L6220

QUAD DARLINGTON SWITCHES

1 FEATURES

- FOUR NON INVERTING INPUTS WITH ENABLE
- OUTPUT VOLTAGE UP TO 50V
- OUTPUT CURRENT UP TO 1.8A
- VERY LOW SATURATION VOLTAGE
- TTL COMPATIBLE INPUTS
- INTEGRAL FAST RECIRCULATION DIODES

2 DESCRIPTION

The L6220 monolithic quad darlington switch is designed for high current, high voltage switching applications. Each of the four switches is controlled by a logic input and all four are controlled by a common inhibit input. All inputs are TTL-compatible for direct connection to logic circuits.

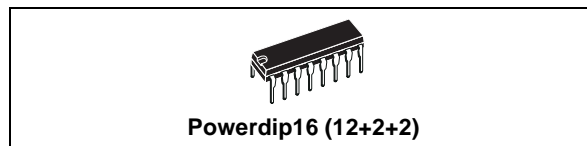Each switch consists of an open-collector darling-

Figure 1. Package

Powerdip16 (12+2+2)

Table 1. Order Codes

Part Number	Package
L6220	Powerdip16

ton transistor plus a fast diode for switching applications with inductive loads. The emitters of the four switches are combined. Any number of inputs and outputs on the same device may be paralleled.

The L6220 is mounted in a Powerdip 12 + 2 + 2 package.
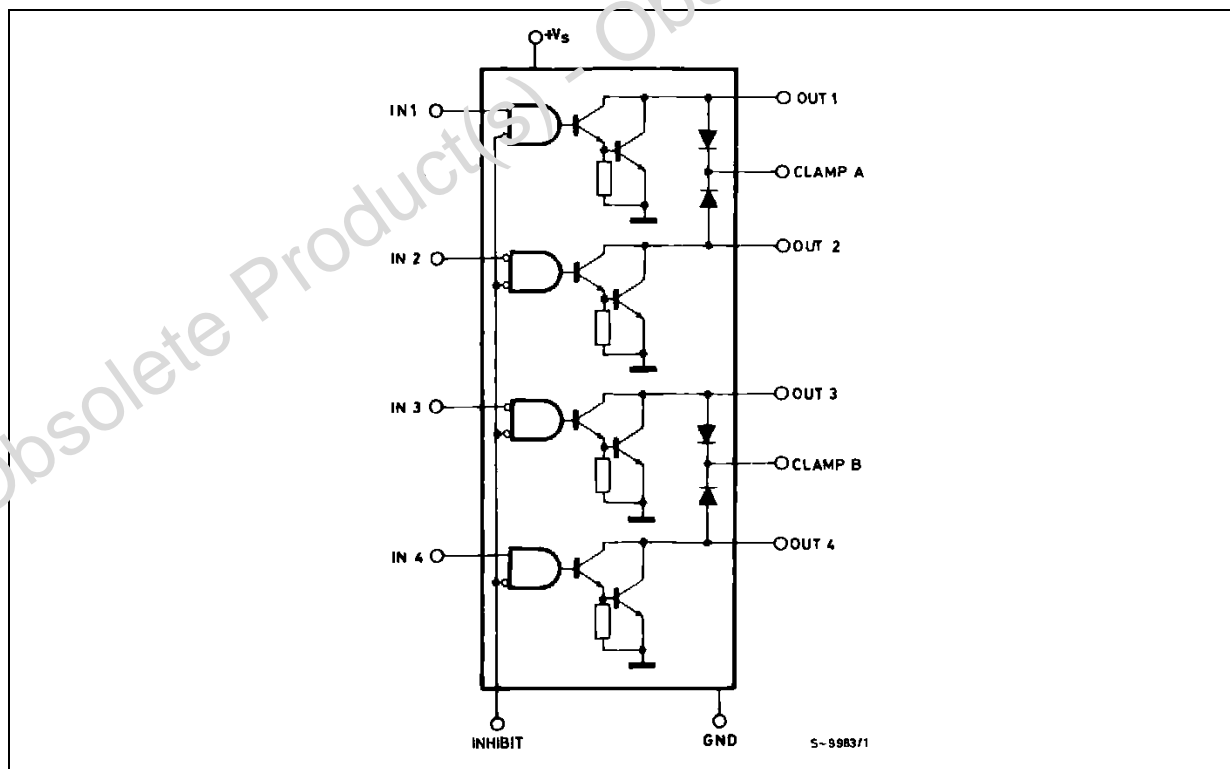
Figure 2. Block Diagram

Table 2. Pin Description

Pin N#	Pin Name	Function
1	OUT 4	Output of Driver 4
2	CLAMP B	Diode Clamp to Driver 3 and Driver 4
3	OUT 3	Output of Driver 3
4, 5, 12, 13	GND	Common Ground
6	OUT 2	Output of Driver 2
7	CLAMP A	Diode Clamp to Driver 1 and Driver 2
8	OUT 1	Output of Driver 1
9	IN 1	Input to Driver 1
10	IN 2	Input to Driver 2
11	V_S	Logic Supply Voltage
14	INHIBIT	Inhibit Input to all Drivers
15	IN 3	Input to Driver 3
16	IN 4	Input to Driver 4

Figure 3. Pin Connections
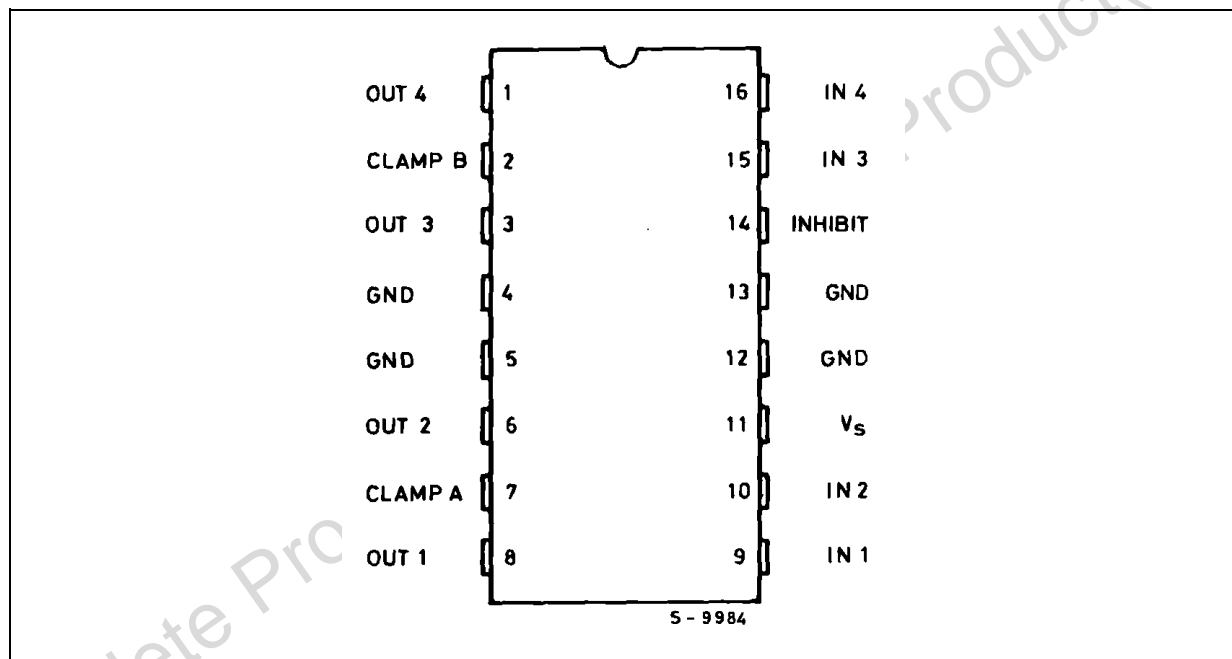
Table 3. TRUTH TABLE

Enable	Inputs 1, 4	Power Out	Enable	Inputs 2, 3	Power Out
L	H	ON	L	L	ON
L	L	OFF	L	H	OFF
H	X	OFF	H	X	OFF

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

Table 4. Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_o	Output Voltage	50	V
V_S	Logic Supply Voltage	7	V
V_{IN}, V_{EN}	Input Voltage, Enable Voltage	V_S	
I_C	Continuous Collector Current (for each channel)	1.8	A
I_C	Collector Peak Current (repetitive, duty cycle = 10 % t_{on} = 5 ms)	2.5	A
I_C	Collector Peak Current (non repetitive, t = 10 μ s)	3.2	A
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 at T_{amb} = 70 °C	4.3 1	W W

Table 5. Thermal Data

Symbol	Parameter	Value	Unit
$R_{th\ j\text{-}pins}$	Thermal Resistance Junction-pins Max.	14	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient Max.	80	°C/W

Table 6. Electrical Characteristcs

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_S	Logic Supply Voltage		4.5		5.5	V
I_s	Logic Supply Current	All Outputs ON, I_C = 0.7A			20	mA
		All Outputs OFF			20	mA
$V_{CE(sus)}$	Output Sustaining Voltage	I_C = 100 mA, V_{IN} = $V_{IN}H$	46			V
I_{CEX}	Output Leakage Current	V_{CE} = 50V, $V_{IN\ 1.4}$ = $V_{IN}H$			1	mA
$V_{CE(sat)}$	Collector Emitter Saturation Voltage (one input on ; all others inputs off.)	V_S = 4.5V $V_{IN\ 2.3}$ = $V_{IN}L$, V_{INH} = $V_{INH}L$ I_C = 0.6A I_C = 1A I_C = 1.8A			 1 1.2 1.6	V
$V_{IN}L$, $V_{INH}L$	Input Low Voltage				0.8	V
$I_{IN}L$, $I_{INH}L$	Input Low Current	V_{IN} = V_{INL}, V_{EN} = V_{ENL}			- 100	μA
$V_{IN}H$, $V_{INH}H$	Input High Voltage		2.0			V
$I_{IN}H$, $I_{INH}H$	Input High Current	V_{IN} = $V_{IN}H$, V_{INH} = $V_{INH}H$			±10	μA
I_R	Clamp Diode Leakage Current	V_R = 50 V, V_{INH} = $V_{INH}H$			100	μA
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 = 10Ω			2	μs
$t_{d\ (off)}$	Turn off Delay Time	V_p = 5V, R_L = 10Ω			5	μs
ΔI_s	Logic Supply Current Variation	V_{IN} = 5V, V_{EN} = 5V I_{out} = − 300 mA for Each Channel			120	mA

3   TEST CIRCUITS

Figure 4. Logic supply current.
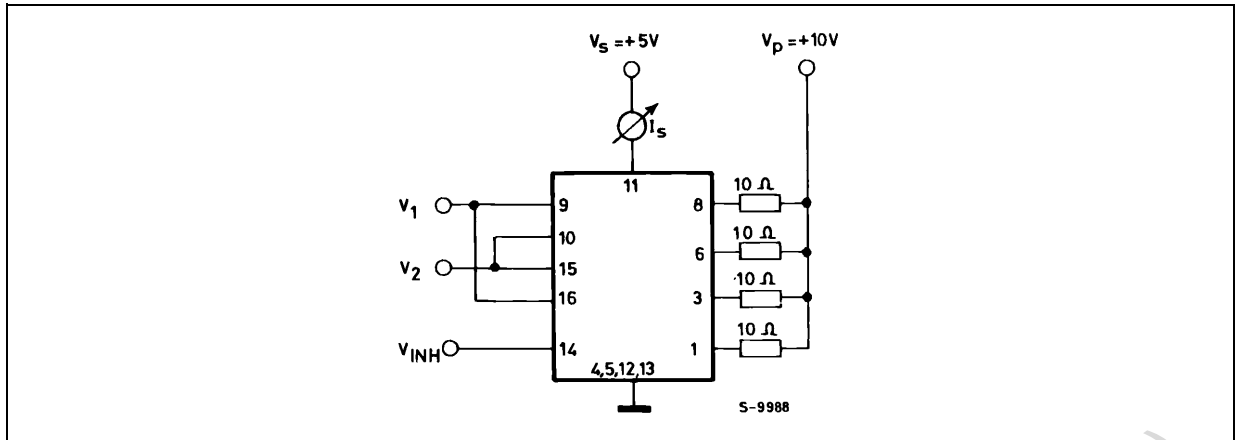
Set V_1 = 4.5V, V_2 = 0.8V, V_{INH} = 4.5V or V_1 = 0.8V, V_2 = 4.5V, V_{INH} = 0.8V for I_S (all outputs off)
Set V_1 = 2V, V_2 = 0.8V, V_{IN} = 0.8V for I_S (all outputs on)

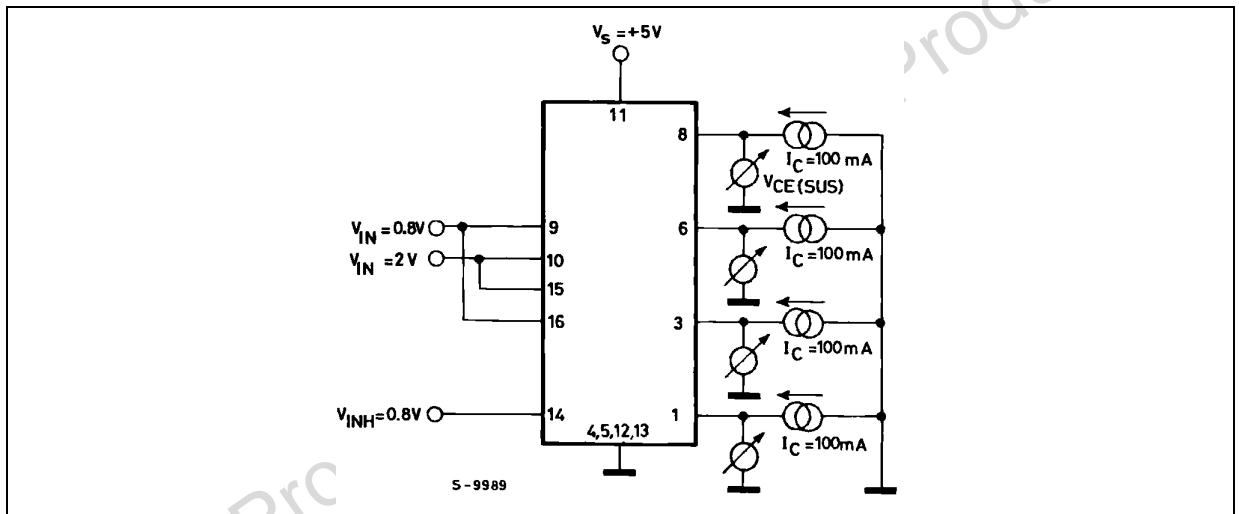**Figure 5. Output Sustaining Voltage.**
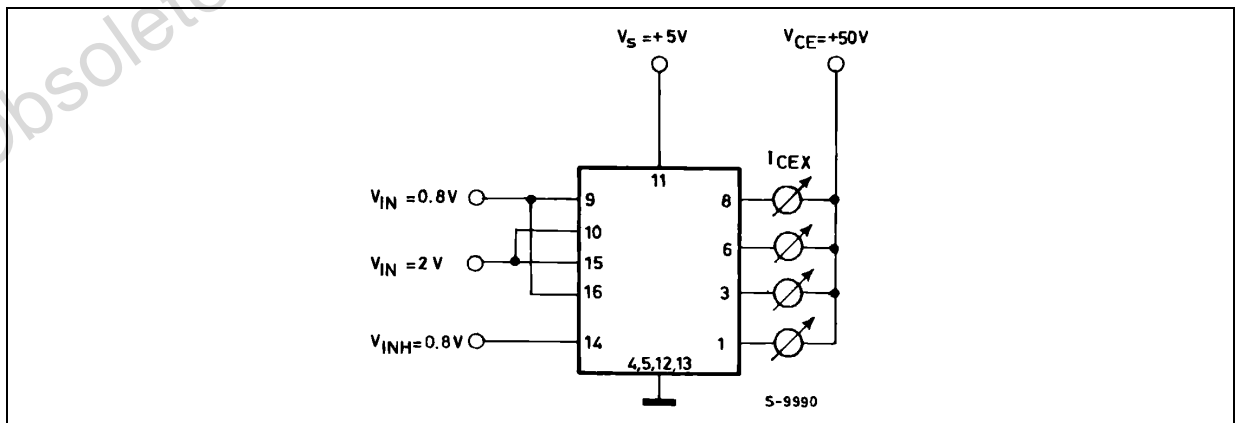

Figure 6. Output Leakage Current.

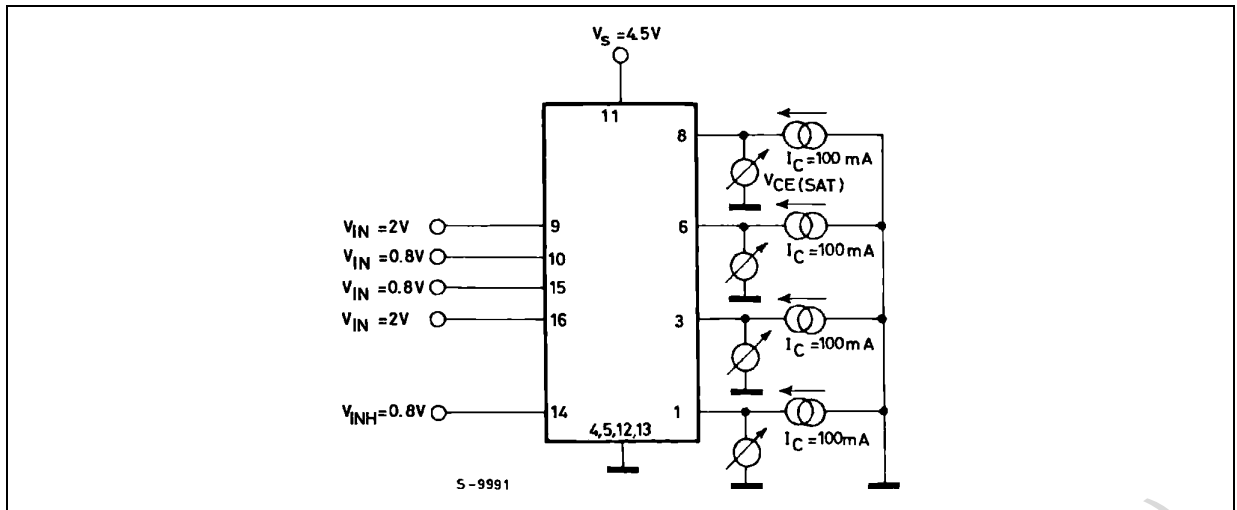**Figure 7. Collector-emitter Saturation Voltage**

Figure 8. Logic Input Characteristics
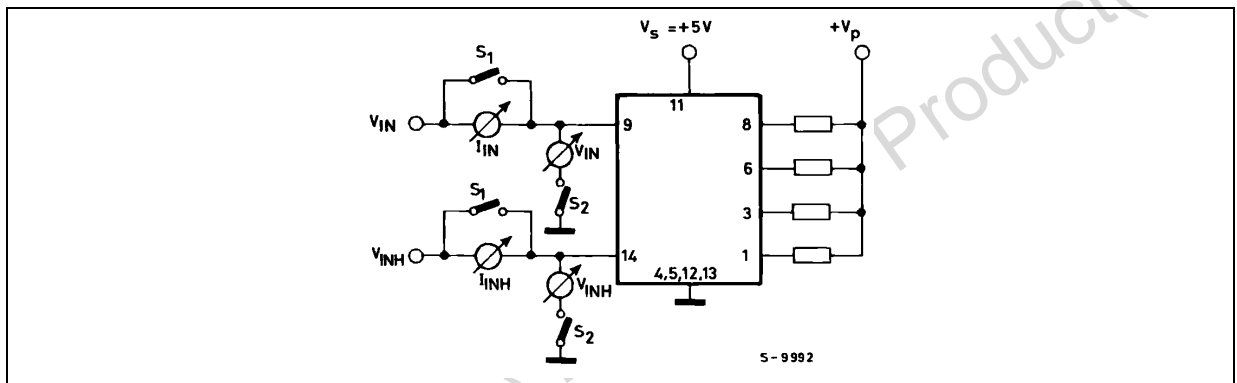
Set S_1, S_2 open, V_{IN}, V_{INH} = 0.8V for I_{IN} L, I_{INH} L
Set S_1, S_2 open, V_{IN}, V_{INH} = 2V for I_{IN} H, I_{INH} H
Set S_1, S_2 close, V_{IN}, V_{INH} = 0.8V for V_{IN} L, V_{INH} L
Set S_1, S_2 close, V_{IN}, V_{INH} = 2V for V_{IN} H, V_{INH} H

Figure 9. Clamp Diode Leakage Current.
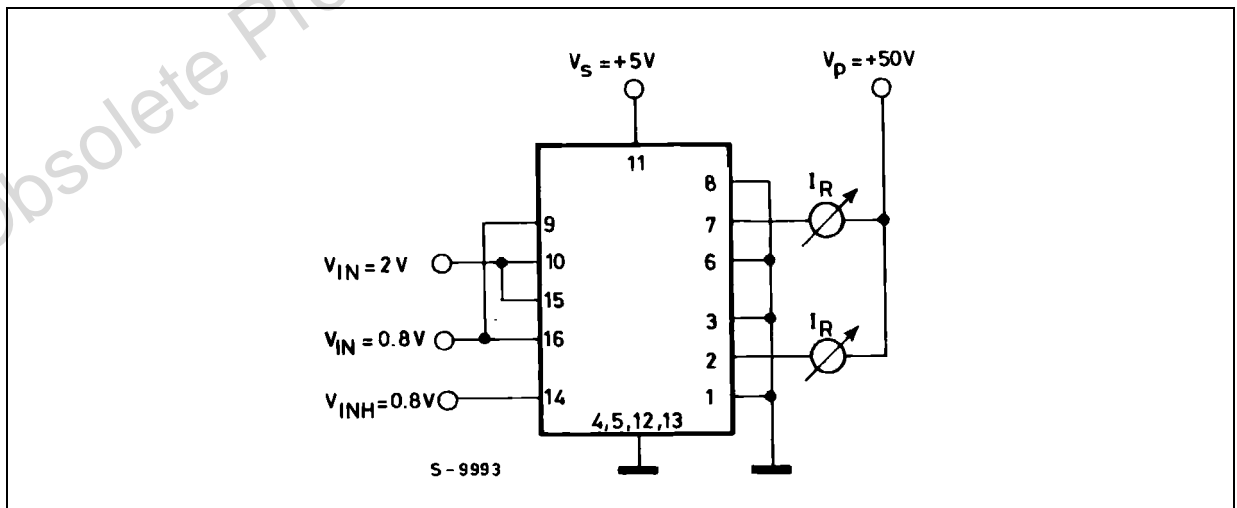
Figure 10. Clamp Diode Forward Voltage.
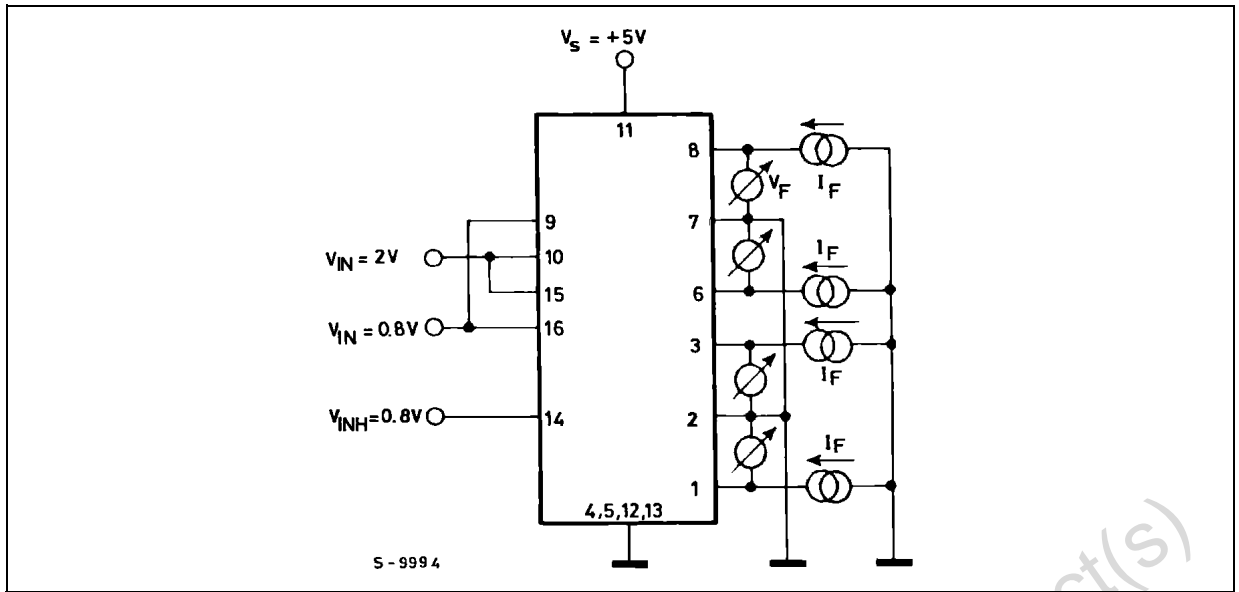
Figure 11. Switching Times Test Circuit.
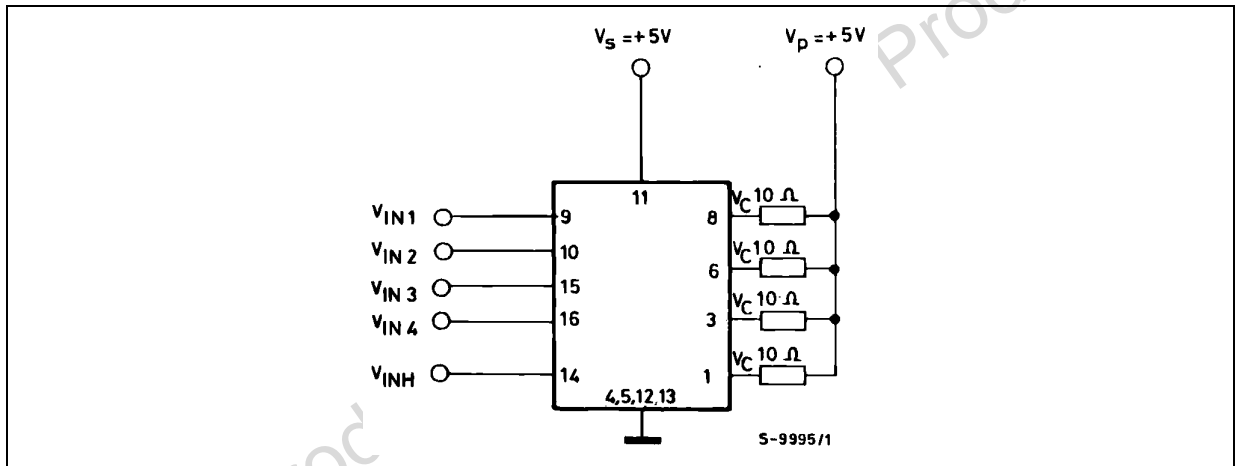
Figure 12. Switching TImes Waveforms.
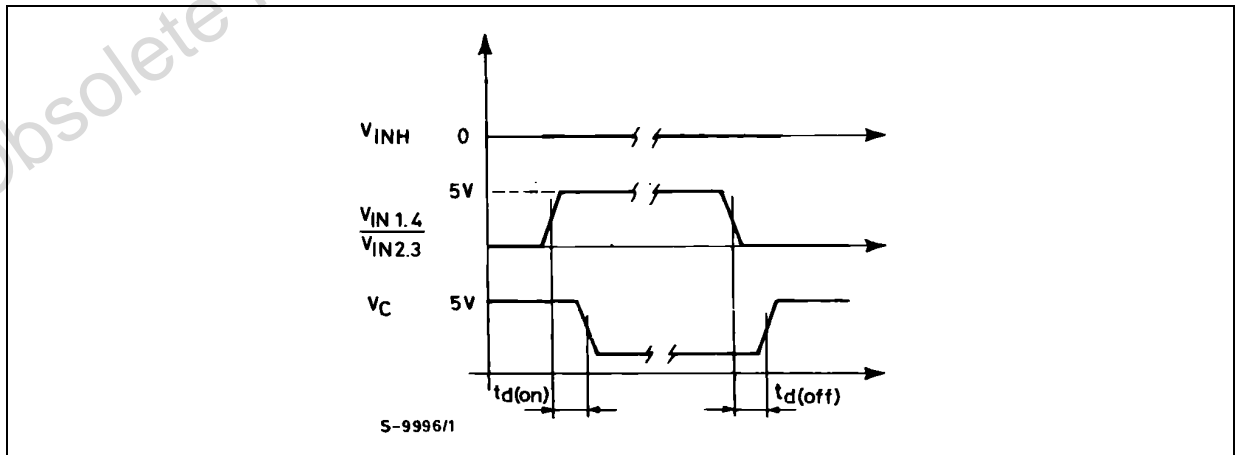
Figure 13. Collector Saturation Voltage versus Collector Current

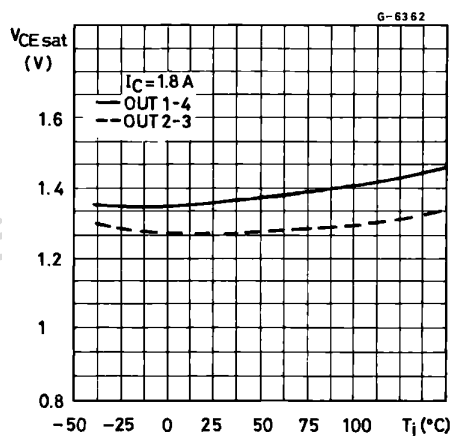**Figure 14. Free-wheeling Diode Forward Voltage versus Diode Current**

Figure 15. Collector Saturation Voltage versus Junction Temperature at IC = 1A

Figure 16. Free-wheeling Diode Forward Voltage versus Junction Temperature at IF = 1A

Figure 17. Collector Saturation Voltage versus Junction Temperature at IC = 8A
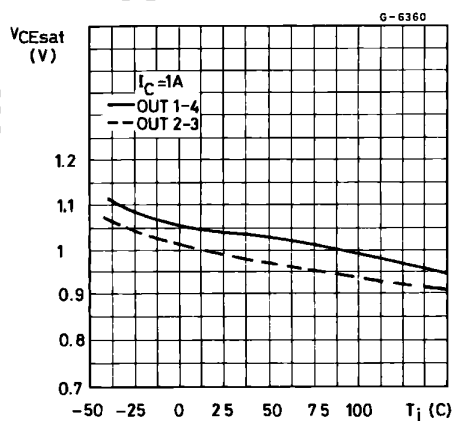
Figure 18. Free-wheeling Diode Forward Voltage versus Junction Temperature at IF = 1A
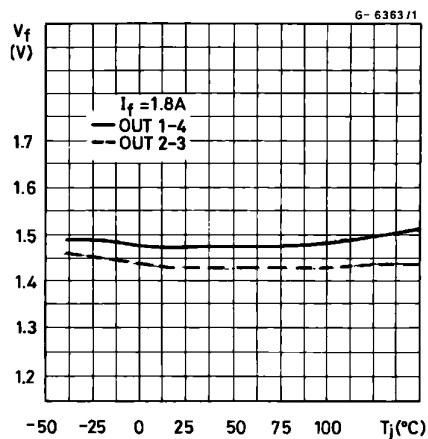
4   APPLICATION INFORMATION

When inductive loads are driven by L6220, 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 (fig. 19).
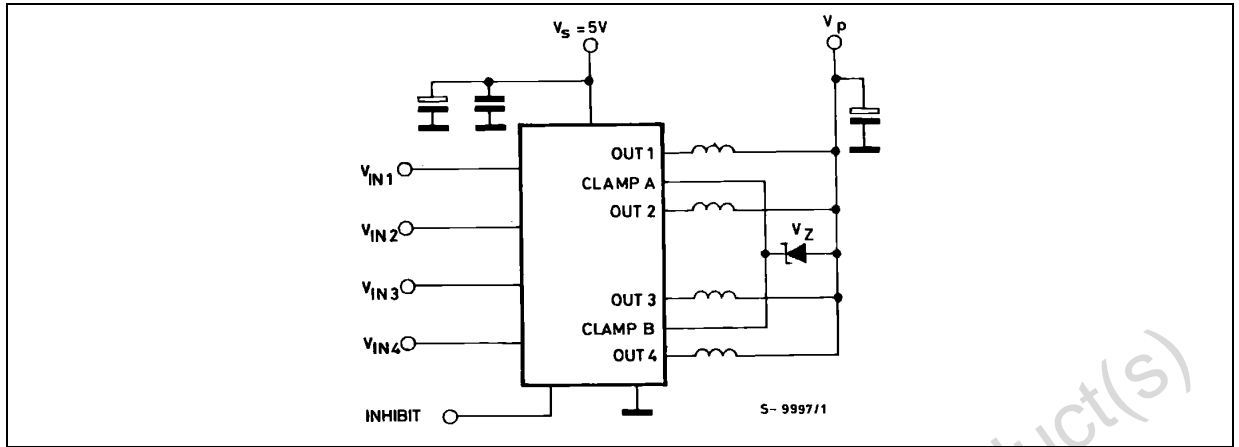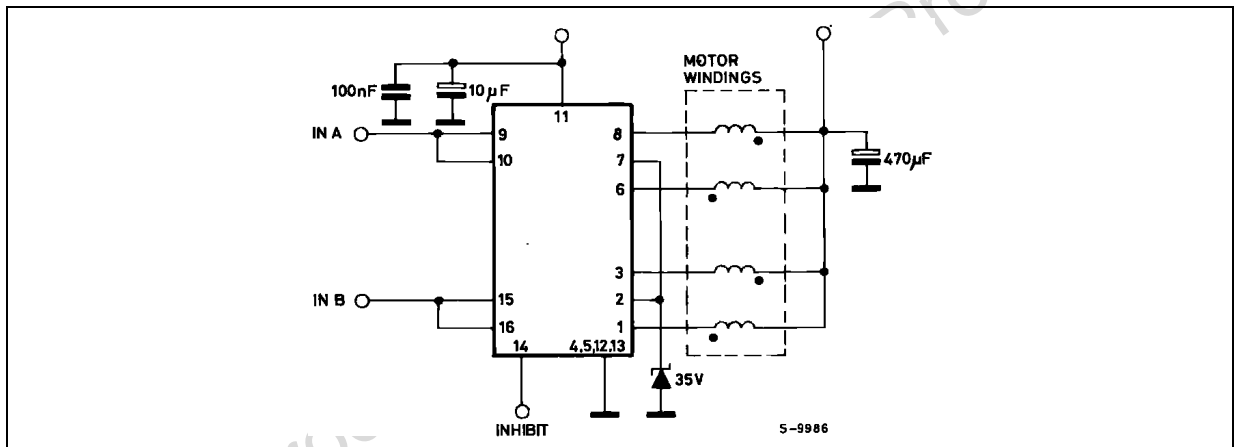
Figure 19.

Figure 20. Unipolar Stepper Motor Driver.

For reliability it is suggested that the zener is chosen so that $V_p + V_z < 35$ V.

The reasons for this are two fold :

1) The zener voltage changes in temperature and current.

2) The instantaneous power must be limited to avoid the reverse second breakdown.

The particular internal logic allows an easier full step driving using only two input signals.
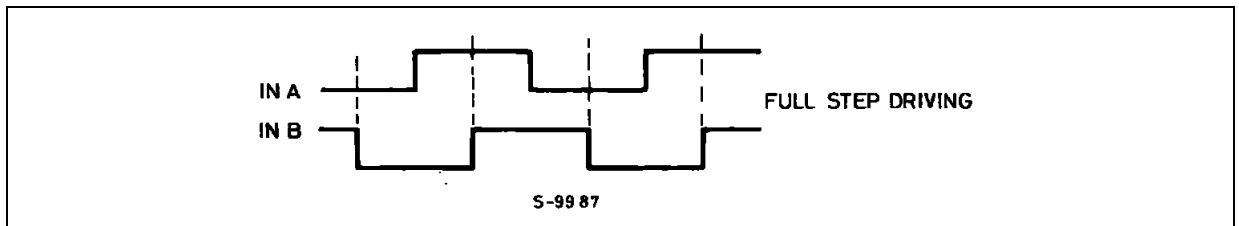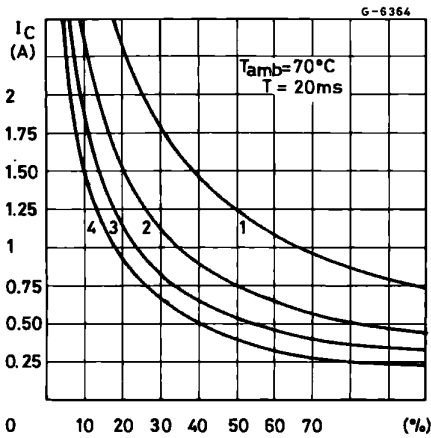
Figure 21.

Figure 22. Allowed Peak Collector-current versus Duty Cycle for 1, 2, 3 or 4 Contemporary Working Outputs (L6220).

5 MOUNTING INSTRUCTION

The Rth j-amb of the L6220 can be reduced by soldering the GND pins to a suitable copper area of the printed circuit board (Fig. 24) or to an external heatsink (Fig. 25).

The diagram of figure 25 shows the maximum dissipable power Ptot and the Rth j-amb as a function of the side " a" of two equal square copper areas having a thickness of 35μ (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 heatsink or printed circuit copper area must be connected to electrical ground.

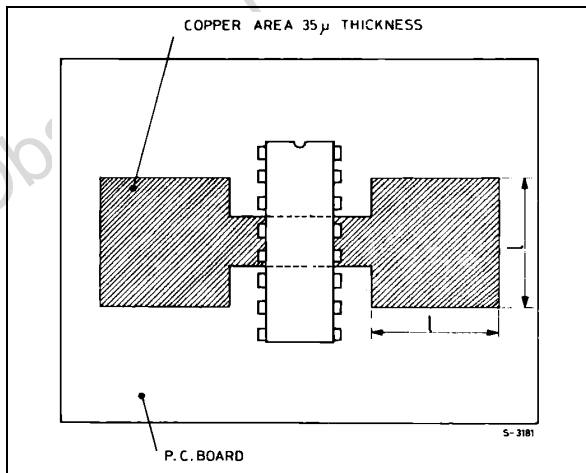**Figure 23. Example of P.C. Board Copperarea which is used as Heatsink**

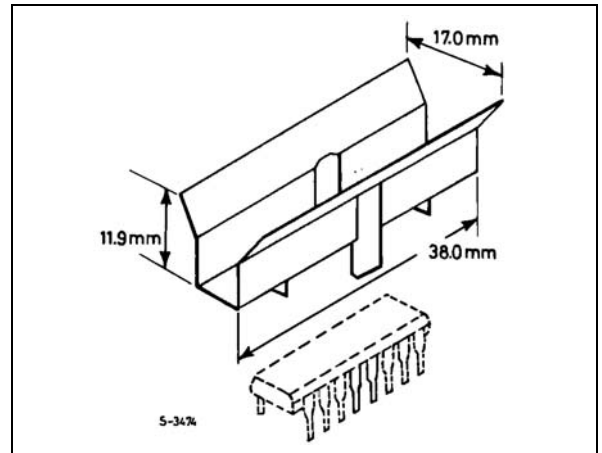
Figure 24. External Heatsink Mounting Example

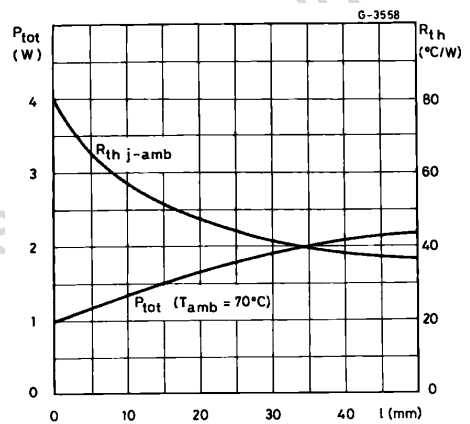**Figure 25. Maximum Dissipable Power and Junction to Ambient Thermal Resistance versus Side "α"**

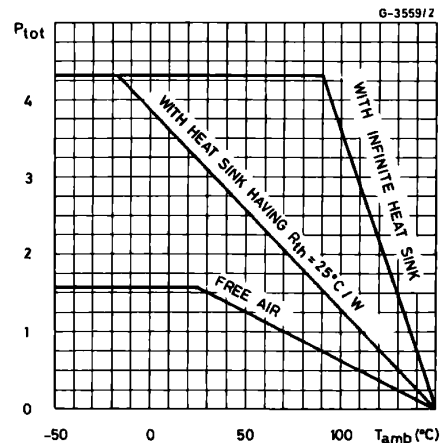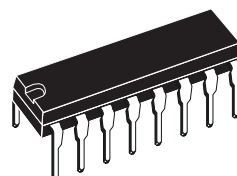**Figure 26. Maximum Allowable Power Dissipation versus Ambient Temperature**

Figure 27. DIP16 Mechanical Data & Package Dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

OUTLINE AND MECHANICAL DATA

DIP16
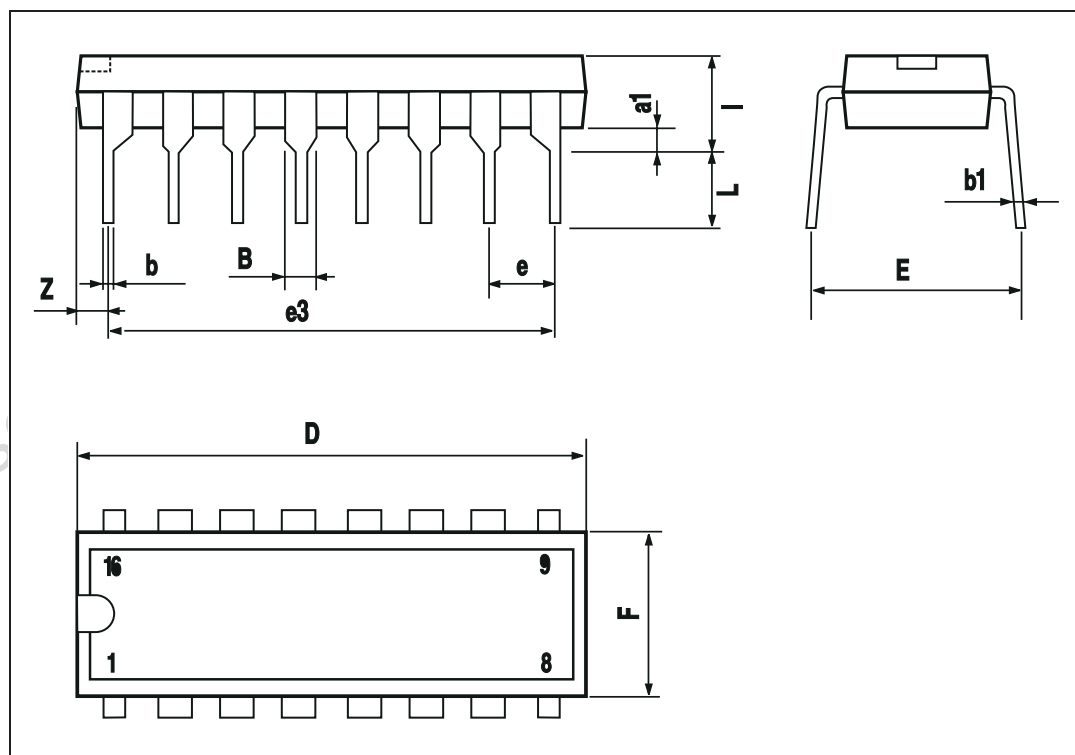
Table 7. Revision History

Date	Revision	Description of Changes
September 2003	1	First Issue
July 2004	2	Cancelled the L6220N part number and the relative references. Changed the style-look following the new "Corporate Technical Pubblications Design Guide" rules.

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