

# DATA SHEET

## **TDA8351** DC-coupled vertical deflection circuit

Product specification  
Supersedes data of January 1995  
File under Integrated Circuits, IC02

1999 Sep 27

## DC-coupled vertical deflection circuit

## TDA8351

## FEATURES

- Few external components
- Highly efficient fully DC-coupled vertical output bridge circuit
- Vertical flyback switch
- Guard circuit
- Protection against:
  - short-circuit of the output pins (7 and 4)
  - short-circuit of the output pins to  $V_P$
- Temperature protection
- High EMC immunity because of common mode inputs
- A guard signal in zoom mode.

## GENERAL DESCRIPTION

The TDA8351 is a power circuit for use in 90° and 110° colour deflection systems for field frequencies of 50 to 120 Hz. The circuit provides a DC driven vertical deflection output circuit, operating as a highly efficient class G system.

## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>DC supply</b>						
$V_P$	supply voltage		9	–	25	V
$I_q$	quiescent supply current		–	30	–	mA
<b>Vertical circuit</b>						
$I_{O(p-p)}$	output current (peak-to-peak value)		–	–	3	A
$I_{diff(p-p)}$	differential input current (peak-to-peak value)		–	600	–	$\mu$ A
$V_{diff(p-p)}$	differential input voltage (peak-to-peak value)		–	1.5	1.8	V
<b>Flyback switch</b>						
$I_M$	peak output current		–	–	$\pm 1.5$	A
$V_{FB}$	flyback supply voltage		–	–	50	V
		note 1	–	–	60	V
<b>Thermal data (in accordance with IEC 747-1)</b>						
$T_{stg}$	storage temperature		–55	–	+150	°C
$T_{amb}$	operating ambient temperature		–25	–	+75	°C
$T_{vj}$	virtual junction temperature		–	–	150	°C

## Note

1. A flyback supply voltage of >50 V up to 60 V is allowed in application. A 220 nF capacitor in series with a 22  $\Omega$  resistor (depending on  $I_O$  and the inductance of the coil) has to be connected between pin 7 and ground. The decoupling capacitor of  $V_{FB}$  has to be connected between pin 6 and pin 3. This supply voltage line must have a resistance of 33  $\Omega$  (see application circuit Fig.6).

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ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA8351	SIL9P	plastic single-in-line power package; 9 leads	SOT131-2

BLOCK DIAGRAM

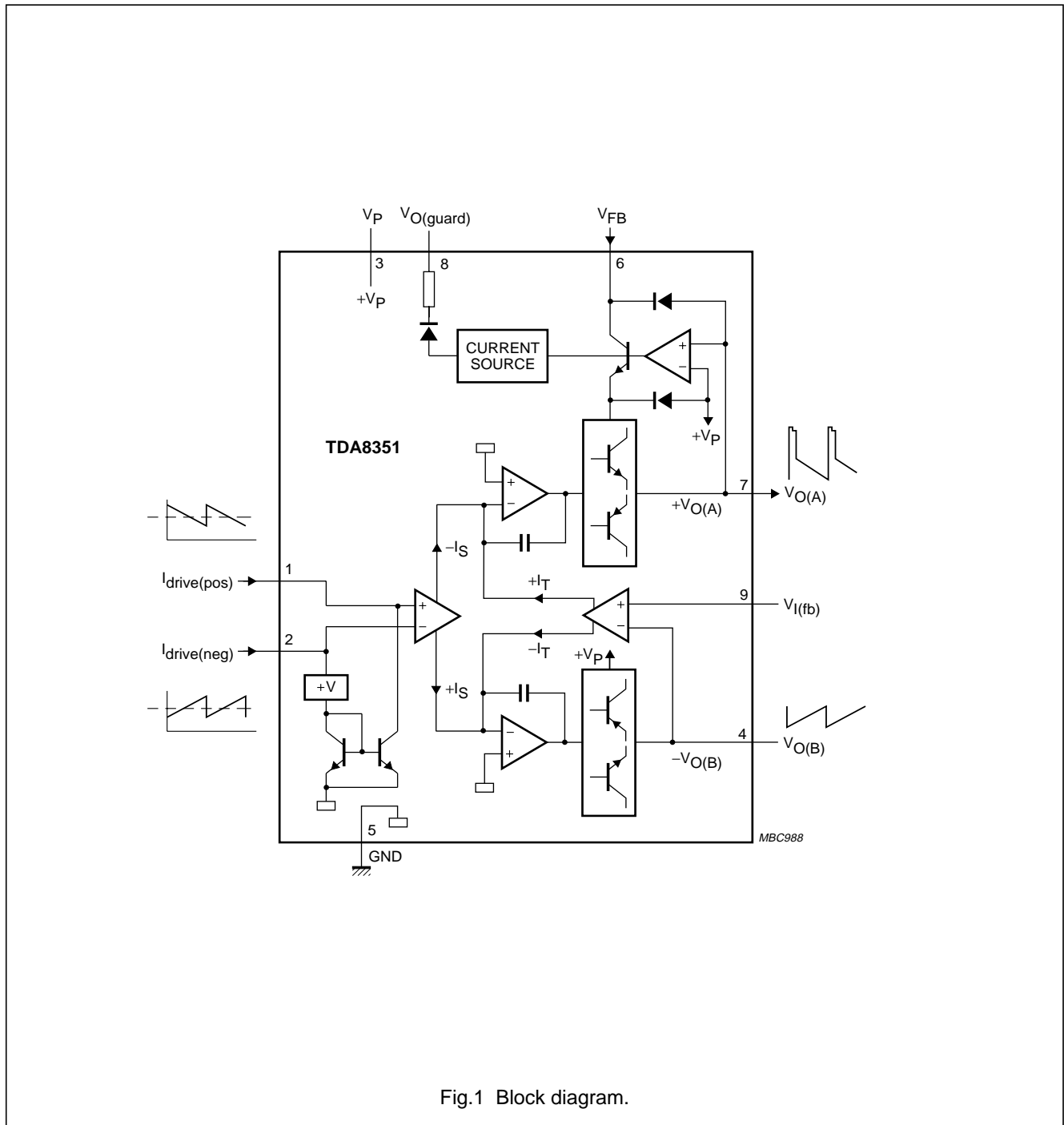


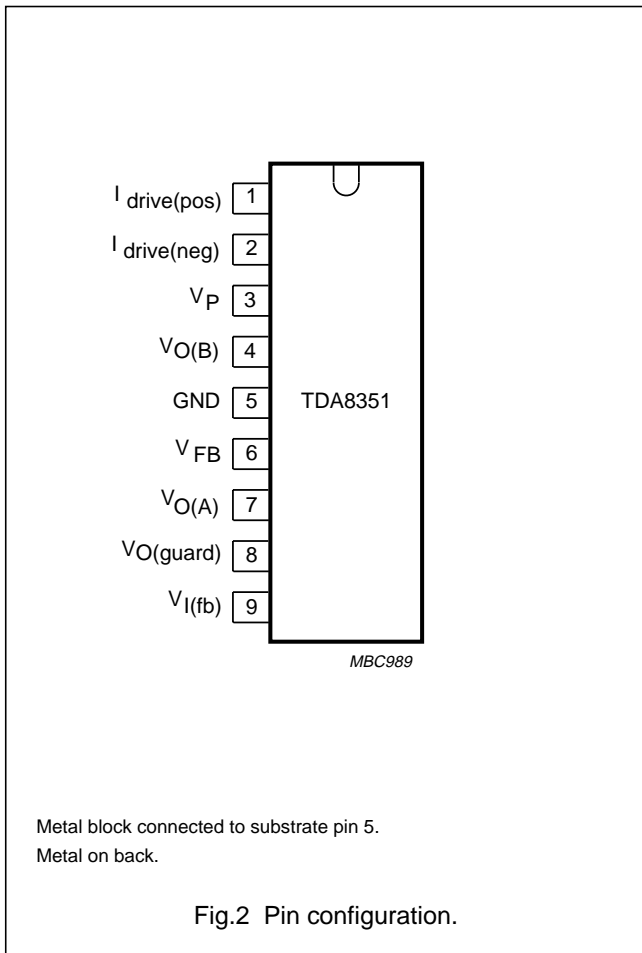
Fig.1 Block diagram.

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PINNING

SYMBOL	PIN	DESCRIPTION
I <sub>drive(pos)</sub>	1	input power-stage (positive); includes I <sub>I(sb)</sub> signal bias
I <sub>drive(neg)</sub>	2	input power-stage (negative); includes I <sub>I(sb)</sub> signal bias
V <sub>P</sub>	3	operating supply voltage
V <sub>O(B)</sub>	4	output voltage B
GND	5	ground
V <sub>FB</sub>	6	input flyback supply voltage
V <sub>O(A)</sub>	7	output voltage A
V <sub>O(guard)</sub>	8	guard output voltage
V <sub>I(fb)</sub>	9	input feedback voltage



FUNCTIONAL DESCRIPTION

The vertical driver circuit is a bridge configuration. The deflection coil is connected between the output amplifiers, which are driven in opposite phase. An external resistor (R<sub>M</sub>) connected in series with the deflection coil provides internal feedback information. The differential input circuit is voltage driven. The input circuit has been adapted to enable it to be used with the TDA9150, TDA9151B, TDA9160A, TDA9162, TDA8366 and TDA8376 which deliver symmetrical current signals. An external resistor (R<sub>CON</sub>) connected between the differential input determines the output current through the deflection coil. The relationship between the differential input current and the output current is defined by: I<sub>diff</sub> × R<sub>CON</sub> = I<sub>coil</sub> × R<sub>M</sub>. The output current is adjustable from 0.5 A (p-p) to 3 A (p-p) by varying R<sub>M</sub>. The maximum input differential voltage is 1.8 V. In the application it is recommended that V<sub>diff</sub> = 1.5 V (typ). This is recommended because of the spread of input current and the spread in the value of R<sub>CON</sub>.

The flyback voltage is determined by an additional supply voltage V<sub>FB</sub>. The principle of operating with two supply voltages (class G) makes it possible to fix the supply voltage V<sub>P</sub> optimum for the scan voltage and the second supply voltage V<sub>FB</sub> optimum for the flyback voltage. Using this method, very high efficiency is achieved.

The supply voltage V<sub>FB</sub> is almost totally available as flyback voltage across the coil, this being possible due to the absence of a decoupling capacitor (not necessary, due to the bridge configuration). Built-in protections are:

- thermal protection
- short-circuit protection of the output pins (pins 4 and 7)
- short-circuit protection of the output pins to V<sub>P</sub>.

A guard circuit V<sub>O(guard)</sub> is provided. The guard circuit is activated at the following conditions:

- during flyback
- during short-circuit of the coil and during short-circuit of the output pins (pins 4 and 7) to V<sub>P</sub> or ground
- during open loop
- when the thermal protection is activated.

This signal can be used for blanking the picture tube screen.

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**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
<b>DC supply</b>					
$V_P$	supply voltage	non-operating	–	40	V
			–	25	V
$V_{FB}$	flyback supply voltage		–	50	V
		note 1	–	60	V
<b>Vertical circuit</b>					
$I_{O(p-p)}$	output current (peak-to-peak value)	note 2	–	3	A
$V_{O(A)}$	output voltage (pin 7)		–	52	V
		note 1	–	62	V
<b>Flyback switch</b>					
$I_M$	peak output current		–	$\pm 1.5$	A
<b>Thermal data (in accordance with IEC 747-1)</b>					
$T_{stg}$	storage temperature		–55	+150	°C
$T_{amb}$	operating ambient temperature		–25	+75	°C
$T_{vj}$	virtual junction temperature		–	150	°C
$R_{th\ vj-c}$	resistance $v_j$ -case		–	4	K/W
$R_{th\ vj-a}$	resistance $v_j$ -ambient in free air		–	40	K/W
$t_{sc}$	short-circuiting time	note 3	–	1	hr

**Notes**

1. A flyback supply voltage of >50 V up to 60 V is allowed in application. A 220 nF capacitor in series with a 22  $\Omega$  resistor (depending on  $I_O$  and the inductance of the coil) has to be connected between pin 7 and ground. The decoupling capacitor of  $V_{FB}$  has to be connected between pin 6 and pin 3. This supply voltage line must have a resistance of 33  $\Omega$  (see application circuit Fig.6).
2.  $I_O$  maximum determined by current protection.
3. Up to  $V_P = 18$  V.

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## CHARACTERISTICS

$V_P = 17.5$  V;  $T_{amb} = 25$  °C;  $V_{FB} = 45$  V;  $f_i = 50$  Hz;  $I_{I(sb)} = 400$   $\mu$ A; measured in test circuit of Fig.3; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>DC supply</b>						
$V_P$	operating supply voltage		9.0	–	25	V
$V_{FB}$	flyback supply voltage		$V_P$	–	50	V
		note 1	$V_P$	–	60	V
$I_P$	supply current	no signal; no load	–	30	55	mA
<b>Vertical circuit</b>						
$V_O$	output voltage swing (scan)	$I_{diff} = 0.6$ mA (p-p); $V_{diff} = 1.8$ V (p-p); $I_O = 3$ A (p-p)	19.8	–	–	V
LE	linearity error	$I_O = 3$ A (p-p); note 2	–	1	3	%
		$I_O = 50$ mA (p-p); note 2	–	1	3	%
$V_O$	output voltage swing (flyback) $V_{O(A)} - V_{O(B)}$	$I_{diff} = 0.3$ mA; $I_O = 1.5$ A	–	39	–	V
$V_{DF}$	forward voltage of the internal efficiency diode ( $V_{O(A)} - V_{FB}$ )	$I_O = -1.5$ A; $I_{diff} = 0.3$ mA	–	–	1.5	V
$I_{osl}$	output offset current	$I_{diff} = 0$ ; $I_{I(sb)} = 50$ to 500 $\mu$ A	–	–	30	mA
$ V_{osl} $	offset voltage at the input of the feedback amplifier ( $V_{I(fb)} - V_{O(B)}$ )	$I_{diff} = 0$ ; $I_{I(sb)} = 50$ to 500 $\mu$ A	–	–	18	mV
$\Delta V_{osT}$	output offset voltage as a function of temperature	$I_{diff} = 0$	–	–	72	$\mu$ V/K
$V_{O(A)}$	DC output voltage	$I_{diff} = 0$ ; note 3	–	8.0	–	V
$G_{vo}$	open-loop voltage gain ( $V_{7-4}/V_{1-2}$ )	notes 4 and 5	–	80	–	dB
	open loop voltage gain ( $V_{7-4}/V_{9-4}$ ; $V_{1-2} = 0$ )	note 4	–	80	–	dB
$V_R$	voltage ratio $V_{1-2}/V_{9-4}$		–	0	–	dB
$f_{res}$	frequency response (–3 dB)	open loop; note 6	–	40	–	Hz
$G_I$	current gain ( $I_O/I_{diff}$ )		–	5000	–	
$\Delta G_{cT}$	current gain drift as a function of temperature		–	–	$10^{-4}$	K
$I_{I(sb)}$	signal bias current		50	400	500	$\mu$ A
$I_{FB}$	flyback supply current	during scan	–	–	100	$\mu$ A
PSRR	power supply ripple rejection	note 7	–	80	–	dB
$V_{I(DC)}$	DC input voltage		–	2.7	–	V
$V_{I(CM)}$	common mode input voltage	$I_{I(sb)} = 0$	0	–	1.6	V
$I_{bias}$	input bias current	$I_{I(sb)} = 0$	–	0.1	0.5	$\mu$ A
$I_{O(CM)}$	common mode output current	$\Delta I_{I(sb)} = 300$ $\mu$ A (p-p); $f_i = 50$ Hz; $I_{diff} = 0$	–	0.2	–	mA

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Guard circuit</b>						
I <sub>O</sub>	output current	not active; V <sub>O(guard)</sub> = 0 V	–	–	50	μA
		active; V <sub>O(guard)</sub> = 3.6 V	1	–	2.5	mA
V <sub>O(guard)</sub>	output voltage on pin 8	I <sub>O</sub> = 100 μA	4.6	–	5.5	V
	allowable voltage on pin 8	maximum leakage current = 10 μA;	–	–	40	V

**Notes**

- A flyback supply voltage of >50 V up to 60 V is allowed in application. A 220 nF capacitor in series with a 22 Ω resistor (dependent on I<sub>O</sub> and the inductance of the coil) has to be connected between pin 7 and ground. The decoupling capacitor of V<sub>FB</sub> has to be connected between pin 6 and pin 3. This supply voltage line must have a resistance of 33 Ω (see application circuit Fig.6).
- The linearity error is measured without S-correction and based on the same measurement principle as performed on the screen. The measuring method is as follows:  
Divide the output signal I<sub>4</sub> – I<sub>7</sub> (V<sub>RM</sub>) into 22 equal parts ranging from 1 to 22 inclusive. Measure the value of two succeeding parts called one block starting with part 2 and 3 (block 1) and ending with part 20 and 21 (block 10). Thus part 1 and 22 are unused. The equations for linearity error for adjacent blocks (LEAB) and linearity error for not adjacent blocks (LENAB) are given below:  

$$\text{LEAB} = \frac{a_k - a_{(k+1)}}{a_{\text{avg}}}; \quad \text{LENAB} = \frac{a_{\text{max}} - a_{\text{min}}}{a_{\text{avg}}}$$
- Referenced to V<sub>P</sub>.
- The V values within formulae relate to voltages at or across relative pin numbers, i.e. V<sub>7-4</sub>/V<sub>1-2</sub> = voltage value across pins 7 and 4 divided by voltage value across pins 1 and 2.
- V<sub>9-4</sub> AC short-circuited.
- Frequency response V<sub>7-4</sub>/V<sub>9-4</sub> is equal to frequency response V<sub>7-4</sub>/V<sub>1-2</sub>.
- At V<sub>(ripple)</sub> = 500 mV eff; measured across R<sub>M</sub>; f<sub>i</sub> = 50 Hz.

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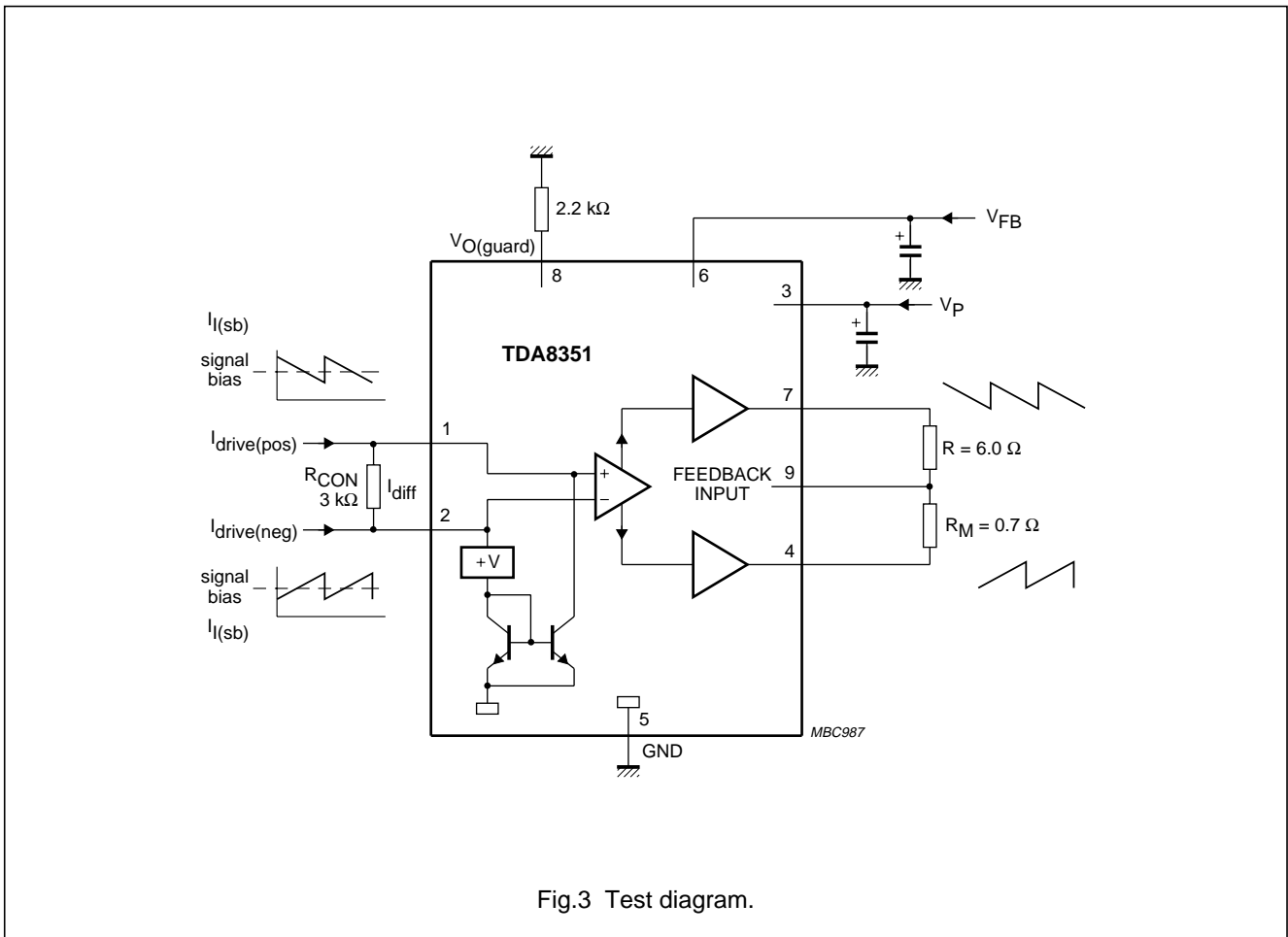


Fig.3 Test diagram.

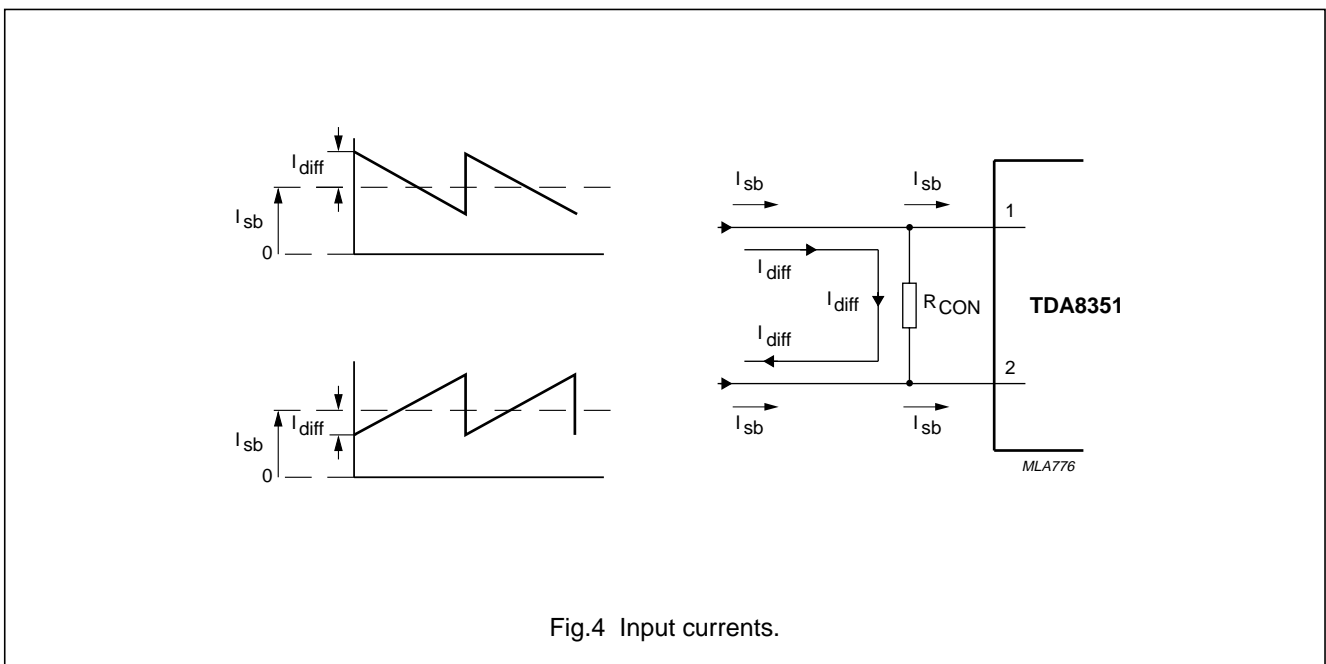


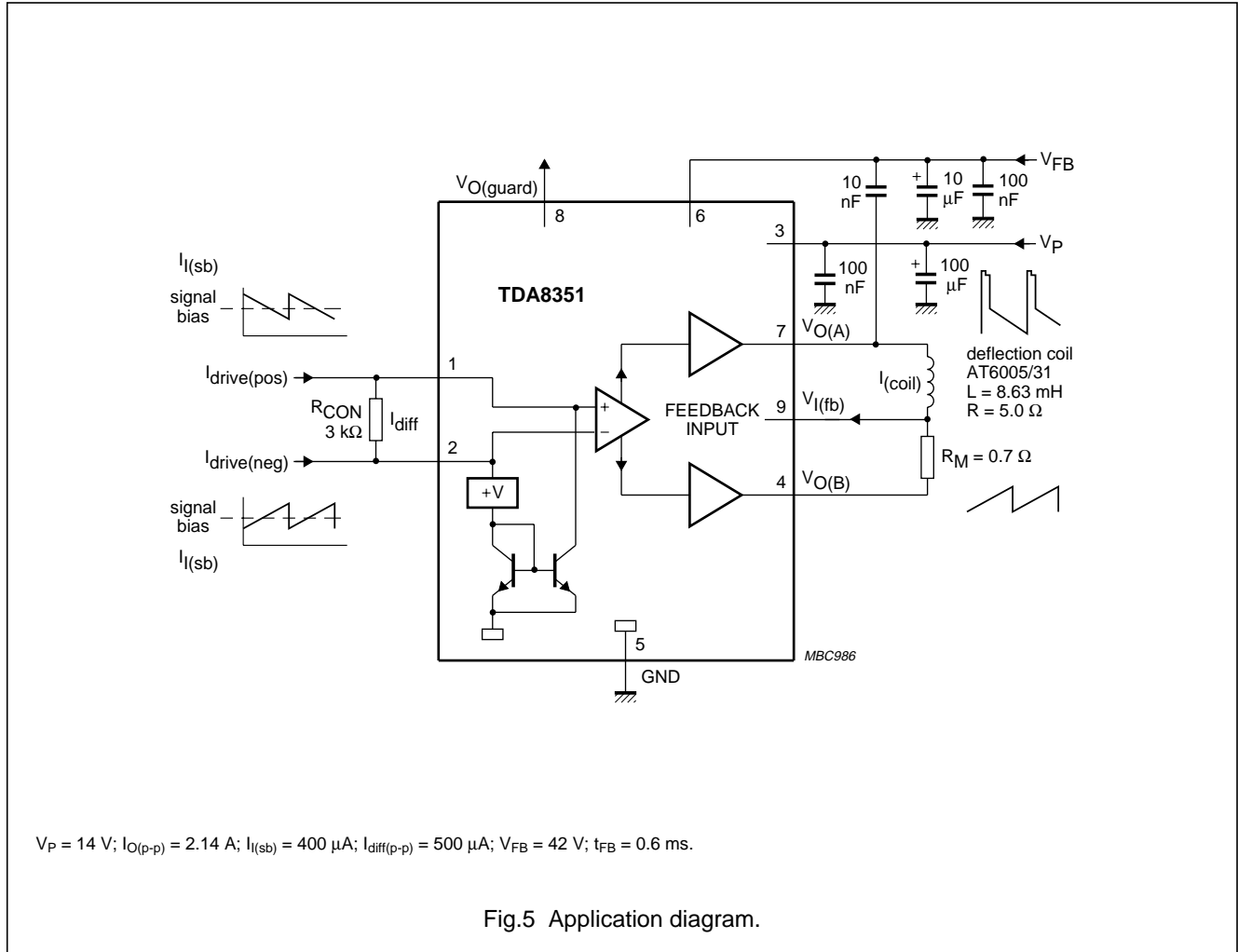
Fig.4 Input currents.



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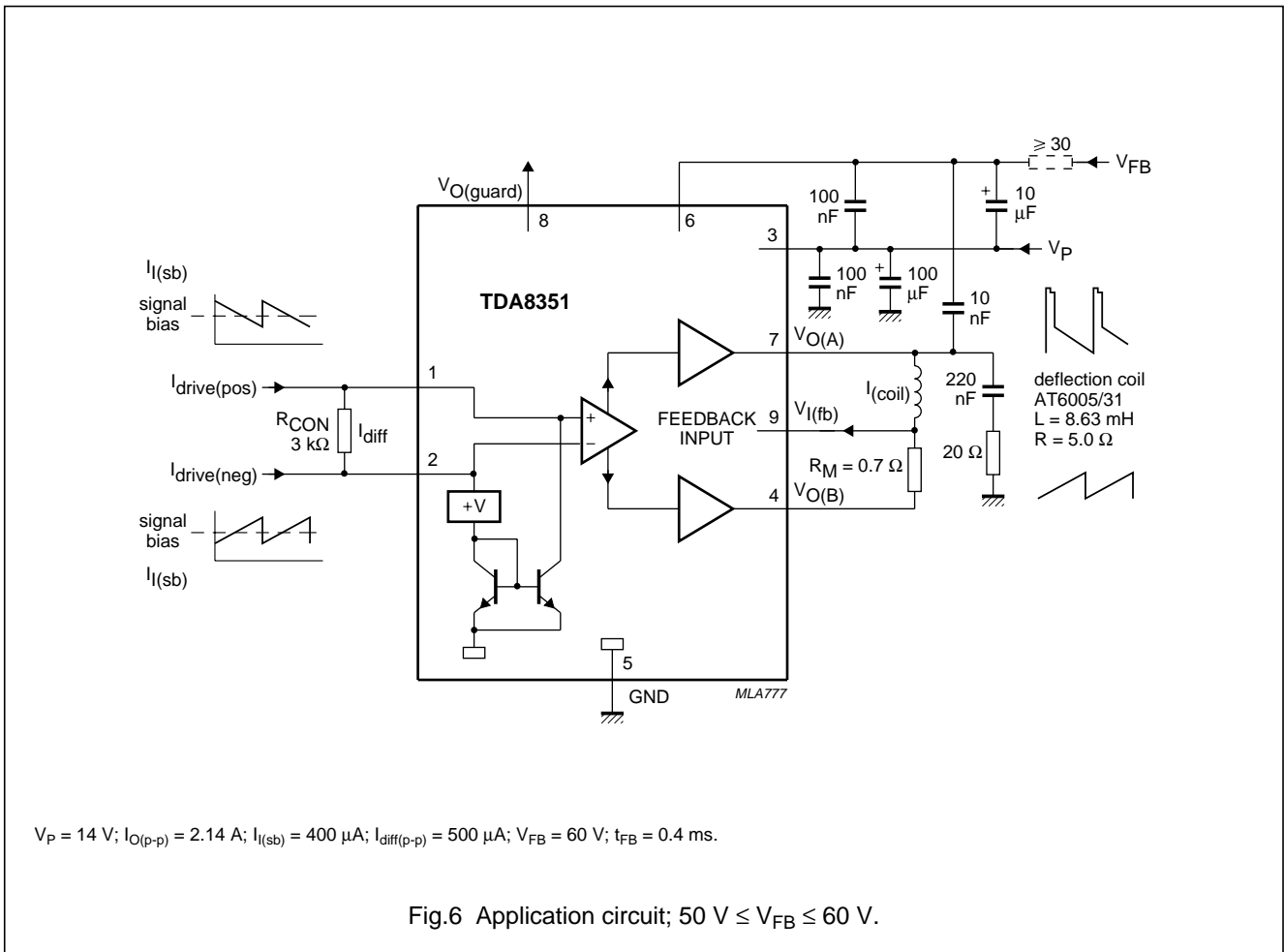
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APPLICATION INFORMATION



DC-coupled vertical deflection circuit

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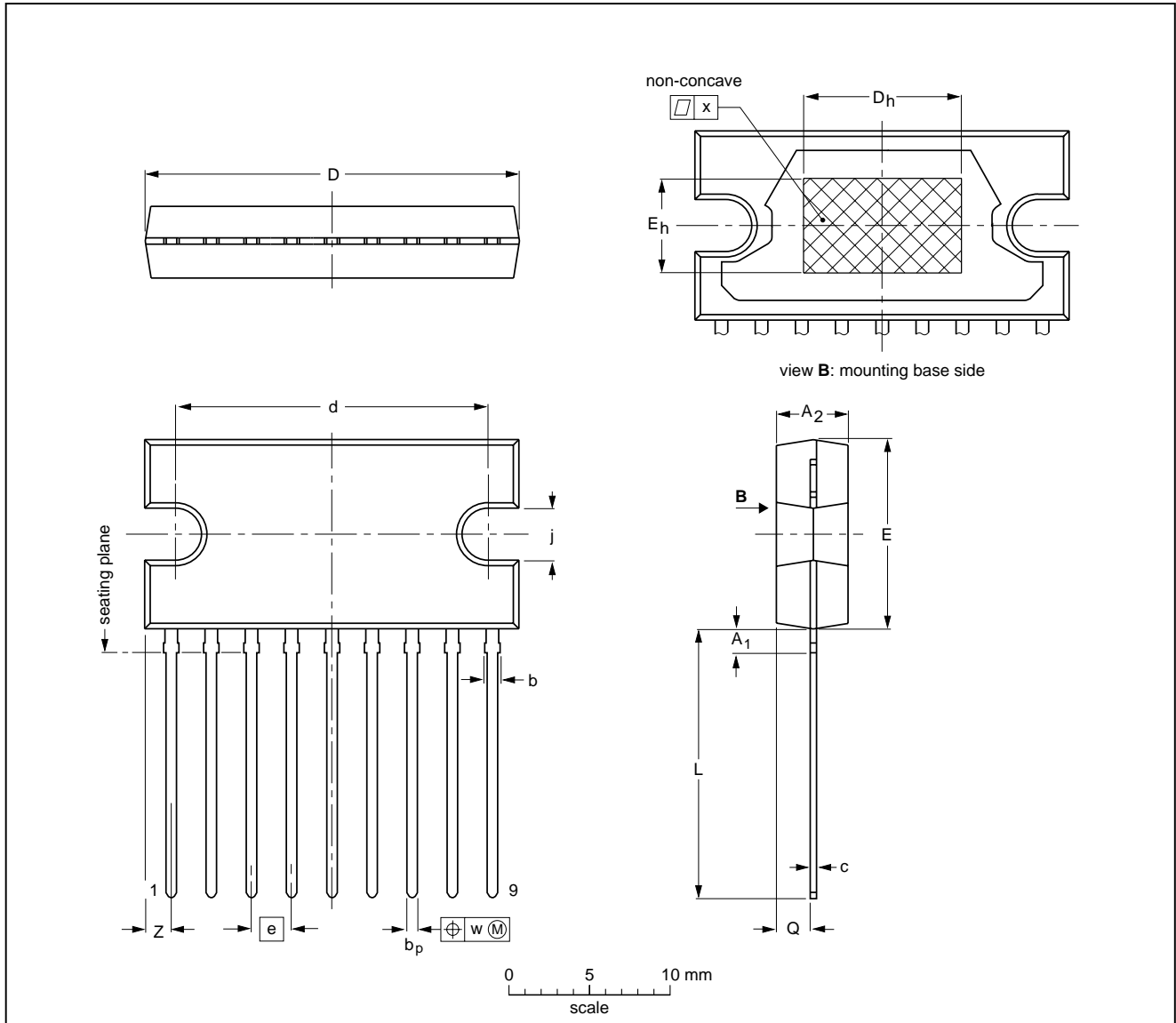
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PACKAGE OUTLINE

SIL9P: plastic single in-line power package; 9 leads

SOT131-2



DIMENSIONS (mm are the original dimensions)

UNIT	A <sub>1</sub> max.	A <sub>2</sub>	b max.	b <sub>p</sub>	c	D <sup>(1)</sup>	d	D <sub>h</sub>	E <sup>(1)</sup>	e	E <sub>h</sub>	j	L	Q	w	x	Z <sup>(1)</sup>
mm	2.0	4.6 4.2	1.1	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	2.54	6	3.4 3.1	17.2 16.5	2.1 1.8	0.25	0.03	2.00 1.45

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT131-2						92-11-17 95-03-11

## DC-coupled vertical deflection circuit

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**SOLDERING****Introduction to soldering through-hole mount packages**

This text gives a brief insight to wave, dip and manual soldering. A more in-depth account of soldering ICs can be found in our "Data Handbook IC26; Integrated Circuit Packages" (document order number 9398 652 90011).

Wave soldering is the preferred method for mounting of through-hole mount IC packages on a printed-circuit board.

**Soldering by dipping or by solder wave**

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joints for more than 5 seconds.

The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ( $T_{stg(max)}$ ). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

**Manual soldering**

Apply the soldering iron (24 V or less) to the lead(s) of the package, either below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

**Suitability of through-hole mount IC packages for dipping and wave soldering methods**

PACKAGE	SOLDERING METHOD	
	DIPPING	WAVE
DBS, DIP, HDIP, SDIP, SIL	suitable	suitable <sup>(1)</sup>

**Note**

- For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.

**DEFINITIONS**

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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