NTE ELECTRONICS, INC.
44 FARRAND STREET
BLOOMFIELD, NJ 07003
(973) 748–5089

NTE7018
Integrated Circuit
Small–Signal Subsystem for Color TV

Description:

The NTE7018 is a TV subsystem circuit intended to be used for base–band demodulation applications. This circuit consists of all small–signal functions (except the tuner) required for a quality color television receiver. The only additional circuits needed to complete a receiver are a tuner, the deflection output stages, and a color decoder. The NTE1567 NTSC color decoder, and the NTE1754 vertical output, are ideal complements for the NTE7018.

Features:

- Vision IF amplifier with synchronous demodulation
- Tuner AGC (negative–going control voltage with increasing signal)
- AGC detector for negative modulation
- AFC circuit
- Video preamplifier
- Sound IF amplifier, demodulator, and preamplifier
- DC volume control
- Horizontal synchronization circuit with two control loops
- Extra time constant switches in the horizontal phase detector
- Vertical synchronization (divider system) and sawtooth generator with automatic amplitude adjustment for 50 or 60H_Z
- Three level sandcastle pulse

Applications:

- Color television receiver
- CATV converters
- Base–band processing

Absolute Maximum Ratings:

Supply Voltage (Pin7), V_{CC} 13.2V
Total Power Dissipation, P_{TOT} 2.3W
Operating Ambient Temperature Range, T_A . . . . –25° to +65°C
Storage Temperature Range, T_{stg} . . . . –65° to +150°C

DC and AC Electrical Characteristics: (V_{CC} = $V_{7–6}$ = 12V, T_A = +25°C, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit
Supplies					
Supply Voltage (Pin7)	$V_{7–6}$	9.5	12	13.2	V
Supply Current (Pin7)	I_7	–	135	–	mA
Supply Voltage (Pin11, Note 1)	$V_{11–6}$	–	8.6	–	V
Supply Current (Pin11) for Horizontal Oscillator Start	I_{11}	–	6	8	mA
Vision IF Amplifier (Pin8 and Pin9)					
Input Sensitivity (38.90MH$_Z$ on set AGC) (45.75MH$_Z$ on set AGC)	$V_{8–9}$	60 –	100 120	140 –	µV
Differential Input Resistance (Pin8 and Pin9)	$R_{8–9}$	800	1300	1800	Ω
Differential Input Capacitance (Pin8 and Pin9)	$C_{8–9}$	–	5	–	pf
Gain Control Range	$G_{8–9}$	56	60	–	dB
Maximum Input Signal	$V_{8–9}$	50	100	–	mV
Expansion of Output Signal for 50dB Variation of Input Signal with $V_{8–9}$ at 150µV (0dB)	$\Delta V_{17–6}$	–	1	–	dB
Video Amplifier (measured at top sync input signal voltage (RMS value) of 10mV)					
Output Level for Zero Signal Input (Zero Point of Switched Demodulator)	$V_{17–6}$	–	5.8	–	V
Output Signal Top Sync Level (Note 2)	$V_{17–6}$	2.7	2.9	3.1	V
Amplitude of Video Output Signal (Peak–to–Peak Value)	$V_{17–6(P–P)}$	–	2.6	–	V
Internal Bias Current of Output Transistor (NPN Emitter–Follower)	$I_{17(INT)}$	1.4	2.0	–	mA
Bandwidth of Demodulated Output Signal	BW	5	–	–	MH$_Z$
Differential Gain (Note 3)	G_{17}	–	4	10	%
Differential Phase (Note 3)	φ	–	3	10	deg.
Video Non–Linearity Complete Video Signal Amplitude (Note 4)		–	–	10	%
Intermodulation at Gain Control = 45dB f = 1.1MH$_Z$; blue f = 1.1MH$_Z$; yellow f = 3.3MH$_Z$; blue f = 3.3MH$_Z$; yellow		 55 50 60 55	 60 54 66 59	 – – – –	 dB
Signal–to–Noise Ratio (Note 5) Z_S = 75Ω, V_I = 10mV end of Gain Control Range	S/N	 50 50	 54 56	 – –	dB
Residual Carrier Signal		–	7	30	mV
Residual 2nd Harmonic of carrier Signal		–	24	30	mV
Tuner AGC (Note 13)					
Minimum Starting Point Take–Over	$V_{1–6(RMS)}$	–	–	0.5	mV
Maximum Starting Point take–Over	$V_{1–6(RMS)}$	50	100	–	mV
Maximum Output Swing	I_{5MAX}	6	8	–	mA
Output Saturation Voltage (I = 2mA)	$V_{5–6(SAT)}$	–	–	300	mV
Leakage Current	I_5	–	–	1	µA
Input Signal Variation Complete Tuner Control (ΔI_5 = 2mA)	ΔV_I	0.5	2.0	5.0	dB
AFC Circuit (Pin18, Note 6)					
AFC Output Voltage Swing	$V_{18–6(P–P)}$	9.5	10.35	11.0	V
Available Output Current	$\pm I_{18}$	–	2.6	–	mA

DC and AC Electrical Characteristics (Cont'd): ($V_{CC} = V_{7–6}$ = 12V, T_A = +25°C, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit
AFC Circuit (Cont'd) (Pin18, Note 6)					
Control Steepness		–	70	–	mV/ kHZ
Output Voltage at Nominal Tuning of the Reference–Tuned Circuit	$V_{18–6}$	–	6	–	V
Offset Current AFC Output (Pin20 and Pin21 Short–Circuited)	I_{18}	–	TBD	–	µA
Sound Circuit					
Input Limiting Voltage ($V_O = V_{O\ MAX}$ –3dB, Q_L = 16, f_{AF} = 1kHZ, f_C = 5.5MHZ)	V_{15LIM}	–	400	800	µV
Input Resistance ($V_{I(RMS)}$ = 1mV)	$R_{15–6}$	–	2.6	–	kΩ
Input Capacitance ($V_{I(RMS)}$ = 1mV)	$C_{15–6}$	–	6	–	pf
AM Rejection (V_I = 10mV) (V_I = 50mV)	AMR	– –	46 50	– –	dB
AF Output Signal (Δf = 7.5kHZ, Minimum Distortion) (Δf = 50kHZ, Pin11 used as Starting Pin)	$V_{12–6(RMS)}$	400 300	600 700	800 1200	mV
AF Output Impedance	$Z_{12–6}$	–	25	100	Ω
Total Harmonic Distortion Volume Control 20dB, (Δf = 27.5kHZ, Weighted Acc. CCIR 468)	THD	–	1	3	%
Ripple Rejection (f_k = 100HZ, Volume Control 20dB) (When Muted)	RR	– –	35 30	– –	dB
Output Voltage in Mute Condition	$V_{12–6}$	–	3	–	V
Signal–to–Noise Ratio (Δf = 27.5kHZ Weighted Noise, CCIR 468)	S/N	–	45	–	dB
Volume Control					
Voltage (Pin11 Disconnected)	$V_{11–6}$	–	5	–	V
Circuit (Pin11 Short Circuited)	I_{11}	–	0.9	–	mA
External Control Resistor	$R_{11–6}$	–	5	–	kΩ
Suppression Output Signal During Mute Condition	OSS	–	66	–	dB
Sync Separator and First Control Loop					
Required Sync Pulse Amplitude ($R_{17–25}$ = 2kΩ, Note 7)	$V_{25–6(P–P)}$	200	800	–	mV
Input Current ($V_{25–6}$ > 5V) ($V_{25–6}$ = 0V)	I_{25}	– –	10 TBD	– –	µA mA
Holding Range PLL	±Δf	–	1100	1500	HZ
Catching Range PLL	±Δf	60	1000	–	HZ
Control Sensitivity (Note 8) (Video to Oscillator, at Weak Signal) (at Strong Signal During Scan) (During Vertical Retrace and Catching)		 – – –	 2.5 3.75 7.5	 – – –	kHZ/µs
Second Control Loop (Positive Edge)					
Control Sensitivity ($R_{28–6}$ = 47kΩ Trim Pot)	$\Delta t_D/\Delta t_O$	–	50	–	
Control Range	t_D	–	25	–	µs
Phase Adjustment (Via Second Control Loop)					
Control Sensitivity		–	25	–	µA/µs
Maximum Allowed Phase Shift	a	–	±2	–	µs

DC and AC Electrical Characteristics (Cont'd): ($V_{CC} = V_{7–6} = 12V$, $T_A = +25°C$, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit
Horizontal Oscillator (Pin23)					
Free–Running Frequency (R = 34kΩ, C = 2.7nf)	f_{FR}	–	15,625	–	H_Z
Spread with Fixed External Components	Δf	–	0.4	4.0	%
Frequency Variation due to Change of Supply Voltage from 9.5V to 13.2V	Δf_{FR}	–	0	0.5	%
Frequency Variation with Temperature	TC	–	–	1×10^{-4}	$°C^{-1}$
Maximum Frequency Shift	Δf_{FR}	–	–	10	%
Maximum Frequency Deviation at Start H–Out	Δf_{FR}	–	8	10	%
Horizontal Output (Pin26)					
Output Voltage (High Level) (at which Protection Commences) (Low, I_{26} = 10mA)	$V_{26–6}$	– – –	– – 0.15	13.2 15.8 0.5	V
Duty Cycle of Horizontal Output Signal (t_p = 10μs)	d	–	0.45	–	
Rise Time of Output Pulse	t_R	–	260	–	ns
Fall Time of Output Pulse	t_F	–	100	–	ns
Flyback Input and Sandcastle Output (Note 9)					
Input Current Required During Flyback Pulse	I_{27}	0.1	–	2.0	mA
Output Voltage (During Burst Key Pulse) (During Horizontal Blanking) (During Vertical Blanking)	$V_{27–6}$	8.0 4.0 2.1	9.0 4.35 2.5	– 5.0 2.9	V
Width of Burst Key Pulse ($60H_Z$) ($50H_Z$)	t_W	3.1 3.6	3.5 4.0	3.9 4.4	μs
Width of Horizontal Blanking Pulse		Flyback Pulse Width			
Width of Vertical Blanking Pulse ($50H_Z$ Divider in Search Window) ($60H_Z$ Divider in Search Window) ($50H_Z$ Divider in Narrow Window) ($60H_Z$ Divider in Narrow Window)		 – – – –	 21 17 25 21	 – – – –	lines
Delay Between Start of Sync Pulse at Video Output and Rising Edge of Burst Key Pulse		–	5.2	–	μs
Coincidence Detector Mute Output (Note 10)					
Voltage for In–Sync Condition	$V_{22–6}$	–	10.3	–	V
Voltage for No–Sync Condition, No Signal	$V_{22–6}$	–	1.5	–	V
Switching Level to Switch Off the AFC	$V_{22–6}$	–	6.4	–	V
Hysteresis AFC Switch	$V_{22–6}$	–	0.4	–	V
Switching Level to Activate Mute Function (Transmitter Identification)	$V_{22–6}$	–	2.4	–	V
Hysteresis Mute Function	$V_{22–6}$	–	0.5	–	V
Charge Current in Sync Condition 4.7μs	$I_{22(P–P)}$	0.7	1.0	–	mA
Discharge Current in Sync Condition 1.3μs	$I_{22(P–P)}$	–	0.5	–	mA
Vertical Ramp Generator (Note 11)					
Input Current During Scan	I_2	–	0.5	2.0	μA
Discharge Current During Retrace	I_2	–	0.4	–	mA
Sawtooth Amplitude	$V_{2–6(p–P)}$	–	0.8	1.1	V

DC and AC Electrical Characteristics (Cont'd): ($V_{CC} = V_{7–6} = 12V$, $T_A = +25°C$, unless otherwise specified)

Parameter	Symbol	Min	Typ	Max	Unit
Vertical Output (Pin3)					
Output Current	I_3	–	–	7	mA
Maximum Output Voltage	$V_{3–6}$	–	5.7	–	V
Feedback Input (Pin4)					
Input Voltage (DC Component) (AC Component (peak–to–peak value))	$V_{4–6}$ $V_{4–6(P–P)}$	– –	3.3 1.2	– –	V
Input Current	I_4	–	–	12	µA
Internal Precorrection to Sawtooth	Δt_p	–	5	–	%
Deviation Amplitude 50/60H_Z		–	0	2	%
Vertical Guard (Note 12)					
Active at a Deviation with Respect to the DC Feedback Level, ($V_{27–6}$ = 2.5V), (at Switching Level Low) (at Switching Level High)	$\Delta V_{4–6}$	 – –	 1.3 1.9	 – –	V

Note 1. Pin11 has a double function. When during switch–on a current of 6mA is supplied to this pin, this current is used to start the horizontal oscillator. The main supply can then be obtained from the horizontal deflection stage. When no current is supplied to this pin it can be used as volume control. The indicated maximum value is the current at which all IC's will start. Higher currents are allowed: the excess current is bypassed to GND.

Note 2. Signal with negative–going sync top white 10% of the top sync amplitude.

Note 3. The differential gain is expressed as a percentage of the difference in peak amplitudes between the largest and smallest value relative to the subcarrier amplitude at blanking level. The differential phase is defined as the difference in degrees between the largest and smallest phase angle.

Note 4. This figure is valid for the complete video signal amplitude (peak white to black).

Note 5. The S/N = $20 \log \frac{V_{OUT\ BLACK–TO–WHITE}}{V_{N(RMS)} \text{ at } B = 5MH_Z}$

Note 6. The AFC control voltage is obtained by multiplying the IF–output signal (which is also used to drive the synchronous demodulator) with a reference carrier. This reference carrier is obtained from the demodulator tuned circuit via a 90° phase shift network. The IF–output signal has an asymmetrical frequency spectrum with respect to the carrier frequency. To avoid problems due to this asymmetrical signal, the AFC circuit is gated by means of an internally generated gating pulse. As a result the detector is operative only during black level at a constant carrier amplitude which contains no additional side bands. As a result the AFC output voltage contains no video information.
At very weak input signals, the driver signal for the AFC circuit will contain a lot of noise. This noise signal has again an asymmetrical frequency spectrum and this will cause an offset of the AFC output voltage. To avoid problems due to this effect, the AFC is switched off when the AGC is controlled to maximum gain.
The measured figures are obtained at an input sign RMS voltage of 10mV and the AFC output loaded with 2 times 220kΩ between $+V_S$ and GND. The unloaded Q–factor of the reference tuned circuit is 70. The AFC is switched off when no signal is detected by the coincidence detector or when the voltage at Pin22 is between 1.2V and 6.4V. This can be realized by a resistor of 68kΩ connected between Pin22 and GND.

Note 7. The slicing level can be varied by changing the value of $R_{17–25}$. A higher resistor value results in a larger value of the minimum sync pulse amplitude. The slicing level is independent of the video information.

Note 8. Frequency control is obtained by supplying a correction current to the oscillator RC–network via a resistor, connected between the phase 1 detector output and the oscillator network. The oscillator can be adjusted to the right frequency in one of the two following ways:
a) Interrupt $R_{23–24}$.
b) Short circuit the sync separator bias network (Pin25) to $+V_{CC}$.
To avoid the need of a VCR switch, the time constant of phase detector at strong input signal is sufficient short to get a stable picture during VCR playback. During the vertical retrace period, the time constant is even shorter so that the head errors of the VCR are compensated at the beginning of the scan. Only at weak signal conditions (information derived from the AGC circuit) is the time constant increased to obtain a good noise immunity.

Note 9. The flyback input and sandcastle output have been combined on one pin. The flyback pulse is clamped to a level of 4.5V. The minimum current to drive the second control loop is 0.1mA.

Note 10. The functions in–sync/out–of–sync and transmitter identification have been combined on this pin. The capacitor is charged during the sync pulse and discharged during the time difference between gating and sync pulse.

Note 11. The vertical scan is synchronized by means of a divider system. Therefore no adjustment is required for the ramp generator. The divider detects whether the incoming signal has a vertical frequency of 50 or $60H_Z$ and corrects the vertical amplitude.

Note 12. To avoid screenburn due to a collapse of the vertical deflection, a continuous blanking level is inserted into the sandcastle pulse when the feedback voltage of the vertical deflection is not within the specified limits.

Note 13. Starting point tuner takeover at 1 = 0.2mA. Takeover to be adjusted with a potentiometer of 47kΩ.

Pin Connection Diagram