

BUCKET BRIGADE DELAY LINE FOR ANALOGUE SIGNALS

The TDA1022 is a MOS monolithic integrated circuit, generally intended to delay analogue signals (e. g. delay time = $512/2 f_{\phi}$).

It can be used with clock frequencies in the range 5 kHz to 500 kHz.

The device contains 512 stages, so the input signal can be delayed from 51,2 ms to 0,512 ms.

Applications in which the device can be used:

- variation of fixed delays of analogue signals, vox control, equalizing speech delay in public address systems;
- in electronic organs and other musical instruments for vibrato and chorus effects;
- reverberation effects;
- variable compression and expansion of speech in tape-recorders;
- in communication systems for speech scrambling and time scale conversion.

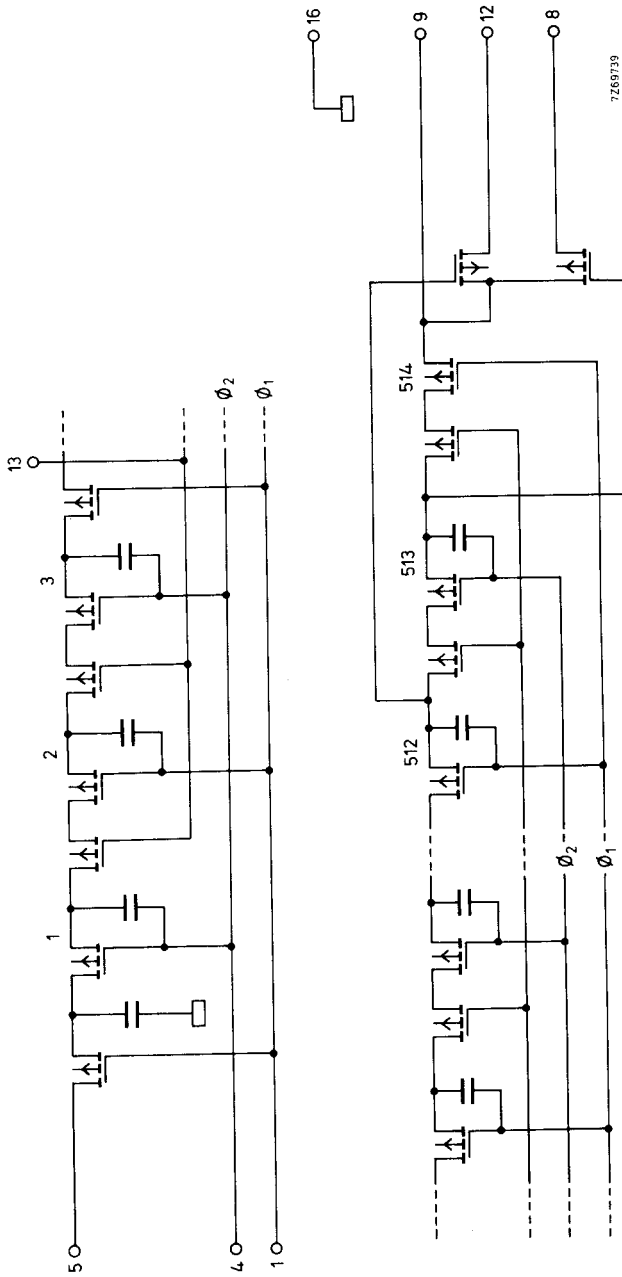
QUICK REFERENCE DATA

Supply voltage (pin 9)	V_{DD}	nom.	-15	V
Clock frequency	f_{ϕ}		5 to 500	kHz
Number of stages			512	
Signal delay range	t_d		51,2 to 0,512	ms
Signal frequency range	f_s		0 (d. c.) to 45	kHz
Input voltage at pin 5 (peak-to-peak value)	$V_{5-16(p-p)}$	typ.	7	V
Line attenuation		typ.	4	dB ¹⁾

PACKAGE OUTLINE plastic 16-lead dual in-line (see general section).

¹⁾ See note 1 on page 4.

CIRCUIT DIAGRAM



PINNING

- | | | | |
|--------------------------------|------------------|---------------------------------|----------------------------------|
| 1. Clock input 1 (V_{CL1}) | 5. Signal input | 9. Negative supply (V_{DD}) | 13. Tetrode gate (V_{13-16}) |
| 2. Not connected | 6. Not connected | 10. Not connected | 14. Not connected |
| 3. Not connected | 7. Not connected | 11. Not connected | 15. Not connected |
| 4. Clock input 2 (V_{CL2}) | 8. Output 513 | 12. Output 512 | 16. Ground (substrate) |

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages (see note)

Supply voltage	V_{9-16}	0 to -20 V
Clock input, data input, output voltage and V_{13-16}		0 to -18 V

Current

Output current	$I_8; I_{12}$	0 to 5 mA
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Temperatures

Storage temperature	T_{stg}	-40 to +150 °C
Operating ambient temperature	T_{amb}	-20 to +85 °C

Note

Though MOS integrated circuits incorporate protection against electrostatic discharge, they can nevertheless be damaged by accidental over-voltages.

To be totally safe, it is desirable to take handling precautions into account.

CHARACTERISTICS at $T_{amb} = -20$ to $+55$ °C; $V_{DD} = -15$ V; $V_{\phi 1} = V_{\phi 2} = -15$ V;
 $V_{13-16} = -14$ V; $R_L = 47$ k Ω (unless otherwise specified)

Supply voltage range	V_{DD}	-10 to -18 V	1)
Supply current	I_9	typ. 0,3 mA	
Clock frequency	$f_{\phi 1}; f_{\phi 2}$	5 to 500 kHz	2)
Clock pulse width	$t_{\phi 1}; t_{\phi 2}$	$\leq 0,5T$	3)
Clock pulse rise time	$t_{\phi 1r}; t_{\phi 2r}$	typ. 0,05T	3)
fall time	$t_{\phi 1f}; t_{\phi 2f}$	typ. 0,05T	3)
Clock pulse voltage levels; HIGH	$V_{\phi 1H}; V_{\phi 2H}$	0 to -1,5 V	
LOW	$V_{\phi 1L}; V_{\phi 2L}$	typ. -15 V	1)
		-10 to -18 V	1)
Signal input voltage at 1% ^o output voltage distortion (r. m. s. value)	$V_{s(rms)}$	typ. 2,5 V	
Signal frequency	f_s	0 (d.c.) to 45 kHz	

1) It is recommended that $V_{13-16} = V_{\phi 1L} + 1$ V = $V_{\phi 2L} + 1$ V; V_{DD} more negative than $V_{\phi L}$.

2) In theory the clock frequency must be higher than twice the highest signal frequency; in practice $f_s \leq 0,3 f_{\phi}$ to $0,5 f_{\phi}$ is recommended, depending on the characteristics of the output filter.

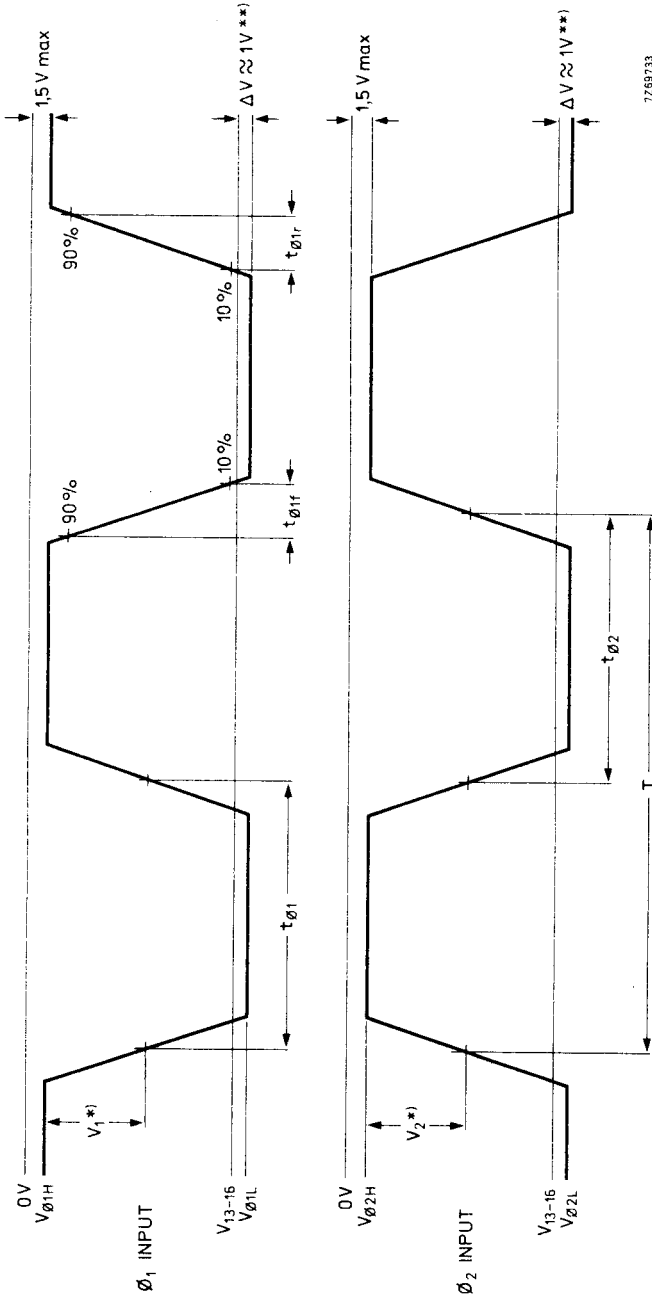
3) T = period time = $1/f_{\phi}$. The data on fall and rise times are given to eliminate overlap between the two clock pulses. To be independent of these rise and fall times a clock generator with simple gating can be used. See also pages 5 and 8.

CHARACTERISTICS (continued)

Attenuation from input to output $f_{\phi} = 40 \text{ kHz}; f_s = 1 \text{ kHz}$	typ.	4	dB	1)
	<	7	dB	
Change in output at $f_s = 1 \text{ kHz}; V_{S(\text{rms})} = 1 \text{ V}$ when f_{ϕ} varies from 5 to 100 kHz	typ.	0,5	dB	
	<	1	dB	
when f_{ϕ} varies from 100 to 300 kHz	typ.	0,5	dB	
	<	1	dB	
D. C. voltage shift when f_{ϕ} varies from 5 to 300 kHz	<	0,5	V	
Noise output voltage (r. m. s. value) $f_{\phi} = 100 \text{ kHz}$ (weighted by "A" curve)	$V_{N(\text{rms})}$ typ.	0,25	mV	
Signal-to-noise ratio at max. output voltage	S/N typ.	74	dB	
Load resistance	R_L >	10	k Ω	1)
	typ.	47	k Ω	

1) Attenuation can be reduced to typ. 2,5 dB if load resistor is replaced by a current source of 100 to 400 μA .

TIMING DIAGRAM



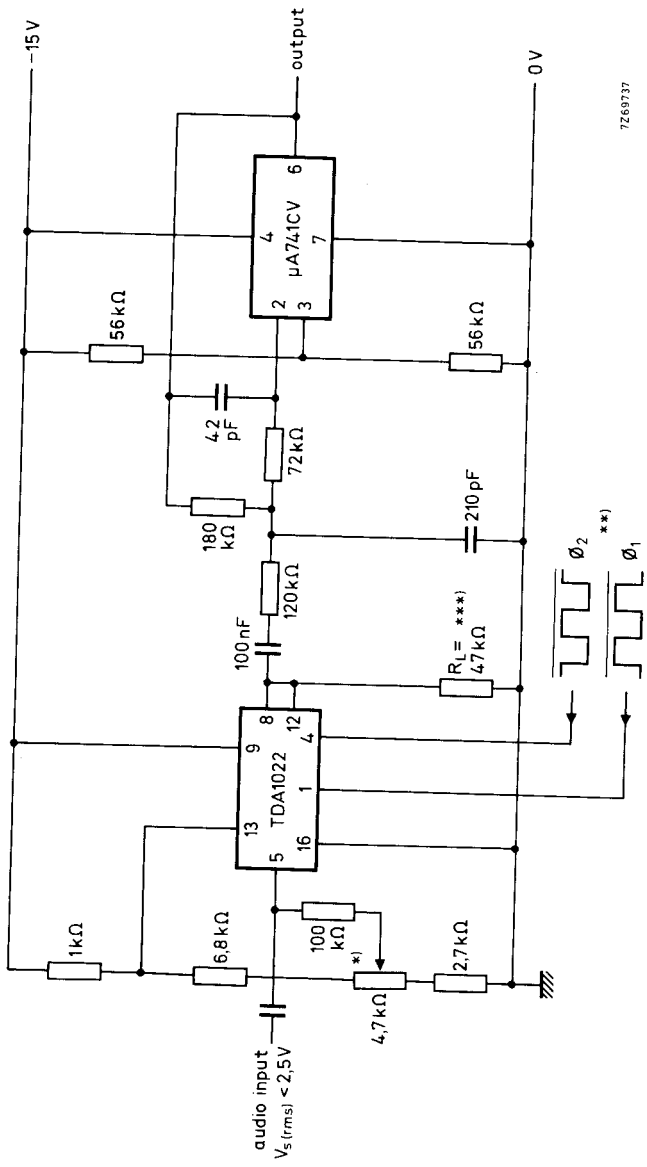
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*) $|V_1 + V_2| \leq |V_{\phi 1L}|$; $V_{\phi 1L} = V_{\phi 2L}$.

**) For maximum dynamic range adjust V_{13-16} so that $\Delta V = V_{13-16} - V_{\phi L} \approx 1 \text{ V}$.



APPLICATION INFORMATION

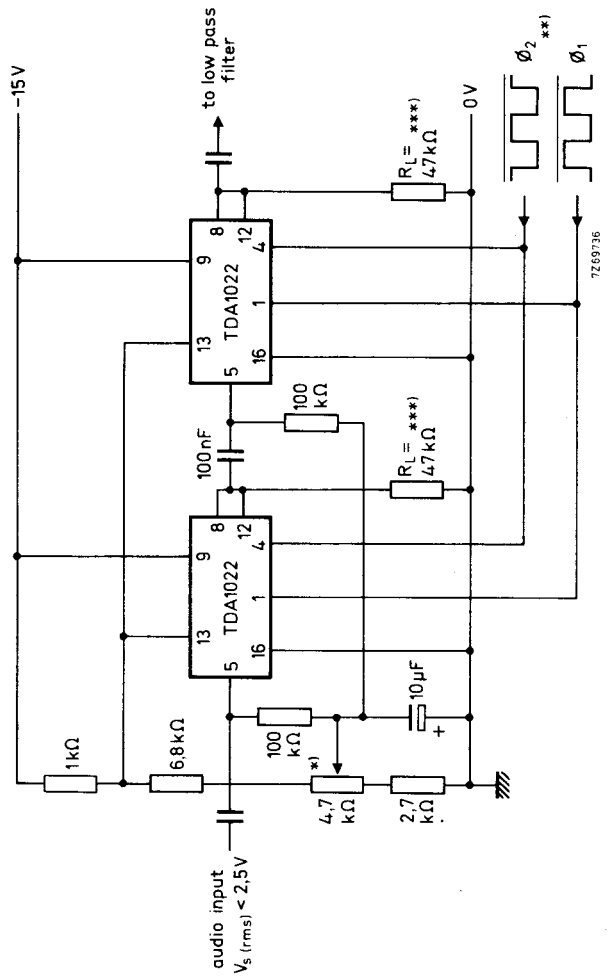


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Single delay line connection

- *) Adjust d. c. voltage for class-A operation (≈ 5 V).
- **) Clock input voltage amplitude: $V_{CL} = -15$ V.
- ***) Can be replaced by a current source of 100 to 400 μ A (see also note 1 on page 4).
- Conditions: low pass filter μ A741CV (12 dB per octave); gain = +3, 5 dB (compensation for line attenuation); $f_{\phi} = 50$ kHz (min.); cut-off frequency = 15 kHz.

APPLICATION INFORMATION (continued)



Series connection of two lines TDA1022

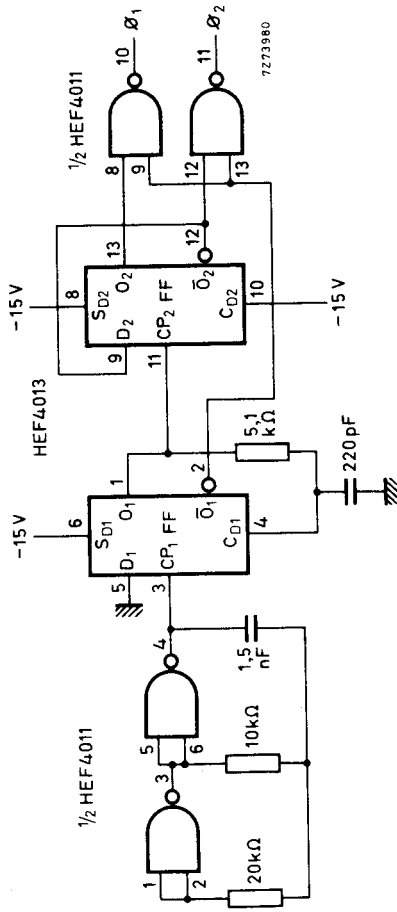
*) Adjust d. c. voltage for class-A operation (≈ 5 V).

***) Clock input voltage amplitude: $V_{CL} = -15$ V.

****) Can be replaced by a current source of 100 to 400 μ A (see also note 1 on page 4).

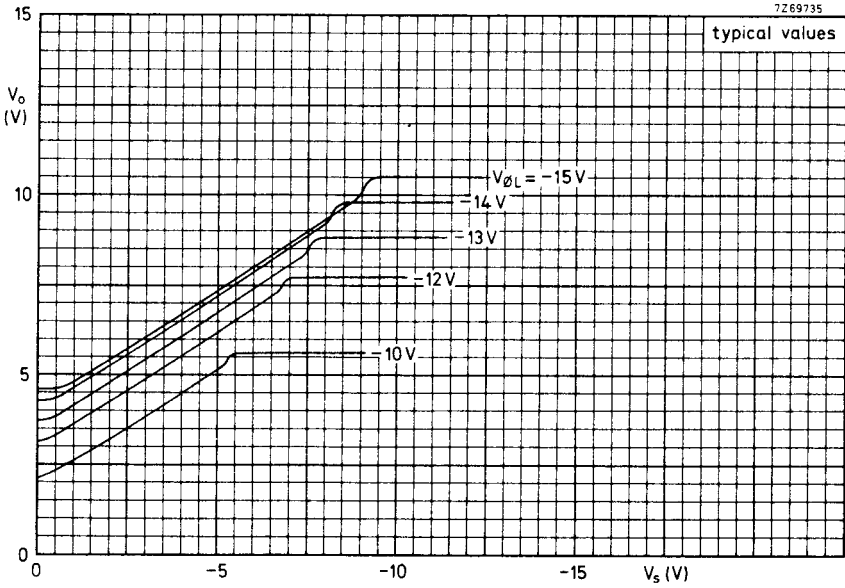


APPLICATION INFORMATION (continued)



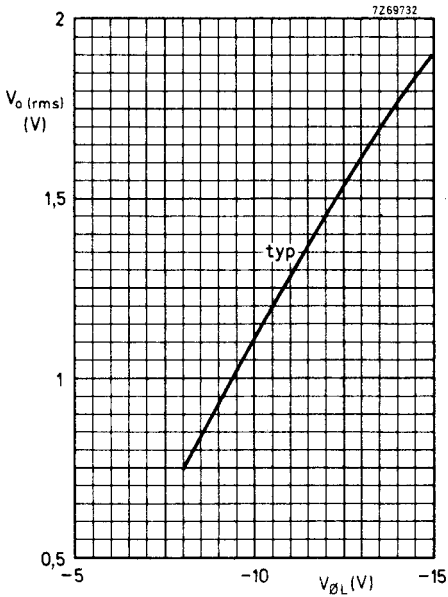
V_{DD} = 0
 V_{SS} = -15 V
 f_φ = 15 kHz

Clock oscillator and driver circuit with elimination of overlap (for max. 6 x TDA1022)



Conditions for the graph above:

- $V_{DD} = -15 V$
- $V_{13-16} = -14 V$
- $V_{\phi H} = 0 V$
- $f_{\phi} = 40 \text{ kHz}$
- $R_L = 47 \text{ k}\Omega$

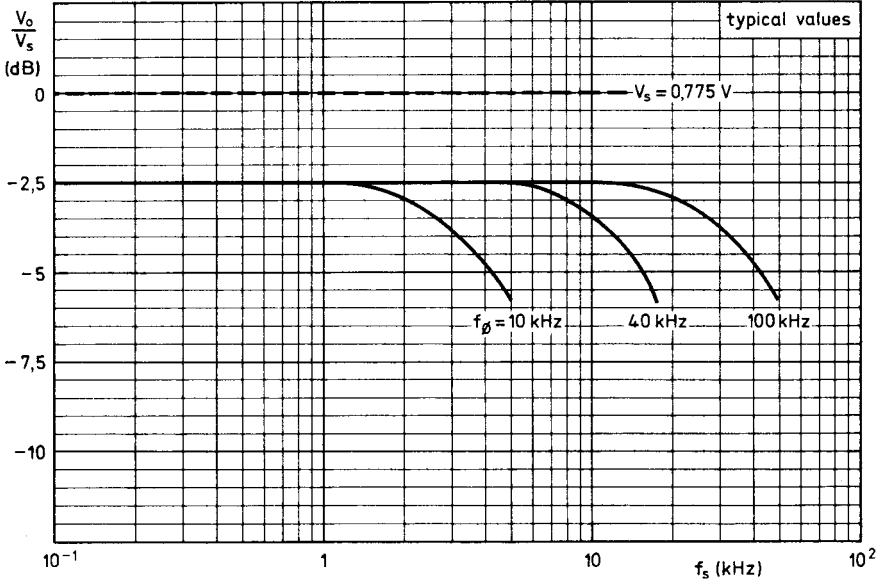


Conditions for the left-hand graph:

- $V_{DD} = -15 V$
- $V_{13-16} = -14 V$
- $V_{\phi H} = 0 V$
- $f_{\phi} = 40 \text{ kHz}$
- $f_S = 1 \text{ kHz}$
- $R_L = 47 \text{ k}\Omega$

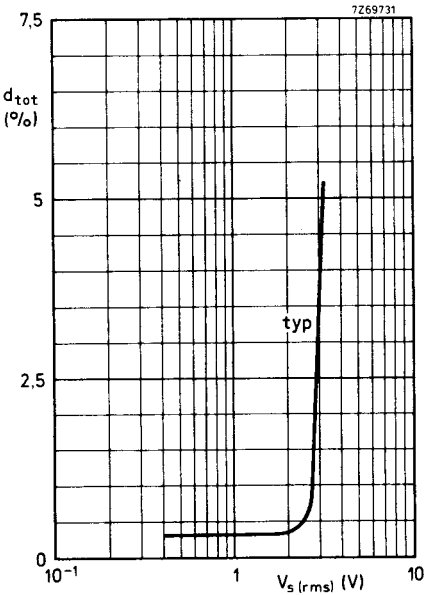


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Conditions for the graph above :

- $V_{DD} = -15 \text{ V}$
- $V_{13-16} = -14 \text{ V}$
- $V_\phi = 0 \text{ to } -15 \text{ V}$



Conditions for the left-hand graph :

- $f_s = 1 \text{ kHz}$
- $V_s = -5,2 \text{ V}$
- $V_{DD} = -15 \text{ V}$
- $V_{13-16} = -14 \text{ V}$
- $V_\phi = 0 \text{ to } -15 \text{ V}$
- $f_\phi = 40 \text{ kHz}$