TS617

Dual wideband high output current operational amplifier

Features

- Wideband of 200 MHz/gain = 4
- Very high slew rate
- High output current
- Specified on 25 and 100-Ω loads
- Thermal shut-down set at Tj = 150° C
- Large protection on outputs
- Power-down mode with high Z-out
- Very low noise
- Tested at 5 and 12-V supplies
- Single or dual supply operation
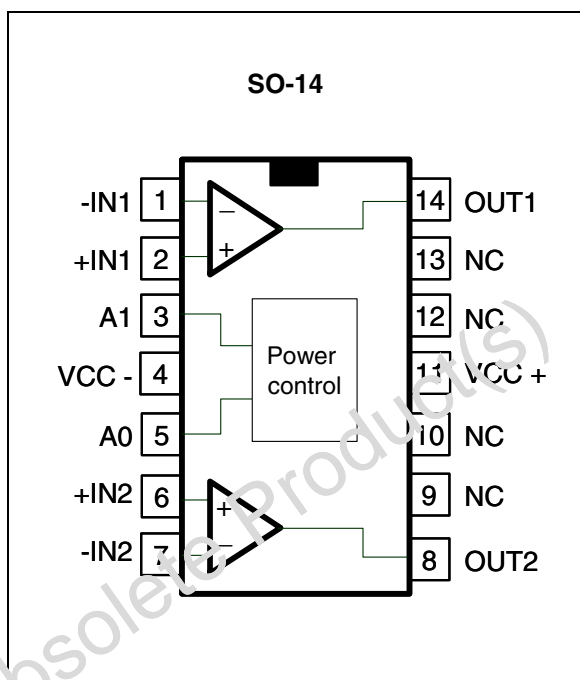- Minimum and maximum limits are tested in full production

Applications

- Power line equipment
- Drivers for xDSL modems
- Video drivers
- Video distribution

Description

The TS617 is a wideband high output current dual operational amplifier optimized for driving high data rates on power lines and twisted pair telephone lines.

The TS617 features a linearity on low resistive loads, large output swing and high output current, very low noise, low consumption and I-supply control and power-down mode with high Z-out and short settling times.

SO-14

Pin	Name		Pin	Name
1	-IN1		14	OUT1
2	+IN1		13	NC
3	A1		12	NC
4	VCC -		11	VCC +
5	A0		10	NC
6	+IN2		9	NC
7	-IN2		8	OUT2

Power control

1 Absolute maximum ratings and operating conditions

Table 1.   Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage [1]	14	V_{DC}
V_{id}	Differential input voltage[2]	±2	V
T_{oper}	Operating free air temperature range	-40 to +85	°C
T_{stg}	Storage temperature	-65 to +150	°C
T_j	Maximum junction temperature	150	°C
Θ_{JA}	SO14 thermal resistance junction to ambient	103	°C/W
Θ_{JC}	SO14 thermal resistance junction to case	31	°C/W
P_{max}	SO14 maximum power dissipation[3] (at Ta = 25° C) for T_j = 150° C	1.2	W
ESD	HBM: human body model [4]	2	kV
	MM: machine model [5]	200	V
	CDM: charged device model	1	kV

1. All voltage values are measured with respect to the ground pin.

2. Differential voltage is between the non-inverting input terminal and the inverting input terminal.

3. Short-circuits can cause excessive heating. Destructive dissipation can result from short circuits on amplifiers. An internal thermal shut-down set the circuit in power down mode automatically when the silicon temperature reaches 150°C.

4. Human body model: 100 pF discharged through a 1.5 kΩ resistor into P_{min} of device.

5. This is a minimum value. Machine model ESD: a 200 pF capacitor is charged to the specified voltage, then discharged directly into the IC with no external series resistor.

Table 2.   Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Power supply voltage [1]	4.5 to13	V
V_{icm}	Common mode input voltage	±6	V

1. Tested in full production at ±2.5 V and ±6 V supply voltages.

2   Electrical characteristics

Table 3. V_{CC} = ±2.5 V, T_{amb} = 25° C, full power mode (unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
DC performance						
V_{io}	Input offset voltage	T_{amb}	-10	2.5	10	mV
		$T_{min.} < T_{amb} < T_{max.}$		2.7		
ΔV_{io}	V_{io} drift vs. temperature	$T_{min.} < T_{amb} < T_{max.}$		5		µV/°C
I_{ib+}	Non-inverting input bias current	T_{amb}	-50	-15	+50	µA
		$T_{min.} < T_{amb} < T_{max.}$		-20		
I_{ib-}	Inverting input bias current	T_{amb}	-30	-11	-30	µA
		$T_{min.} < T_{amb} < T_{max.}$		-12		
CMR	Common mode rejection ratio 20 log ($\Delta V_{ic}/\Delta V_{io}$)	ΔV_{ic} = ±1 V	45	51		dB
		$T_{min.} < T_{amb} < T_{max.}$		50		
SVR	Supply voltage rejection ratio 20 log ($\Delta V_{CC}/\Delta V_{io}$)	ΔV_{CC} = ±2 V to ±2.5 V	50	76		dB
		$T_{min.} < T_{amb} < T_{max.}$		55		
PSRR	Power supply rejection ratio 20 log ($\Delta V_{CC}/\Delta V_{out}$)	Gain = +4, Rfb = 390 Ω ΔV_{CC} = ±100 mV at 100 kHz		50		dB
I_{CC}	Supply current per operator	Full power, no load		9	11	mA
		$T_{min.} < T_{amb} < T_{max.}$		10		
		Medium power, no load		7	8	mA
		$T_{min.} < T_{amb} < T_{max.}$		7.5		
		Low power, no load		2	3	mA
		$T_{min.} < T_{amb} < T_{max.}$		2.3		
Dynamic performance and output characteristics						
Bw	-3 dB bandwidth in small signal	Small signal V_{out} = 20 mVp-p R_L = 100 Ω Gain = +2, Rfb = 620 Ω Gain = +4, Rfb = 390 Ω Gain = +8, Rfb = 390 Ω	70	125 105 55		MHz
		Gain = +4, medium power		90		
		Gain = +4, low power		33		
R_{OL}	Open-loop transimpedance	R_L = 100 Ω, V_{out} = 2 Vp-p	50	110		kΩ
		$T_{min.} < T_{amb} < T_{max.}$		90		
SR	Slew rate	V_{out} = 3 Vp-p, gain = +4, R_L = 100 Ω	300	450		V/µs
		Medium power		400		
		Low power		100		

Table 3. V_{CC} = ±2.5 V, T_{amb} = 25° C, full power mode (unless otherwise specified) (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{OH}	High level output voltage	R_L = 100 Ω R_L = 25 Ω	1.6 1.5	1.68 1.58		V
		$T_{min.}$ < T_{amb} < $T_{max.}$ R_L = 100 Ω R_L = 25 Ω		1.6 1.5		
V_{OL}	Low level output voltage	R_L = 100 Ω R_L = 25 Ω		-1.68 -1.57	-1.60 -1.50	V
		$T_{min.}$ < T_{amb} < $T_{max.}$ R_L = 100 Ω R_L = 25 Ω		-1.6 -1.5		
I_{out}	I_{sink}	V_{out} = -1 V	300	350		mA
		$T_{min.}$ < T_{amb} < $T_{max.}$		330		
	I_{source}	V_{out} = +1 V		-370	-300	
		$T_{min.}$ < T_{amb} < $T_{max.}$		-350		
	$I_{short circuit}$ (limited by thermal shut down)	Output to GND		600		
Noise and distortion						
eN	Input noise voltage	F = 100 kHz		3.5		nV/√Hz
iNp	Positive input noise current	F = 100 kHz		39		pA/√Hz
iNn	Positive input noise current	F = 100 kHz		20		pA/√Hz
H2/H3	2nd and 3rd harmonics	V_{out} = 2 Vp-p, gain = +4, Rfb=390 Ω, F = 6 MHz R_L = 25 Ω H2 H3		-58 -68		dBc
Power-down function						
Ipdw	Consumption in power-down mode	A1 = 0, A0 = 0		65	200	µA
		$T_{min.}$ < T_{amb} < $T_{max.}$		80		
ton	Time for power-down mode to operating mode	A1 = A0 = 0 to A1 = A0 = 1 V_{out} = 1 Vdc, gain = +4		80	200	ns
toff	Time for operating mode to power-down mode	A1 = A0 = 1 to A1 = A0 = 0 V_{out} = 1 Vdc, gain = +4		450	1000	ns

Table 4. V_{CC} = ±6 V, T_{amb} = 25° C, full power mode (unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
DC performance						
V_{io}	Input offset voltage	T_{amb}	-12	4.5	12	mV
		$T_{min.} < T_{amb} < T_{max.}$		5		
ΔV_{io}	V_{io} drift vs. temperature	$T_{min.} < T_{amb} < T_{max.}$		5		µV/°C
I_{ib+}	Non-inverting input bias current	T_{amb}	-80	-25	80	µA
		$T_{min.} < T_{amb} < T_{max.}$		-30		
I_{ib-}	Inverting input bias current	T_{amb}	-35	-7	35	µA
		$T_{min.} < T_{amb} < T_{max.}$		-9		
CMR	Common mode rejection ratio 20 log $(\Delta V_{ic}/\Delta V_{io})$	ΔV_{ic} = ±3 V	45	51		dB
		$T_{min.} < T_{amb} < T_{max.}$		50		
SVR	Supply voltage rejection ratio 20 log $(\Delta V_{CC}/\Delta V_{io})$	ΔV_{CC} = ±2.5 V to ±6 V	50	72		dB
		$T_{min.} < T_{amb} < T_{max.}$		65		
PSRR	Power supply rejection ratio 20 log $(\Delta V_{CC}/\Delta V_{out})$	Gain = +4, Rfb = 390 Ω ΔV_{CC} = ±100 mV at 100 kHz		50		dB
I_{CC}	Supply current per operator	Full power, no load		13	16	mA
		$T_{min.} < T_{amb} < T_{max.}$		14		
		Medium power, no load		9.7	12	mA
		$T_{min.} < T_{amb} < T_{max.}$		10.5		
		Low power, no load		2.6	4	mA
		$T_{min.} < T_{amb} < T_{max.}$		2.9		
Dynamic performance and output characteristics						
Bw	-3 dB bandwidth in small signal	Small signal V_{out} = 20 mVp-p R_L = 100 Ω Gain = +2, Rfb = 620 Ω Gain = +4, Rfb = 390 Ω Gain = +8, Rfb = 390 Ω	140	300 210 110		MHz
		Gain = +4, medium power		160		
		Gain = +4, low power		60		
R_{OL}	Open-loop transimpedance	R_L = 100 Ω V_{out} = 7 Vp-p	30	70		kΩ
		$T_{min.} < T_{amb} < T_{max.}$		50		
SR	Slew rate	Gain = +4, R_L = 100 Ω V_{out} = 5 Vp-p V_{out} = 10 Vp-p	400	650 1000		V/µs
		Medium power, V_{out} = 5 Vp-p		500		
		Low power, V_{out} = 5 Vp-p		200		
V_{OH}	High level output voltage	R_L = 100 Ω	5	5.1		V
		$T_{min.} < T_{amb} < T_{max.}$		5		

Table 4. $V_{CC} = \pm 6$ V, $T_{amb} = 25°$ C, full power mode (unless otherwise specified) (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{OL}	Low level output voltage	$R_L = 100 \ \Omega$		-5.1	-5	V
		$T_{min.} < T_{amb} < T_{max.}$		-5		
I_{out}	I_{sink}	$V_{out} = -4$ V	450	540		mA
		$T_{min.} < T_{amb} < T_{max.}$		510		
	I_{source}	$V_{out} = +4$ V		-550	-450	
		$T_{min.} < T_{amb} < T_{max.}$		-490		
	$I_{short\ circuit}$ (limited by thermal shut down)	Output to GND (limited by internal thermal shut-down)		800		
Noise and distortion						
eN	Equivalent input noise voltage	F = 100 kHz		3.5		nV/√Hz
iNp	Positive input noise current	F = 100 kHz		39		pA/√Hz
iNn	Positive input noise current	F = 100 kHz		20		pA/√Hz
H2/H3	2nd and 3rd harmonics	$V_{out} = 2$ Vp-p, gain = +4, F = 6 MHz $R_L = 100 \ \Omega$, H2 H3		-66 -73		dBc
Power-down function						
Ipdw	Consumption in power-down mode	A1= 0, A0 = 0		90	300	µA
		$T_{min.} < T_{amb} < T_{max.}$		110		
ton	Time for power-down mode to operating mode	A1 = A0 = 0 to A1 = A0 = 1 $V_{out} = 4$ Vdc, gain = +4		60	200	ns
toff	Time for operating mode to power-down mode	A1 = A0 = 1 to A1 = A0 = 0 $V_{out} = 4$ Vdc, gain = +4		550	1000	ns

Table 5. **A1 and A0 thresholds**

Symbol	Parameter	Test condition	Min.	Max.
A1	A1 and A0 threshold	High level	$-V_{CC} + 2$ V	$+V_{CC}$
A0		Low level	$-V_{CC}$	$-V_{CC} + 0.8$ V

Table 6. **A1 and A0 states**

A1	A0	State of the TS617
0	0	Standby
0	1	Low power
1	0	Medium power
1	1	High power

Table 7. **Feedback resistor**

Gain (V2/V1)	Rfb (Ω)
2	620
4	390
8	390

Figure 1. **Feedback configuration**

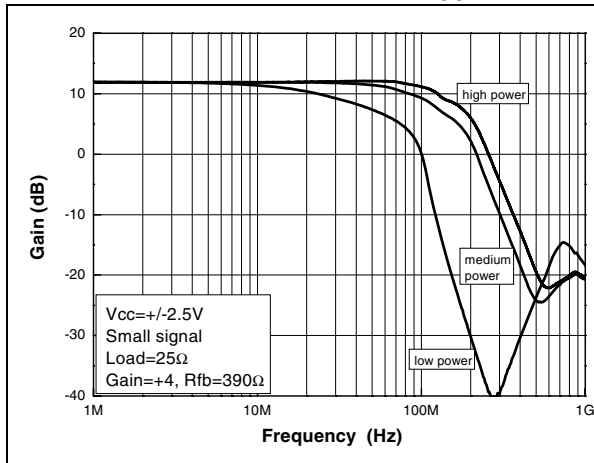AM00811
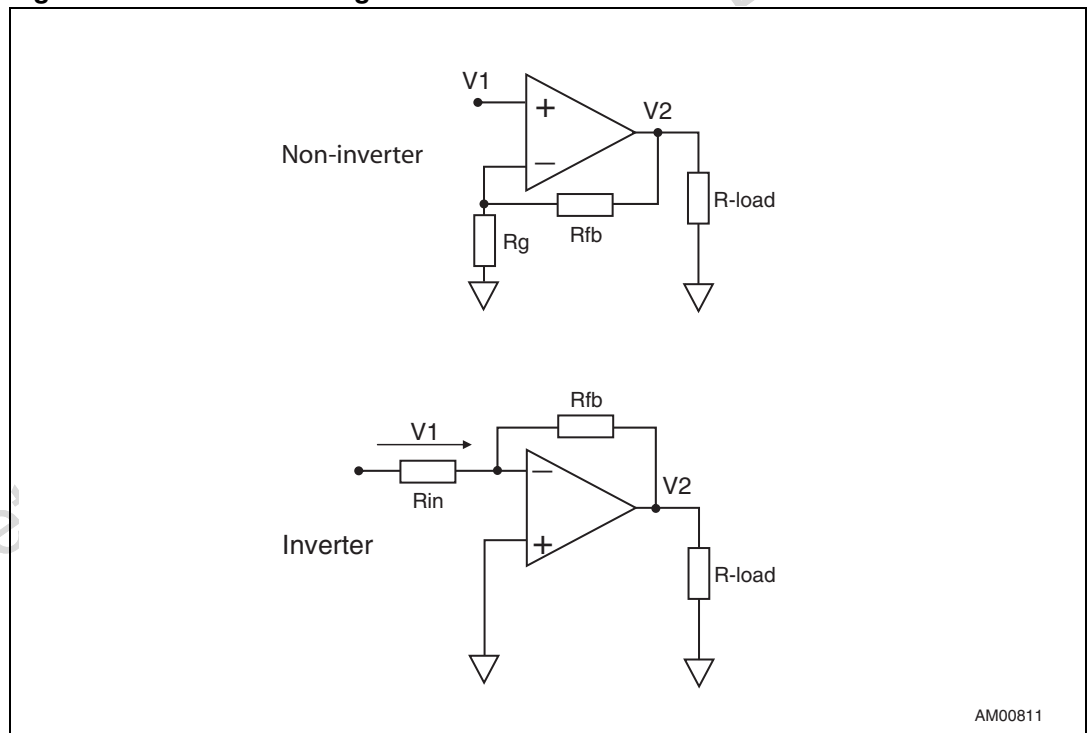
Figure 2. Gain vs. frequency (V$_{CC}$ = 5 V)

Vcc=+/-2.5V
Small signal
Load=25Ω
Gain=+4, Rfb=390Ω

Figure 3. Gain vs. frequency (V$_{CC}$ = 12 V)

Vcc=+/-6V
Small signal
Load=100Ω
Gain=+4, Rfb=390Ω
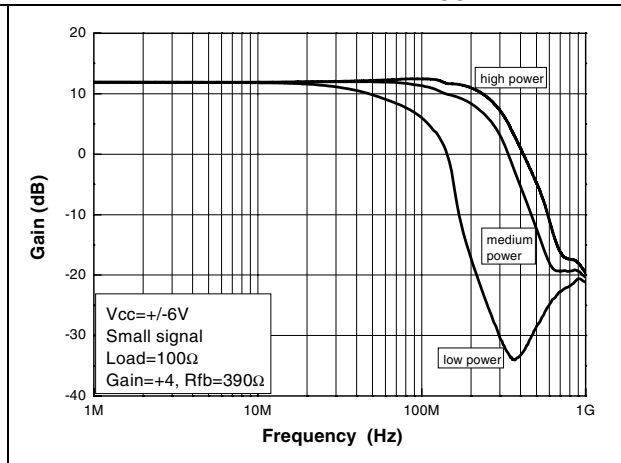
Figure 4. Input noise

No load
Input to GND
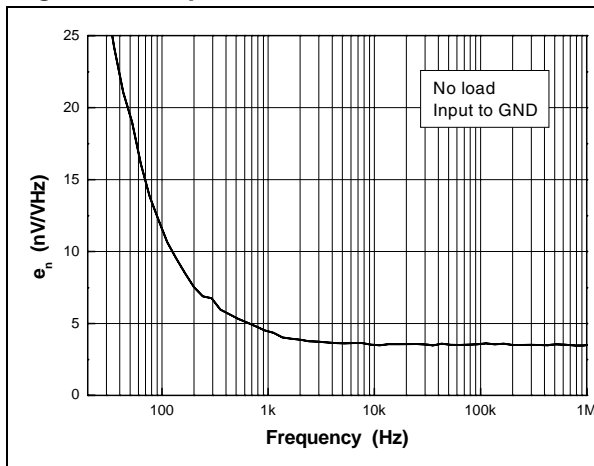
Figure 5. Distortion (V$_{CC}$ = 5 V)

Vcc=+/-2.5V
F=6MHz
Load=25Ω
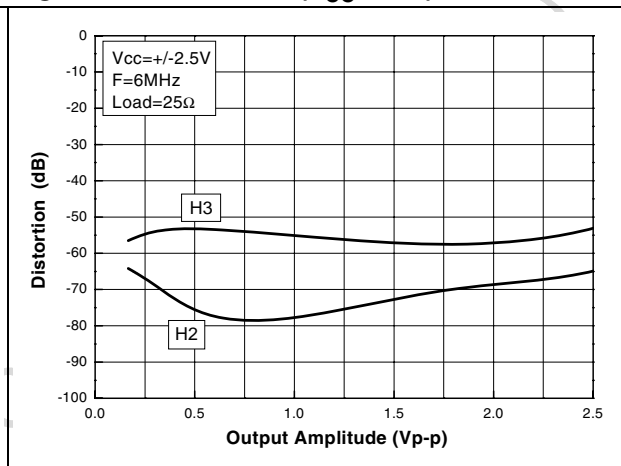
Figure 6. Distortion (V$_{CC}$ = 12 V)

Vcc=+/-6V
F=6MHz
Load=100Ω

Figure 7. I$_{CC}$ vs. V$_{CC}$

dual supply
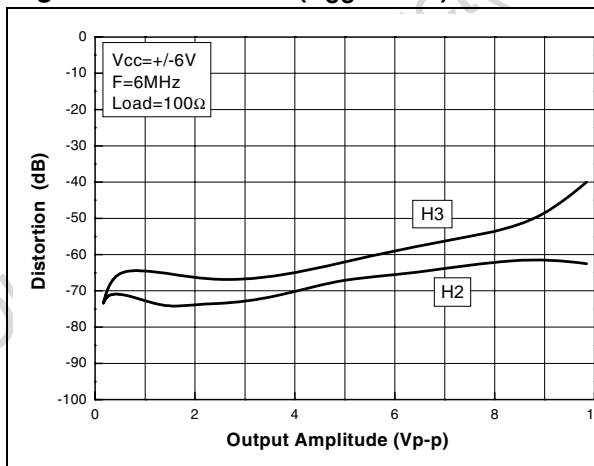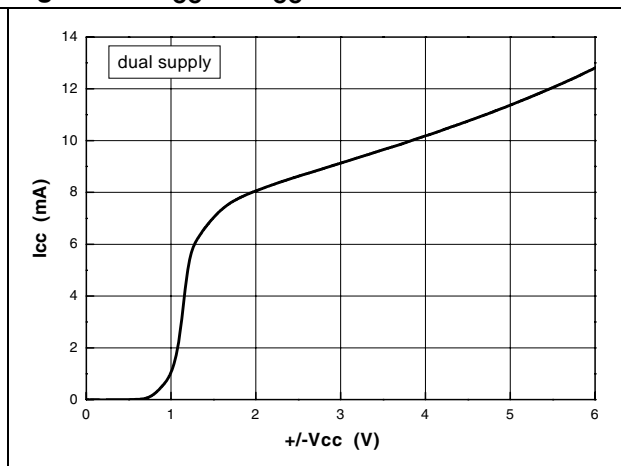
Figure 8.   **PSRR**
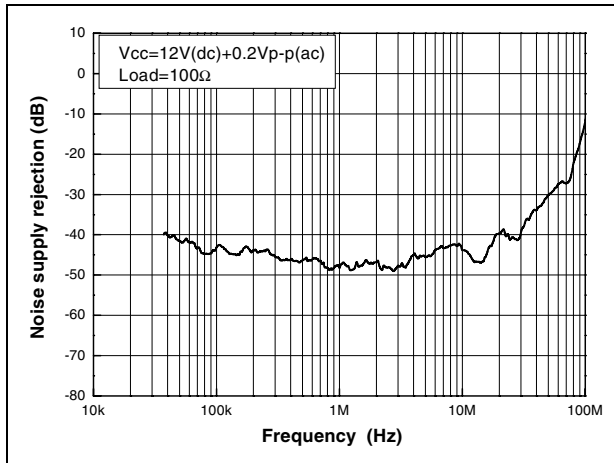
Figure 9.   **Bandwidth vs. temperature**
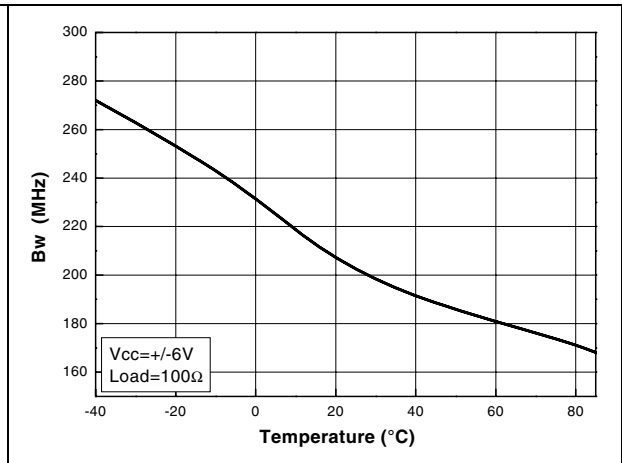
Figure 10.   **Transimpedance vs. temperature**
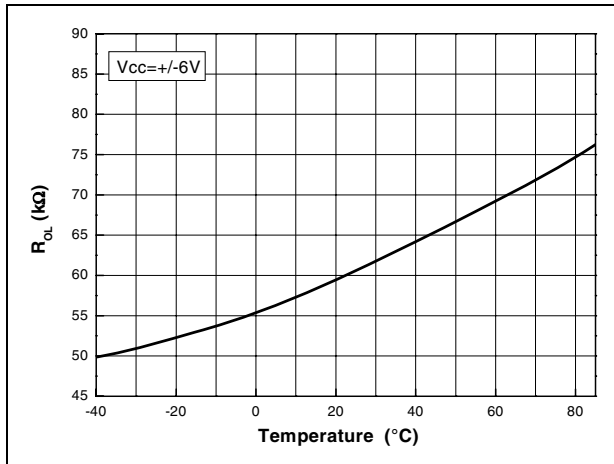
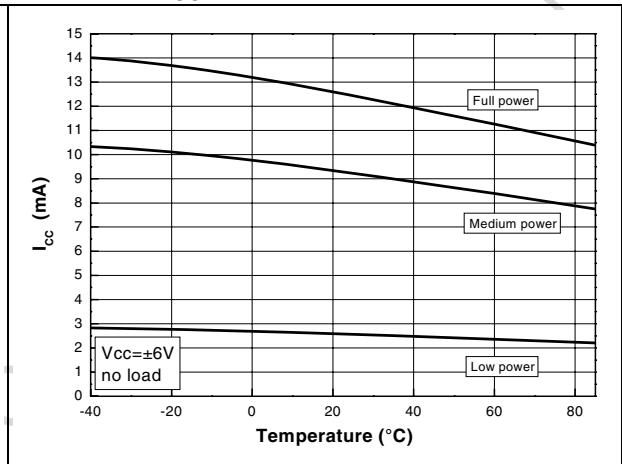**Figure 11.**   **I_CC vs. temperature**

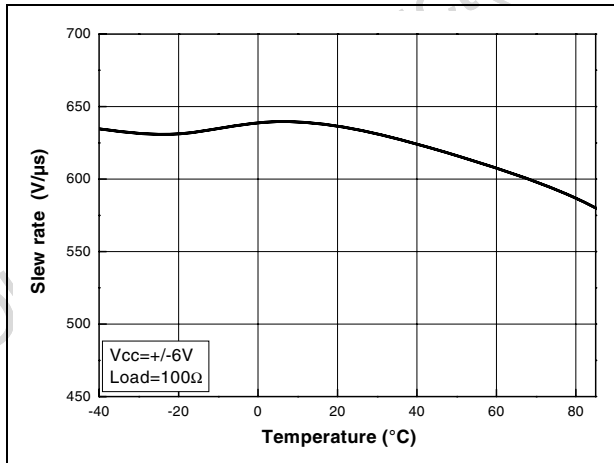**Figure 12.**   **Slew rate vs. temperature**

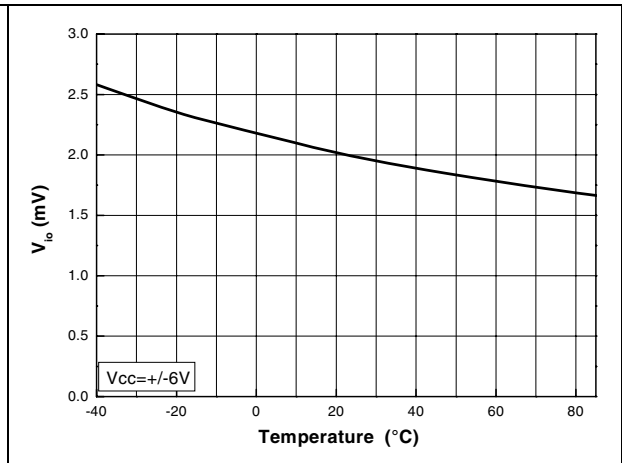
Figure 13.   **Vio vs. temperature**

Figure 14. Ibias vs. temperature
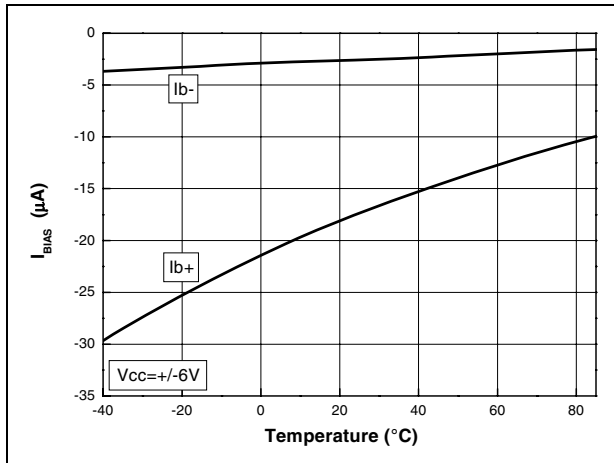
Figure 15. Power down vs. temperature
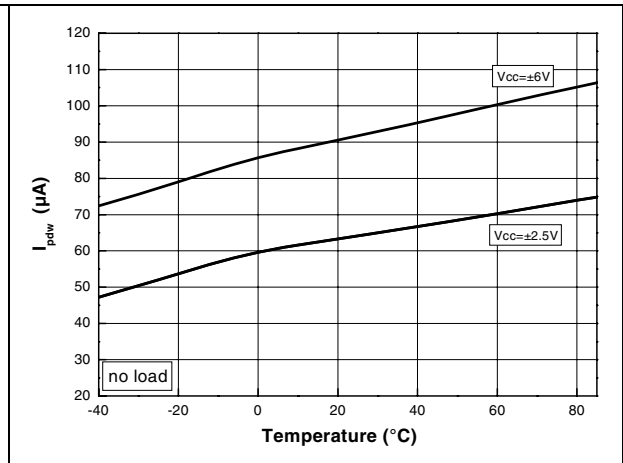
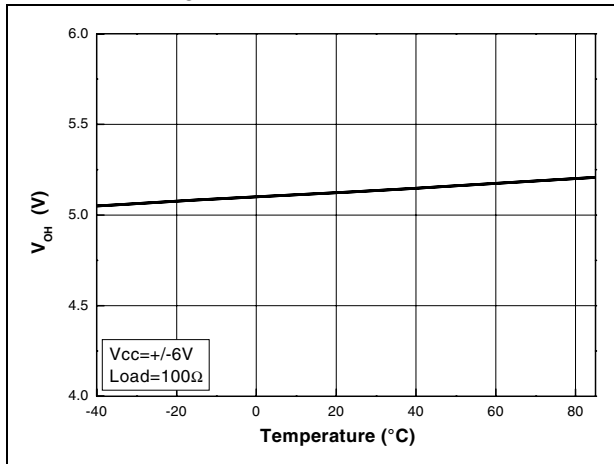**Figure 16. V_{OH} vs. temperature**

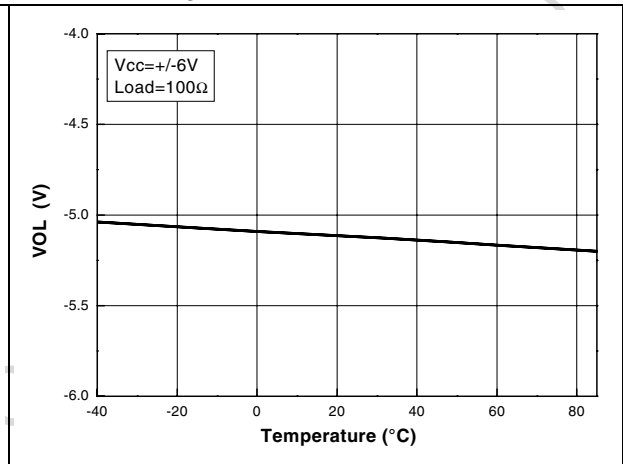**Figure 17. V_{OL} vs. temperature**

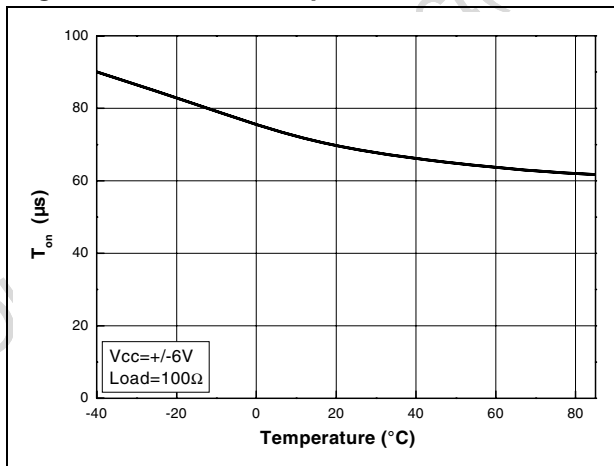**Figure 18. Ton vs. temperature**
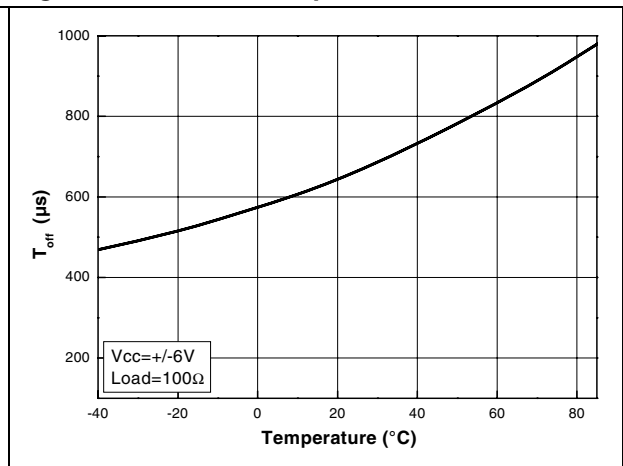

Figure 19. Toff vs. temperature
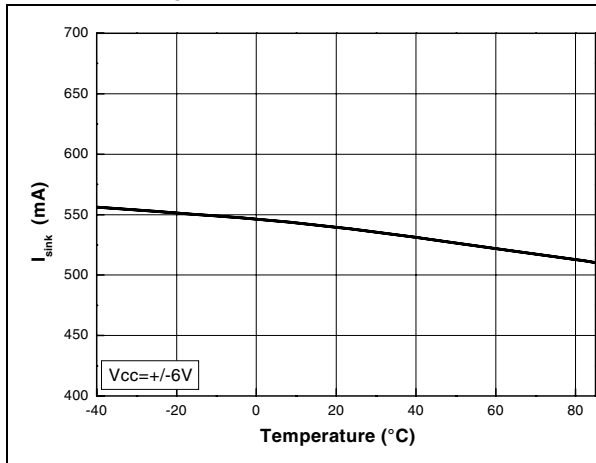
Figure 20.   I$_{sink}$ vs. temperature

Figure 21.   I$_{source}$ vs. temperature
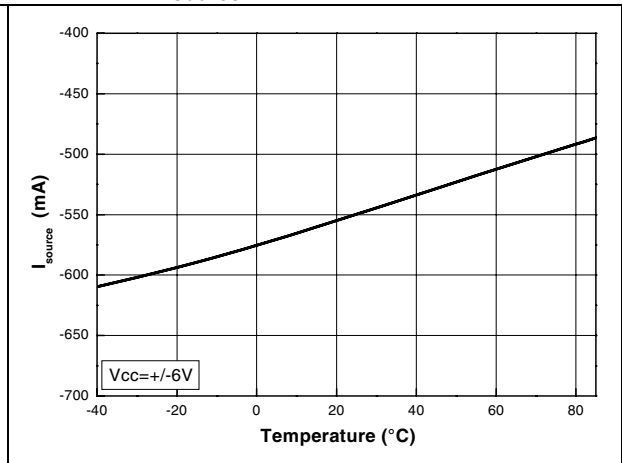
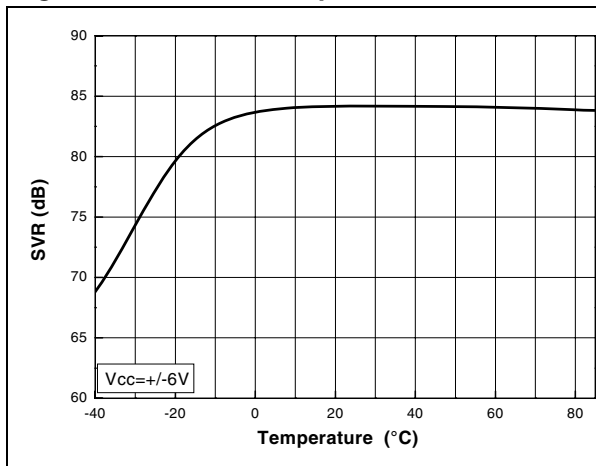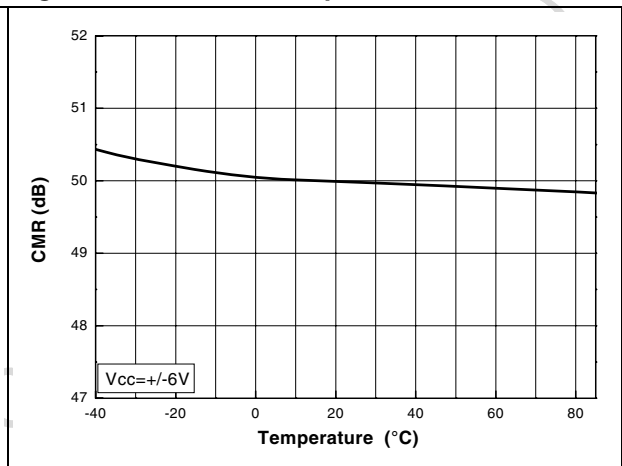**Figure 22.   SVR vs. temperature**
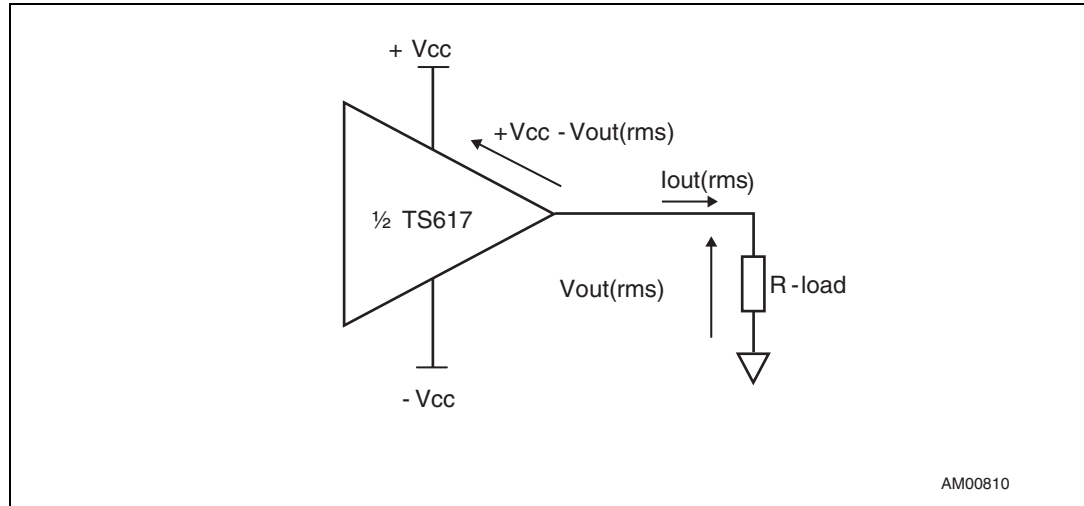

Figure 23.   CMR vs. temperature

3 Safe operating area

Figure 24. Equivalent schematic

AM00810

Vout(rms) is the rms output voltage value. *Iout(rms)* is the rms output current value through the output load R-load. When supplied by +/-Vcc, the power which must be dissipated by one operator is p=Iout(rms)x(+Vcc-Vout(rms)). Since the TS617 is used in a differential configuration using both operators, it must dissipate 2 x p. The power dissipated by the TS617 is derived from:

(eq1),

$$P = 2 \times [\ Iout(rms) \times (+Vcc-Vout(rms))\ ].$$

In the following formula:

(eq2),

$$P = \frac{(Tj - Tamb)}{Rthja}$$

T_j is the junction temperature, T_{amb} is the ambient temperature and Rthja is the junction-to-ambient thermal resistance of the package (SO-14: Rthja = 103° C/watt).

Assuming that T_j must be lower than 150° C to avoid any damage to the dice, it is derived from (eq2):

(eq3),

$$Pmax = \frac{150 - Tamb}{103},\ (inWatt)$$

From (eq1) and (eq3) we can easily extract the maximum value of V_{out}(rms) that the TS617 can drive without any damage (according to T_{amb} and R-load).

4 Typical application
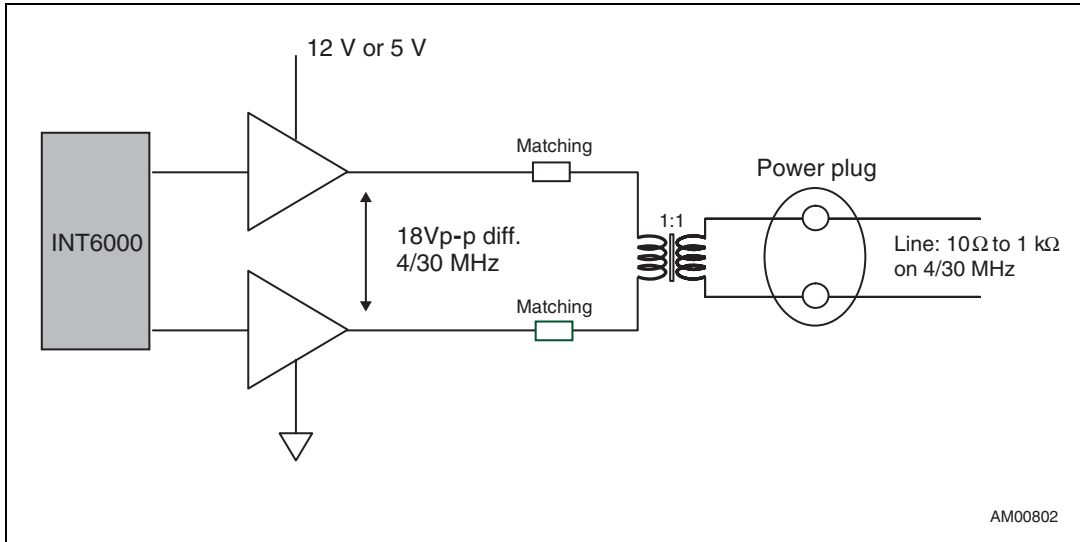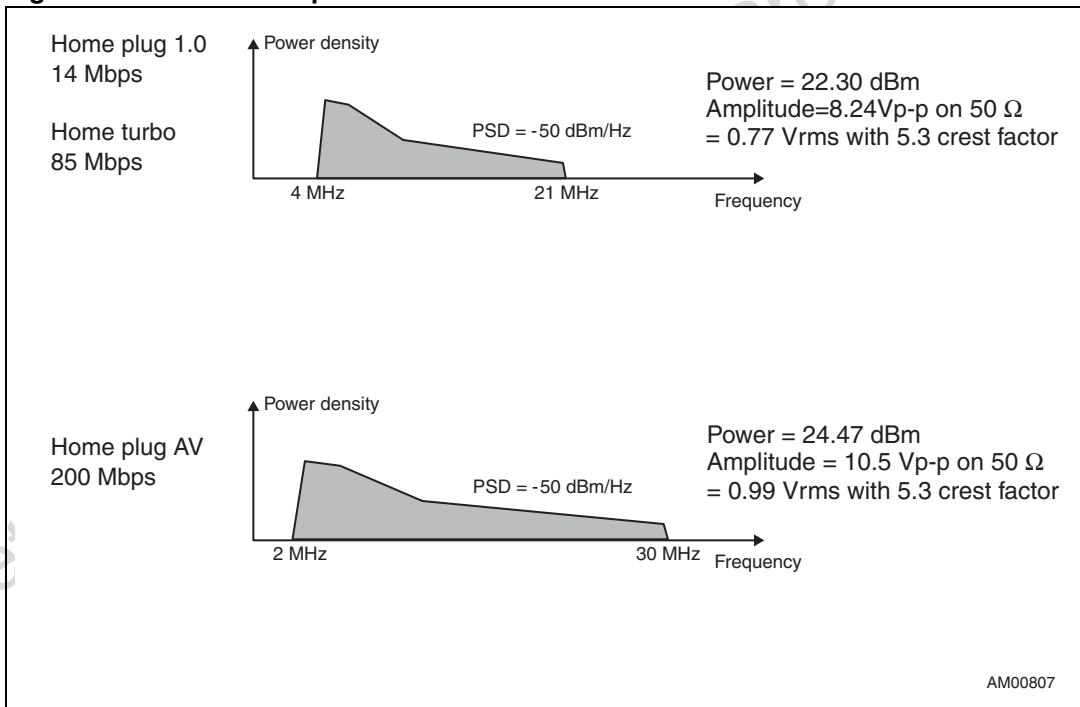
Figure 25.   Power line interface

Figure 26.   Power line spectrums

● Power on the line: P(dBm) = 10 Log(ΣBw x $10^{PSD/10}$)

● PSD: power spectrum density

● ΣBw: total bandwidth summation

● Power line: PSD = -50 dBm/Hz on 50 Ω

Figure 27. vDSL interface

AM00808
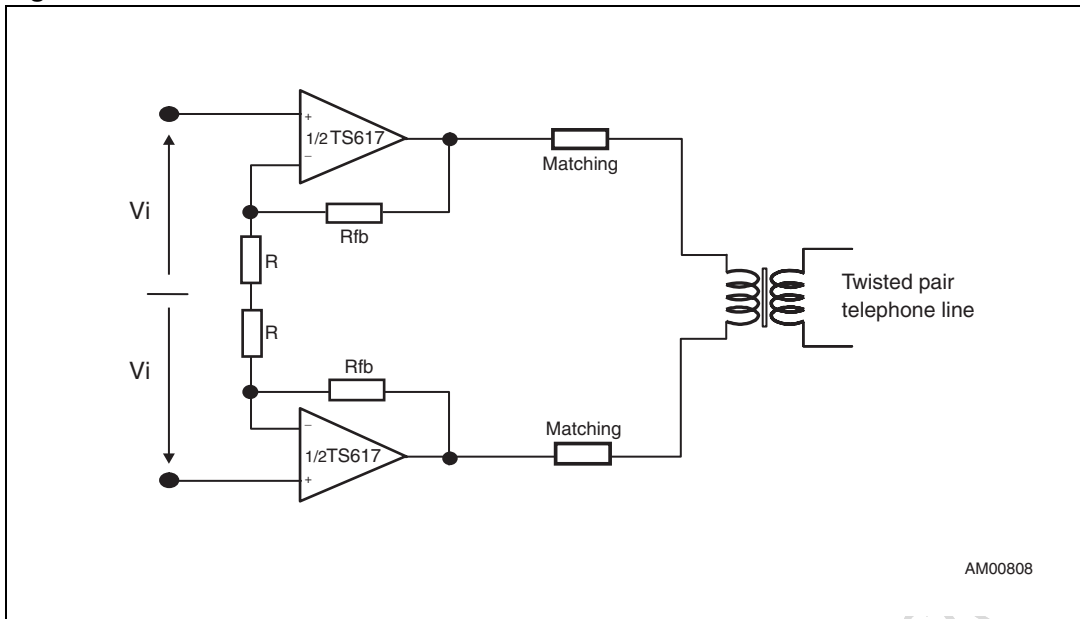
Figure 28. vDSL spectrum

AM00809
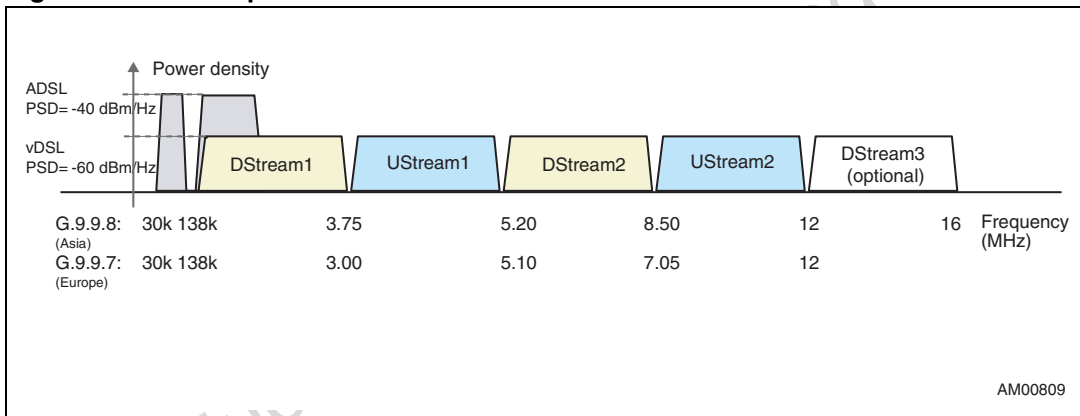
Table 8. vDSL spectrum

G. 9.9.8 Standard		G. 9.9.7 Standard	
Power (on 100-Ω line)	Vp-p (on 100-Ω line)	Power (on 100-Ω line)	Vp-p (on 100-Ω line)
CPE: 6.95 dBm	7.9 Vp-p	CPE: 8.48 dBm	9.4 Vp-p
CO: 8.4 dBm	9.3 Vp-p	CO: 6.82 dBm	7.8 Vp-p
CO DS3: 10.4 dBm	11.7 Vp-p	CO DS3: 9.45 dBm	10.5 Vp-p

5 Package information

In order to meet environmental requirements, STMicroelectronics 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 STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

Figure 29. SO-14 package mechanical drawing
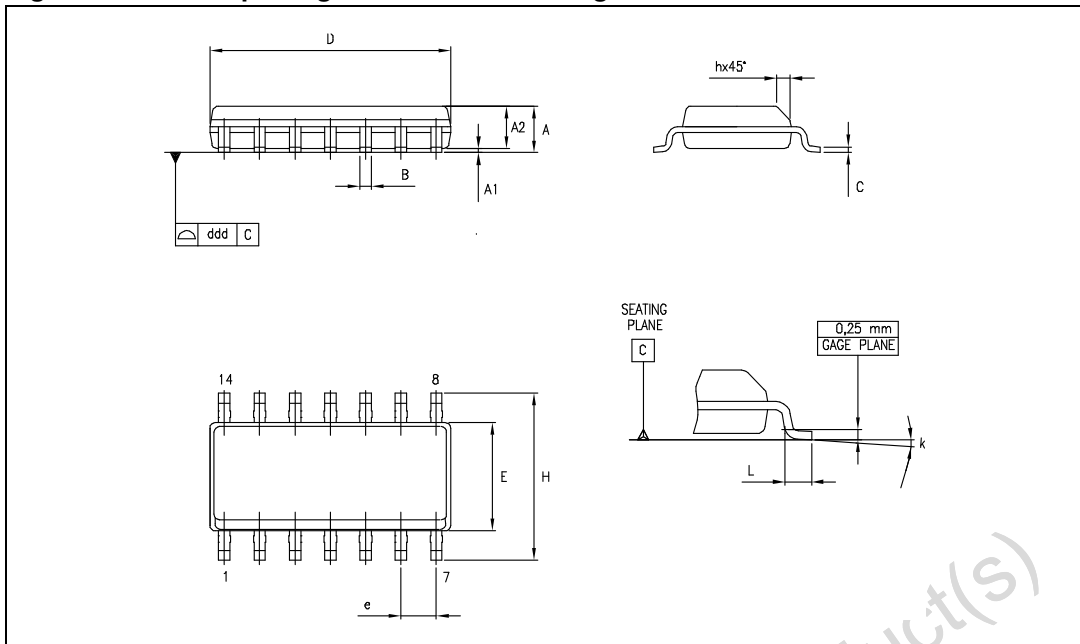
Table 9. SO-14 package mechanical data

Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.05		0.068
A1	0.10		0.25	0.004		0.009
A2	1.10		1.65	0.04		0.06
B	0.33		0.51	0.01		0.02
C	0.19		0.25	0.007		0.009
D	8.55		8.75	0.33		0.34
E	3.80		4.0	0.15		0.15
e		1.27			0.05	
H	5.80		6.20	0.22		0.24
h	0.25		0.50	0.009		0.02
L	0.40		1.27	0.015		0.05
k	8° (max.)					
ddd			0.10			0.004

Note: *D and F dimensions do not include mold flash or protrusions. Mold flash or protrusions must not exceed 0.15 mm.*

6 Ordering information

Table 10. Order codes

Order code	Temperature range	Package	Packaging	Marking
TS617ID	-40°C to +85°C	SO-14	Tube	TS617I
TS617IDT			Tape & reel	

7 Revision history

Table 11. Document revision history

Date	Revision	Changes
03-Nov-2008	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.