

DATA SHEET

TDA9615H

Audio processor for VHS hi-fi

Preliminary specification
File under Integrated Circuits, IC02

1997 Jun 16

Audio processor for VHS hi-fi

TDA9615H

FEATURES

- All functions controlled via the 2-wire I²C-bus
- Single supply
- Integrated standby modes for low power consumption
- Integrated power muting for line and RFC output
- Full support of video recorder feature modes
- Audio level meter output
- Hi-fi signal processing:
 - Adjustment-free
 - High performance
 - Patented low distortion switching noise suppressor
 - NTSC and PAL (SECAM) standard
- Linear audio input with level adjustment
- 5 stereo inputs and additional mono audio input
- 2 stereo outputs (line and decoder) with independent output selection
- RF converter output with overload protect AGC.



GENERAL DESCRIPTION

The TDA9615H is an audio control and processing circuit for VHS hi-fi video recorders, controlled via the I²C-bus. The device is adjustment-free using an integrated auto-calibration circuit. Extensive input and output selection is offered, including full support for (Euro-SCART) pay-TV decoding and video recorder feature modes.

ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|-------------|---------|---|----------|
| | NAME | DESCRIPTION | VERSION |
| TDA9615H | QFP44 | plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 × 10 × 1.75 mm | SOT307-2 |

Audio processor for VHS hi-fi

TDA9615H

BLOCK DIAGRAM

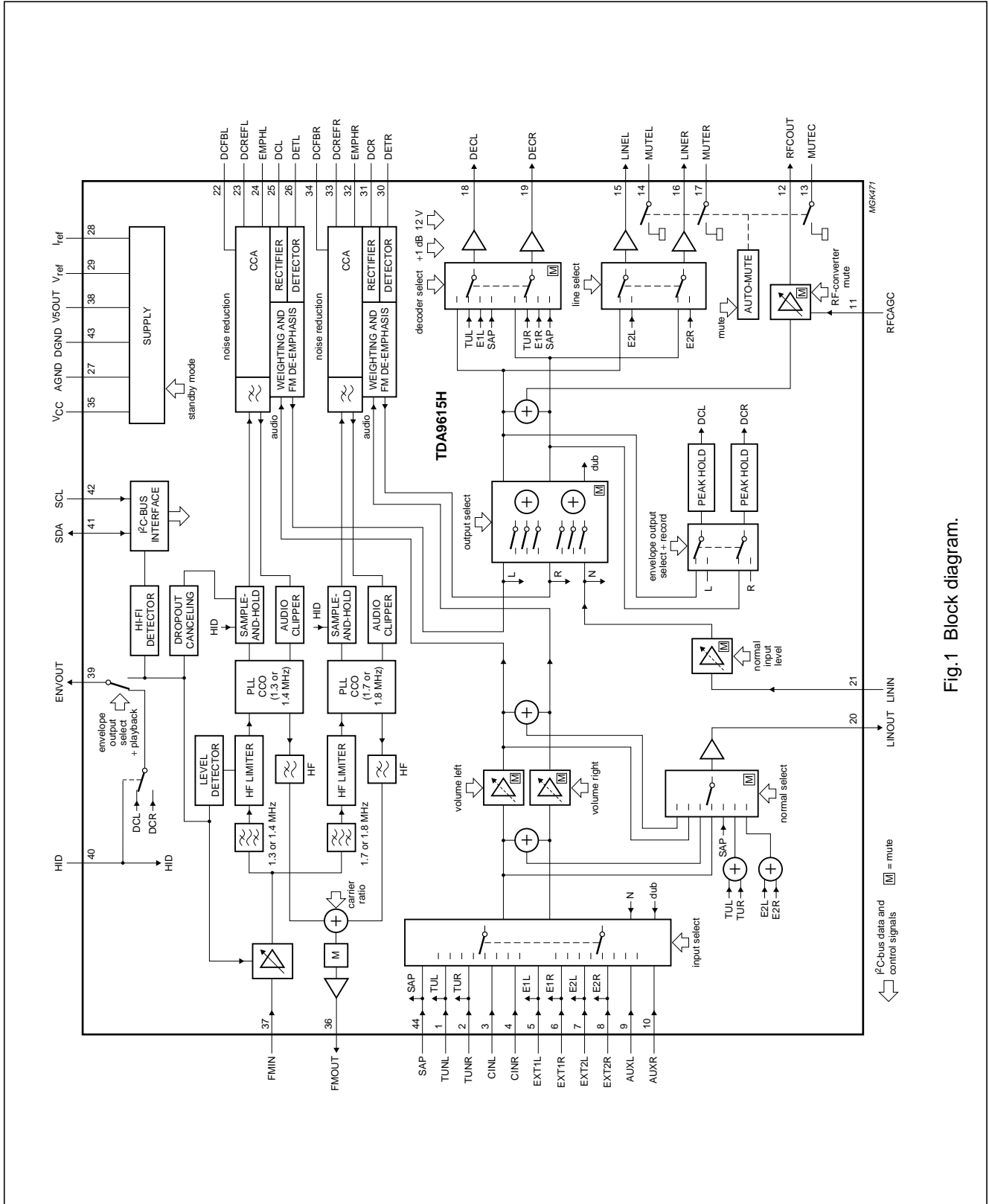


Fig.1 Block diagram.

Audio processor for VHS hi-fi

TDA9615H

PINNING

| SYMBOL | PIN | DESCRIPTION |
|--------|-----|----------------------------|
| TUNL | 1 | tuner input left |
| TUNR | 2 | tuner input right |
| CINL | 3 | cinch input left |
| CINR | 4 | cinch input right |
| EXT1L | 5 | external 1 input left |
| EXT1R | 6 | external 1 input right |
| EXT2L | 7 | external 2 input left |
| EXT2R | 8 | external 2 input right |
| AUXL | 9 | auxiliary input left |
| AUXR | 10 | auxiliary input right |
| RFCAGC | 11 | RFC AGC timing input |
| RFCOUT | 12 | RFC output |
| MUTEC | 13 | mute for RFC output |
| MUTEL | 14 | mute for line output left |
| LINEL | 15 | line output left |
| LINER | 16 | line output right |
| MUTER | 17 | mute for line output right |
| DECL | 18 | decoder output left |
| DECR | 19 | decoder output right |
| LINOUT | 20 | linear audio output |
| LININ | 21 | linear audio input |
| DCFBL | 22 | NR DC feedback left |

| SYMBOL | PIN | DESCRIPTION |
|-----------|-----|---------------------------------------|
| DCREFL | 23 | NR DC reference left |
| EMPHL | 24 | NR emphasis left |
| DCL | 25 | NR DC decoupling left |
| DETL | 26 | NR detector left |
| AGND | 27 | analog ground |
| I_{ref} | 28 | reference current standard |
| V_{ref} | 29 | reference voltage filter |
| DETR | 30 | NR detector right |
| DCR | 31 | NR DC decoupling right |
| EMPHR | 32 | NR emphasis right |
| DCREFR | 33 | NR DC reference right |
| DCFBR | 34 | NR DC feedback right |
| V_{CC} | 35 | supply voltage |
| FMOUT | 36 | FM output |
| FMIN | 37 | FM input |
| V5OUT | 38 | 5 V decoupling output |
| ENVOUT | 39 | envelope output |
| HID | 40 | HID input |
| SDA | 41 | I ² C-bus SDA input/output |
| SCL | 42 | I ² C-bus SCL input |
| DGND | 43 | digital ground |
| SAP | 44 | tuner SAP input |

Audio processor for VHS hi-fi

TDA9615H

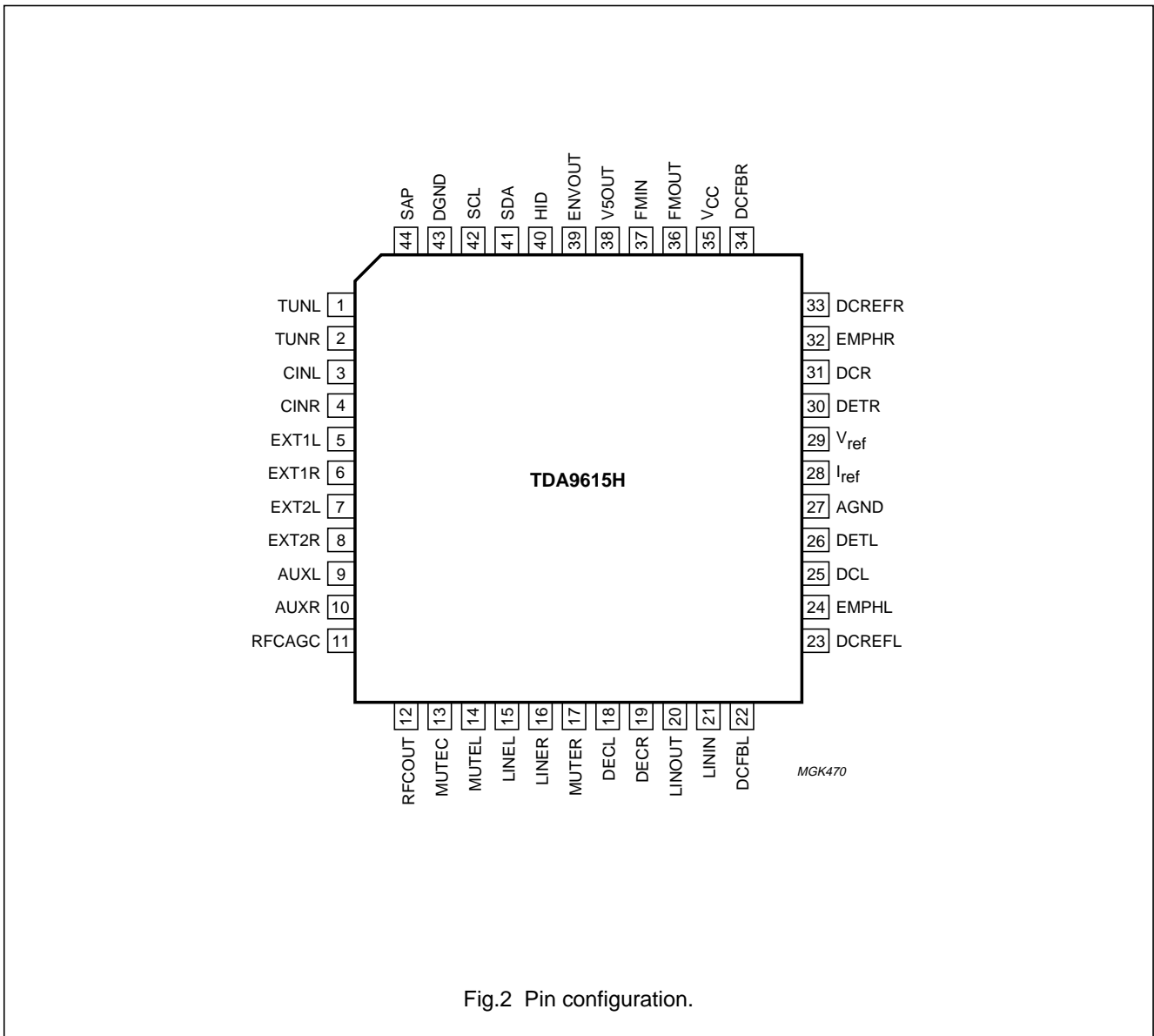


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

An overview of input/output selections is given in Figs 3 to 5.

Full control of the TDA9615H is accomplished via the 2-wire I²C-bus. Up to 400 kbits/s bus speed can be used, in accordance with the I²C-bus fast-mode specification. The detailed functional description can be found in Chapter "I²C-bus protocol".

Audio processor for VHS hi-fi

TDA9615H

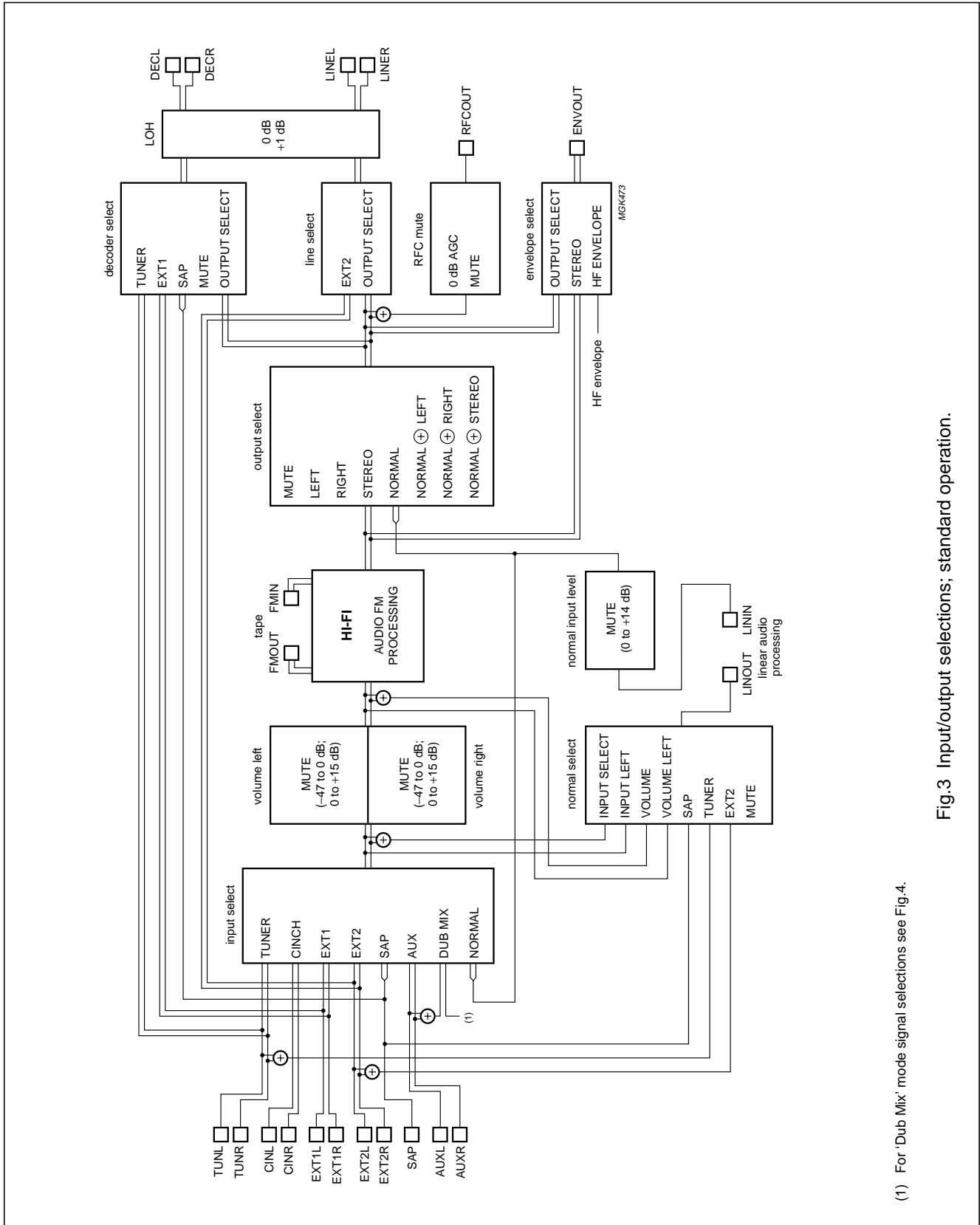
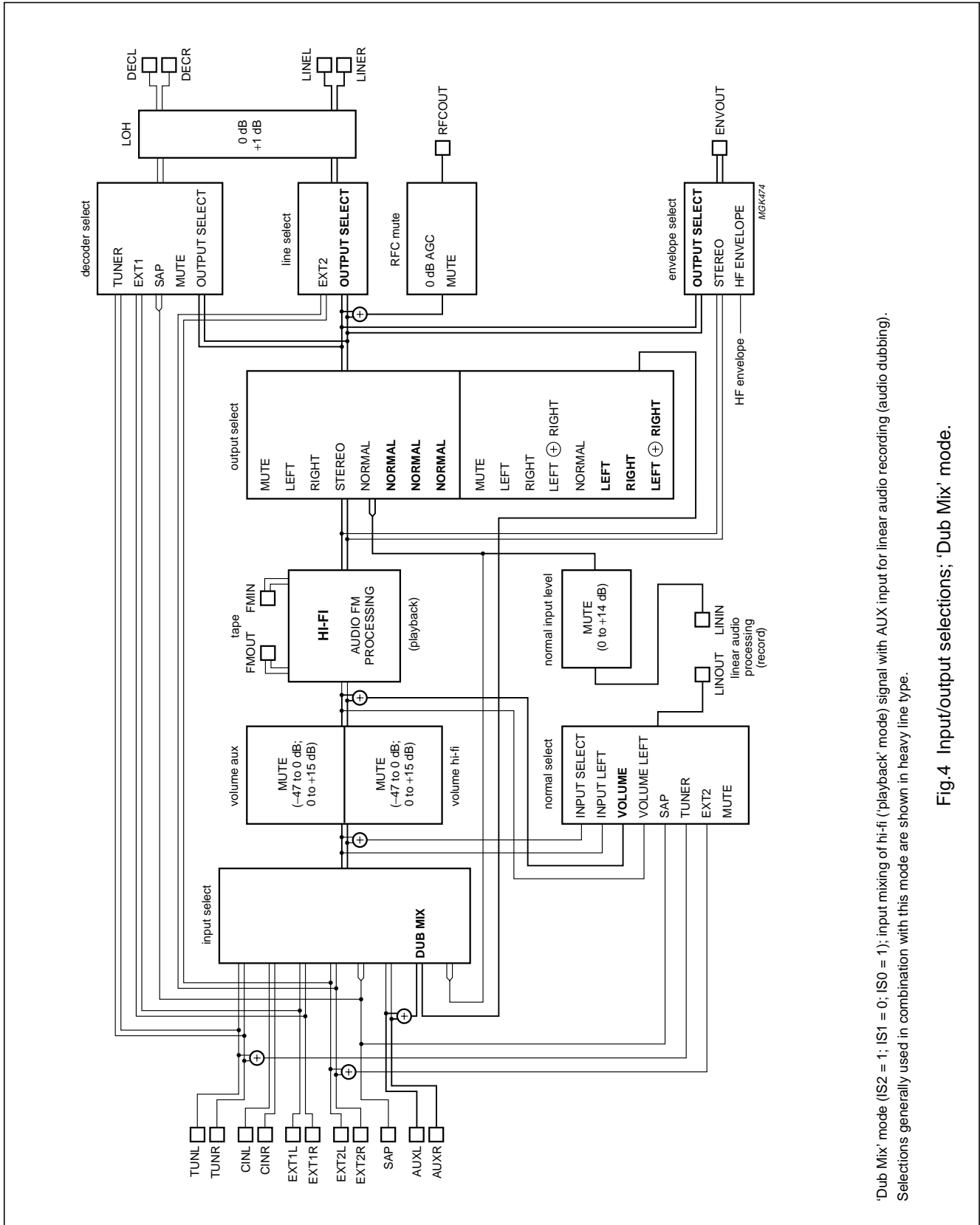


Fig.3 Input/output selections; standard operation.

(1) For 'Dub Mix' mode signal selections see Fig.4.

Audio processor for VHS hi-fi

TDA9615H

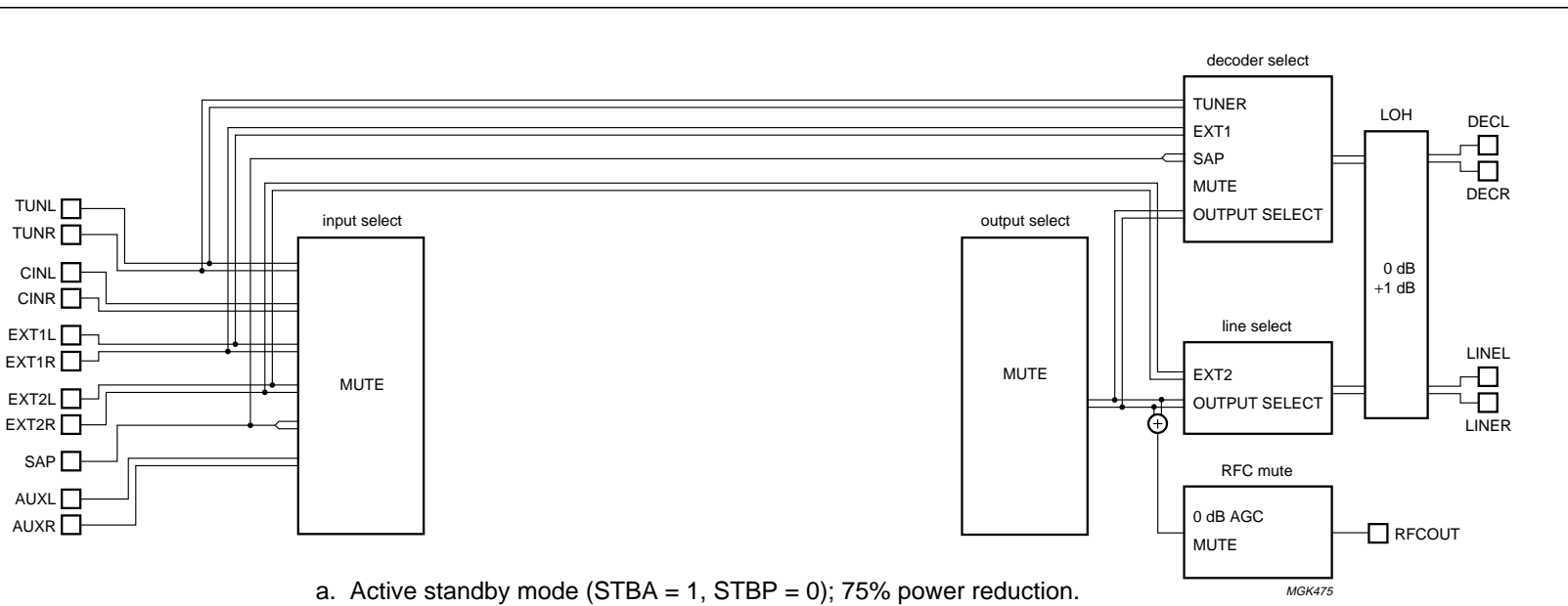


'Dub Mix' mode (IS2 = 1; IS0 = 0; IS1 = 0; IS0 = 1); input mixing of hi-fi ('playback' mode) signal with AUX input for linear audio recording (audio dubbing). Selections generally used in combination with this mode are shown in heavy line type.

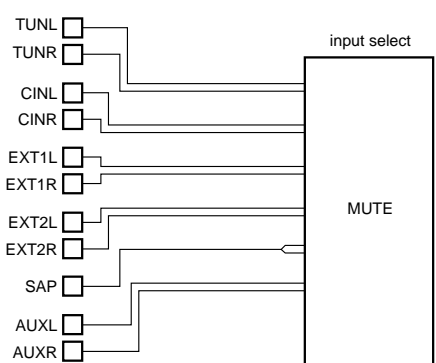
Fig.4 Input/output selections; 'Dub Mix' mode.

Audio processor for VHS hi-fi

TDA9615H



a. Active standby mode (STBA = 1, STBP = 0); 75% power reduction.



b. Passive standby mode (STBP = 1); 90% power reduction.

Fig.5 Input/output selections; standby modes.

Audio processor for VHS hi-fi

TDA9615H

I²C-BUS PROTOCOL**Addressing and data bytes**

For programming the device (write mode) seven data byte registers are available; they are addressable via eight subaddresses. Automatic subaddress incrementing enables the writing of successive data bytes in one transmission. During power-on, data byte registers are reset to a default state by use of a Power On Reset (POR) circuit which signal is derived from the internally generated I²C-bus supply voltage (V5OUT; pin 38). For reading from the device (read mode) one data byte register is available without subaddressing.

Table 1 TDA9615H addresses and data bytes

| DATA BYTE | ADDRESS | | | | | | | |
|-----------------------------------|--|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Write mode | | | | | | | | |
| Slave address byte (B8H) | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| Subaddress bytes (00H to 07H) | 0 ⁽¹⁾ | 0 ⁽¹⁾ | 0 ⁽¹⁾ | 0 ⁽¹⁾ | 0 | 0 or 1 | 0 or 1 | 0 or 1 |
| Control byte (subaddress 00) | AFM | DOC | SHH | DETH | NTSC | MUTE | STBP | STBA |
| Select byte (subaddress 01) | DOS1 | DOS0 | s5 | s4 | NIL3 | NIL2 | NIL1 | NIL0 |
| Input byte (subaddress 02) | i7 | IS2 | IS1 | IS0 | NS2 | NS1 | NS0 | i0 |
| Output byte (subaddress 03) | LOH | OSN | OSR | OSL | EOS | LOS | DOS | RFCM |
| Left volume byte (subaddress 04) | l7 | VLS | VL5 | VL4 | VL3 | VL2 | VL1 | VL0 |
| Right volume byte (subaddress 05) | r7 | VRS | VR5 | VR4 | VR3 | VR2 | VR1 | VR0 |
| Volume byte (subaddress 06) | simultaneous loading of subaddress 04 and subaddress 05 register | | | | | | | |
| Power byte (subaddress 07) | CALS | VCCH | TEST | PORR | p3 | p2 | p1 | p0 |
| Read mode | | | | | | | | |
| Slave address byte (B9H) | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| Read byte | CALR | AUTN | 0 ⁽²⁾ | POR | 0 ⁽²⁾ | 1 ⁽²⁾ | 0 ⁽²⁾ | 0 ⁽²⁾ |

Notes

1. Use of subaddress F0H to F7H (1111 0XXX) instead of 00H to 07H (0000 0XXX) disables the automatic subaddress incrementing allowing continuous writing to a single data byte register.
2. The state of unused read bits are not reliable; their state may change during development.

Table 2 Status of data bytes after POR

| DATA BYTE | ADDRESS | | | | | | | |
|-------------------|------------------|---|------------------|------------------|------------------|------------------|------------------|------------------|
| Control byte | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| Select byte | 0 | 0 | 1 ⁽¹⁾ | 1 ⁽¹⁾ | 0 | 0 | 0 | 0 |
| Input byte | 0 ⁽¹⁾ | 0 | 0 | 0 | 1 | 1 | 1 | 0 ⁽¹⁾ |
| Output byte | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Left volume byte | 0 ⁽¹⁾ | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Right volume byte | 0 ⁽¹⁾ | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power byte | 0 | 0 | 0 | 0 | 0 ⁽¹⁾ | 0 ⁽¹⁾ | 0 ⁽¹⁾ | 0 ⁽¹⁾ |

Note

1. For eventual future compatibility it is advised to keep unused write bits equal to POR state.

Audio processor for VHS hi-fi

TDA9615H

Valid transmissions to and from TDA9615H

Table 3 Examples of valid transmissions

| FUNCTION | DATA TRANSFER SEQUENCE |
|------------------------------|--|
| Write | START - B8H - 00H - data_for_00 - STOP |
| Write with auto-increment | START - B8H - 00H - data_for_00 - data_for_01 - data_for_02 - STOP |
| Auto-increment 'wrap-around' | START - B8H - 07H - data_for_07 - data_for_00 - data_for_01 - STOP |
| Write without auto-increment | START - B8H - F6H - data_for_06 - data_for_06 - data_for_06 - STOP |
| Read | START - B9H - data_from_ic - STOP |
| | START - B9H - data_from_ic - data_from_ic - data_from_ic - STOP |

Overview of TDA9615H I²C-bus control

Table 4 Condensed overview

| FUNCTION | MODES | CONTROL BITS |
|--|--|--------------------|
| Audio FM mode | playback; loop-through ⁽¹⁾ ; record | AFM, DOC and SHH |
| Dropout cancelling | on; off | DOC |
| Headswitch noise cancel sample-and-hold time | 6 μ s; 8 μ s | SHH |
| Playback hi-fi carrier detection | slow; fast | DETH |
| Record carrier ratio | 0; 6; 8; 9.5; 11; 12.5; 13.5 dB | DOC, SHH and DETH |
| System standard | NTSC ⁽¹⁾ ; PAL | NTSC |
| Power mute | output muting ⁽¹⁾ | MUTE |
| Operation mode | full operation ⁽¹⁾ ; active standby; passive standby | STBP and STBA |
| Normal input level | 0 ⁽¹⁾ to +14 dB; mute | NIL3 to NIL0 |
| Input select | Tuner ⁽¹⁾ ; Cinch; Ext1; Ext2; SAP; Dub Mix; Normal; Aux | IS2, IS1 and IS0 |
| Normal select | Input Select; Volume; Input-Left; Volume-Left; SAP; Tuner; Ext2; mute ⁽¹⁾ | NS2, NS1 and NS0 |
| Line output amplification | 0 dB ⁽¹⁾ ; +1 dB | LOH |
| Output select | mute ⁽¹⁾ ; Left; Right; Stereo; Normal; Mix-Left; Mix-Right; Mix-Stereo | OSN, OSR and OSL |
| Envelope output | Output Select ⁽¹⁾ ; Stereo; HF Envelope | EOS and AFM |
| Line output select | Output Select ⁽¹⁾ ; Ext2 | LOS |
| Decoder output select | Output Select ⁽¹⁾ ; Tuner; Ext1; SAP; mute | DOS, DOS1 and DOS0 |
| RFC output | 0 dB; mute ⁽¹⁾ | RFCM |
| Volume left | -47 to 0 dB ⁽¹⁾ ; 0 to +15 dB; mute | VLS, VL5 to VL0 |
| Volume right | -47 to 0 dB ⁽¹⁾ ; 0 to +15 dB; mute | VRS, VR5 to VR0 |
| Auto-calibration | off ⁽¹⁾ ; start calibration | CALS |
| Supply voltage | 9 V ⁽¹⁾ ; 12 V | VCCH |
| Test | standard operation ⁽¹⁾ ; test modes | TEST, s4 to NIL0 |

Note

1. POR.

Audio processor for VHS hi-fi

TDA9615H

Control byte; subaddress 00 (hi-fi and general control)**Table 5** Bits of control byte

| BIT | DESCRIPTION |
|------|--|
| AFM | audio FM mode; see Table 6 |
| DOC | dropout cancel; see Table 6 |
| SHH | sample-and-hold high-state; see Table 6 |
| DETH | detector high; see Table 6 |
| NTSC | NTSC television system standard; see Table 7 |
| MUTE | power mute; see Table 8 |
| STBP | standby mode passive; see Table 9 |
| STBA | standby mode active; see Table 9 |

Table 6 Bits AFM, DOC, SHH and DETH

| AFM | DOC | SHH | DETH | MODE | REMARKS | DESCRIPTION |
|-----|------------------|------------------|------------------|--------------------------------|----------------------------------|---|
| 0 | X ⁽¹⁾ | X ⁽¹⁾ | X ⁽¹⁾ | playback ⁽²⁾ | | hi-fi circuit in playback mode |
| 0 | 0 | X ⁽¹⁾ | X ⁽¹⁾ | playback | DOC off | no dropout cancelling |
| 0 | 1 | X ⁽¹⁾ | X ⁽¹⁾ | playback | DOC on | dropout cancelling active |
| 0 | X ⁽¹⁾ | 0 | X ⁽¹⁾ | playback | sample-and-hold time = 6 μ s | headswitch noise cancel time is 6 μ s |
| 0 | X ⁽¹⁾ | 1 | X ⁽¹⁾ | playback | sample-and-hold time = 8 μ s | headswitch noise cancel time is 8 μ s |
| 0 | X ⁽¹⁾ | X ⁽¹⁾ | 0 | playback | detect = fast | hi-fi detector timing: fast mode |
| 0 | X ⁽¹⁾ | X ⁽¹⁾ | 1 | playback | detect = slow | hi-fi detector timing: slow mode |
| 1 | X ⁽¹⁾ | X ⁽¹⁾ | X ⁽¹⁾ | record/loop-through | | hi-fi circuit in record/loop-through mode |
| 1 | 0 | 0 | 0 | loop-through ⁽³⁾⁽⁴⁾ | | no FM output signal (EE mode) |
| 1 | 0 | 0 | 1 | record | 0 dB mix | 0 dB FM output carrier ratio (1 : 1) |
| 1 | 0 | 1 | 0 | record | 6 dB mix | 6 dB FM output carrier ratio (1 : 2) |
| 1 | 0 | 1 | 1 | record | 8 dB mix | 8 dB FM output carrier ratio (1 : 2.5) |
| 1 | 1 | 0 | 0 | record | 9.5 dB mix | standard 9.5 dB FM output carrier ratio (1 : 3) |
| 1 | 1 | 0 | 1 | record | 11 dB mix | 11 dB FM output carrier ratio (1 : 3.5) |
| 1 | 1 | 1 | 0 | record | 12.5 dB mix | 12.5 dB FM output carrier ratio (1 : 4.2) |
| 1 | 1 | 1 | 1 | record | 13.5 dB mix | 13.5 dB FM output carrier ratio (1 : 4.7) |

Notes

1. X = don't care.
2. Auto-normal function: if during hi-fi 'playback' mode no FM carrier is detected at FMIN (pin 37) the 'Normal' mode audio signal (LININ; pin 21) is automatically selected by the output select function.
 - a) Hi-fi carrier detection time (i.e. auto-normal release time) can be selected via bit DETH:
 - 'fast' mode: 1 to 2 HID periods (33 to 66 ms NTSC, 40 to 80 ms PAL)
 - 'slow' mode: 7 to 8 HID periods (233 to 267 ms NTSC, 280 to 320 ms PAL).
 - b) The status of hi-fi detection can be monitored via the I²C-bus; see bit AUTN of the read byte (see Table 31).
 - c) If muting is required instead of automatic selection of the 'Normal' mode audio signal the normal input level function should be set to mute; see bits NIL3 to NIL0 of the select byte.

Audio processor for VHS hi-fi

TDA9615H

3. Modes 'loop-through' and 'record' are equal in audio signal flow; FMOUT (pin 36) however is muted during 'loop-through' mode.
4. POR.

Table 7 Bit NTSC

| NTSC ⁽¹⁾ | MODE | DESCRIPTION |
|---------------------|---------------------|---|
| 0 | PAL | hi-fi circuit in 'PAL' mode (FM carriers: 1.4 and 1.8 MHz) |
| 1 | NTSC ⁽²⁾ | hi-fi circuit in 'NTSC' mode (FM carriers: 1.3 and 1.7 MHz) |

Notes

1. Bit NTSC selects between the system standard settings for NTSC and PAL (SECAM) use. The auto-calibration function uses the system standard HID frequency of 29.97 Hz for NTSC and 25 Hz for PAL. After calibration bit NTSC allows immediate switching between the NTSC and PAL system standard.
2. POR.

Table 8 Bit MUTE

| MUTE ⁽¹⁾ | MODE | DESCRIPTION |
|---------------------|---------------------|---|
| 0 | – | power mute function released; mute switches open |
| 1 | mute ⁽²⁾ | power mute function activated; mute switches closed |

Notes

1. Bit MUTE controls the line and RFC output mute switches at pins 13, 14 and 17 (power mute function). Power mute is also automatically activated at supply voltage power-up or power-down (V_{CC} ; pin 35).
2. POR.

Table 9 Bits STBP and STBA

| STBP | STBA | MODE | DESCRIPTION |
|------------------|------------------|--------------------------------|---|
| 0 | 0 | – (note 1) | full operation |
| 0 | 1 ⁽²⁾ | active standby ⁽³⁾ | standby mode; reduced power consumption |
| 1 ⁽⁴⁾ | X ⁽⁵⁾ | passive standby ⁽³⁾ | standby mode; minimum power consumption |

Notes

1. POR.
2. By selecting STBA = 1 the TDA9615H is switched to low-power 'active standby' mode. To reduce power consumption most circuits are switched off. RFC, line and decoder outputs however remain active. This way the direct audio selections offered via the line output select and decoder output select functions (bits LOS and DOS of the output byte) remain operable in this mode. The 'Output Select' mode signal is muted.
3. Calibration and I²C-bus registers are not affected by using 'active standby' or 'passive standby' mode.
4. By selecting STBP = 1 the TDA9615H is switched to minimum power 'passive standby' mode. All circuits except power mute, I²C-bus and the line input reference buffer (voltage at pins 1 to 10 and 44) are switched off for minimum power consumption. Use of the power mute function (bit MUTE of control byte) ensures pop-free switching of the line and RFC output to and from 'passive standby' mode. To obtain minimum power consumption the power mute function should be de-activated again during 'passive standby' mode.
5. X = don't care.

Audio processor for VHS hi-fi

TDA9615H

Select byte; subaddress 01 (decoder output select and linear audio volume control)**Table 10** Bits of select byte

| BIT | DESCRIPTION |
|------|---------------------------------------|
| DOS1 | decoder output select 1; see Table 11 |
| DOS0 | decoder output select 0; see Table 11 |
| NIL3 | normal input level 3; see Table 12 |
| NIL2 | normal input level 2; see Table 12 |
| NIL1 | normal input level 1; see Table 12 |
| NIL0 | normal input level 0; see Table 12 |

Table 11 Bits DOS1 and DOS0; note 1

| DOS1 | DOS0 | MODE | DESCRIPTION |
|------|------|-------|---|
| 0 | 0 | Tuner | decoder output signal is TUNL and TUNR input signal |
| 0 | 1 | Ext1 | decoder output signal is EXT1L and EXT1R input signal |
| 1 | 0 | SAP | decoder output signal is SAP input signal |
| 1 | 1 | mute | mute |

Note

1. By selecting bit DOS = 1 of the output byte several independent signal input selections are offered for the decoder outputs DECL and DECR (pins 18 and 19) via bits DOS1 and DOS0:
 - a) TUNL and TUNR inputs (pins 1 and 2)
 - b) EXT1L and EXT1R inputs (pins 5 and 6)
 - c) SAP input (pin 44)
 - d) Mute.

These decoder selections are also operable in 'active standby' mode (bit STBA = 1 of the control byte).

Audio processor for VHS hi-fi

TDA9615H

Table 12 Bits NIL3, NIL2, NIL1 and NIL0; note 1

| NIL3 | NIL2 | NIL1 | NIL0 | DESCRIPTION |
|------|------|------|------|--------------|
| 0 | 0 | 0 | 0 | 0 dB; note 2 |
| 0 | 0 | 0 | 1 | 1 dB |
| 0 | 0 | 1 | 0 | 2 dB |
| 0 | 0 | 1 | 1 | 3 dB |
| 0 | 1 | 0 | 0 | 4 dB |
| 0 | 1 | 0 | 1 | 5 dB |
| 0 | 1 | 1 | 0 | 6 dB |
| 0 | 1 | 1 | 1 | 7 dB |
| 1 | 0 | 0 | 0 | 8 dB |
| 1 | 0 | 0 | 1 | 9 dB |
| 1 | 0 | 1 | 0 | 10 dB |
| 1 | 0 | 1 | 1 | 11 dB |
| 1 | 1 | 0 | 0 | 12 dB |
| 1 | 1 | 0 | 1 | 13 dB |
| 1 | 1 | 1 | 0 | 14 dB |
| 1 | 1 | 1 | 1 | mute |

Notes

1. Mute and 15 settings of amplification can be selected for the linear audio input signal (LININ; pin 21). This level control can replace the manual adjustment of 'playback' mode level at the linear audio circuit.
2. POR.

Input byte; subaddress 02 (input selection for hi-fi and normal audio)**Table 13** Bits of input byte

| BIT | DESCRIPTION |
|-----|-------------------------------|
| IS2 | input select 2; see Table 14 |
| IS1 | input select 1; see Table 14 |
| IS0 | input select 0; see Table 14 |
| NS2 | normal select 2; see Table 15 |
| NS1 | normal select 1; see Table 15 |
| NS0 | normal select 0; see Table 15 |

Audio processor for VHS hi-fi

TDA9615H

Table 14 Bits IS2, IS1 and IS0; note 1

| IS2 | IS1 | IS0 | MODE | DESCRIPTION |
|-----|-----|-----|------------------------|---|
| 0 | 0 | 0 | Tuner ⁽²⁾ | TUNL and TUNR input |
| 0 | 0 | 1 | Cinch | CINL and CINR input |
| 0 | 1 | 0 | Ext1 | EXT1L and EXT1R input (TV input) |
| 0 | 1 | 1 | Ext2 | EXT2L and EXT2R input (decoder input) |
| 1 | 0 | 0 | SAP | SAP; mono input |
| 1 | 0 | 1 | Dub Mix ⁽³⁾ | AUX input signal (L) and selection of hi-fi output signal (R) |
| 1 | 1 | 0 | Normal | LININ input (linear audio) |
| 1 | 1 | 1 | Aux | AUXL and AUXR input (e.g. camcorder input) |

Notes

- Bits IS2, IS1 and IS0 select the input signal which is led to the volume controls of the hi-fi processing and generally via the normal select function to the linear audio circuit (LINOUT; pin 20).
- POR.
- 'Dub Mix' is a special selection for linear audio use supporting audio dubbing (a video recorder feature mode for sound recording of linear audio only). 'Dub Mix' connects the AUX input signal to the left channel ($\frac{1}{2}$ AUXL + $\frac{1}{2}$ AUXR) and the hi-fi output signal to the right channel (generally $\frac{1}{2}$ hi-fi left + $\frac{1}{2}$ hi-fi right but also hi-fi left or hi-fi right can be selected). 'Dub Mix' also changes part of the 'Output Select' mode settings to 'Normal' mode for monitoring of the linear audio recording (see control bits OSN, OSR and OSL of the output byte for 'Dub Mix' mode input and output selection).

Table 15 Bits NS2, NS1, NS0; note 1

| NS2 | NS1 | NS0 | MODE | DESCRIPTION |
|-----|-----|-----|---------------------|--|
| 0 | 0 | 0 | Input Select | hi-fi input selection |
| 0 | 0 | 1 | Volume | hi-fi volume control |
| 0 | 1 | 0 | Input-Left | left channel of hi-fi input selection only |
| 0 | 1 | 1 | Volume-Left | left channel of hi-fi volume control |
| 1 | 0 | 0 | SAP | SAP; mono input |
| 1 | 0 | 1 | Tuner | TUNL and TUNR input |
| 1 | 1 | 0 | Ext2 | EXT2L and EXT2R input |
| 1 | 1 | 1 | mute ⁽²⁾ | mute |

Notes

- With bits NS2, NS1 and NS0 the input signal is selected which is available at the LINOUT output (pin 20) for connection to an external linear audio circuit. The signal selected with the input select function (via bits IS2, IS1 and IS0) is available in the following ways:
 - Left and right channel combined, optional including hi-fi volume control ($\frac{1}{2}$ hi-fi left + $\frac{1}{2}$ hi-fi right).
 - Left channel only (language I), optional including left channel volume control.
Furthermore the SAP input (pin 44), tuner input (pins 1 and 2) or EXT2 input (pins 7 and 8) can be selected independently. Also a mute setting is available.
- POR.

Audio processor for VHS hi-fi

TDA9615H

Output byte; subaddress 03 (output selection and control)**Table 16** Bits of output byte

| BIT | DESCRIPTION |
|------|--------------------------------------|
| LOH | line output high; see Table 17 |
| OSN | output select normal; see Table 18 |
| OSR | output select right; see Table 18 |
| OSL | output select left; see Table 18 |
| EOS | envelope output select; see Table 20 |
| LOS | line output select; see Table 21 |
| DOS | decoder output select; see Table 22 |
| RFCM | RFC mute; see Table 23 |

Table 17 Bit LOH; note 1

| LOH | MODE | DESCRIPTION |
|-----|---------------------|--------------------------------|
| 0 | 0 dB ⁽²⁾ | no line output amplification |
| 1 | 1 dB | 1 dB line output amplification |

Notes

1. An additional 1 dB amplification can be selected for line and decoder outputs LINEL, LINER, DECL and DECR (pins 15, 16, 18 and 19).
2. POR.

Table 18 Bits OSN, OSR and OSL; notes 1 and 2

| OSN | OSR | OSL | MODE | DESCRIPTION |
|-----|-----|-----|---------------------|--|
| 0 | 0 | 0 | mute ⁽³⁾ | mute; no selection |
| 0 | 0 | 1 | Left | left hi-fi channel selected (language I) |
| 0 | 1 | 0 | Right | right hi-fi channel selected (language II) |
| 0 | 1 | 1 | Stereo | hi-fi stereo selected |
| 1 | 0 | 0 | Normal | normal selected (linear audio; LININ input) |
| 1 | 0 | 1 | Mix-Left | mix of hi-fi left with normal ($\frac{1}{2}$ hi-fi left + $\frac{1}{2}$ normal) |
| 1 | 1 | 0 | Mix-Right | mix of hi-fi right with normal ($\frac{1}{2}$ hi-fi right + $\frac{1}{2}$ normal) |
| 1 | 1 | 1 | Mix-Stereo | mix of hi-fi stereo with normal ($\frac{1}{2}$ hi-fi stereo + $\frac{1}{2}$ normal) |

Notes

1. When no hi-fi signal is found on tape during 'playback' mode the auto-normal function is activated; all output select function modes except 'mute' will be overruled and changed to 'Normal' mode. If muting of the hi-fi sound is desired instead of selecting linear audio the normal input level (bits NIL3 to NIL0 of the select byte) should be set to mute. Activation of the auto-normal function can be monitored by reading bit AUTN of the read byte.
2. If 'Dub Mix' mode is selected via the input select function (see control bits IS2, IS1 and IS0 of the input byte) functionality of the modes 'Mix-Left', 'Mix-Right' and 'Mix-Stereo' are changed to support audio dubbing input mixing. Hi-fi channel selection is offered for the input and normal sound is available at the output for monitoring of the linear audio recording. See also Table 19.
3. POR.

Audio processor for VHS hi-fi

TDA9615H

Table 19 Dub Mix selections

| MODE | DUB MIX OUTPUT SELECTION | DUB MIX INPUT SELECTION |
|---------------------|--------------------------|--|
| mute ⁽¹⁾ | mute | mute |
| Left | left | hi-fi left |
| Right | right | hi-fi right |
| Stereo | stereo | $\frac{1}{2}$ hi-fi left + $\frac{1}{2}$ hi-fi right |
| Normal | normal | normal |
| Mix-Left | normal | hi-fi left |
| Mix-Right | normal | hi-fi right |
| Mix-Stereo | normal | $\frac{1}{2}$ hi-fi left + $\frac{1}{2}$ hi-fi right |

Note

1. POR.

Table 20 Bit EOS

| EOS ⁽¹⁾ | MODE | DESCRIPTION |
|--------------------|--------------------------------------|--|
| 0 | Output Select ⁽²⁾ | audio peak envelope of 'Output Select' mode signal |
| 1 | Stereo or HF envelope ⁽³⁾ | audio peak envelope of hi-fi stereo or HF envelope |

Notes

1. A signal selection for output ENVOUT (pin 39) is available using bit EOS.
2. POR.
3. The selection made for mode 'Stereo or HF envelope' depends upon the mode of the hi-fi processing:
 - a) Hi-fi 'loop-through' mode or 'record' mode (bit AFM = 1): audio peak envelope of hi-fi stereo.
 - b) Hi-fi 'playback' mode (bit AFM = 0): HF envelope of left channel FM carrier.

Table 21 Bit LOS; notes 1 and 2

| LOS | MODE | DESCRIPTION |
|-----|------------------------------|---|
| 0 | Output Select ⁽³⁾ | line output signal is set by output select function |
| 1 | Ext2 | line output signal is EXT2L and EXT2R input |

Notes

1. An independent selection of EXT2L and EXT2R inputs (pins 7 and 8) to the line outputs LINEL and LINER (pins 15 and 16) is possible by setting bit LOS to 1. This direct selection is also operable in 'active standby' mode (STBA = 1 of the control byte).
2. Using bit DOS and bits DOS1 and DOS0 of the output byte mode 'Tuner' or 'Ext1' selection to the outputs DECL and DECR (pins 18 and 19) is offered realizing full Euro-SCART pay-TV decoder switching.
3. POR.

Audio processor for VHS hi-fi

TDA9615H

Table 22 Bit DOS; notes 1 and 2

| DOS | MODE | DESCRIPTION |
|-----|-------------------------------|--|
| 0 | Output Select ⁽³⁾ | decoder output signal is set by output select function |
| 1 | decoder select ⁽⁴⁾ | decoder output signal is set by decoder output select function |

Notes

1. An independent selection of TUNL and TUNR (pins 1 and 2), EXT1L and EXT1R (pins 5 and 6), SAP (pin 44) or mute is possible for the decoder outputs DECL and DECR (pins 18 and 19) by setting bit DOS to 1. Source selection is offered by using bits DOS1 and DOS0 of the select byte. These direct selections are also operable in 'active standby' mode (STBA = 1 of the control byte).
2. In combination with the independent EXT2 selection to the outputs LINEL and LINER (pins 15 and 16) via bit LOS full Euro-SCART pay-TV decoder switching is offered.
3. POR.
4. Internal mode.

Table 23 Bit RFCM; note 1

| RFCM | MODE | DESCRIPTION |
|------|---------------------|---|
| 0 | – | RFC output is set by output select function |
| 1 | mute ⁽²⁾ | RFC output signal is muted (AGC reset) |

Notes

1. RF converter output RFCOUT (pin 12) can be muted using bit RFCM. During mute the AGC capacitor at pin 11 (RFCAGC) is discharged, resetting AGC control.
2. POR.

Audio processor for VHS hi-fi

TDA9615H

Volume bytes; subaddresses 04, 05 and 06 (left and right channel volume control)**Table 24** Bits of volume bytes; see Table 25

| BIT | DESCRIPTION |
|-----|-------------------|
| VLS | volume left sign |
| VL5 | volume left 5 |
| ↓ | ↓ |
| VL0 | volume left 0 |
| VRS | volume right sign |
| VR5 | volume right 5 |
| ↓ | ↓ |
| VR0 | volume right 0 |

Table 25 bits VLS, VRS, VL5 to VL0 and VR5 to VR0; note 1

| VLS | VL5 | VL4 | VL3 | VL2 | VL1 | VL0 | MODE |
|-----|------------------|------------------|------------------|------------------|------------------|------------------|---------------------|
| VRS | VR5 | VR4 | VR3 | VR2 | VR1 | VR0 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 dB |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | -1 dB |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | -2 dB |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | -3 dB |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | -4 dB |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | -43 dB |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | -44 dB |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | -45 dB |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | -46 dB |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | -47 dB |
| 0 | 1 | 1 | X ⁽²⁾ | X ⁽²⁾ | X ⁽²⁾ | X ⁽²⁾ | mute |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 0 | 0 | 0 | 0 | 0 dB ⁽³⁾ |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 0 | 0 | 0 | 1 | +1 dB |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 0 | 0 | 1 | 0 | +2 dB |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 0 | 0 | 1 | 1 | +3 dB |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 0 | 1 | 0 | 0 | +4 dB |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 1 | 0 | 1 | 1 | +11 dB |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 1 | 1 | 0 | 0 | +12 dB |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 1 | 1 | 0 | 1 | +13 dB |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 1 | 1 | 1 | 0 | +14 dB |
| 1 | X ⁽²⁾ | X ⁽²⁾ | 1 | 1 | 1 | 1 | +15 dB |

Notes

- Left and right volume controls can be set simultaneous by using subaddress 06 (volume byte). Addressing the volume byte will load both the left and right volume registers with the same data value.
- X = don't care.
- POR.

Audio processor for VHS hi-fi

TDA9615H

Power byte; subaddress 07 (power-up control and test)**Table 26** Bits of power byte

| BIT | DESCRIPTION |
|------|------------------------------------|
| CALS | calibration start; see Table 27 |
| VCCH | V _{CC} high; see Table 28 |
| TEST | test; see Table 29 |
| PORR | POR reset; see Table 30 |

Table 27 Bit CALS; note 1

| CALS ⁽²⁾ | MODE | DESCRIPTION |
|---------------------|-------------------|--------------------------------------|
| 0 | – (note 3) | – |
| 1 | start calibration | start of automatic calibration cycle |

Notes

- Pin 39 (ENVOUT) or bit CALR of the read byte can be monitored to check for successful completion of the calibration. It is advised to keep CALS logic 1 after calibration to ensure a reliable CALR state.
- After a change of bit CALS from logic 0 to logic 1, an automatic frequency calibration is performed setting hi-fi modem, band-pass filter and noise reduction. Use of auto-calibration is only needed after power-up of the supply voltage (POR).
- POR.

Table 28 Bit VCCH; notes 1 and 2

| VCCH | MODE | DESCRIPTION |
|------|-------------|----------------------------|
| 0 | 9 V; note 3 | output DC voltage is 4.5 V |
| 1 | 12 V | output DC voltage is 6 V |

Notes

- To maximize the output drive when using 12 V supply voltage (V_{CC}; pin 35), the DC level of outputs LINEL, LINER, DECL and DECR (pins 15, 16, 18 and 19) can be changed using bit VCCH.
- Use of the power mute function (bit MUTE of the control byte) ensures disturbance-free switching of the line output signal when setting VCCH after power-up.
- POR.

Table 29 Bit TEST; note 1

| TEST | MODE | DESCRIPTION |
|------|------------|--------------------------------|
| 0 | – (note 2) | standard operation |
| 1 | test | special measurement test modes |

Notes

- Several special test modes can be selected for testing and evaluation purposes. Bits s4 to NIL0 of the select byte are used for selection of these tests.
- POR.

Audio processor for VHS hi-fi

TDA9615H

Table 30 Bit PORR; note 1

| PORR | MODE | DESCRIPTION |
|------|------------|-------------------------|
| 0 | – (note 2) | – |
| 1 | POR reset | reset of POR signal bit |

Notes

1. Bit POR of the read byte can be used to detect the occurrence of a power-on reset situation (bit POR reads logic 1 in case the I²C register contents equal the POR default state). When applying bit POR this way, PORR should be used after a power-on reset to force a reset of the POR read bit state to logic 0.
2. POR.

Read byte (device state information)**Table 31** Bits of read byte

| BIT | DESCRIPTION |
|------|---------------------------------|
| CALR | calibration ready; see Table 32 |
| AUTN | auto-normal; see Table 33 |
| POR | power-on reset; see Table 34 |

Table 32 Bit CALR; notes 1 and 2

| CALR | DESCRIPTION |
|------|---------------------------------------|
| 0 | device is not calibrated |
| 1 | device has completed auto-calibration |

Notes

1. Bit CALR = 0 indicates the device is not calibrated. After an automatic calibration is started by setting bit CALS of the power byte the end of calibration is signalled by this bit. If for some reason a calibration cannot be completed (e.g. no HID signal available or hi-fi processing is in 'playback' mode) CALR remains logic '0'. If calibration is lost due to a power-on reset situation CALR will return to logic 0 as well.
2. Also the envelope output (pin 39) can be used to check for end of calibration.

Table 33 Bit AUTN; notes 1 and 2

| AUTN | DESCRIPTION |
|------|--|
| 0 | audio FM signal is detected at FM input |
| 1 | no audio FM signal detected; normal sound is selected instead of hi-fi |

Notes

1. When hi-fi processing is in 'playback' mode but no hi-fi carrier input signal is detected the auto-normal function is activated. Auto-normal overrules the 'Output Select' mode setting, selecting normal sound (i.e. linear audio) instead of hi-fi. The state of this auto-normal function can be checked via bit AUTN.
2. The auto-normal function is only active (bit AUTN = logic 1) for hi-fi 'playback' mode (bit AFM = 0); during 'record' or 'loop-through' mode bit AUTN is always logic 0.

Audio processor for VHS hi-fi

TDA9615H

Table 34 Bit POR; notes 1 and 2

| POR | DESCRIPTION |
|-----|--|
| 0 | I ² C-bus bit state differs from power-on reset state |
| 1 | I ² C-bus bit state equals power-on reset state |

Notes

- At power-on or during a power voltage dip, an internal power-on reset signal is generated which resets the I²C-bus data bits to a predefined state. When the internal data bits are found to be in POR state (due to an actual power-on reset but also if set via the I²C-bus) bit POR signals logic 1.
- Using the POR bit to detect the occurrence of a power-on reset requires bit PORR to be set logic 1 after power-up. Setting bit PORR forces the POR bit to logic 0 independent of other I²C-bus bit settings. After calibration is completed also the CALR bit can be used to detect a power-on reset; calibration will be lost in such situation which is signalled by CALR = 0.

LIMITING VALUES

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

| SYMBOL | PARAMETER | MIN. | MAX. | UNIT |
|------------------|-------------------------------|-------|-------|------|
| V _{CC} | supply voltage | 0 | 13.2 | V |
| T _{stg} | storage temperature | -65 | +150 | °C |
| T _{amb} | operating ambient temperature | 0 | 70 | °C |
| V _{es} | electrostatic handling | | | |
| | machine model | -300 | +300 | V |
| | human body model | -3000 | +3000 | V |

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---------------------|---|-------------|-------|------|
| R _{th j-a} | thermal resistance from junction to ambient | in free air | 60 | K/W |

DC CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-----------------------|------------------------|--------------------------------------|------|------|------|------|
| Supply voltage | | | | | | |
| V _{CC} | supply voltage; pin 35 | VCCH = 0 | 8.1 | 9 | 13.2 | V |
| | | VCCH = 1 | 8.1 | 12 | 13.2 | V |
| Supply current | | | | | | |
| I _{CC} | supply current; pin 35 | | – | 45 | 60 | mA |
| | | STBA = 1 (‘active standby’ mode) | – | 12 | 18 | mA |
| | | STBP = 1 (‘passive standby’ mode) | – | 4 | 6 | mA |

Audio processor for VHS hi-fi

TDA9615H

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|--|------------|------|------|------|------|
| Input voltages (internally generated) | | | | | | |
| V_i | input voltage pins 1 to 10, 21 and 44 pin 37 | | – | 3.8 | – | V |
| | | | – | 1.9 | – | V |
| Output voltages | | | | | | |
| V_o | output voltage pin 12 | | – | 3.8 | – | V |
| | | $VCCH = 0$ | – | 4.5 | – | V |
| | pins 15, 16, 18 and 19 | $VCCH = 1$ | – | 6 | – | V |
| | | | – | 4.5 | – | V |
| | | pin 20 | – | 1.2 | – | V |
| | | pin 36 | – | 5 | – | V |
| pin 38 | | – | | – | V | |
| Output current | | | | | | |
| I_o | output current at pin 38 | | – | – | 3 | mA |
| HID input; pin 40 | | | | | | |
| V_{IH} | HIGH-level input voltage | | 2.75 | – | 5.5 | V |
| V_{IL} | LOW-level input voltage | | 0 | – | 2.25 | V |

AC CHARACTERISTICS**Loop-through mode**

Audio input level –8 dBV for $f = 1$ kHz at TUN inputs (pins 1 and 2); $V_{CC} = 12$ V; $T_{amb} = 25$ °C; POR state with mute off; calibrated; bit NTSC set to logic 1 or logic 0; measured in application diagram of Fig.6; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---------------------------|--------------------------------------|------|------|------|------------|
| Line inputs and linear audio input (TUN, CIN, EXT1, EXT2, AUX, SAP and LININ; pins 1 to 10, 44 and 21) | | | | | | |
| R_i | input impedance | | 100 | 130 | – | k Ω |
| V_i | input voltage | | – | – | 9 | dBV |
| Line and decoder outputs (LINEL, LINER, DECL, DECR; pins 15, 16, 18 and 19) | | | | | | |
| V_o | output voltage | | –9 | –8 | –7 | dBV |
| | | LOH = 1 (+1 dB output signal) | –8 | –7 | –6 | dBV |
| $V_{o(max)}$ | maximum output voltage | note 1 | 7 | 8 | – | dBV |
| | | note 1; $VCCH = 1$; $V_{CC} = 12$ V | 10 | 11 | – | dBV |
| THD | total harmonic distortion | | – | 0.01 | 0.1 | % |
| α_{cb} | channel balance | | –1 | 0 | +1 | dB |
| V_n | noise level | TUN = $-\infty$ dBV; note 2 | – | –94 | –90 | dBV |
| R_o | output impedance | | – | 100 | 150 | Ω |
| α_{mute} | volume mute | VLS to VL0 and VRS to VR0 = mute | – | –95 | –70 | dB |
| | output mute | OSN, OSR and OSL = mute | – | –85 | –70 | dB |

Audio processor for VHS hi-fi

TDA9615H

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|--|-------|------|-------|------------|
| $\alpha_{ct(ch)}$ | crosstalk between channels | channel crosstalk TUNL or TUNR = $-\infty$ dBV | – | –83 | –70 | dB |
| $\alpha_{ct(ch)(i)}$ | crosstalk between input channels | note 3 | – | –93 | – | dB |
| $I_{o(max)}$ | output current limiting | MUTE = 1; power mute | – | +1 | – | mA |
| I_o | discharge output current | STBP = 1; passive standby | – | –1 | – | mA |
| Linear audio output (LINOUT; pin 20) | | | | | | |
| V_o | output voltage | | –9 | –8 | –7 | dBV |
| R_o | output impedance | | – | 200 | 300 | Ω |
| RF converter output (RFCOUT; pin 12) | | | | | | |
| V_o | output voltage | | –9 | –8 | –7 | dBV |
| | output voltage at high level | TUN = +8 dBV | –4.5 | –3 | –1.5 | dBV |
| THD | total harmonic distortion | | – | 0.03 | – | % |
| | | TUN = up to +8 dBV | – | <0.2 | – | % |
| V_n | noise level | TUN = $-\infty$ dBV; note 2 | – | –80 | – | dBV |
| R_o | output impedance | | – | 200 | 300 | Ω |
| $I_{o(max)}$ | output current limiting | MUTE = 1; power mute | – | +1 | – | mA |
| I_o | discharge output current | STBP = 1; passive standby | – | –1 | – | mA |
| Power mute outputs (MUTEC, MUTEL, MUTER; pins 13, 14 and 17) | | | | | | |
| R_o | output impedance | | 50 | 100 | – | k Ω |
| | | MUTE = 1; DC load = ± 1 mA | – | 15 | – | Ω |
| Envelope output (ENVOUT; pin 39); audio peak envelope | | | | | | |
| V_o | output voltage | | 1.69 | 1.8 | 1.91 | V |
| | output voltage at zero level | TUN = $-\infty$ dBV | – | – | 0.3 | V |
| | output voltage at zero level; maximum volume | TUN = $-\infty$ dBV; volume = +15 dB | – | – | 0.35 | V |
| | output voltage at high level | TUN = +8 dBV | 4.0 | 4.5 | 5.0 | V |
| α_{cb} | channel balance | | –0.11 | 0 | +0.11 | V |
| R_o | output impedance | | – | 1 | 1.5 | k Ω |

Notes

- THD = 1%; output load: $R_L = 5$ k Ω ; $C_L = 2.2$ nF; volume = +3 dB (12 V); TUN level varied.
- Typical value: B = 20 Hz to 20 kHz, 'unweighted'; production testing: B = 300 Hz to 20 kHz, 'unweighted'.
- Crosstalk of any line input pair (TUN, CIN, EXT1, EXT2, AUX or SAP) to any other line input.

Audio processor for VHS hi-fi

TDA9615H

Record mode

For test modes see Table 38.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|--|-------|----------|-------|----------|
| Noise reduction (test 25: LINEL and LINER; pins 15 and 16) | | | | | | |
| THD | total harmonic distortion | | – | 0.1 | 0.3 | % |
| | | at high level; TUN = +8 dBV | – | 0.2 | 1 | % |
| α_{cb} | channel balance | | –1 | 0 | +1 | dB |
| α_{lin} | linearity | TUN = –8 to –68 dBV | –31.5 | –30.2 | –28.5 | dB |
| | high-level linearity | TUN = –8 to +8 dBV | 7.5 | 8 | 8.5 | dB |
| α_n | noise level with respect to output signal | TUN = –8 to $-\infty$ dBV; note 1 | – | –46 | –41 | dB |
| t_{att} | attack time | in accordance with VHS specification | – | 5 | – | ms |
| t_{rec} | recovery time | | – | 70 | – | ms |
| f_{res} | frequency response 300 Hz | TUN = 1 kHz to 300 Hz | –0.7 | –0.2 | +0.3 | dB |
| | frequency response 10 kHz | TUN = 1 kHz to 10 kHz | 3.1 | 3.9 | 4.7 | dB |
| | audio low-pass filter response 20 kHz | TUN = 1 kHz to 20 kHz; test 26 | –0.5 | –0.1 | +0.5 | dB |
| | audio low-pass filter response 60 kHz | TUN = 1 kHz to 60 kHz; test 26 | – | –24 | –12 | dB |
| FM modulator (test 25, test 26 and no test: FMOUT; pin 36) | | | | | | |
| THD | total harmonic distortion | $\Delta f = 50$ kHz | – | 0.1 | 0.2 | % |
| $\Delta f_{(max)}$ | maximum FM frequency deviation | | 140 | 150 | 160 | kHz |
| $f_{c(error)}$ | carrier frequency error | after calibration | –5 | 0 | +5 | kHz |
| $\Delta f_{c(l-r)}$ | carrier frequency difference between left and right channel | $f_{c(r)} - f_{c(l)}$ after NTSC calibration | 399.2 | 401.2 | 403.2 | kHz |
| Δf_c | carrier frequency shift | NTSC/PAL system switching | 97 | 100 | 103 | kHz |
| TC | temperature coefficient | | – | ± 50 | – | ppm/K |
| Noise reduction and FM modulator (FMOUT; pin 36) | | | | | | |
| Δf | FM deviation | | 44.5 | 50 | 56.1 | kHz |
| HF output (FMOUT; pin 36) | | | | | | |
| $V_{o(rms)}$ | output voltage left carrier | 1st harmonic (RMS value) | 53 | 60 | 68 | mV |
| | output voltage right carrier | 1st harmonic (RMS value) | 160 | 180 | 202 | mV |
| $V_{o(l)}/V_{o(r)}$ | output voltage ratio between left and right carrier | | 2.7 | 3.0 | 3.3 | |
| D_{3H} | distortion (3rd harmonic) | 3rd harmonic/1st harmonic | – | –28 | –18 | dB |
| R_o | output impedance | | – | 100 | 150 | Ω |

Note

1. Typical value: B = 20 Hz to 20 kHz, 'unweighted'; production testing: B = 300 Hz to 20 kHz, 'unweighted'.

Audio processor for VHS hi-fi

TDA9615H

Playback mode

$V_{FMIN(rms)} = 30$ mV (RMS value); $\Delta f = 50$ kHz; $f_{mod} = 1$ kHz; $f = f_0$; $V_{CC} = 12$ V; $T_{amb} = 25$ °C; bit NTSC set to logic 1 or logic 0; measured in application diagram of Fig.6; unless otherwise specified. For test modes see Table 38.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|------|------|------|---------|
| FMIN; pin 37 and HF AGC (test 5 and test 6: FMOUT; pin 36) | | | | | | |
| $V_{i(p-p)}$ | input voltage level (peak-to-peak value) | left plus right channel; note 1 | – | 0.17 | 2 | V |
| | AGC start level (at pin 37) | left plus right channel | 59 | 84 | 118 | mV |
| B | control bandwidth | note 2 | – | 10 | – | kHz |
| Left channel band-pass filter (test 3: FMOUT; pin 36) | | | | | | |
| V_o | band-pass filter output voltage | $f = f_0$; $V_{FMIN(rms)} = 30$ mV (RMS value) | 105 | 150 | 215 | mV |
| V_{o1}/V_o | band-pass filter output voltage ratio | $\frac{f_0 - 400 \text{ kHz}}{f_0}$ | – | –30 | –20 | dB |
| V_{o2}/V_o | | $\frac{f_0 - 150 \text{ kHz}}{f_0}$ | –9 | –6 | – | dB |
| V_{o3}/V_o | | $\frac{f_0 + 150 \text{ kHz}}{f_0}$ | –9 | –5 | – | dB |
| V_{o4}/V_o | | $\frac{f_0 + 250 \text{ kHz}}{f_0}$ | – | –17 | –12 | dB |
| V_{o5}/V_o | | $\frac{f_0 + 250 \text{ kHz}}{f_0 + 150 \text{ kHz}}$ | – | –12 | –9 | dB |
| V_{o6}/V_o | | $\frac{f_0 + 400 \text{ kHz}}{f_0}$ | – | – | –30 | dB |
| $R_{d(g)}$ | group delay ripple | $f_0 - 150$ kHz to $f_0 + 150$ kHz | – | <0.5 | – | μ s |

Audio processor for VHS hi-fi

TDA9615H

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|--|---|--|------|------|---------|
| Right channel band-pass filter (test 4: FMOUT; pin 36) | | | | | | |
| V_o | band-pass filter output voltage | $f = f_0$; $V_{FMIN(rms)} = 30$ mV (RMS value) | 105 | 150 | 215 | mV |
| V_{o1}/V_o | band-pass filter output voltage ratio | $\frac{f_0 - 400 \text{ kHz}}{f_0}$ | – | – | –30 | dB |
| V_{o2}/V_o | | $\frac{f_0 - 250 \text{ kHz}}{f_0}$ | – | –17 | –10 | dB |
| V_{o3}/V_o | | $\frac{f_0 - 150 \text{ kHz}}{f_0}$ | –9 | –5 | – | dB |
| V_{o4}/V_o | | $\frac{f_0 - 250 \text{ kHz}}{f_0 - 150 \text{ kHz}}$ | – | –12 | –9 | dB |
| V_{o5}/V_o | | $\frac{f_0 + 150 \text{ kHz}}{f_0}$ | –9 | –6 | – | dB |
| V_{o6}/V_o | | $\frac{f_0 + 400 \text{ kHz}}{f_0}$ | – | –30 | –20 | dB |
| $R_{d(g)}$ | | group delay ripple | $f_0 - 150 \text{ kHz}$ to $f_0 + 150 \text{ kHz}$ | – | <0.5 | – |
| Hi-fi detector and dropout cancelling | | | | | | |
| $V_{i(A)}$ | AUTN activation level | left channel carrier at FMIN (RMS value) | 3.0 | 4.2 | 5.8 | mV |
| $V_{i(D)}/V_{i(A)}$ | DOC level with respect to AUTN level | left channel carrier at FMIN | –7 | –4 | –2 | dB |
| $t_{d(A)}$ | AUTN activation delay | carrier to no carrier at FMIN | 200 | 300 | 500 | μ s |
| $t_{d(D)}$ | DOC switch-off delay | no carrier to carrier at FMIN | 5 | 9 | 14 | μ s |
| Head switching noise suppressor (test 25: LINEL and LINER; pins 15 and 16) | | | | | | |
| t_h | hold pulse length | | 5 | 6 | 7 | μ s |
| | | SHH = 1 | 7 | 8 | 9 | μ s |
| THD | total harmonic distortion (audio signal) | note 3 | – | – | –73 | dB |
| t_d | delay from HID to hold | | – | 0.3 | – | μ s |
| Envelope output (ENVOUT; pin 39) | | | | | | |
| V_o | output voltage | FMIN = 2 mV (RMS value); left channel | 0.6 | 0.9 | 1.2 | V |
| | | FMIN = 20 mV (RMS value); left channel | 2.5 | 2.9 | 3.3 | V |
| | | FMIN = 200 mV (RMS value); left channel | 4.2 | 4.7 | 5.0 | V |

Audio processor for VHS hi-fi

TDA9615H

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|--------------------------------------|--|------|------|------|------|
| PLL FM demodulator (test 25: LINEL and LINER; pins 15 and 16) | | | | | | |
| V_i | sensitivity | $\Delta f = 150 \text{ kHz}$; $S/N = 35 \text{ dB}$ | – | 0.3 | 1.2 | mV |
| THD | total harmonic distortion | $\Delta f = 50 \text{ kHz}$ | – | 0.03 | 0.3 | % |
| | total harmonic distortion at maximum | $\Delta f = 150 \text{ kHz}$ | – | 0.2 | 1.5 | % |
| S/N | signal to noise ratio | $\Delta f = 50 \text{ to } 0 \text{ kHz}$ | 54 | 60 | – | dB |
| $\alpha_{ct(ch)}$ | channel crosstalk | left or right carrier $\Delta f = 0 \text{ kHz}$ | – | –80 | – | dB |
| Noise reduction (test 26: LINEL and LINER; pins 15 and 16) | | | | | | |
| V_n | noise level | TUN = $-\infty \text{ dBV}$; note 4 | – | –96 | –90 | dBV |
| THD | total harmonic distortion | TUN = -3.5 dBV | – | 0.05 | 0.2 | % |
| α_l | linearity | TUN = $-3.5 \text{ to } -33.5 \text{ dBV}$ | 58 | 59.6 | 62 | dB |
| f_{res} | frequency response 300 Hz | TUN = 1 kHz to 300 Hz | –0.6 | +0.4 | +1.4 | dB |
| | frequency response 10 kHz | TUN = 1 kHz to 10 kHz | –9.2 | –7.7 | –6.2 | dB |
| FM demodulator and noise reduction (LINEL and LINER; pins 15 and 16) | | | | | | |
| V_o | output voltage | | –10 | –8 | –6 | dBV |
| α_{cb} | channel balance | | –1.5 | 0 | +1.5 | dB |

Notes

1. Signals below maximum input level are handled without internal clipping. Higher input levels however can still be handled properly by the demodulators. Typical input level equals two carriers of 30 mV (RMS value).
2. Single carrier signal at FMIN of 75 mV (RMS value) and amplitude modulated. Control bandwidth is the modulation frequency at which the amplitude modulation is attenuated 3 dB by the HF AGC.
3. Sample-and-hold audio distortion is measured using 500 Hz at HID input (pin 40). FMIN: $f_{mod} = 10 \text{ kHz}$; $\Delta f = 50 \text{ kHz}$. Audio distortion is measured using a 3 kHz 4th order low-pass filter. Value is corrected with 24 dB in order to calculate equivalent distortion at 30 Hz HID input.
4. Typical value: B = 20 Hz to 20 kHz, unweighted; production testing: B = 300 Hz to 20 kHz, unweighted.

Audio processor for VHS hi-fi

TDA9615H

APPLICATION AND TEST INFORMATION

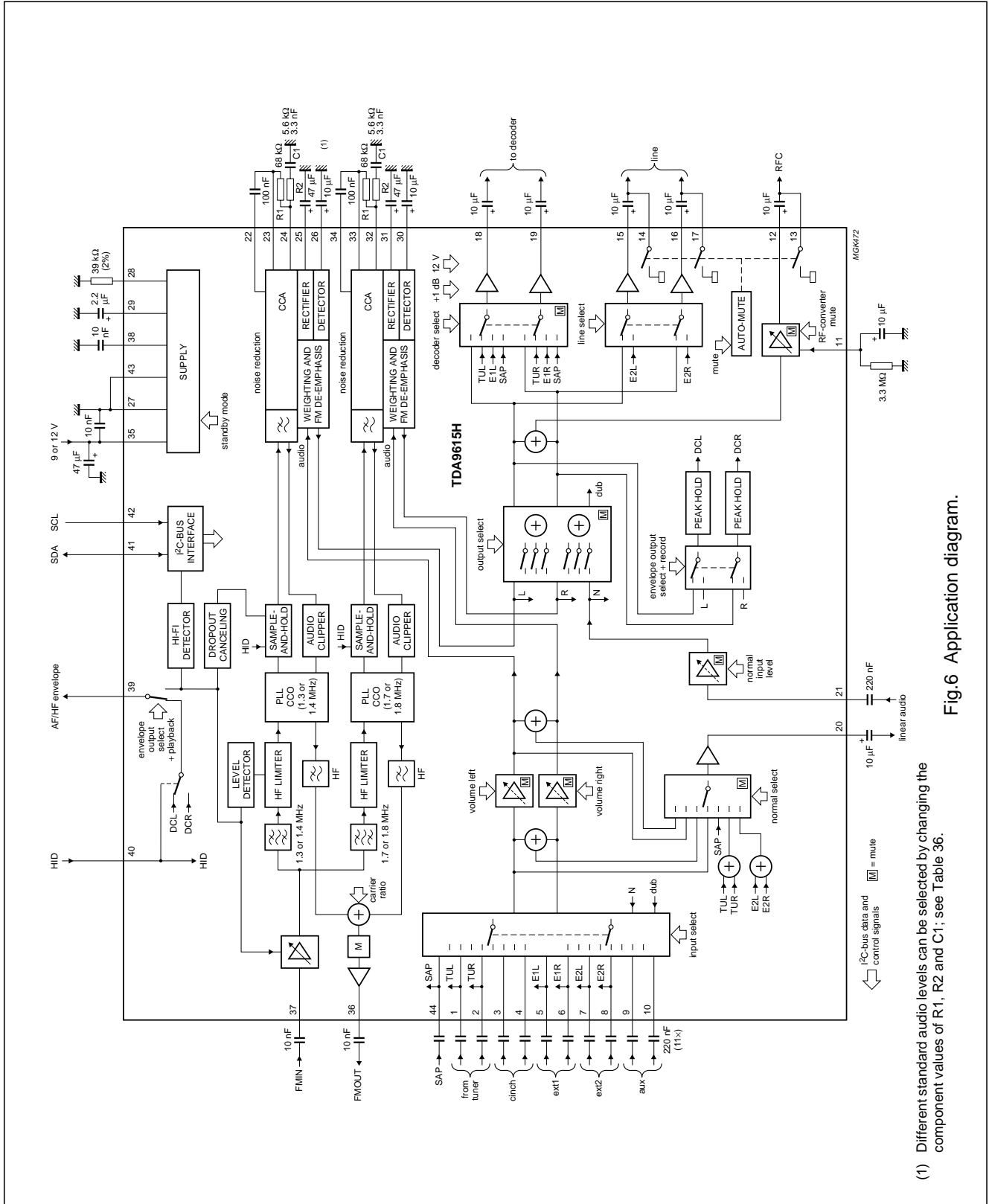


Fig. 6 Application diagram.

(1) Different standard audio levels can be selected by changing the component values of R1, R2 and C1; see Table 36.

Audio processor for VHS hi-fi

TDA9615H

Automatic calibration; see Fig.7

By means of bit CALS (power byte) the integrated auto-calibration system is activated. By adjusting the carrier frequencies, band-pass filters and noise reduction filters auto-calibration ensures that the hi-fi processing always is in accordance with the VHS hi-fi system standard. Calibration is only needed after start-up of the video recorder; as long as the supply voltage (pin 35) is available calibration settings remain stable.

Auto-calibration is performed with the device in hi-fi 'loop-through' mode, no standby or test mode should be active (auto-calibration demands bit settings AFM = 1, STBP = 0, STBA = 0 and TEST = 0). After setting bit CALS (power byte) to logic 1 auto-calibration is started. Calibration is performed fully automatically, using the HID input signal as a reference.

Calibration of the oscillator frequencies is performed by measuring the number of oscillator cycles within one HID HIGH period and comparing this with an internal value stored in ROM. Four different ROM values are available for NTSC or PAL (SECAM) system calibration of both the left and right channel carrier.

In case of NTSC calibration a special routine is active for the right channel carrier calibration resulting in a frequency difference between the left and right channel carrier of

approximately 401.2 kHz. This value effectively reduces the crosstalk from hi-fi carriers to the video colour signal as present during 'playback' mode using Extended Play (EP) tape speed.

NTSC calibration uses the standard 29.97 Hz (i.e. 16.683 ms) HID signal where PAL calibration uses the standard 25 Hz (i.e. 20 ms) HID signal. The maximum frequency error after auto-calibration is ± 5 kHz assuming a HID HIGH-time error of maximum 5 μ s. To realize NTSC EP optimization within ± 2 kHz, HID jitter should not exceed 1 μ s. In general the crystal based HID signal available in the video recorder can be used without modification.

After calibration of the oscillators, the band-pass filters are calibrated together with the integrated 'weighting' and 'FM de-emphasis' filter of the noise reduction. The total auto-calibration time needed is 17 HID cycles or less. End of calibration is signalled by bit CALR of the read byte.

The envelope output can also be used to monitor calibration; for this purpose ENVOUT (pin 39) is forced >2.5 V during calibration. The audio signal to the audio envelope (level meter) function should be muted; otherwise the audio envelope output may be >2.5 V as well making it impossible to detect end of calibration via the ENVOUT pin.

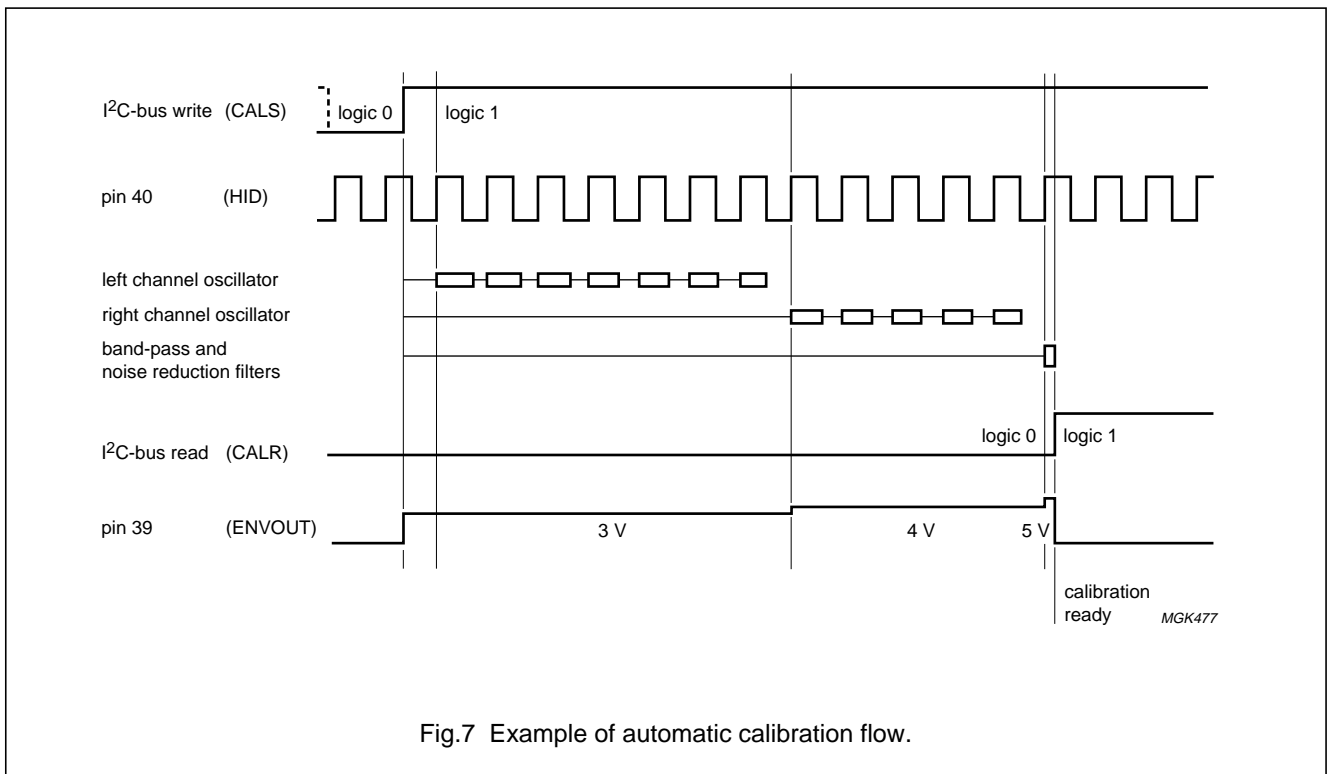


Fig.7 Example of automatic calibration flow.

Audio processor for VHS hi-fi

TDA9615H

After a calibration in 'NTSC' or 'PAL' mode the oscillators and band-pass filters can be switched between NTSC and PAL system frequencies without the need for additional calibration. Switching between these system modes is executed immediately and can be done in any operational mode. Frequency accuracy of switching is 100 kHz \pm 3 kHz for both carriers. For 'record' mode however it is advised to use re-calibration after system switching; this to obtain the best possible frequency accuracy. A new auto-calibration can be started by first resetting bit CALS to logic 0 followed by setting bit CALS to logic 1 again.

carrier level (e.g. auto-tracking). At the microcontroller only one A/D converter input is needed for reading of all necessary information. During 'playback' mode I²C-bus bit EOS offers selection between audio or carrier level information. Audio level information is always output during 'loop-through' mode and 'record' mode however now EOS offers a fixed selection of hi-fi stereo (i.e. independent of the 'Output Select' mode setting); helpful when audio level information is used by the microcontroller for controlling the hi-fi record volume.

Envelope output; see Figs 8 to 11

ENVOUT (pin 39) is an analog output for stereo audio level (e.g. level meter display) and for 'playback' mode FM

Table 35 Envelope output select

| AFM | EOS | ENVELOPE OUTPUT | FUNCTIONAL USE |
|---------------------------------------|-----|------------------------------|---|
| 0 (playback mode) | 0 | AF envelope of output select | level meter display |
| 0 (playback mode) | 1 | HF envelope | auto-tracking or manual tracking display |
| 1 (record mode/ loop-through mode) | 0 | AF envelope of output select | level meter display |
| 1 (record mode/ loop-through mode) | 1 | AF envelope of hi-fi stereo | record volume control (and level display) |

Audio envelope uses time multiplexing to output both left and right channel audio level. A peak hold function and dynamic range compression (square root function) are included for easy read-out. The peak hold function as well as left and right channel multiplexing is controlled by the HID input signal (pin 40).

The HF envelope output signal is continuous and derived from the left channel carrier. HF envelope shows a logarithmic characteristic.

Audio processor for VHS hi-fi

TDA9615H

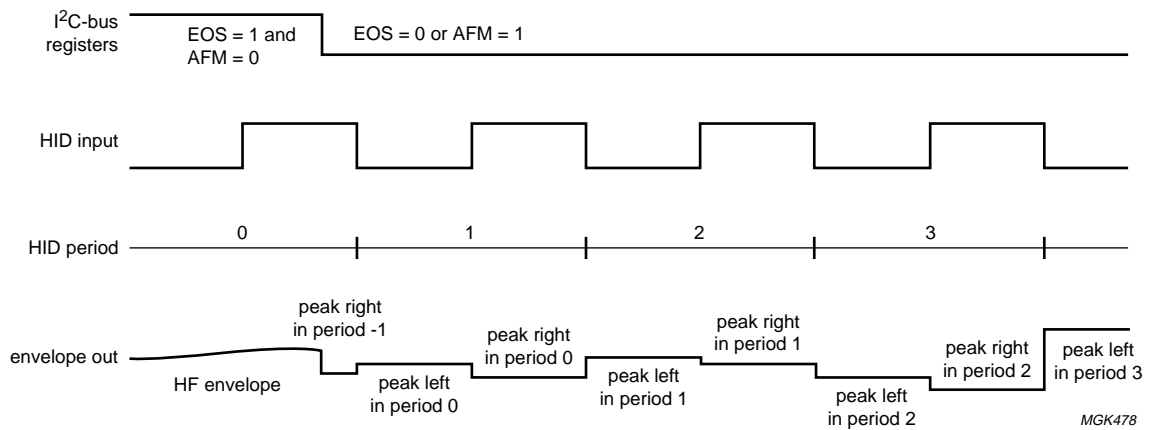


Fig.8 Timing diagram of envelope output signal.

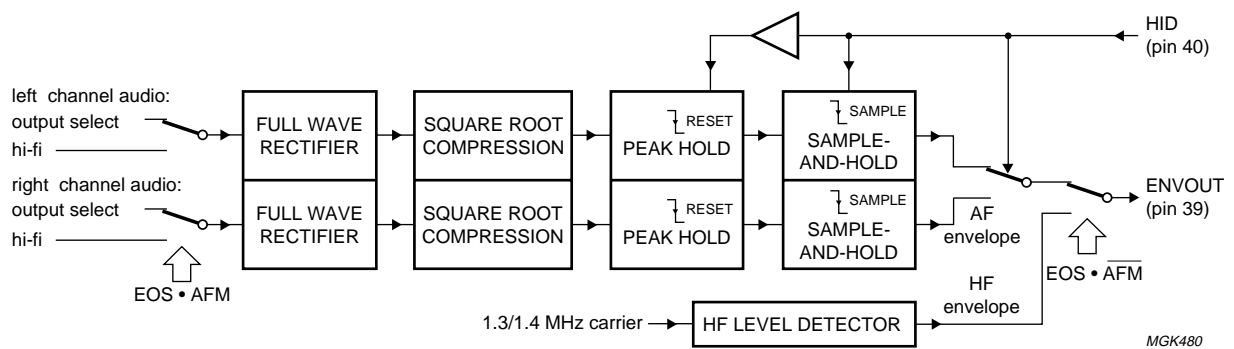
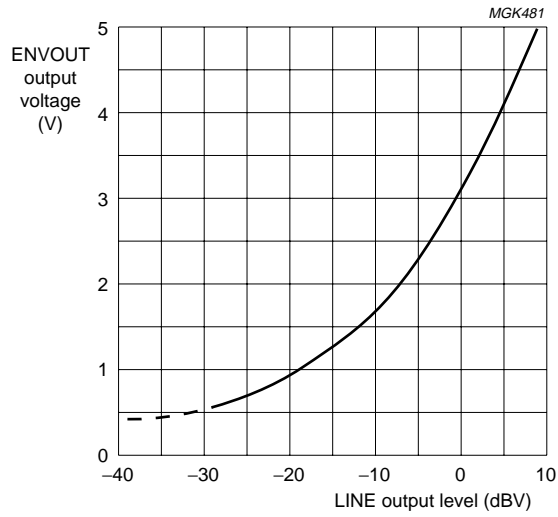


Fig.9 Functional diagram of envelope output circuit.

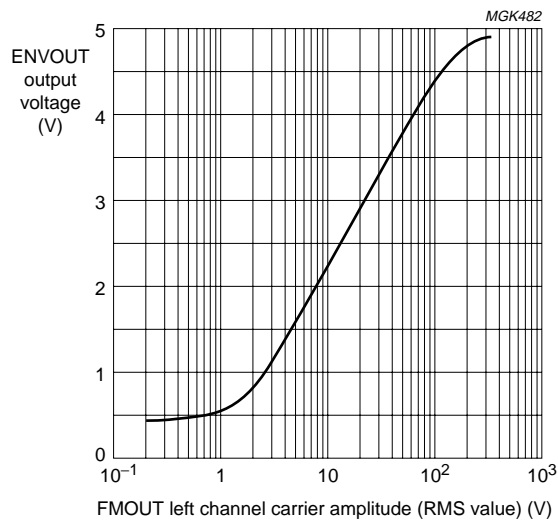
Audio processor for VHS hi-fi

TDA9615H



LOH = 0.

Fig.10 Envelope output; AF envelope (audio peak level).



NTSC (1.3 MHz) or PAL (1.4 MHz).

Fig.11 Envelope output; HF envelope (playback carrier level).

Audio processor for VHS hi-fi

TDA9615H

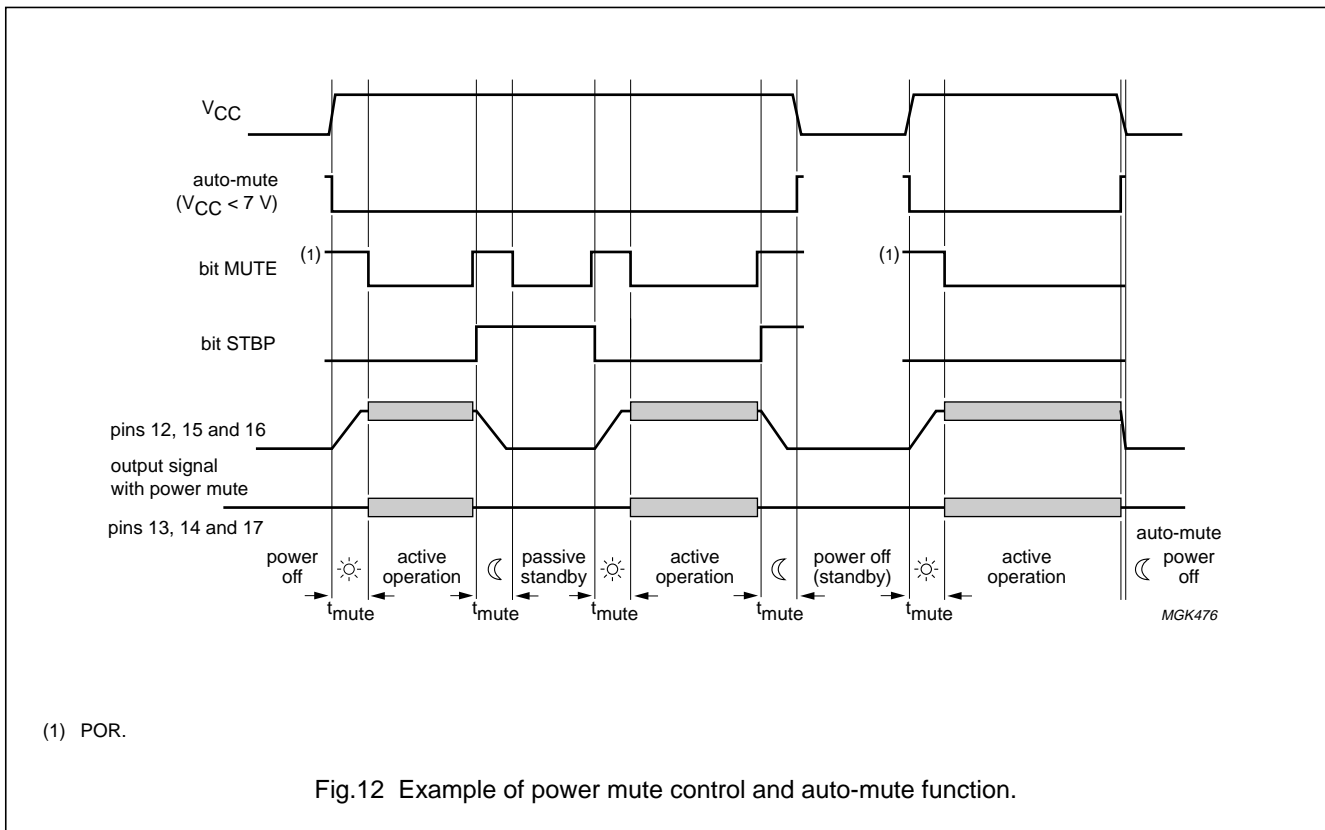
Power mute; see Fig.12

Without countermeasures switching of the power supply voltage (V_{CC} ; pin 35) or use of the built-in 'passive standby' mode causes strong disturbances on the output pins because of the rise or drop of the output's DC voltages. The TDA9615H includes three integrated mute switches to block such disturbances and avoiding the need of an external mute circuit. By connecting the power mute switches behind the line and RFC output capacitors pop-free line and RFC output signals are realized.

Power muting is active when control byte bit MUTE = 1. Because this also is the POR default state, muting is automatically activated when the power supply voltage is switched on. The integrated mute switches (MUTEC, MUTEL and MUTER; pins 13, 14 and 17) are closed, forming a low impedance path to ground. Furthermore the line and RFC outputs (RFCOUT, LINEL and LINER; pins 12, 15 and 16) are current limited to 1 mA to achieve good attenuation without the need for a series resistor between output and mute switch. Although the decoder outputs (DECL and DECR; pins 18 and 19) have no integrated muting these are current limited also for use with the integrated mute switches or to assist possible external muting.

After the output DC voltage is settled the power mute function can be deactivated by selecting MUTE = 0. Now the mute switches are opened showing a high impedance of 100 k Ω to ground and output current limiting is deactivated. Note that the time needed for output DC settling is proportional to the output capacitor value used; with a 10 μ F capacitor a safe mute time to use is 200 ms (i.e. $t_{mute} = C \times 20000$). Using such controlled muting very good performance is achieved for power-up, power-down and 'passive standby' mode switching.

At a sudden supply power loss however (e.g. mains power plug pulled) there may be no time to activate the power mute function via the I²C-bus. A power-down detector however instantly activates the power mute function in case the supply voltage falls below 7 V (auto-mute). For proper muting supply voltage drop rate should not exceed 1 V/10 ms.



Audio processor for VHS hi-fi

TDA9615H

Do not set MUTE and change STBP at the same time; to avoid output glitches power muting should precede the switching of 'passive standby' mode. Power muting takes up approximately 4 mA supply current, so to realize the minimum power consumption of 'passive standby' mode muting has to be deactivated. Note also the use of 'passive standby' mode to initiate a controlled power-off switching.

I_{ref} resistor

The external resistor at pin 28 defines internal reference currents and determines temperature stability of the circuits adjusted by the auto-calibration function.

The external resistor should have the following dimensions: value = 39.0 kΩ ±2%; temperature coefficient = ±50 ppm/K.

Standard hi-fi audio level

Using the application circuit as proposed in Fig.6, the standard FM deviation of 50 kHz equals a 1 kHz audio signal of -8 dBV line output level (LOH = 0). A different standard audio level can be selected by changing the external filter components of the noise reduction at pins 24 and 32 (EMPHL and EMPHR); standard audio level changes proportional to the impedance of the external de-emphasis filter; see Table 36.

Table 36 Standard audio levels; see application diagram of Fig.6

| COMPONENT VALUES | | | LINE OUTPUT LEVEL FOR 50 kHz FM DEVIATION (EQUIVALENT TO 1 kHz AUDIO SIGNAL) (dBV) |
|------------------|---------|---------|--|
| R1 (kΩ) | R2 (kΩ) | C1 (nF) | |
| 91 | 7.5 | 2.4 | -5.6 |
| 82 | 6.8 | 2.7 | -6.4 |
| 75 | 6.2 | 3.0 | -7.1 |
| 68 | 5.6 | 3.3 | -8.0 |
| 62 | 5.1 | 3.6 | -8.8 |
| 56 | 4.7 | 3.9 | -9.8 |
| 51 | 4.3 | 4.3 | -10.6 |

RFC AGC; see Fig.13

To avoid over modulation in the RF converter unit connected to RFCOUT (pin 12) an AGC function is incorporated, limiting the maximum signal level at pin RFCOUT to -3 dBV.

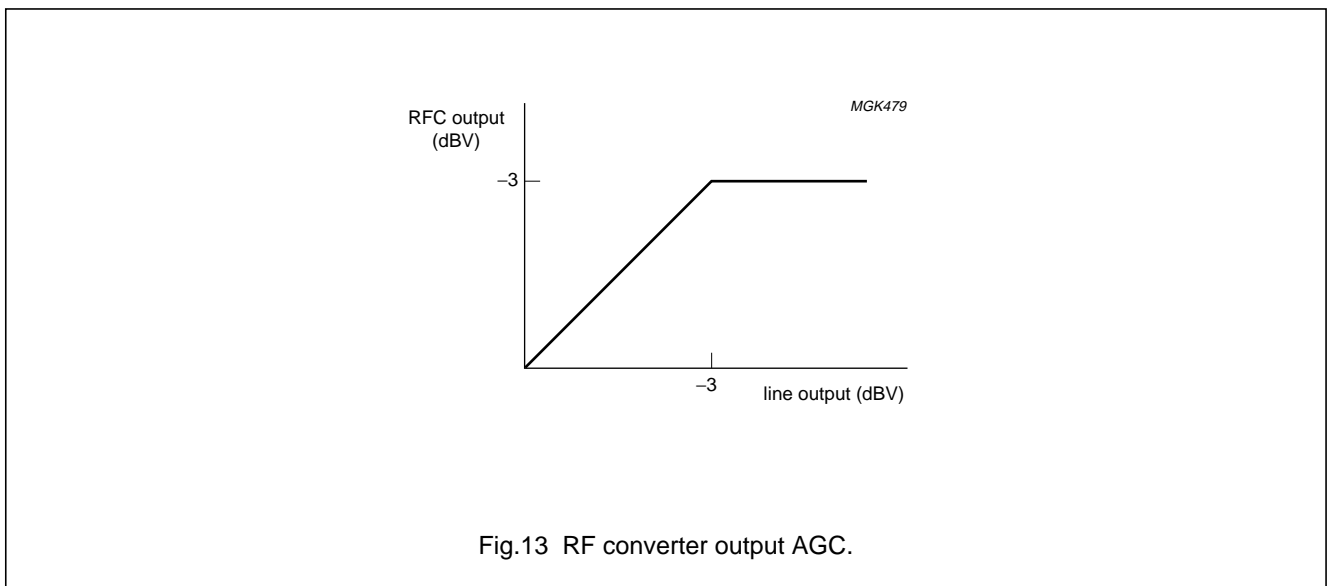


Fig.13 RF converter output AGC.

Audio processor for VHS hi-fi

TDA9615H

The RFC output can be muted by setting of bit RFCM = 1. When applying this mute the AGC control is reset by discharging the capacitor at pin 11 (RFCAGC).

Audio dubbing

TDA9615H includes unparalleled functionality supporting the audio dubbing function of hi-fi video recorders. Audio dubbing is a feature mode for recording of new sound material on the linear audio track (i.e. normal sound) of an existing recording. Audio dubbing can be used in two different ways.

OUTPUT MIX

A new, partly, recording is made on the linear audio track; afterwards during 'playback' mode the new linear audio and the original hi-fi sound are combined. This way hi-fi stereo quality remains and linear audio is only partly used e.g. for speech only (commentary track). However there is no control over the original (hi-fi) sound.

'Playback' mode mixing of hi-fi and normal sound is supported by the output select function modes 'Mix-Left', 'Mix-Right' and 'Mix-Stereo' (OSN, OSR and OSL of the output byte) creating a fixed output signal of $\frac{1}{2}$ hi-fi left + $\frac{1}{2}$ normal.

INPUT MIX

A new, complete, recording is made on the linear audio track; afterwards 'playback' mode uses linear audio sound only. This way hi-fi stereo quality is lost but there is total freedom in defining the new material. Furthermore this way 'playback' mode is no longer restricted to hi-fi video recorders with output mix option.

Selection 'Dub Mix' mode of the input select function, when combined with selection 'Volume' mode of the normal select function, changes the circuit into a mixing desk. A new linear audio recording can be created mixing together new and original sound. By use of the left and right channel volume controls continuous control is offered over amplitude and ratio mix of the AUX input signal (e.g. a microphone input) and the original hi-fi 'playback' mode sound.

This functionality is realized by internal connection of the AUX input pair to the left channel volume control and by internal connection of the hi-fi output signal pair to the right channel volume control. For output and hi-fi selection the 'Dub Mix' mode uses, and partly overrules, the output select function settings. Output select function modes 'Mix-Left', 'Mix-Right' and 'Mix-Stereo' make the normal sound available at the line outputs for monitoring of the 'Dub Mix' mode recording.

Table 37 Input select function is set to 'Dub Mix' mode (IS2, IS1, IS0 = 101); note 1

| OUTPUT SELECT MODE | OSN | OSR | OSL | DUB MIX OUTPUT SELECTION | DUB MIX INPUT SELECTION | |
|--------------------|-----|-----|-----|--------------------------|-------------------------|---------------------|
| | | | | | LEFT CHANNEL | RIGHT CHANNEL |
| Mute | 0 | 0 | 0 | mute | aux stereo | mute |
| Left | 0 | 0 | 1 | hi-fi left | aux stereo | hi-fi left |
| Right | 0 | 1 | 0 | hi-fi right | aux stereo | hi-fi right |
| Stereo | 0 | 1 | 1 | stereo | aux stereo | stereo |
| Normal | 1 | 0 | 0 | normal | aux stereo | normal |
| Mix-Left | 1 | 0 | 1 | normal | aux stereo | hi-fi left |
| Mix-Right | 1 | 1 | 0 | normal | aux stereo | hi-fi right |
| Mix-Stereo | 1 | 1 | 1 | normal | aux stereo | hi-fi stereo |

Note

1. Modes shown in bold are the most used modes.

Output select function mode 'Mix-Stereo' is the setting generally used for audio dubbing. In combination with setting the normal select function to 'Volume' mode user control over amplitude and ratio is offered for the AUX and hi-fi signal as follows: $(\frac{1}{4}AUXL + \frac{1}{4}AUXR) \times \text{volume left} + (\frac{1}{4}\text{hi-fi left} + \frac{1}{4}\text{hi-fi right}) \times \text{volume right}$.

Switching hi-fi to a mode other than 'playback' or selection of output select function mode 'Normal' should be avoided; using these settings a signal loop can be closed from output to input possibly leading to audio oscillation. For the same reason auto-normal switching is not active during 'Dub Mix' mode; in case no hi-fi input signal is detected the hi-fi sound is muted.

Audio processor for VHS hi-fi

TDA9615H

Test modes; see Table 38

Special test modes are implemented for testing and evaluation purposes. These test modes are available via the power byte TEST bit and selection is enabled via bits of the select byte.

Table 38 Test modes for evaluation purposes

| TEST | s4 | NIL3 | NIL2 | NIL1 | NIL0 | DESCRIPTION |
|------------------|------------------|------------------|------------------|------------------|------------------|---|
| 0 | X ⁽¹⁾ | X ⁽¹⁾ | X ⁽¹⁾ | X ⁽¹⁾ | X ⁽¹⁾ | standard operation |
| 1 | 0 | 0 | 0 | 0 | 1 | test 1: left channel FM carrier only (1.3 or 1.4 MHz); record mode |
| 1 | 0 | 0 | 0 | 1 | 0 | test 2: right channel FM carrier only (1.7 or 1.8 MHz); record mode |
| 1 | 0 | 0 | 0 | 1 | 1 | test 3: left channel band-pass filter, HF AGC off; playback mode (test output = FMOUT) |
| 1 | 0 | 0 | 1 | 0 | 0 | test 4: right channel band-pass filter, HF AGC off; playback mode (test output = FMOUT) |
| 1 | 0 | 0 | 1 | 0 | 1 | test 5: HF AGC (via left channel band-pass filter); playback mode (test output = FMOUT) |
| 1 | 0 | 0 | 1 | 1 | 0 | test 6: HF AGC (via right channel band-pass filter); playback mode (test output = FMOUT) |
| 100111 to 111000 | | | | | | product testing; not for evaluation; note 2 |
| 1 | 1 | 1 | 0 | 0 | 1 | test 25 (note 3) a: left channel FM modulator (left carrier only); record mode (test input = line in left) b: left and right channel noise reduction (compressor); record mode (test output = line out) c: left and right channel FM demodulator; playback mode (test output = line out) |
| 1 | 1 | 1 | 0 | 1 | 0 | test 26 (note 3) a: right channel FM modulator (right carrier only); record mode (test input = line in right) b: left and right channel audio low-pass filter; record mode (test input = line in, test output = line out) c: left and right channel noise reduction (expander); playback mode (test input = line in); note 4 |

Notes

1. X = don't care.
2. Calibration may be lost when selecting product testing modes.
3. Audio output level for tests 25b and 25c (test output = line out) is typical -6.5 dBV (with input = -8 dBV or FM deviation = 50 kHz; LOH = 0). Audio input level for tests 25a, 26a and 26c (test input = line in) is typical -6.5 dBV (for output = -8 dBV or FM deviation = 50 kHz; hi-fi volume = -3 dB). The test outputs and test inputs used for tests 25 and 26 directly connect to internal signal lines. Signals found here are not compensated for temperature or tolerance spread, level measurements therefore can be used relative only. Absolute values are no indication of overall performance.
4. Test 26c (expander test) requires the auto-normal function to be deactivated (i.e. carrier available at FMIN pin).

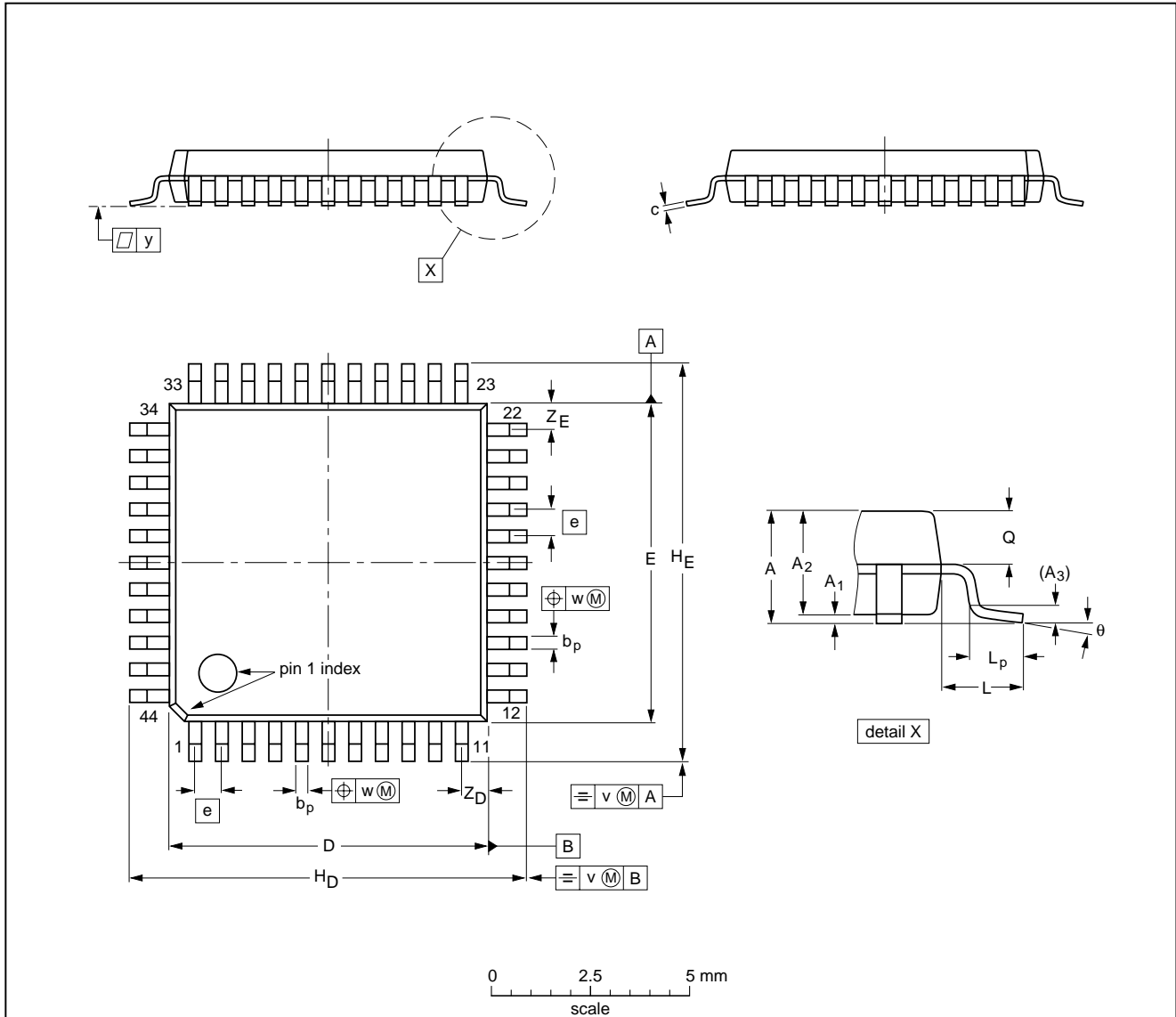
Audio processor for VHS hi-fi

TDA9615H

PACKAGE OUTLINE

QFP44: plastic quad flat package; 44 leads (lead length 1.3 mm); body 10 x 10 x 1.75 mm

SOT307-2



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _D | H _E | L | L _p | Q | v | w | y | Z _D ⁽¹⁾ | Z _E ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|-----|----------------|----------------|-----|----------------|--------------|------|------|-----|-------------------------------|-------------------------------|-----------|
| mm | 2.10 | 0.25 0.05 | 1.85 1.65 | 0.25 | 0.40 0.20 | 0.25 0.14 | 10.1 9.9 | 10.1 9.9 | 0.8 | 12.9 12.3 | 12.9 12.3 | 1.3 | 0.95 0.55 | 0.85 0.75 | 0.15 | 0.15 | 0.1 | 1.2 0.8 | 1.2 0.8 | 10° 0° |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT307-2 | | | | | | 92-11-17 95-02-04 |

Audio processor for VHS hi-fi

TDA9615H

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 "IC Package Databook" (order code 9398 652 90011).

Reflow soldering

Reflow soldering techniques are suitable for all QFP packages.

The choice of heating method may be influenced by larger plastic QFP packages (44 leads, or more). If infrared or vapour phase heating is used and the large packages are not absolutely dry (less than 0.1% moisture content by weight), vaporization of the small amount of moisture in them can cause cracking of the plastic body. For more information, refer to the Drypack chapter in our "Quality Reference Handbook" (order code 9397 750 00192).

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 is **not** recommended for QFP packages. This is because of the likelihood of solder bridging due to closely-spaced leads and the possibility of incomplete solder penetration in multi-lead devices.

If wave soldering cannot be avoided, the following conditions must be observed:

- **A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.**
- **The footprint must be at an angle of 45° to the board direction and must incorporate solder thieves downstream and at the side corners.**

Even with these conditions, do not consider wave soldering the following packages: QFP52 (SOT379-1), QFP100 (SOT317-1), QFP100 (SOT317-2), QFP100 (SOT382-1) or QFP160 (SOT322-1).

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.

Audio processor for VHS hi-fi

TDA9615H

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.

PURCHASE OF PHILIPS I²C COMPONENTS

Purchase of Philips I²C components conveys a license under the Philips' I²C patent to use the components in the I²C system provided the system conforms to the I²C specification defined by Philips. This specification can be ordered using the code 9398 393 40011.

Audio processor for VHS hi-fi

TDA9615H

NOTES

Audio processor for VHS hi-fi

TDA9615H

NOTES

Audio processor for VHS hi-fi

TDA9615H

NOTES

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213,
Tel. +43 1 60 101, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 689 211, Fax. +359 2 689 102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,
Tel. +45 32 88 2636, Fax. +45 31 57 0044

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615800, Fax. +358 9 61580920

France: 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

Greece: No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,
Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

Hungary: see Austria

India: Philips INDIA Ltd, Shivsagar Estate, A Block, Dr. Annie Besant Rd.
Worli, MUMBAI 400 018, Tel. +91 22 4938 541, Fax. +91 22 4938 722

Indonesia: see Singapore

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 1231,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

South America: Rua do Rocio 220, 5th floor, Suite 51,
04552-903 São Paulo, SÃO PAULO - SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 829 1849

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 3 301 6312, Fax. +34 3 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2686, Fax. +41 1 481 7730

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2865, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. +90 212 279 2770, Fax. +90 212 282 6707

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 625 344, Fax. +381 11 635 777

For all other countries apply to: Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

Internet: <http://www.semiconductors.philips.com>

© Philips Electronics N.V. 1997

SCA54

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in The Netherlands

547047/1200/01/pp44

Date of release: 1997 Jun 16

Document order number: 9397 750 01744

Let's make things better.

**Philips
Semiconductors**



PHILIPS