INTEGRATED CIRCUITS

DATA SHEET

TZA1025

Data amplifier and laser supply circuit for CD audio and video optical systems (ADALASLC)

Product specification
File under Integrated Circuits, IC01

1998 Oct 30

Philips
Semiconductors

PHILIPS

FEATURES

- Supports a wide range of voltage output mechanisms
- RF amplifier designed for audio and video applications with 1 × data rate
- Programmable RF gain for CD-Audio/Video (CD-A/V) and CD-Read/Write (CD-R/W) discs
- Equalizer for optimal performance
- Fully Automatic Laser Power Control (ALPC) including stabilization plus a separate laser supply voltage for power efficiency
- Adjustable current range of ALPC output
- Automatic N- or P-substrate monitor diode selection
- Adjustable laser bandwidth and laser switch-on current slope using external capacitor
- Protection circuit to prevent laser damage due to laser supply voltage dip
- Optimized interconnection between data amplifier and Philips' digital signal processor CD10LC (SAA7325)
- Wide supply voltage range
- Power-down switch to reduce power consumption during standby
- Low power consumption.

GENERAL DESCRIPTION

The TZA1025 is a data amplifier and laser supply circuit for voltage output mechanisms found in a wide range of audio and video CD systems. The device contains an RF amplifier and an automatic laser power control circuit.

The preamplifier forms an interface for voltage output CD mechanisms to the Philips' digital signal processor CD10LC (SAA7325).

The RF bandwidth allows this device to be used in CD-A/V applications with a data rate of n = 1 times speed. The RF gain can be adapted for CD-A/V discs or CD-R/W discs by means of the gain select signal.

The equalizer ensures an optimal performance.

The TZA1025 can be adapted to a wide range of voltage output mechanisms by means of external resistors.

The ALPC circuit will maintain control over the laser diode current. With an on-chip reference voltage generator, a constant and stabilized output power is ensured independent of ageing. The ALPC can accommodate N- or P-substrate monitor diodes.

A separate supply voltage connection for the laser allows the internal power dissipation to be reduced by connecting a low voltage supply. The laser output current range can be optimized to fit the requirements of the laser diode by means of one external resistor. When a DC-to-DC converter is used, in combination with the control loop of the ALPC, the adjustable output current range provides the possibility to compensate for the extra gain a DC-to-DC converter introduces in the control loop.

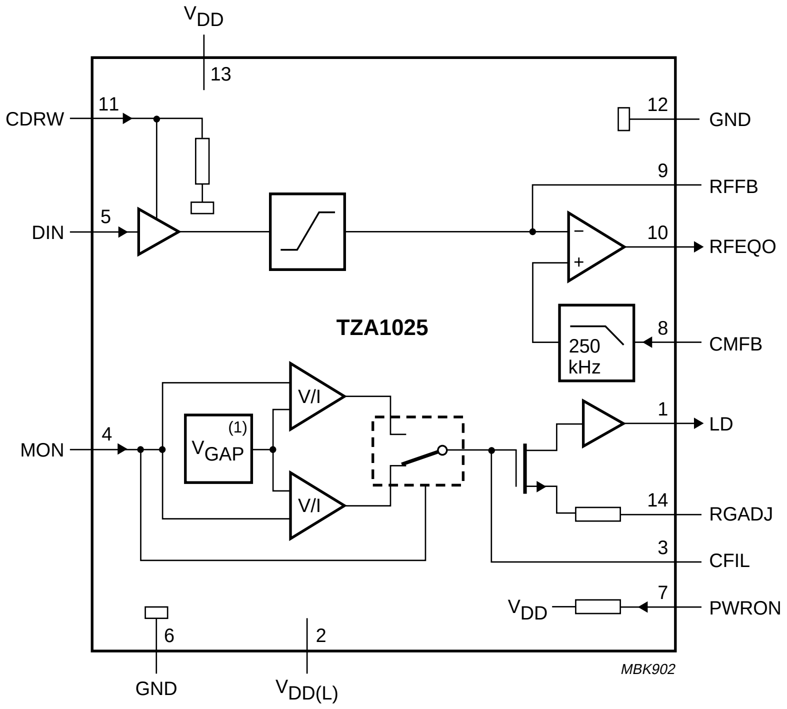
ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TZA1025T	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{DD}	supply voltage		2.4	–	5.5	V
I_{DD}	supply current		–	3	–	mA
$V_{DD(L)}$	laser supply voltage		2.4	–	5.5	V
RF amplifier						
$t_{d(f)(RF)}$	RF flatness delay		–	–	10	ns
Laser supply circuit						
$I_{o(LASER)(max)}$	maximum laser output current	$V_{DD(L)} - V_{o(LASER)} = 0.55$ V	80	–	–	mA
$V_{i(mon)}$	monitor input voltage					
	N-substrate monitor diode		–	0.150	–	V
	P-substrate monitor diode		–	$V_{DD} - 0.150$	–	V
Temperature range						
T_{amb}	operating ambient temperature		0	–	70	°C

BLOCK DIAGRAM



(1) Band gap reference voltage.

Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
LD	1	current output to laser diode
$V_{DD(L)}$	2	laser supply voltage
CFIL	3	external filter capacitor
MON	4	laser monitor diode input
DIN	5	central diode input
GND	6	ground
PWRON	7	power-on select input
CMFB	8	common mode feedback voltage input
RFFB	9	external RF feedback resistor
RFEQO	10	RF amplifier output
CDRW	11	gain select input for CD-A/V, CD-R/W
GND	12	ground
V_{DD}	13	supply voltage
RGADJ	14	external laser supply gain adjust resistor

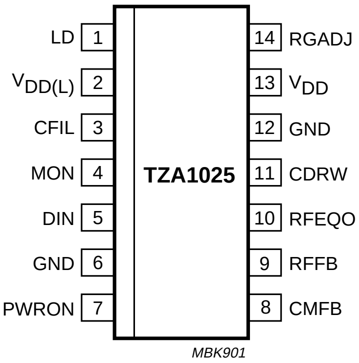


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

The TZA1025 consists of two sections, the RF amplifier and the automatic laser power control circuit.

RF amplifier

The RF amplifier consists of a current input amplifier, an equalizer/bandwidth section and a transimpedance output amplifier with an external feedback resistor of 10 kΩ (fixed value).

The gain of the RF amplifier can be adjusted by the external input resistors. Fig.3 shows the simplified schematic which can be used to determine the RF gain. The signal is AC coupled to the RF amplifier. The formula to determine the gain is shown below:

$$G_{RF} = -n \times \frac{Z_{tr(RF)}}{R2} \quad (1)$$

where:

G_{RF} is the RF amplifier gain

n is the number of input resistors

$Z_{tr(RF)}$ is the transimpedance of the amplifier (Ω)

R2 is the value of the input resistors (Ω).

The gain can be increased by a factor of 4 by making pin CDRW HIGH. The value of $Z_{tr(RF)}$ is 9.8 kΩ for CD-A/V (CDRW = LOW) and 38 kΩ for CD-R/W (CDRW = HIGH).

An internal equalizer ensures an optimal performance.

The DC output level of the amplifier can be set by applying a DC voltage on the common mode feedback pin CMFB. Since the input signal is AC-coupled the RF output voltage will swing (symmetrically) around this DC level.

The coupling of the TZA1025 to the signal processor (SAA7325) can be either AC or DC. When an AC-coupling is chosen (see Fig.6) the minimum supply voltage can be applied. When a DC-coupling is chosen (see Fig.7) a minimum supply voltage of 2.8 V is required.

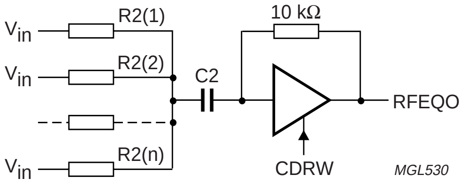


Fig.3 Simplified schematic.

Automatic laser power control circuit

The ALPC stabilises the laser output power thereby reducing the effect of ageing of the laser.

The TZA1025 automatically detects when an N- or P-substrate monitor diode is used and selects the correct reference voltage. A simplified diagram for the use of an N- or P-substrate monitor diode is given in Fig.4.

The gain of the loop can be controlled (reduced) by adding an external resistor between pins RGADJ and GND. The loop gain then becomes:

$$G_{loop} = G_{ALPC} \times G_{lm} \times G_{con} \times \frac{250}{250 + R_{RGADJ}} \qquad (2)$$

where:

G_{loop} is the loop gain

G_{ALPC} is the ALPC transfer (60 A/V)

G_{lm} is the laser-to-monitor transfer (V/A)

G_{con} is the extra gain introduced when a DC-to-DC converter is used in the loop; $G_{con} = 1$ when no DC-to-DC converter is used

250 is a fixed internal resistor value (Ω)

R_{RGADJ} is the value of the external resistor (Ω).

The minimum available output current is also reduced when an external resistor is used. The formula to determine the minimum available output current is shown in equation (3).

$$I_o = I_{o(LASER)(max)} \times \frac{250}{250 + R_{RGADJ}} \qquad (3)$$

where:

I_o is output current (mA)

$I_{o(LASER)(max)}$ is the maximum laser output current (mA)

250 is a fixed internal resistor value (Ω)

R_{RGADJ} is the value of the external resistor (Ω).

The bandwidth of the loop is determined by the external filter capacitor C_{CFIL} and the loop gain. The formula to determine the bandwidth is shown in equation (4).

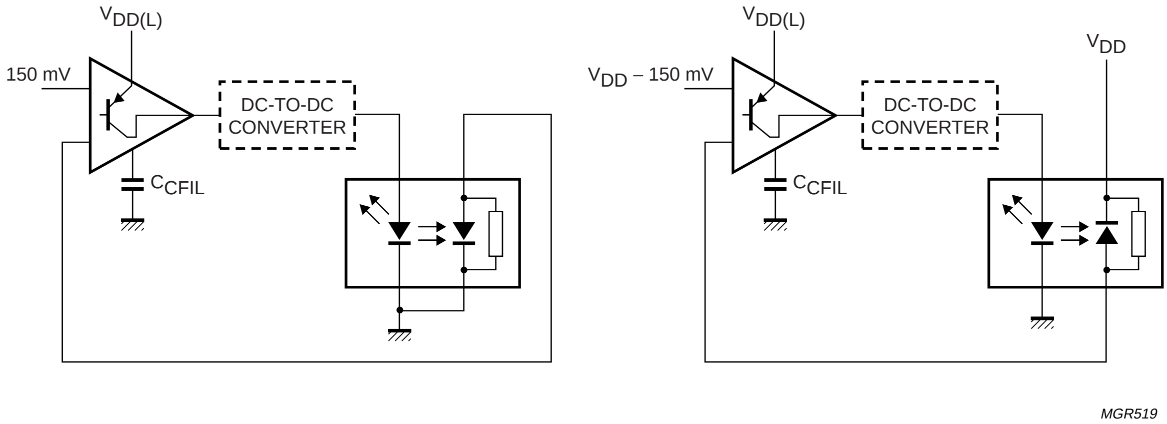
$$\tau_{-3dB} = \frac{C_{CFIL} \times 16 \cdot 10^6}{G_{loop}} \qquad (4)$$

where:

C_{CFIL} is the value of the capacitor (F)

G_{loop} is the loop gain.

The TZA1025 has a protection circuit to prevent laser damage that can occur due to a dip of $V_{DD(L)}$. When a dip occurs the output transistor (see Fig.4) will go into saturation making it unable to supply the required laser current. Without the protection circuit the ALPC would still try to supply the required laser current by charging the filter capacitor C_{CFIL}. After the dip a fully charged capacitor would create a large output current during the few milliseconds it needs to discharge the capacitor to a normal level. The protection circuit monitors the output transistor and switches off the ALPC when saturation occurs by discharging the capacitor. The ALPC will automatically restart within a few milliseconds after the dip has passed.



a. N-substrate monitor diode.

b. P-substrate monitor diode.

Fig.4 Automatic Laser Power Control (ALPC) loop.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DD}	supply voltage		–0.5	+5.5	V
$V_{DD(L)}$	laser supply voltage		–0.5	+5.5	V
$V_{i(n)}$	input voltage on pins 3, 4, 7, 8, 10, 11, 12 and 14	note 1	–0.5	V_{DD} + 0.5	V
$V_{o(LASER)}$	laser output voltage	note 2	–0.5	$V_{DD(L)}$ + 0.5	V
$V_{i(DIN)}$	central diode input voltage	note 3	–0.5	–	V
$I_{i(DIN)}$	central diode input current	note 4	–1	+1	mA
$V_{i(RFFB)}$	RF feedback voltage	note 3	–0.5	–	V
$I_{i(RFFB)}$	RF feedback current	note 4	–1	+1	mA
V_{es}	electrostatic handling	human body model; note 5	–2000	+2000	V
		machine model; note 6	–250	+250	V
T_{amb}	operating ambient temperature		0	70	°C

Notes

1. The maximum value V_{DD} + 0.5 must not exceed 5.5 V.
2. The maximum value $V_{DD(L)}$ + 0.5 must not exceed 5.5 V.
3. Pins DIN and RFFB are current inputs with a limitation on the maximum input current.
4. The maximum peak current must not exceed ten times the absolute average input current with a maximum for the absolute average input current of 1 mA. Averaging is only allowed over a maximum time interval of 100 ms.
5. Equivalent to discharging a 100 pF capacitor via a 1.5 kΩ series resistor with a rise time of 15 ns.
6. Equivalent to discharging a 200 pF capacitor via a 2.5 μH series inductor.

QUALITY SPECIFICATION

In accordance with *“SNW-FQ-611-E”*.

CHARACTERISTICS

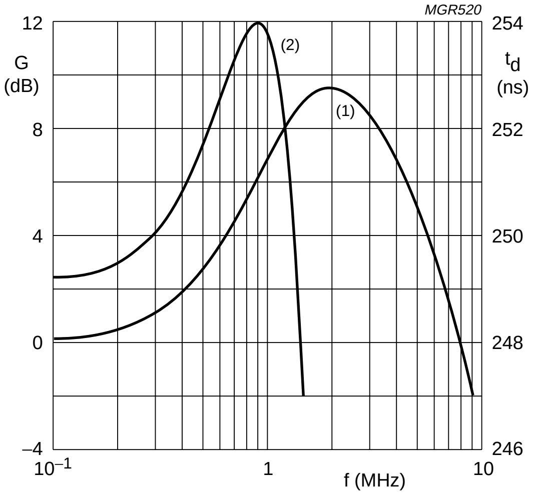
V_{DD} = 2.4 V; $V_{DD(L)} - V_{o(LASER)}$ = 0.55 V; $I_{i(DIN)}$ = 0 mA; $I_{o(LASER)}$ = 80 mA; $V_{CMFB} = \frac{1}{2}V_{DD}$; PWRON = HIGH; CDRW = LOW; C_{CFIL} = 10 nF; R_{RFFB} = 10 kΩ; pin RGADJ connected to ground; T_{amb} = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{DD}	supply voltage		2.4	–	5.5	V
$V_{DDL(L)}$	laser supply voltage		2.4	–	5.5	V
I_{DD}	supply current		–	3	–	mA
I_q	quiescent supply current	PWRON = LOW	–	–	40	μA
RF amplifier						
$I_{i(DIN)}$	central diode input current		–70	–	+70	μA
$Z_{i(DIN)}$	central diode input impedance		–	100	–	Ω
V_{CMFB}	common mode feedback input voltage		0.7	$\frac{1}{2}V_{DD}$	$V_{DD} - 0.4$	V
$V_{O(RFEQO)}$	RF amplifier output DC-level	CDRW = LOW	$V_{CMFB} - 0.05$	–	$V_{CMFB} + 0.25$	V
		CDRW = HIGH	$V_{CMFB} - 0.35$	–	$V_{CMFB} + 0.35$	V
$V_{o(RFEQO)}$	RF amplifier output voltage		0.25	–	$V_{DD} - 0.25$	V
$Z_{o(RFEQO)}$	RF amplifier output impedance	note 1	–	100	–	Ω
$t_{d(f)(RF)}$	RF flatness delay		–	–	10	ns
G_{RF}	RF path gain boost	f = 720 kHz; note 2	–	5	–	dB
$Z_{tr(RF)}$	RF transimpedance	note 3				
		CDRW = LOW	9.2	9.8	10.4	kΩ
		CDRW = HIGH	35.6	38	40.4	kΩ
THD_{RF}	RF total harmonic distortion	note 4	–	–50	–	dB
$PSRR_{RF}$	RF power supply ripple rejection	0 to 100 kHz	–	40	–	dB
$V_{n(in-band)(rms)}$	in-band noise (RMS value)	note 4	–	2.7	–	mV
Laser supply circuit						
V_{drop}	drop voltage	note 5	0.55	–	5.5	V
$I_{o(LASER)(max)}$	maximum laser output current	V_{drop} = 0.55 V; note 6	80	–	–	mA
$Z_{o(LASER)}$	laser output impedance	V_{drop} = 0.55 V; note 7				
		$I_{o(LASER)}$ = 53 mA	–	500	–	Ω
		$I_{o(LASER)}$ = 20 mA	–	1200	–	Ω

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{i(mon)}$	monitor input voltage					
	N-substrate		0.132	0.150	0.168	V
	P-substrate		V_{DD} – 0.168	V_{DD} – 0.150	V_{DD} – 0.132	V
$I_{i(mon)}$	monitor input current		–200	–	+200	nA
$t_{sw(on)(LASER)}$	laser switch-on time		–	3	–	ms
RS_{ref}	reference supply rejection	note 8	–	–	5	%
V_{clamp}	ALPC clamp voltage	note 9	–	–	0.5	V
Control inputs						
$Z_{i(pd)}$	pull-down input impedance pin CDRW		–	200	–	kΩ
$Z_{i(pu)}$	pull-up input impedance pin PWRON		–	200	–	kΩ
V_{IL}	LOW-level input voltage					
	pin CDRW		–0.2	–	$\frac{1}{3}V_{DD}$	V
	pin PWRON		–0.2	–	$\frac{1}{3}V_{DD}$	V
V_{IH}	HIGH-level input voltage					
	pin CDRW		$\frac{2}{3}V_{DD}$	–	V_{DD} + 0.2	V
	pin PWRON		$\frac{2}{3}V_{DD}$	–	V_{DD} + 0.2	V

Notes

1. Closed-loop output impedance (10 kΩ feedback resistor connected between pins RFEQO and RFFB).
2. $G_{RF} = (G_{RFEQO}$ at $f_{EQ}) - (G_{RFEQO}$ at 720 kHz).
3. Values to be used in equation (1).
4. An RF filter of 1 kΩ and 47 pF should be used on the RF output.
5. $V_{drop} = V_{DD(L)} - V_{o(LASER)}$.
6. An external resistor can be used to reduce the maximum output current (and the gain) of the laser supply; see equation (4).
7. The output impedance strongly depends on the drop voltage (V_{drop}). The output impedance will approximately double when the drop voltage doubles.
8. $$RS_{ref} = \frac{\dfrac{\Delta V_{mon}}{V_{mon}}}{\dfrac{\Delta V_{DD}}{V_{DD}}}$$
9. When a voltage dip at $V_{DD(L)}$ occurs it could cause peak currents on $I_{o(LASER)}$ coming out of the ALPC output. To protect the laser against such peak currents a protection circuit will switch-off the laser current when V_{drop} becomes lower than V_{clamp}. When $V_{drop} > V_{clamp}$ the laser will switch-on automatically again.



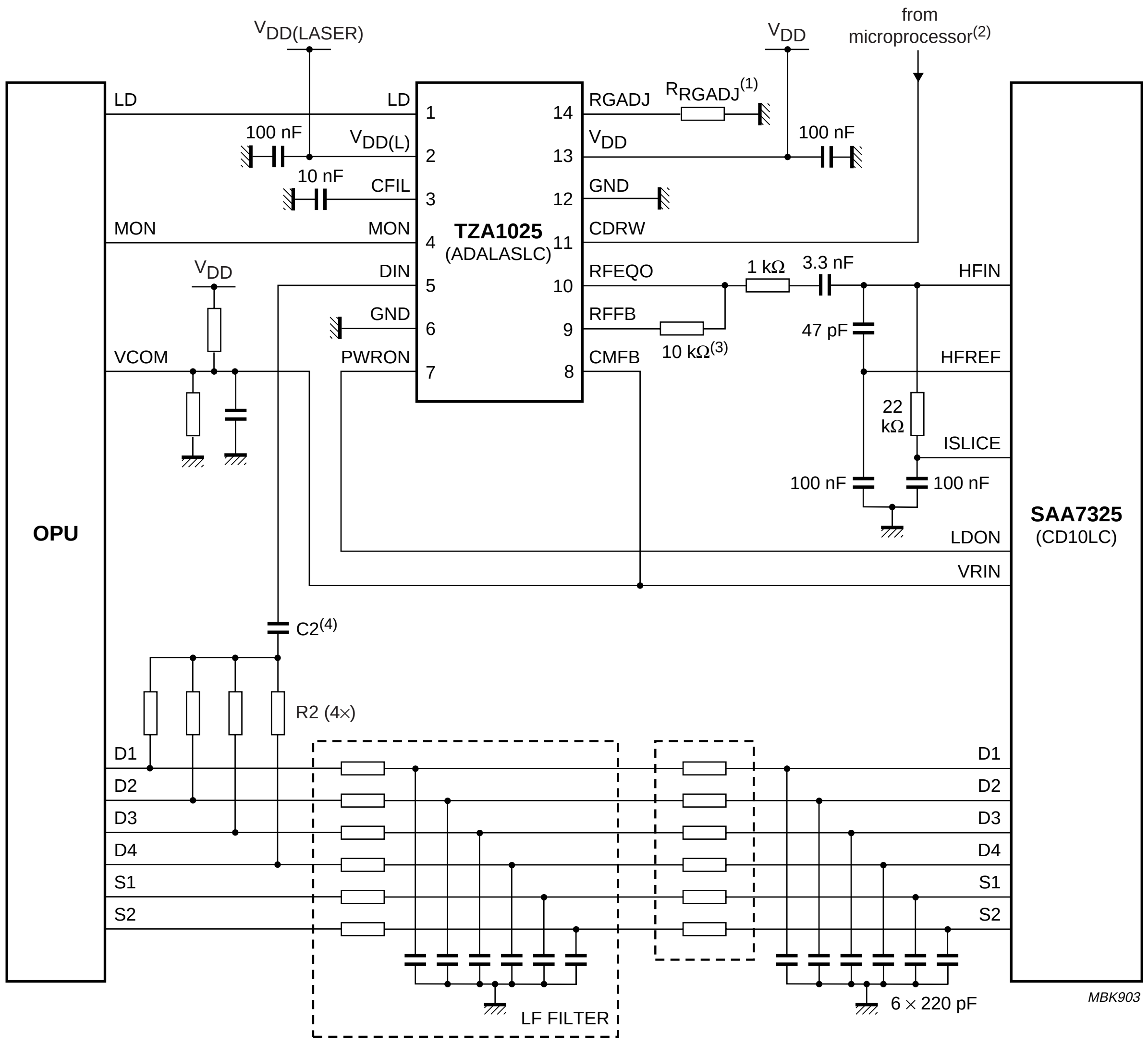
(1) Gain.

(2) Delay. Definition of delay: $t_d = \frac{\left(\frac{\varphi}{360}\right)}{f}$

Fig.5 Equalizer gain and delay.

APPLICATION INFORMATION

The application for the TZA1025 (ADALASLC) with the SAA7325 (CD10LC) using a coupling capacitor of 3.3 nF is shown in Fig.6.



(1) See equation (3) to calculate the value of this resistor.

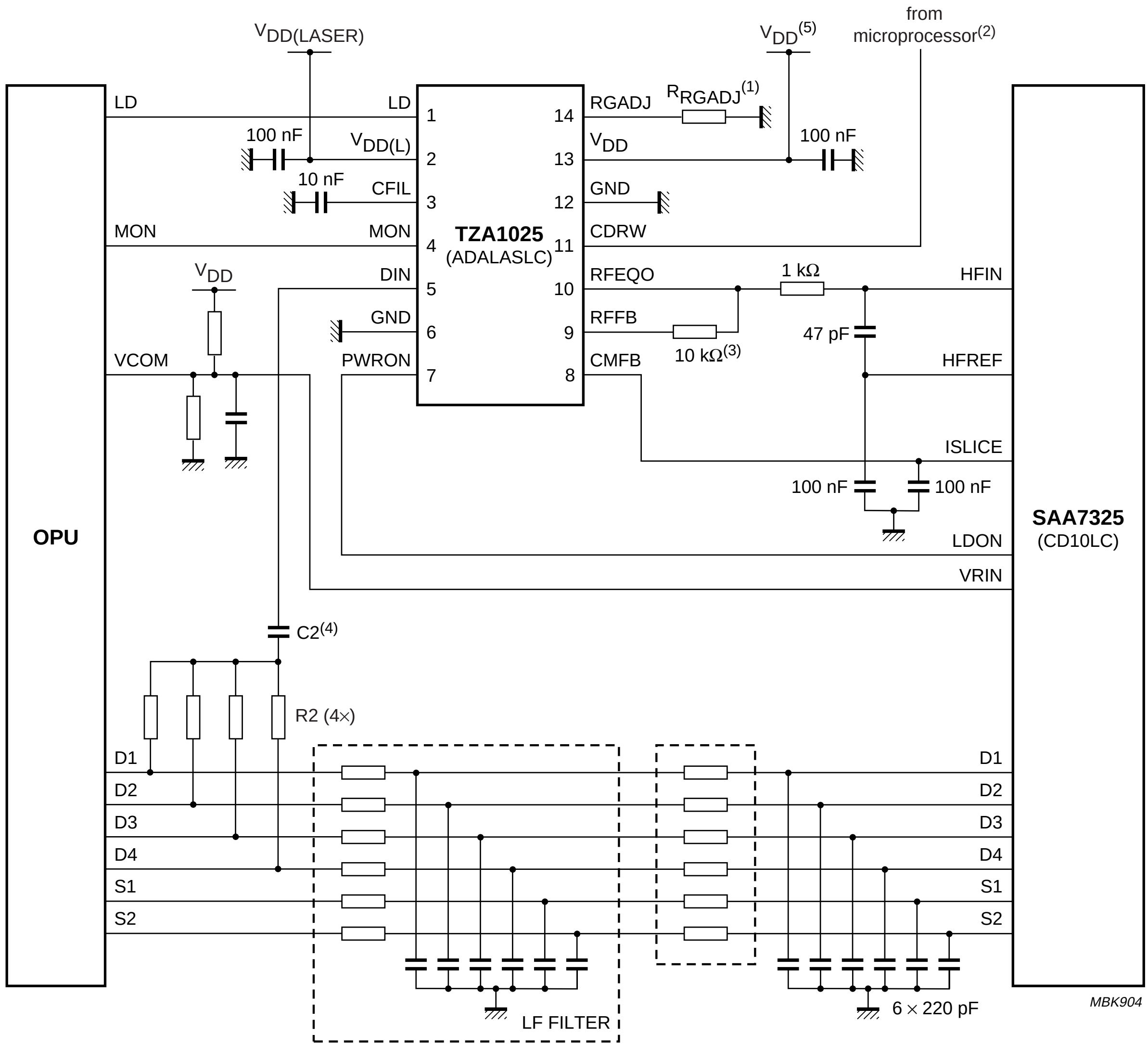
(2) Pin CDRW can be controlled by the CD10LC or a microprocessor but can also be fixed or switched by any other means.

(3) The 10 kΩ feedback resistor between pins 9 and 10 is a fixed value.

(4) The high-pass filter (AC-coupling) is placed at the input of the preamplifier. The –3 dB point (f = 10 kHz) is at $\frac{R2\,(\Omega)\times C2\,(F)}{4}$

Fig.6 Application diagram with SAA7325 (CD10LC) using a coupling capacitor.

The application for the TZA1025 (ADALASLC) with the SAA7325 (CD10LC) without a coupling capacitor is shown in Fig.7. A minimum supply voltage (V_{DD}) is required for optimal performance.



(1) See equation (3) to calculate the value of this resistor.

(2) Pin CDRW can be controlled by the CD10LC or a microprocessor but can also be fixed or switched by any other means.

(3) The 10 kΩ feedback resistor between pins 9 and 10 is a fixed value.

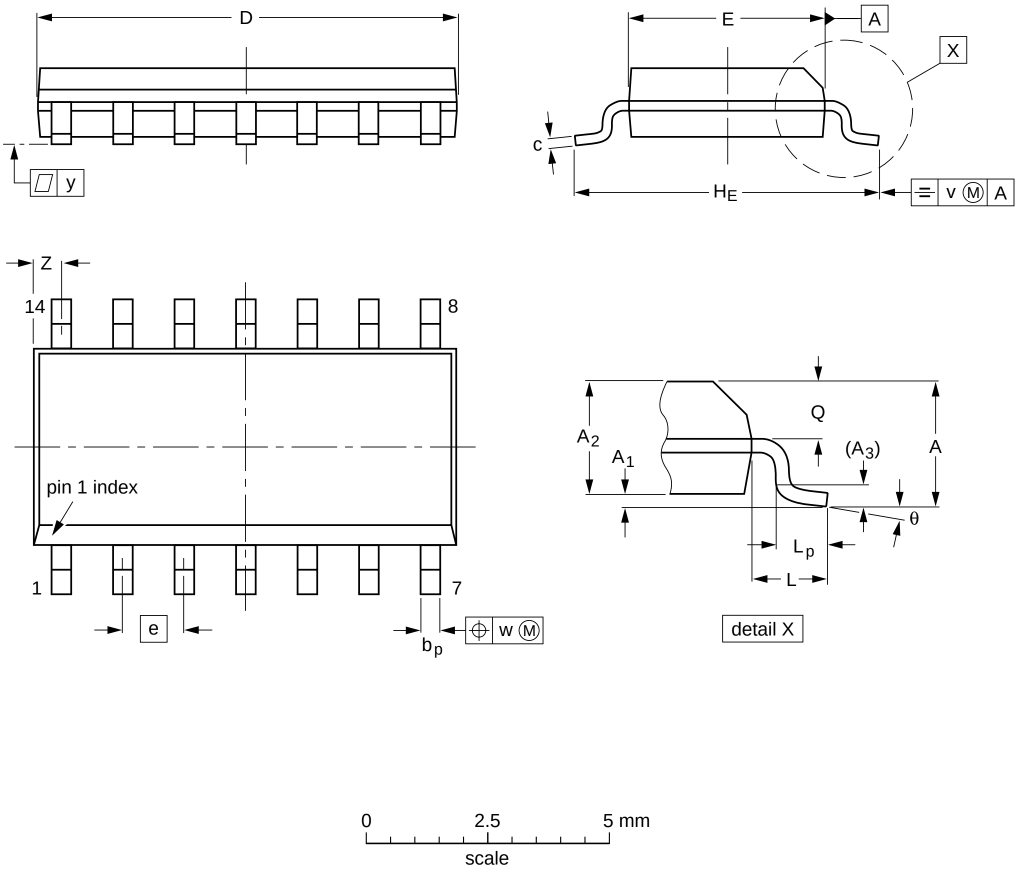
(4) The high-pass filter (AC-coupling) is placed at the input of the preamplifier. The –3 dB point (f = 10 kHz) is at $\frac{R2\,(\Omega) \times C2\,(F)}{4}$

(5) The minimum supply voltage (V_{DD}) without using a coupling capacitor is 2.8 V.

Fig.7 Application diagram with SAA7325 (CD10LC) without coupling capacitor.

PACKAGE OUTLINE

SO14: plastic small outline package; 14 leads; body width 3.9 mm **SOT108-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT108-1	076E06S	MS-012AB				~~95-01-23~~ 97-05-22

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).

Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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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