DATA SHEET

TDA8354Q
Full bridge current driven vertical deflection output circuit in LVDMOS

Product specification
Supersedes data of 1998 Sep 03
File under Integrated Circuits, IC02

2001 Jul 11

Philips
Semiconductors

PHILIPS

Full bridge current driven vertical deflection output circuit in LVDMOS

TDA8354Q

FEATURES

- Few external components required
- High efficiency fully DC-coupled vertical output bridge circuit
- Vertical flyback switch with short fall and rise times
- Built-in guard circuit
- Thermal protection circuit
- Improved EMC performance due to differential inputs
- A guard signal in zoom mode.

GENERAL DESCRIPTION

The TDA8354Q is a power circuit for use in 90° and 110° colour deflection systems for 25 to 200 Hz field frequencies, and for 4 : 3 and 16 : 9 picture tubes. The IC contains a vertical deflection output circuit, operating as a high efficiency class G system. The full bridge output circuit allows DC coupling of the deflection coil in combination with single positive supply voltages.

The IC is constructed in a Low Voltage DMOS (LVDMOS) process that combines bipolar, CMOS and DMOS devices. DMOS transistors are used in the output stage because of the absence of second breakdown.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC supply						
V_P	supply voltage		7.5	12	18	V
V_{flb}	flyback supply voltage		$2 \times V_P$	45	68	V
$I_{q(av)}$	average quiescent supply current	during scan	–	10	15	mA
$I_{Vflb(av)}$	average flyback supply current	during scan	–	–	10	mA
Vertical circuit						
$I_{o(p-p)}$	output current (peak-to-peak value)		–	–	3.2	A
$I_{i(diff)(p-p)}$	input current (peak-to-peak value) at pin 11 or 12		–	500	600	μA
Flyback switch						
$I_{o(Vflb)}$	peak output current	$t \leq 1.5$ ms	–	–	±1.6	A
Thermal data (in accordance with IEC 60747-1)						
T_{stg}	storage temperature		–55	–	+150	°C
T_{amb}	ambient temperature		–25	–	+85	°C
T_{vj}	virtual junction temperature		–	–	150	°C

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA8354Q	DBS13P	plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)	SOT141-6

BLOCK DIAGRAM

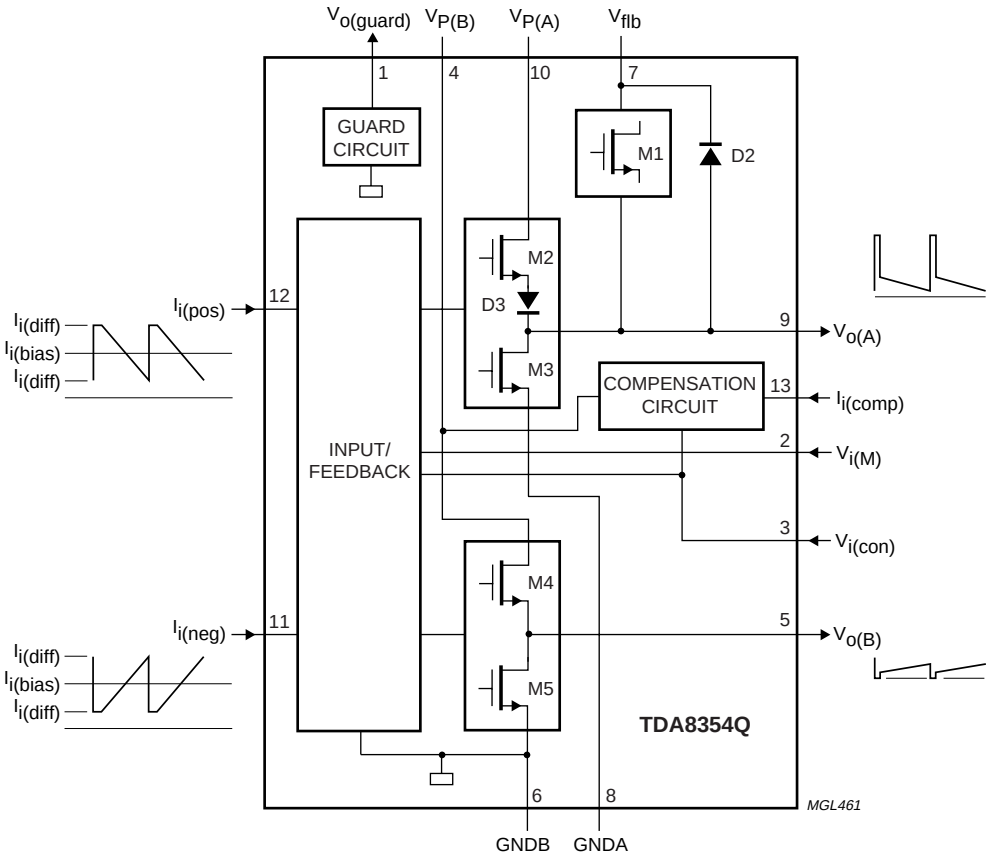
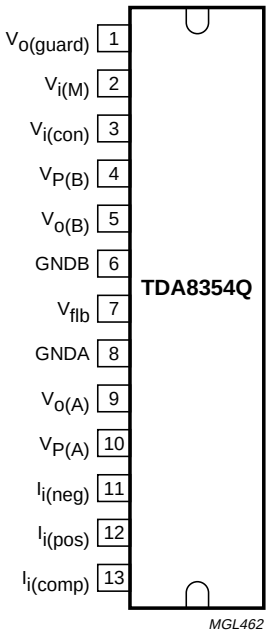


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
$V_{o(guard)}$	1	guard output voltage
$V_{i(M)}$	2	input measuring resistor
$V_{i(con)}$	3	input conversion resistor
$V_{P(B)}$	4	supply voltage B
$V_{o(B)}$	5	output voltage B
GNDB	6	ground B
V_{flb}	7	flyback supply voltage
GNDA	8	ground A
$V_{o(A)}$	9	output voltage A
$V_{P(A)}$	10	supply voltage A
$I_{i(neg)}$	11	input power stage (negative); includes $I_{i(sb)}$ signal bias
$I_{i(pos)}$	12	input power stage (positive); includes $I_{i(sb)}$ signal bias
$I_{i(comp)}$	13	input for damping resistor compensation current



The die has been glued to the metal block of the package. If the metal block is not insulated from the heat sink, the heat sink may only be connected directly to pin 6 and pin 8.

Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

Vertical output stage

The vertical driver circuit has a bridge configuration, with the deflection coil connected between the complimentary driven output amplifiers. The differential input circuit is current driven, and is specially designed for direct connection to driver circuits delivering a differential current signal. However, it is also suitable for single-ended input signals.

The current to voltage conversion is done by the external resistor (R_{con}) connected between the output of the input conversion stage and output stage B. This voltage is compared with the output current through the deflection coil, measured as a voltage across R_M, which provides internal feedback information. The relationship between the differential input current and the output current is defined by:

$$2 \times I_{i(diff)} \times R_{con} = I_{coil} \times R_M$$

The output current is determined by the value of R_{con} and should measure 0.5 to 3.2 A (peak-to-peak value). The allowable input current range is 50 to 800 μA for each input.

Flyback supply

The flyback voltage is determined by an additional supply voltage V_{flb}. The principle of operating with two supply voltages (class G) makes it possible to optimize the supply voltage V_P for the scan voltage and optimize the second supply voltage V_{flb} for the flyback voltage. Using this method, very high efficiency is achieved. The supply voltage V_{flb} is almost totally available as flyback voltage across the coil, because of the absence of a coupling capacitor (which is not necessary as a result of the bridge configuration). The very short rise and fall times of the flyback switch are >400 V/μs.

Protection

The output circuit has protection circuits for:

- Too high die temperature
- Overvoltage of output stage A.

Guard circuit

A guard circuit with output signal $V_{o(guard)}$ is provided.

The guard circuit generates an active HIGH level during the flyback period. The guard circuit is also activated for one or more of the following conditions:

- When the thermal protection is activated ($T_j \approx 170$ °C)
- During short circuit of the output pins (pins 5 and 9) to V_P or ground
- During open coil
- During open loop
- During short circuit of the input pins to V_P or ground.

An active HIGH level of the guard signal is also generated for the following conditions:

- No drive signal
- Short circuit of the coil.

However, for these events, the signal is generated via an internal timer circuit. The guard signal set via this timer has a delay of ≈120 ms. The delay time is given by the lowest applicable field frequency.

The guard signal can be used to blank the picture tube screen and signal a fault condition. The guard signal can also be used as a vertical synchronisation input pulse for an On Screen Display (OSD) microcontroller.

Damping resistor compensation

For HF loop stability, a damping resistor is connected across the deflection coil. There is a large difference in current in the damping resistor R_p during scan and flyback. The resistor current is summed to the current in the deflection coil via the measuring resistor R_M, which results in a too low current in the deflection coil at the start of the scan.

To reach a short settling time, the difference in the current during scan and flyback in the damping resistor can be compensated by external means. For this purpose, a resistor (R_{comp}) of about 1 MΩ can be connected between the output of output stage A (pin 9) and pin 13 (I_{comp}).

For a more accurate calculation of R_{comp}, we have:

$$R_{comp} = \frac{(V_{flb} - V_{loss} - V_P) \times R_p \times R_{con}}{(V_{flb} - V_{loss} - I_L \times R_L) \times R_M}$$

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
DC supplies					
V_P	supply voltage		–	18	V
V_{flb}	flyback supply voltage		–	68	V
Vertical circuit					
$I_{o(p-p)}$	output current (peak-to-peak value)		–	3.2	A
$V_{o(A)}$	output voltage	note 1	–	68	V
$V_{o(B)}$	output voltage		–	V_P	V
$I_{1,2,3,11,12,13}$	current in or out of pins 1 to 3 and 11 to 13		–20	+20	mA
$V_{1,2,3,11,12,13}$	peak voltage on pins 1 to 3 and 11 to 13		–0.5	V_P	V
Flyback switch					
$I_{o(Vflb)}$	peak output current	$t \leq 1.5$ ms	–	±1.6	A
Thermal data (in accordance with IEC 60747-1)					
T_{stg}	storage temperature		–55	+150	°C
T_{amb}	operating ambient temperature		–25	+85	°C
T_{vj}	virtual junction temperature	note 2	–	150	°C
Miscellaneous					
t_{sc}	short-circuiting time	note 3	–	1	hr
$I_{i/o}$	current into any pin	$1.5 \times V_P$ (ABSmax); note 4	–	+200	mA
	current out of any pin	$-1.5 \times V_P$ (ABSmax); note 4	–200	–	mA
V_{ESD}	electrostatic handling machine model	note 5	–	±300	V
	electrostatic handling human body model	note 6	–	±2000	V

Notes

1. When the pin voltage exceeds 70 V, the device functions asa power Zener diode, and limits the voltage.
2. Internally limited by thermal protection; switching point ≈ 170 °C.
3. Up to V_P = 18 V.
4. Latch-up test at $T_{j(max)}$.
5. Machine model: equivalent to discharging a 200 pF capacitor through a 0 Ω series resistor.
6. Human body model: equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th(j-c)}$	thermal resistance from junction to case		4	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	40	K/W

CHARACTERISTICS

V_P = 12 V; V_{flb} = 45 V; f_i = 50 Hz; $I_{i(bias)}$ = 330 μA; T_{amb} = 25 °C; measured in test circuit of Fig.3; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC supplies						
V_P	operating supply voltage		7.5	–	18	V
V_{flb}	flyback supply voltage		$2 \times V_P$	–	68	V
$I_{q(av)}$	average quiescent supply current	during scan	–	10	15	mA
I_q	quiescent supply current	no signal; no load	–	60	80	mA
$I_{Vflb(av)}$	average flyback supply current	during scan	–	–	10	mA
Output stages A and B						
V_{loss}	total voltage loss from pin 10 to 9 and from pin 5 to 6	I_o = +1.6 A; note 1	–	–	6.0	V
	total voltage loss from pin 4 to 5 and from pin 9 to 8	I_o = –1.6 A; note 1	–	–	4.8	V
	total voltage loss from pin 10 to 9 and from pin 5 to 6	I_o = +1.1 A; note 1	–	–	4.2	V
	total voltage loss from pin 4 to 5 and from pin 9 to 8	I_o = –1.1 A; note 1	–	–	3.4	V
LE	linearity error					
	adjacent blocks	I_o = 3.2 A (p-p); note 2	–	0.5	2	%
	not adjacent blocks	I_o = 3.2 A (p-p); note 2	–	0.5	3	%
V_o	output voltage swing (flyback) $V_{o(A)} - V_{o(B)}$	$I_{i(diff)}$ = 0.3 mA; I_o = –1.6 A	–	46	–	V
$\lvert V_{offset} \rvert$	offset voltage across R_M	$I_{i(diff)}$ = 0				
		$I_{i(bias)}$ = 500 μA	–	–	15	mV
		$I_{i(bias)}$ = 100 μA	–	–	13	mV
$\Delta V_{offset(T)}$	offset voltage as a function of temperature	$I_{i(diff)}$ = 0	–	–	40	μV/K
$V_{o(A)}$, $V_{o(B)}$	DC output voltage	$I_{i(diff)}$ = 0; note 3	–	$V_P/2$	–	V
$G_{v(ol)}$	open-loop voltage gain $V_{9\ to\ 5}/V_{3\ to\ 5}$	notes 4 and 5	–	60	–	dB
$V_{3\ to\ 5}/V_{2\ to\ 5}$	voltage ratio $V_{3\ to\ 5}/V_{2\ to\ 5}$	note 4	–	0	–	dB
f_{res}	frequency response (–3 dB)	open loop	–	1	–	kHz
G_i	current gain ($I_o/I_{i(diff)}$)		–	8000	–	
$\Delta G_c T$	current gain drift as a function of temperature		–	–	10^{-4}	/K
PSRR	power supply rejection ratio	note 6	80	90	–	dB
Input stage						
$I_{i(sb)}$	signal bias current		–	330	500	μA
$I_{i(diff)(p-p)}$	differential mode input current (peak-to-peak value) pin 11 or 12	note 7	–	500	600	μA
$V_{i(diff)}$	differential mode input voltage	$I_{i(diff)}$ = 500 μA	–	0.75	–	V
$V_{i(cm)}$	common mode input voltage	$I_{i(bias)}$ = 330 μA	0.95	1.15	1.35	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Flyback switch						
I_{flb}	output peak current	t < 1.5 ms	–	–	±1.6	A
V_{loss}	voltage loss ($V_{flb} - V_{o(A)}$)					
		I_o = 1.6 A	–	8	9	V
		I_o = 1.1 A	–	7.5	8.5	V
Guard circuit						
$I_{o(guard)}$	output current	not active; $V_{o(guard)}$ = 0 V	–	–	10	μA
		active; $V_{o(guard)}$ = 4.5 V	1	–	2.5	mA
$V_{o(guard)}$	output voltage on pin 1	$I_{o(guard)}$ = 100 μA	5	6	7	V
	allowable voltage on pin 1	maximum leakage current = 10 μA	–	–	18	V

Notes

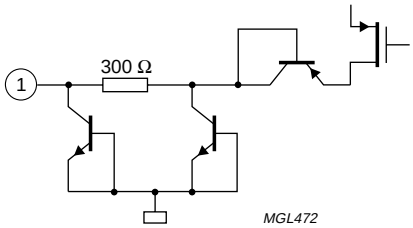
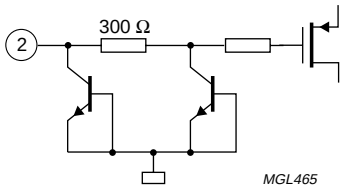
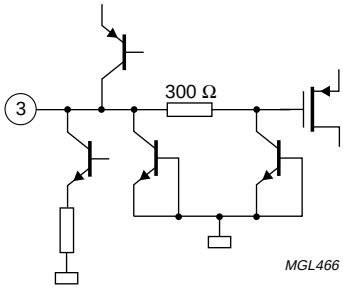
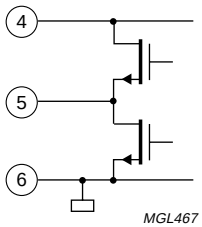
1. At T_j = 125 °C, the temperature coefficient of the V_{loss} has a positive sign.
2. The linearity error is measured for a linear input signal without S correction and is based on the ‘on screen’ measurement principle. This method is defined as follows. The output signal is divided into 22 successive equal time parts. The 1st and 22nd parts are ignored. The remaining 20 parts form 10 successive blocks k, where a block consists of two successive parts. The voltage amplitudes are measured across RM, starting at k = 1 and ending at k = 10, where V_k and V_{k+1} are the measured voltages of two successive blocks. V_{min}, V_{max} and V_{av} are the minimum, maximum and average voltages respectively. The linearity errors are defined as:

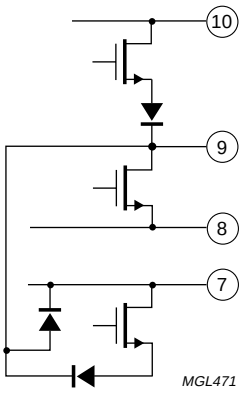
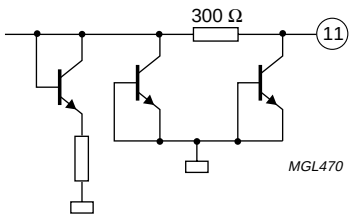
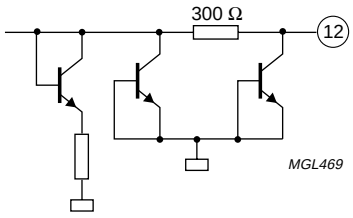
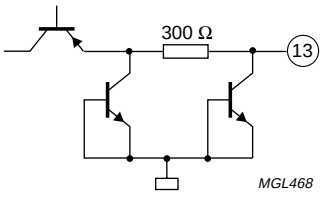
   $$LE = \frac{V_k - V_{k+1}}{V_{av}} \times 100\% \text{ (adjacent blocks) and } LE = \frac{V_{max} - V_{min}}{V_{av}} \times 100\% \text{ (non-adjacent blocks).}$$

3. $V_{o(A)} + V_{o(B)} = V_P$. At the start of the scan, this equation is one diode voltage less.
4. The V value within formulae relates to voltages at or between relative pin numbers, i.e. $V_{9\ to\ 5}/V_{3\ to\ 5}$ = voltage value across pins 9 and 5, divided by voltage value across pins 3 and 5.
5. $V_{2\ to\ 5}$ AC short circuited.
6. At V_{ripple} = 500 mV_{eff} at V_P; measured across R_M; f_{ripple} = 50 Hz to 1 kHz.
7. $I_{i(abs)(max)}$ = 800 μA and $I_{i(abs)(min)}$ = 50 μA per pin.

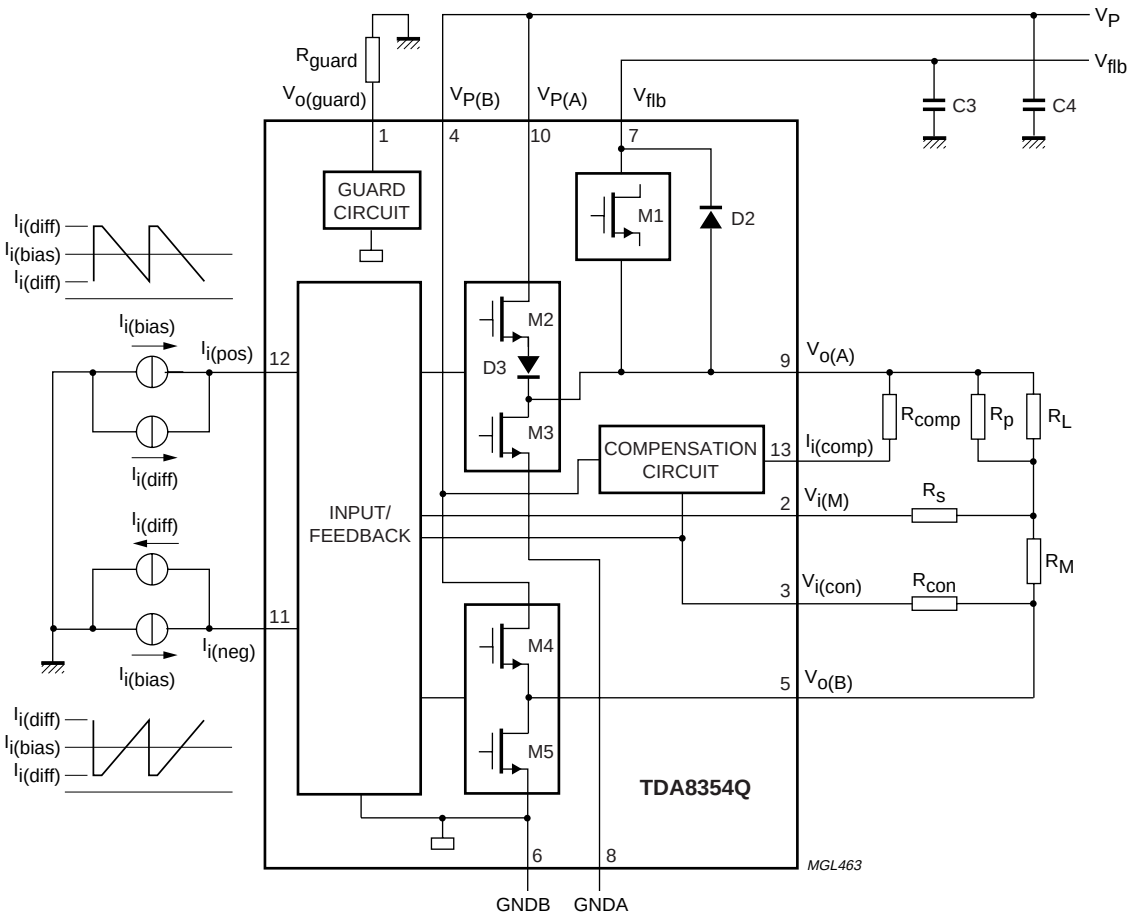
INTERNAL CIRCUITS

Table 1 Equivalent pin circuits

PIN	SYMBOL	EQUIVALENT CIRCUIT
1	$V_{o(guard)}$	
2	$V_{i(M)}$	
3	$V_{i(con)}$	
4	$V_{P(B)}$	
5	$V_{o(B)}$	
6	GNDB	

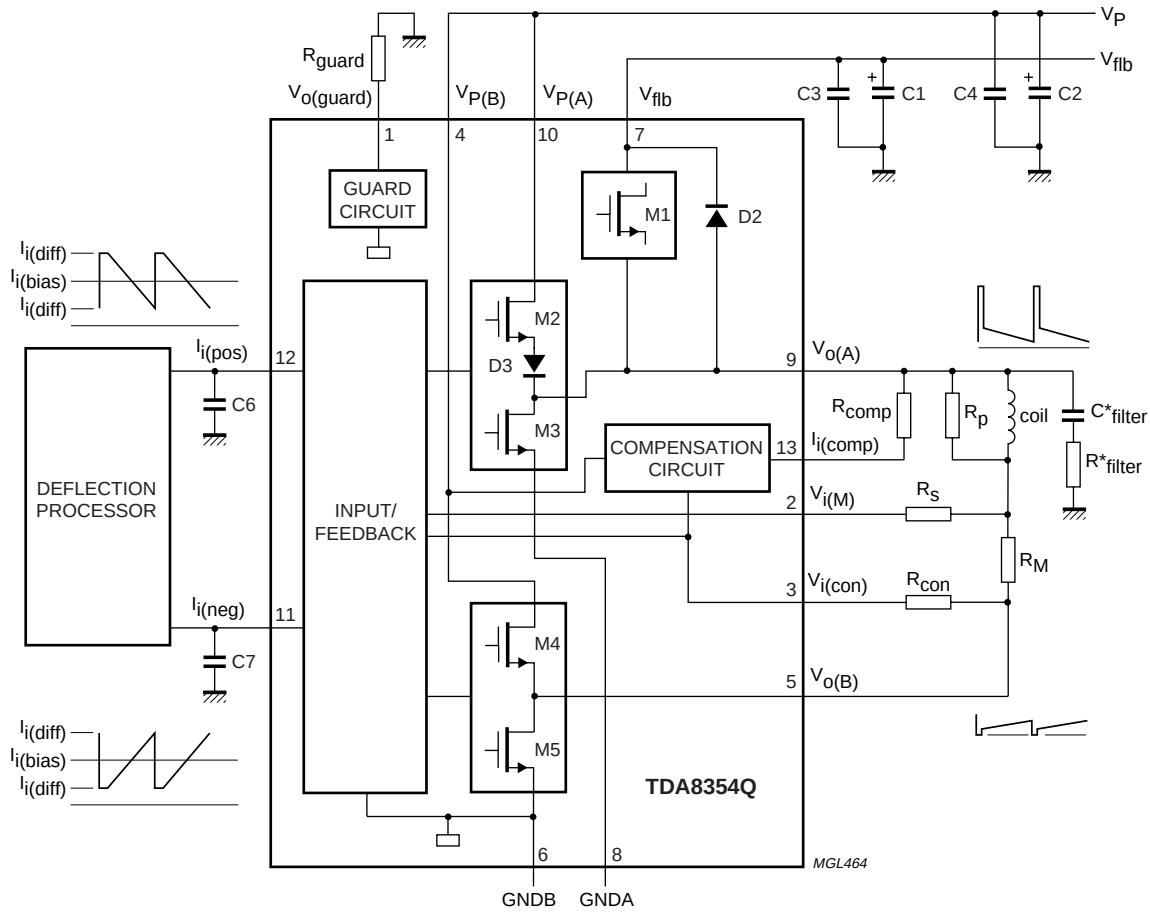
PIN	SYMBOL	EQUIVALENT CIRCUIT
7	V_{flb}	
8	GNDA	
9	$V_{o(A)}$	
10	$V_{P(A)}$	
11	$I_{i(neg)}$	
12	$I_{i(pos)}$	
13	$I_{i(comp)}$	

TEST AND APPLICATION INFORMATION



R_M = 0.5 Ω;
R_{con} = 1.2 kΩ;
R_L = 3.2 Ω;
R_p = 300 Ω;
R_{comp} = 650 kΩ;
$R_{(guard)}$ = 5 kΩ;
R_S = 2.2 kΩ;
C3 = C4 = 100 nF.

Fig.3 Test diagram.



Coil: AT6216/42;
V_P = 12.1 V at f_v = 50 Hz (vertical frame frequency); inclusive spread (absolute) and temperature rise in the coil;
V_P = 12.8 V at f_v = 100 Hz (vertical frame frequency); inclusive spread (absolute) and temperature rise in the coil;
$I_{o(p-p)}$ = 2.33 A (peak-to-peak value);
$I_{i(bias)}$ = 330 µA;
$I_{i(diff)(12-11)}$ = 485 µA (peak value);
V_{flb} = 45 V;
t_{flb} = 0.6 ms.

R_M = 0.5 Ω;
R_{con} = 1.2 kΩ;
R_p = 300 Ω;
R_{comp} = 650 kΩ;
$R_{(guard)}$ = 5 kΩ;
R_S = 2.2 kΩ.

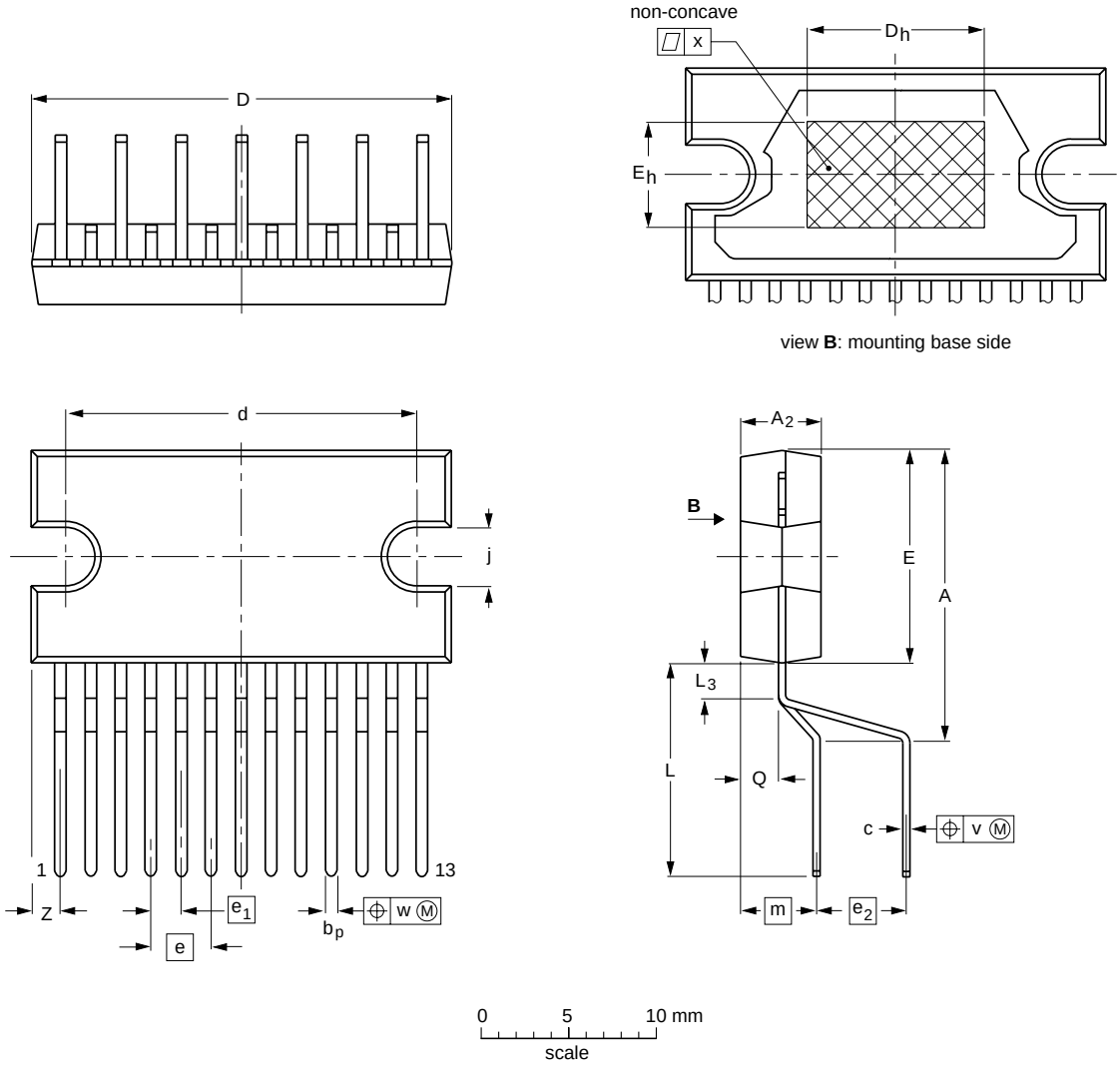
C1 = 47 µF; 100 V;
C2 = 220 µF; 25 V;
C3 = C4 = 100 nF;
C6 = C7 = 10 nF;
C_{filter} = 47 nF*;
R_{filter} = 1.5 Ω*.

* Values depend on coil impedance.

Fig.4 Application diagram.

PACKAGE OUTLINE

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm) **SOT141-6**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_2	b_p	c	$D^{(1)}$	d	D_h	$E^{(1)}$	e	e_1	e_2	E_h	j	L	L_3	m	Q	v	w	x	$Z^{(1)}$
mm	17.0 15.5	4.6 4.4	0.75 0.60	0.48 0.38	24.0 23.6	20.0 19.6	10	12.2 11.8	3.4	1.7	5.08	6	3.4 3.1	12.4 11.0	2.4 1.6	4.3	2.1 1.8	0.8	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			
SOT141-6						~~97-12-16~~ 99-12-17

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[1]

Note

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

DATA SHEET STATUS

DATA SHEET STATUS[1]	PRODUCT STATUS[2]	DEFINITIONS
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A.

Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

DISCLAIMERS

Life support applications — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no licence or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 3 Figtree Drive, HOMEBUSH, NSW 2140,
Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213,
Tel. +43 1 60 101 1248, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 20 0733, Fax. +375 172 20 0773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 68 9211, Fax. +359 2 68 9102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Sydhavnsgade 23, 1780 COPENHAGEN V,
Tel. +45 33 29 3333, Fax. +45 33 29 3905

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615 800, Fax. +358 9 6158 0920

France: 7 - 9 Rue du Mont Valérien, BP317, 92156 SURESNES Cedex,
Tel. +33 1 4728 6600, Fax. +33 1 4728 6638

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 2353 60, Fax. +49 40 2353 6300

Hungary: Philips Hungary Ltd., H-1119 Budapest, Fehervari ut 84/A,
Tel: +36 1 382 1700, Fax: +36 1 382 1800

India: Philips INDIA Ltd, Band Box Building, 2nd floor,
254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025,
Tel. +91 22 493 8541, Fax. +91 22 493 0966

Indonesia: PT Philips Development Corporation, Semiconductors Division,
Gedung Philips, Jl. Buncit Raya Kav.99-100, JAKARTA 12510,
Tel. +62 21 794 0040 ext. 2501, Fax. +62 21 794 0080

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Via Casati, 23 - 20052 MONZA (MI),
Tel. +39 039 203 6838, Fax +39 039 203 6800

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku,
TOKYO 108-8507, Tel. +81 3 3740 5130, Fax. +81 3 3740 5057

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381, Fax +9-5 800 943 0087

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Pakistan: see Singapore

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Al.Jerozolimskie 195 B, 02-222 WARSAW,
Tel. +48 22 5710 000, Fax. +48 22 5710 001

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 319762,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 58088 Newville 2114,
Tel. +27 11 471 5401, Fax. +27 11 471 5398

South America: Al. Vicente Pinzon, 173, 6th floor,
04547-130 SÃO PAULO, SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 821 2382

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 93 301 6312, Fax. +34 93 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2741 Fax. +41 1 488 3263

Taiwan: Philips Semiconductors, 5F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2451, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
60/14 MOO 11, Bangna Trad Road KM. 3, Bagna, BANGKOK 10260,
Tel. +66 2 361 7910, Fax. +66 2 398 3447

Turkey: Yukari Dudullu, Org. San. Blg., 2.Cad. Nr. 28 81260 Umraniye,
ISTANBUL, Tel. +90 216 522 1500, Fax. +90 216 522 1813

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 208 730 5000, Fax. +44 208 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 3341 299, Fax.+381 11 3342 553

For all other countries apply to: Philips Semiconductors,
Marketing Communications, Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN,
The Netherlands, Fax. +31 40 27 24825

Internet: http://www.semiconductors.philips.com

Printed in The Netherlands 753504/02/pp16 Date of release: 2001 Jul 11 Document order number: 9397 750 08034

Let's make things better.

Philips Semiconductors

PHILIPS