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NTE1681 **Integrated Circuit** **High Power Switching Regulator**

Description:

The NTE1681 is a stepdown power switching regulator in a 15-Lead Staggered SIP type package delivering 4A at a voltage variable from 5.1V to 40V. Features of this device include soft start, remote inhibit, thermal protection, a reset output for microprocessors and a PWM comparator input for synchronization in multichip configurations.

Efficient operation at switching frequencies up to 200kHz allows a reduction in the size and cost of external filter components. A voltage sense input and SCR drive output are provided for optional crowbar overvoltage protection with an external SCR.

Features:

- 4A Output Current
- 5.1V to 40V Output Voltage Range
- 0 to 100% Duty Cycle Range
- Precise ($\pm 2\%$) On-Chip Reference
- Switching Frequency up to 200kHz
- Very High Efficiency (Up to 90%)
- Very Few External Components
- Soft Start
- Reset Output
- Control Circuit for Crowbar SCR
- Input for Remote Inhibit and Synchronous PWM
- Thermal Shutdown

Absolute Maximum Ratings:

Input Voltage (Pin3), V_i	50V
Input –to–Output Voltage Differenct, $V_i - V_2$	0V
Output DC Voltage, V_2	
Continuous	–1V
Peak ($t = 0.1\mu s$, $f = 200kHz$)	–7V
Voltage at Pin1 and Pin12, V_1, V_{12}	10V
Voltage at Pin15, V_{15}	15V
Voltage at Pin4, Pin5, Pin7, Pin9, and Pin13, $V_4, V_5, V_7, V_9, V_{13}$	5.5V
Voltage at Pin10 and Pin6, V_{10}, V_6	7V

Voltage at Pin14 ($I_{14} \leq 1\text{mA}$), V_{14} V_i

Absolute Maximum Ratings (Cont'd):

Pin9 Sink Current, I_9 1mA
Pin11 Source Current, I_{11} 20mA
Pin14 Sink Current ($V_{14} < 5\text{V}$), I_{14} 50mA
Power Dissipation ($T_C \leq +90^\circ\text{C}$), P_{tot} 20W
Operating Junction Temperature Range, T_J -40° to $+150^\circ\text{C}$
Storage Temperature Range, T_{stg} -40° to $+150^\circ\text{C}$
Maximum Thermal Resistance, Junction-to-Case, R_{thJC} 3°C/W
Maximum Thermal Resistance, Junction-to-Ambient, R_{thJA} 35°C/W

Electrical Characteristics: ($V_i = 35\text{V}$, $T_J = +25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Dynamic Characteristics (Pin6 to GND unless otherwise specified)						
Output Voltage Range	V_O	$V_i = 46\text{V}$, $I_O = 1\text{A}$	V_{ref}	–	40	V
Input Voltage Range	V_i	$V_O = V_{\text{ref}}$ to 36V, $I_O \leq 3\text{A}$	–	–	46	V
		$V_O = V_{\text{ref}}$ to 36V, $I_O = 4\text{A}$, Note 1	–	–	46	V
Line Regulation	Reg_{line}	$V_i = 10\text{V}$ to 40V , $V_O = V_{\text{ref}}$, $I_O = 2\text{A}$	–	15	50	mV
Load Regulation	Reg_{load}	$V_O = V_{\text{ref}}$ $I_O = 2\text{A}$ to 4A	–	10	30	mW
		$I_O = 0.5\text{A}$ to 4A	–	15	45	mW
Internal Reference Voltage (Pin10)	V_{ref}	$V_i = 9\text{V}$ to 46V , $I_O = 2\text{A}$	5.0	5.1	5.2	V
Average Temperature Coefficient of Reference Voltage		$T_J = 0^\circ$ to $+125^\circ\text{C}$, $I_O = 2\text{A}$	–	0.4	–	mV/ $^\circ\text{C}$
Dropout Voltage Between Pin2 & Pin3	V_d	$I_O = 4\text{A}$	–	2.0	3.2	V
		$I_O = 2\text{A}$	–	1.3	2.1	V
Current Limiting Threshold (Pin2)	I_{2L}	Pin4 Open, $V_i = 9\text{V}$ to 40V , $V_O = V_{\text{ref}}$ to 36V	4.5	–	7.5	A
Input Average Current	I_{SH}	$V_i = 46\text{V}$, Output Short-Circuited	–	60	100	mA
Efficiency	η	$I_O = 3\text{A}$ $V_O = V_{\text{ref}}$	–	75	–	%
		$V_O = 12\text{V}$	–	85	–	%
Supply Voltage Ripple Rejection	SVR	$\Delta V_i = 2V_{\text{rms}}$, $V_O = V_{\text{ref}}$, $I_O = 2\text{A}$, $f_{\text{ripple}} = 100\text{Hz}$	50	56	–	dB
Switching Frequency	f		85	100	115	kHz
Voltage Stability of Switching Frequency		$V_i = 9\text{V}$ to 46V	–	0.5	–	%
Temperature Stability of Switching Frequency		$T_J = 0^\circ$ to $+125^\circ\text{C}$	–	1	–	%
Maximum Operating Switching Frequency	f_{max}	$V_O = V_{\text{ref}}$, $I_O = 1\text{A}$	200	–	–	kHz
Thermal Shutdown Junction Temperature	T_{sd}		135	145	–	$^\circ\text{C}$

Note 1. Using min. 7A Schottky Diode.

Electrical Characteristics (Cont'd): ($V_i = 35V$, $T_J = +25^{\circ}C$ unless otherwise specified)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
DC Characteristics							
Quiescent Drain Current	I _{3Q}	V _i = 46V, V ₇ = 0V, S1: B, S2: B	V ₆ = 0V	–	66	85	mA
			V ₆ = 3V	–	30	40	mA
Output Leakage Current	–I _{2L}	V _i = 46V, V ₆ = 3V, V ₇ = 0V, S1: B, S2: A		–	–	2	mA
Soft Start							
Source Current	I _{5 so}	V ₆ = 0V, V ₅ = 3V		80	130	150	μA
Sink Current	I _{5 si}	V ₆ = 3V, V ₅ = 3V		50	70	120	μA
Inhibit							
Low Input Voltage	V _{6L}	V _i = 9V to 46V, V ₇ = 0V, S1: B, S2: B		–0.3	–	0.8	V
High Input Voltage	V _{6H}			2.0	–	5.5	V
Input Current with Low Input Voltage	–I _{6L}	V _i = 9V to 46V, V ₇ = 0V, S1: B, S2: B	V ₆ = 0.8V	–	–	10	μA
Input Current with High Input Voltage	–I _{6H}		V ₆ = 2V	–	–	3	μA
Error Amplifier							
High Level Output Voltage	V _{9H}	V ₁₀ = 4.7V, I ₉ = 100μA, S1: A, S2: A		3.5	–	–	V
Low Level Output Voltage	V _{9L}	V ₁₀ = 5.3V, I ₉ = 100μA, S1: A, S2: E		–	–	0.5	V
Sink Output Current	I _{9 si}	V ₁₀ = 5.3V, S1: A, S2: B		100	150	–	μA
Source Output Current	I _{9 so}	V ₁₀ = 4.7V, S1: A, S2: D		100	150	–	μA
Input Bias Current	I ₁₀	V ₁₀ = 5.2V, S1: B		–	2	10	μA
DC Open Loop Gain	G _v	V ₉ = 1V to 3V, S1: A, S2: C		46	55	–	dB
Oscillator and PWM Comprator							
Input Bias Current of PWM Comparator	–I ₇	V ₇ = 0.5V to 3.5V		–	–	5	μA
Oscillator Source Current	–I ₁₁	V ₁₁ = 2V, S1: A, S2: B		5	–	–	mA
Reset							
Rising Threshold Voltage	V _{12 R}	V _i = 9V to 46V, S1: B, S2: B		V _{ref} –150mV	V _{ref} –100mV	V _{ref} –50mV	V
Falling Threshold Voltage	V _{12 F}			4.75	V _{ref} –150mV	V _{ref} –100mV	V
Delay Threshold Voltage	V _{13 D}	V ₁₂ = 5.3V, S1: A, S2: B		4.3	4.5	4.7	V
Delay Threshold Voltage Hysteresis	V _{13 H}			–	100	–	mV
Output Saturation Voltage	V _{12 S}	I ₁₄ = 16mA, V ₁₂ = 4.7V, S1, S2: B		–	–	0.4	V
Input Bias Current	I ₁₂	V ₁₂ = 0V to V _{ref} , S1: B, S2: B		–	1	3	μA
Delay Source Current	–I _{13 so}	V ₁₃ = 3V, S1: A, S2: B	V ₁₂ = 5.3V	70	110	140	μA
Delay Sink Current	I _{13 si}		V ₁₂ = 4.7V	10	–	–	mA
Output Leakage Current	I ₁₄	V _i = 46V, V ₁₂ = 5.3V, S1: B, S2: A		–	–	100	μA
Crowbar							
Input Threshold Voltage	V ₁	S1: B		5.5	6.0	6.4	V
Output Saturation Voltage	V ₁₅	V _i = 9V to 46V, V ₁ = 5.4V, I ₁₅ = 5mA, S1: A		–	0.2	0.4	V
Input Bias Current	I ₁	V ₁ = 6V, S1: B		–	–	10	μA
Output Source Current	–I ₁₅	V _i = 9V to 46V, V ₁ = 6.5V, V ₁₅ = 2V, S1: B		70	100	–	mA

Pin Connection Diagram (Front View)

