

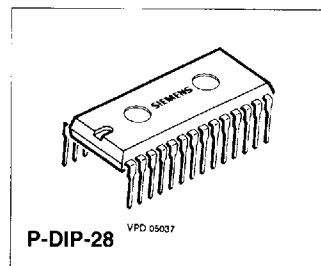
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T-77-07-07

TV-Stereo Processor**TDA 6610-2****Bipolar IC****Features**

- All functions are I²C-bus controlled
- Suitable for multistandard including NICAM SCART-interface
- Independent headphones output high signal noise ratio
- Extremely low total harmonic distortion
- High security of detection of the stereo decoder part because of the digital interference suppression and the very narrow bandwidth



| Type | Ordering Code | Package |
|------------|---------------|----------|
| TDA 6610-2 | Q67000-A5026 | P-DIP-28 |

General

The TDA 6610-2 represents a complete TV-stereo sound system controlled via the I²C-bus. The IC is divided into three functional blocks:

1. **Stereo Sound Processing with High Quality (exceeds DIN 45500; suitable for NICAM and CD)**
 - a) Matrix for G-standard
 - b) Additional single-channel AF-input (for e.g. AF-signal according to L-standard)
 - c) Stereo SCART-interface is in accordance with FTZ-official specification
 - d) Stereo loudspeaker signal section with Ch1/Ch2 switch, treble/bass control, quasi-stereo/ stereo base width control and separate left/right loudspeaker volume control
 - e) Signal section with Ch1/Ch2 switch and volume control for stereo headphones

2. TV-Sound Identification Signal Decoder Consisting of:

- a) Active pilot signal filter
- b) Phase-independent rectifier with very narrow bandwidth for evaluation of the identification signal
- c) Digital integrator to reduce interference
- d) Multiplexer for cyclical switch over between "stereo" or "dual" recognition
- e) PLL for the generation of the reference signal. External synchronization with either the fly-back pulse or external reference clock signals of 62.5 kHz

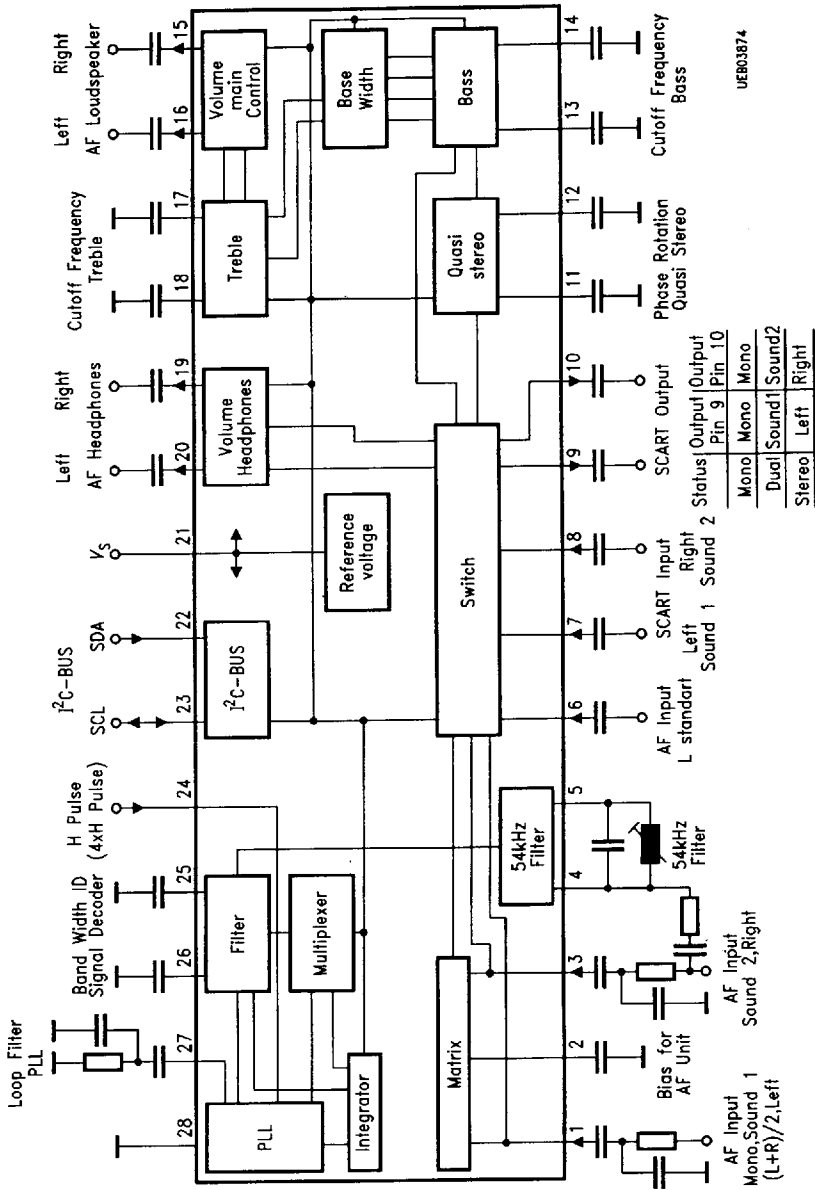
3. Control Section for:

- a) I²C-bus interface with listen/talk function
- b) Control of the complete AF-sound processing
- c) Control of the identification signal decoder
- d) Reading of the identification signal decoder status
- e) Test modes

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| Pin No. | Function |
|----------------|--|
| 1 | AF-input mono, left, sound 1 |
| 2 | Bias for AF-unit |
| 3 | AF-input right, sound 2 |
| 4 | 54-kHz input |
| 5 | 54-kHz filter |
| 6 | AF-input (L-standard) |
| 7 | AF-input SCART left (sound 1) |
| 8 | AF-input SCART right (sound 2) |
| 9 | AF-output SCART (mono, sound 1, left) |
| 10 | AF-output SCART (mono, sound 2, right) |
| 11 | Phase-shifter quasi-stereo |
| 12 | Phase-shifter quasi-stereo |
| 13 | Cutoff frequency base (base-width) left |
| 14 | Cutoff frequency base (base-width) right |
| 15 | AF-output, loudspeaker left |
| 16 | AF-output, loudspeaker right |
| 17 | Cutoff frequency treble left |
| 18 | Cutoff frequency treble right |
| 19 | AF-output, headphones left |
| 20 | AF-output, headphones right |
| 21 | + V_s (supply voltage) |
| 22 | I ² C-bus SCL |
| 23 | I ² C-bus SDA |
| 24 | Input H-pulse (4 x H-pulse) |
| 25 | Filter ID-signal decoder |
| 26 | Filter ID-signal decoder |
| 27 | PLL-filter ID-signal decoder |
| 28 | Ground |

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Block Diagram

Circuit Description

Signal Section

The audio signal processing in the matrix and the switch-over for multichannel TV-sound signals according to the two-carrier system used in Germany takes place in the matrix and switching sections. In addition to the two inputs for the demodulated sound carrier a two-channel SCART-input and an additional mono input (e.g. for demodulated L-standard sound) are provided. The two AF-inputs can be by-passed internally in such a way that decoded stereo sound signals of other audio systems (NICAM) can be processed. The switching section is terminated with the SCART-output and an independently switchable Ch1/Ch2 switch for the loudspeaker and headphone outputs.

In the loudspeaker signal path a switchable quasi-stereo section follows the Ch1/Ch2 switch. This section gives a special audio effect with mono signals due to a 180° phase shift at medium frequencies (about 1 kHz) in one channel. The following bass control exhibits a step of 3 dB with an adjustment range of +15/-12 dB. The cutoff frequency is set for each channel with an external capacitor.

A circuit for stereo base-width expansion, switchable if stereo signals are recognized, provides a more spatial audio effect due to 50 % of frequency dependent crosstalk in opposing phases. The circuit operates with the same cutoff frequency as the bass control, but the function is largely independent. Likewise the treble control, whose cutoff frequency is also controlled by a capacitor in each channel, has a step of 3 dB with an adjustment range of ±12 dB. The volume control can be adjusted independently for the right and left loudspeaker signal path. Using 57 steps of 1.25 dB each, a 70 dB adjustment range is available, where the 57th step activates the "MUTE" function. Functions such as "balance" or "loudness" are realized by software adjustment of the appropriate tone and volume controls.

In the signal path for the headphones after the Ch1/Ch2 switch a volume control circuit is used for the simultaneous left/right adjustment. Thirty-two steps of 2 dB each allow an adjustment range of 62 dB (31 x 2 dB = 62 dB, while the 32nd step activates the "MUTE" function).

Identification Sound Decoder

The input of the identification sound decoder consists of an op-amp for the pilot signal with its sidebands. An external LC-circuit is used to select the pilot carrier and his sidebands. The signal is then passed to a phase-independent active band-pass filter with a very narrow bandwidth (adjustable externally). This filter detects whether the lower side-band of the pilot carrier, modulated with the identification signal, is present. The center frequency of the filter is switched between "dual" and "stereo" by a multiplexer. The multiplexing frequency is adjustable by software. If a side-band is detected, the multiplexer stops. The first "detected" criterion is processed by a digital integrator and a following comparator in order to suppress interferences due to noise. The decoder status can be read out via I²C-bus (talk mode) as the "stereo" or "dual" mode. The control of the corresponding signal path can take place either directly internally or through the μ C. All required clock signals are derived from a fast locking PLL synchronized by an external reference frequency. This reference frequency has to be sufficiently close to the horizontal frequency, but a **rigid phase coupling is not required**. Therefore, alternatively to the line frequency the use of a crystal-controlled 62.5 kHz frequency commonly available in PLL tuning systems is possible.

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Control Section

All functions are controlled via I²C-bus interface with listen/talk functions. The actual valid data are stored in a latch block.

The telegram structure is:

start condition - chip address - any number of data bytes - stop condition

The following conditions apply to the data bytes:

Before a data byte (with the adjustment information) is transmitted, a subaddress byte has **always** to be transmitted.

Example: The headphone volume (HP vol) has to be increased in several (i.e. 3) steps.

| Right | | Wrong | |
|-----------------|----------|-----------------|----------|
| Start condition | | Start condition | |
| Chip address | 84 (Hex) | Chip address | 84 (Hex) |
| Subaddr. vol | 03 (Hex) | Subaddr. vol | 03 (Hex) |
| Volume step 8 | 08 (Hex) | Volume step 8 | 08 (Hex) |
| Subaddr. vol | 03 (Hex) | Volume step 9 | 09 (Hex) |
| Volume step 9 | 09 (Hex) | Volume step 10 | 0A (Hex) |
| Subaddr. vol | 03 (Hex) | Stop condition | |
| Volume step 10 | 0A (Hex) | | |
| Stop condition | | | |

Within a telegram (i.e. without a new start condition) any different subaddresses can be accessed. The changeover between "listen" and "talk" however has always to be initialized via the sequence "stop condition - start condition - chip address". Before each readout always a start condition and chip address (talk) has to be transmitted. The data to be read out are loaded into the I²C-bus interface after this sequence and are available for the transfer to the μ C.

Chip Address

| MSB | • | • | • | • | • | • | LSB |
|-----|---|---|---|---|---|---|-----|
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | R/W |

R/W = 0 → Read (Listen)

R/W = 1 → Write (Talk)

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Subaddress Bytes

| | MSB | • | • | • | • | • | • | LSB |
|--------------------------|-----|---|---|---|---|---|---|-----|
| Loudspeaker volume left | X | X | X | X | X | 0 | 0 | 1 |
| Loudspeaker volume right | X | X | X | X | X | 0 | 1 | 0 |
| Headphone volume | X | X | X | X | X | 0 | 1 | 1 |
| Treble/bass | X | X | X | X | X | 1 | 0 | 1 |
| Switch byte I | X | X | X | X | X | 1 | 1 | 1 |
| Switch byte II | X | X | X | X | X | 0 | 0 | 0 |

Setting Bytes**a) Loudspeaker Volume Left / Right**

| | MSB | • | • | • | • | • | • | LSB |
|----------------|-----|---|---|---|---|---|---|-----|
| Maximum volume | X | X | 1 | 1 | 1 | 1 | 1 | 1 |
| Max - 1 step | X | X | 1 | 1 | 1 | 1 | 1 | 0 |
| Max - 15 steps | X | X | 1 | 1 | 0 | 0 | 0 | 0 |
| Max - 55 steps | X | X | 0 | 0 | 1 | 0 | 0 | 0 |
| MUTE | X | X | 0 | 0 | 0 | 1 | 1 | 1 |
| MUTE | X | X | 0 | 0 | 0 | 0 | 0 | 0 |
| MUTE | X | X | 0 | 0 | 0 | X | X | X |
| Power ON | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

b) Headphone Volume

| | MSB | • | • | • | • | • | • | LSB |
|----------------|-----|----|----|---|---|---|---|-----|
| Max. volume | T2 | T1 | T0 | 1 | 1 | 1 | 1 | 1 |
| Max - 1 step | T2 | T1 | T0 | 1 | 1 | 1 | 1 | 0 |
| Max - 15 steps | T2 | T1 | T0 | 1 | 0 | 0 | 0 | 0 |
| Max - 31 steps | T2 | T1 | T0 | 0 | 0 | 0 | 0 | 1 |
| MUTE | T2 | T1 | T0 | 0 | 0 | 0 | 0 | 0 |
| Power ON | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

T0 - T2 are test bits; these have to be set to 0 for normal operation.

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c) Treble / Bass

| | MSB | • | • | • | • | • | • | LSB |
|------------------------|--------|---|---|---|--------|------|---|------|
| Linear | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Max. treble, lin. bass | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Max. treble, lin. bass | 1 | 1 | X | X | 1 | 0 | 0 | 0 |
| Min. treble, lin. bass | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Min. treble, lin. bass | 0 | 0 | X | X | 1 | 0 | 0 | 0 |
| Lin. treble, max. bass | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| Lin. treble, max. bass | 1 | 0 | 0 | 0 | 1 | 1 | X | 1 |
| Lin. treble, max. bass | 1 | 0 | 0 | 0 | 1 | 1 | 1 | X |
| Lin. treble, min. bass | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Lin. treble, min. bass | 1 | 0 | 0 | 0 | 0 | 0 | X | X |
| Max. treble, max. bass | 1 | 1 | X | X | 1 | 1 | X | 1 |
| Min. treble, min. bass | 0 | 0 | X | X | 0 | 0 | X | X |
| Power ON | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | MSB | | | | LSB | MSB | | LSB |
| | treble | | | | treble | bass | | bass |

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d) Switch Byte I

| | | | | | | | |
|--------|---------|------------------------|-----------------------|------|-------|---------|-----|
| MSB | . | . | . | . | . | . | LSB |
| MUTE I | MUTE II | Ch1/Ch2 _{vol} | Ch1/Ch2 _{HP} | Mono | SCART | SCART-D | AM |

MUTE I = 0 All AF-outputs are muted (loudspeakers, headphones, SCART); power ON

MUTE I = 1 All AF-outputs ON

MUTE II = 0 Loudspeaker outputs muted; power ON

MUTE II = 1 Loudspeaker outputs ON

MUTE I and MUTE II are OR gated with respect to the loudspeaker outputs

| MUTE I | MUTE II | Loudspeaker outputs | Headphones, SCART-outputs |
|--------|---------|---------------------|---------------------------|
| 0 | 0 | muted | muted |
| 0 | 1 | muted | muted |
| 1 | 0 | muted | ON |
| 1 | 1 | ON | ON |

CH1/Ch2_{vol} = 0 Sound 1 on the loudspeaker outputs; power ON

CH1/Ch2_{vol} = 1 Sound 2 on the loudspeaker outputs

CH1/Ch2_{HP} = 0 Sound 1 on the headphone outputs; power ON

CH1/Ch2_{HP} = 1 Sound 2 on the headphone outputs

CH1/Ch2_{vol} and CH1/Ch2_{HP} are only effective if the matrix is set to the position "dual sound".

Mono = 0 identification signal decoder is set to mono position and held; power ON

Mono = 1 normal operation of identification signal decoder

SCART = 0 normal TV-operation; power ON

SCART = 1 SCART-playback; connection of SCART-inputs - AF-outputs. SCART = 1 has priority over AM = 1 (loudspeaker and headphones)

SCART-D = 0 SCART-playback stereo (mono); power ON

SCART-D = 1 Enable for the Ch1/Ch2 switch during SCART-playback (only effective when SCART = 1)

Standard L = 0 normal operation (G-standard)

Standard L = 1 AM AF-input is activated; power ON

AM = 1 has priority over bypass = 1

e) Switch Byte II

| MSB | | • | • | • | • | • | • | LSB |
|------|-------|------------|----|----------|----------|-------------|--------------------------|-----|
| MPX0 | MPX1 | Quasi-st | Be | H-pul | Matrix 0 | Matrix 1 | Bypass | |
| MPX0 | MPX 1 | MPX period | | | | | recommended $C_{25, 26}$ | |
| 0 | 0 | 2 s | | power ON | | 1 μ F | | |
| 0 | 1 | 4 s | | | | 2.2 μ F | | |
| 1 | 0 | 8 s | | | | 4.7 μ F | | |
| 1 | 1 | 1 s | | | | 470 nF | | |

MPX-period = 2 s signifies: Identification (ID) signal decoder searches 1 s for dual and 1 s for stereo transmission

Quasi-st = 0 Quasi-stereo OFF; Power ON

Quasi-St = 1 Quasi-stereo ON

Be = 0 Stereo basewidth expansion OFF; Power ON

Be = 1 Stereo basewidth expansion ON

H pul = 0 ID-signal decoder synchronization with $f_H = 15.625$ kHz; power ON

H pul = 1 ID-synchronization with $4 \times f_H$

Matrix 0 Matrix 1 Matrix status

0 0 mono power ON

0 1 stereo

1 0 dual

1 1 automatic according to ID-signal decoder

Bypass = 0 Normal operations (G-standard)

Bypass = 1 Matrix is bridged so that left/right signals can be fed in; power ON (AM = 1 has priority over bypass = 1)

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Priority List of Setting Bits

1. MUTE I
2. MUTE II (only with regard to the loudspeaker outputs)
3. SCART
4. Standard L
5. Bypass
6. Matrix 0, 1

h) Talk Mode

| MSB | • | • | • | • | • | • | LSB |
|-----|---|------------------------|----|----|---|---|-----|
| St | D | T5 | T4 | T3 | X | X | X |
| 0 | 0 | decoder detects mono | | | | | |
| 1 | 0 | decoder detects stereo | | | | | |
| 0 | 1 | decoder detects dual | | | | | |
| 1 | 1 | internally inhibited | | | | | |

T3 - T5 are test bits

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Absolute Maximum Ratings

 $T_A = 0$ to 70 °C; all voltages relatives to V_{SS}

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|--------------------------------------|-------------|--------------|----------|------|---------|
| | | min. | max. | | |
| Supply voltage | V_{21} | 0 | 14 | V | |
| Max. DC-voltage | V_1 | 0 | V_{21} | V | |
| Max. DC-voltage | V_2 | 0 | V_{21} | V | |
| Max. DC-voltage | V_3 | 0 | V_{21} | V | |
| Max. DC-voltage | V_4 | 0 | V_{21} | V | |
| Max. DC-voltage | V_6 | 0 | V_{21} | V | |
| Max. DC-voltage | V_7 | 0 | V_{21} | V | |
| Max. DC-voltage | V_8 | 0 | V_{21} | V | |
| Max. DC-voltage | V_{11} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{12} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{13} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{14} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{17} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{18} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{22} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{23} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{24} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{25} | 0 | V_{21} | V | |
| Max. DC-voltage | V_{26} | 0 | V_{21} | V | |
| Max. DC-current | I_5 | 0 | 2 | mA | |
| Max. DC-current | I_9 | 0 | 2 | mA | |
| Max. DC-current | I_{10} | 0 | 2 | mA | |
| Max. DC-current | I_{15} | 0 | 2 | mA | |
| Max. DC-current | I_{16} | 0 | 2 | mA | |
| Max. DC-current | I_{19} | 0 | 2 | mA | |
| Max. DC-current | I_{20} | 0 | 2 | mA | |
| Max. DC-current | I_{27} | 0 | 1 | mA | |
| Junction temperature | T_j | | 150 | °C | |
| Storage temperature | T_{stg} | - 40 | 125 | °C | |
| Thermal resistance system ambient | $R_{th SA}$ | | 53 | K/W | |

Operating Range

| | | | | | |
|-----------------------|-------|------|------|-----|--|
| Supply voltage | V_6 | 10 | 13.2 | V | |
| Ambient temperature | T_A | 0 | 70 | °C | |
| Input frequency range | f_i | 0.01 | 20 | kHz | |

Characteristics

$V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$, in accordance with test circuit 1

I²C-bus present: start - 84 - 01,3F - 0 2,3F - 0 3,1F - 0 5,88 - 0 6,10 - 07,C8 - 00,01 - stop

Chip address - *Vol_{LSI} 63* - *Vol_{LSr} 63* - *Vol_{HP} 31* - *tone lin* - *adj 0dB* - *MUTE I*, *MUTE II*, *Mono* - *Bypass*

The basic setting for each point in the specification is always preset; only settings which deviate from this are given in the test conditions. Details in *italics* only provide explanation of the hexadecimal code and with switch bits on the set bits and features are stated.

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|---------------------|----------|--------------|------|------|------|----------------|
| | | min. | typ. | max. | | |
| Current consumption | I_{21} | | 50 | | mA | |

Signal Section

| | | | | | | |
|-----------|------------|----|----|----|----|--|
| Max. gain | V_{16-1} | -2 | 0 | 2 | dB | |
| Max. gain | V_{15-3} | -2 | 0 | 2 | dB | |
| Max. gain | V_{20-1} | -2 | 0 | 2 | dB | |
| Max. gain | V_{19-3} | -2 | 0 | 2 | dB | |
| Max. gain | V_{16-3} | -2 | 0 | 2 | dB | 00,02; $V_1 = 01$ <i>Matrix: Stereo</i> |
| Max. gain | V_{15-3} | -2 | 0 | 2 | dB | 00,02; $V_1 = 01$ <i>Matrix: Stereo</i> |
| Max. gain | V_{20-3} | -2 | 0 | 2 | dB | 00,02; $V_1 = 0$ <i>Matrix: Stereo</i> |
| Max. gain | V_{19-3} | -2 | 0 | 2 | dB | 00,02; $V_1 = 0$ <i>Matrix: Stereo</i> |
| Max. gain | V_{16-1} | 4 | 6 | 8 | dB | 00,02; $V_3 = 0$ <i>Matrix: Stereo</i> |
| Max. gain | V_{20-1} | 4 | 6 | 8 | dB | 00,02; $V_3 = 0$ <i>Matrix: Stereo</i> |
| Max. gain | V_{16-7} | -5 | -3 | -1 | dB | 07,CC, SCART |
| Max. gain | V_{15-8} | -5 | -3 | -1 | dB | 07,CC, SCART |
| Max. gain | V_{20-7} | -5 | -3 | -1 | dB | 07,CC, SCART |
| Max. gain | V_{19-8} | -5 | -3 | -1 | dB | 07,CC, SCART |
| Max. gain | V_{16-6} | -2 | 0 | 2 | dB | 07,C9, Standard L |
| Max. gain | V_{15-6} | -2 | 0 | 2 | dB | 07,C9, Standard L |
| Max. gain | V_{20-6} | -2 | 0 | 2 | dB | 07,C9, Standard L |
| Max. gain | V_{19-6} | -2 | 0 | 2 | dB | 07,C9, Standard L |

Characteristics (cont'd)

$V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$, in accordance with test circuit 1

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|-----------------|--------------------|--------------|------|---------|------|---|
| | | min. | typ. | max. | | |
| Gain | V_{9-1} | -2 | 0 | 2 | dB | 00,02; $V_1 = 0$ Matrix: Stereo |
| Gain | V_{10-3} | -2 | 0 | 2 | dB | |
| Gain | V_{9-3} | -2 | 0 | 2 | dB | |
| Gain | V_{10-3} | -2 | 0 | 2 | dB | 00,02; $V_1 = 0$ Matrix: Stereo |
| Gain | V_{9-1} | 4 | 6 | 8 | dB | 00,02; $V_3 = 0$ Matrix: Stereo |
| Gain | V_{10-6} | -2 | 0 | 2 | dB | 07,C9 Standard L |
| Gain | V_{9-6} | -2 | 0 | 2 | dB | 07,C9 Standard L |
| Min. gain | V_{16-1} | -65 | -70 | | dB | 01,08-02,08 $Vol_{LSI} 8-Vol_{LSr} 8$ |
| Min. gain | V_{15-3} | -65 | -70 | | dB | 01,08-02,08 $Vol_{LSI} 8-Vol_{LSr} 8$ |
| Min. gain | V_{20-1} | -57 | -62 | | dB | 03,01 $Vol_{HP} 1$ |
| Min. gain | V_{19-3} | -57 | -62 | | dB | 03,01 $Vol_{HP} 1$ |
| Min. gain | V_{16-7} | -68 | -73 | | dB | 07,CC-01,08-02,08 SCART- $Vol_{LSI} 8-Vol_{LSr} 8$ |
| Min. gain | V_{15-8} | -68 | -73 | | dB | 07,CC-01,08-02,08 SCART- $Vol_{LSI} 8-Vol_{LSr} 8$ |
| Min. gain | V_{20-7} | -60 | -65 | | dB | 07,CC-03,01 SCART- $Vol_{KH} 1$ |
| Min. gain | V_{19-8} | -60 | -65 | | dB | 07,CC-03,01 SCART- $Vol_{KH} 1$ |
| Min. gain | V_{16-6} | -60 | -70 | | dB | 07,C9-01,08-02,08 Standard L $Vol_{LSI} 8-Vol_{LSr} 8$ |
| Min. gain | V_{15-6} | -60 | -70 | | dB | 07,C9-01,08-02,08 Standard L $Vol_{LSI} 8-Vol_{LSr} 8$ |
| Min. gain | V_{20-8} | -57 | -62 | | dB | 07,C9-03,01 Standard L $Vol_{KH} 1$ |
| Min. gain | V_{19-6} | -57 | -62 | | dB | 07,C9-03,01 Standard L $Vol_{KH} 1$ |
| Flutter and wow | ΔV_{15-16} | | | ± 2 | dB | 01,3F to 01,24 02,3F to 02,24 $Vol_{LSI} 63-36-Vol_{LSr} 63-36$ |
| Flutter and wow | ΔV_{19-20} | | | ± 2 | dB | 03,1F to 03,13 $Vol_{KH} 31-19$ |

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Characteristics (cont'd)

$V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$, in accordance with test circuit 1

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|-------------------------|--------------------|--------------|------|---------|------|--|
| | | min. | typ. | max. | | |
| Step width Vol_{15} | ΔV_{15} | 0 | 1.25 | 2.5 | dB | 01,X-01, ($X \pm 1$) $Vol_{LSI} X - Vol_{LSI} (X \pm 1)$ |
| Step width Vol_{16} | ΔV_{16} | 0 | 1.25 | 2.5 | dB | 02,X-02, ($X \pm 1$) $Vol_{LSr} X - Vol_{LSr} (X \pm 1)$ |
| Step width Vol_{19} | ΔV_{19} | 0 | 2 | 4 | dB | 03,X-03, ($X \pm 1$) $Vol_{KH} X - Vol_{KH} (X \pm 1)$ |
| Step width Vol_{20} | ΔV_{20} | 0 | 2 | 4 | dB | 03,X-03, ($X \pm 1$) $Vol_{KH} X - Vol_{KH} (X \pm 1)$ |
| Bass boost | V_{16-1} | 13 | 15 | | dB | 05,8F; $f_i = 40\text{ Hz}$ <i>Bass max, treble lin.</i> |
| Bass boost | V_{15-3} | 13 | 15 | | dB | 05,8F; $f_i = 40\text{ Hz}$ <i>Bass max, treble lin.</i> |
| Bass boost | V_{16-1} | -10 | -12 | | dB | 05,8F; $f_i = 40\text{ Hz}$ <i>Bass max, treble lin.</i> |
| Bass boost | V_{15-3} | -10 | -12 | | dB | 05,8F; $f_i = 40\text{ Hz}$ <i>Bass max, treble lin.</i> |
| Step wide bass | ΔV_{15} | 1 | 3 | 5 | dB | 05,8X-05,8 ($X \pm 1$) <i>Bass X - bass ($X \pm 1$)</i> |
| Step wide bass | ΔV_{16} | 1 | 3 | 5 | dB | 05,8X-05,8 ($X \pm 1$) <i>Bass X - bass ($X \pm 1$)</i> |
| High frequency emphasis | V_{16-1} | 10 | 12 | | dB | 05,8F; $f_i = 15\text{ kHz}$ <i>Treble max, bass lin.</i> |
| High frequency emphasis | V_{15-3} | 10 | 12 | | dB | 05,8F; $f_i = 15\text{ kHz}$ <i>Treble max, bass lin.</i> |
| High frequency emphasis | V_{16-1} | -10 | -12 | | dB | 05,8F; $f_i = 15\text{ kHz}$ <i>Treble max, bass lin.</i> |
| High frequency emphasis | V_{15-3} | -10 | -12 | | dB | 05,8F; $f_i = 15\text{ kHz}$ <i>Treble max, bass lin.</i> |
| Step wide treble | ΔV_{15} | 1 | 3 | 5 | dB | 05,X8-0,5 ($X \pm 1$) 8 <i>Treble X - treble ($X \pm 1$)</i> |
| Step wide treble | ΔV_{16} | 1 | 3 | 5 | dB | 05,X8-0,5 ($X \pm 1$) 8 <i>Treble X - treble ($X \pm 1$)</i> |
| Linearity sound | ΔV_{15} | | | ± 2 | dB | 05,88; $f_i = 40\text{ Hz} - 15\text{ kHz}$ <i>Treble, bass lin.</i> |
| Linearity sound | ΔV_{16} | | | ± 2 | dB | 05,88; $f_i = 40\text{ Hz} - 15\text{ kHz}$ <i>Treble, bass lin.</i> |
| Channel separation | ΔV_{15-16} | 50 | | | dB | V_3 or $V_1 = 600\text{ mVrms}$ |
| Channel separation | ΔV_{19-20} | 50 | | | dB | V_3 or $V_1 = 600\text{ mVrms}$ |
| Channel separation | ΔV_{9-10} | 50 | | | dB | V_3 or $V_1 = 600\text{ mVrms}$ |

Characteristics (cont'd)

 $V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$, in accordance with test circuit 1

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|--|--|--------------|------|------|------|--|
| | | min. | typ. | max. | | |
| Cross talk attenuation switch | $\alpha_{\text{input interf. / Output rms}}$ | 60 | | | | $V_{i\text{rms}} = 0$ $V_{i\text{Int}1,3,6} = 600\text{ mVrms}$ $V_{i\text{Int}7,8} = 2\text{ Vrms}$ |
| Attenuation MUTE | α_{1-16} | 80 | | | | 01,00-02,00 $Vol_{LSI} 0 - Vol_{LSr} 0$ $V_1 = 600\text{ mVrms}$ |
| Attenuation MUTE | α_{1-16} | 80 | | | | 07,48; $V_1 = 600\text{ mVrms}$ MUTE I: 0 |
| Attenuation MUTE | α_{1-16} | 80 | | | | 07,88; $V_1 = 600\text{ mVrms}$ MUTE II: 0 |
| Attenuation MUTE | α_{3-15} | 80 | | | | 01,00-02,00 $Vol_{LSI} 0 - Vol_{LSr} 0$ $V_3 = 600\text{ mVrms}$ |
| Attenuation MUTE | α_{3-15} | 80 | | | | 07,48; $V_3 = 600\text{ mVrms}$ MUTE I: 0 |
| Attenuation MUTE | α_{3-15} | 80 | | | | 07,88; $V_3 = 600\text{ mVrms}$ MUTE II: 0 |
| Attenuation MUTE | α_{1-20} | 80 | | | | 03,00; $V_1 = 600\text{ mVrms}$ $Vol_{KH} 0$ |
| Attenuation MUTE | α_{1-20} | 80 | | | | 07,48; $V_1 = 600\text{ mVrms}$ MUTE I: 0 |
| Attenuation MUTE | α_{3-19} | 80 | | | | 03,00; $V_3 = 600\text{ mVrms}$ $Vol_{KH} 0$ |
| Attenuation MUTE | α_{3-19} | 80 | | | | 07,48; $V_3 = 600\text{ mVrms}$ MUTE I: 0 |
| Analog values are valid for feed-in at the pin 6, 7, 8; $V_{7,8} = 2\text{ Vrms}$; $V_6 = 600\text{ mVrms}$ | | | | | | |
| Attenuation MUTE | α_{3-10} | 80 | | | | 07,48; $V_3 = 600\text{ mVrms}$ MUTE I: 0 |
| Attenuation MUTE | α_{1-9} | 80 | | | | 07,48; $V_3 = 600\text{ mVrms}$ MUTE I: 0 |
| Attenuation MUTE | α_{6-10} | 80 | | | | 07,49; $V_6 = 600\text{ mVrms}$ MUTE I: 0, Standard L |
| Attenuation MUTE | α_{6-9} | 80 | | | | 07,49; $V_6 = 600\text{ mVrms}$ MUTE I: 0, Standard L |

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Characteristics (cont'd) $V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$, in accordance with test circuit 1

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|--|--------------------|--------------|------|------|-------|--|
| | | min. | typ. | max. | | |
| Max. input voltage | V_6 | 600 | | | mVrms | $THD_{15,16} = 1\%$ |
| Max. input voltage | V_3 | 600 | | | mVrms | $THD_{15} = 1\%$ |
| Max. input voltage | V_1 | 600 | | | mVrms | $THD_{16} = 1\%$ |
| Max. input voltage | V_1 | 300 | | | mVrms | $THD_{16} = 1\%$; 00,02 Matrix: Stereo |
| Max. input voltage | V_7 | 2 | | | Vrms | $THD_{16} = 1\%$ |
| Max. input voltage | V_8 | 2 | | | Vrms | 07, CC, SCART |
| Max. input voltage | V_8 | 2 | | | % | $THD_{15} = 3\%$ 07, CC, SCART |
| Distorsion | THD_{19} | 0 | 0.01 | 0.1 | % | $V_3 = 250\text{ mVrms}$ |
| Distorsion | THD_{20} | | 0.01 | 0.1 | % | $V_1 = 250\text{ mVrms}$ |
| Distorsion | THD_{19} | | 0.01 | 0.1 | % | $V_3 = 250\text{ mVrms}$; 03,15 $Vol_{KH} 21$ |
| Distorsion | THD_{20} | | 0.01 | 0.1 | % | $V_1 = 250\text{ mVrms}$; 03,15 $Vol_{KH} 21$ |
| Analog values are valid for feed-in at the pin 6, 7, 8; $V_{7,8} = 2\text{ Vrms}$; $V_6 = 250\text{ mVrms}$ | | | | | | |
| Distorsion | THD_{16} | | 0.01 | 0.1 | % | $V_1 = 250\text{ mVrms}$ |
| Distorsion | THD_{15} | | 0.01 | 0.1 | % | $V_3 = 250\text{ mVrms}$ |
| Distorsion | THD_{16} | | 0.01 | 0.2 | % | $V_1 = 250\text{ mVrms}$; 01 2F-02,2F $Vol_{LSI} 47$ - $Vol_{LSr} 47$ |
| Distorsion | THD_{15} | | 0.01 | 0.2 | % | $V_3 = 250\text{ mVrms}$; 01 2F-02,2F $Vol_{LSI} 47$ - $Vol_{LSr} 47$ |
| Distorsion | THD_{16} | | 0.01 | 0.4 | % | $V_1 = 250\text{ mVrms}$; 05,XX any sound |
| Distorsion | THD_{15} | | 0.01 | 0.4 | % | $V_3 = 250\text{ mVrms}$; 05,XX any sound |
| Analog values are valid for feed-in at the pin 6, 7, 8; $V_{7,8} = 2\text{ Vrms}$; $V_6 = 250\text{ mVrms}$ | | | | | | |
| Distorsion | THD_{10} | | 0.01 | 0.1 | % | $V_3 = 250\text{ mVrms}$ |
| Distorsion | THD_9 | | 0.01 | 0.1 | % | $V_1 = 250\text{ mVrms}$ |
| Distorsion | THD_{10} | | 0.01 | 0.1 | % | $V_6 = 250\text{ mVrms}$ 07,C9, Standard L |
| Distorsion | THD_9 | | 0.01 | 0.1 | % | $V_1 = 250\text{ mVrms}$ 07,C9, Standard L |
| Antiphase Cross talk atten. | ΔV_{16-15} | 0.5 | 0.55 | | | $V_3 = 600\text{ mVrms}$ |
| Base width | | | | | | $f_i = 2\text{ kHz}$; 00,11, Basis width |

Characteristics (cont'd)

$V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$, in accordance with test circuit 1

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|--------------------------------------|--------------------|--------------|------|------|------------------|--|
| | | min. | typ. | max. | | |
| Antiphase Cross talk atten. | ΔV_{16-15} | 0.5 | 0.55 | | | $V_3 = 600\text{ mVrms}$ |
| Base width | | | | | | $f_1 = 2\text{ kHz}$; 00,11, <i>Basis width</i> |
| Base width phase | Φ_{16-15} | 150 | 180 | 210 | deg | $V_1 = 600\text{ mVrms}$; 00,11 <i>Basis width</i> , $f = 2\text{ kHz}$ |
| Base width phase | Φ_{15-16} | 150 | 180 | 210 | deg | $V_1 = 600\text{ mVrms}$; 00,11 <i>Basis width</i> , $f = 2\text{ kHz}$ |
| Phase rotation quasi stereo | Φ_{16-15} | 0 | 10 | 40 | deg | $V_{3,1} = 600\text{ mVrms}$; 00,21 <i>Quasi stereo</i> , $f = 40\text{ Hz}$ |
| Phase rotation quasi stereo | Φ_{16-15} | 130 | 180 | 230 | deg | $V_{3,1} = 600\text{ mVrms}$; 00,21 <i>Quasi stereo</i> , $f = 1\text{ kHz}$ |
| Phase rotation quasi stereo | Φ_{16-15} | -30 | 10 | 0 | deg | $V_{3,1} = 600\text{ mVrms}$; 00,21 <i>Quasi stereo</i> , $f = 15\text{ kHz}$ |
| Unweighted signal- to-noise ratio | $\alpha_{S/N16}$ | 1 | 90 | 97 | dB | $V_{N\text{ rms } 20\text{ Hz-20 kHz}}$; $V_1 = 0.6\text{ Vrms}$ |
| Unweighted signal- to-noise ratio | $\alpha_{S/N15}$ | 1 | 90 | 97 | dB | $V_{N\text{ rms } 20\text{ Hz-20 kHz}}$; $V_3 = 0.6\text{ Vrms}$ |
| Unweighted signal- to-noise ratio | $\alpha_{S/N16}$ | 70 | 80 | | dB | $V_{N\text{ rms } 20\text{ Hz-20 kHz}}$; $V_1 = 0.6\text{ Vrms}$ 01,27-02,27 $Vol_{LSI} 39 - Vol_{LSr} 39$ |
| Unweighted signal- to-noise ratio | $\alpha_{S/N15}$ | 70 | 80 | | dB | $V_{N\text{ rms } 20\text{ Hz-20 kHz}}$; $V_3 = 0.6\text{ Vrms}$ 01,27-02,27 $Vol_{LSI} 39 - Vol_{LSr} 39$ |
| External voltage | V_{N15} | | 2 | 10 | μVrms | $V_{N\text{ rms } 20\text{ Hz-20 kHz}}$ 01,00-02,00 $Vol_{LSI} 0 - Vol_{LSr} 0$ |
| External voltage | V_{N16} | | 2 | 10 | μVrms | $V_{N\text{ rms } 20\text{ Hz-20 kHz}}$ 01,00-02,00 $Vol_{LSI} 0 - Vol_{LSr} 0$ |

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Characteristics (cont'd)

 $V_S = 12 \text{ V}$; $T_A = 25 \text{ }^\circ\text{C}$, in accordance with test circuit 1

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|---------------------------------------|------------------|--------------|------|----------|------------------|---|
| | | min. | typ. | max. | | |
| Unweighted signal-to-noise ratio | $\alpha_{S/N20}$ | 90 | 97 | | dB | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; $V_1 = 0.6 \text{ Vrms}$ |
| Unweighted signal-to-noise ratio | $\alpha_{S/N19}$ | 1 | 90 | 97 | dB | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; $V_3 = 0.6 \text{ Vrms}$ |
| Unweighted signal-to-noise ratio | $\alpha_{S/N20}$ | 70 | 80 | | dB | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; $V_1 = 0.6 \text{ Vrms}$ 03,10, $Vol_{KH} 16$ |
| Unweighted signal-to-noise ratio | $\alpha_{S/N19}$ | 70 | 80 | | dB | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; $V_3 = 0.6 \text{ Vrms}$ 03,10, $Vol_{KH} 16$ |
| External voltage | V_{N20} | | 2 | 10 | μVrms | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; 03,00 $Vol_{KH} 0$ |
| External voltage | V_{N19} | | 2 | 10 | μVrms | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; 03,00 $Vol_{KH} 0$ |
| Unweighted signal-to-noise ratio | $\alpha_{S/N9}$ | 1 | 90 | 97 | dB | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; $V_1 = 0.6 \text{ Vrms}$ |
| Unweighted signal-to-noise ratio | $\alpha_{S/N10}$ | 1 | 90 | 97 | dB | $V_{N \text{ rms } 20 \text{ Hz-20 kHz}}$; $V_1 = 0.6 \text{ Vrms}$ |
| Change of DC-switch $\Delta 1$ Bit | ΔV_{16} | | | ± 10 | mV | 01,X-01,X ± 1 $Vol_{LSI} X - Vol_{LSI} (X \pm 1)$ |
| Change of DC-switch $\Delta 1$ Bit | ΔV_{15} | | | ± 10 | mV | 02,X-02,X ± 1 $Vol_{LSr} X - Vol_{LSr} (X \pm 1)$ |
| Change of DC-switch $\Delta 1$ Bit | ΔV_{16} | | | ± 10 | mV | 05,X-05,X ± 1 Sound X-Sound $(X \pm 1)$ |
| Change of DC-switch $\Delta 1$ Bit | ΔV_{15} | | | ± 10 | mV | 05,X-05,X ± 1 Sound X-Sound $(X \pm 1)$ |
| Change of DC-switch $\Delta 1$ Bit | ΔV_{19} | | | ± 10 | mV | 03,X-03,X ± 1 $Vol_{KH} X - Vol_{KH} (X \pm 1)$ |
| Change of DC-switch $\Delta 1$ Bit | ΔV_{20} | | | ± 10 | mV | 03,X-03,X ± 1 $Vol_{KH} X - Vol_{KH} (X \pm 1)$ |

Characteristics (cont'd) $V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$, in accordance with test circuit 1

| Parameter | Symbol | Limit Values | | | Unit | Test Condition |
|-----------|--------|--------------|------|------|------|----------------|
| | | min. | typ. | max. | | |

Design-Related Data

| | | | | | | |
|-------------------|----------|----|--|-----|------------------|--|
| Input resistance | R_7 | 35 | | | $\text{k}\Omega$ | |
| Input resistance | R_8 | 35 | | | $\text{k}\Omega$ | |
| Input resistance | R_6 | 20 | | | $\text{k}\Omega$ | |
| Input resistance | R_3 | 20 | | | $\text{k}\Omega$ | |
| Input resistance | R_1 | 20 | | | $\text{k}\Omega$ | |
| Output resistance | R_{19} | | | 200 | Ω | |
| Output resistance | R_{20} | | | 200 | Ω | |
| Output resistance | R_{15} | | | 200 | Ω | |
| Output resistance | R_{16} | | | 200 | Ω | |
| Output resistance | R_9 | | | 200 | Ω | |
| Output resistance | R_{10} | | | 200 | Ω | |

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Characteristics (cont'd)

$V_S = 12\text{ V}; T_A = 25\text{ }^\circ\text{C}$

| Parameter | Symbol | Limit Values | | | Unit | Test Condition | Test Circuit |
|-----------|--------|--------------|------|------|------|----------------|--------------|
| | | min. | typ. | max. | | | |

ID-Signal Decoder

| | | | | | | | |
|--------------------|----------|-----|----|-----|------|--|---|
| Gain | | | | | | | |
| Filter OP-amp | V_5 | 13 | 14 | 15 | dB | $V_{IF} = 80\text{ mVpp}$ | 1 |
| Max. input voltage | V_5 | 6 | | | mVpp | Function | 2 |
| VCO voltage PLL | V_{27} | 1.3 | | | V | $f_{24} = 14.6\text{ kHz};$ $V_{24} = 2.5\text{ }V_{OS}$ | 2 |
| VCO voltage PLL | V_{27} | 2 | 3 | 4 | V | $f_{24} = 15.625\text{ kHz};$ $V_{24} = 2.5\text{ }V_{OS}$ | 2 |
| VCO voltage PLL | V_{27} | | | 4.7 | V | $f_{24} = 16.6\text{ kHz};$ $V_{24} = 2.5\text{ }V_{OS}$ | 2 |
| VCO voltage PLL | V_{27} | 1.3 | | | V | $f_{24} = 58.4\text{ kHz};$ $V_{24} = 2.5\text{ }V_{OS}$ | 2 |
| VCO voltage PLL | V_{27} | | | 4.7 | V | 00,09, <i>H-Imp</i> $f_{24} = 66.4\text{ kHz};$ $V_{24} = 2.5\text{ }V_{OS}$ | 2 |
| VCO voltage PLL | V_{27} | | | | V | 00,09, <i>H-Imp</i> | 2 |

$$V_{KT\text{ FILTER}} = \frac{\sqrt{(V_{25} - V_{25}^*)^2 + (V_{26} - V_{26}^*)^2}}{V_5} \quad \begin{matrix} V_{25} \text{ or } V_{26} \text{ when } V_5 = 0 \\ V_{25}^* \text{ or } V_{26}^* \text{ when } V_5 = 400\text{ mVpp} \end{matrix}$$

| | | | | | | | |
|----------------|------------------------|-----|--|-----|--|---|--|
| ID-filter gain | $V_{KT\text{ Filter}}$ | 3.4 | | 6.8 | | $f_5 = \text{Pilot signal: Dual}$ $I^2\text{C-talk: Dual}$ | |
| ID-filter gain | $V_{KT\text{ Filter}}$ | 3.4 | | 6.8 | | $f_5 = \text{Pilot signal: Stereo}$ $I^2\text{C-talk: Stereo}$ | |

$$V_{25\text{ test}} = V_{25} (V_5 = 0) \pm \Delta V_{25}; V_{26\text{ test}} = V_{26} (V_5 = 0) \pm \Delta V_{26}$$

| | | | | | | | |
|---------------------|------------------|-----|--|--|----|---------------------------------------|---|
| Detection threshold | ΔV_{25} | 900 | | | mV | $I^2\text{C-talk: Stereo o.}$ Dual | 3 |
| Detection threshold | $-\Delta V_{25}$ | 900 | | | mV | $I^2\text{C-talk: Stereo o.}$ Dual | 3 |
| Detection threshold | ΔV_{26} | 900 | | | mV | $I^2\text{C-talk: Stereo o.}$ Dual | 3 |
| Detection threshold | $-\Delta V_{26}$ | 900 | | | mV | $I^2\text{C-talk: Stereo o.}$ Dual | 3 |

Characteristics (cont'd)

$V_S = 12\text{ V}; T_A = 25\text{ }^\circ\text{C}$

| Parameter | Symbol | Limit Values | | | Unit | Test Condition | Test Circuit |
|--------------------------------------|------------------|--------------|------|----------|-----------|---|--------------|
| | | min. | typ. | max. | | | |
| Mono threshold | ΔV_{25} | 0 | | 100 | mV | I ² C-talk: Mono | 3 |
| Mono threshold | $-\Delta V_{25}$ | 0 | | 100 | mV | I ² C-talk: Mono | 3 |
| Mono threshold | ΔV_{26} | 0 | | 100 | mV | I ² C-talk: Mono | 3 |
| Mono threshold | $-\Delta V_{26}$ | 0 | | 100 | mV | I ² C-talk: Mono | 3 |
| Detection response | t_{det} | 1/4 | | 1/2 | t_{MPX} | I ² C-talk: Stereo o. Dual $\pm \Delta V_{25} = 1\text{ V}$ | 3 |
| Detection response | t_{det} | 1/4 | | 1/2 | | I ² C-talk: Stereo o. Dual $\pm \Delta V_{25} = 1\text{ V}$ | 3 |
| Switching threshold f_{REF} -input | V_{24L} | 0 | | 1.5 | V | | 2 |
| Switching threshold f_{REF} -input | V_{24L} | 3.5 | | V_{21} | V | | 2 |
| Multiplexer clock | t_{MPX} | | 1.08 | | s | 00,C0, $MPX = 1\text{ s}$ | |
| Multiplexer clock | t_{MPX} | | 2.17 | | s | 00,C0, $MPX = 2\text{ s}$ | |
| Multiplexer clock | t_{MPX} | | 4.34 | | s | 00,C0, $MPX = 4\text{ s}$ | |
| Multiplexer clock | t_{MPX} | | 8.68 | | s | 00,C0, $MPX = 8\text{ s}$ | |

Design-Related Data

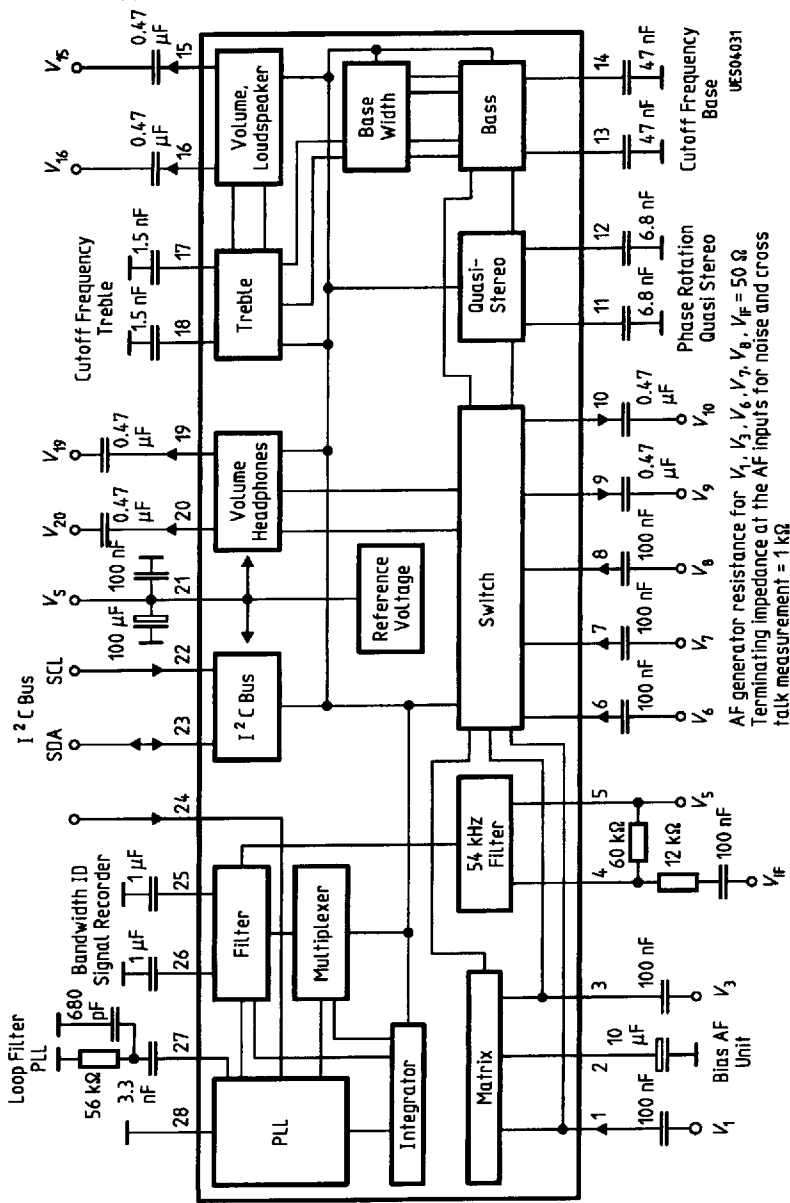
| | | | | | | | |
|-----------------------------|--------------|-----|--|--|------------|--|--|
| Filter output resistance | $R_{25, 26}$ | 110 | | | k Ω | | |
| f_{REF} -input resistance | R_{24} | 7 | | | k Ω | | |

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Characteristics

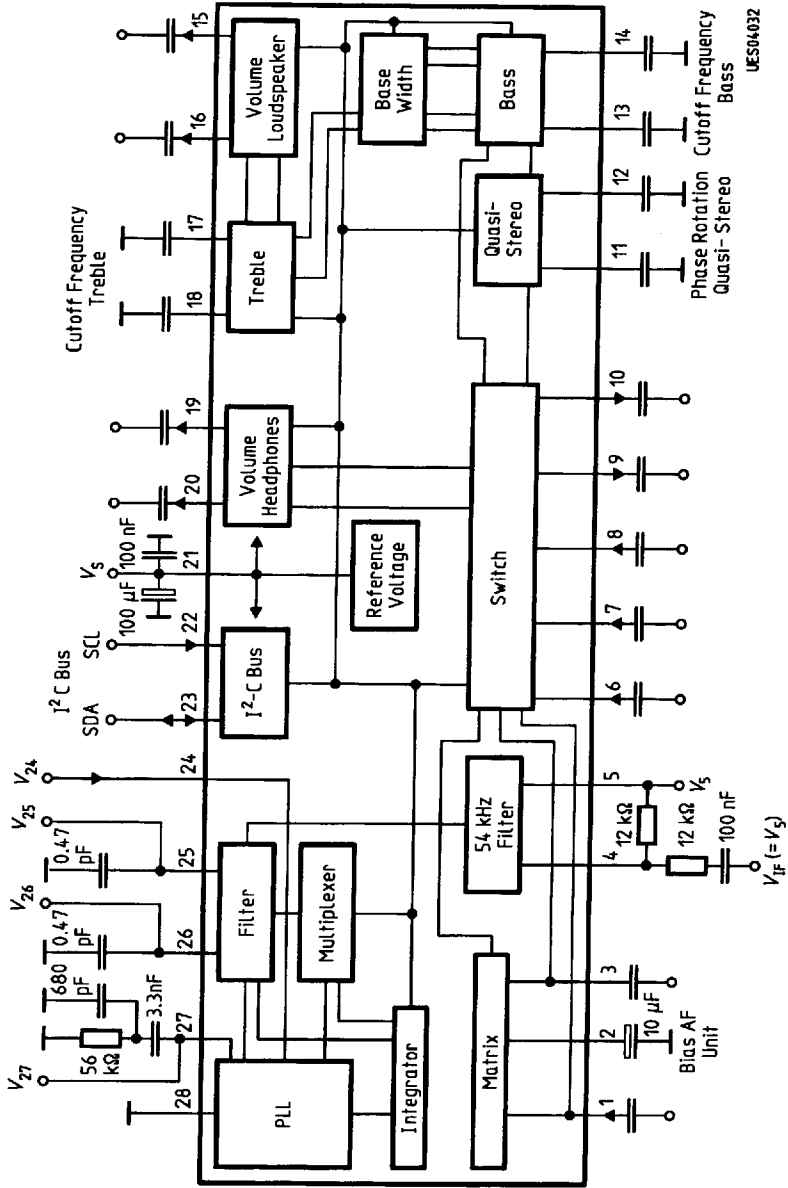
 $V_S = 12\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$

| Parameter | Symbol | Limit Values | | | Unit |
|--------------------------------------|--------------------|--------------|------|------|---------------|
| | | min. | typ. | max. | |
| I²C-Bus (SCL, SDA) | | | | | |
| SCL, SDA edges | | | | | |
| Rise time | t_R | | | 1 | μs |
| Fall time | t_F | | | 300 | ns |
| Shift register clock pulse SCL | | | | | |
| Frequency | f_{SCL} | 0 | | 100 | kHz |
| H-pulse width | t_{HIGH} | 4 | | | μs |
| L-pulse width | t_{LOW} | 4 | | | μs |
| Start | | | | | |
| Setup time | t_{SUSTA} | 4 | | | μs |
| Hold time | t_{HDSTA} | 4 | | | μs |
| Stop | | | | | |
| Setup time | t_{SUSTO} | 4 | | | μs |
| Bus free time | t_{BUF} | 4 | | | μs |
| Data transfer | | | | | |
| Setup time | t_{SUDAT} | 1 | | | μs |
| Hold time | t_{HDDAT} | 1 | | | μs |
| Input SCL, SDA | | | | | |
| Input voltage | V_{QH} | 2.4 | | 5.5 | V |
| | V_{QL} | | | 1 | V |
| Input current | I_{QH} | | | 20 | μA |
| | I_{QL} | | | 20 | μA |
| Output SDA (open collector) | | | | | |
| Output voltage | V_{QH} | 5.4 | | | V |
| | V_{QL} | | | 0.4 | V |
| $R_L = 2.5\text{ k}\Omega$ | | | | | |
| $I_{\text{QL}} = 3\text{ mA}$ | | | | | |



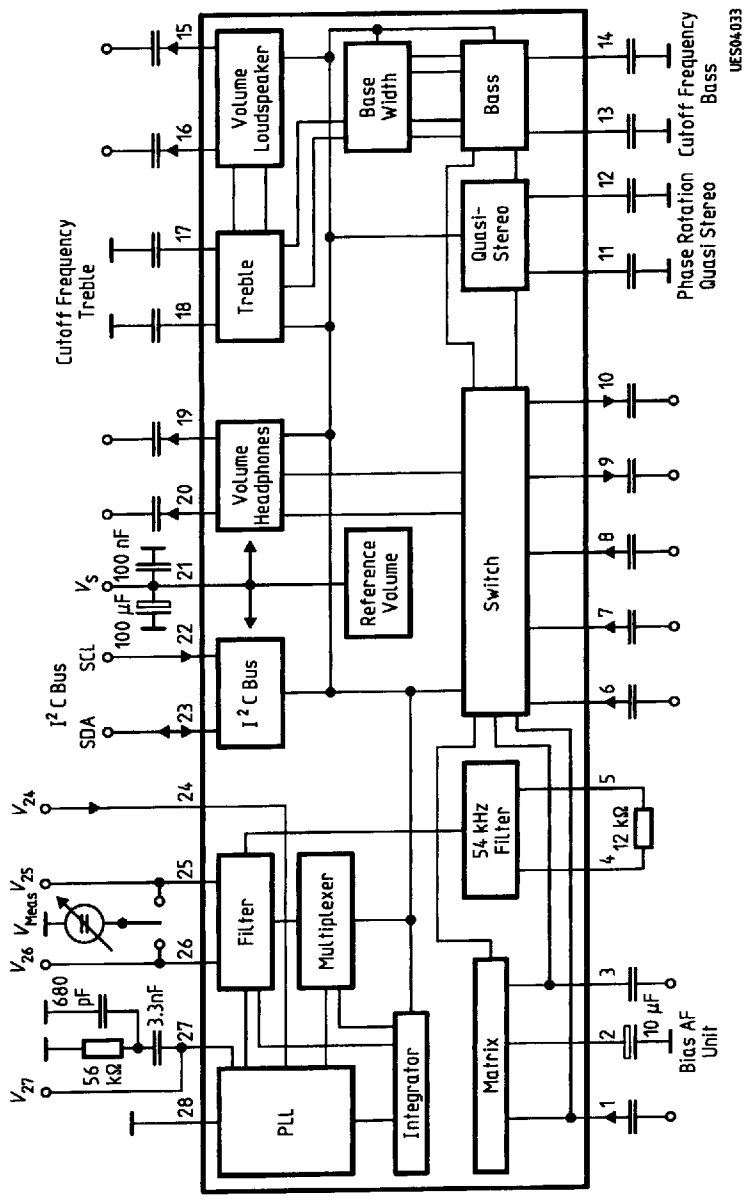
Test Circuit 1

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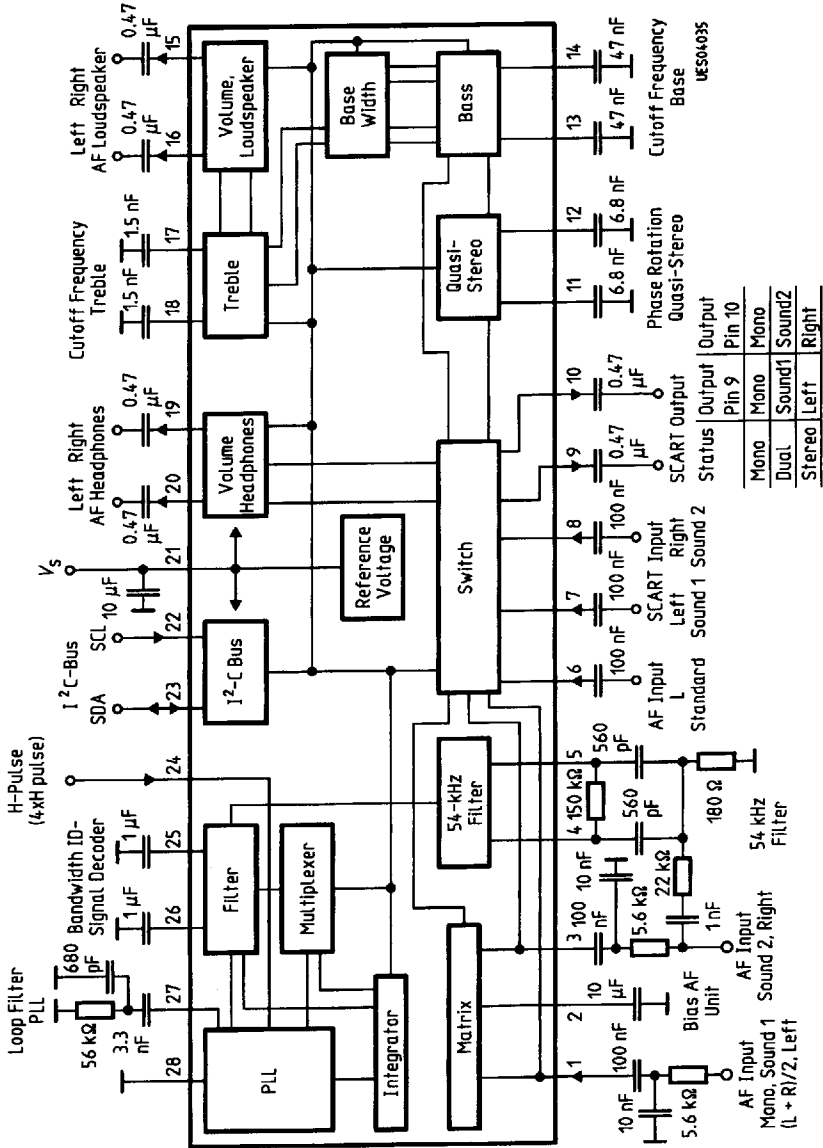
UES04032

Test Circuit 2

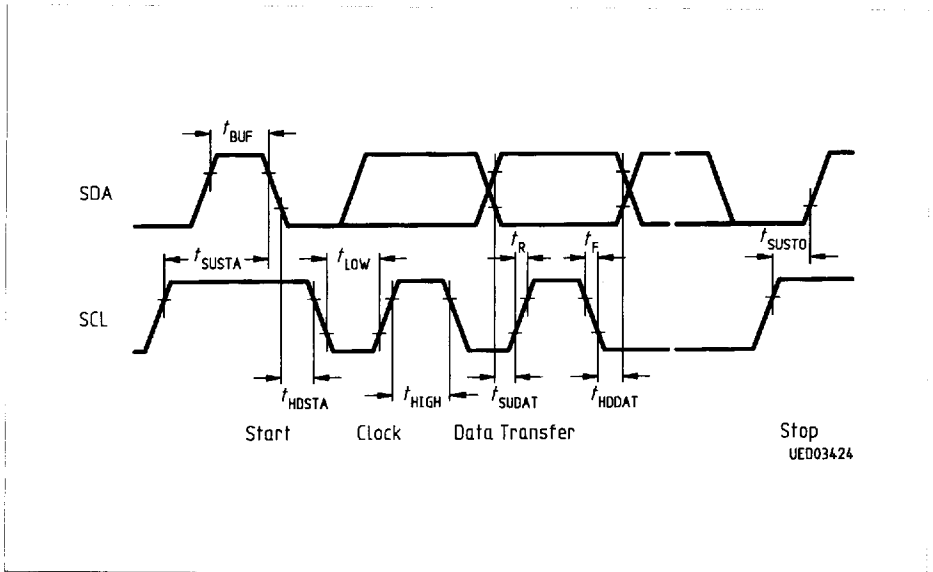


Test Circuit 3

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Application Circuit 2



I²C-Bus Timing Diagram

| | |
|-------------|----------------------------|
| t_{SUSTA} | Setup time (start) |
| t_{HDSTA} | Hold time (start) |
| t_{HIGH} | H-pulse width (clock) |
| t_{LOW} | L-pulse width (clock) |
| t_{SUDAT} | Setup time (data transfer) |
| t_{HDDAT} | Hold time (data transfer) |
| t_{SUSTO} | Setup time (stop) |
| t_{BUF} | Bus free time |
| t_F | Fall time |
| t_R | Rise time |

All times referred to V_{IH} and V_{IL} values.