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

NTE1753
Integrated Circuit
Pulse Width Modulator (PWM) Control Circuit

Description:

The NTE1753 is a fixed–frequency pulse width modulation control circuit in a 14–Lead DIP type package incorporating the primary building blocks required for the control of a switching power supply. An internal–linear sawtooth oscillator frequency is determined by:

$$f_{OSC} \square \frac{1.1}{R_T \bullet C_T}$$

Output pulse width modulation is accomplished by comparison of the positive sawtooth waveform across capacitor C_T to either of two control signals. The output is enabled only during that portion of time when the sawtooth voltage is greater than the control signals. Therefore, an increase in control–signal amplitude causes a corresponding linear decrease of output pulse width.

The control signals are external inputs that can be fed into the dead–time control, the error amplifier inputs, or the feed–back input. The dead–time control comparator has an effective 120mV input offset which limits the minimum output dead time to approximately the first 4% of the sawtooth–cycle time. This would result in a maximum duty cycle of 96%. Additional dead time may be imposed on the output by setting the dead time–control input to a fixed voltage, ranging between 0 to 3.3V.

The pulse width modulator comparator provides a means for the error amplifiers to adjust the output pulse width from the maximum percent on–time, established by the dead time control input, down to zero, as the voltage at the feedback pin varies from 0.5 to 3.5V. Both error amplifiers have a common–mode input range from –0.3V to (V_{CC} –2V), and may be used to sense power supply output voltage and current. The error–amplifier outputs are active high and are 0 red together at the non–inverting input of the pulse–width modulator comparator. With this configuration, the amplifier that demands minimum output on time, dominates control of the loop.

The NTE1753 has an internal 5.0V reference capable of sourcing up to 10mA of load currents for external bias circuits. The reference has an internal accuracy of ±5% with a typical thermal drift of less than 50mV over an operating temperature range of 0 to +70°C.

Features:

- Complete Pulse Width Modulation Control Circuitry
- On–Chip Oscillator with Master or Slave Operation
- On–Chip Error Amplifiers
- On–Chip 5.0 Volt Reference
- Adjustable Dead Time Control
- Uncommitted Output Transistor for 200mA Source or Sink

Absolute Maximum Ratings: (T_A = 0° to +70°C unless otherwise specified)

Power Supply Voltage, V_{CC} 42V
Collector Output Voltage, V_C 42V
Collector Output Current, I_C 250mA
Amplifier Input Voltage, V_{in} .... V_{CC} +0.3V
Power Dissipation ($T_A \leq$ 45°C), P_D 1000mW
Operating Junction Temperature, T_J .... +125°C
Operating Ambient Temperature Range, T_A .... 0° to +70°C
Storage Temperature Range, T_{stg} .... –55° to +125°C
Thermal Resistance, Junction to Ambient, $R_{\Theta JA}$ .... +80°C/W
Power Derating Factor, $1/R_{\Theta JA}$ .... 12.5mW/°C
Derating Ambient Temperature, T_A .... +45°C

Recommended Operating Conditions:

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{CC}	7.0	15	40	V
Collector Output Voltage	V_C	–	30	40	V
Collector Output Current	I_C	–	–	200	mA
Amplifier Input Voltage	V_{in}	–0.3	–	V_{CC}–2	V
Current Into Feedback Terminal	$I_{f\,b}$	–	–	0.3	mA
Reference Output Current	I_{ref}	–	–	10	mA
Timing Resistor	R_T	1.8	47	500	kΩ
Timing Capacitor	C_T	0.0047	0.001	10	μF
Oscillator Frequency	f_{OSC}	1.0	25	200	kHz

Electrical Characteristics: (V_{CC} = 15V, C_T = 0.01μF, R_T = 12kΩ. For typical values T_A = +25°C, for min/max values T_A is 0° to +70°C unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Reference Section						
Reference Voltage	V_{ref}	I_O = 1mA	4.75	5.0	5.25	V
Line Regulation	Reg_{line}	V_{CC} = 7V to 40V	–	2	25	mV
Load Regulation	Reg_{load}	I_O = 1mA to 10mA	–	3	15	mV
Short–Circuit Output Current	I_{SC}	V_{ref} = 0	15	35	75	mA
Output Section						
Collector Off–State Current	$I_{C(off)}$	V_{CE} = 40V, V_{CC} = 40V	–	2	100	μA
Emitter Off–State Current	$I_{E(off)}$	V_{CC} = V_C = 40V, V_E = 0	–	–	–100	μA
Collector–Emitter Saturation Voltage	$V_{sat(C)}$	I_C = 200mA, V_E = 0, Common Emitter	–	1.1	1.3	V
	$V_{sat(E)}$	I_E = 200mA, V_C = 15V, Emitter Follower	–	1.5	2.5	V
Output Voltage Rise Time	t_r	T_A = +25°C, Common Emitter	–	100	200	ns
		T_A = +25°C, Emitter Follower	–	100	200	ns
Output Voltage Fall Time	t_f	T_A = +25°C, Common Emitter	–	25	100	ns
		T_A = +25°C, Emitter Follower	–	40	100	ns

Electrical Characteristics (Cont'd): (V_{CC} = 15V, C_T = 0.01µF, R_T = 12kΩ. For typical values T_A = +25°C, for min/max values T_A is 0° to +70°C unless otherwise specified.)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Error Amplifier Section							
Input Offset Voltage		V_{IO}	$V_{O(Pin3)}$ = 2.5V	–	2	10	mV
Input Offset Current		I_{IO}	$V_{C(Pin3)}$ = 2.5V	–	5	250	nA
Input Bias Current		I_{IB}	$V_{O(Pin3)}$ = 2.5V	–	–0.1	–1.0	µA
Common Mode Input Voltage Range	Low	V_{ICR}	V_{CC} = 40V, T_A = +25°C	–0.3	–	–	V
	High			V_{CC}–2	–	–	V
Open–Loop Voltage Gain		A_{VOL}	ΔV_O = 3V, V_O = 0.5V to 3.5V, R_L = 2kΩ	70	95	–	dB
Unity Gain Crossover Frequency		f_c	V_O = 0.5V to 3.5V, R_L = 2kΩ	–	350	–	kHz
Phase Margin at Unity Gain		Φm	V_O = 0.5V to 3.5V, R_L = 2kΩ	–	65	–	deg.
Common Mode Rejection Ratio		CMRR	V_{CC} = 40V	65	90	–	dB
Power Supply Rejection Ratio		PSRR	ΔV_{CC} = 33V, V_O = 2.5V, R_L = 2kΩ	–	100	–	dB
Output Sink Current		I_{O}–	$V_{O(Pin3)}$ = 0.7V	0.3	0.7	–	mA
Output Source Current		I_{O}+	$V_{O(Pin3)}$ = 3.5V	–2	–4	–	mA
PWM Comparator Section							
Input Threshold Voltage		V_{TH}	Zero Duty Cycle	–	3.5	4.5	V
Input Sink Current		I_{I}–	$V_{(Pin3)}$ = 0.7V	0.3	0.7	–	mA
Dead–Time Control Section							
Input Bias Current (Pin4)		$I_{IB(DT)}$	V_{IN} = 0 to 5.25V	–	–2	–10	µA
Maximum Output Duty Cycle		DC_{max}	V_{IN} = 0, C_T = 0.01µF, R_T = 12kΩ	90	96	100	%
			V_{IN} = 0, C_T = 0.001µF, R_T = 47k–Ω	–	92	100	%
Input Threshold Voltage (Pin4)		V_{TH}	Zero Duty Cycle	–	2.8	3.3	V
			Maximum Duty Cycle	0	–	–	V
Oscillator Section							
Frequency		f_{OSC}	C_T = 0.001µF, R_T = 47kΩ	–	25	–	kHz
Standard Deviation of Frequency		αf_{OSC}	C_T = 0.001µF, R_T = 47kΩ	–	3	–	%
Frequency Change with Temperature		$\Delta f_{OSC}(\Delta T)$	0° ≤ ΔT_A ≤ +70°C	–	–	12	%
			C_T = 0.01µF, R_T = 12kΩ	–	–	12	%
Frequency Change with Voltage		$\Delta f_{OSC}(\Delta V)$	V_{CC} = 7V to 40V, T_A = +25°C	–	1	–	%
Total Device							
Standby Supply Current		I_{CC}	V_{CC} = 15V, all other inputs and outputs open	–	5.5	10	mA
			V_{CC} = 40V, all other inputs and outputs open	–	7.0	15	mA
Average Supply Current		I_S	$V_{(Pin4)}$ = 2V, C_T = 0.001µF, R_T = 47kΩ	–	7	–	mA

Note 1. Standard deviation is a measure of the statistical distribution about the mean as derived from the formula:

$$\alpha = \sqrt{\frac{\sum_{n=1}^{N} (X_n - \overline{X})^2}{N - 1}}$$

Pin Connection Diagram