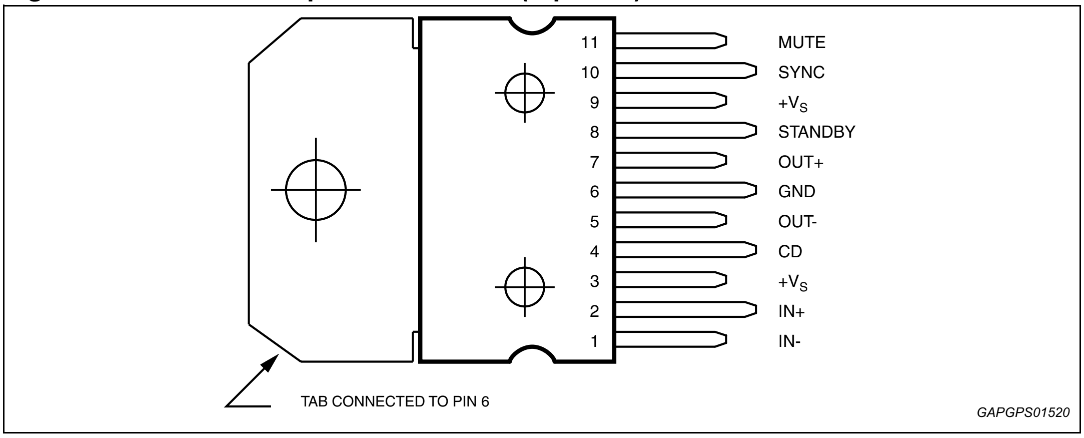


Figure 4. PowerSO-20 pins connection (top view)

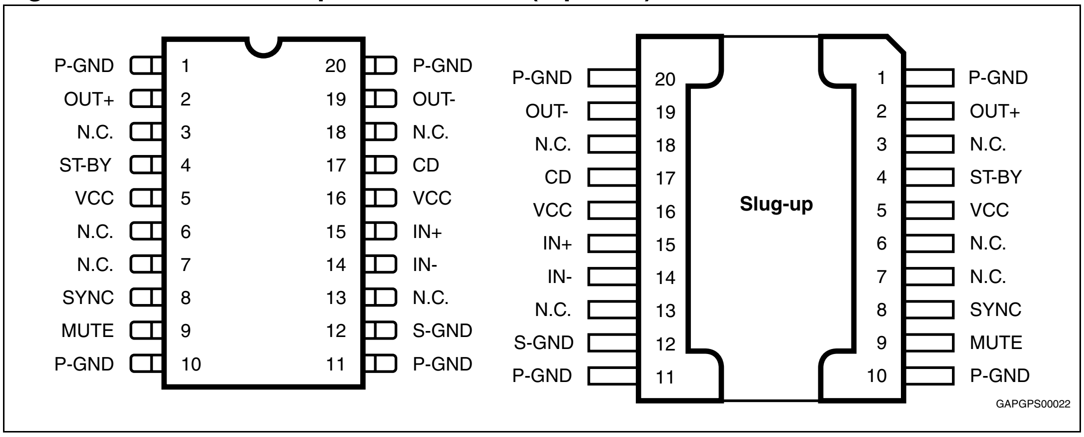


Table 2. Pins function

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	$^{+}V_S$	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 3.2Ω. 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 μA). When the standby pin is high the IC becomes fully operational.
10	8	SYNC	A resistor (R_2) has to be connect between pin 8 and GND in order to program the current that flows in the C_3 capacitor (pin 9). The values of C_3 and R_2 determine the time required to bias the amplifier.
11	9	MUTE	The pin will have 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 °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
$R_{th\ j\text{-}case}$	Thermal resistance junction-to-case	Max.	1.8	2	°C/W

3.3 Electrical characteristics

V_S = 14.4 V; R_L = 4 Ω, f = 1 kHz, T_{amb} = 25 °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	$V_{ST\text{-}BY}$ = 1.5 V	-	-	50	µA
I_{SBin}	Standby input bias current	$V_{ST\text{-}BY}$ = 5 V	-	-	10	µA
V_{SBon}	Standby on threshold voltage	-	-	-	1.5	V
V_{SBoff}	Standby off threshold voltage	-	3.5	-	-	V
$ATT_{ST\text{-}BY}$	Standby attenuation	-	-	90	-	dB
$I_{M\ in}$	Mute input bias current	(V_{MUTE} = 5 V)	-	-	10	µA
A_M	Mute attenuation	-	-	90	-	dB

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
P_O	Output power	THD = 10 %	20	26	-	W
		THD = 1 %	-	21	-	W
		THD = 10 %; R_L = 3.2 Ω	-	32	-	W
$P_{O\ MAX}$	Max. output power (1)	V_S = 14.4 V; R_L = 3.2 Ω	-	45	-	W
THD	Total harmonic distortion	-	-	0.06	-	%
		P_O = 0.1 to 15 W	-	0.03	-	%
G_V	Voltage gain	-	29.5	30	30.5	dB
f_H	High frequency roll-off	P_O = 1 W; -3 dB	75	-	-	kHz
R_{IN}	Input Impedance	Differential	36	60	-	kΩ
		Single ended	30	55	-	kΩ
E_{IN}	Input noise voltage	R_g = 0 Ω; f = 22 Hz to 22 kHz	-	4	-	mV
CMRR	Input common mode rejection	f = 1 kHz; V_{IN} = 1 V_{rms}	-	65	-	dB
SVR	Supply voltage rejection	R_g = 0 Ω; V_r = 1 Vrms	-	60	-	dB
CDL	Clipping detection level	-	5	10	15	%
T_{sd}	Absolute thermal shutdown junction temperature	-	-	160	-	°C

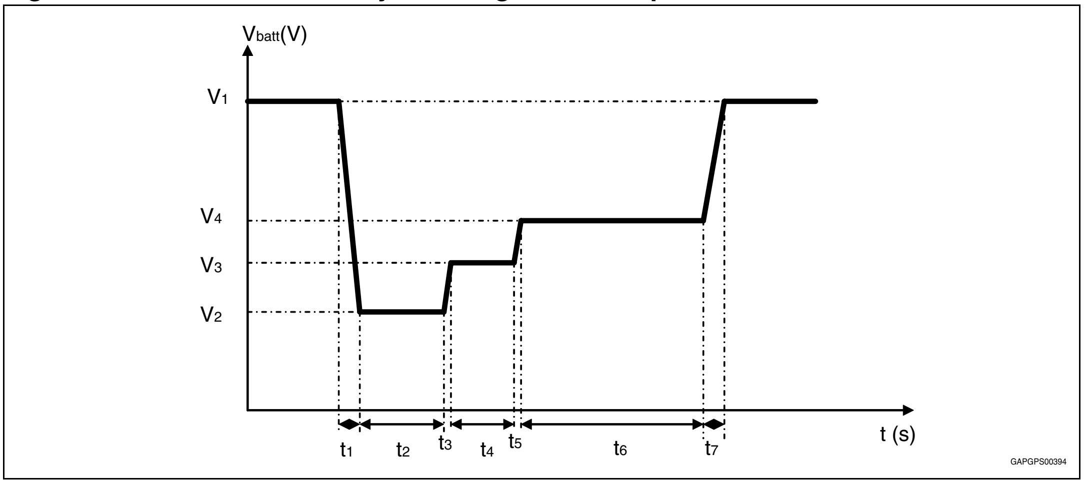
1. Saturated square wave output.

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.

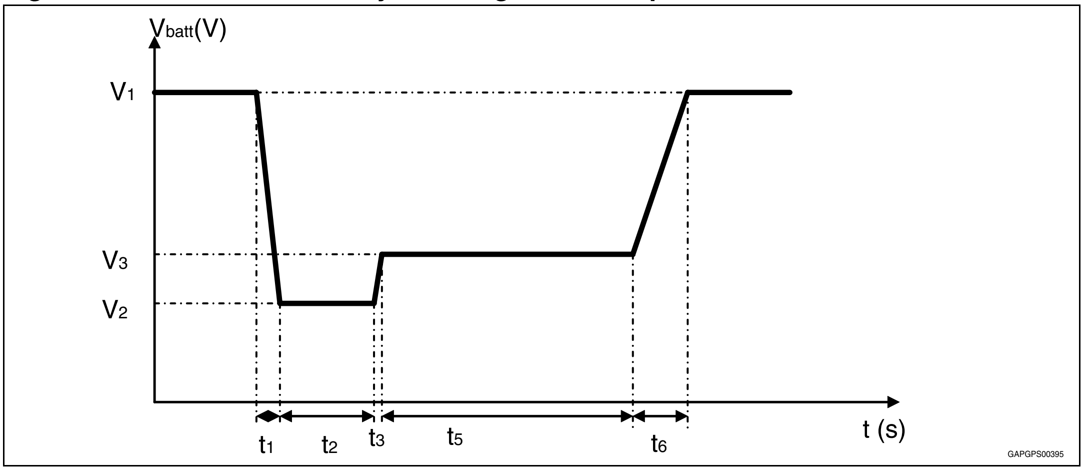
Figure 5. Worts case battery cranking curve sample 1



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

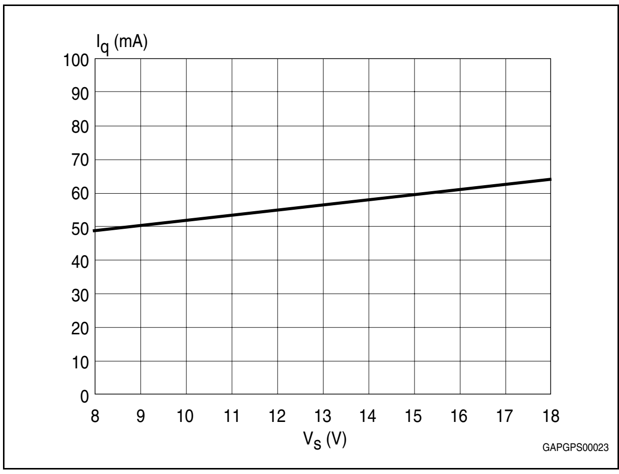


Figure 8. Output power vs. supply voltage (@R_L = 4Ω)

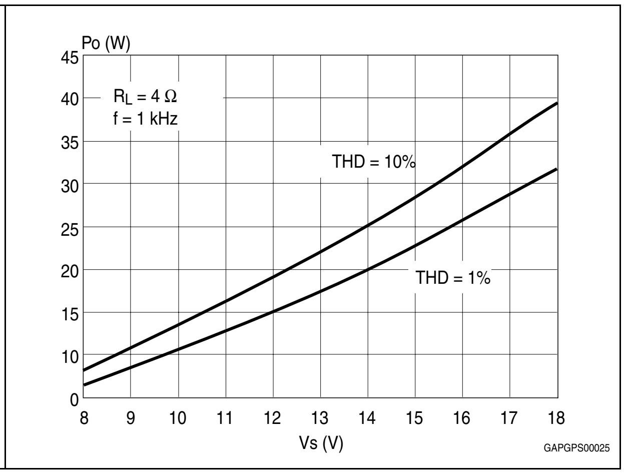


Figure 9. Distortion vs. frequency (@ R_L = 4Ω)

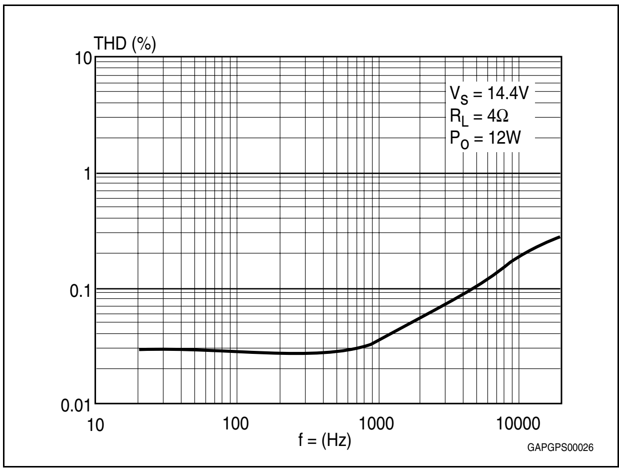


Figure 10. Output power vs. supply voltage (@R_L = 3.2 Ω)

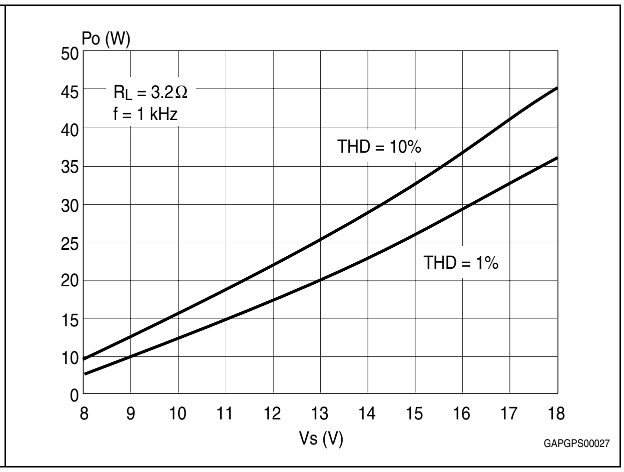


Figure 11. Distortion vs. frequency (@ R_L = 3.2 Ω)

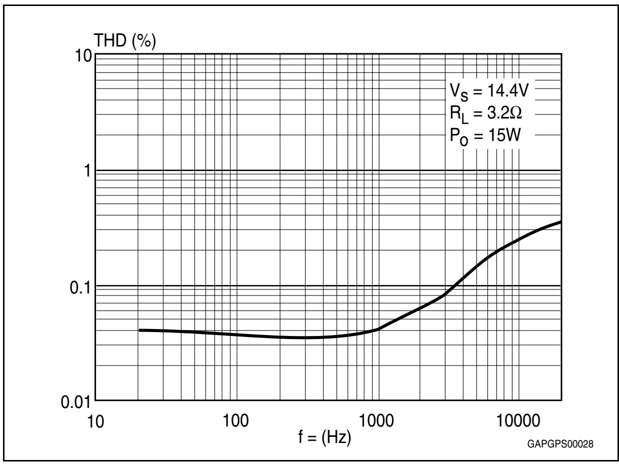


Figure 12. Supply voltage rejection vs. frequency

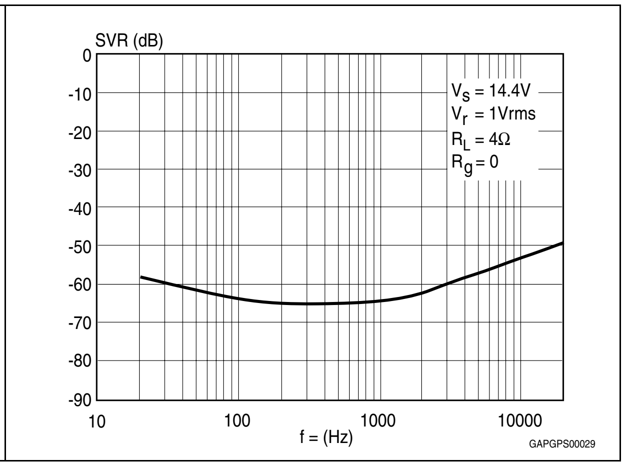


Figure 13. Common mode rejection vs. frequency

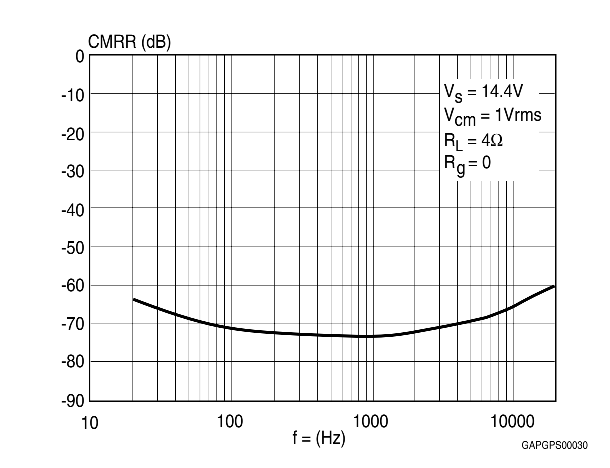


Figure 14. Total power dissipation and efficiency vs. output power (@R_L = 4 Ω)

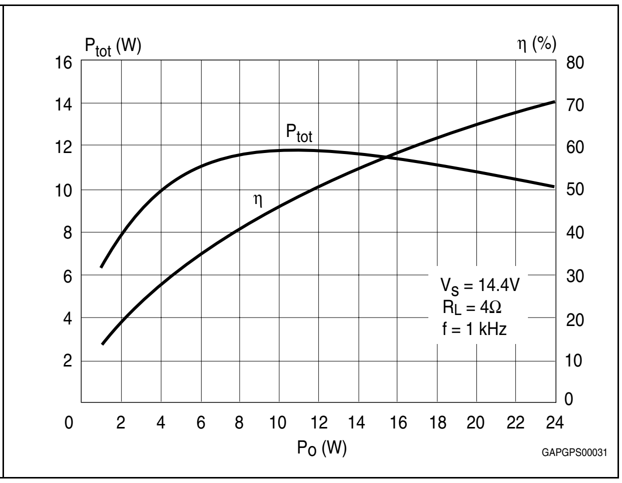
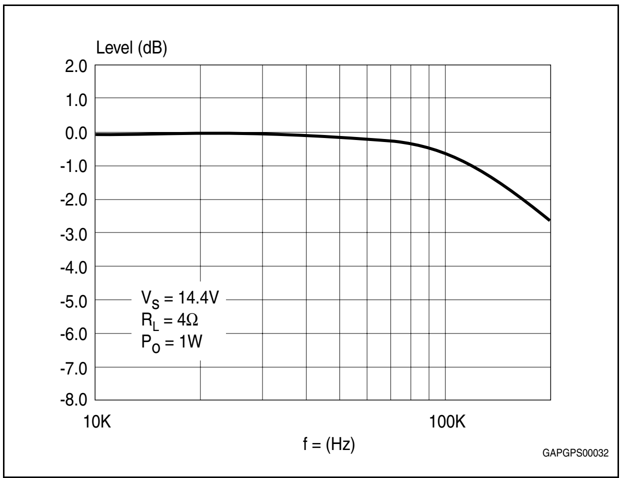


Figure 15. Power bandwidth



4 Package information

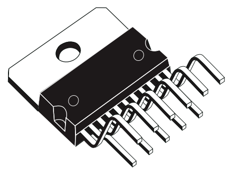
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.

ECOPACK® is an ST trademark.

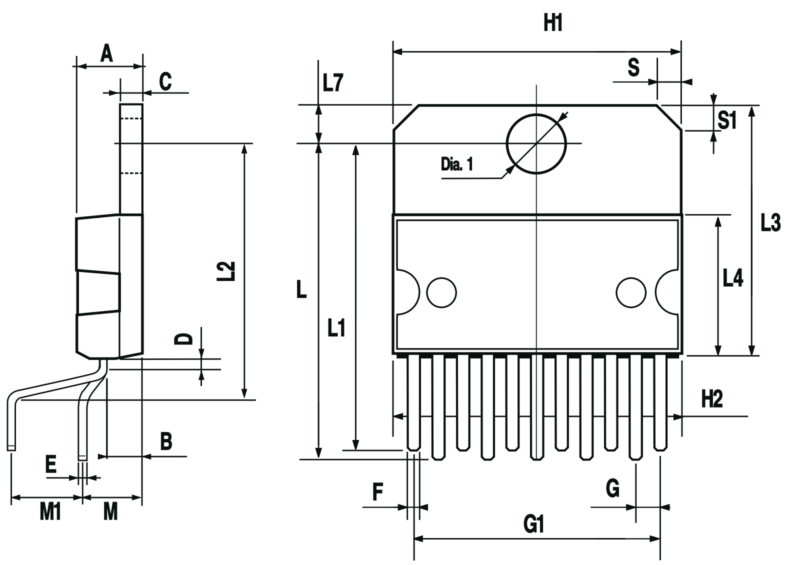
Figure 16. Multiwatt11 (vertical) mechanical data and package dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			5			0.197
B			2.65			0.104
C			1.6			0.063
D		1			0.039	
E	0.49		0.55	0.019		0.022
F	0.88		0.95	0.035		0.037
G	1.45	1.7	1.95	0.057	0.067	0.077
G1	16.75	17	17.25	0.659	0.669	0.679
H1	19.6			0.772		
H2			20.2			0.795
L	21.9	22.2	22.5	0.862	0.874	0.886
L1	21.7	22.1	22.5	0.854	0.87	0.886
L2	17.4		18.1	0.685		0.713
L3	17.25	17.5	17.75	0.679	0.689	0.699
L4	10.3	10.7	10.9	0.406	0.421	0.429
L7	2.65		2.9	0.104		0.114
M	4.25	4.55	4.85	0.167	0.179	0.191
M1	4.73	5.08	5.43	0.186	0.200	0.214
S	1.9		2.6	0.075		0.102
S1	1.9		2.6	0.075		0.102
Dia1	3.65		3.85	0.144		0.152

OUTLINE AND MECHANICAL DATA



Multiwatt11 (Vertical)



0016035 H

GAPGPS00293

Figure 17. PowerSO20 mechanical data and package dimensions

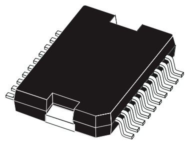
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A1			3.6			0.142
a1	0.1		0.3	0.004		0.012
a2			3.3			0.130
a3	0		0.1	0.000		0.004
b	0.4		0.53	0.016		0.021
c	0.23		0.32	0.009		0.013
D (1)	15.8		16	0.622		0.630
D1 (2)	9.4		9.8	0.370		0.386
E	13.9		14.5	0.547		0.570
e		1.27			0.050	
e3		11.43			0.450	
E1 (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 protusions.
- Mold flash or protusions 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

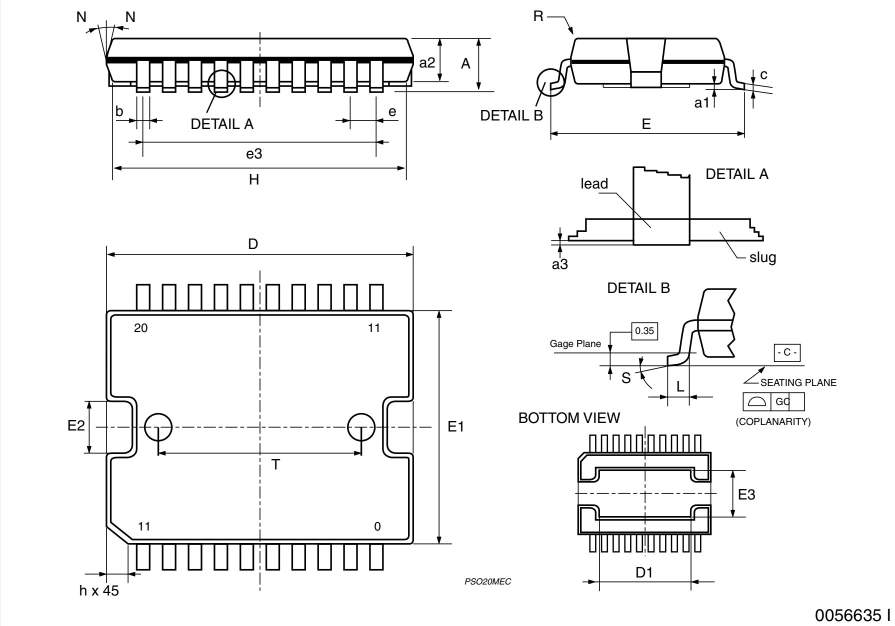
OUTLINE AND MECHANICAL DATA

Weight: 1.9gr



JEDEC MO-166

PowerSO20



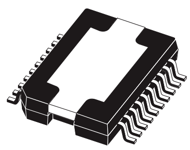
GAPGPS00033

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

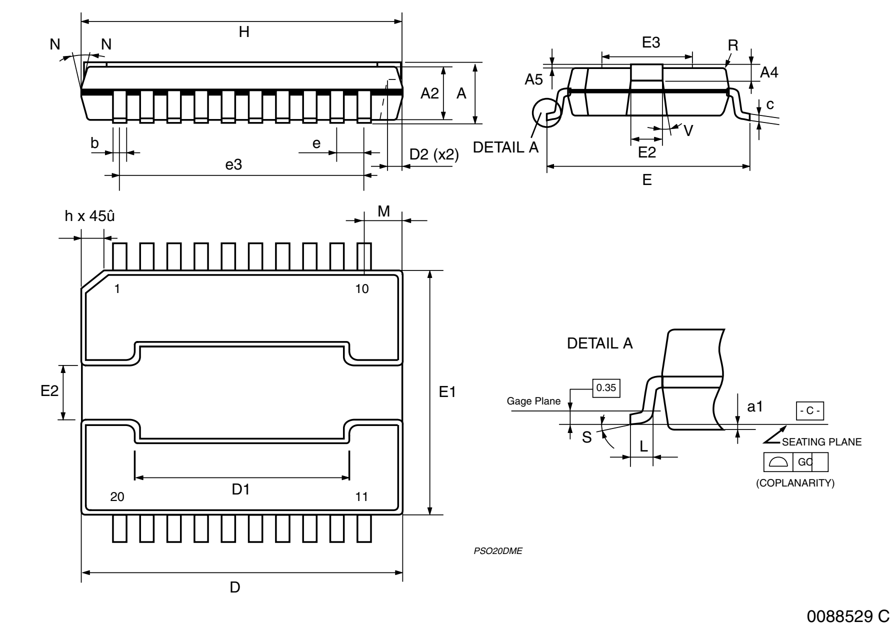
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	3.25		3.5	0.128		0.138
A2	3	3.15	3.3	0.118	0.124	0.130
A4	0.8		1	0.031		0.039
A5	0.15	0.2	0.25	0.006	0.008	0.010
a1	0.030		-0.040	0.0012		-0.0016
b	0.4		0.53	0.016		0.021
c	0.23		0.32	0.009		0.012
D (1)	15.8		16	0.622		0.630
D1	9.4		9.8	0.370		0.385
D2		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.)					

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

OUTLINE AND MECHANICAL DATA



PowerSO20 (Slug-up)



GAPGPS00034

5 Revision history

Table 6. Document revision history

Date	Revision	Changes
29-Mar-2012	1	Initial release.