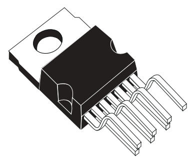
# STV9326

## Vertical Deflection Booster for 3-$A_{PP}$TV/Monitor Applications with 60-V Flyback Generator

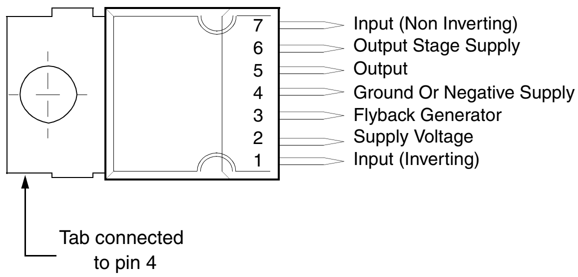
DATASHEET

## Main Features

- **Power Amplifier**
- **Flyback Generator**
- **Output Current up to 3 App**
- **Thermal Protection**



**HEPTAWATT**
**(Plastic Package)**
**ORDER CODE: STV9326**

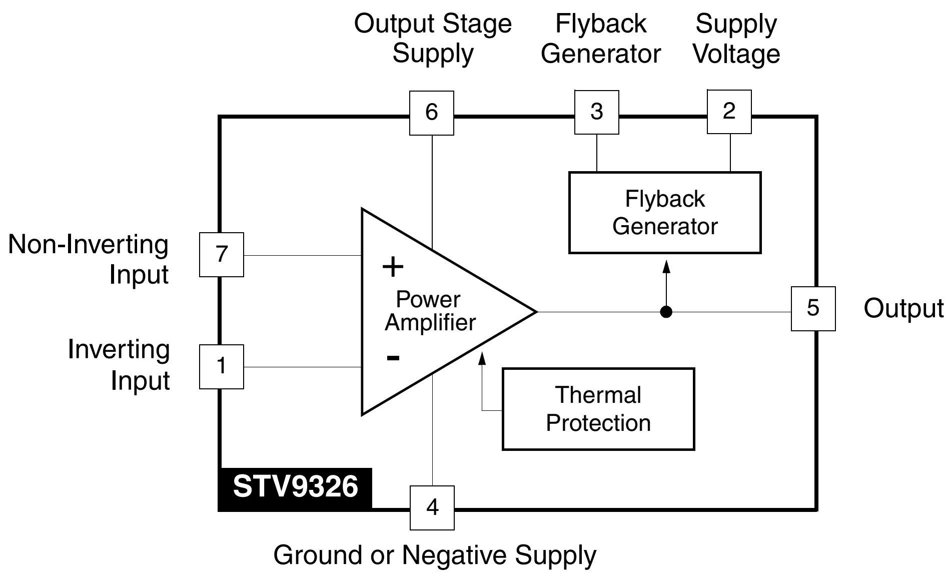



## Description

The STV9326 is a Vertical Deflection Booster designed for 3-$A_{PP}$ TV (50-60 Hz) applications.

This device, supplied with up to 30 V, provides up to 3 App output current to drive the vertical deflection yoke.

The internal flyback generator delivers flyback voltages up to 65 V.



# 1 Absolute Maximum Ratings

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| **Voltage** | | | |
| $V_S$ | Supply Voltage (pin 2) - Note 1 and Note 2 | 40 | V |
| $V_5$, $V_6$ | Flyback Peak Voltage - Note 2 | 65 | V |
| $V_3$ | Voltage at Pin 3 - Note 2, Note 3 and Note 6 | -0.4 to ($V_S$ + 3) | V |
| $V_1$, $V_7$ | Amplifier Input Voltage - Note 2, Note 6 and Note 7 | - 0.4 to ($V_S$ + 2) or +40 | V |
| **Current** | | | |
| $I_0$ (1) | Output Peak Current at f = 50 to 200 Hz, t ≤10µs - Note 4 | ±5 | A |
| $I_0$ (2) | Output Peak Current non-repetitive - Note 5 | ±2 | A |
| $I_3$ Sink | Sink Current, t<1ms - Note 3 | 2 | A |
| $I_3$ Source | Source Current, t < 1ms | 2 | A |
| $I_3$ | Flyback pulse current at f=50 to 200 Hz, t≤10µs - Note 4 | ±5 | A |
| **ESD Susceptibility** | | | |
| ESD1 | Human body model (100 pF discharged through 1.5 kΩ) | 2 | kV |
| ESD2 | EIAJ Standard (200 pF discharged through 0 Ω) | 300 | V |
| **Temperature** | | | |
| $T_s$ | Storage Temperature | -40 to 150 | °C |
| $T_j$ | Junction Temperature | +150 | °C |

*Note:1. Usually the flyback voltage is slightly more than 2 x $V_S$. This must be taken into consideration when setting $V_S$.*

*2. Versus pin 4*

*3. V3 is higher than $V_S$ during the first half of the flyback pulse.*

*4. Such repetitive output peak currents are usually observed just before and after the flyback pulse.*

*5. This non-repetitive output peak current can be observed, for example, during the Switch-On/Switch-Off phases. This peak current is acceptable providing the SOA is respected (Figure 8 and Figure 9).*

*6. All pins have a reverse diode towards pin 4, these diodes should never be forward-biased.*

*7. Input voltages must not exceed the lower value of either $V_S$ + 2 or 40 volts.*

# 2 Thermal Data

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJC}$ | Junction-to-Case Thermal Resistance | 3 | °C/W |
| $T_T$ | Temperature for Thermal Shutdown | 150 | °C |
| $T_J$ | Recommended Max. Junction Temperature | 120 | °C |

# 3 Electrical Characteristics

($V_S$ = 29 V, $T_{AMB}$ = 25°C, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit | Fig. |
|---|---|---|---|---|---|---|---|
| **Supply** | | | | | | | |
| $V_S$ | Operating Supply Voltage Range ($V_2$-$V_4$) | Note 8 | 10 | | 30 | V | |
| $I_2$ | Pin 2 Quiescent Current | $I_3$ = 0, $I_5$ = 0 | | 5 | 20 | mA | 1 |
| $I_6$ | Pin 6 Quiescent Current | $I_3$ = 0, $I_5$ = 0, $V_6$ =30v | 8 | 19 | 50 | mA | 1 |
| **Input** | | | | | | | |
| $I_1$ | Input Bias Current | $V_1$ = 1 V, $V_7$ = 2.2 V | | - 0.6 | -1.5 | µA | 1 |
| $I_7$ | Input Bias Current | $V_1$ = 2.2 V, $V_7$ = 1 V | | - 0.6 | -1.5 | µA | |
| $V_{IR}$ | Operating Input Voltage Range | | 0 | | $V_S$ - 2 | V | |
| $V_{I0}$ | Offset Voltage | | | 2 | | mV | |
| $\Delta V_{I0}/dt$ | Offset Drift versus Temperature | | | 10 | | µV/°C | |
| **Output** | | | | | | | |
| $I_0$ | Operating Peak Output Current | 0°<Tcase<125°C | | | ±1.5 | A | |
| $V_{5L}$ | Output Saturation Voltage to pin 4 | $I_5$ = 1.5 A | | 1 | 1.7 | V | 3 |
| $V_{5H}$ | Output Saturation Voltage to pin 6 | $I_5$ = -1.5 A | | 1.8 | 2.3 | V | 2 |
| **Miscellaneous** | | | | | | | |
| G | Voltage Gain | | 80 | | | dB | |
| $V_{D5-6}$ | Diode Forward Voltage Between pins 5-6 | $I_5$ = 1.5 A | | 1.8 | 2.3 | V | |
| $V_{D3-2}$ | Diode Forward Voltage between pins 3-2 | $I_3$ = 1.5 A | | 1.6 | 2.2 | V | |
| $V_{3SL}$ | Saturation Voltage on pin 3 | $I_3$ = 20 mA | | 0.4 | 1 | V | 3 |
| $V_{3SH}$ | Saturation Voltage to pin 2 (2nd part of flyback) | $I_3$ = -1.5 A | | 2.1 | 2.8 | V | |

8. *In normal applications, the peak flyback voltage is slightly greater than 2 x ($V_S$ - $V_4$). Therefore, ($V_S$ - $V_4$) = 30 V is not allowed without special circuitry.*

**Figure 1: Measurement of $I_1$, $I_2$ and $I_6$**

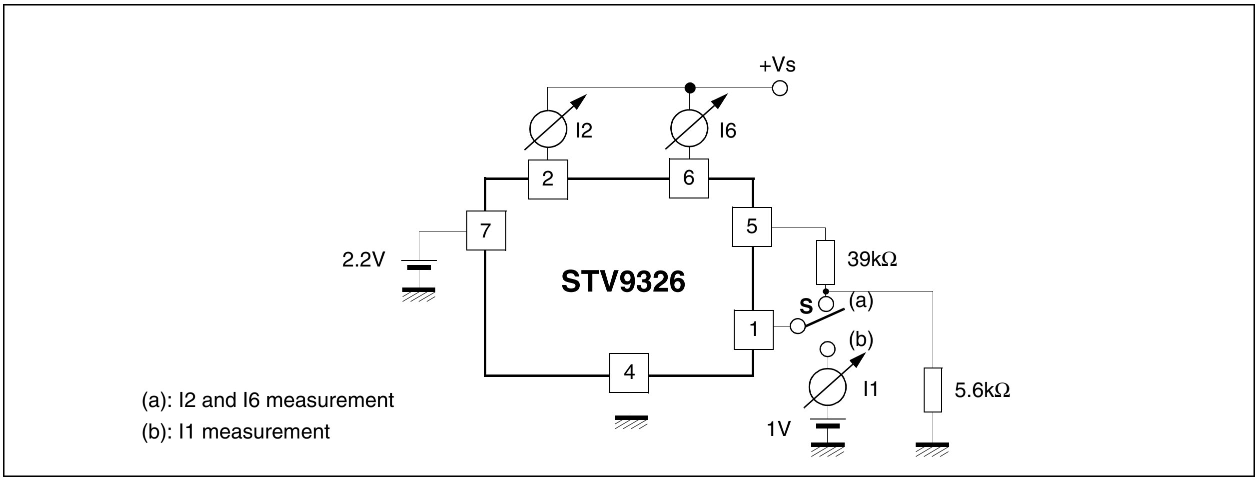



**Figure 2: Measurement of $V_{5H}$**

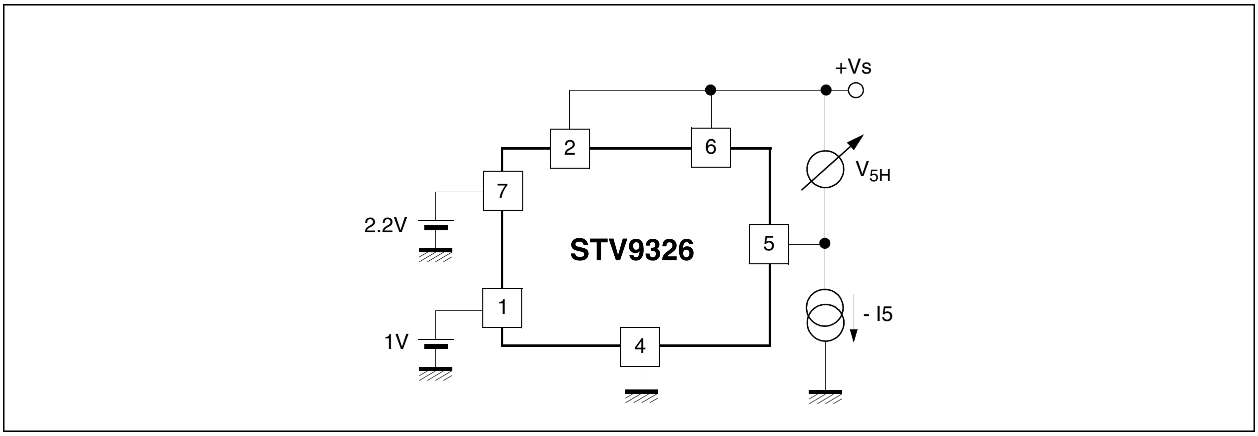
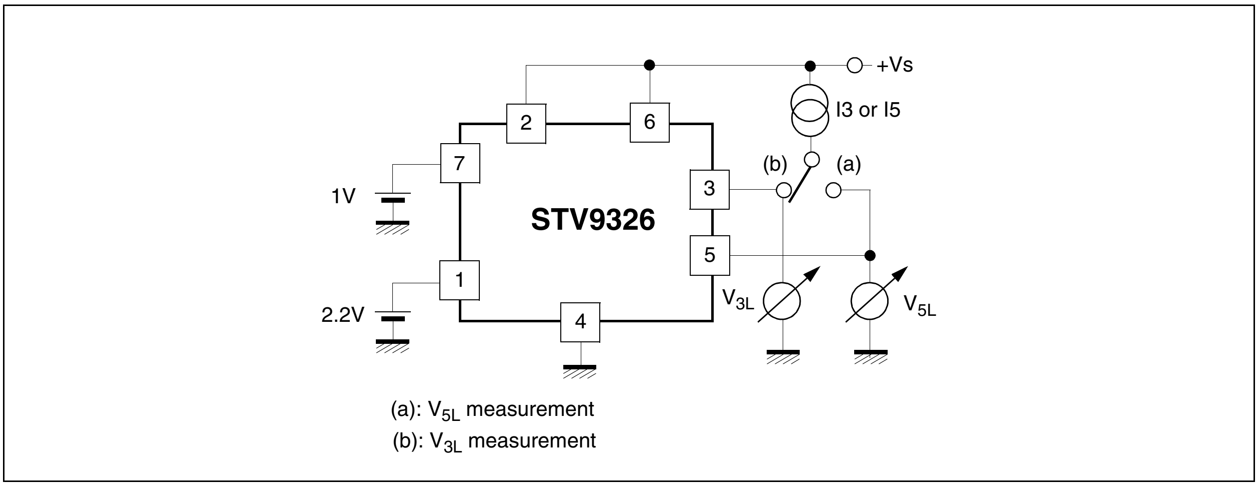



**Figure 3: Measurement of $V_{3L}$ and $V_{5L}$**



# 4 Application Hints

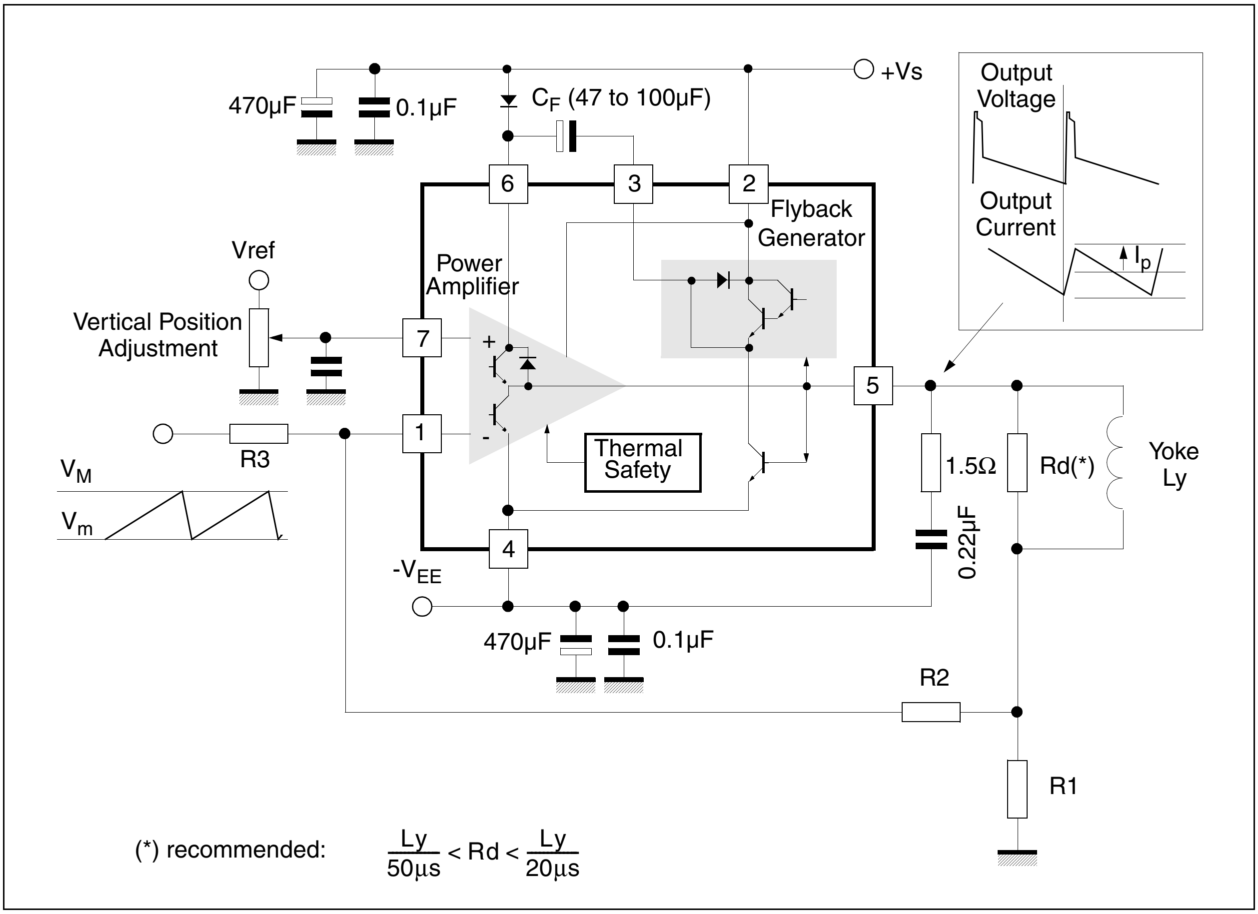
The yoke can be coupled either in AC or DC.

## 4.1 DC-coupled Application

When DC coupled (see Figure 4), the display vertical position can be adjusted with input bias. On the other hand, 2 supply sources ($V_S$ and $-V_{EE}$) are required.

A Stand-by state will be reached by switching OFF the positive supply alone. In this state, where both inputs are the same voltage as pin 2 or higher, the output will sink negligible current from the deviation coil.

**Figure 4: DC-coupled Application**




### 4.1.1 Application Hints

For calculations, treat the IC as an op-amp, where the feedback loop maintains $V_1 = V_7$.

#### 4.1.1.1 Centering

Display will be centered (null mean current in yoke) when voltage on pin 7 is ($R_1$ is negligible):

$$V_7 = \frac{V_M + V_m}{2} \times \left(\frac{R_2}{R_2 + R_3}\right)$$

#### 4.1.1.2 Peak Current

$$I_P = \frac{(V_M - V_m)}{2} \times \frac{R_2}{R_1 x R_3}$$

Example: for $V_m = 2$ V, $V_M = 5$ V and $I_P = 1$ A

Choose $R_1$ in the1 $\Omega$ range, for instance $R_1$=1 $\Omega$

From equation of peak current: $\frac{R_2}{R_3} = \frac{2 \times I_P \times R_1}{V_M - V_m} = \frac{2}{3}$

Then choose $R_2$ or $R_3$. For instance, if $R_2 = 10$ k$\Omega$, then $R_3 = 15$ k$\Omega$

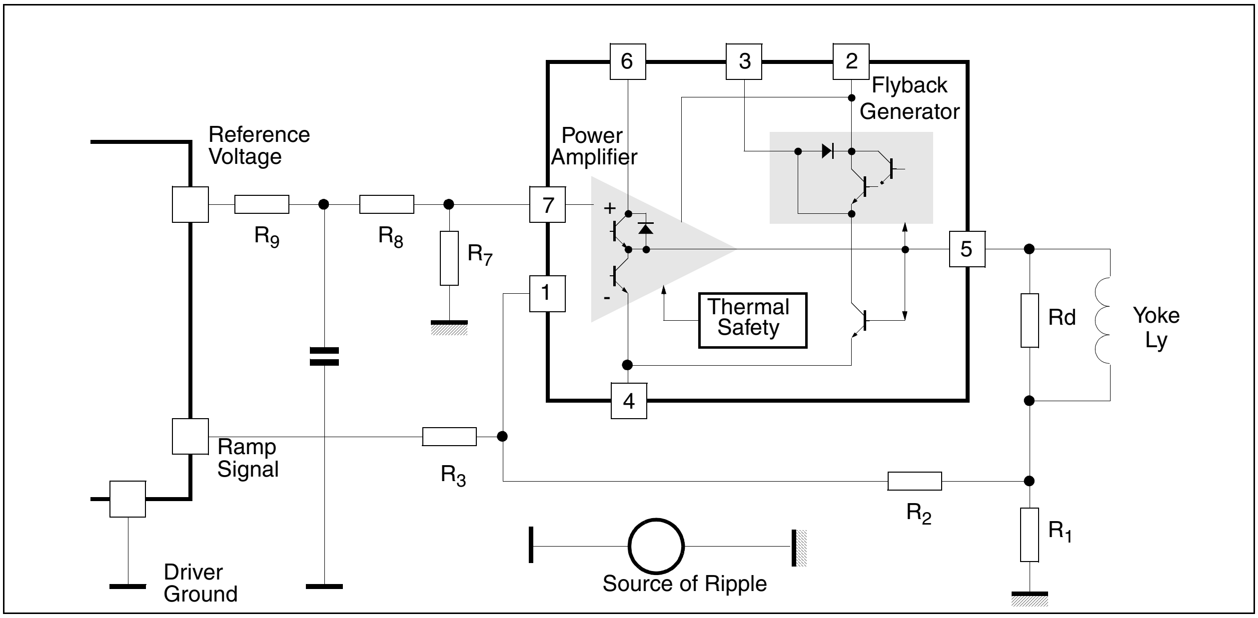
Finally, the bias voltage on pin 7 should be:

$$V_7 = \frac{V_M + V_m}{2} \times \frac{1}{1 + \frac{R_3}{R_2}} = \frac{7}{2} \times \frac{1}{2.5} = 1.4V$$

### 4.1.2 Ripple Rejection

When both ramp signal and bias are provided by the same driver IC, you can gain natural rejection of any ripple caused by a voltage drop in the ground (see Figure 5), if you manage to apply the same fraction of ripple voltage to both booster inputs. For that purpose, arrange an intermediate point in the bias resistor bridge, such that ($R_8$ / $R_7$) = ($R_3$ / $R_2$), and connect the bias filtering capacitor between the intermediate point and the local driver ground. Of course, $R_7$ should be connected to the booster reference point, which is the ground side of $R_1$.

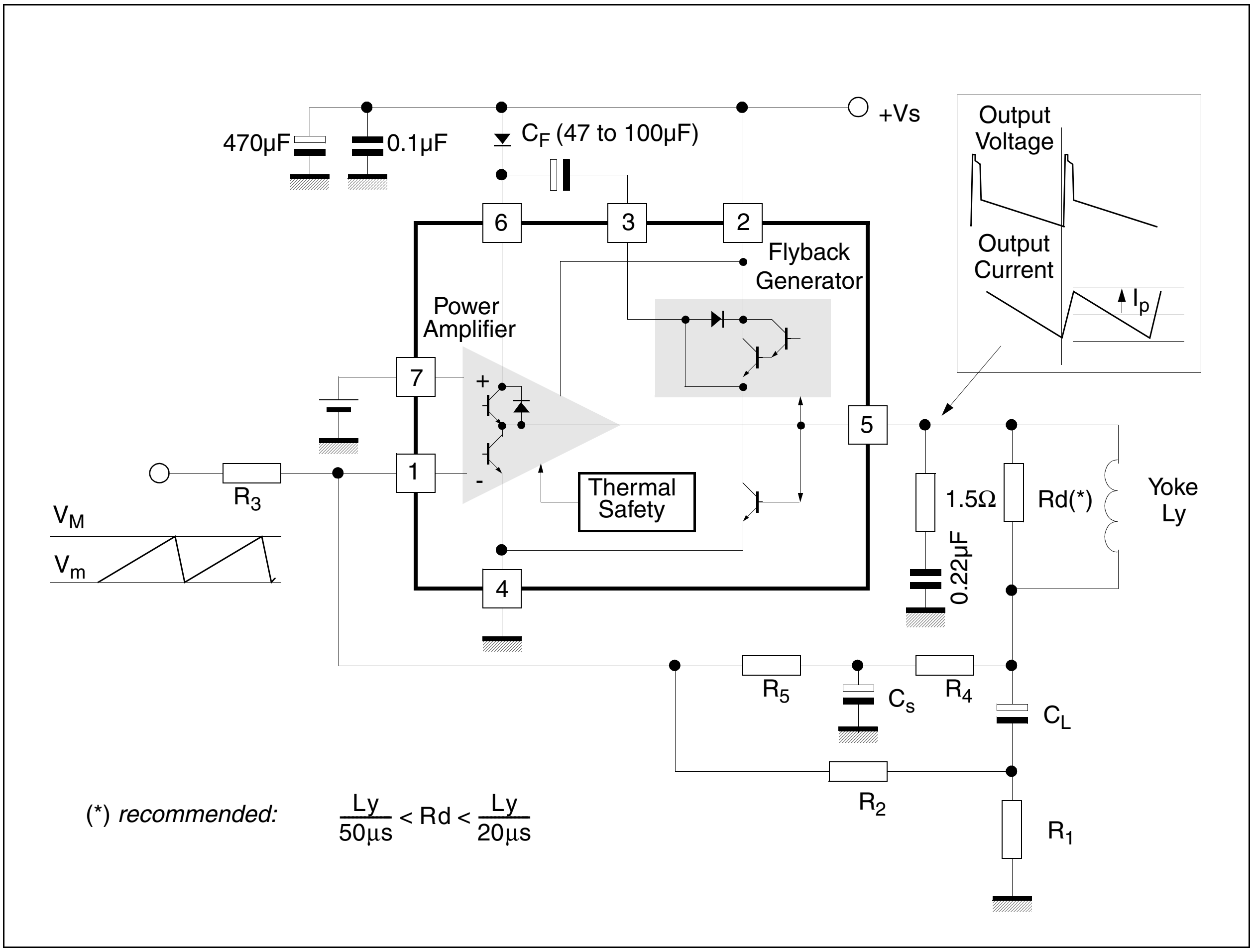
**Figure 5: Ripple Rejection**



## 4.2 AC-Coupled Applications

In AC-coupled applications (See Figure 6), only one supply ($V_S$) is needed. The vertical position of the scanning cannot be adjusted with input bias (for that purpose, usually some current is injected or sunk with a resistor in the low side of the yoke).

**Figure 6: AC-coupled Application**




### 4.2.1 Application Hints

Gain is defined as in the previous case:

$$I_p = \frac{V_M - V_m}{2} \times \frac{R_2}{R_1 \times R_3}$$

Choose $R_1$ then either $R_2$ or $R_3$. For good output centering, $V_7$ must fulfill the following equation:

$$\frac{\frac{V_S}{2} - V_7}{R_4 + R_5} = \frac{V_7 - \frac{V_M + V_m}{2}}{R_3} + \frac{V_7}{R_2}$$

or

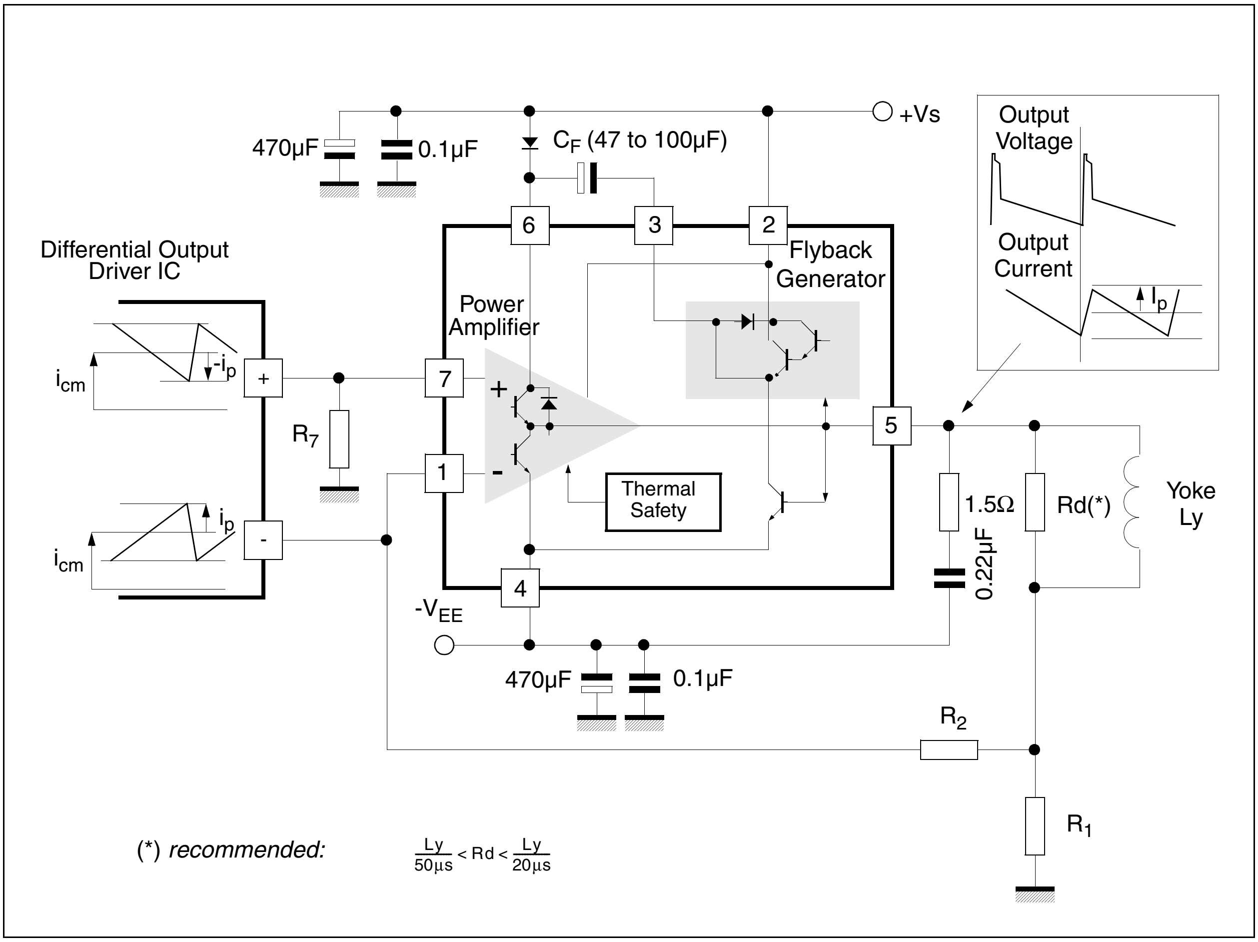
$$V_7 \times \left(\frac{1}{R_3} + \frac{1}{R_2} + \frac{1}{R_4 + R_5}\right) = \left(\frac{V_S}{2(R_4 + R_5)} + \frac{V_M + V_m}{2 \times R_3}\right)$$

$C_S$ performs an integration of the parabolic signal on $C_L$, therefore the amount of S correction is set by the combination of $C_L$ and $C_s$.

## 4.3 Application with Differential-output Drivers

Certain driver ICs provide the ramp signal in differential form, as two current sources $i_+$ and $i_-$with opposite variations.

**Figure 7: Using a Differential-output Driver**




Let us set some definitions:

- $i_{cm}$ is the common-mode current: $i_{cm} = \frac{1}{2}(i_+ + i_-)$
- at peak of signal, $i_+ = i_{cm} + i_p$ and $i_- = i_{cm} - i_p$, therefore the peak differential signal is $i_p - (-i_p) = 2\,i_p$, and the peak-peak differential signal, $4i_p$.

The application is described in Figure 7 with DC yoke coupling. The calculations still rely on the fact that $V_1$ remains equal to $V_7$.

### 4.3.1 Centring

When idle, both driver outputs provide $i_{cm}$ and the yoke current should be null ($R_1$ is negligible), hence:

$$i_{cm} \cdot R_7 = i_{cm} \cdot R_2 \quad \text{therefore} \quad R_7 = R_2$$

### 4.3.2 Peak Current

Scanning current should be $I_P$ when positive and negative driver outputs provide respectively $i_{cm}$ - $i_p$ and $i_{cm}$ + $i_p$, therefore

$$(i_{cm} - i) \cdot R_7 = I_p \cdot R_1 + (i_{cm} + i) \cdot R_2 \text{ and since } R_7 = R_2\text{:} \quad \frac{I_p}{i} = -\frac{2R_7}{R_1}$$

Choose $R_1$ in the 1Ω range, the value of $R_2 = R_7$ follows. Remember that i is one-quarter of driver peak-peak differential signal! Also check that the voltages on the driver outputs remain inside allowed range.

- Example: for $i_{cm}$ = 0.4mA, i = 0.2mA (corresponding to 0.8mA of peak-peak differential current), $I_p$ = 1A

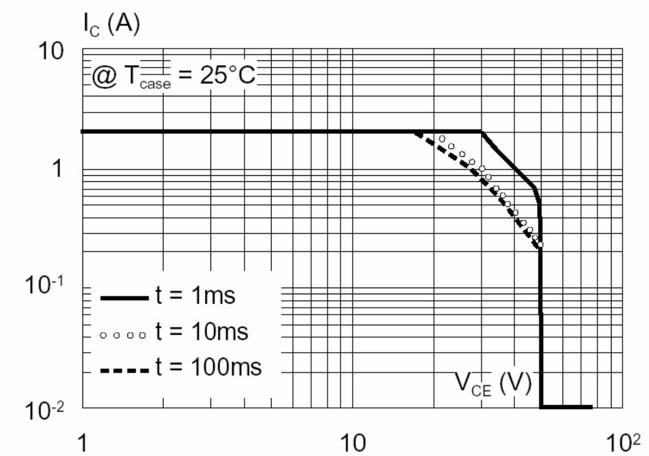
  Choose $R_1$ = 0.75Ω, it follows $R_2 = R_7$ = 1.875kΩ

### 4.3.3 Ripple Rejection

Make sure to connect $R_7$ directly to the ground side of $R_1$.

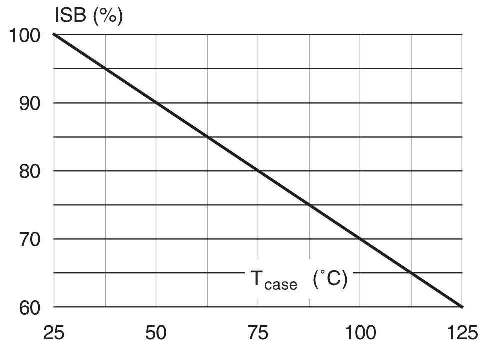
### 4.3.4 Secondary Breakdown Diagrams

**Figure 8: Output Transistor Safe Operating Area (SOA) for Secondary Breakdown**




The diagram has been arbitrarily limited to max I0 (2 A).

**Figure 9: Secondary Breakdown Temperature Derating Curve (ISB = Secondary Breakdown Current)**

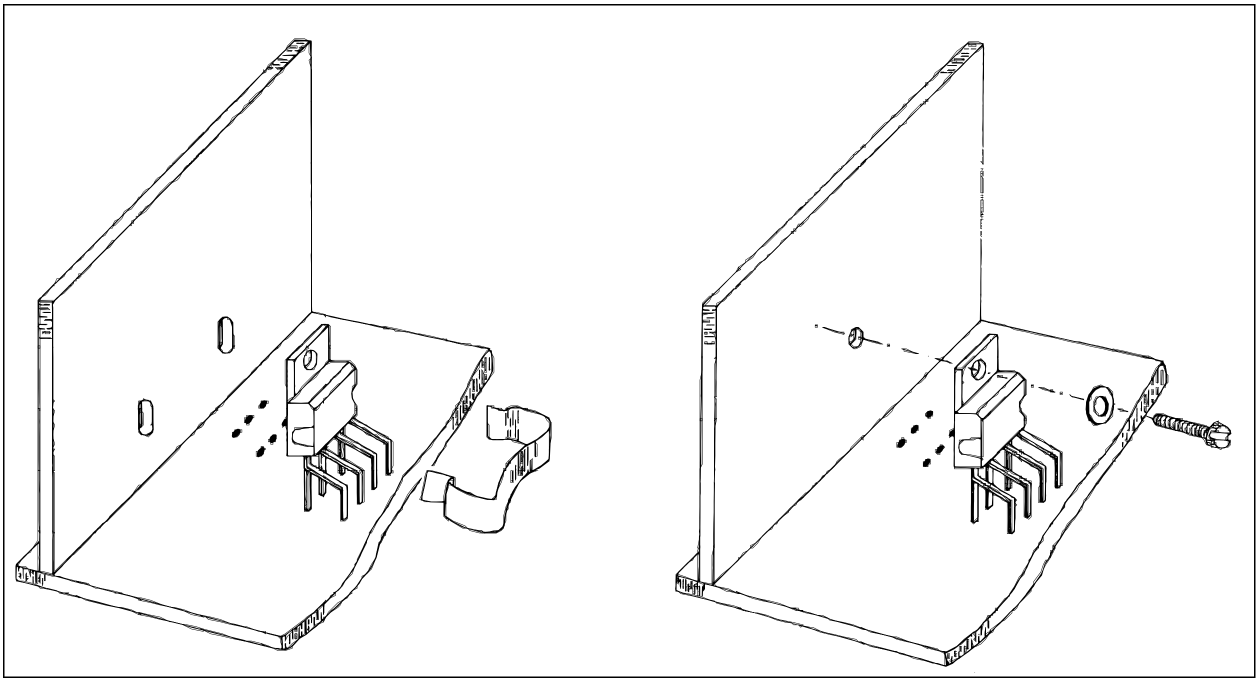


# 5 Mounting Instructions

The power dissipated in the circuit is removed by adding an external heatsink. With the HEPTAWATT™ package, the heatsink is simply attached with a screw or a compression spring (clip).

A layer of silicon grease inserted between heatsink and package optimizes thermal contact. In DC-coupled applications we recommend to use a silicone tape between the device tab and the heatsink to electrically isolate the tab.

**Figure 10: Mounting Examples**



# 6 Pin Configuration

**Figure 11: Pins 1 and 7**

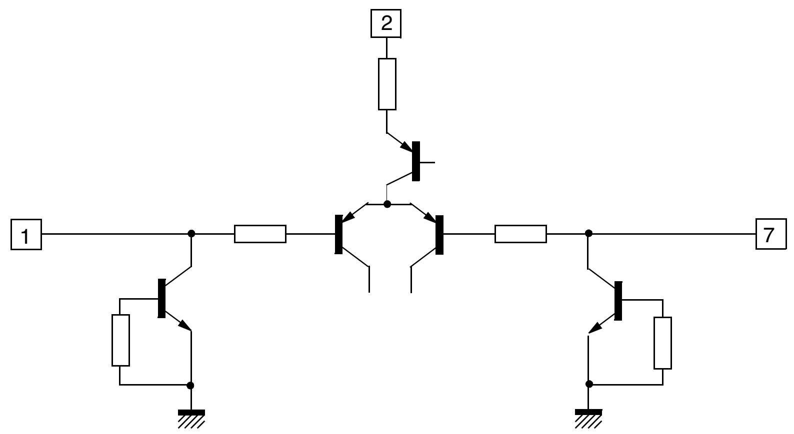
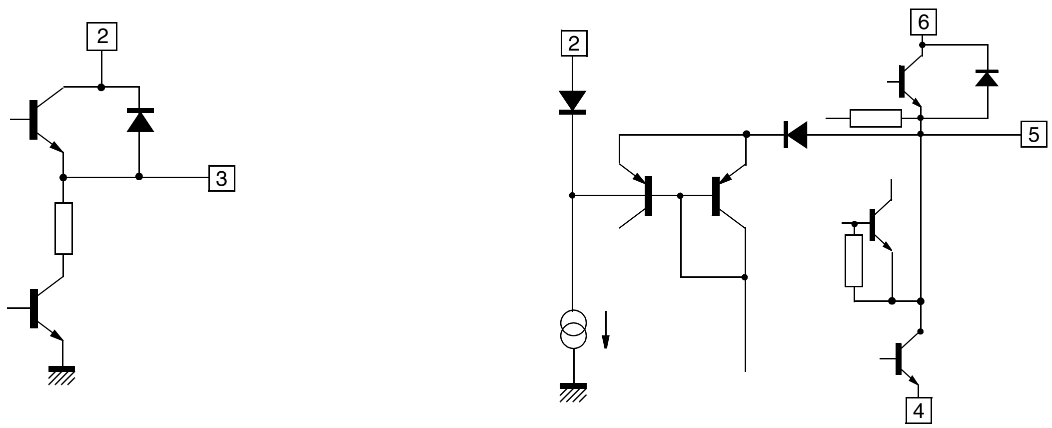



**Figure 12: Pin 3 & Pins 5 and 6**



# 7 Package Mechanical Data

**Figure 13: 7-pin Heptawatt Package**

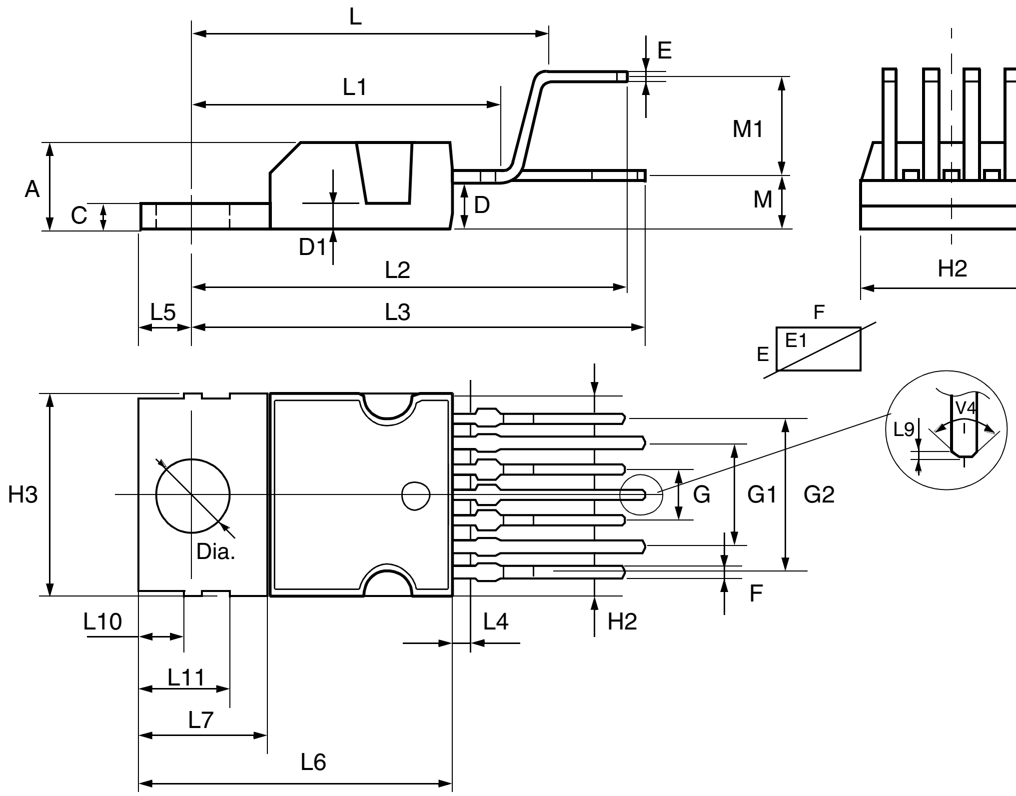



**Table 1: Heptawatt Package**

| Dim. | mm | | | inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 4.8 | | | 0.189 |
| C | | | 1.37 | | | 0.054 |
| D | 2.40 | | 2.80 | 0.094 | | 0.110 |
| D1 | 1.20 | | 1.35 | 0.047 | | 0.053 |
| E | 0.35 | | 0.55 | 0.014 | | 0.022 |
| E1 | 0.70 | | 0.97 | 0.028 | | 0.038 |
| F | 0.60 | | 0.80 | 0.024 | | 0.031 |
| G | 2.34 | 2.54 | 2.74 | 0.095 | 0.100 | 0.105 |
| G1 | 4.88 | 5.08 | 5.28 | 0.193 | 0.200 | 0.205 |
| G2 | 7.42 | 7.62 | 7.82 | 0.295 | 0.300 | 0.307 |
| H2 | | | 10.40 | | | 0.409 |
| H3 | 10.05 | | 10.40 | 0.396 | | 0.409 |
| L | 16.70 | 16.90 | 17.10 | 0.657 | 0.668 | 0.673 |

**Table 1: Heptawatt Package (Continued)**

| Dim. | mm | | | inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| **L1** | | 14.92 | | | 0.587 | |
| **L2** | 21.24 | 21.54 | 21.84 | 0.386 | 0.848 | 0.860 |
| **L3** | 22.27 | 22.52 | 22.77 | 0.877 | 0.891 | 0.896 |
| **L4** | | | 1.29 | | | 0.051 |
| **L5** | 2.60 | 2.80 | 3.00 | 0.102 | 0.110 | 0.118 |
| **L6** | 15.10 | 15.50 | 15.80 | 0.594 | 0.610 | 0.622 |
| **L7** | 6.00 | 6.35 | 6.60 | 0.0236 | 0.250 | 0.260 |
| **L9** | | 0.20 | | | 0.008 | |
| **L10** | 2.10 | | 2.70 | 0.082 | | 0.106 |
| **L11** | 4.30 | | 4.80 | 0.169 | | 0.190 |
| **M** | 2.55 | 2.80 | 3.05 | 0.100 | 0.110 | 0.120 |
| **M1** | 4.83 | 5.08 | 5.33 | 0.190 | 0.200 | 0.210 |
| **V4** | 40 (Typ.) | | | | | |
| **Dia.** | 3.65 | | 3.85 | 0.144 | | 0.152 |

# 8 Revision History

**Table 2: Summary of Modifications**

| Version | Date | Description |
|---|---|---|
| 1.0 | December 2003 | First Issue. |
| 1.1 | June 2004 | Datasheet status changed to “datasheet”. |
| 1.2 | February 2005 | Updated Figure 7: Using a Differential-output Driver on page 8. |
| 2 | March 2005 | Removed Stand-by Control and Monitor information. |