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## **NTE7116** **Integrated Circuit** **Phase Lock Loop (PLL) Stereo Decoder** **(BTSC System)**

### **Description:**

The NTE7116 is a phase lock loop (PLL) stereo decoder in a 20-Lead DIP type package designed primarily for low cost stereo decoding in a low-to-medium-line TV. The MUX input (Pin1) is a low impedance current input, the gain of the input amplifier is therefore determined by the external resistor R1. All characteristics are measured with  $R1 = 47k\Omega$ . The de-emphasis of (L, R) and (L - R) can be chosen by means of external capacitors and resistors. The supply voltage range of the device is from 7V to 16V.

### **Features:**

- Wide Supply Voltage Range
- Automatic Mono/Stereo Switching (Pilot Presence Detector)
- LED Driver for Stereo Indicator
- Smooth Mono/Stereo Control
- Matrix and Two Amplifiers for Left and Right Output Signals
- A Source Selector to Switch between the MUX Signal and an External Signal
- Mute Circuit for 60dB Muting of the Output Level
- External De-Emphasis Control of (L, R) and (L - R)
- 6dB Fixed Attenuation of (L - R) with respect to (L + R) Prior to Matrix
- All Pins are Protected Against Electrostatic Discharge (ESD)

### **Absolute Maximum Ratings:**

Supply Voltage Range (Pin5), $V_P$ .....	18V
LED Driver Current (Peak Value), $I_3$ .....	75mA
Total Power Dissipation ( $T_A = +25^\circ\text{C}$ ), $P_{tot}$ .....	1.9W
Electrostatic Handling, $V_{es}$ .....	-2 to +2kV
Operating Ambient Temperature Range, $T_A$ .....	0° to +70°C
Storage Temperature Range, $T_{stg}$ .....	-65° to +150°C

**DC Characteristics:** ( $V_S = 8.5V$ ,  $T_A = +25^\circ C$ , all voltages are with respect to GND (Pin20), all currents are positive into the device unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	$V_S$		7.0	8.5	16.0	V
Total Current Consumption	$I_{tot}$	Without LED Driver	–	19	25	mA
Power Dissipation	$P_{tot}$		–	160	–	mW
Voltage Pin1	$V_1$		–	2.1	–	V
Pins 8, 9, 10, 11, 12, & 13	$V_{8-13}$		–	4.2	–	V
DC Output Current (Pin14 & Pin15)	$-I_{14}, I_{15}$		1.1	1.4	1.8	mA
LED Driver Current (Pin3)	$I_3$		–	–	20	mA
Switch “VCO–OFF” Voltage	$V_{19}$	$I_{19} = 50\mu A$	–	2	–	V
Switch “VCO–OFF” Current	$I_{19}$		50	–	–	$\mu A$

**AC Characteristics:** ( $V_S = 8.5V$ ,  $T_A = +25^\circ C$ , AC Conditions: (1) Input signal ( $V_i$ ) of  $815mV_{P-P}$  for  $L = 1$ ,  $R = 1$  (mono),  $f_m = 1kHz$  (80% modulation); (2) MUX input signal ( $V_i$ ) of  $1.2V_{P-P}$  for  $L = 1$ ,  $R = 0$  and no dbx,  $f_m = 1kHz$  (stereo) and  $V_{pilot} = 200V_{P-P}$ ; (3) S1 open, unless specified (without L – R filter), VCO measured with an external IF roll-off network ( $-2dB$  at  $31.5kHz = 2f_H$ ) at the input. All the above conditions apply unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Overall Performance <math>V_i</math> to <math>V_o</math></b>						
Input Current (rms)	$I_{(rms)}$		–	–	12	$\mu A$
Overall gain	$G_O$	Mono; $R1 = 47k\Omega$	4.0	5.8	7.0	dB
AF Output Voltage (rms)	$V_{11} = V_{10}$		460	560	640	mV
	$V_{15} = V_{14}$		–	245	–	mV
Total Harmonic Distortion	THD	Note 1	–	0.3	0.5	%
Output Voltage	$V_{11} = V_{10}$	THD = 1%	–	800	–	mV
Output Channel Unbalance	$V_{11}/V_{10}$		–	0.1	1.0	dB
Channel Separation	$\alpha$	$L = 1, R = 0$	24	28	–	dB
Signal to Noise Ratio	S/N	Bandwidth 20Hz to 16kHz	–	76	–	dB
<b>Pilot Presence Detector (Note 2)</b>						
Switching to Stereo	$V_{pilot}$		–	40	60	mV
		Mono	15	30	–	mV
Hysteresis	$\Delta V_{pilot}$		–	2.5	–	dB
Channel Separation Full Stereo	$\alpha$	$V_{16} \geq 1.25V$	24	28	–	dB
		$V_{16} = 1V$ Typ	–	10	–	dB
Attenuation (L – R)			–	6	–	dB

Note 1. Guaranteed for mono, mono + pilot and stereo.

Note 2. Adjustable.

**AC Characteristics (Cont'd):** ( $V_S = 8.5V$ ,  $T_A = +25^\circ C$ , AC Conditions: (1) Input signal ( $V_i$ ) of  $815mV_{P-P}$  for  $L = 1$ ,  $R = 1$  (mono),  $f_m = 1kHz$  (80% modulation); (2) MUX input signal ( $V_i$ ) of  $1.2V_{P-P}$  for  $L = 1$ ,  $R = 0$  and no dbx,  $f_m = 1kHz$  (stereo) and  $V_{pilot} = 200V_{P-P}$ ; (3) S1 open, unless specified (without  $L - R$  filter), VCO measured with an external IF roll-off network ( $-2dB$  at  $31.5kHz = 2f_H$ ) at the input. All the above conditions apply unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Carrier &amp; Harmonic Suppression at the Output (Note 3)</b>						
Pilot Signal Suppression	$\alpha f_H$	$f_{pilot} = 15.734kHz (1f_H)$	32	36	–	dB
Subcarrier Suppression	$\alpha 2f_H$	$f = 2f_H$	–	60	–	dB
VCO Suppression	$\alpha 12f_H$	$f = 12f_H$	–	75	–	dB
SAP Signal Suppression (Second Audio Program)	$\alpha 5f_H$	$f = 5f_H$	–	60	–	dB
Intermodulation Suppression $f_m = 8.367kHz$	$\alpha_2$	Spurious Signal, $f_s = 1kHz$	–	80	–	dB
	$\alpha_3$	Spurious Signal, $f_s = 1kHz$	–	70	–	dB
Ripple Rejection	$RR_{120}$	$f = 120Hz$ , $V_{ripple} = 100mV$ , mono	–	50	–	dB
<b>Voltage Controlled Oscillator (VCO)</b>						
R Adjust (R5)	$R_{adj}$	$f_{OSC} = 188.808kHz$ , $R7 = 10k\Omega$ 5%, $C6 = 820pF$ 1%	0	–	8	$k\Omega$
Capture Range	$\Delta f/f$	Deviation from $f_{OSC}$ center frequency: $V_{pilot} = 200mV_{P-P}$	–	45	–	%
Temperature Coefficient	TC	Uncompensated	–	$250 \times 10^{-6}$	–	$K^{-1}$
<b>Output Amplifiers</b>						
Gain MUX	$G_V$		6.7	7.2	7.7	dB
		External Signal	–0.5	0	+0.5	dB
Input Impedance	$Z_i$		–	50	–	$k\Omega$
Output Impedance	$Z_o$		–	10	–	$\Omega$
External Load Impedance	$Z_1$		10	–	–	$k\Omega$
External Load Capacitance	$Z_1$		–	–	1.5	nF
Mute Suppression MUX Signal	$\alpha$		56	60	–	dB
		External Signal	56	60	–	dB
DC Offset Voltage at Outputs	$\Delta V$	Mute OFF-to-ON	–	10	50	mV
		Mute ON-to-OFF	–	10	50	mV
<b>Source Selector (Pin6)</b>						
Suppression of MUX Signal	$\alpha$	$V_6 \geq 2V$	80	90	–	dB
Suppression of External Signal	$\alpha$	$V_6 \leq 0.8V$	56	60	–	dB
Switching Level (MUX Selected) Voltage	$V_{IL}$		–	–	0.8	V
		Current	$I_{IL}$	$V_i = 0.8V$	–	10

Note 3. S1 closed; reference: AF output voltage  $f = 1kHz$  mono.

**AC Characteristics (Cont'd):** ( $V_S = 8.5V$ ,  $T_A = +25^\circ C$ , AC Conditions: (1) Input signal ( $V_i$ ) of  $815mV_{P-P}$  for  $L = 1$ ,  $R = 1$  (mono),  $f_m = 1kHz$  (80% modulation); (2) MUX input signal ( $V_i$ ) of  $1.2V_{P-P}$  for  $L = 1$ ,  $R = 0$  and no dbx,  $f_m = 1kHz$  (stereo) and  $V_{pilot} = 200V_{P-P}$ ; (3) S1 open, unless specified (without L – R filter), VCO measured with an external IF roll-off network ( $-2dB$  at  $31.5kHz = 2f_H$ ) at the input. All the above conditions apply unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Source Selector (Cont'd) (Pin6)</b>						
Switching Level (External Selected) Voltage	$V_{IH}$		2	–	$V_P$	V
Current	$I_{IH}$	$V_i = V_P$	–	0.1	1.0	$\mu A$
<b>Muting Circuit (Pin7)</b>						
Input Voltage	$V_{IL}$	Mute ON	–	–	0.8	V
	$V_{IH}$	Mute OFF	2	–	$V_P$	V
Input Current	$-I_{IL}$	Mute ON, $V_{IL} = 0.8V$	–	10	25	$\mu A$
	$I_{IL}$	Mute OFF, $V_{IH} = V_P$	–	0.1	1.0	$\mu A$

Note 4. Intermodulation suppression (Beat Frequency Components (BFC)):

$$\alpha_2 = \frac{V_O \text{ (signal) (at 1kHz)}}{V_O \text{ (spurious) (at 1kHz)}} ; f_s = (2 \times 8.367kHz) - f_H$$

$$\alpha_3 = \frac{V_O \text{ (signal) (at 1kHz)}}{V_O \text{ (spurious) (at 1kHz)}} ; f_s = (3 \times 10.823kHz) - 2f_H$$

measured with 100% modulated input signal:  $L = R$ ; pilot signal =  $200mV_{P-P}$ ;  $f_m = 8.367$  or  $10.823kHz$ .

**Pin Connection Diagram**



