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|  <div style="float: right; text-align: right;"> <h1 style="margin: 0;">AK4711</h1> <h2 style="margin: 0;">Low Power Single SCART Driver with HD Video Filter</h2> </div> |
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| GENERAL DESCRIPTION |
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The AK4711 is a low power single AV line driver for single SCART applications. Individual video output switches can be controlled via a serial I2C bus. The AK4711 has both SD and HD video filters and line drivers offering the ideal features for digital set-top-box systems. The integrated audio drivers support ground referenced outputs, eliminating the need for large AC-coupling capacitors, reducing cost and saving board space. The AK4711 is housed in a space saving small 36-pin QFN package. For applications that do not use HD video filters and line drivers, AKM recommends the PCB compatible AK4710.

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| FEATURES |
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Audio section

- THD+N: -92dB (@2Vrms)
- Dynamic Range: 96dB (@2Vrms, A-weighted)
- Full Differential or Single-ended input for Decoder DAC
- Stereo Output for TV SCART and CINCH (2Vrms)
- Selectable audio gain from -6 to 24dB
- Audio Output Muting
- Ground-Referenced Output Eliminates DC-Blocking Capacitor and Mute Circuit

Video section

- Integrated LPF
 - SD: -40dB@27MHz
 - HD: -40dB@74.25MHz or 54MHz or 27MHz selectable
- 6dB Gain for Outputs
- 5ch 75ohm driver
 - 4ch for SCART: CVBS/Y, R/C, G, B
 - 1ch for CINCH: CVBS
- Y/Pb/Pr Option (to 6MHz)

Low-power Standby

SCART pin#16(Fast Blanking), pin#8(Slow Blanking) Output Control

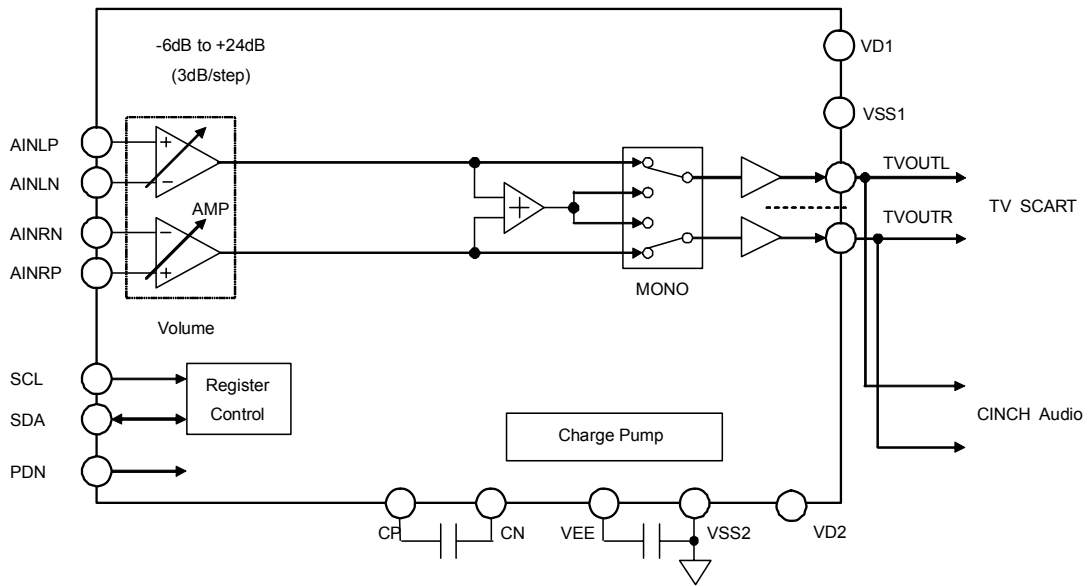
Power supply

- 3.3V+/-5% and 12V+/-5%
- Low Power Dissipation / Low Power Standby Mode

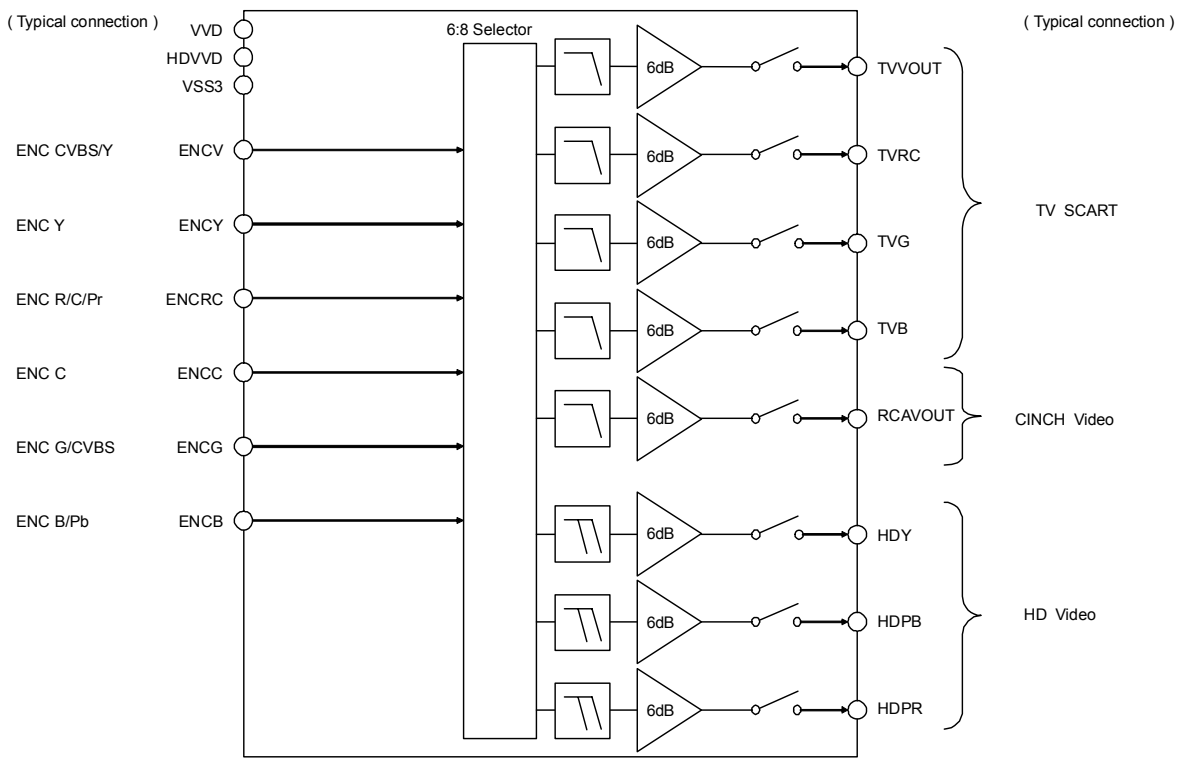
Package

- 36pin QFN (0.4mm pitch)

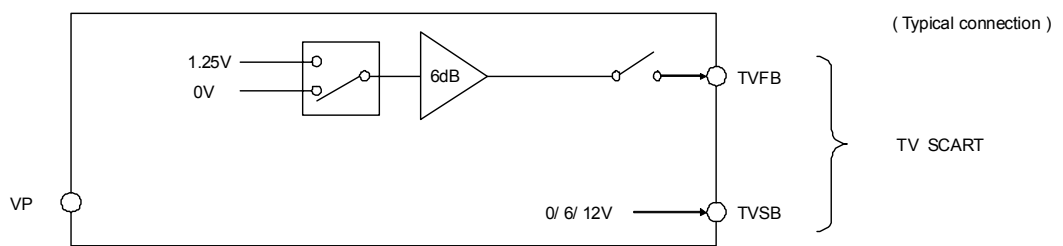
■ Block Diagram



Audio Block



Video Block



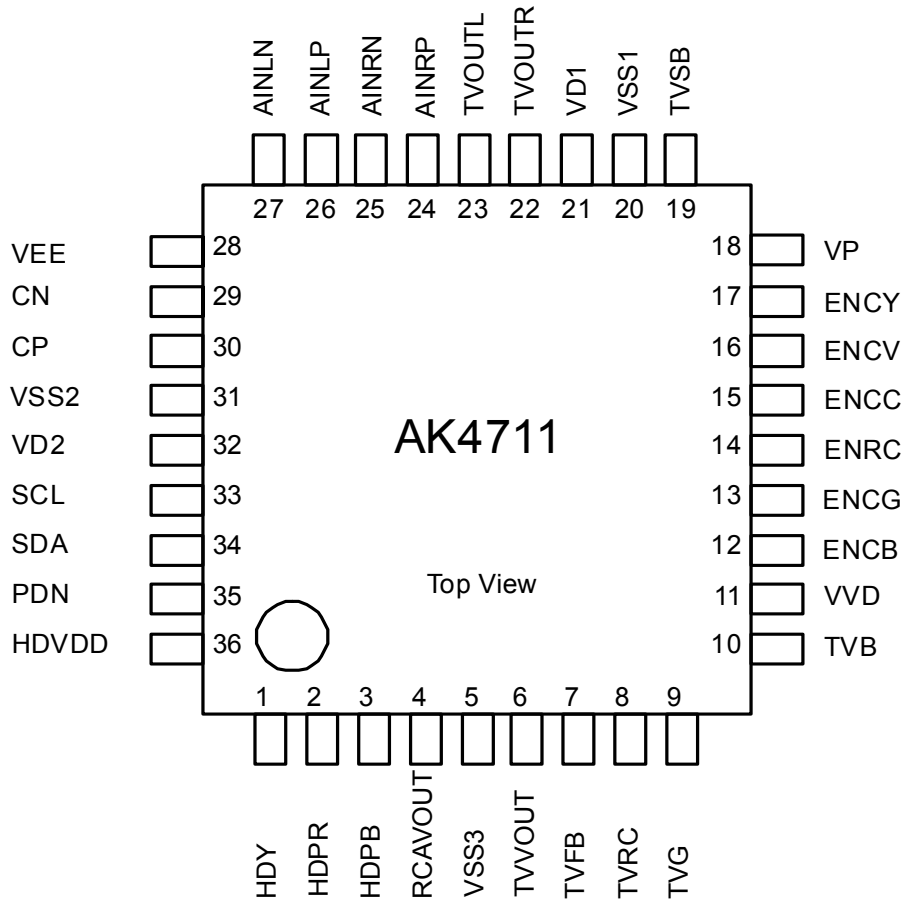
Video Blanking Block

■ **Ordering Guide**

AK4711EN -10 ~ +70°C 36pin QFN (0.4mm pitch)
 AKD4711 Evaluation board for AK4711

■ **Pin Layout**

36pin QFN (0.4mm pitch)



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| PIN/FUNCTION |
|---------------------|

| No. | Pin Name | I/O | Function |
|-----|----------|-----|---|
| 1 | HDY | O | Green/Y Output Pin |
| 2 | HDPR | O | Red/Pr Output Pin |
| 3 | HDPB | O | Blue/Pb Output Pin |
| 4 | RCAVOUT | O | Composite/Luminance Output Pin for RCA |
| 5 | VSS3 | - | Video Ground Pin , 0V |
| 6 | TVVOUT | O | Composite/Luminance Output Pin for TV |
| 7 | TVFB | O | Fast Blanking Output Pin for TV |
| 8 | TVRC | O | Red/Chrominance Output Pin for TV |
| 9 | TVG | O | Green Output Pin for TV |
| 10 | TVB | O | Blue Output Pin for TV |
| 11 | VVD | - | Video Power Supply Pin: 3.13V ~ 3.47V Normally connected to VSS3 via a 0.1μF ceramic capacitor in parallel with a 4.7μF electrolytic capacitor. |
| 12 | ENCB | I | Blue Input Pin for Encoder |
| 13 | ENCG | I | Green Input Pin for Encoder |
| 14 | ENCRC | I | Red/Chrominance Input Pin #1 for Encoder |
| 15 | ENCC | I | Chrominance Input Pin #2 for Encoder |
| 16 | ENCV | I | Composite/Luminance Input Pin #1 for Encoder |
| 17 | ENCY | I | Composite/Luminance Input Pin #2 for Encoder |
| 18 | VP | - | Blanking Power Supply Pin, 10.8V ~ 13.2V The VP pin must be connected to power supply via a 10ohm resistor with a 0.1μF ceramic capacitor in parallel with a 1μF electrolytic capacitor to VSS1. |
| 19 | TVSB | O | Slow Blanking Output Pin for TV A 470ohm ±5% resistor must be connected between the TVSB pin and SCART connector. |
| 20 | VSS1 | - | Audio Ground Pin , 0V |
| 21 | VD1 | - | Audio Power Supply Pin: 3.13V ~ 3.47V Normally connected to VSS1 via a 0.1μF ceramic capacitor in parallel with a 4.7μF electrolytic capacitor. |
| 22 | TVOUTR | O | Rch Analog Output Pin #2 |
| 23 | TVOUTL | O | Lch Analog Output Pin #2 |
| 24 | AINRP | I | Rch Positive Analog Input Pin |
| 25 | AINRN | I | Rch Negative Analog Input Pin |
| 26 | AINLP | I | Lch Positive Analog Input Pin |
| 27 | AINLN | I | Lch Negative Analog Input Pin |
| 28 | VEE | O | Negative Voltage Output Pin Connect to VSS2 via a 1.0μF low ESR (Equivalent Series Resistance) capacitor over temperature. When this capacitor is polarized, the positive polarity pin should be connected to the VSS2 pin. Non polarized capacitors can also be used. |
| 29 | CN | I | Negative Charge Pump Capacitor Terminal Pin Connect to CP via a 1.0μF low ESR (Equivalent Series Resistance) capacitor over temperature. When this capacitor is polarized, the positive polarity pin should be connected to the CP pin. Non polarized capacitors can also be used. |
| 30 | CP | I | Positive Charge Pump Capacitor Terminal Pin Connect to CN via a 1.0μF low ESR (Equivalent Series Resistance) capacitor over temperature. When this capacitor is polarized, the positive polarity pin should be connected to the CP pin. Non polarized capacitors can also be used. |
| 31 | VSS2 | - | Charge Pump Ground Pin , 0V |

| | | | |
|----|-------|-----|--|
| 32 | VD2 | - | Charge Pump Power Supply Pin: 3.13V ~ 3.47V Normally connected to VSS2 via a 0.1 μ F ceramic capacitor in parallel with a 4.7 μ F electrolytic capacitor. |
| 33 | SCL | I | Control Data Clock Pin |
| 34 | SDA | I/O | Control Data Pin |
| 35 | PDN | I | Power-Down Mode Pin When at "L", the AK4711 is in the power-down mode and is held in reset. The AK4711 should always be reset upon power-up. |
| 36 | HDVVD | - | Video Power Supply Pin: 3.13V ~ 3.47V Normally connected to VSS3 via a 0.1 μ F ceramic capacitor in parallel with a 4.7 μ F electrolytic capacitor. |

Note: All digital input pins must not be allowed to float.

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| ABSOLUTE MAXIMUM RATINGS |
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(VSS1 =VSS2 =VSS3 = 0V; [Note 1](#))

| Parameter | Symbol | Min | max | Unit |
|--|--------|---------|---------|------|
| Power Supply (Note 2) | VD1 | -0.3 | 4.0 | V |
| | VD2 | -0.3 | 4.0 | V |
| | VVD | -0.3 | 4.0 | V |
| | HDVDD | -0.3 | 4.0 | V |
| | VP | -0.3 | 14 | V |
| Input Current (any pins except for supplies) | IIN | - | ±10 | mA |
| Digital Input Voltage(PDN pin) | VIND1 | -0.3 | VVD+0.3 | V |
| Digital Input Voltage(SCL, SDA pins) | VIND2 | -0.3 | 4.0 | V |
| Video Input Voltage | VINV | -0.3 | VVD+0.3 | V |
| Audio Input Voltage (Note 3) | VINA | VEE-0.3 | VD1+0.3 | V |
| Ambient Operating Temperature | Ta | -10 | 70 | °C |
| Storage Temperature | Tstg | -65 | 150 | °C |

Note 1. All voltages with respect to ground.

Note 2. VSS1, VSS2 and VSS3 must be connected to the same analog ground plane.

Note 3. VEE: VEE pin voltage.

The internal negative power supply generating circuit provides negative power supply(VEE).

The PDN pin and MUTE bit control operation mode as shown in [Table 2](#) and [Table 3](#).

| Mode | | VEE pin Voltage |
|------|------------------|-----------------|
| 0 | Full Power-down | 0V |
| 1 | Mute | 0V |
| 2 | Normal operation | No video input |
| | | Video input |
| | | -VD2+0.2V |

Table 1. VEE pin voltage

WARNING: Operation at or beyond these limits may result in permanent damage to the device.
Normal operation is not guaranteed at these extremes.

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| RECOMMENDED OPERATING CONDITIONS |
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(VSS1 = VSS2 = VSS3 = 0V; [Note 1](#))

| Parameter | Symbol | min | typ | max | Unit |
|---|--------|------|-----|------|------|
| Power Supply (Note 4) | VD1 | 3.13 | 3.3 | 3.47 | V |
| | VD2 | 3.13 | 3.3 | 3.47 | V |
| | VVD | 3.13 | 3.3 | 3.47 | V |
| | HDVDD | 3.13 | 3.3 | 3.47 | V |
| | VP | 10.8 | 12 | 13.2 | V |

Note 1. All voltages with respect to ground.

Note 4. VVD and HDVDD must be connected to the same voltage.

*AKM assumes no responsibility for the usage beyond recommended operating conditions in this datasheet.

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| ELECTRICAL CHARACTERISTICS |
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(Ta = 25°C; VP=12V, VD1=VD2=VVD=HDVDD= 3.3V)

| Power Supplies | min | typ | max | Unit |
|------------------------------|-----|-----|-----|------|
| Power Supply Current | | | | |
| Normal Operation (PDN = "H") | | 133 | 160 | mA |
| VD1+VD2+VVD+HDVDD | | | | |
| VP | | 48 | 58 | μA |
| Power-Down Mode (PDN = "L") | | 0 | 10 | μA |
| VD1+VD2 | | | | |
| VVD | | | | |
| HDVDD | | | | |
| VP | | | | |

Note 5. 1kHz 2Vrms output with 4.5kΩ load at all audio output pins.

47.46 IRE at all video inputs corresponding to all video output pins with 150Ω load. Refer to [Table 3](#).

Note 6. All digital inputs are held at VVD or VSS3. No signal, no load for A/V switches.

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| DIGITAL CHARACTERISTICS |
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(Ta = 25°C; VD1=VD2=VVD=HDVDD= 3.13 ~ 3.47V)

| Parameter | Symbol | min | typ | max | Unit |
|--|--------|---------|-----|---------|------|
| High-Level Input Voltage | VIH | 70% VVD | - | - | V |
| Low-Level Input Voltage | VIL | - | - | 30% VVD | V |
| Low-Level Output Voltage (SDA pin: Iout= 3mA) | VOL | - | - | 0.4 | V |
| Input Leakage Current | Iin | - | - | ± 10 | μA |

ANALOG CHARACTERISTICS (AUDIO)

(Ta=25°C; VP=12V, VD1=VD2=VVD=HDVVD= 3.3V; Signal Frequency=1kHz; Measurement frequency=20Hz ~ 20kHz; $R_L \geq 4.5k\Omega$; 0dB=2Vrms output; Volume =0dB, unless otherwise specified)

| Parameter | min | typ | max | Unit |
|--|------|-----|------|------------|
| Analog Input: (AINLP/AINLN/AINRN/AINRP pins) | | | | |
| Analog Input Characteristics | | | | |
| Input Voltage (AIN+) – (AIN–) (Note 7) | | | 2.0 | Vrms |
| Input Resistance (AINLP, AINRP pins) | 85 | 120 | | k Ω |
| Input Resistance (AINLN, AINRN pins) | 85 | 120 | - | k Ω |
| Stereo/Mono Output: (TVOUTL/TVOUTR pins) (Note 8) | | | | |
| Analog Output Characteristics | | | | |
| Volume Step Width | 2.3 | 3.0 | 3.7 | dB |
| THD+N (at 2Vrms output, Note 10, Note 12) | | -92 | -80 | dB |
| Dynamic Rang (-60dB Output, A-weighted, Note 10) | 92 | 96 | | dB |
| S/N (A-weighted, Note 10, Note 14) | 92 | 96 | | dB |
| Interchannel Isolation (Note 10, Note 11) | 80 | 90 | | dB |
| Interchannel Gain Mismatch (Note 10, Note 11) | -0.5 | 0 | +0.5 | dB |
| DC offset (Note 13) | -5 | 0 | +5 | mV |
| Gain Drift | - | 200 | - | ppm/°C |
| Load Resistance TVOUTL/R | 4.5 | | | k Ω |
| Load Capacitance TVOUTL/R | | | 20 | pF |
| Output Voltage (Note 9) | 1.8 | 2 | 2.2 | Vrms |
| Power Supply Rejection (PSR) (Note 15) | - | 65 | | dB |

Note 7. $f = 1\text{kHz}$, THD+N < -80dB, gain = 0dB (Volume=0dB)

Note 8. Measured by Audio Precision System Two Cascade.

Note 9. The output level of the internal amplifier with volume should be less than 2Vrms.

Note 10. Analog In to TVOUT. Path : AINLP/N → TVOUTL, AINRP/N → TVOUTR, Volume=0dB.

At 2Vrms single input, THD+N is -91dB (typ), on path AINLP → TVOUTL, AINRP → TVOUTR, Volume=0dB

Note 11. Between TVOUTL and TVOUTR with analog inputs AINLP/N, AINLN/N, AINRP/N, 1kHz/0dB.

Inter-channel crosstalk is -80dB (typ), at 20Hz~20kHz other than 1kHz.

Note 12. -79dB (typ) referred to 0.5Vrms output level at Volume=+24dB

: path = AIN+/- → TVOUT.

Note 13. Analog In to TVOUT. Volume=0dB

Path : AINLP/N → TVOUTL, AINRP/N → TVOUTR

Note 14. 82dB (typ) referred to 0.5Vrms output level at Volume=+24dB

84dB (typ), referred to 0.5Vrms output level at Volume = +21dB.

: path = AIN+/- → TVOUT.

Note 15. The PSR is applied to VD1 and VD2 with 1kHz, 100mV.

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| ANALOG CHARACTERISTICS (SD VIDEO) |
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($T_a = 25^\circ\text{C}$; $V_P = 12\text{V}$, $V_{D1}=V_{D2}=V_{VD}=H_{DVVD}=3.3\text{V}$; unless otherwise specified.)

| Parameter | Conditions | min | typ | max | Unit |
|----------------------------|---|------|------|------|-----------------|
| Sync Tip Clamp Voltage | at output pin. | | 0.20 | | V |
| R/G/B Clamp Voltage | at output pin. | | 0.20 | | V |
| Pb/Pr Clamp Voltage | at output pin. | | 1.44 | | V |
| Chrominance Bias Voltage | at output pin. | | 1.44 | | V |
| Gain | Input = 0.3V _{p-p} , 100kHz | 5.5 | 6 | 6.5 | dB |
| Interchannel Gain Mismatch | TVRC, TVG, TVB. Input = 0.3V _{p-p} , 100kHz. | -0.5 | - | 0.5 | dB |
| Frequency Response | Input=0.3V _{p-p} , C1=C2=0pF. 100kHz to 6MHz. at 10MHz. at 27MHz. | -1.0 | | 0.5 | dB |
| | | | -3 | | dB |
| | | | -40 | -20 | dB |
| Group Delay Distortion | At 4.43MHz with respect to 1MHz. | | | 20 | ns |
| Input Impedance | Chrominance input (internally biased) | 70 | 100 | - | k Ω |
| Input Signal | f = 100kHz, maximum with distortion < 1.0%, gain = 6dB. | - | - | 1.25 | V _{pp} |
| Load Resistance | (Figure 1) | 150 | - | - | Ω |
| Load Capacitance | C1 (Figure 1) | | | 400 | pF |
| | C2 (Figure 1) | | | 15 | pF |
| Dynamic Output Signal | f = 100kHz, maximum with distortion < 1.0% | - | - | 2.5 | V _{pp} |
| Y/C Crosstalk | f = 4.43MHz, 1V _{p-p} input. Among TVVOUT, TVRC and RCAVOUT outputs. | - | -50 | - | dB |
| S/N | Reference Level = 0.7V _{p-p} , CCIR 567 weighting. BW = 15kHz to 5MHz. | - | 74 | - | dB |
| Differential Gain | 0.7V _{pp} 5steps modulated staircase. chrominance & burst are 280mV _{pp} , 4.43MHz. | - | 0.6 | - | % |
| Differential Phase | 0.7V _{pp} 5steps modulated staircase. chrominance & burst are 280mV _{pp} , 4.43MHz. | - | 1.4 | - | Degree |

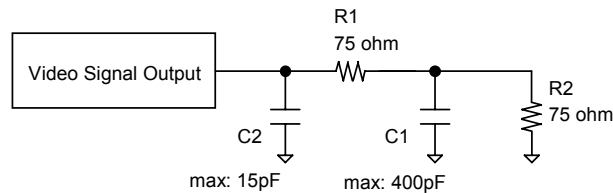


Figure 1. Load Resistance R1+R2 and Load Capacitance C1/C2.

ANALOG CHARACTERISTICS (HD VIDEO)

(Ta = 25°C; VP=12V, VD1=VD2=VVD=HDVVD= 3.3V, unless otherwise specified.)

| Parameter | Conditions | min | typ | max | Unit | |
|------------------------|---|--|------|-------------|------------|----------------|
| Sync Tip Clamp Voltage | at output pin. | | 0.20 | | V | |
| R/G/B Clamp Voltage | at output pin. | | 0.20 | | V | |
| Pb/Pr Clamp Voltage | at output pin. | | 1.44 | | V | |
| Gain | Input=0.3Vp-p, 100kHz | 5.5 | 6 | 6.5 | dB | |
| Frequency response | Input=0.3Vp-p, C1=C2=0pF (Figure 1) | FL1/0,FLPB1/0,FLPR1/0= "10" 100kHz to 20MHz, at 30MHz. at 74.25MHz. | -1.0 | -2.5 -40 | 1.0 -25 | dB dB dB |
| | | FL1/0,FLPB1/0,FLPR1/0= "01" 100kHz to 15MHz, at 54MHz. | -1.0 | -40 | 1.0 -25 | dB dB |
| | | FL1/0,FLPB1/0,FLPR1/0= "00" 100kHz to 6MHz, at 27MHz. | -1.0 | -40 | 0.5 -25 | dB dB |
| Input Signal | f=100kHz, distortion < 1.0%, gain=6dB | - | - | 1.25 | Vpp | |
| Load Resistance | (Figure 1) | 150 | - | - | Ω | |
| Load Capacitance | C1 | (Figure 1) | | 400 | pF | |
| | C2 | (Figure 1) | | 10 | pF | |
| Dynamic Output Signal | f=100kHz, distortion < 1.0% | - | - | 2.5 | Vpp | |
| S/N | Reference Level = 0.7Vp-p, CCIR 567 weighting. BW = 15kHz to 5MHz. | - | 74 | - | dB | |
| Differential Gain | 0.7Vpp 5steps modulated staircase. chrominance &burst are 280mVpp, 4.43MHz. FL1/0, FLPB1/0, FLPR1/0= "00" | - | +0.3 | - | % | |
| Differential Phase | 0.7Vpp 5steps modulated staircase. chrominance &burst are 280mVpp, 4.43MHz. FL1/0, FLPB1/0, FLPR1/0= "00" | - | +0.6 | - | Degree | |

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| SWITCHING CHARACTERISTICS |
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(Ta = 25°C; VP = 10.8 ~ 13.2V, VD1=VD2= VVD=HDVVD= 3.13 ~ 3.47V)

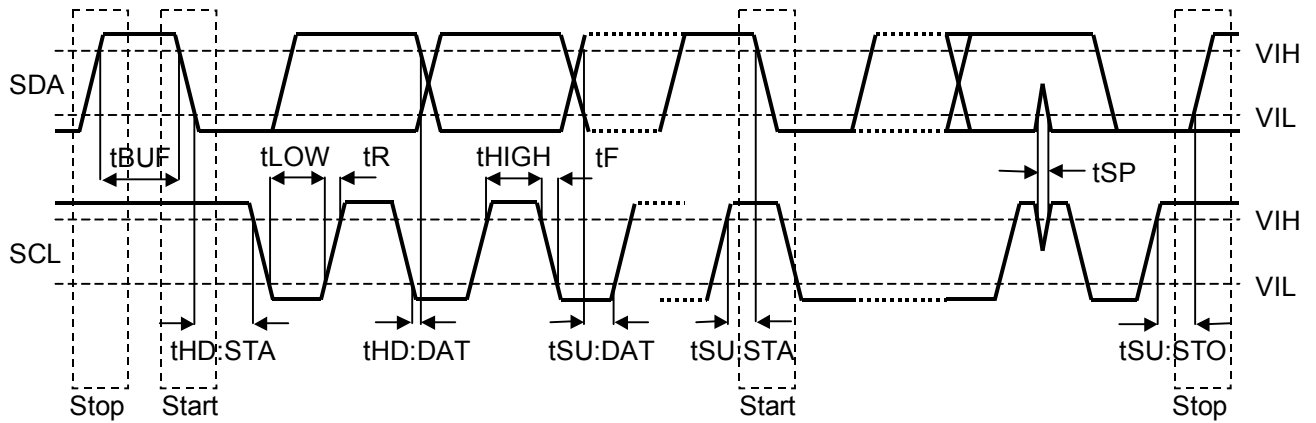
| Parameter | Symbol | min | typ | max | Unit |
|---|---------|-----|-----|-----|------|
| Control Interface Timing (I²C Bus): | | | | | |
| SCL Clock Frequency | fSCL | - | | 400 | kHz |
| Bus Free Time Between Transmissions | tBUF | 1.3 | | - | μs |
| Start Condition Hold Time (prior to first clock pulse) | tHD:STA | 0.6 | | - | μs |
| Clock Low Time | tLOW | 1.3 | | - | μs |
| Clock High Time | tHIGH | 0.6 | | - | μs |
| Setup Time for Repeated Start Condition | tSU:STA | 0.6 | | - | μs |
| SDA Hold Time from SCL Falling (Note 16) | tHD:DAT | 0 | | - | μs |
| SDA Setup Time from SCL Rising | tSU:DAT | 0.1 | | - | μs |
| Rise Time of Both SDA and SCL Lines | tR | - | | 0.3 | μs |
| Fall Time of Both SDA and SCL Lines | tF | - | | 0.3 | μs |
| Setup Time for Stop Condition | tSU:STO | 0.6 | | - | μs |
| Pulse Width of Spike Noise Suppressed by Input Filter | tSP | 0 | | 50 | ns |
| Capacitive load on bus | Cb | | | 400 | pF |
| Reset Timing | | | | | |
| PDN Pulse Width (Note 17) | tPD | 150 | | | ns |

Note 16. Data must be held for sufficient time to bridge the 300 ns transition time of SCL.

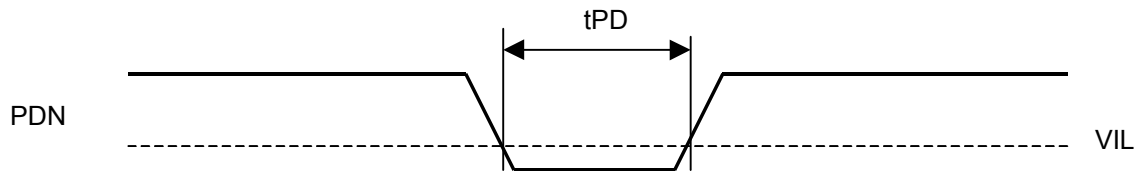
Note 17. The AK4711 should be reset once by bringing the PDN pin = "L" after all power supplies are supplied.

Note 18. I²C-bus is a trademark of NXP B.V.

■ Timing Diagram



I²C Bus mode Timing



Power-down Timing

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|---------------------------|
| OPERATION OVERVIEW |
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1. System Reset and Power-down Options

The AK4711 should be reset once by bringing the PDN pin = “L” after all power supplies are supplied. The AK4711 has several operation modes. The PDN pin and MUTE bit control operation mode as shown in [Table 2](#) and [Table 3](#).

■ System Reset and Full Power-down Mode

The AK4711 should be reset once by bringing the PDN pin = “L” after all power supplies are supplied.

PDN pin: Power down pin

L: Full Power-down Mode. Power-down, reset and initializes control registers.

H: Device active.

■ Mute Mode

When the MUTE bit = “1”, the audio outputs settle to VSS(0V, typ) and the charge pump circuit is in power down mode.

MUTE bit (00H D1): Audio output control

0: Normal operation.

1: All audio outputs to GND (default)

| Mode | PDN pin | MUTE bit | Mode |
|------|---------|----------|--|
| 0 | L | x | Full Power-down |
| 1 | H | 1 | Mute (Note 19) (AMP power down) |
| 2 | H | 0 | Normal operation (AMP operation) |

Note 19. TVOUTL/R are muted by Mute bit in the default state.

Table 2. Operation Mode Settings (x: Don't Care)

| Mode | | Register Control | Audio Charge pump | Video Output | TVFB | TVSB | Power Consumption (typ.) (Note 20) |
|------|----------------------------------|------------------|-------------------|--------------|--------|---------------------------------------|--|
| 0 | Full Power-down | NOT available | Power down | Hi-Z | Hi-Z | Pull-down (Note 21) | 0.6mW |
| 1 | Mute (AMP power down) | Available | | Active | Active | Active | 1.86mW |
| | | | | Hi-Z | | | 228mW |
| 2 | Normal operation (AMP operation) | | No video input | Active | | | Active |
| | | Video input | Active | | 250mW | | |

Note 20. 1kHz 2Vrms output with 4.5kΩ load at all audio output pins.

47.46 IRE at all video inputs corresponding to all video output pins with 150Ω load.

Note 21. Internally pulled down by a 120kΩ (typ) resistor.

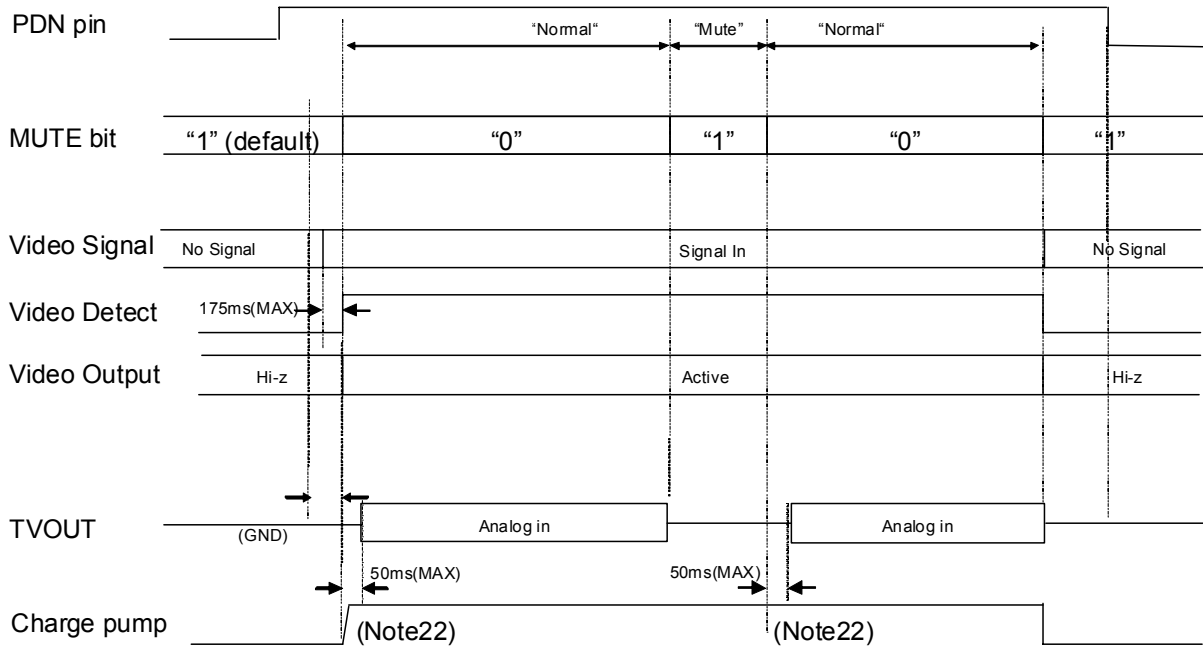
Table 3. Status of each operation modes

■ Normal Operation Mode

To change analog switches, set the MUTE bit to “0”. The AK4711 is in power-down mode until the PDN pin = “H”. Figure 2 shows an example of the system timing at the power-down and power-up by the PDN pin.

■ Typical Operation Sequence

Figure 2 shows an example of the system timing at normal operation mode.



Note 22. Mute the analog outputs externally if click noise affects the system.

Figure 2. Typical Operating Sequence

2. Audio Block

■ Volume Control (11-Level Volume)

The AK4711 has an 11-level volume control as shown in Table 4. The volume reflects the change of register value immediately.

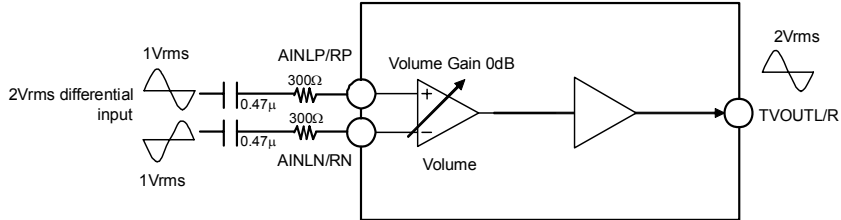


Figure 3. Volume (Volume Gain=0dB: default), Full Differential Stereo Input

(0DH: D6-D3)

| VOL3 | VOL2 | VOL1 | VOL0 | Volume Gain | Output Level (Typ) |
|------|------|------|------|-------------|--|
| 1 | 1 | x | x | -- | Reserved |
| 1 | 0 | 1 | 1 | +24dB | 2Vrms (with 0.13Vrms differential input) |
| 1 | 0 | 1 | 0 | +21dB | - |
| 1 | 0 | 0 | 1 | +18dB | 2Vrms (with 0.25Vrms differential input) |
| 1 | 0 | 0 | 0 | +15dB | - |
| 0 | 1 | 1 | 1 | +12dB | 2Vrms (with 0.5Vrms differential input) |
| 0 | 1 | 1 | 0 | +9dB | - |
| 0 | 1 | 0 | 1 | +6dB | 2Vrms (with 1Vrms differential input) |
| 0 | 1 | 0 | 0 | +3dB | - |
| 0 | 0 | 1 | 1 | 0dB | 2Vrms (with 2Vrms differential input: default) |
| 0 | 0 | 1 | 0 | -3dB | - |
| 0 | 0 | 0 | 1 | -6dB | 1Vrms (with 2Vrms differential input) |
| 0 | 0 | 0 | 0 | Mute | - |

(x: Don't care)

Table 4. Volume, Full Differential Stereo Input

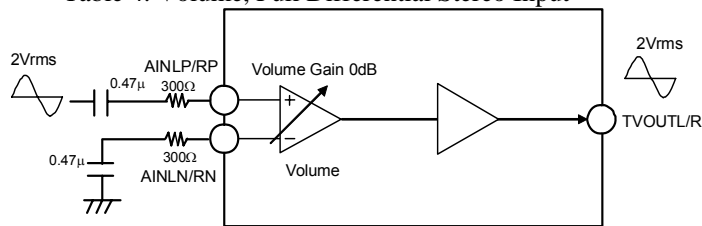


Figure 4. Volume (Volume Gain=0dB:default), Single-ended Input

(ODH: D6-D3)

| VOL3 | VOL2 | VOL1 | VOL0 | Volume Gain | Output Level (Typ) |
|------|------|------|------|-------------|-----------------------------------|
| 1 | 1 | x | x | -- | Reserved |
| 1 | 0 | 1 | 1 | +24dB | 2Vrms (with 0.13Vrms input) |
| 1 | 0 | 1 | 0 | +21dB | - |
| 1 | 0 | 0 | 1 | +18dB | 2Vrms (with 0.25Vrms input) |
| 1 | 0 | 0 | 0 | +15dB | - |
| 0 | 1 | 1 | 1 | +12dB | 2Vrms (with 0.5Vrms input) |
| 0 | 1 | 1 | 0 | +9dB | - |
| 0 | 1 | 0 | 1 | +6dB | 2Vrms (with 1Vrms input) |
| 0 | 1 | 0 | 0 | +3dB | - |
| 0 | 0 | 1 | 1 | 0dB | 2Vrms (with 2Vrms input: default) |
| 0 | 0 | 1 | 0 | -3dB | - |
| 0 | 0 | 0 | 1 | -6dB | 1Vrms (with 2Vrms input) |
| 0 | 0 | 0 | 0 | Mute | - |

(x: Don't care)

Table 5. Volume, Single-ended Input

■ Analog output block

The AK4711 has a charge pump circuit generating negative power supply rail from a 3.3V(typ) power supply. (Figure 5) It allows the AK4711 to output audio signal centered at VSS (0V, typ) as shown in Figure 6. The negative power generating circuit (Figure 5) needs 1.0uF low ESR (Equivalent Series Resistance) capacitors (Ca, Cb). When using polarized capacitors, the positive pin of Ca and Cb should be connected to CP and VSS2 for respectively. When the MUTE bit = "1", the charge pump circuit is in power down mode and its analog outputs become VSS (0V, typ).

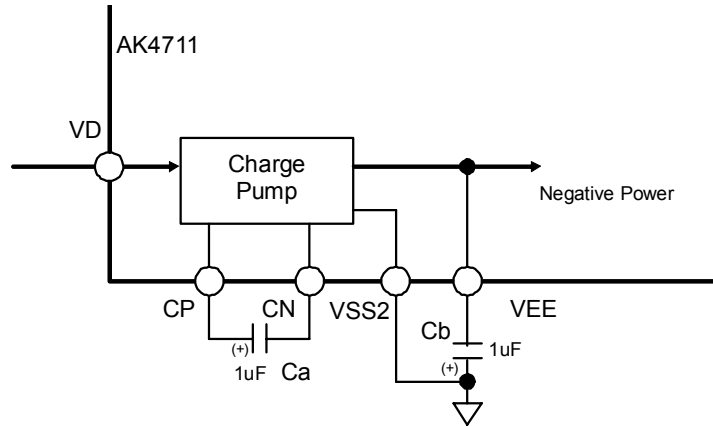


Figure 5. Negative Power Generate Circuit

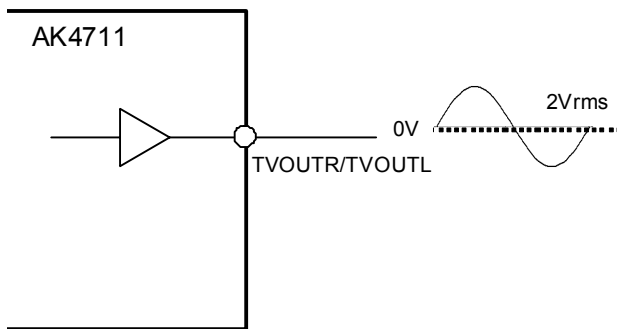


Figure 6. Audio Signal Output

3. Video Block

■ Video Switch Control

The AK4711 has switches for TV. Each switch can be controlled via the registers independently.

(04H: D1-D0)

| Mode | VTV1-0 bit | Source of TVVOUT pin | Source of TVRC pin | Source of TVG pin | Source of TVB pin |
|-----------------------------------|------------|------------------------------|---------------------------------|-------------------------------|-------------------------------|
| Shutdown (default) | 00 | (Hi-Z) | (Hi-Z) | (Hi-Z) | (Hi-Z) |
| Encoder CVBS+RGB or Encoder YPbPr | 01 | ENCV pin (Encoder CVBS or Y) | ENCRC pin (Encoder Red,C or Pr) | ENCG pin (Encoder Green or Y) | ENCB pin (Encoder Blue or Pb) |
| Encoder Y/C 1 | 10 | ENCV pin (Encoder Y) | ENCRC pin (Encoder C) | (Hi-Z) | (Hi-Z) |
| Encoder Y/C 2 | 11 | ENCY pin (Encoder Y) | ENCC pin (Encoder C) | (Hi-Z) | (Hi-Z) |

Table 6. TV Video Output (Note 23)

(04H: D4-D3)

| Mode | RCA1-0 bit | Source of RCAVOUT pin |
|-------------------|------------|-----------------------|
| Shutdown(default) | 00 | (Hi-Z) |
| Encoder CVBS | 01 | ENCV pin |
| Encoder CVBS | 10 | ENCY pin |
| (Reserved) | 11 | - |

Table 7. RCA Video Output (Note 23)

Note 23. When input video signals via the ENCRC pin, set CLAMP1 bit.

■ Video Output Control (05H: D6-D0)

Each video output can be set to Hi-Z individually via the control registers.

TVV: TVVOUT output control
 TVR: TVRCOUT output control
 TVG: TVGOUT output control
 TVB: TVBOUT output control
 RCAV: RCAVOUT output control
 TVFB: TVFB output control
 0: Hi-Z. (default)
 1: Active.

■ Clamp and DC-restore Circuit Control (06H: D7-D3)

Each CVBS and Y input has a sync tip clamp circuit. The DC-restore circuit has two clamp voltages; 0.20V(typ) and 1.44V(typ) to support both RGB and YPbPr signal. They correspond to 0.10V(typ) and 0.72V(typ) at the SCART connector when matched by 75Ω resistors. CLAMP1 and CLAMPB bits select the input circuit for both the ENCRG pin (Encoder Red/Chroma) and the ENCB pin (Encoder Blue), and CLAMP2 bit selects the input circuit for the ENCG pin. VCLP1-0 bits select the sync source of the DC- restore circuit.

| CLAMPB | CLAMP1 | ENCRG Input Circuit | ENCB Input Circuit | note |
|--------|--------|--|--|-------------------|
| 0 | 0 | DC restore clamp active (0.20V at sync timing/output pin) | DC restore clamp active (0.20V at sync timing/output pin) | for RGB (default) |
| 0 | 1 | Biased (1.44V at sync timing/output pin) | DC restore clamp active (0.20V at sync timing output pin) | for Y/C |
| 1 | 0 | DC restore clamp active (1.44V at sync timing/output pin) | DC restore clamp active (1.44V at sync timing/output pin) | for Y/Pb/Pr |
| 1 | 1 | (reserved) | (reserved) | |

Table 8. DC-restore Control for Encoder Input

| CLAMP2 | ENCG Input Circuit | note |
|--------|--|-------------------|
| 0 | DC restore clamp active (0.20V at sync timing/output pin) | for RGB (default) |
| 1 | Sync tip clamp active (0.20V at sync timing/output pin) | for Y/Pb/Pr |

Note: When the VTV1-0 bits = "01" (source for TV = Encoder CVBS /RGB), TVG bit = "1" (TVG = active) and VCLP1-0 bits = "11" (DC restore source = ENCG), the sync tip is selected even if the CLAMP2 bit = "0".

Table 9. DC-restore Control for Encoder Green/Y Input

VCLP1-0: DC restore source control

| VCLP1 | VCLP0 | Sync Source of DC Restore |
|-------|-------|---------------------------|
| 0 | 0 | ENCV (default) |
| 0 | 1 | ENCY |
| 1 | 0 | (Reserved) |
| 1 | 1 | ENCG |

Table 10. DC-restore Source Control

■ HD Video Control (0AH: D7-D6)

FLY1/0, FLPB1/0, FLPR1/0 bits and HDCP1/0, HDY1/0 bits set the HD video switch and filter response.

| HDCP1 | HDCP0 | HD PbPr – RGB Control |
|-------|-------|---|
| 0 | 0 | YPbPr.(default) Y = 0.2V Clamp, ENCB = 1.44V DC-restore, ENCRC = 1.44V DC-restore. (Y= Sync Source only for ENCPB, ENCPR) |
| 1 | 0 | RGB. Y = 0.2V Clamp, ENCB = 0.2V DC-restore, ENCRC = 0.2V DC-restore. (Y= Sync Source only for ENCPB, ENCPR) |
| 1 | 1 | RGB. Y = 0.2V DC-restore, ENCB = 0.2V DC-restore, ENCRC = 0.2V DC-restore. Sync Source = ENCV |
| 0 | 1 | Hi-Z |

Table 11. HD Video Switch Control (3ch common)

| HDY1 | HDY0 | Y Input Control |
|------|------|-----------------|
| 0 | 0 | ENCG(default) |
| 0 | 1 | ENCV |
| 1 | 0 | ENCY |
| 1 | 1 | (Reserved) |

Table 12. HD Video Switch Control (3ch common)

| Input | | Output |
|-----------------------|-----------------------|--------------------|
| FLY1/ FLPB1/FLPR1 bit | FLY0/ FLPB0/FLPR0 bit | LFP response |
| 0 | 0 | 6MHz LPF (default) |
| 0 | 1 | 12MHz LPF |
| 1 | 0 | 30MHz LPF |
| 1 | 1 | (Reserved) |

Table 13. HD Video Filter Control (3ch independent)

4. Blanking Control

The AK4711 supports Fast Blanking signals and Slow Blanking (Function Switching) signals for TV SCART.

■ Input/Output Control for Fast/Slow Blanking

FB: TV Fast Blanking output control (07H: D1-D0)

| Input | | Output |
|---------|---------|-----------------------------|
| FB1 bit | FB0 bit | TVFB pin Output Level |
| 0 | 0 | 0V (default) |
| 0 | 1 | 2V<, 2.5V(typ) at 150Ω load |
| 1 | 0 | (Reserved) |
| 1 | 1 | (Reserved) |

Table 14. TV Fast Blanking Output (Note: minimum load is 150Ω)

SBT1-0: TV Slow Blanking output control (07H: D3-D2)

| Input | | Output |
|----------|----------|-----------------------|
| SBT1 bit | SBT0 bit | TVSB pin Output Level |
| 0 | 0 | <2V (default) |
| 0 | 1 | 4.73V <, < 7V |
| 1 | 0 | (Reserved) |
| 1 | 1 | 10V< |

Table 15. TV Slow Blanking Output (Note: minimum load is 10kΩ)

5. Control Interface (I²C-bus Control)

1. WRITE Operations

Figure 7 shows the data transfer sequence in I²C-bus mode. All commands are preceded by a START condition. A HIGH to LOW transition on the SDA line while SCL is HIGH indicates a START condition (Figure 13). After the START condition, a slave address is sent. This address is 7bits long followed by the eighth bit that is a data direction bit (R/W). The most significant seven bits of the slave address are fixed as “0010001”. If the slave address match that of the AK4711, the AK4711 generates the acknowledge and the operation is executed. The master must generate the acknowledge-related clock pulse and release the SDA line (HIGH) during the acknowledge clock pulse (Figure 15). A “1” for R/W bit indicates that the read operation is to be executed. A “0” indicates that the write operation is to be executed. The second byte consists of the address for control registers of the AK4711. The format is MSB first, and those most significant 3-bits are fixed to zeros (Figure 9). The data after the second byte contain control data. The format is MSB first, 8bits (Figure 10). The AK4711 generates an acknowledge after each byte has been received. A data transfer is always terminated by a STOP condition generated by the master. A LOW to HIGH transition on the SDA line while SCL is HIGH defines a STOP condition (Figure 13).

The AK4711 can execute multiple one byte write operations in a sequence. After receipt of the third byte, the AK4711 generates an acknowledge, and awaits the next data again. The master can transmit more than one byte instead of terminating the write cycle after the first data byte is transferred. After the receipt of each data, the internal address counter is incremented by one, and the next data is taken into next address automatically. If the address exceeds 0DH prior to generating the stop condition, the address counter will “roll over” to 00H and the previous data will be overwritten. The data on the SDA line must be stable during the HIGH period of the clock. The HIGH or LOW state of the data line can only change when the clock signal on the SCL line is LOW (Figure 15) except for the START and the STOP condition.

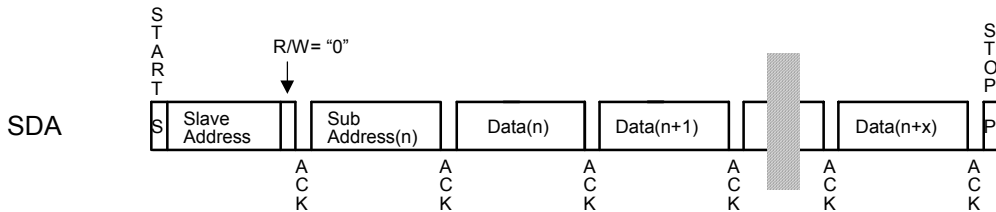


Figure 7. Data transfer sequence at the I²C-bus mode

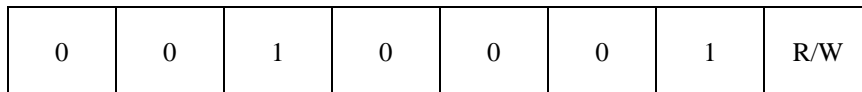


Figure 8. The first byte

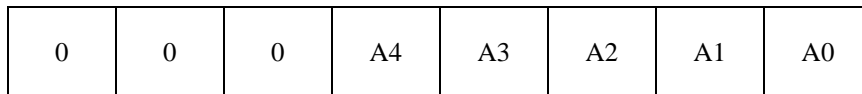


Figure 9. The second byte

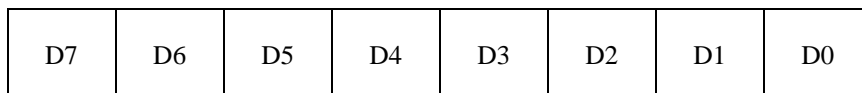


Figure 10. Byte structure after the second byte

2. READ Operations

Set R/W bit = "1" for READ operations. After transmission of data, the master can read the next address's data by generating an acknowledge instead of terminating the write cycle after the receipt the first data word. After the receipt of each data, the internal address counter is incremented by one, and the next data is taken into next address automatically. If the address exceeds 09H prior to generating a stop condition, the address counter will "roll over" to 00H and the previous data will be overwritten.

The AK4711 supports two basic read operations: CURRENT ADDRESS READ and RANDOM READ.

2-1. CURRENT ADDRESS READ

The AK4711 contains an internal address counter that maintains the address of the last word accessed, incremented by one. Therefore, if the last access (either a read or write) was to address "n", the next CURRENT READ operation would access data from the address "n+1". After receipt of the slave address with R/W bit set to "1", the AK4711 generates an acknowledge, transmits 1byte data which address is set by the internal address counter and increments the internal address counter by 1. If the master does not generate an acknowledge to the data but generate a stop condition, the AK4711 discontinues transmission.

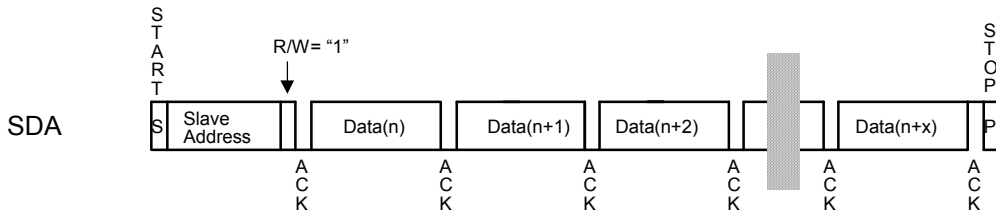


Figure 11. CURRENT ADDRESS READ

2-2. RANDOM READ

Random read operation allows the master to access any memory location at random. Prior to issuing the slave address with the R/W bit set to "1", the master must first perform a "dummy" write operation. The master issues a start condition, slave address (R/W bit = "0") and then the register address to read. After the register address is acknowledge, the master immediately reissues the start condition and the slave address with the R/W bit set to "1". Then the AK4711 generates an acknowledge, 1-byte data and increments the internal address counter by 1. If the master does not generate an acknowledge to the data but generate a stop condition, the AK4711 discontinues transmission.

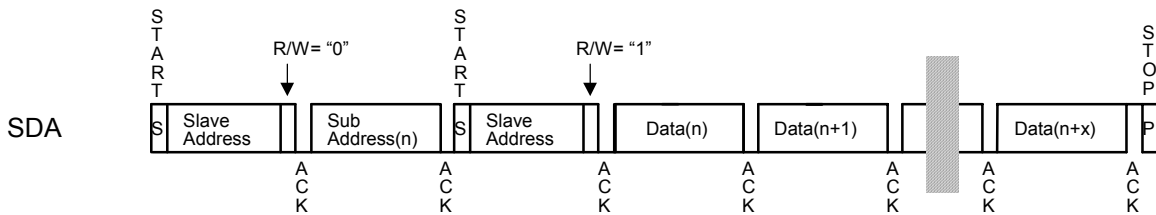


Figure 12. RANDOM ADDRESS READ

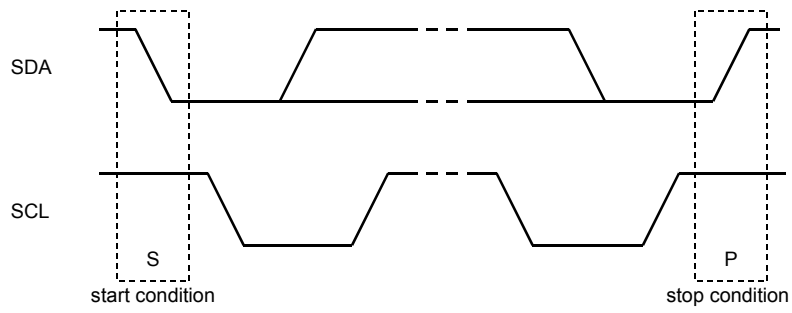


Figure 13. START and STOP Conditions

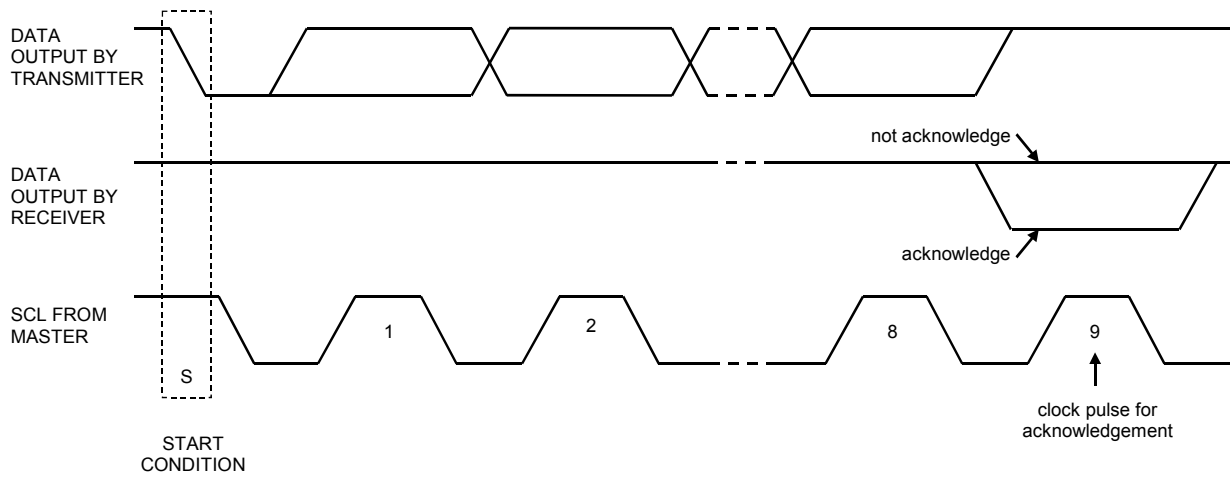


Figure 14. Acknowledge on the I²C-bus

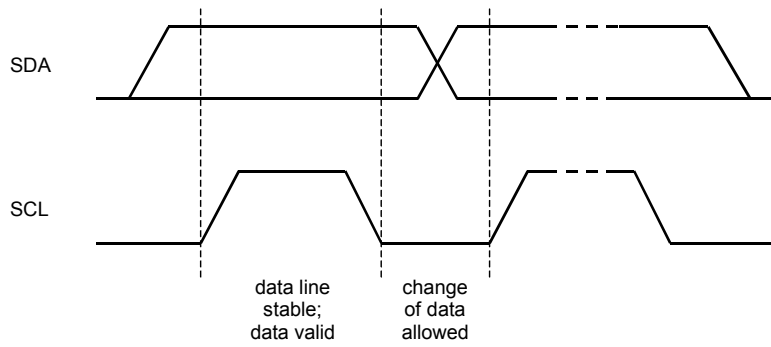


Figure 15. Bit transfer on the I²C-bus

■ Register Map

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------------------|--------|-------|-------|--------|--------|-------|------|------|
| 00H | Control | 0 | 0 | 0 | 0 | 1 | 0 | MUTE | 1 |
| 01H | Switch | 1 | 0 | 0 | 1 | MONO | 1 | 0 | 1 |
| 02H | Reserve | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03H | Zerocross | 0 | 0 | CAL | 0 | 0 | 1 | 1 | 1 |
| 04H | Video switch | 0 | 0 | 0 | RCA1 | RCA0 | 1 | VTV1 | VTV0 |
| 05H | Video output enable | 0 | TVFB | 0 | RCAV | TVB | TVG | TVR | TVV |
| 06H | Video volume/clamp | CLAMPB | VCLP1 | VCLP0 | CLAMP2 | CLAMP1 | 1 | 0 | 0 |
| 07H | S/F Blanking control | 0 | 0 | 0 | 0 | SBT1 | SBT0 | FB1 | FB0 |
| 08H | Reserve | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 09H | Reserve | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0AH | HD switch | HDCP1 | HDCP0 | HDAPW | 0 | 0 | 0 | 1 | 1 |
| 0BH | HD filter | HDY1 | HDY0 | FLPR1 | FLPR0 | FLPB1 | FLPB0 | FLY1 | FLY0 |
| 0CH | Sync filter | 0 | FLT | 0 | 0 | 0 | 0 | 0 | 0 |
| 0DH | Volume | 0 | VOL3 | VOL2 | VOL1 | VOL0 | 1 | 1 | 1 |

When the PDN pin goes “L”, the registers are initialized to their default values.

While the PDN pin = “H”, all registers can be accessed.

Do not write any data to the register over 0DH.

■ Register Definitions

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-----|----|----|----|----|----|------|----|
| 00H | Control | 0 | 0 | 0 | 0 | 1 | 0 | MUTE | 1 |
| | R/W | R/W | | | | | | | |
| | Default | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |

MUTE: Audio output control

0: Normal operation

1: ALL Audio outputs to GND (default)

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-----|----|----|----|------|----|----|----|
| 01H | Switch | 1 | 0 | 0 | 1 | MONO | 1 | 0 | 1 |
| | R/W | R/W | | | | | | | |
| | Default | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |

MONO: Mono select for TVOUTL/R pins

0: Stereo. (default)

1: Mono. (L+R)/2

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------------|-----|----|-----|----|----|----|----|----|
| 03H | Volume Control | 0 | 0 | CAL | 0 | 0 | 1 | 1 | 1 |
| | R/W | R/W | | | | | | | |
| | Default | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |

CAL: Offset calibration Enable

0: Offset calibration disable.

1: Offset calibration enable (default)

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-----|----|----|------|------|----|------|------|
| 04H | Video switch | 0 | 0 | 0 | RCA1 | RCA0 | 1 | VTV1 | VTV0 |
| | R/W | R/W | | | | | | | |
| | Default | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |

VTV1-0: Selector for TV video output

Refer to [Table 6](#).

RCA1-0: Selector for RCA video output

Refer to [Table 7](#).

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-----|------|----|------|-----|-----|-----|-----|
| 05H | Output Enable | 0 | TVFB | 0 | RCAV | TVB | TVG | TVR | TVV |
| | R/W | R/W | | | | | | | |
| | Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TVV: TVVOUT output control

TVR: TVRCOUT output control

TVG: TVGOUT output control

TVB: TVBOUT output control

RCAV: RCAVOUT output control

TVFB: TVFB output control

0: Hi-Z (default)

1: Active.

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|--------|-------|-------|--------|--------|----|----|----|
| 06H | Video volume | CLAMPB | VCLP1 | VCLP0 | CLAMP2 | CLAMP1 | 1 | 0 | 0 |
| | R/W | R/W | | | | | | | |
| | Default | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

CLAMPB, CLAMP2-1: Clamp control.

Refer to [Table 8](#) and [Table 9](#).

VCLP1-0: DC restore source control

00: ENCV pin (default)

01: ENCY pin

10: (Reserved)

11: ENCG pin

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-----|----|----|----|------|------|-----|-----|
| 07H | S/F Blanking | 0 | 0 | 0 | 0 | SBT1 | SBT0 | FB1 | FB0 |
| | R/W | R/W | | | | | | | |
| | Default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

FB1-0: TV Fast Blanking output control (for TVFB pin)

00: 0V (default)

01: 2V<, 2.5V(typ) at 150Ω load

10: (Reserved)

11: (Reserved)

SBT1-0: TV Slow Blanking output control (for TVSB pin. minimum load is 10kΩ.)

00: < 2V (default)

01: 4.73V <, < 7V

10: (Reserved)

11: 10V <

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-------|-------|-------|----|----|----|----|----|
| 0AH | HD switch | HDCP1 | HDCP0 | HDAPW | 0 | 0 | 0 | 1 | 1 |
| | R/W | R/W | | | | | | | |
| | default | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

HDAPW: HD filter power-up bit(HD Video output)

1: HD filter power-up.

0: HD filter power-down (default).

HDCP1-0: HD Video Switch Control

Refer to [Table 11](#).

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|------|------|-------|-------|-------|-------|------|------|
| 0BH | HD filter | HDY1 | HDY0 | FLPR1 | FLPR0 | FLPB1 | FLPB0 | FLY1 | FLY0 |
| | R/W | R/W | | | | | | | |
| | default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

HDY1-0: Y Input Control

Refer to [Table 12](#).

FLY1-0, FLPB1-0, FLPR1-0: HD Video Filter Control

Refer to [Table 13](#).

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-----|-----|----|----|----|----|----|----|
| 0CH | Sync filter | 0 | FLT | 0 | 0 | 0 | 0 | 0 | 0 |
| | R/W | R/W | | | | | | | |
| | default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

FLT: HD Sync detection filter (500kHz band-width)

1: filter ON in all case

0: filter OFF when HD path is used (default).

| Addr | Register Name | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|---------------|-----|------|------|------|------|----|----|----|
| 0DH | Main volume | 0 | VOL3 | VOL2 | VOL1 | VOL0 | 1 | 1 | 1 |
| | R/W | R/W | | | | | | | |
| | Default | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |

VOL3-0: Volume control

Those registers control both Lch and Rch of Volume.

- 1011: Volume gain = +24dB
- 1010: Volume gain = +21dB
- 1001: Volume gain = +18dB
- 1000: Volume gain = +15dB
- 0111: Volume gain = +12dB
- 0110: Volume gain = +9dB
- 0101: Volume gain = +6dB
- 0100: Volume gain = +3dB
- 0011: Volume gain = +0dB (default)
- 0010: Volume gain = -3dB
- 0001: Volume gain = -6dB
- 0000: MUTE

SYSTEM DESIGN

Figure 16 shows the system connection diagram example. An evaluation board (AKD4711) demonstrates application circuits, the optimum layout, power supply arrangements and measurement results.

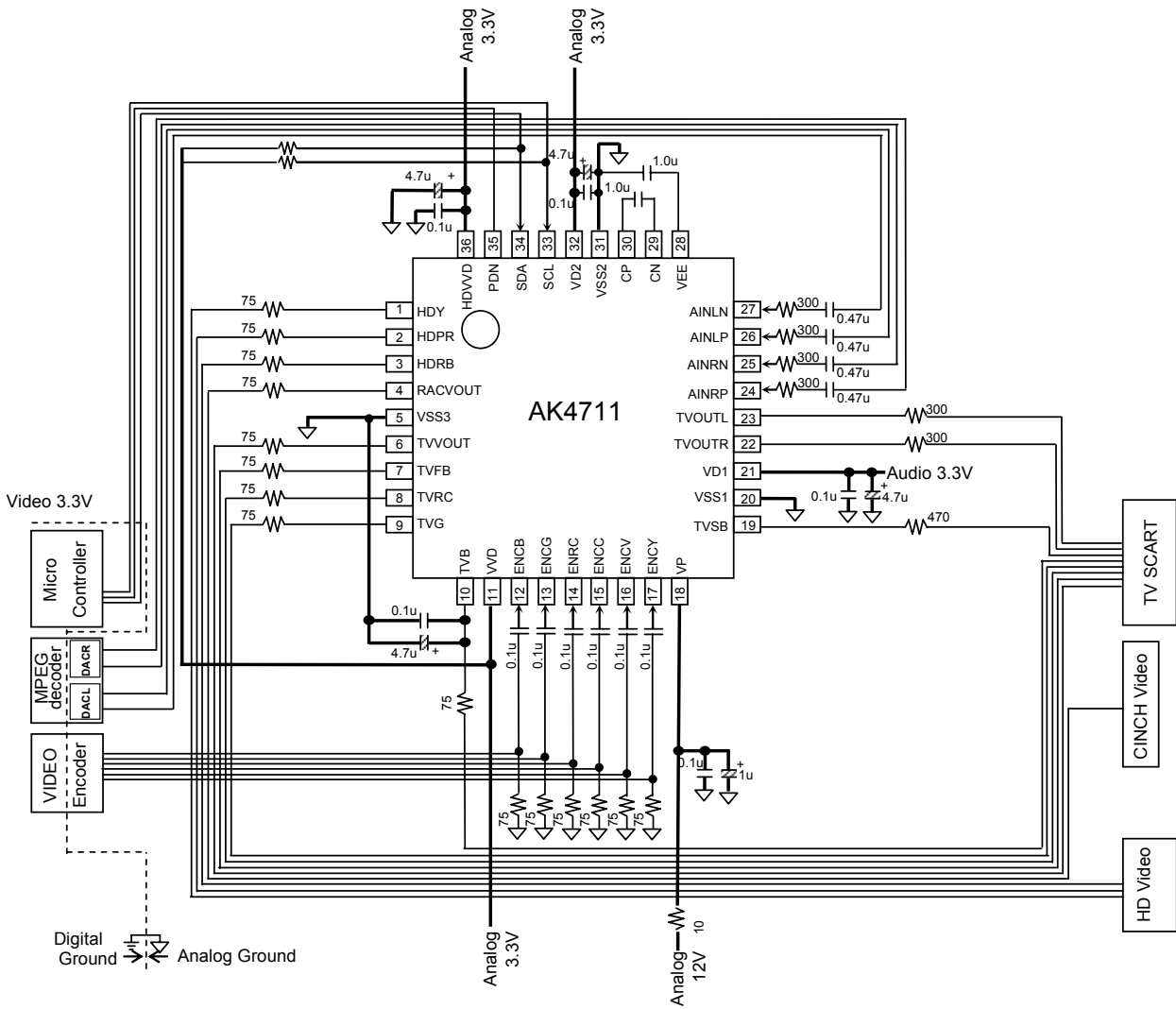


Figure 16. Typical Connection Diagram

■ Grounding and Power Supply Decoupling

VD1, VD2, VP, VVD, VSS1, VSS2 and VSS3 should be supplied from analog supply unit with low impedance and be separated from system digital supply. An electrolytic capacitor 4.7 μ F parallel with a 0.1 μ F ceramic capacitor should be attached to VD1, VD2, VVD, VSS1, VSS2 and VSS3 pin to eliminate the effects of high frequency noise. The 0.1 μ F ceramic capacitor should be placed as near to VD1 (VD2, VVD) as possible.

The VP pin must be connected to the Analogue 12V power supply via a 10ohm resistor and with a 0.1 μ F ceramic capacitor in parallel with a 1 μ F electrolytic capacitor to VSS1, as shown in [Figure 16](#).

■ Analog Audio Outputs

The analog outputs are also single-ended and centered on 0V(typ.). The output signal range is typically 2Vrms .

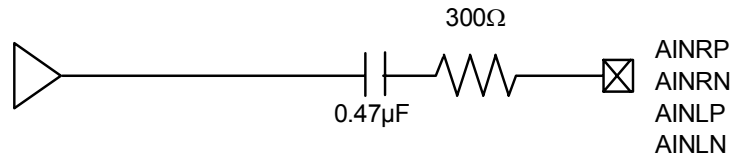
■ Slow Blanking Pin

The slow blanking pin must have a 470ohm \pm 5% series resistor.

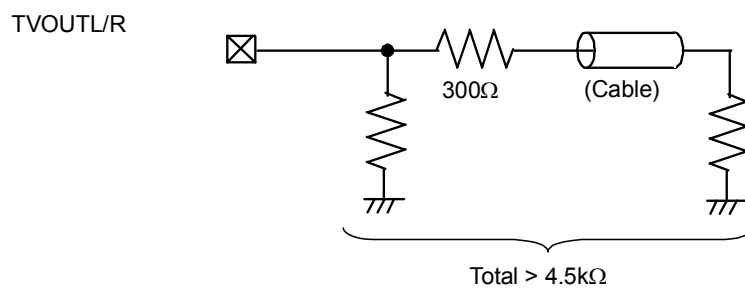
■ External Circuit Example

The analog audio input pin must have a 300ohm resistor and a 0.47uF capacitor in series.

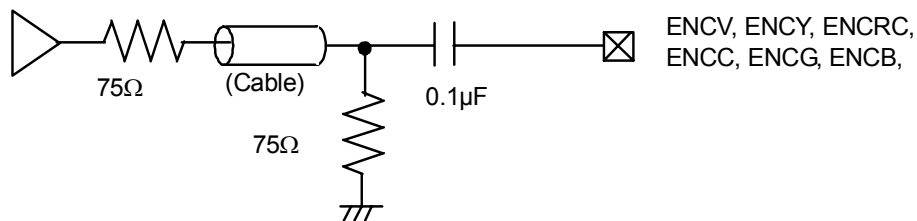
Analog Audio Input pin



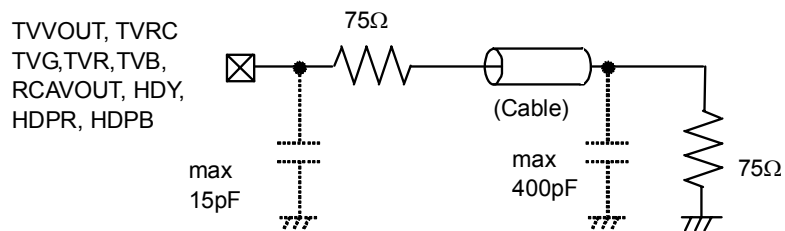
Analog Audio Output pin



Analog Video Input pin

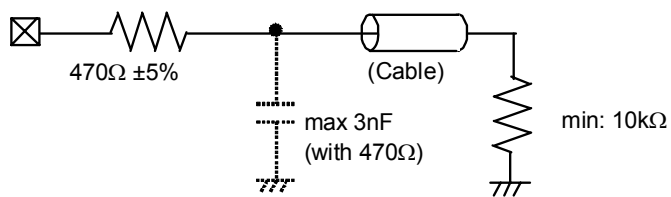


Analog Video Output pin

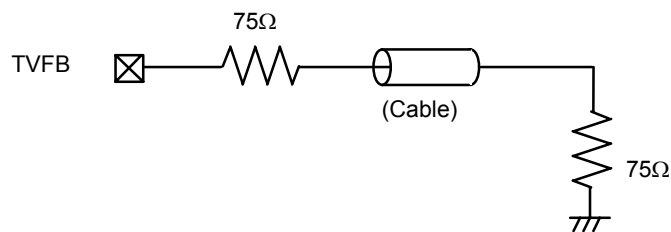


Slow Blanking pin

TVSB

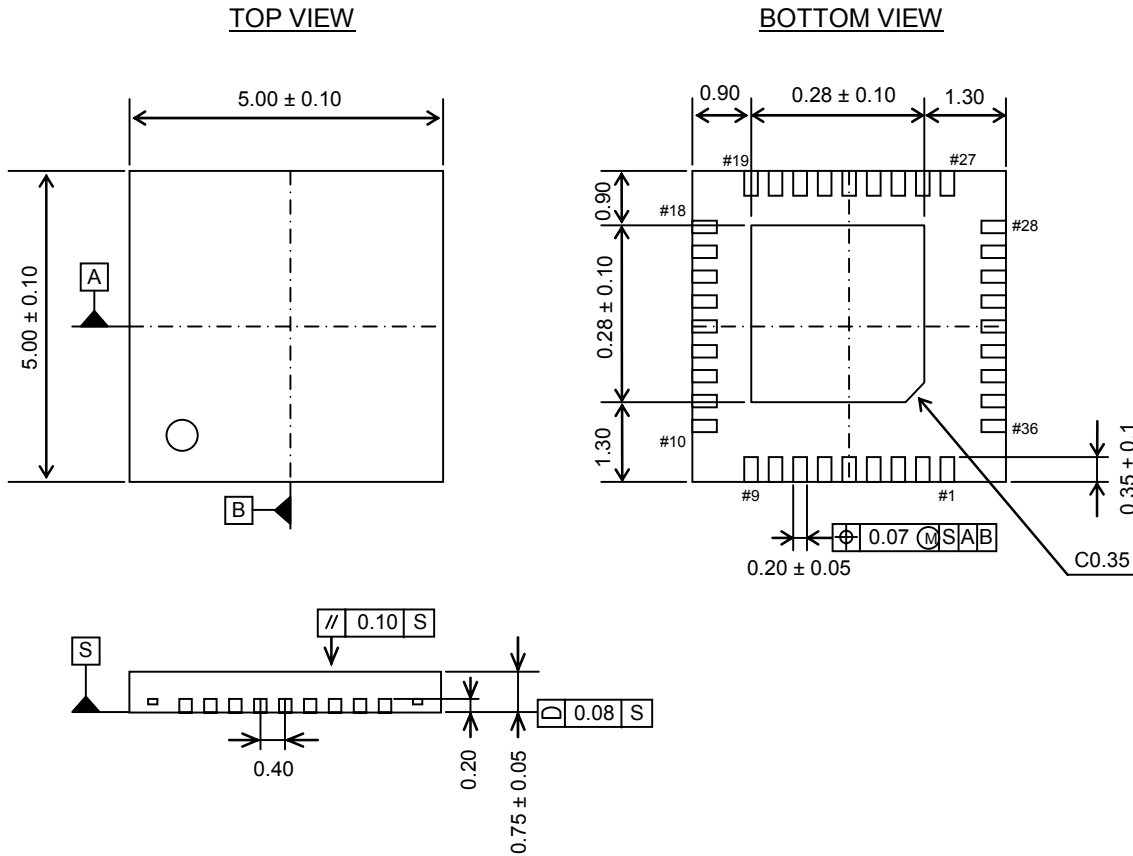


Fast Blanking Output pin



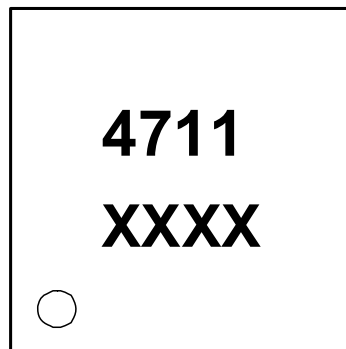
PACKAGE

36pin QFN (Unit: mm)



■ Package & Lead frame material

- Package molding compound: Epoxy
- Lead frame material: Cu
- Lead frame surface treatment: Solder (Pb free) plate

MARKING

1

XXXX : Date code (4 digit)
Pin #1 indication

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