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:

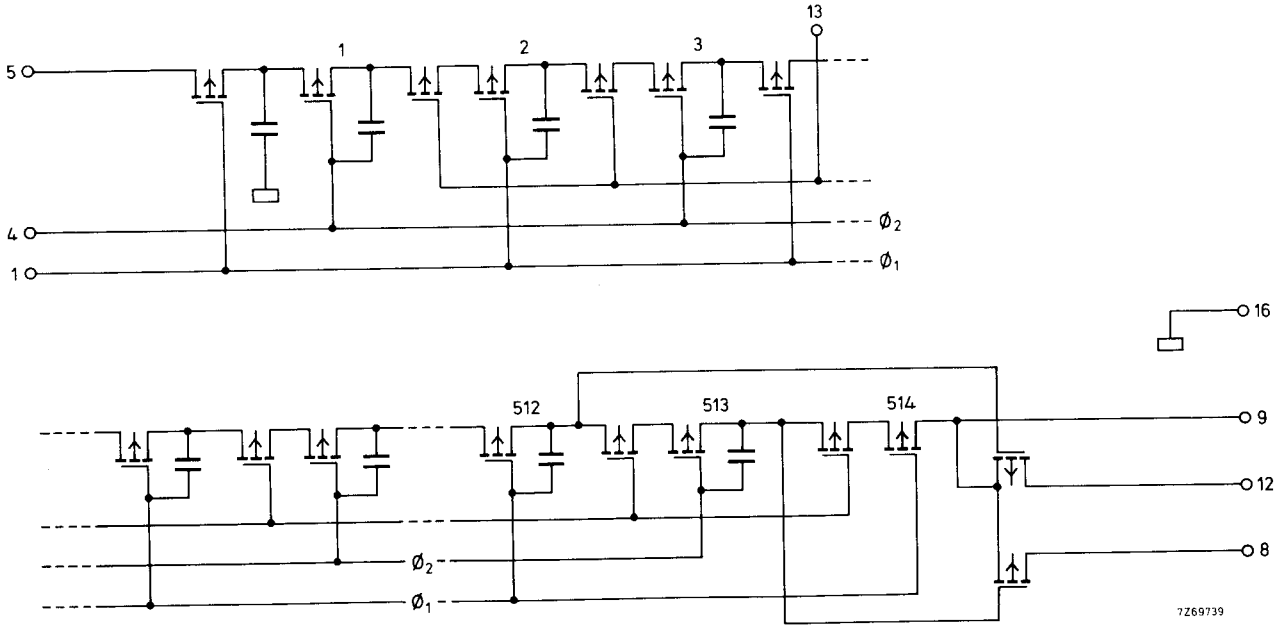
- variation of fixed delays of analogue signals, vox control, equalizing speech delay in public address systems;
- in electronic organs and other musical instruments for vibrato and chorus effects;
- reverberation effects;
- variable compression and expansion of speech in tape-recorders;
- in communication 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)	$V_{5\text{-}16(p\text{-}p)}$	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})
2. Not connected
3. Not connected
4. Clock input 2 (V_{CL2})
5. Signal input
6. Not connected
7. Not connected
8. Output 513
9. Negative supply (V_{DD})
10. Not connected
11. Not connected
12. Output 512
13. Tetrode gate (V_{13-16})
14. Not connected
15. Not connected
16. Ground (substrate)

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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
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 kΩ (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	$t_{\phi 1}$; $t_{\phi 2}$	≤	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 −10 to −18	V V	1) 1)
Signal input voltage at 1% 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.

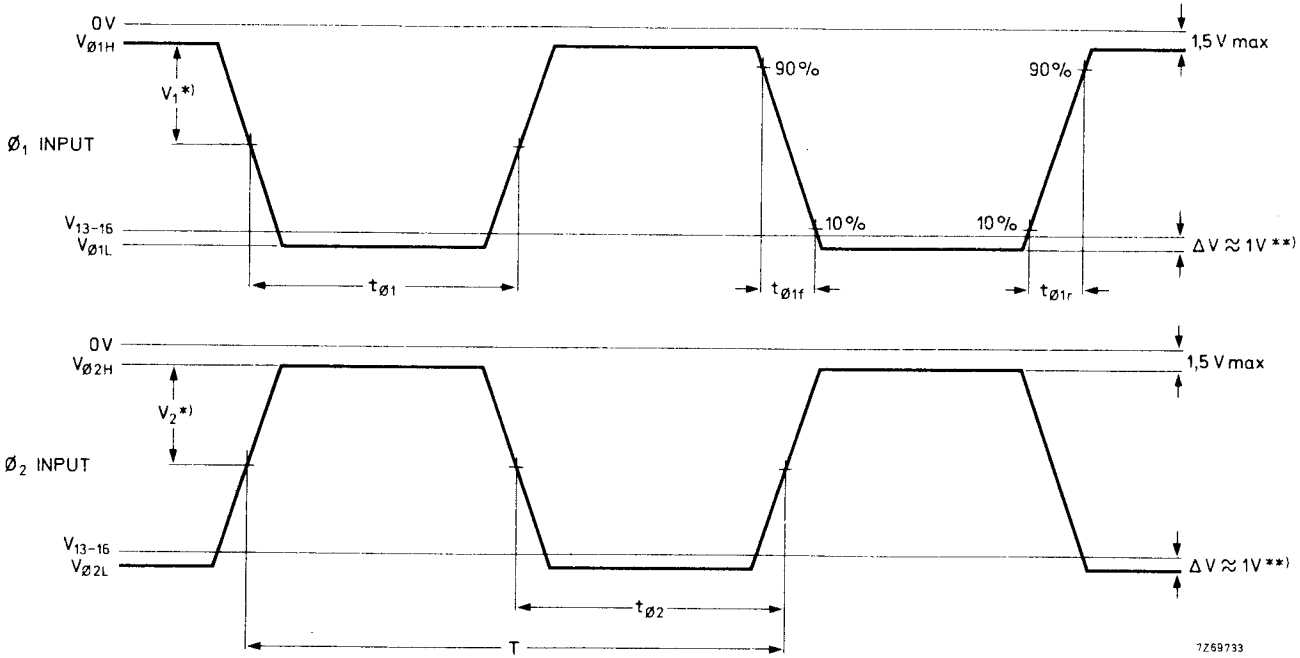
3) T = period time = $1/f_\phi$. The data on fall and rise times are given to eliminate overlap between the two clock pulses. To be independent of these rise and fall times a clock generator with simple gating can be used. See also pages 5 and 8.

CHARACTERISTICS (continued)

Attenuation from input to output f_ϕ = 40 kHz; f_S = 1 kHz		typ. <	4 7	dB dB	[1]
Change in output at f_S = 1 kHz; $V_{S(rms)}$ = 1 V when f_ϕ varies from 5 to 100 kHz		typ. <	0,5 1	dB dB	
when f_ϕ varies from 100 to 300 kHz		typ. <	0,5 1	dB 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_ϕ = 100 kHz (weighted by "A" curve)	$V_{N(rms)}$	typ.	0,25	mV	
Signal-to-noise ratio at max. output voltage	S/N	typ.	74	dB	
Load resistance	R_L	> typ.	10 47	kΩ kΩ	[1]

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

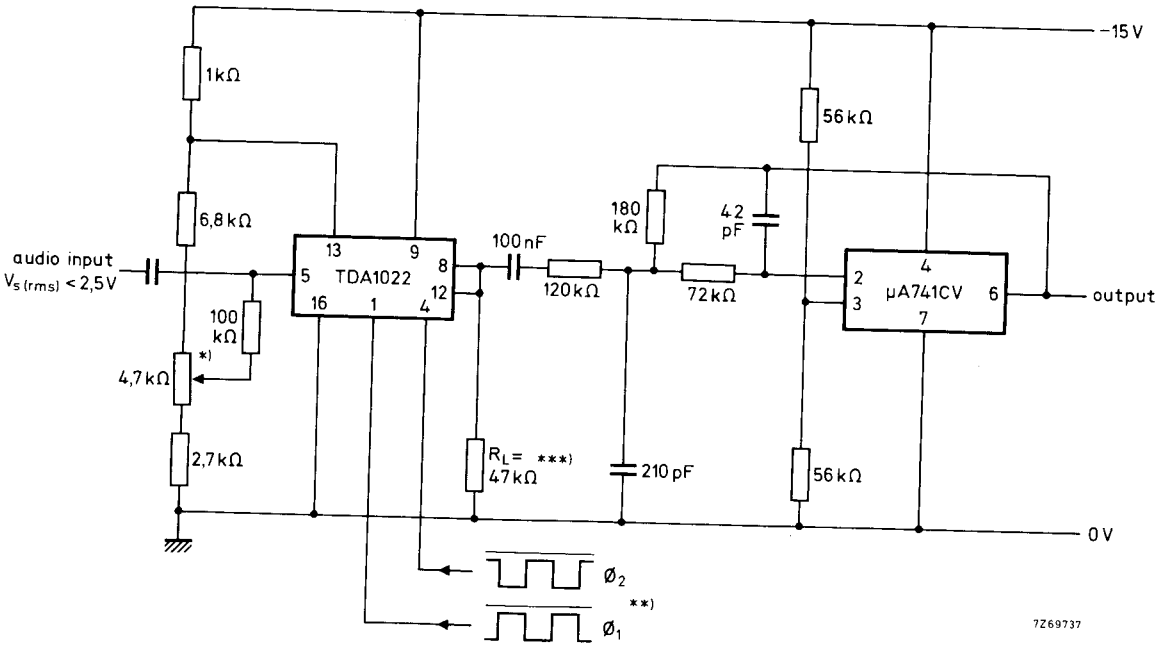
TIMING DIAGRAM



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

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

APPLICATION INFORMATION



Single delay line connection

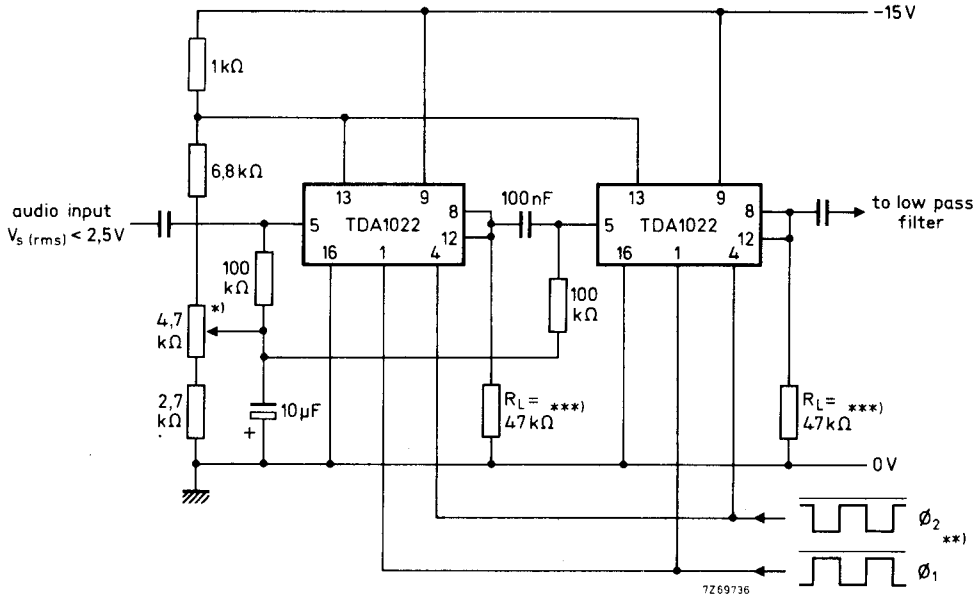
*) Adjust d.c. voltage for class-A operation (≈ 5 V).

Conditions: low pass filter μA741CV (12 dB per octave);
gain = +3,5 dB (compensation for line attenuation);
f_ϕ = 50 kHz (min.);
cut-off frequency = 15 kHz.

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

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

APPLICATION INFORMATION (continued)



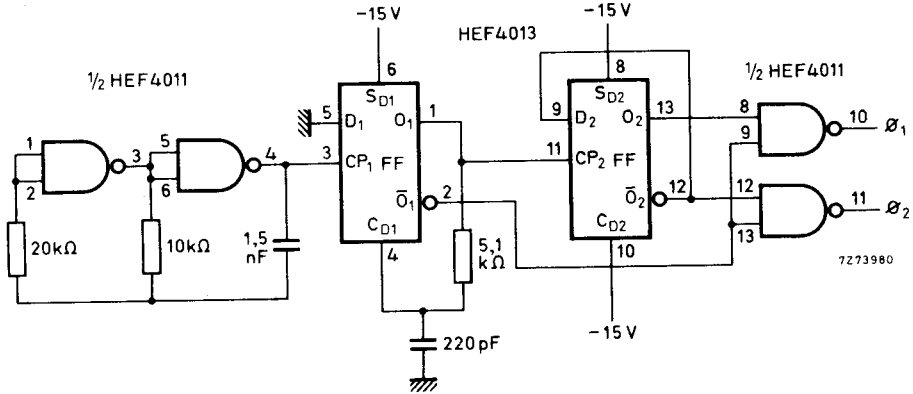
Series connection of two lines TDA1022

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

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

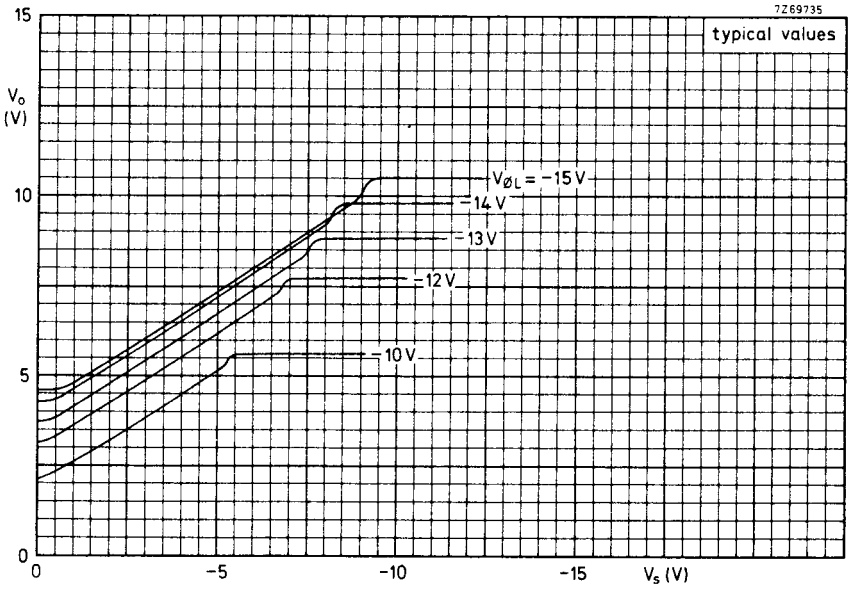
***) Can be replaced by a current source of 100 to 400 µA (see also note 1 on page 4).

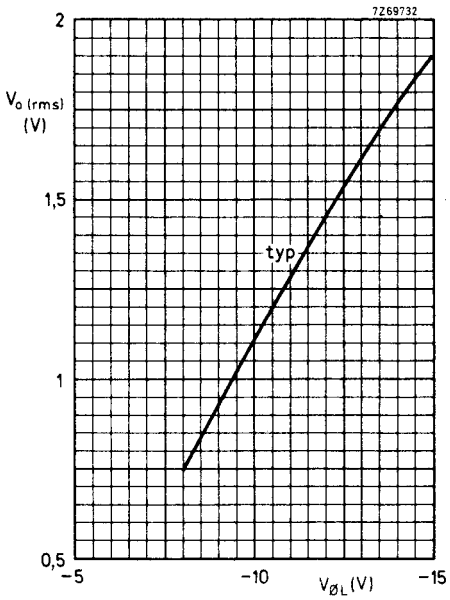
APPLICATION INFORMATION (continued)



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

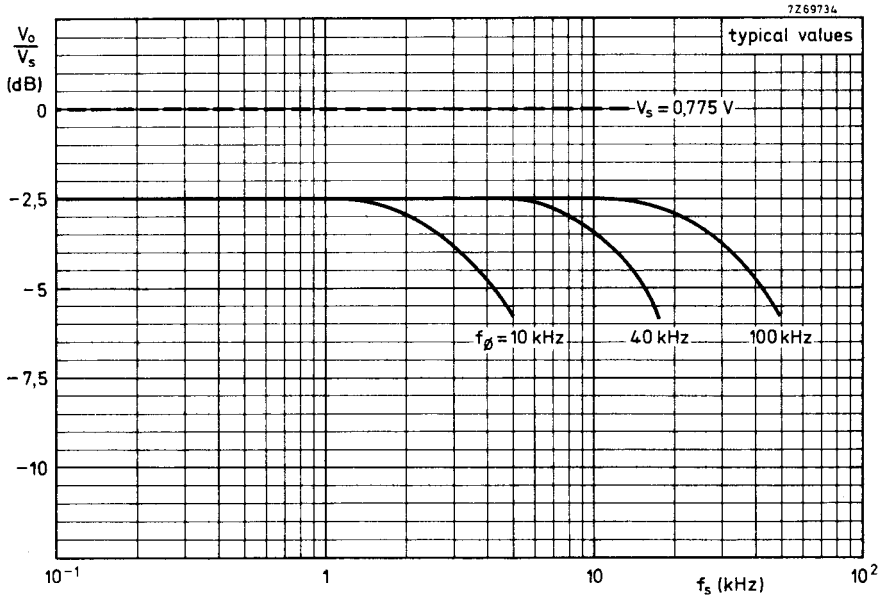
Clock oscillator and driver circuit with elimination of overlap (for max. 6 x TDA1022)



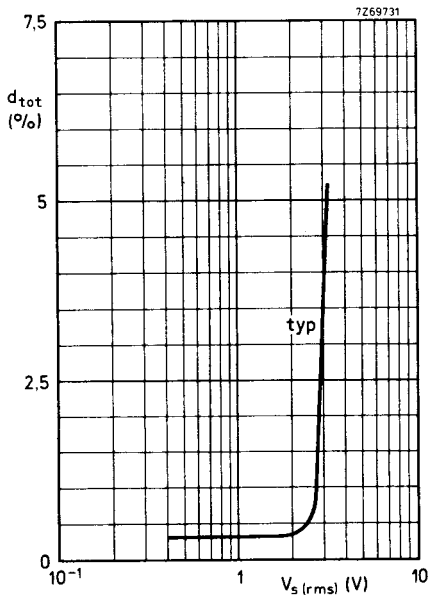


Conditions for the graph above:
V_{DD} = −15 V
$V_{13\text{-}16}$ = −14 V
$V_{\phi H}$ = 0 V
f_ϕ = 40 kHz
R_L = 47 kΩ

Conditions for the left-hand graph:
V_{DD} = −15 V
$V_{13\text{-}16}$ = −14 V
$V_{\phi H}$ = 0 V
f_ϕ = 40 kHz
f_S = 1 kHz
R_L = 47 kΩ



Conditions for the graph above:
V_{DD} = −15 V
V_{13-16} = −14 V
V_ϕ = 0 to −15 V



Conditions for the left-hand graph:
f_S = 1 kHz
V_S = −5,2 V
V_{DD} = −15 V
V_{13-16} = −14 V
V_ϕ = 0 to −15 V
f_ϕ = 40 kHz