

INTEGRATED CIRCUITS

DATA SHEET

TDA8354Q

Full bridge current driven vertical deflection output circuit in LVDMOS

Preliminary specification
File under Integrated Circuits, IC02

1998 Sep 03

Full bridge current driven vertical deflection output circuit in LVDMOS

TDA8354Q

FEATURES

- Few external components
- Highly efficient fully DC-coupled vertical output bridge circuit
- Short rise and fall times of the vertical flyback switch
- Guard circuit
- Temperature (thermal) protection
- High ElectroMagnetic Compatibility (EMC) because of common mode inputs
- Guard signal in zoom mode.

GENERAL DESCRIPTION

The TDA8354Q is a power circuit for use in 90° and 110° colour deflection systems for field frequencies of 25 to 200 Hz and 16 : 9 picture tubes. The circuit provides a DC-driven vertical deflection output circuit, operating as a highly efficient class G system. Due to the full bridge output circuit the deflection coils can be DC coupled.

The IC is constructed in a low-voltage DMOS process that combines bipolar, CMOS and DMOS devices, to provide ruggedness.

QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|--|-----------------|----------------|------|-----------|--------------|
| DC supply | | | | | | |
| V_P | supply voltage | | 7.5 | 12 | 18 | V |
| $I_{q(av)}$ | average quiescent supply current | during scan | – | 10 | 15 | mA |
| V_{flb} | flyback supply voltage | | $2 \times V_P$ | 45 | 68 | V |
| $I_{Vflb(av)}$ | 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 | μ A |
| Flyback switch | | | | | | |
| $I_{o(Vflb)}$ | peak output current | $t \leq 1.5$ ms | – | – | ± 1.6 | A |
| Thermal data (in accordance with IEC 747-1) | | | | | | |
| T_{stg} | storage temperature | | –55 | – | +150 | $^{\circ}$ C |
| T_{amb} | operating ambient temperature | | –25 | – | +75 | $^{\circ}$ C |
| T_j | junction temperature | | – | – | 150 | $^{\circ}$ 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 |

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BLOCK DIAGRAM

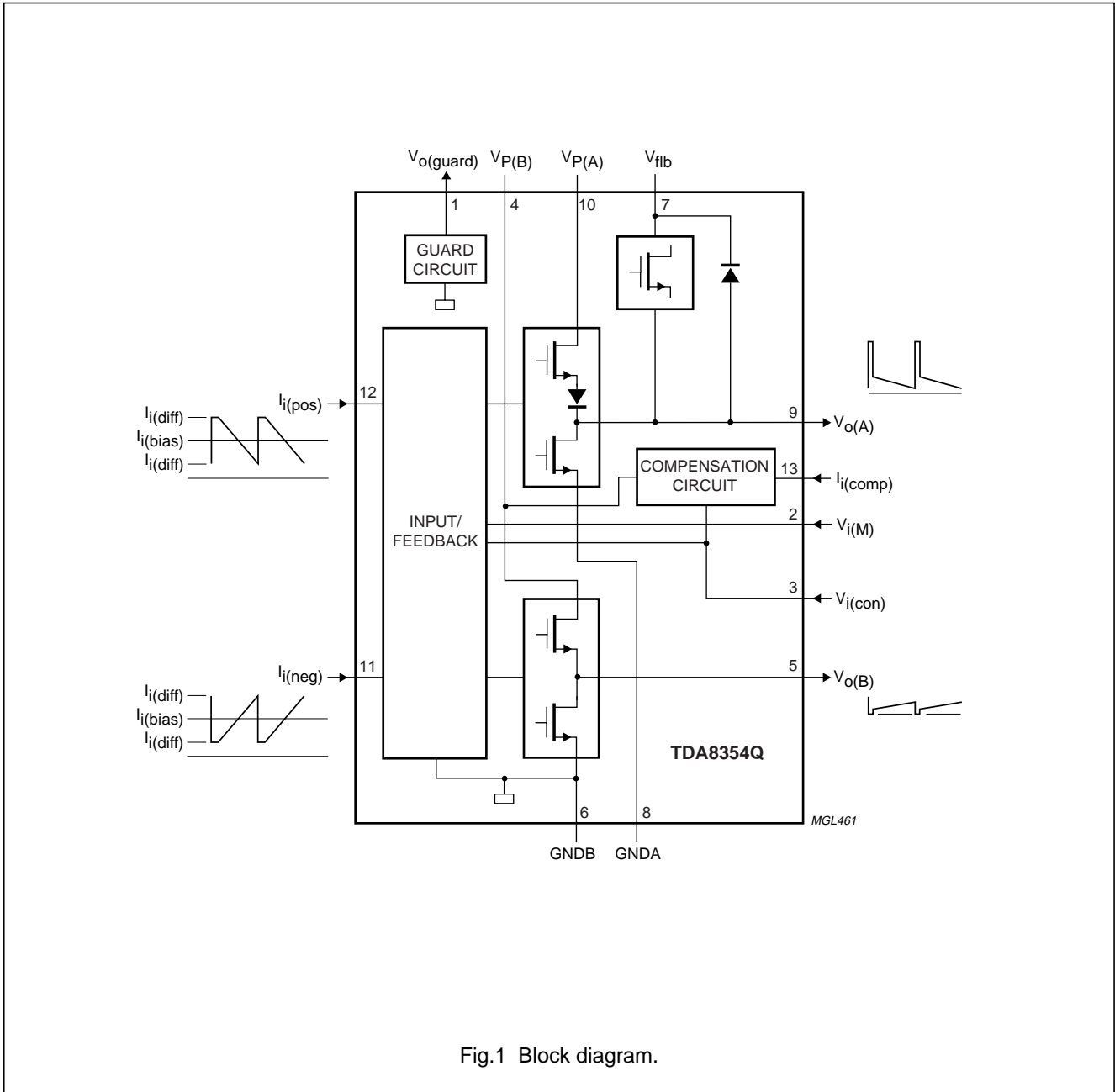


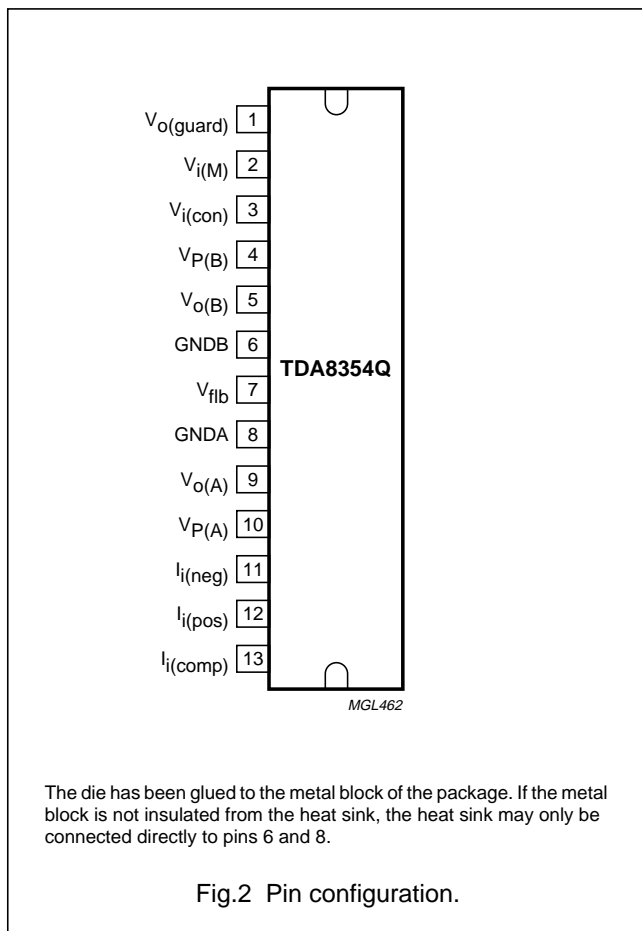
Fig.1 Block diagram.

Full bridge current driven vertical deflection output circuit in LVDMOS

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PINNING

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



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. The differential input circuit is current driven. The input circuit is special intended for direct connection to driver circuits which deliver symmetrical current signals, but is also suitable for asymmetrical currents. 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 voltage across R_{M} , which provides internal feedback information. The relationship between the differential input current and the output current is defined by:

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

The output current is adjustable from 0.5 A (p-p) to 3.2 A (p-p) by varying R_{con} . The maximum input current is 800 μA peak for each pin. The minimum input current should be 50 μA .

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 fix the supply voltage V_{P} optimum for the scan voltage and the second supply voltage V_{flb} optimum 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, this being possible due to the absence of a coupling capacitor (not necessary, due to the bridge configuration). The very short rise and fall time of the flyback switch is $>400 \text{ V}/\mu\text{s}$.

Protection

The output circuit has protection circuits for:

- Die temperature control
- Overvoltage of output stage A.

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Guard circuit

A guard circuit with output signal $V_{o(\text{guard})}$ 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 ($T_j \approx 170\text{ °C}$)
- 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 (pins 11 and 12) to V_P or ground.

An active HIGH level of the guard signal is also generated for the next 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 for blanking the picture tube screen and signalling a fault condition.

Damping resistor compensation

For HF-loop stability a damping resistor is connected across the deflection coil. There is a big 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 for by external means. To do so a resistor (R_{comp}) of about $1\text{ M}\Omega$ can be connected between the output of stage A (pin 9) and the damping resistor compensation current input (pin 13).

For a more accurate calculation of R_{comp} refer to the following formula:

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

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LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|--|---|-------------------------------------|------|------------|------|
| DC supply | | | | | |
| 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 (pin 9) | note 1 | – | 68 | V |
| $V_{o(B)}$ | output voltage (pin 5) | | – | V_P | V |
| $I_{1,2,3,11,12,13}$ | current into 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 | | – | ± 1.6 | A |
| Thermal data (in accordance with IEC 747-1) | | | | | |
| T_{stg} | storage temperature | | –55 | +150 | °C |
| T_{amb} | operating ambient temperature | | –25 | +75 | °C |
| T_j | junction temperature | note 2 | – | 150 | °C |
| Miscellaneous | | | | | |
| t_{sc} | short-circuiting time | note 3 | – | 1 | h |
| $I_{i/o}$ | current into any pin | $+1.5 \times V_{P(max)} $; note 4 | – | +200 | mA |
| | current out of any pin | $-1.5 \times V_{P(max)} $; note 4 | –200 | – | mA |
| V_{ESD} | electrostatic handling | note 5 | – | ± 300 | V |
| | | note 6 | – | ± 2000 | V |

Notes

- When the pin voltage exceeds 70 V the device behaves like a power zener diode thus limiting the voltage.
- Internally limited by thermal protection; switching point ≈ 170 °C.
- Up to $V_P = 18$ V.
- At $T_{j(max)}$.
- Machine model: equivalent to discharge a 200 pF capacitor through a 0 Ω series resistor. Except pin 7: ± 250 V.
- Human body model: equivalent to discharge a 100 pF capacitor through a 1.5 k Ω series resistor. Except pin 7: ± 1500 V.

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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

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---------------------------------------|--|--|----------------|-----------------|------|-----------------|
| DC supply | | | | | | |
| V_P | operating supply voltage | | 7.5 | 12 | 18 | V |
| V_{flb} | flyback supply voltage | | $2 \times V_P$ | 45 | 68 | V |
| $I_{q(\text{av})}$ | average quiescent supply current | during scan | – | 10 | 15 | mA |
| I_q | quiescent supply current | no signal; no load | – | 60 | 80 | mA |
| $I_{V_{flb}(\text{av})}$ | average flyback supply current | during scan | – | – | 10 | mA |
| Output stage A and B | | | | | | |
| V_{loss} | voltage loss from pin 10 to 9 and from pin 5 to 6 | $I_o = 3.2\text{ A (p-p)}$; note 1 | – | – | 6.0 | V |
| | voltage loss from pin 4 to 5 and from pin 9 to 8 | | – | – | 4.8 | V |
| | voltage loss from pin 10 to 9 and from pin 5 to 6 | $I_o = 2.2\text{ A (p-p)}$; note 1 | – | – | 4.2 | V |
| | voltage loss from pin 4 to 5 and from pin 9 to 8 | | – | – | 3.4 | V |
| LE | linearity error | | | | | |
| | adjacent blocks | $I_o = 3.2\text{ A (p-p)}$; note 2 | – | 0.5 | 2 | % |
| | not adjacent blocks | $I_o = 3.2\text{ A (p-p)}$; note 2 | – | 0.5 | 3 | % |
| V_o | output voltage swing (flyback) $V_{o(A)} - V_{o(B)}$ | $I_{i(\text{diff})} = 0.3\text{ mA}$; $I_o = 1.6\text{ A}$ | – | 46 | – | V |
| $ V_{\text{offset}} $ | offset voltage across R_M | $I_{i(\text{diff})} = 0$ | – | – | 15 | mV |
| | | $I_{i(\text{bias})} = 500\text{ }\mu\text{A}$ $I_{i(\text{bias})} = 100\text{ }\mu\text{A}$ | – | – | 13 | mV |
| $\Delta V_{\text{offset}(T)}$ | offset voltage as function of temperature | $I_{i(\text{diff})} = 0$ | – | – | 40 | $\mu\text{V/K}$ |
| $V_{o(A)}, V_{o(B)}$ | DC output voltage | $I_{i(\text{diff})} = 0$; note 3 | – | $\frac{V_P}{2}$ | – | V |
| $G_{V(\text{ol})}$ | open-loop voltage gain $V_{9\text{ to }5}/V_{3\text{ to }5}$ | notes 4 and 5 | – | 60 | – | dB |
| $V_{3\text{ to }5}/V_{2\text{ to }5}$ | voltage ratio $V_{3\text{ to }5}/V_{2\text{ to }5}$ | note 4 | – | 0 | – | dB |
| f_{res} | frequency response (–3 dB) | open loop | – | 1 | – | kHz |
| G_i | current gain ($I_o/I_{i(\text{diff})}$) | | – | 8000 | – | |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|----------------------------------|---|--|------|------|-----------|---------------|
| $\Delta G_{i(T)}$ | current gain drift as function of temperature | | – | – | 10^{-4} | /K |
| PSRR | power supply rejection ratio | note 6 | 80 | 90 | – | dB |
| Input stage | | | | | | |
| $I_{i(\text{bias})}$ | signal bias current | | – | 330 | 500 | μA |
| $I_{i(\text{diff})(\text{p-p})}$ | differential mode input current (peak-to-peak value) pin 11 or 12 | note 7 | – | 500 | 600 | μA |
| $V_{i(\text{diff})}$ | differential mode input voltage | $I_{i(\text{diff})} = 500 \mu\text{A}$ | – | 0.75 | – | V |
| $V_{i(\text{cm})}$ | common mode input voltage | $I_{i(\text{bias})} = 330 \mu\text{A}$ | 0.95 | 1.15 | 1.35 | V |
| Flyback switch | | | | | | |
| $I_{o(V\text{flb})}$ | output peak current | $t < 1.5 \text{ ms}$ | – | – | ± 1.6 | A |
| V_{loss} | voltage loss ($V_{\text{flb}} - V_{o(A)}$) | $I_o = +1.6 \text{ A}$ | – | 8 | 9 | V |
| Guard circuit | | | | | | |
| $I_{o(\text{guard})}$ | output current | not active; $V_{o(\text{guard})} = 0 \text{ V}$ | – | – | 10 | μA |
| | | active; $V_{o(\text{guard})} = 4.5 \text{ V}$ | 1 | – | 2.5 | mA |
| $V_{o(\text{guard})}$ | output voltage on pin 1 | $I_{o(\text{guard})} = 100 \mu\text{A}$ | 5 | 6 | 7 | V |
| | allowable voltage on pin 1 | maximum leakage current = $10 \mu\text{A}$ | – | – | 18 | V |

Notes

- At $T_j = 125 \text{ }^\circ\text{C}$. The temperature coefficient of V_{loss} has a positive sign.
- 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 into 22 equal time parts ranging from 1 to 22 inclusive. Measure the value of the voltage across R_M of two succeeding parts called one block (a) starting with part 2 and 3 (block 1) and ending with part 20 and 21 (block 10). Thus parts 1 and 22 are unused. The equations for linearity error for adjacent blocks (LEAB) and not adjacent blocks (LENAB) are given below:

$$\text{LEAB} = \frac{a_k - a_{(k+1)}}{a_{\text{av}}}$$

$$\text{LENAB} = \frac{a_{\text{max}} - a_{\text{min}}}{a_{\text{av}}}$$

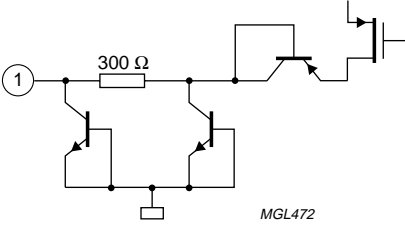
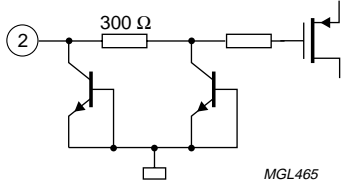
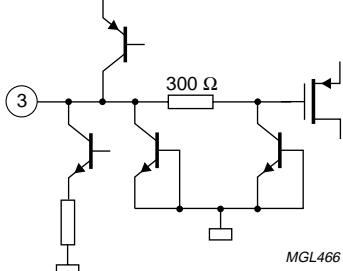
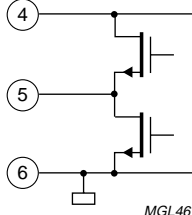
- $V_{o(A)} + V_{o(B)} = V_P$. At the start of the scan this equation is one diode voltage less.
- The V value within formulae relates to voltages at or between relative pin numbers, i.e. $V_{9 \text{ to } 5} / V_{3 \text{ to } 5}$ = voltage value across pins 9 and 5 divided by voltage value across pins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

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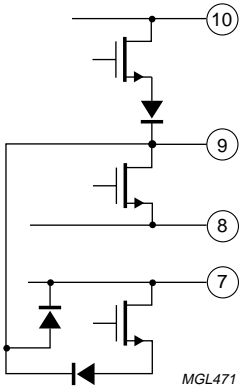
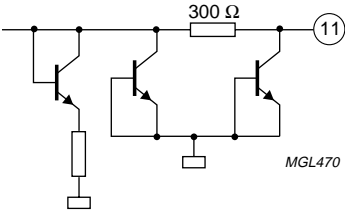
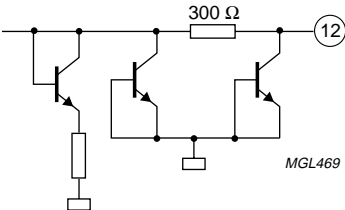
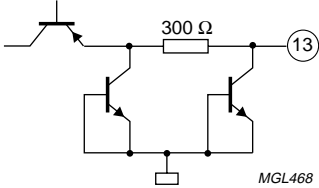
INTERNAL CIRCUITRY

Table 1 Equivalent pin circuits

| PIN | SYMBOL | EQUIVALENT CIRCUIT |
|-----|-----------------------|--|
| 1 | $V_{o(\text{guard})}$ |  <p>MGL472</p> |
| 2 | $V_{i(M)}$ |  <p>MGL465</p> |
| 3 | $V_{i(\text{con})}$ |  <p>MGL466</p> |
| 4 | $V_{P(B)}$ |  <p>MGL467</p> |
| 5 | $V_{o(B)}$ | |
| 6 | GNDB | |

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

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TEST AND APPLICATION INFORMATION

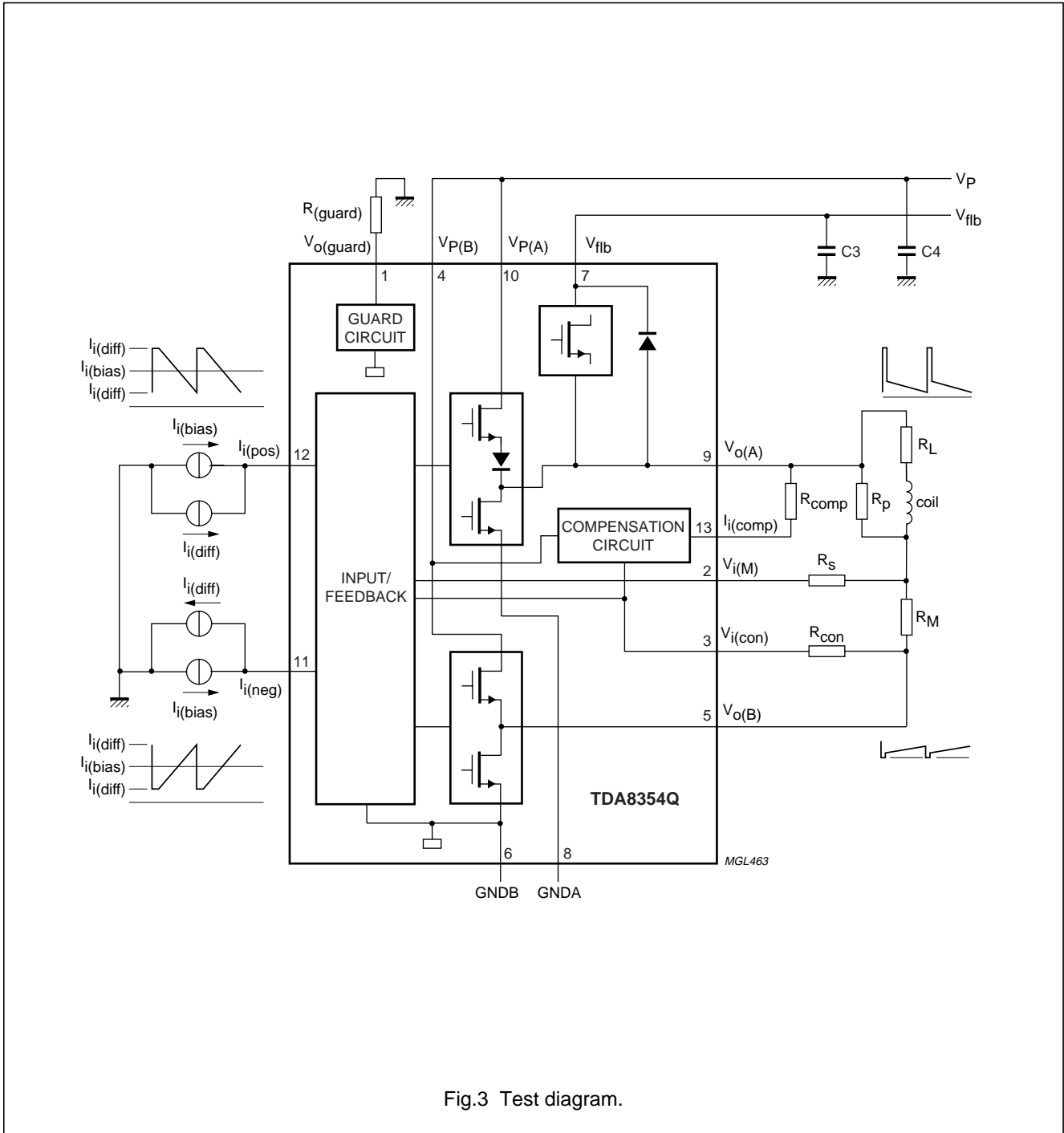
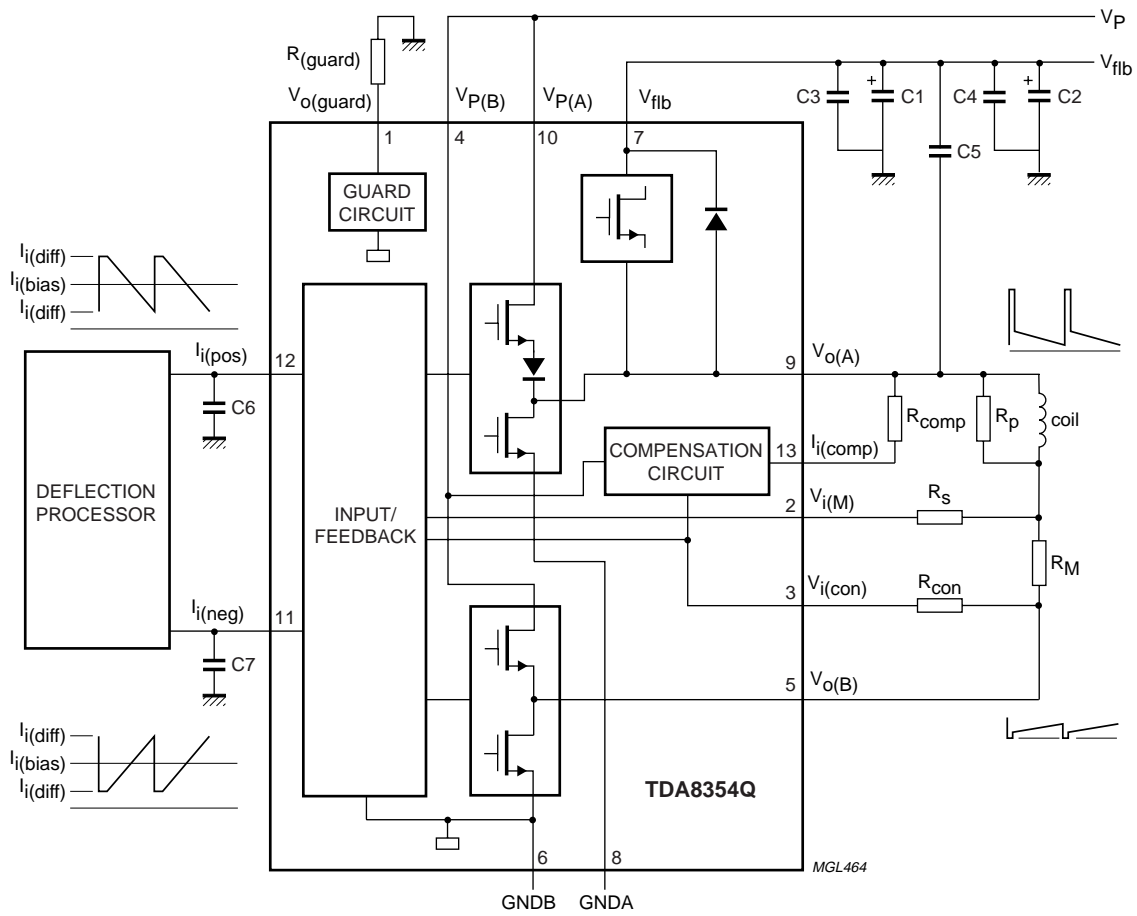


Fig.3 Test diagram.

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

$R_M = 0.5\text{ }\Omega$;
 $R_{\text{con}} = R_s = 1.2\text{ k}\Omega$;
 $R_p = 300\text{ }\Omega$;
 $R_{\text{comp}} = 650\text{ k}\Omega$;
 $R_{(\text{guard})} = 5\text{ k}\Omega$.

$C1 = 47\text{ }\mu\text{F}$; 100 V;
 $C2 = 220\text{ }\mu\text{F}$; 25 V;
 $C3 = C4 = 100\text{ nF}$;
 $C5 = 10\text{ nF}$;
 $C6 = C7 = 10\text{ nF}$.

Fig.4 Application diagram.

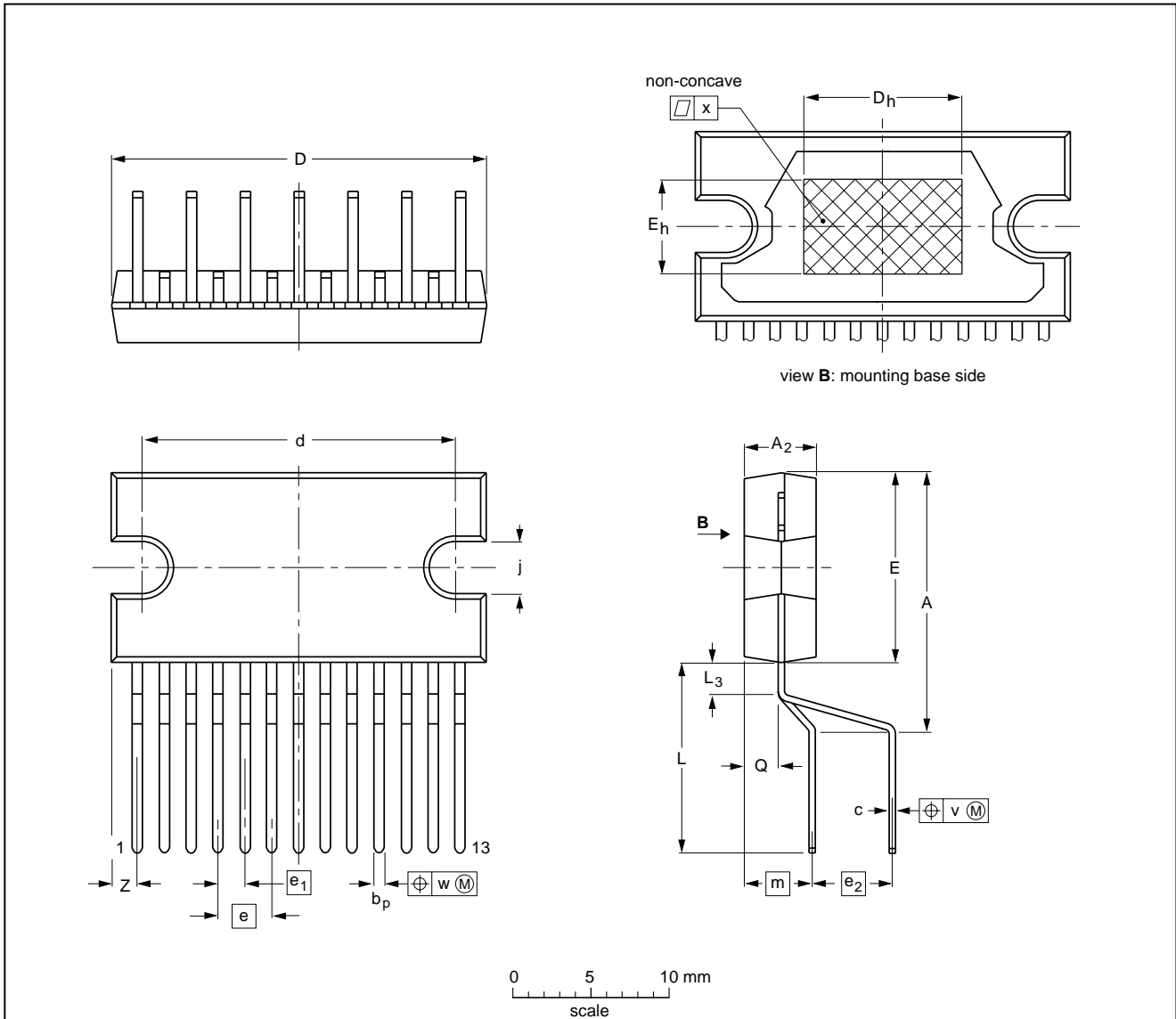
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PACKAGE OUTLINE

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 4.2 | 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 | | | | | 95-03-11 97-12-16 |

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SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint 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.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, 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.

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 the 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. | |

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 customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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NOTES

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