

Quad Darlington switch

Features

- Four non-inverting inputs with enable
- Output voltage up to 50 V
- Output current up to 1.8 A
- Very low saturation voltage
- TTL compatible inputs
- Integral fast recirculation diodes

Applications

The L6221 monolithic quad Darlington switch is designed for high current, high voltage switching applications.

Description

Each of the four switches is controlled by a logic input and all four are controlled by a common enable input. All inputs are TTL-compatible for direct connection to logic circuits.

Each switch consists of an open-collector Darlington transistor plus a fast diode for switching applications with inductive device loads. The emitters of the four switches are commoned. Any number of inputs and outputs of the same device may be paralleled.

Table 1. Device summary

Order code	Package
E-L6221AS	Power DIP
E-L6221AD	SO16+2+2
E-L6221AD013TR	SO16+2+2 (tape and reel)
E-L6221C/CD/CN	Obsolete product

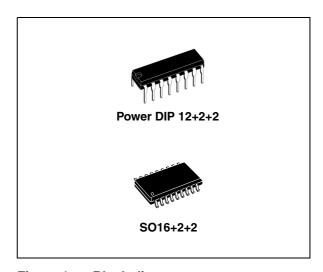
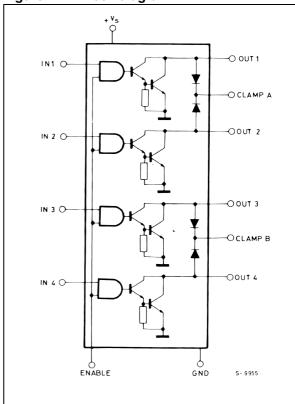


Figure 1. Block diagram



Contents

1	Thermal data	3
2	Pin information	4
3	Absolute maximum ratings	6
4	Electrical characteristics	7
5	Test circuits	8
6	Application information 1	4
7	Mounting instructions	6
8	Package mechanical data 1	8
9	Revision history	1

1 Thermal data

Table 2. Thermal data

Symbol	Parameter	SO20	Power DIP	Unit
R _{th j-pins}	Thermal resistance junction-pins max.	17	14	°C/W
R _{th j-amb}	Thermal resistance junction-ambient max.	80	80	°C/W

2 Pin information

Figure 2. Pin connections (top views)

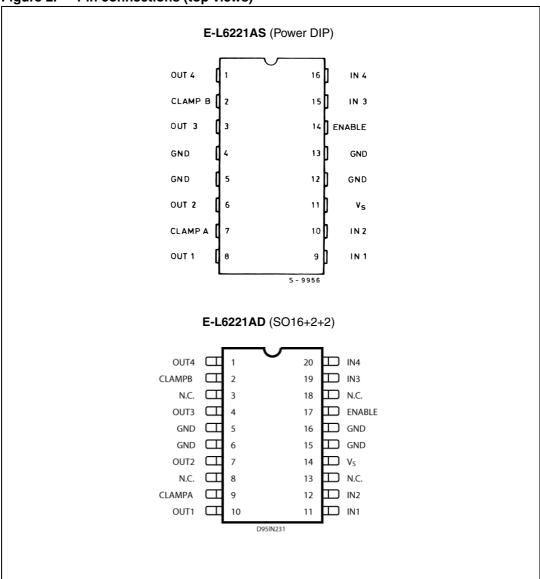


Table 3. Truth table⁽¹⁾

Enable	Input	Power out
Н	Н	ON
Н	L	OFF
L	X	OFF

For each input: H = High level, L = Low level

Table 4. Pin description⁽¹⁾

Name	Function		
IN 1	Input to driver 1		
IN 2	Input to driver 2		
OUT 1	Output of driver 1		
OUT 2	Output of driver 2		
CLAMP A	Diode clamp to driver 1 and driver 2		
IN 3	Input to driver 3		
IN 4	Input to driver 4		
OUT 3	Output of driver 3		
OUT 4	Output of driver 4		
CLAMP B	Diode clamp to driver 3 and driver 4		
ENABLE	Enable input to all drivers		
٧S	Logic supply voltage		
GND	Common ground		

^{1.} See Figure 1: Block diagram

3 Absolute maximum ratings

Table 5. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V _o	Output voltage	50	V
V _s	Logic supply voltage	7	٧
V _{IN} , V _{EN}	Input voltage, enable voltage	V _S	
I _C	Continuous collector current (for each channel)	1.8	Α
I _C	Collector peak current (repetitive, duty cycle = 10% t _{on} = 5 ms)	2.5	Α
I _C	Collector peak current (non repetitive, t = 10 μ s)	3.2	Α
T _{op}	Operating temperature range (junction)	-40 to +150	°C
T _{stg}	Storage temperature range	-55 to +150	°C
I _{sub}	Output substrate current	350	mA
P _{tot}	Total power dissipation at: T _{pins} = 90 °C (Power DIP) T _{case} = 90 °C (SO20) T _{amb} = 70 °C (Power DIP) T _{amb} = 70 °C (SO20)	4.3 3.5 1	W W W

Electrical characteristics 4

Refer to the test circuits Figure 3 to Figure 10 ($V_S = 5$ V, $T_{amb} = 25$ °C unless otherwise specified). Note:

Table 6. **Electrical characteristics**

Symbol	Parameter Test condition		Min.	Тур.	Max.	Unit	
V _S	Logic supply voltage	-		-	5.5	V	
	Logic cumply current	All outputs ON, I _C = 0.7A	-	-	20	mA	
I _s	Logic supply current	All outputs OFF	-	-	20	mA	
V _{CE(sus)}	Output sustaining voltage	$V_{IN} = V_{IN}L$, $V_{EN} = V_{EN}H$ $I_C = 100 \text{ mA}$	46	-	-	V	
I _{CEX}	Output leakage current	$V_{CE} = 50V$ $V_{IN} = V_{IN}L$, $V_{EN} = V_{EN}H$	-	-	1	mA	
V _{CE(sat)}	Collector emitter saturation voltage (one input on, all others inputs off.)	$V_{S} = 4.5 \text{ V}$ $V_{IN} = V_{IN}H, V_{EN} = V_{EN}H$ $I_{C} = 0.6 \text{ A}$ $I_{C} = 1 \text{ A}$ $I_{C} = 1.8 \text{ A}$		- - -	1 1.2 1.6	V	
$V_{IN}L$, $V_{EN}L$	Input low voltage	-	-	-	0.8	٧	
I _{IN} L, I _{EN} L	Input low current	$V_{IN} = V_{INL}, V_{EN} = V_{ENL}$	-	-	-100	μΑ	
V _{IN} L, V _{EN} H	Input high voltage	-	2.0	-	-	V	
I _{IN} H, I _{EN} H	Input high current	$V_{IN} = V_{IN}H$, $V_{EN} = V_{EN}H$	-	-	10	μΑ	
I _R	Clamp diode leakage current	$V_R = 50 \text{ V}, V_{EN} = V_{EN}H$ $V_{IN} = V_{IN}L$	-	-	100	μΑ	
V _F	Clamp diode forward voltage	I _F = 1A I _F = 1.8A	-	-	1.6 2.0	V V	
t _{d (on)}	Turn-on delay time	$V_p = 5V$, $R_L = 10\Omega$	-	-	2	μs	
t _{d (off)}	Turn-off delay time	$V_p = 5V$, $R_L = 10\Omega$	-	-	5	μs	
Δl_{s}	Logic supply current variation	V _{IN} = 5V, V _{EN} = 5V I _{out} = -300 mA for each channel	-	-	120	mA	

5 Test circuits

Note: Pin numbers without parentheses apply to the Power DIP package.
Pin numbers in parentheses are not applicable.

Figure 3. Logic supply current

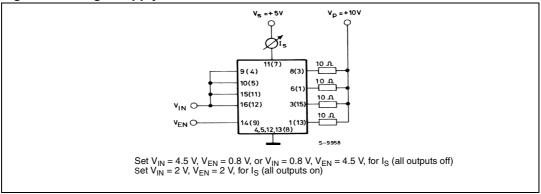


Figure 4. Output sustaining voltage

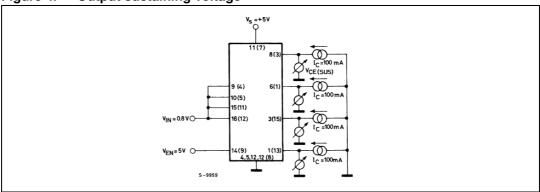


Figure 5. Output leakage current

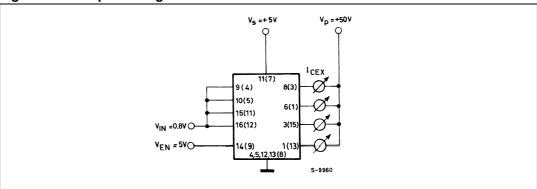


Figure 6. Collector-emitter saturation voltage

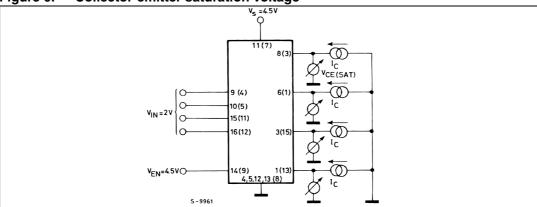


Figure 7. Logic input characteristics

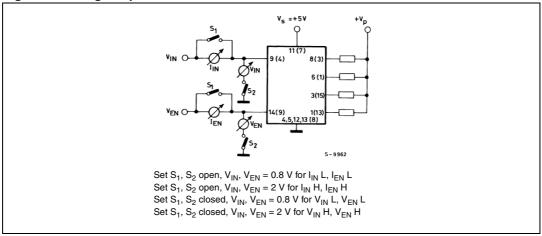


Figure 8. Clamp-diode leakage current

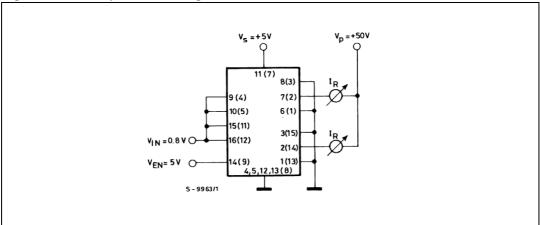


Figure 9. Clamp-diode forward voltage

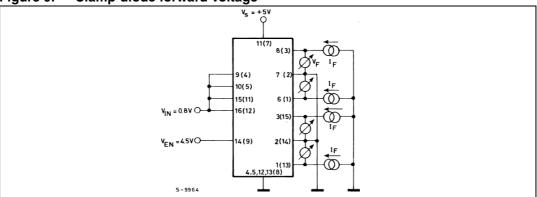


Figure 10. Switching time test circuit

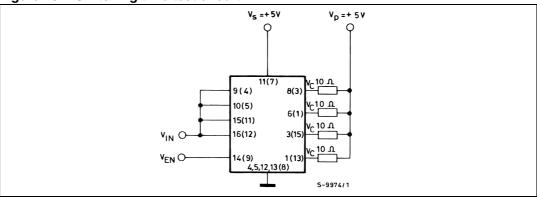


Figure 11. Switching time waveforms

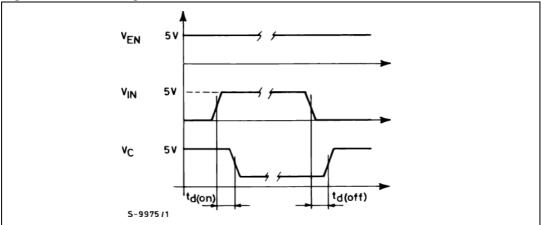


Figure 12. Allowed peak collector current versus duty cycle for 1, 2, 3 or 4 contemporary working outputs (L6221AS)

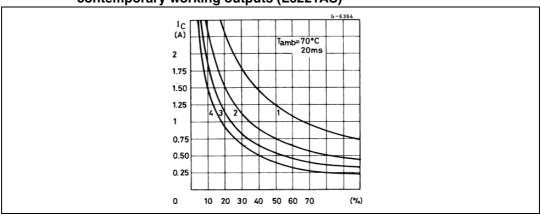


Figure 13. Collector saturation voltage versus collector current

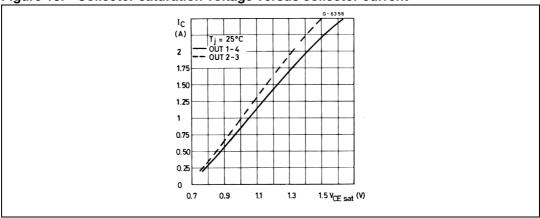
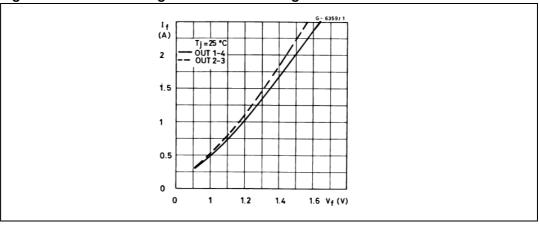
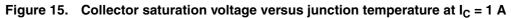


Figure 14. Free-wheeling diode forward voltage versus diode current





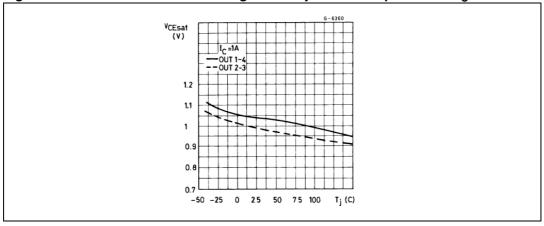


Figure 16. Free-wheeling diode forward voltage versus junction temperature at $I_F = 1~\text{A}$

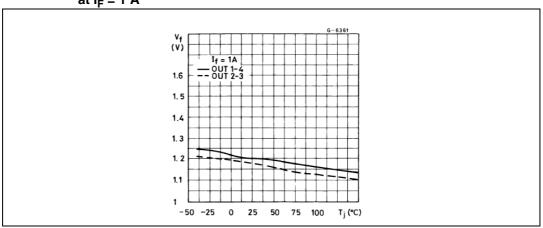
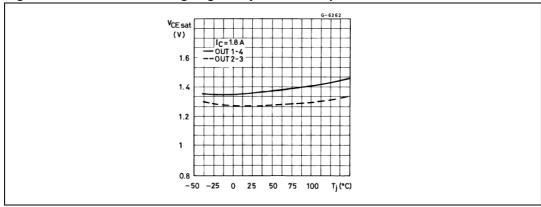


Figure 17. Saturation voltage against junction temperature



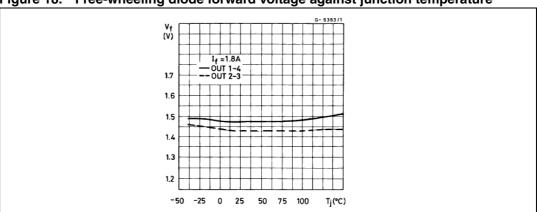


Figure 18. Free-wheeling diode forward voltage against junction temperature

6 Application information

When inductive loads are driven by the L6221, a Zener diode in series with the integral free-wheeling diodes increases the voltage across which energy stored in the load is discharged and therefore speeds the current decay (*Figure 19*).

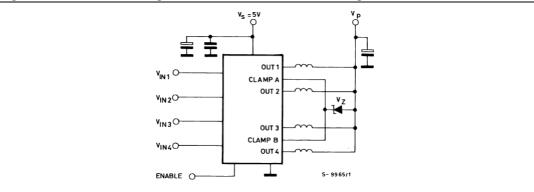
For reliability it is suggested that the Zener is chosen so that

$$V_{D} + V_{Z} < 35 \text{ V}$$

There are two reasons for this:

- The Zener voltage changes in temperature and current.
- The instantaneous power must be limited to avoid the reverse second breakdown.

Figure 19. Free-wheeling diode connection when driving inductive loads



Care must be taken to ensure that the collectors are placed close together to avoid different current partitioning at turn-off.

It is suggested to put in parallel channel 1 and 4 and channel 2 and 3 as shown in *Figure 20* for the similar electrical characteristics of the logic section (turn-on and turn-off delay time) and the power stages (collector saturation voltage, free-wheeling diode forward voltage).

V_S = +5V (35Vmax) V_D (70μF (200 PLED) COIL (270μF (270μF (270 PLED) COIL (270 PLED) COIL (270 PLED) COIL (270 PLED) (270 PLED)

Figure 20. Driver for solenoids up to 3 A

Figure 21. Saturation voltage versus collector current

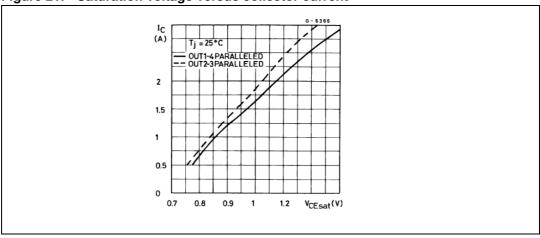
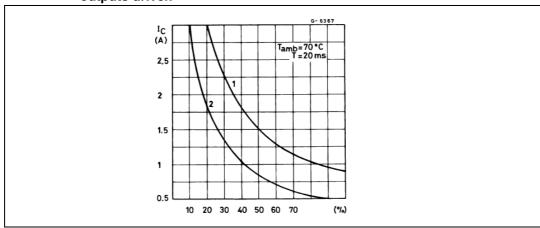


Figure 22. L6221AS peak collector current versus duty cycle for 1 or 2 paralleled outputs driven



7 Mounting instructions

The $R_{th\ j\text{-}amb}$ of the E-L6221AS can be reduced by soldering the GND pins to a suitable copper area of the printed circuit board (*Figure 23*) or to an external heat sink (*Figure 24*).

Figure 23. Example of PCB copper area used as heat sink

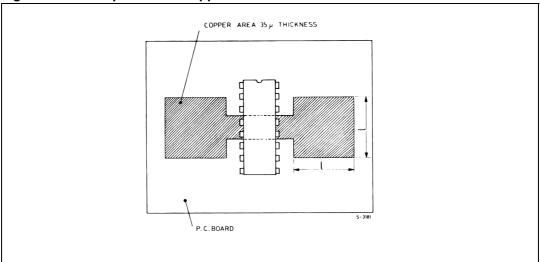


Figure 24. External heat sink mounting example

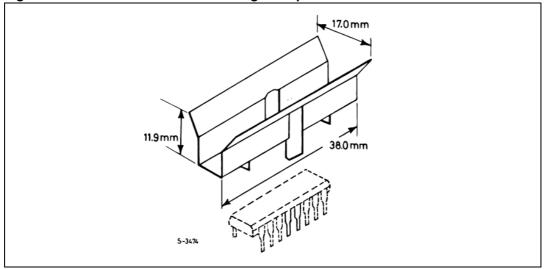


Figure 25 shows the maximum dissipable power P_{tot} and the $R_{th\ j\text{-amb}}$ as a function of the side "α" of two equal square copper areas having a thickness of 35 μm (1.4 mils). During soldering the pins temperature must not exceed 260 °C and the soldering time must not be longer than 12 seconds.

The external heat sink or printed circuit copper area must be connected to electrical ground.

Figure 25. Maximum dissipable power and junction-to-ambient thermal resistance versus side " α "

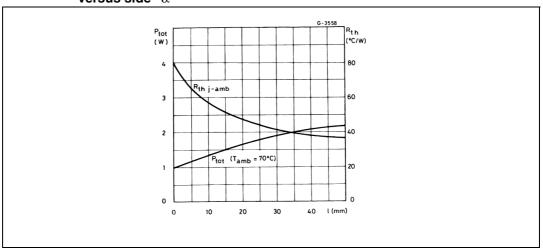
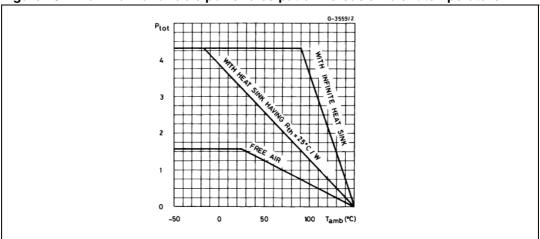


Figure 26. Maximum allowable power dissipation versus ambient temperature



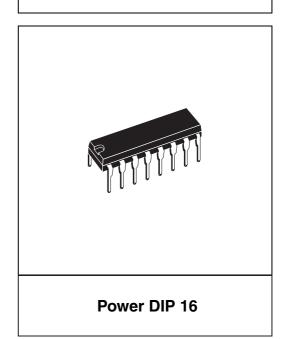
8 Package mechanical data

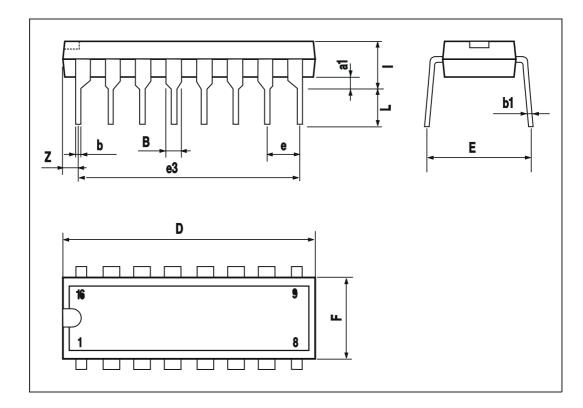
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.



DIM.	mm					
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
В	0.85		1.40	0.033		0.055
b		0.50			0.020	
b1	0.38		0.50	0.015		0.020
D			20.0			0.787
Е		8.80			0.346	
е		2.54			0.100	
еЗ		17.78			0.700	
F			7.10			0.280
I			5.10			0.201
L		3.30			0.130	
Z			1.27			0.050

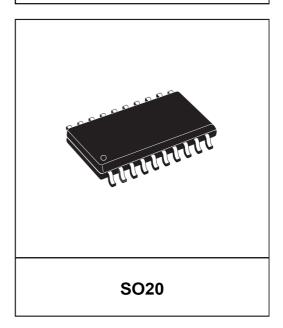
OUTLINE AND MECHANICAL DATA

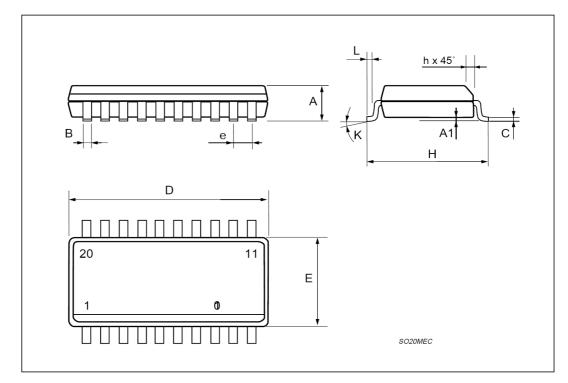




DIM.	mm ir			inch	nch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
А	2.35		2.65	0.093		0.104	
A1	0.1		0.3	0.004		0.012	
В	0.33		0.51	0.013		0.020	
С	0.23		0.32	0.009		0.013	
D	12.6		13	0.496		0.512	
Е	7.4		7.6	0.291		0.299	
е		1.27			0.050		
Н	10		10.65	0.394		0.419	
h	0.25		0.75	0.010		0.030	
L	0.4		1.27	0.016		0.050	
К	0° (min.)8° (max.)						

OUTLINE AND MECHANICAL DATA





9 Revision history

Table 7. Document revision history

Date	Revision	Changes
14-Jan-2004 2 Released in EDOCS		Released in EDOCS
19-Jan-2009	3	Document reformatted. Inserted title for <i>Figure 19</i> . Removed reference to obsolete product L6221N and the associated package (multiwatt-15).
30-Mars-2009	4	Obsolete products E-L6221C/CD/CN added in <i>Table 1</i> .

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.

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

© 2009 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 - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com



Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

STMicroelectronics:

L6221AD L6221AS L6221AD013TR E-L6221AD E-L6221AD013TR E-L6221AS