Signetics

Linear Products

DESCRIPTION

The integration into a single package of all small-signal functions (except the tuner) required for color TV reception is achieved in the TDA4501. The only additional circuits needed to complete the receiver are a tuner, the deflection output stages, and a color decoder. The TDA3563 or 67, NTSC color decoder. and TDA3653, vertical output, are ideal complements for the TDA4501.

The IC includes a vision IF amplifier with synchronous demodulator and AFC circuit, an AGC detector with tuner output, an integral three-level sandcastle pulse generator, and fully synchronized vertical and horizontal drive outputs. A triggered vertical divider automatically adapts to a 50 or 60Hz vertical signal and eliminates the need for an external vertical frequency control.

Signal strength-dependent, time constant switches in the horizontal phase detector make external VCR switching unnecessary.

Sound signals are demodulated and amplified within the IC in a circuit which includes volume control and muting.

TDA4501 Small-Signal Subsystem IC for Color TV

Product Specification

FEATURES

- Vision IF amplifier with synchronous demodulator
- AGC detector for negative modulation
- AGC output to tuner
- AFC circuit
- Video and audio preamplifiers
- Sound IF amplifier and demodulator
- Choice of sound volume control or horizontal oscillator starting function
- Horizontal synchronization circuit with two control loops
- Triggered divider system for vertical synchronization and sawtooth generation giving automatic amplitude adjustment for 50 or 60Hz vertical signal
- Transmitter identification circuit with mute output
- Sandcastle pulse generator

APPLICATION

• Color TV

PIN CONFIGURATION

| | N Package | • |
|--|-----------|--|
| AGC TAKEOVER RAMP GEN VERT FEEDBACK FEEDBACK GND GND GND GND GND FIN DECOUP CAP CONTROLS CONTROLS CONTROLS SOUND IT SOUND IT DECOUP IT DECOUP IT | | 23 PHASE DET 27 SANDCASTLE 0177 OUT7 28 HORIZ DRIVE 29 FREQ 20 CONTROL 20 HORIZ OSC 20 CON DET 21 HORIZ OSC 22 COIN DET 23 SYNC DEMOD 20 SYNC DEMOD 20 SYNC DEMOD 20 SYNC DEMOD 30 AFC 17 VIDEO OUT 18 AFC 17 SOUND IF 13 SOUND IF |
| | TOP VIEW | CD131305 |

ORDERING INFORMATION

| DESCRIPTION | TEMPERATURE RANGE | ORDER CODE |
|------------------------------|-------------------|------------|
| 28-Pin Plastic DIP (SOT-117) | -25°C to +65°C | TDA4501N |

ABSOLUTE MAXIMUM RATINGS

| SYMBOL | PARAMETER | RATING | UNIT |
|------------------------|-------------------------------------|-------------|------|
| $V_{\rm CC} = V_{7-6}$ | Supply voltage (Pin 7) | 13.2 | v |
| PTOT | Total power dissipation | 1.7 | w |
| T _A | Operating ambient temperature range | -25 to +65 | °C |
| T _{STG} | Storage temperature range | -65 to +150 | °C |

BLOCK DIAGRAM



DC AND AC ELECTRICAL CHARACTERISTICS $V_{CC} = V_{7-6} = 10.5V$; $T_A = 25^{\circ}C$, unless otherwise specified.

| | | Li Min 1 | LIMITS | LIMITS | |
|------------------------|--|----------------------|----------------------|--------|----------------------|
| SYMBOL | PARAMETER | | Тур | Max | UNIT |
| Supplies | | | | | |
| V _{CC} | Supply voltage (Pin 7) | 9.5 | 10.5 | 13.2 | v |
| Icc | Supply current (Pin 7) | | 120 | | mA |
| V ₁₁₋₆ | Supply voltage (Pin 11) | | 10.5 | | v |
| l ₁₁ | Supply current (Pin 11) for horizontal oscillator start | | 6 | | mA |
| Vision IF an | nplifier (Pins 8 and 9) | | | | |
| V ₈₋₉ | Input sensitivity at 38.9MHz ¹ | 40 | 70 | 120 | μV |
| V ₈₋₉ | Input sensitivity at 45.75MHz ¹ | | 90 | | μV |
| R ₈₋₉ | Differential input resistance (Pin 8 to 9) | | 1.3 | | kΩ |
| C ₈₋₉ | Differential input capacitance (Pin 8 to 9) | | 5 | | pF |
| | AGC range | | 60 | | dB |
| V ₈₋₉ | Maximum input signal | 50 | 70 | | mV |
| ΔV ₁₇₋₆ | Expansion of output signal for 50dB variation of input signal with V _{B-9} at 150 μ V (0dB) | | 1 | | dB |
| Video ampli | fler | | | | |
| V ₁₇₋₆ | Output level for zero signal input (zero point of switched demodulator) | | 4.5 | | v |
| V ₁₇₋₆ | Output signal top sync level ² | | 1.4 | | v |
| V _{17-6(P-P)} | Amplitude of video output signal (peak-to-peak value) | | 2.8 | | v |
| I _{17(INT)} | Internal bias current of output transistor (NPN emitter-follower) | 1.4 | 2.0 | | mA |
| BW | Bandwidth of demodulated output signal | | 6 | | MHz |
| dG ₁₇ | Differential gain (Figure 3) | | 6 | | % |
| dρ | Differential phase (Figure 3) | | 4 | | % |
| | Video non-linearity complete video signal amplitude | | | 10 | % |
| | Intermodulation (Figure 4) at gain control = 45dB f = 1.1MHz; blue; f = 1.1MHz; yellow; f = 3.3MHz; blue; f = 3.3MHz; yellow | 55 50 60 55 | 60 54 66 59 | | dB dB dB dB |
| S/N S/N | Signal-to-noise ratio ³ $Z_S = 75\Omega$ $V_I = 10mV$ End of gain control range | 50 50 | 54 56 | | dB dB |
| | Residual carrier signal | | 7 | 30 | mV |
| | Residual 2nd harmonic of carrier signal | | 3 | 30 | mV |

SYMBOL

Tuner AGC⁴ V1-6

V1 - 6(RMS)

V1 - 6(RMS)

V1-6

Small-Signal Subsystem IC for Color TV

DC AND AC ELECTRICAL CHARACTERISTICS (Continued) $V_{CC} = V_{7-6} = 10.5V$; $T_A = 25^{\circ}C$, unless otherwise specified.

PARAMETER

Take-over voltage (Pin 1) for positive-going tuner AGC

| (NPN tuner) | | | |
|--|-----|----------|----|
| Starting point takeover; V = 5V | | 0.4 | 2 |
| Starting point takeover; V = 1.2V | 50 | 70 | |
| Take-over voltage (Pin 1) for negative-going tuner AGC (PNP tuner) | | 8 | |
| Starting point takeover; V = 9.5V | | 0.3 | 2 |
| Starting point takeover; V = 5.6V | 50 | 70 | |
| Maximum output swing | 2 | 3 | |
| Output saturation voltage I = 2mA | | | 30 |
| Leakage current | | | 1 |
| Input signal variation complete tuner control | 0.5 | 2 | 4 |
| Pin 18) ⁵ | | | |
| AFC output voltage swing | 9 | | 1 |
| Available output current | | 1 | |
| Control steepness 100% picture carrier 10% picture carrier | 20 | 40 15 | 8 |
| ~ · · · · · · · · · · · · · · · · · · · | 1 | | 1 |

| | (PNP tuner) | | | | |
|---------------------|--|-----|----------|-----|------------------|
| V1 - 6(RMS) | Starting point takeover; V = 9.5V | | 0.3 | 2 | mV |
| V1 - 6(RMS) | Starting point takeover; V = 5.6V | 50 | 70 | | mV |
| I5 MAX | Maximum output swing | 2 | 3 | | mA |
| V5-6(SAT) | Output saturation voltage I = 2mA | | | 300 | mV |
| l5 | Leakage current | | | 1 | μA |
| ΔVI | Input signal variation complete tuner control | 0.5 | 2 | 4 | dB |
| AFC circuit | (Pin 18) ⁵ | | | | |
| V18 - 6(P-P) | AFC output voltage swing | 9 | | 10 | V |
| ± ₁₈ | Available output current | | 1 | | mA |
| | Control steepness 100% picture carrier 10% picture carrier | 20 | 40 15 | 80 | mV/kHz mV/kHz |
| V _{18 - 6} | Output voltage at nominal tuning of the reference-tuned circuit | | 5.25 | | v |
| V ₁₈₋₆ | Output voltage without input signal | 2.7 | 5.25 | 8.5 | v |
| Sound circui | t | | | | |

| V _{15LIM} | Input limiting voltage $V_O = V_O$ maximum -3dB; $Q_L = 16$ $f_{AF} = 1$ kHz; $f_C = 5.5$ MHz | | 400 | μ٧ |
|--------------------|---|-----|----------|----------|
| R ₁₅₋₆ | Input resistance V _{I(RMS)} = 1mV | | 2.6 | kΩ |
| C15-6 | Input capacitance V _{I(RMS)} = 1mV | | 6 | pF |
| AMR AMR | AM rejection (Figures 7 and 8) V _I = 10mV V _I = 50mV | | 35 43 | dB dB |
| V12-6(RMS) | AF output signal $\Delta f = 7.5 \text{kHz}$; minimum distortion | 220 | 320 | mV |
| Z ₁₂₋₆ | AF output impedance | | 150 | Ω |
| THD | Total harmonic distortion $\Delta f = 27.5 \text{kHz}$ | | 1 | % |
| RR RR | Ripple rejection f _K = 100Hz, volume control 20dB when muted | | 22 26 | dB dB |
| V ₁₂₋₆ | Output voltage Mute condition | | 2.6 | v |
| S/N | Signal-to-noise ratio weighted noise (CCIR 468) | | 47 | dB |

Product Specification

TDA4501

UNIT

v

m٧

m٧

٧

LIMITS

Тур

3.5

Max

Min

DC AND AC ELECTRICAL CHARACTERISTICS (Continued) $V_{CC} = V_{7-6} = 10.5V$; $T_A = 25^{\circ}C$, unless otherwise specified.

| SVMBOI | DADAMETED | | LIMITS | | |
|---------------------------------|---|-----|-------------|----------------------|----------------------------|
| STMBOL | | Min | Тур | Max | UNIT |
| Volume con | itrol | | | | |
| V ₁₁₋₆ | Voltage (Pin 11 disconnected) | | 4.8 | | v |
| l ₁₁ | Current (Pin 11 short-circuited) | | 1 | | mA |
| R ₁₁₋₆ | External control resistor | | 10 | | kΩ |
| | Suppression output signal during Mute condition | | 66 | | dB |
| Horizontal s | synchronization | | | | |
| | Slicing level sync separator | | 30 | | % |
| | Holding range PLL | 800 | 1100 | 1500 | Hz |
| | Catching range PLL | 600 | 1000 | | Hz |
| | Control sensitivity video-to-oscillator; at weak signal at strong signal during scan during vertical retrace and during catching | | 2 3 6 | | kHz/μs kHz/μs kHz/μs |
| Second con | trol loop (positive edge) | | | | |
| $\Delta t_D / \Delta t_O$ | Control sensitivity | | 300 | | μs |
| t _D | Control range | | 25 | | μs |
| | Phase adjustment via second control loop; control sensitivity maximum allowed phase shift | | 25 ± 2 | | μΑ/μs μs |
| Horizontal d | oscillator (Pin 23) | | | | |
| f _{FR} | Free-running frequency R = $35k\Omega$; C = 2.7nF | | 15,625 | | Hz |
| | Spread with fixed external components | | | 4 | % |
| Δf_{FR} | Frequency variation due to change of supply voltage from 8 to 12V | | 0 | 0.5 | % |
| Δf _{FR} | Frequency variation with temperature | | | 1 × 10 ⁻⁴ | K ⁻¹ |
| Δf _{FR} | Maximum frequency shift | | | 10 | % |
| Δf_{FR} | Maximum frequency deviation $(V_{7-6} = 8V)$ | | | 10 | % |
| Horizontal d | putput (Pin 26) | • | | | |
| V ₂₆₋₆ | Output voltage HIGH | | | 13.2 | V |
| V ₂₆₋₆ | Output voltage at which protection commences | | | 15.8 | V |
| V ₂₆₋₆ | Output voltage LOW at I ₂₆ = 10mA | | 0.3 | 0.5 | V |
| δ ₀ | Duty cycle of horizontal output signal | | 45 | | % |
| t _R , t _F | Rise and fall times of output pulse | | 150 | | ns |

TDA4501

DC AND AC ELECTRICAL CHARACTERISTICS (Continued) $V_{CC} = V_{7-6} = 10.5V$; $T_A = 25^{\circ}C$, unless otherwise specified.

| | PARAMETER | | LIMITS | | |
|--|--|------|-----------------|----------|----------------------|
| SYMBOL | | Min | Тур | Max | UNIT |
| Flyback inpu | it and sandcastle output | | · | | |
| I ₂₇ | Input current required during flyback pulse | 0.1 | | 2 | mA |
| V ₂₇₋₆ | Output voltage during burst key pulse | 7.5 | | | v |
| V ₂₇₋₆ | Output voltage during horizontal blanking | 3.5 | 4.0 | 4.5 | v |
| V ₂₇₋₆ | Output voltage during vertical blanking | 1.8 | 2.2 | 2.6 | V |
| | Width of burst key pulse | 3.1 | 3.5 | 3.9 | μs |
| | Width of horizontal blanking pulse | flyb | ack pulse v | vidth | |
| | Width of vertical blanking pulse 50Hz working 60Hz working Delay between start of sync pulse at video output and rising | | 21 17 5.2 | | lines lines µs |
| Coincidence | detector mute output (Pin 22) | | l | | |
| Vac | | T | 95 | <u> </u> | v |
| V 22 - 0 | Voltage for no-sync condition no signal | | 1.0 | 15 | v |
| V22-0 | Switching level to switch phase detector from slow to fast | 4.9 | 5.3 | 5.8 | v |
| • 22 - 0 | Fast-to-slow hysteresis | | 1 | | v |
| V ₂₂₋₆ | Switching level to activate mute function (transmitter identification) | 2.25 | 2.5 | 2.75 | v |
| I22(P-P) | Output current for in-sync condition (peak-to-peak value) | 0.7 | 1.0 | | mA |
| Vertical ram | p generator (Pin 2) | | | | |
| l ₂ | Input current during scan | | 12 | | mA |
| l ₂ | Discharge current during retrace | | 0.5 | | mA |
| V ₂₋₆ | Minimum voltage | | 1.5 | | v |
| Vertical outp | but (Pin 3) | | | | |
| 13 | Output current | | | 10 | mA |
| R ₃₋₆ | Output impedance | | 400 | | Ω |
| Feedback in | put (Pin 4) | | · · · · · | | |
| V ₄₋₆ V ₄₋₆ (P-P) | Input voltage DC component AC component (peak-to-peak value) | | 3 1.2 | | v |
| 14 | Input current | | | 12 | μA |
| | Internal precorrection to sawtooth | | 6 | | % |
| | Deviation amplitude 50/60Hz | | | 5 | % |

NOTES:

1. Typical value taken at starting level of AGC.

2. Signal with negative-going sync, maximum white level 10% of the maximum sync amplitude (see Figure 2). 3. Signal with negative-going sync, maximum white level 10% of the maximum sync amplitude (see Figure 2).

3. Signal-to-noise ratio equals 20log $\frac{1}{V_{N(RMS)}}$ at B = 5MHz

4. Starting point tuner takeover NPN current 1.8mA;

5. VI(RMS) = 10mV; see Figure 1; Q-factor = 36.

FUNCTIONAL DESCRIPTION IF Amplifier, Demodulator, and AFC

The IF amplifier has a symmetrical input (Pins 8 and 9), the input impedance of which is suitable for SAW filtering to be used. The synchronous demodulator and the AFC circuit (Pins 20 and 21). An internal RC network provides the necessary phase-shifting for AFC operation. The AFC circuit provides a control voltage output with a swing greater than 9V from Pin 18.

AGC Circuit

Gating of the AGC detector is performed to reduce sensitivity of the IF amplifier to external electrical noise. The AGC time constant is provided by an RC circuit connected to Pin 19. Tuner AGC voltage is supplied from Pin 5 and is suitable for tuners with PNP or NPN RF stages. The sense of the AGC (to increase in a positive or negative direction) and the point of tuner take-over are preset by the voltage level at Pin 1.

Video Amplifier

The signal through the video amplifier comprises video and sound information; therefore, no gating of the video amplifier is performed during flyback periods.

Sound Circuit and Horizontal Oscillator Starting Function

The input to the sound IF amplifier is obtained by a bandpass filter coupling from the video output (Pin 17). The sound is demodulated and passed via a dual-function volume control stage to the audio output amplifier. The volume control function is obtained by connecting a variable resistor ($10k\Omega$) between Pin 11 and ground, or by supplying Pin 11 with a variable voltage. Sound output is suppressed by an internal mute signal when no input signal is present.

The horizontal oscillator starting function is obtained by supplying Pin 11 with a current of 6mA during the switching-on period. The IC then uses this current to generate drive pulses for the horizontal deflection. For this application, the main supply voltage for the IC can be obtained from the horizontal deflection circuit.

Vertical Divider System

A triggered divider system is used to synchronize the vertical drive waveforms, adjusting automatically to 50 or 60Hz working. A large window (search window) is opened between counts of 488 and 722; when a separated vertical sync pulse occurs before count 576, the system works in the 60Hz mode; otherwise, 50Hz working is chosen.

A narrow window is opened when 15 approved sync pulses have been detected. Divider ratio between 522 and 528 switches to 60Hz mode; between 622 and 628 switches to 50Hz mode.

The vertical blanking pulse is also generated via the divider system by adding the anti-topflutter pulse and the blanking pulse.

Line Phase Detector

The circuit has three operating conditions:

- a. Strong input signal and synchronized.
- b. Weak signal and synchronized.
- c. Non-synchronized (weak and strong) signal.

The input signal condition is obtained from the AGC circuit.

DC Volume Control/Horizontal Oscillator Start

The operation depends on the application. When during switch-on no current is supplied, Pin 11 will act as volume control. When a current of 6mA is applied, the volume control is set to maximum and the circuit will generate drive pulses for the horizontal deflection.





Product Specification

Small-Signal Subsystem IC for Color TV





