

# DATA SHEET

## **TDA8350Q**

DC-coupled vertical deflection and  
East-West output circuit

Preliminary specification  
Supersedes data of September 1991  
File under Integrated Circuits, IC02

January 1995

**Philips Semiconductors**



**PHILIPS**

## DC-coupled vertical deflection and East-West output circuit

## TDA8350Q

### 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
  - short-circuit of the output pins to  $V_P$
- High EMC immunity due to common mode inputs
- Temperature (thermal) protection
- East-West output stage with one single conversion resistor.

### GENERAL DESCRIPTION

The TDA8350Q 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 and an East-West driver for sinking the diode modulator current.

### QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>DC supply</b>						
$V_P$	supply voltage		9	–	25	V
$I_P$	quiescent 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>East-West amplifier</b>						
$I_{O(sink)}$	output current (sink only)		–	–	500	mA
$V_{O(sink)}$	peak output voltage	$I_{O(sink)} = 10 \mu$ A	–	–	40	V
$I_{bias}$	input bias current		–	–	1	$\mu$ A
<b>Thermal data (in accordance with IEC 747-1)</b>						
$T_{stg}$	storage temperature		–65	–	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 (dependent 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 8 and pin 4. This supply voltage line must have a resistance of 33  $\Omega$  (see application circuit Fig.5).

# DC-coupled vertical deflection and East-West output circuit

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## ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA8350Q	DBS13P	plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	SOT141-6

## BLOCK DIAGRAM

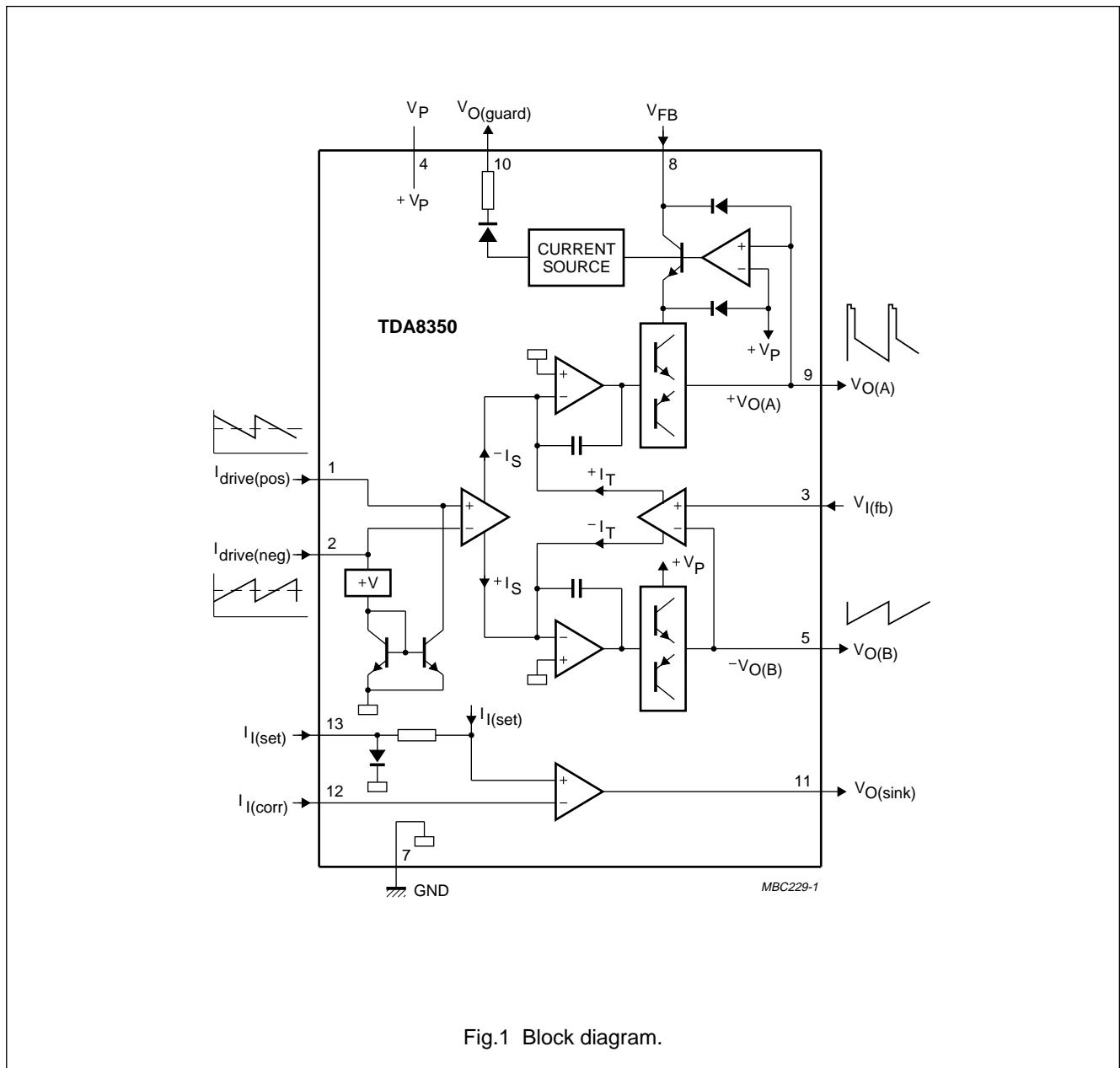


Fig.1 Block diagram.

# DC-coupled vertical deflection and East-West output circuit

## TDA8350Q

### PINNING

SYMBOL	PIN	DESCRIPTION
$I_{drive(pos)}$	1	input power-stage (positive); includes $I_{I(sb)}$ signal bias
$I_{drive(neg)}$	2	input power-stage (negative); includes $I_{I(sb)}$ signal bias
$V_{I(fb)}$	3	feedback voltage input
$V_P$	4	supply voltage
$V_{O(B)}$	5	output voltage B
n.c.	6	not connected
GND	7	ground
$V_{FB}$	8	flyback supply voltage
$V_{O(A)}$	9	output voltage A
$V_{O(guard)}$	10	guard output voltage
$V_{O(sink)}$	11	East-West amplifier driver (sink) output voltage
$I_{I(corr)}$	12	East-West amplifier input correction current (negative)
$I_{I(set)}$	13	East-West amplifier set input current (positive)

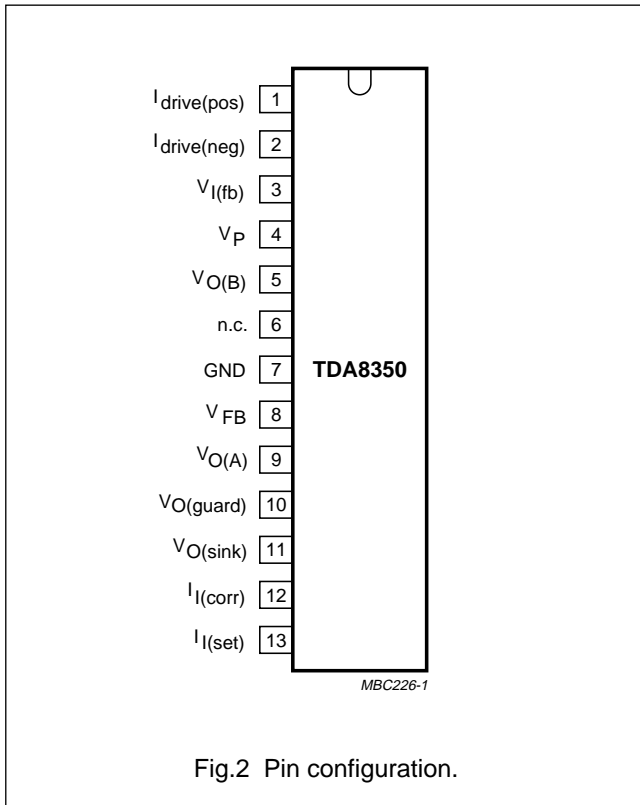


Fig.2 Pin configuration.

### FUNCTIONAL DESCRIPTION

The vertical driver circuit is a bridge configuration. The deflection coil is connected between the output amplifiers, which are driven in phase opposition. An external resistor ( $R_M$ ) connected in series with the deflection coil provides internal feed back 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 TDA8367 which deliver symmetrical current signals. An external resistor ( $R_{CON}$ ) 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:  $I_{diff} \times R_{CON} = I_{(coil)} \times R_M$ . The output current is adjustable from 0.5 A (p-p) to 3 A (p-p) by varying  $R_M$ . The maximum input differential voltage is 1.8 V. In the application it is recommended that  $V_{diff} = 1.5$  V (typ). This is recommended because of the spread of input current and the spread in the value of  $R_{CON}$ .

The flyback voltage is determined by an additional supply voltage  $V_{FB}$ . The principle of operating with two supply voltages (class G) makes it possible to fix the supply voltage  $V_P$  optimum for the scan voltage and the second supply voltage  $V_{FB}$  optimum for the flyback voltage. Using this method, very high efficiency is achieved.

The supply voltage  $V_{FB}$  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). The output circuit is fully protected against the following:

- thermal protection
- short-circuit protection of the output pins (pins 5 and 9)
- short-circuit of the output pins to  $V_P$ .

A guard circuit  $V_{O(guard)}$  is provided. The guard circuit is activated at the following conditions:

- during flyback
- during various short-circuit possibilities at the output pins
- during open loop
- when the thermal protection is activated.

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

An East-West amplifier is also provided. This amplifier is an inverting amplifier which is current driven with sink current only capabilities.

## DC-coupled vertical deflection and East-West output circuit

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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>					
$I_O$	output current (peak-to-peak value)	note 2	–	3	A
$V_{O(A)}$	output voltage (pin 9)		–	52	V
		note 1		62	V
<b>Flyback switch</b>					
$I_M$	peak output current		–	±1.5	A
<b>East-West amplifier</b>					
$V_{O(sink)}$	output voltage	$I_{O(sink)} = 10 \mu\text{A}$ ; note 3	–	40	V
$I_{O(sink)}$	output current	$V_{O(sink)} = 2 \text{ V}$ ; note 3	–	500	mA
<b>Thermal data (in accordance with IEC 747-1)</b>					
$T_{stg}$	storage temperature		–65	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 4	–	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 (dependent 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 8 and pin 4. This supply voltage line must have a resistance of 33  $\Omega$  (see application circuit Fig.5).
2.  $I_O$  maximum determined by current protection.
3. The operating area is limited by a straight line between the points  $V_{O(sink)} = 40 \text{ V}$ ;  $I_{O(sink)} = 10 \mu\text{A}$  and  $V_{O(sink)} = 2 \text{ V}$ ;  $I_{O(sink)} = 500 \text{ mA}$ .
4. Up to  $V_p = 18 \text{ V}$ .

## DC-coupled vertical deflection and East-West output circuit

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### CHARACTERISTICS

$V_P = 17.5$  V;  $V_{FB} = 45$  V;  $V_{O(sink)} = 20$  V;  $f_i = 50$  Hz;  $I_{I(sb)} = 400$   $\mu$ A;  $T_{amb} = 25^\circ$ C; 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	–	25	V
$V_{FB}$	flyback supply voltage		$V_P$	–	50	V
		note 1	–	–	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);	–	1	2	%
		$I_O = 50$ mA (p-p); note 2	–	1	2	%
$V_O$	output voltage swing (flyback) $V_{O(A)} - V_{O(B)}$	$I_{diff} = 0.3$ mA; $I_O = 1.5$ A (M)	–	39	–	V
$V_{DF}$	forward voltage of the internal efficiency diode ( $V_{O(A)} - V_{FB}$ )	$I_O = -1.5$ A (M); $I_{diff} = 0.3$ 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	–	V
$G_v$	open loop voltage gain ( $V_{9.5}/V_{1.2}$ )	notes 4 and 5	–	80	–	dB
	open loop voltage gain ( $V_{9.5}/V_{3.5}$ ; $V_{1.2} = 0$ )	note 4	–	80	–	dB
$V_R$	voltage ratio $V_{1.2}/V_{3.5}$		–	0	–	dB
$f_{res}$	frequency response (–3 dB)	note 6	–	40	–	Hz
$G_I$	current gain ( $I_O/I_{diff}$ )		–	5000	–	
$\Delta G_I T$	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 voltage at the input		–	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>East-West amplifier</b>						
$V_{O(\text{sink})}$	saturation voltage	$I_{O(\text{sink})} = 500 \text{ mA};$ $I_{I(\text{corr})} = 0 \text{ }\mu\text{A};$ note 8	–	2.0	2.5	V
$G_V$	open loop voltage gain ( $V_{11}/V_{12}$ )		–	47	–	dB
$f_{\text{res}}$	frequency response (–3 dB)		–	4000	–	Hz
LE	linearity error	$V_{O(\text{sink})} = 3 \text{ V}$	–	–	1	%
		$V_{O(\text{sink})} = 10 \text{ V};$ note 2	–	–	0.5	%
$I_{\text{bias}}$	input bias current (pin 12)		–	–	2	$\mu\text{A}$
$V_{I(\text{DC})}$	DC input voltage		–	1	–	V
$I_{\text{set}}$	offset voltage set current		–	1	–	mA
$V_{13-7}$	maximum allowed voltage at pin 13		–	–	0.3	V
<b>Guard circuit</b>						
$I_O$	output current	not active; $V_{O(\text{guard})} = 0 \text{ V}$	–	–	50	$\mu\text{A}$
	output current	active; $V_{O(\text{guard})} = 4.5 \text{ V}$	1	–	2.5	mA
$V_{O(\text{guard})}$	output voltage	$I_O = 100 \text{ }\mu\text{A}$	–	–	5.5	V
	allowable voltage on pin 10	maximum leakage current = $10 \text{ }\mu\text{A}$	–	–	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  $\Omega$  resistor (dependent on  $I_O$  and the inductance of the coil) has to be connected between pin 7 and ground. The decoupling capacitor of  $V_{\text{FB}}$  has to be connected between pin 8 and pin 4. This supply voltage line must have a resistance of 33  $\Omega$  (see application circuit Fig.5).
- 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  $I_5 - I_9 (V_{\text{RM}})$  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 not adjacent blocks (NAB) are given below;

$$\text{LEAB} = \frac{a_k - a_{(k+1)}}{a_{\text{avg}}}; \quad \text{NAB} = \frac{a_{\text{max}} - a_{\text{min}}}{a_{\text{avg}}}$$

- Referenced to  $V_p$ .
- V values within formulae, relate to voltages at or between relative pin numbers, i.e.  $V_{9.5}/V_{1.2}$  = voltage value across pins 9 and 5 divided by voltage value across pins 1 and 2.
- $V_{3.5}$  AC short-circuited.
- Frequency response  $V_{9.5}/V_{3.5}$  is equal to frequency response  $V_{9.5}/V_{1.2}$ .
- At  $V_{(\text{ripple})} = 500 \text{ mV eff};$  measured across  $R_M; f_i = 50 \text{ Hz}.$
- The output pin 11 requires a capacitor of minimum value 68 nF.

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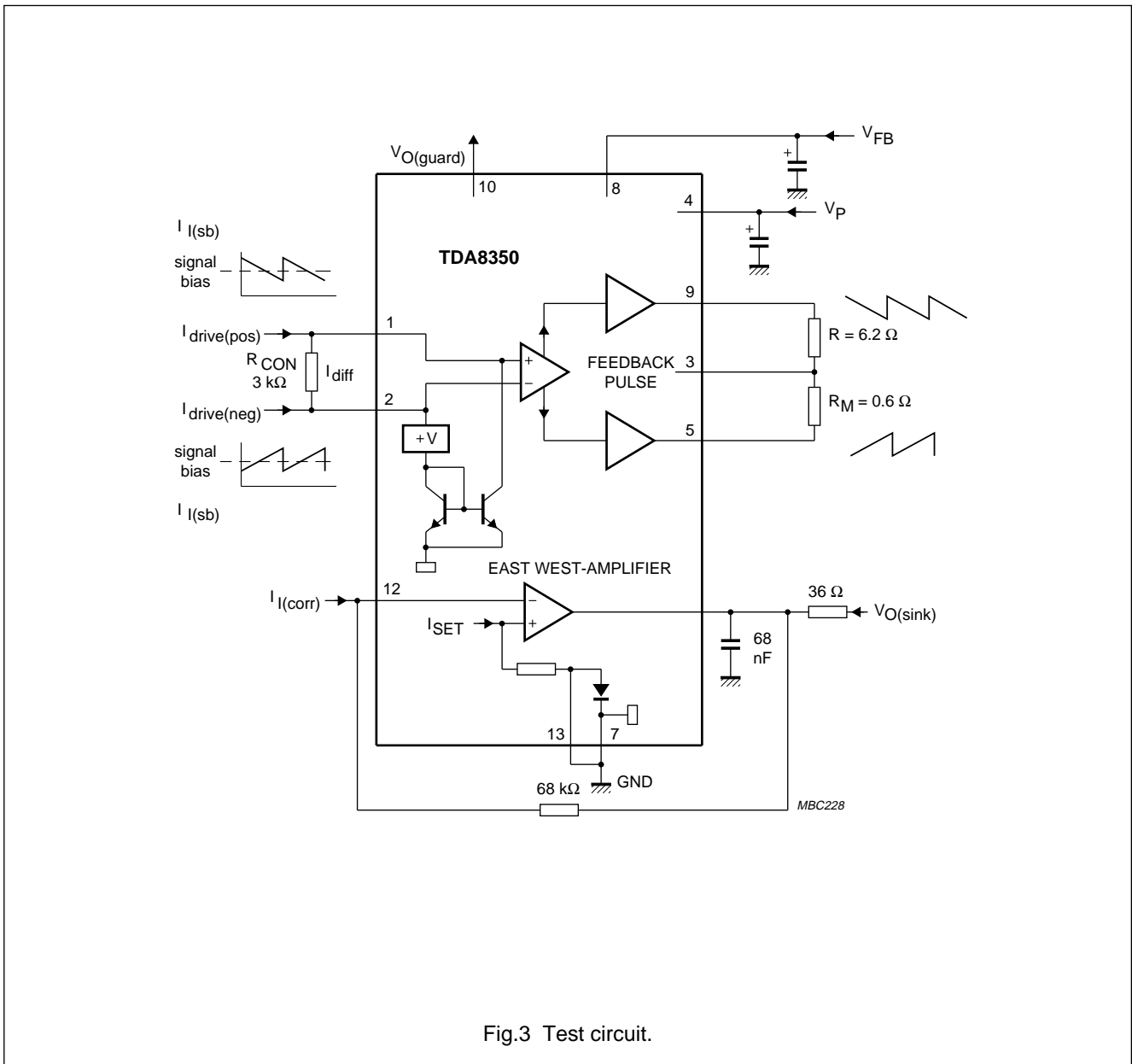


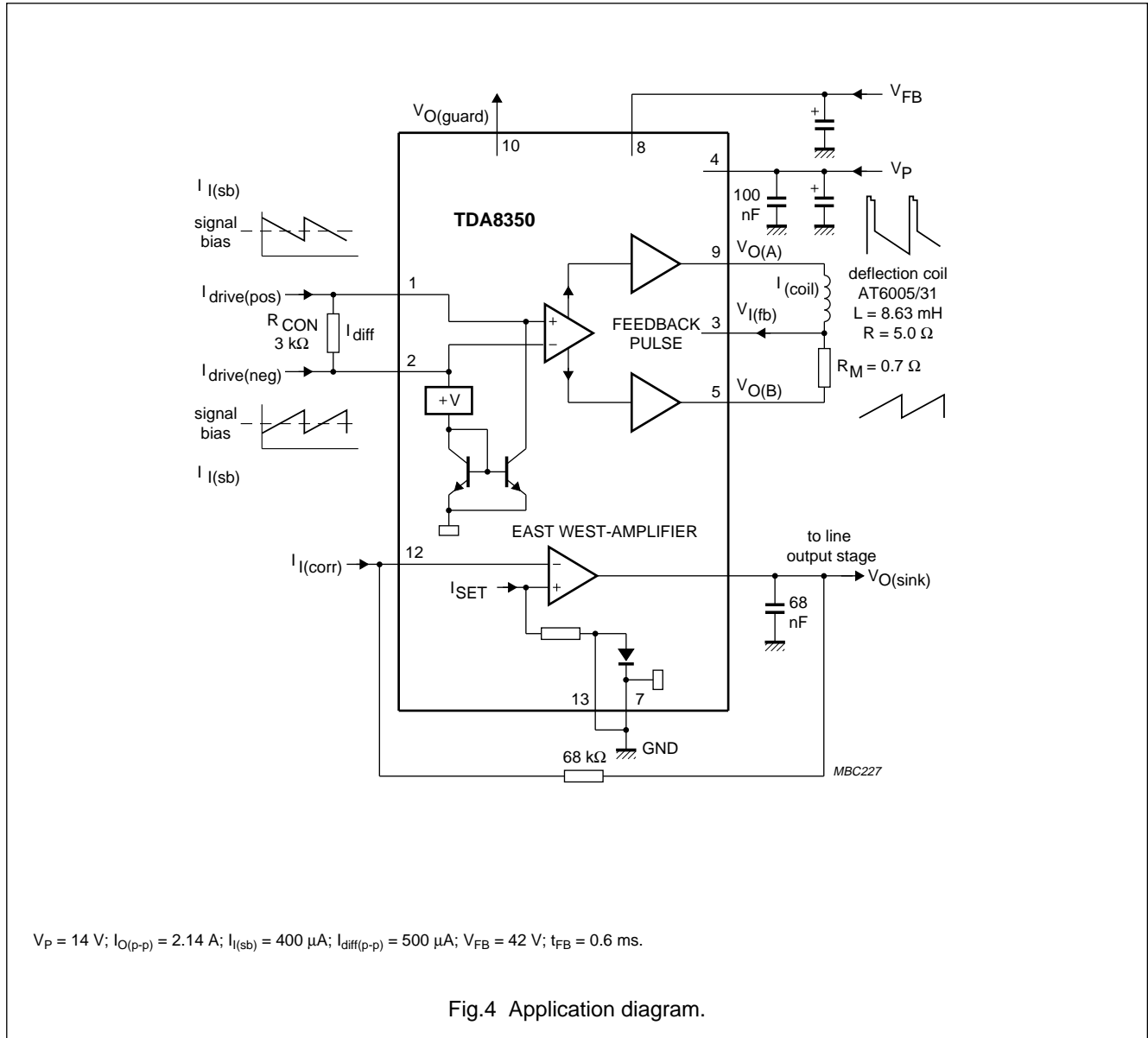
Fig.3 Test circuit.



# DC-coupled vertical deflection and East-West output circuit

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## APPLICATION INFORMATION

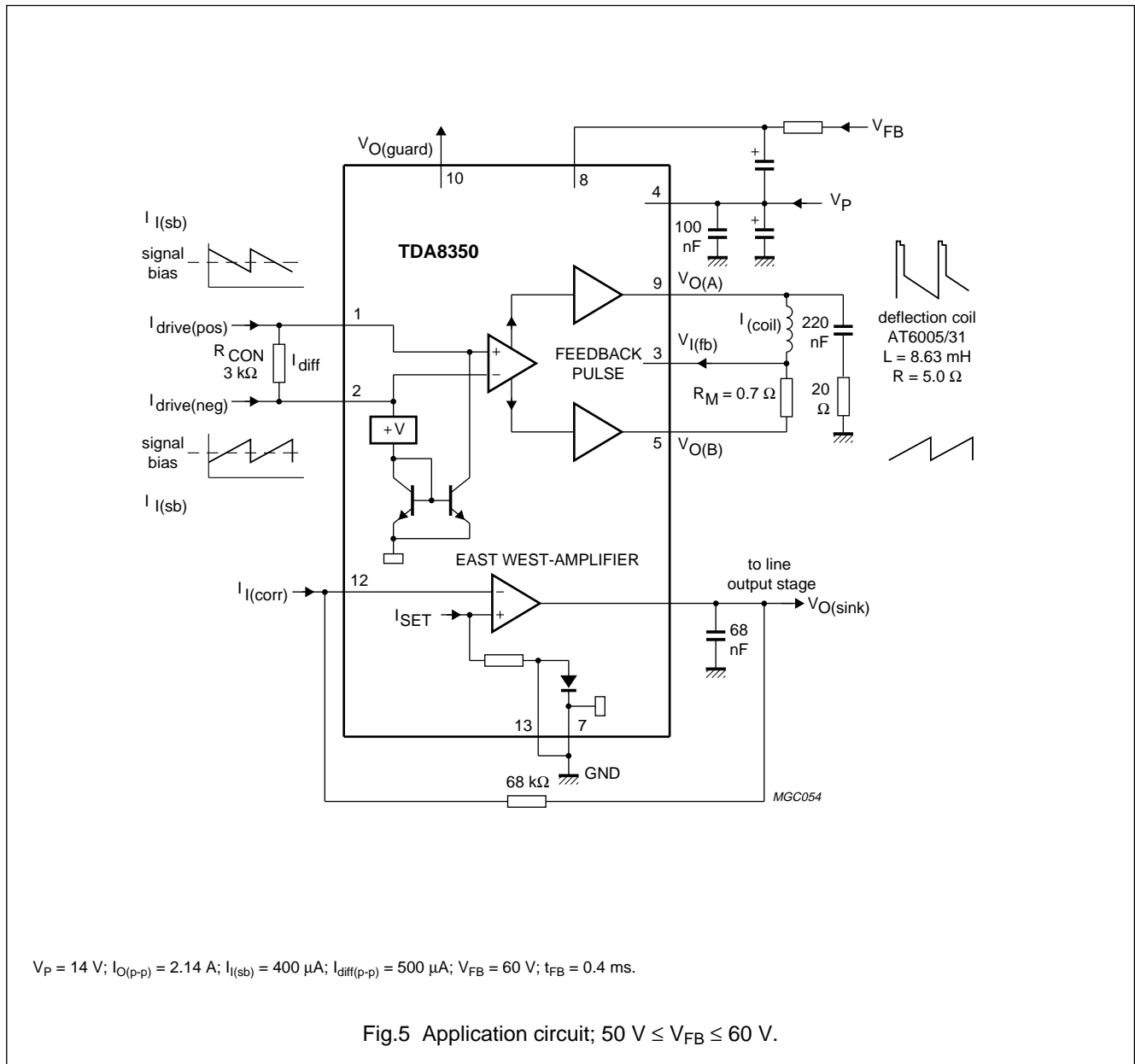


$V_P = 14\text{ V}$ ;  $I_{O(p-p)} = 2.14\text{ A}$ ;  $I_{I(sb)} = 400\ \mu\text{A}$ ;  $I_{diff(p-p)} = 500\ \mu\text{A}$ ;  $V_{FB} = 42\text{ V}$ ;  $t_{FB} = 0.6\text{ ms}$ .

Fig.4 Application diagram.

# DC-coupled vertical deflection and East-West output circuit

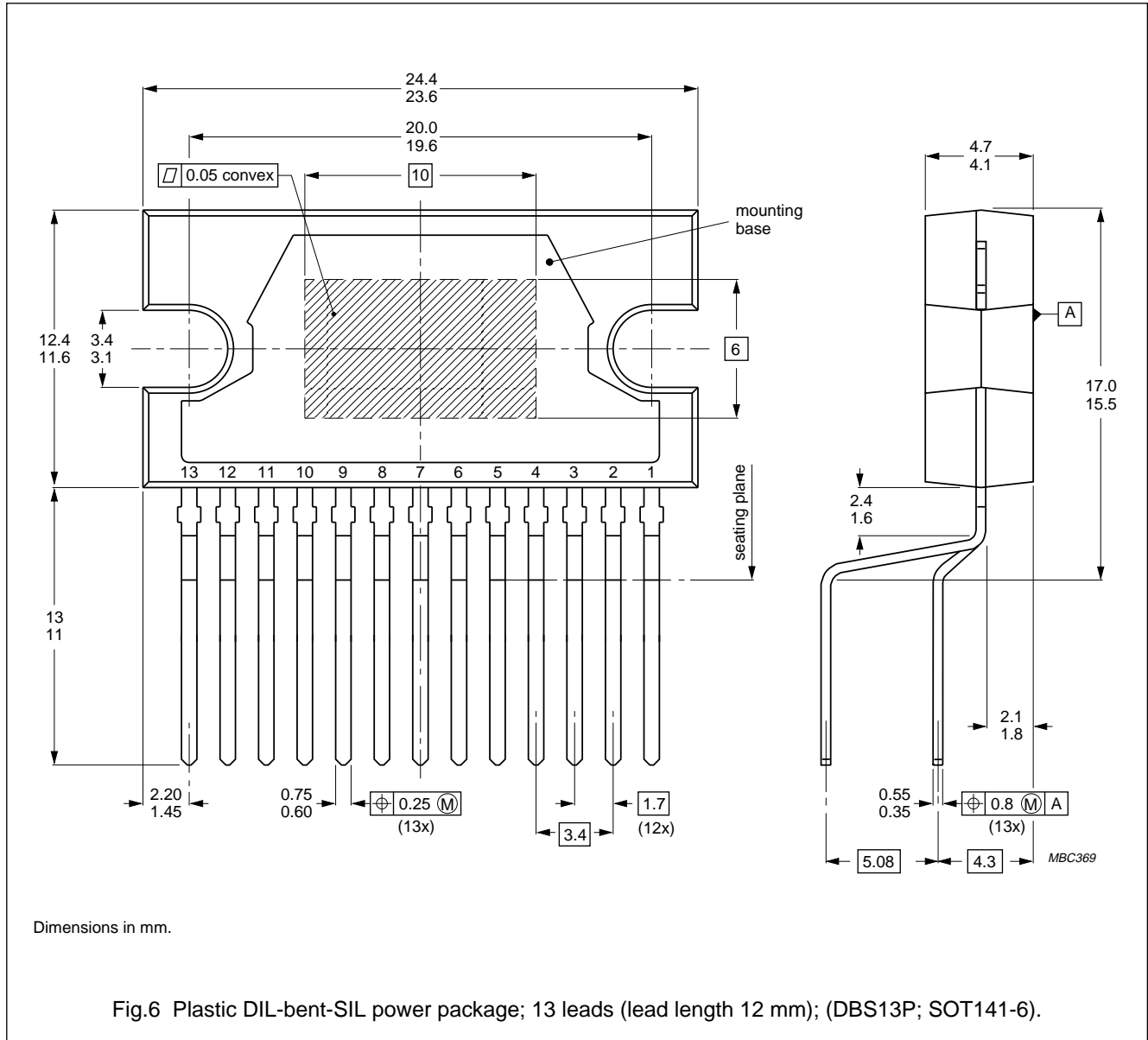
## TDA8350Q



DC-coupled vertical deflection and  
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PACKAGE OUTLINE



## DC-coupled vertical deflection and East-West output circuit

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### SOLDERING

#### Plastic DIL-bent-SIL packages

BY DIP OR WAVE

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 s. The total contact time of successive solder waves must not exceed 5 s.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the

specified storage maximum. 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.

#### REPAIRING SOLDERED JOINTS

Apply the soldering iron below the seating plane (or not more than 2 mm above it). If its temperature is below 300 °C, it must not be in contact for more than 10 s; if between 300 and 400 °C, for not more than 5 s.

### DEFINITIONS

<b>Data sheet status</b>	
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.
<b>Limiting values</b>	
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 the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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DC-coupled vertical deflection and  
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**NOTES**

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NOTES

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