

NTE1786 Integrated Circuit Frequency Lock Loop (FLL) Tuning & Control Circuit

Description:

The NTE1786 is an integrated circuit in a 24-Lead DIP type package that provides closed-loop digital tuning of TV receivers, with or without AFC, as required. This device also controls up to 4 analog functions, 4 general purpose I/O ports and 4 high-current outputs for tuner band selection.

Features:

- Combined Analog and Digital Circuitry Minimizes the Number of Additional Interfacing Components Required
- Frequency Measurement with Resolution of 50kHz
- Selectable Prescaler Divisor of 64 or 256
- 32V Tuning Voltage Amplifier
- 4 High-Current Outputs for Direct Band Selection
- 4 Static Digital-to-Analog Convertors (DACs) for Control of Analog Functions
- 4 General Purpose Input/Output (I/O) Ports
- Tuning with Control of Speed and Direction
- Tuning with or without AFC
- Single-Pin, 4MHz On-Chip Oscillator
- I²C Bus Slave Transceiver

Applications:

- TV Receivers
- Satellite Receivers
- CATV Converters

Absolute Maximum Ratings:

Supply Voltage Ranges,

Pin13, V _{CC1}		–0.3 to +18V
Pin19, V _{CC2}		–0.3 to +18V
Pin14, V _{CC3}		–0.3 to +36V

Absolute Maximum Ratings (Cont'd):

Input/Output Voltage Ranges,

Pin2, V_{SDA}	–0.3 to +18V
Pin3, V_{SCL}	–0.3 to +18V
Pin4 to Pin7, V_{P2X}	–0.3 to +18V
Pin8 & Pin9 (Note 1), V_{AFC+} , V_{AFC-}	–0.3 to V_{CC1}
Pin10, V_{TI}	–0.3 to V_{CC1}
Pin12 (Note 2), V_{TUN}	–0.3 to V_{CC3}
Pin15 to Pin18 (Note 2), V_{P1X}	–0.3 to V_{CC2}
Pin20 (Note 1), V_{FDIV}	–0.3 to V_{CC1}
Pin21, V_{OSC}	–0.3 to +5V
Pin1, Pin22 to Pin24 (Note 1), V_{DACX}	–0.3 to V_{CC1}

Total Power Dissipation, P_{TOT} 1000mWOperating Ambient Temperature Range, T_A –20° to +70°CStorage Temperature Range, T_{stg} –65° to +150°C

Note 1. Pin voltage may exceed supply voltage if current is limited to 10mA.

Note 2. Pin voltage must not exceed 18v but may exceed V_{CC2} if current is limited to 200mA.**DC and AC Electrical Characteristics:** ($T_A = +25^{\circ}\text{C}$, V_{CC1} , V_{CC2} , V_{CC3} at typical voltages unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{CC1}		10.5	12.0	13.5	V
	V_{CC2}		4.7	13.0	16.0	V
	V_{CC3}		30	32	35	V
Supply Current (No Outputs Loaded)	I_{CC1}		18	30	45	mA
	I_{CC2}		0	–	0.1	mA
	I_{CC3}		0.2	0.6	2.0	mA
Additional Supply Currents (A)	I_{CC2A}	Note 3	–2	–	I_{OHP1X}	mA
	I_{CC3A}	Note 3	0.2	–	2.0	mA
Total Power Dissipation	P_{TOT}		–	380	–	mW
Operating Ambient Temperature	T_A		–20	–	+70	°C
I²C Bus Inputs SDA Input (Pin2); SCL Input (Pin3)						
Input Voltage, HIGH	V_{IH}	Note 4	3	–	V_{CC-1}	V
Input Voltage, LOW	V_{IL}		–0.3	–	1.5	V
Input Current, HIGH	I_{IH}	Note 4	–	–	10	μA
Input Current, LOW	I_{IL}		–	–	10	μA
I²C Bus Outputs SDA Output (Pin2, Open Collector)						
Output Voltage, LOW	V_{OL}	$I_{OL} = 3\text{mA}$	–	–	0.4	V
Maximum Output Sink Current	I_{OL}		–	5	–	mA
Open-Collector I/O Ports P20, P21, P22, P23 (Pin4 to Pin7, Open Collector)						
Input Voltage, HIGH	V_{IH}		2	–	16	V
Input Voltage, LOW	V_{IL}		–0.3	–	0.8	V
Input Current, HIGH	I_{IH}		–	–	25	μA
Input Current, LOW	I_{IL}		–	–	25	μA
Output Voltage, LOW	V_{OL}	$I_{OL} = 2\text{mA}$	–	–	0.4	V
Maximum Output Sink Current	I_{OL}		–	4	–	mA

Note 3. For each band-select output which is programmed at logic 1, sourcing a current I_{OOP1X} , the additional supply currents (A) shown must be added to I_{CC2} and I_{CC3} , respectively.Note 4. If $V_{CC1} < 1\text{V}$, the input current is limited to 10μA at input voltages up to 16V.

DC and AC Electrical Characteristics (Cont'd): ($T_A = +25^\circ\text{C}$, V_{CC1} , V_{CC2} , V_{CC3} at typical voltages unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
AFC Amplifier Inputs AFC+, AFC– (Pin8, Pin9)						
Transconductance for Input Voltages up to 1V Differential	g00	AFCS1: 0, AFCS2: 0	100	250	800	nA/V
	g01	AFCS1: 0, AFCS2: 1	15	25	35	$\mu\text{A/V}$
	g10	AFCS1: 1, AFCS2: 0	30	50	70	$\mu\text{A/V}$
	g11	AFCS1: 1, AFCS2: 1	60	100	140	$\mu\text{A/V}$
Tolerance of Transconductance Multiplying Factor (2, 4, or 8) when Correction-in-Band is Used	ΔM_g		–20	–	+20	%
Input Offset Voltage	V_{IOFF}		–75	–	+75	mV
Common-Mode Input Voltage	V_{COM}		3	–	$V_{CC1}-2.5$	V
Common-Mode Rejection Ratio	CMRR		–	50	–	dB
Power Supply (V_{CC1}) Rejection Ratio	PSRR		–	50	–	dB
Input Current	I_I		–	–	500	nA
Tuning Voltage Amplifier Input TI, Output TUN (Pin10, Pin12)						
Maximum Output Voltage	V_{TUN}	$I_{LOAD} = \pm 2.5\text{mA}$	$V_{CC3}-1.6$	–	$V_{CC3}-0.4$	V
Maximum Output Voltage	V_{TM00}	$I_{LOAD} = \pm 2.5\text{mA}$, $VTMI1: 0$, $VTMI0: 0$	300	–	500	mV
	V_{TM10}	$I_{LOAD} = \pm 2.5\text{mA}$, $VTMI1: 1$, $VTMI0: 0$	450	–	650	mV
	V_{TM11}	$I_{LOAD} = \pm 2.5\text{mA}$, $VTMI1: 1$, $VTMI0: 1$	650	–	900	mV
Maximum Output Source Current	$-I_{TUNH}$		2.5	–	8.0	mA
Maximum Output Sink Current	I_{TUNL}		–	40	–	mA
Input Bias Current	I_{TI}		–5	–	+5	nA
Power Supply (V_{CC3}) Rejection Ratio	PSRR		–	60	–	dB
Minimum Charge IT to Tuning Voltage Amplifier	CH_{00}	TUHN1: 0, TUHN0: 0	0.4	1.0	1.7	$\mu\text{A/V}$
	CH_{01}	TUHN1: 0, TUHN0: 1	4	8	14	$\mu\text{A/V}$
	CH_{10}	TUHN1: 1, TUHN0: 0	15	30	48	$\mu\text{A/V}$
	CH_{11}	TUHN1: 1, TUHN0: 1	130	250	370	$\mu\text{A/V}$
Tolerance of Charge (or ΔV_{TUN}) Multiplying Factor when COIB and/or TUS are Used	ΔCH		–20	–	+20	%
Maximum Current I into Tuning Amplifier	I_{T00}	TUHN1: 0, TUHN0: 0	1.7	3.5	5.1	μA
	I_{T01}	TUHN1: 0, TUHN0: 1	15	29	41	μA
	I_{T10}	TUHN1: 1, TUHN0: 0	65	110	160	μA
	I_{T11}	TUHN1: 1, TUHN0: 1	530	875	1220	μA
Correction-in-Band						
Tolerance of Correction-in-Band Levels 12V, 18V, and 24V	ΔV_{CIB}		–15	–	+15	%
Band-Select Output Ports P10, P11, P12, P13 (Pin15 to Pin18)						
Output Voltage, HIGH	V_{OH}	$-I_{OH} = 50\text{mA}$, Note 5	$V_{CC2}-0.6$	–	–	V
Output Voltage, LOW	V_{OL}	$I_{OL} = 2\text{mA}$	–	–	0.4	V

Note 5. At continuous operation the output current should not exceed 50mA. When the output is short-circuited to GND for several seconds the device may be damaged.

DC and AC Electrical Characteristics (Cont'd): ($T_A = +25^\circ\text{C}$, V_{CC1} , V_{CC2} , V_{CC3} at typical voltages unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Band-Select Output Ports (Cont'd) P10, P11, P12, P13 (Pin15 to Pin18)						
Maximum Output Source Current	$-I_{OH}$	Note 5	–	130	200	mA
Maximum Output Sink Current	I_{OL}		–	5	–	mA
FDIV Input (Pin20)						
Input Voltage (Peak-to-Peak Value)	V_{FDIV}^{P-P}	t_{RISE} and $t_{FALL} \leq 40\text{ns}$	0.1	–	2.0	V
Duty Cycle			40	–	60	%
Maximum Input Frequency	f_{MAX}		14.5	–	–	MHz
Input Impedance	Z_i		–	8	–	k Ω
Input Capacitance	C_i		–	5	–	pF
OSC Input (Pin21)						
Crystal Resistance at Resonance (4MHz)	R_X		–	–	150	Ω
DAC Outputs (Pin1, Pin22 to Pin24)						
Maximum Output Voltage (No Load)	V_{DH}	$V_{CC1} = 12\text{V}$, Note 6	10.0	–	11.5	V
Minimum Output Voltage (No Load)	V_{DL}	$V_{CC1} = 12\text{V}$, Note 6	0.1	–	1.0	V
Positive Value of Smallest Step	ΔV_D	1 Least Significant Bit	0	–	350	mV
Deviation from Linearity			–	–	0.5	V
Output Impedance	Z_D	$I_{LOAD} = \pm 2\text{mA}$	–	–	70	Ω
Maximum Output Source Current	$-I_{DH}$		–	–	6	mA
Maximum Output Sink Current	I_{DL}		–	8	–	mA
Power-Down Reset						
Maximum Supply Voltage (V_{CC1}) at which Power-Down Reset is Active	V_{PD}		7.5	–	9.5	V
V_{CC1} Rise Time During Power-Up (Up to V_{PD})	t_R		5	–	–	μs
Voltage Level for Valid Module Address						
Voltage Level at P20 (Pin4) for Valid Module Address as a Function of MA1, MA0	V_{VA00}	MA1: 0, MA0: 0	–0.3	–	16	V
	V_{VA01}	MA1: 0, MA0: 1	–0.3	–	0.8	V
	V_{VA10}	MA1: 1, MA0: 0	2.5	–	$V_{CC1}-2$	V
	V_{VA11}	MA1: 1, MA0: 1	$V_{CC1}-0.3$	–	V_{CC1}	V

Note 5. At continuous operation the output current should not exceed 50mA. When the output is short-circuited to GND for several seconds the device may be damaged.

Note 6. Values are proportional to V_{CC1} .

Pin Connection Diagram

DAC3 Output	1	24	DAC2 Output
Serial Data Line	2	23	DAC1 Output
Serial Clock Line	3	22	DAC0 Output
I/O Ports	P20	4	21 X'tal OSC Input
	P21	5	20 Prescaler Input
	P22	6	19 V _{CC} 2 (13V Typ)
	P23	7	18 P13
AFC (+) Input	8	17	P12
AFC (-) Input	9	16	P11
Tuning Voltage Amp Invert Input	10	15	P10
GND	11	14	V _{CC} 3 (32V Typ)
Tuning Voltage Amp Output	12	13	V _{CC} 1 (12V Typ)

