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NTE7109
Integrated Circuit
Switching Regulator Control

Description:

The NTE7109 is a primary switching regulator controller in a 16–Lead DIP type package designed to get the regulated DC voltage from an AC power supply. This device can directly drive a MOSFET with fast rise and fall output pulses.

The NTE7109 contains not only a high frequency OSC and fast output drive, but also a current limiter with fast response and high sensibility so a true “fast switching regulator” can be realized. By adding additional compenents to the primary side, a timer–type protection circuit can be made for protection against short–circuit and overcurrent.

Features:

- 500kHz Operation to MOSFET
  - Output Current: ±2A
  - Output Rise Time: 60ns; Fall Time: 40ns
  - Modified Totem–Pole Output Method with Low Through Current
- Compact and Light–Weight Power Supply
  - Low Start–Up Current: 90μA Typ.
  - Wide Range Between “Start–Up Voltage” and “Stop Voltage” make the Power Input Smooting Capacitor Low; Start–Up Threshold Voltage: 16V; Stop Voltage: 10V
  - High Power Dissipation Package withstands the Heat Generated bt the Gate–Drive Current of a MOSFET
- Simplified Peripheral Circuit with Protection Circuit and Built–In Large–Capacity Totem–Pole Output
  - High–Speed Current Limiting Circuit using Pulse–by–Pulse Method (Two Systems of CLM+pin, CLM–pin)
  - Protection by Intermittent Operation of Output Overcurrent: Timer Protection Circuit
  - Overvoltage Protection Circuit with an Externally Resettable Latch (OVP)
  - Protection Circuit for Output Miss Action at Low Supply Voltage (UVLO)
- High–Performance and Highly Functional Power Supply
  - Triangular Wave Oscillator for Easy Dead Time Setting

Applications:

- Feed Forward Regulator
- Flyback Regulator

Absolute Maximum Ratings:

Supply Voltage, V_{CC} 31V

Collector Voltage, V_C 31V
Output Current, I_O
Peak . . . . . ±2A
Continuous . . . . . ±0.5A
VF Terminal Voltage, V_{VF} . . . . . V_{CC}
ON/OFF Terminal Voltage, $V_{ON/OFF}$ . . . . . V_{CC}
CLM – Terminal Voltage, V_{CLM-} . . . . . –4.0 to +4.0V
CLM + Terminal Voltage, V_{CLM+} . . . . . –0.3 to +4.0V
OVP Terminal Current, I_{OVP} 8mA
DET Terminal Voltage, V_{DET} 6V
DET Terminal Input Current, I_{DET} 5mA
F/B Terminal Voltage, $V_{F/B}$ . . . . . 0 to 10V
T–ON Terminal Input Current, I_{TON} . . . . . –1mA
T–OFF Terminal Input Current, I_{TOFF} . . . . . –2mA
Power Dissipation (T_A = +25°C), P_d 1.5W
Derate Above 25° . . . . . 12mW/°C
Junction Temperature, T_J . . . . . +150°C
Operating Temperature Range, T_{opr} . . . . . –30° to +85°C
Storage Temperature Range, T_{stg} . . . . . –40° to +125°C

Note 1. "+" sign shows the direction of current flow into the IC and "–" sigh shows the current flow from the IC.

Note 2. This terminal has the constant voltage characteristic of 6V to 8V when current is supplied from outside. The maximum allowable voltage is 6V when the constant voltage is applied to this terminal. And maximum allowable current into this terminal is 5mA.

Note 3. The low impedance voltage supply should not be applied to the OVP terminal.

Recommended Operating Conditions:

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage Range	V_{CC}		12	18	30	V
Operating Frequency	f_{OSC}		–	–	500	kHz
Oscillator Frequency Setting Resistance T–ON Pin Resistance	R_{ON}		10	–	75	kΩ
T–OFF Pin Resistance	R_{OFF}		2	–	30	kΩ

Electrical Characteristics: (V_{CC} = 18V, T_A = +25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage Circuit Current						
Operating Supply Voltage Range	V_{CC}		$V_{CC(STOP)}$	–	30	V
Operation Start–Up Voltage	$V_{CC(START)}$		15.2	16.2	17.2	V
Operation Stop Voltage	$V_{CC(STOP)}$		9.0	9.9	10.9	V
Difference Between Operation Start and Stop Voltage	ΔV_{CC}	$\Delta V_{CC} = V_{CC(START)} - V_{CC(STOP)}$	5.0	6.3	7.6	V
Stand–By Current	I_{CCL}	V_{CC} = 14.5V, T_A = +25°C	50	90	140	μA
		V_{CC} = 14.5V, –30° ≤ T_A ≤ +85°C	40	90	190	μA
Operating Circuit Current	I_{CCO}	V_{CC} = 30V	10	15	21	mA

Electrical Characteristics (Cont'd): (V_{CC} = 18V, T_A = +25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage Circuit Current (Cont'd)						
Circuit Current in OFF State	$I_{CC\ OFF}$	V_{CC} = 25V	0.95	1.31	5.0	mA
		V_{CC} = 14V	50	90	140	μA
Circuit Current in Timer OFF State	$I_{CC\ CT}$	V_{CC} = 25V	0.95	1.35	2.0	mA
		V_{CC} = 14V	–	160	240	μA
Circuit Current in OVP State	$I_{CC\ OVP}$	V_{CC} = 25V	1.3	2.0	3.0	mA
		V_{CC} = 14V	126	200	310	
ON/OFF						
High Threshold Voltage	$V_{THH\ ON/OFF}$		2.1	2.6	3.1	V
Low Threshold Voltage	$V_{THL\ ON/OFF}$		1.9	2.4	2.9	V
Hysterisis	$\Delta V_{TH\ ON/OFF}$		0.1	0.2	0.3	V
F/B						
Current at 0% Duty	$I_{FB\ MIND}$	F/B Terminal Input Current	–2.1	–1.54	–1.0	mA
Current at Maximum Duty	$I_{FB\ MAXD}$	F/B Terminal Input Current	–0.90	–0.55	–0.40	mA
Current Difference Between Max and 0% Duty	ΔI_{FB}	$\Delta I_{FB} = I_{FB\ MIND} - I_{FB\ MAXD}$	–1.35	–0.99	–0.70	mA
Terminal Voltage	V_{FB}	F/B Terminal Input Current = 0.95mA	4.9	5.9	7.1	V
Terminal Resistance	R_{FB}		420	600	780	Ω
Detection						
Detection Voltage	V_{DET}		2.4	2.5	2.6	V
Input Current of Detection Amp	$I_{IN\ DET}$	V_{DET} = 2.5V	–	1.0	3.0	μA
Voltage Gain of Detection Amp	$G_{AV\ DET}$		30	40	–	dB
OVP						
High Threshol Voltage	$V_{TH\ OVPH}$		540	750	960	mV
Hysterisis Voltage	$\Delta V_{TH\ OVP}$	$\Delta V_{TH\ OVP} = V_{TH\ OVPH} - V_{TH\ OVPL}$	–	30	–	mV
Threshold Current	$I_{TH\ OVP}$		80	150	250	μA
Input Current	$I_{IN\ OVP}$	V_{OVP} = 400mV	80	150	250	μA
Reset Supply Voltage	$V_{CC\ OVPC}$	OVP Terminal is Open (High Impedance)	7.5	9.0	10.0	V
Difference Between Operation Supply Voltage Stop and OVP Reset	$V_{CC\ (STOP)} - V_{CC\ OVPC}$		0.55	1.20	–	V
Current From OVP Terminal for OVP Reset	$I_{TH\ OVPC}$	V_{CC} = 30V	–480	–320	–213	μA
		V_{CC} = 18V	–210	–140	–93	μA
OVP						
Threshold Voltage	$V_{TH\ OVP}$		1.00	1.40	1.90	V
Input Current	$I_{IN\ OVP}$		–	1.2	3.6	μA
Reset Supply Voltage	$V_{CC\ OVPC}$		7.6	8.6	9.6	V
Difference Between Operation Supply Voltage Stop and OVP Reset	$V_{CC\ (STOP)} - V_{CC\ OVPC}$		0.65	1.30	–	V

Electrical Characteristics (Cont'd): (V_{CC} = 18V, T_A = +25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Timer						
Timer Frequency	I_{TIMER}	C_T = 4.7µF	0.27	0.40	0.60	Hz
Timer Charge Current	$I_{TIM\ CH}$	V_{CT} = 3.3V, T_A = –5°C	–193	–138	–102	µA
		T_A = +25°C	–178	–127	–94	µA
		T_A = +85°C	–147	–105	–78	µA
OFF Time/ON Time Ratio	$TIME_{OFF/ON}$		7.0	8.7	11.0	
CLM –						
Threshold Voltage	$V_{TH\ CLM-}$	–5° ≤ T_A ≤ 85°C	–220	–200	–180	mV
Input Current	$I_{IN\ CLM-}$	V_{CLM-} = –0.1V	–170	–125	–90	µA
Delay Time from CLM– to V_{OUT}	$T_{PD\ CLM-}$		–	170	–	ns
CLM +						
Threshold Voltage	$V_{TH\ CLM+}$	–5° ≤ T_A ≤ 85°C	180	200	220	mV
Input Current	$I_{IN\ CLM+}$	V_{CLM+} = –0.1V	–270	–205	–140	µA
Delay Time from CLM+ to V_{OUT}	$T_{PD\ CLM+}$		–	130	–	ns
Oscillator						
Oscillating Frequency	f_{OSC}	R_{ON} = 20kΩ, R_{OFF} = 17kΩ, C_F = 220pF, –5° ≤ T_A ≤ 85°C	170	188	207	kHz
Maximum ON Duty	T_{DUTY}		47	50	53	%
Upper Limit of Oscillation Waveform	V_{OSCH}	f_{OSC} = 188kHz	3.97	4.37	4.77	V
Lower Limit of Oscillation Waveform	V_{OSCL}	f_{OSC} = 188kHz	1.76	1.96	2.16	V
Difference Betwee Upper Limit and Lower Limit Voltage of OSC Waveform	ΔV_{OSC}	f_{OSC} = 188kHz	2.11	2.41	2.71	V
V_F						
OSC Frequency in CLM Operating State	$f_{OSC\ VF}$	V_F = 5V; R_{ON} = 20kΩ, R_{OFF} = 17kΩ, C_F = 220pF	170	188	207	kHz
		V_F = 2V	108	124	143	kHz
Duty in CLM Operating State	$T_{VF\ DUTY}$	V_F = 0.2V, Min OFF Duty/Max ON Duty	11.0	13.7	22.0	
Timer Operating Start Voltage	$V_{TH\ TIME}$		2.7	3.0	3.3	V
Input Current	I_{VF}	Source Current	–	2	6	µA
Output						
Output Low Voltage	$V_{OL\ 1}$	V_{CC} = 18V, I_O = 10mA	–	0.05	0.4	V
	$V_{OL\ 2}$	V_{CC} = 18V, I_O = 100mA	–	0.7	1.4	V
	$V_{OL\ 3}$	V_{CC} = 5V, I_O = 1mA	–	0.69	1.0	V
	$V_{OL\ 4}$	V_{CC} = 5V, I_O = 100mA	–	1.3	2.0	V
Output High Voltage	$V_{OH\ 1}$	V_{CC} = 18V, I_O = –10mA	16.0	16.5	–	V
	$V_{OH\ 2}$	V_{CC} = 18V, I_O = –100mA	15.5	16.0	–	V
Output Voltage Rise Time	T_{RISE}	No Load	–	50	–	ns
Output Voltage Fall Time	t_{FALL}	No Load	–	35	–	ns

Pin Connection Diagram