

Power Switching Regulator

FEATURES

- Output Switch Current in Excess of 3.0A
- Operation from 2.5V to 40V Input
- Low Standby Current
- Precision 2% Reference
- Controlled Duty Cycle Oscillator
- Driver with Bootstrap Capability for Increased Efficiency
- Cycle-by-Cycle Current Limiting
- Internal Thermal Shutdown Protection
- Low Voltage Indicator Output for Direct Microprocessor Interface
- Heat Tab Power Package

TYPICAL APPLICATIONS

- Set-Top Boxes
- Industrial Controllers
- Network Boxes
- Automotive
- Computing
- Consumer Electronics

GENERAL DESCRIPTION

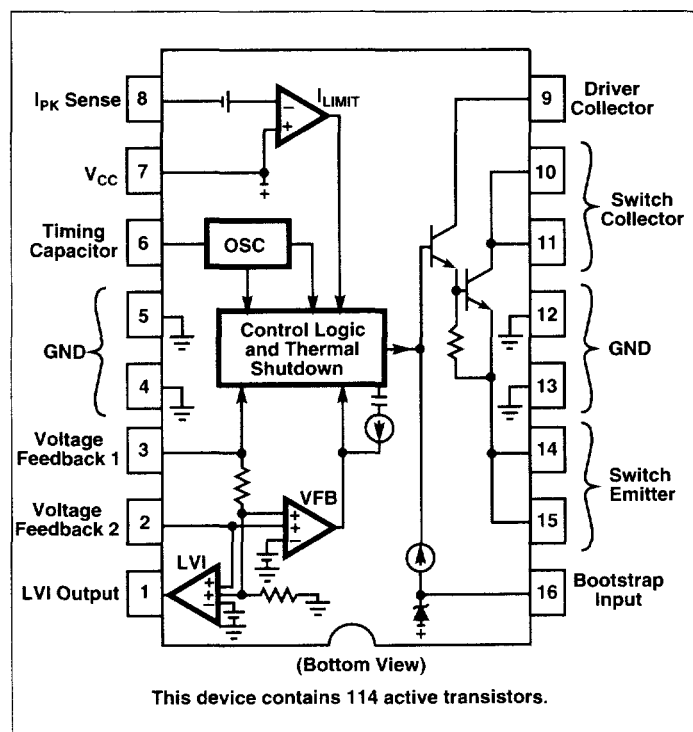
The TC33163 is a monolithic power switching regulator that contains the primary functions required for DC-to-DC converters. This device is specifically designed to be incorporated in step-up, step-down, and voltage-inverting applications with a minimum number of external components.

The TC33163 consists of two high gain voltage feedback comparators, temperature compensated reference, controlled duty cycle oscillator, driver with bootstrap capability for increased efficiency, and a high current output switch. Protective features consist of cycle-by-cycle current limiting, and internal thermal shutdown. Also included is a low voltage indicator output designed to interface with microprocessor based systems. This device is contained in a 16-Pin dual-in-line heat tab plastic package for improved thermal conduction.

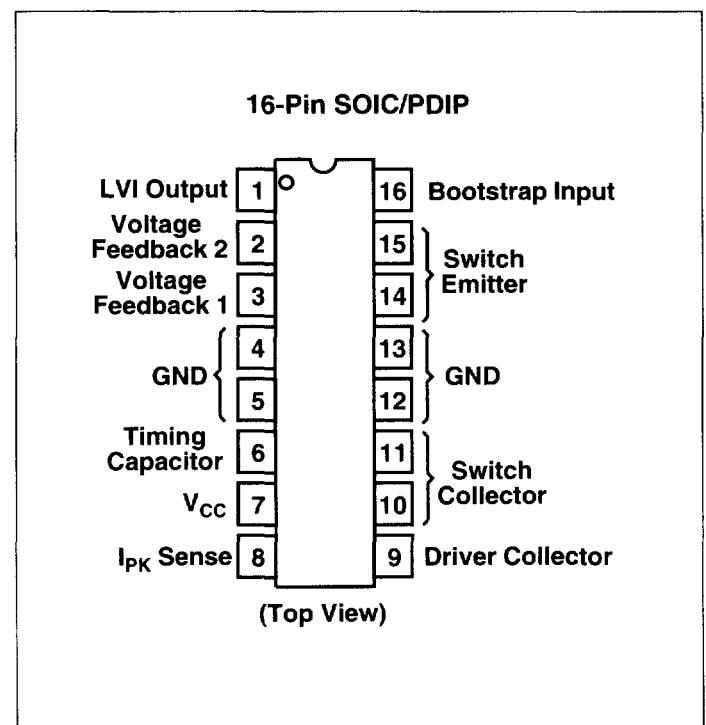
ORDERING INFORMATION

Part Number	Package	Temperature Range
TC33163EOE	16-Pin SOIC (W)	$T_A = -40^\circ$ to $+85^\circ\text{C}$
TC33163EPE	16-Pin PDIP (N)	$T_A = -40^\circ$ to $+85^\circ\text{C}$

REPRESENTATIVE BLOCK DIAGRAM



PIN CONFIGURATIONS



PART III

New Product Data Sheets

TC33163

ABSOLUTE MAXIMUM RATINGS*

Power Supply Voltage $V_{CC} = 40V$
 Switch Collector Voltage Range $V_{C(SWITCH)} = -1.0$ to $40V$
 Switch Emitter Voltage Range $V_{E(SWITCH)} = -2.0$ to $V_{C(SWITCH)}$
 Switch Collector to Emitter Voltage $V_{CE(SWITCH)} = 40V$
 Switch Current (Note 1) $I_{SW} = 3.4A$
 Driver Collector Voltage $V_{C(DRIVER)} = -1.0$ to $40V$
 Driver Collector Current $I_{C(DRIVER)} = 150mA$
 Bootstrap Input Current Range (Note 1) $I_{BS} = -100$ to $+100mA$
 Current Sense Input Voltage Range:
 $V_{LPK(SENSE)} = (V_{CC} - 7.0)$ to $(V_{CC} + 1.0) V$
 Feedback and Timing Capacitor Input Voltage Range:
 $V_{IN} = -1.0$ to $+7.0V$
 Low Voltage Indicator Output Voltage Range:
 $V_{C(LVI)} = -1.0$ to $+40V$

Low Voltage Indicator Output Sink Current $I_{C(LVI)} = 10mA$
 Thermal Characteristics:

16-Pin PDIP (N) Package
 Thermal Resistance, Junction-to-Air $R_{\theta JA} = 80^{\circ}C/W$
 Thermal Resistance, Junction-to-Case $R_{\theta JC} = 15^{\circ}C/W$
 (Pins 4, 5 12, 13)

16-Pin SOIC (W) Package
 Thermal Resistance, Junction-to-Air $R_{\theta JA} = 94^{\circ}C/W$
 Thermal Resistance, Junction-to-Case $R_{\theta JC} = 18^{\circ}C/W$
 (Pins 4, 5 12, 13)

Operating Junction Temperature $T_J = +150^{\circ}C$
 Operating Ambient Temperature (Note 3) ... $T_A = -40$ to $+85^{\circ}C$
 Storage Temperature Range $T_{STG} = -65$ to $+150^{\circ}C$

*This is a stress rating only, and functional operation of the device at these or any other conditions beyond those indicated in the operation section of the specifications is not implied. Exposure to absolute maximum ratings conditions for extended periods of time may affect device reliability.

ELECTRICAL CHARACTERISTICS: $V_{CC} = 15V$, Pin 16 = V_{CC} , $C_T = 620pF$, for typical values $T_A = 25^{\circ}C$, for min/max values T_A is the operating temperature range that applies (Note 3), unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Oscillator						
f_{OSC}	Frequency	$T_A = 25^{\circ}C$ Total variation over $V_{CC} = 2.5V$ to $40V$, and Temperature	46 45	50 —	54 55	kHz
I_{CHG}	Charge Current		—	225	—	μA
I_{DISCHG}	Discharge Current		—	25	—	μA
I_{CHG} / I_{DISCHG}	Charge to Discharge Current Ratio		8.0	9.0	10	—
$V_{OSC(P)}$	Sawtooth Peak Voltage		—	1.25	—	V
$V_{OSC(V)}$	Sawtooth Valley Voltage		—	0.55	—	V
Feedback Comparator 1						
$V_{TH(FB1)}$	Threshold Voltage	$T_A = 25^{\circ}C$ Line Regulation ($V_{CC} = 2.5V$ to $40V$, $T_A = 25^{\circ}C$) Total Variation Over Line, and Temperature	4.9 — 4.85	5.05 0.008 —	5.2 0.03 5.25	V %/V V
$I_{B(FB1)}$	Input Bias Current	$V_{FB1} = 5.05V$	—	100	200	μA
Feedback Comparator 2						
$V_{TH(FB2)}$	Threshold Voltage	$T_A = 25^{\circ}C$ Line Regulation ($V_{CC} = 2.5V$ to $40V$, $T_A = 25^{\circ}C$) Total Variation Over Line, and Temperature	— 1.225	0.008 1.25	0.03 1.275	%/V V
$I_{B(FB2)}$	Input Bias Current	$V_{FB2} = 1.25V$	-0.4	0	0.4	μA

- NOTES:**
1. Maximum package power dissipation limits must be observed.
 2. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
 3. $T_{LOW} = -40^{\circ}C$ $T_{HIGH} = +85^{\circ}C$

ELECTRICAL CHARACTERISTICS: $V_{CC} = 15V$, Pin 16 = V_{CC} , $C_T = 620pF$, for typical values $T_A = 25^\circ C$, for min/max values T_A is the operating ambient temperature range that applies (Note 3), unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Current Limit Comparator						
$V_{TH(LPK\ SENSE)}$	Threshold Voltage	$T_A = 25^\circ C$ Total Variation Over $V_{CC} = 2.5V$ to $40V$, and Temperature	— 230	250 —	— 270	mV
$I_{B(SENSE)}$	Input Bias Current	$V_{LPK\ (SENSE)} = 15V$	—	1.0	20	μA
Driver and Output Switch (Note 2)						
$V_{CE(SAT)}$	Sink Saturation Voltage Non-Darlington Connection Darlington Connection	$I_{SW} = 2.5A$, Pins 14, 15 Grounded $R_{PIN9} = 110$ to V_{CC} , $I_{SW}/I_{DRV} = 20$ Pins 9, 10, 11 Connected	— —	0.6 1.0	1.0 1.4	V
$I_{C(OFF)}$	Collector Off-State Leakage Current	$V_{CE} = 40V$	—	0.02	100	μA
$I_{SOURCE\ (DRV)}$	Bootstrap Input Current Source	$V_{BS} = V_{CC} + 5.0V$	0.5	2.0	4.0	mA
V_Z	Bootstrap Input Zener Clamp Voltage	$I_Z = 25mA$	$V_{CC} + 6.0$	$V_{CC} + 6.0$	$V_{CC} + 9.0$	V
Low Voltage Indicator						
V_{TH}	Input Threshold	V_{FB2} Increasing	1.07	1.125	1.18	V
V_H	Input Hysteresis	V_{FB2} Decreasing	—	15	—	mV
$V_{OL(LVI)}$	Output Sink Saturation Voltage	$I_{SINK} = 2.0mA$	—	0.15	0.4	V
I_{OH}	Output Off-State Leakage Current	$V_{OH} = 15V$	—	0.01	5.0	μA
Total Device						
I_{CC}	Standby Supply Current	$V_{CC} = 2.5V$ to $40V$, Pin 8 = V_{CC} , Pins 6, 14, 15 = GND, Remaining Pins Open	—	6.0	10	mA

- NOTES:** 1. Maximum package power dissipation limits must be observed.
2. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
3. $T_{LOW} = -40^\circ C$ $T_{HIGH} = +85^\circ C$

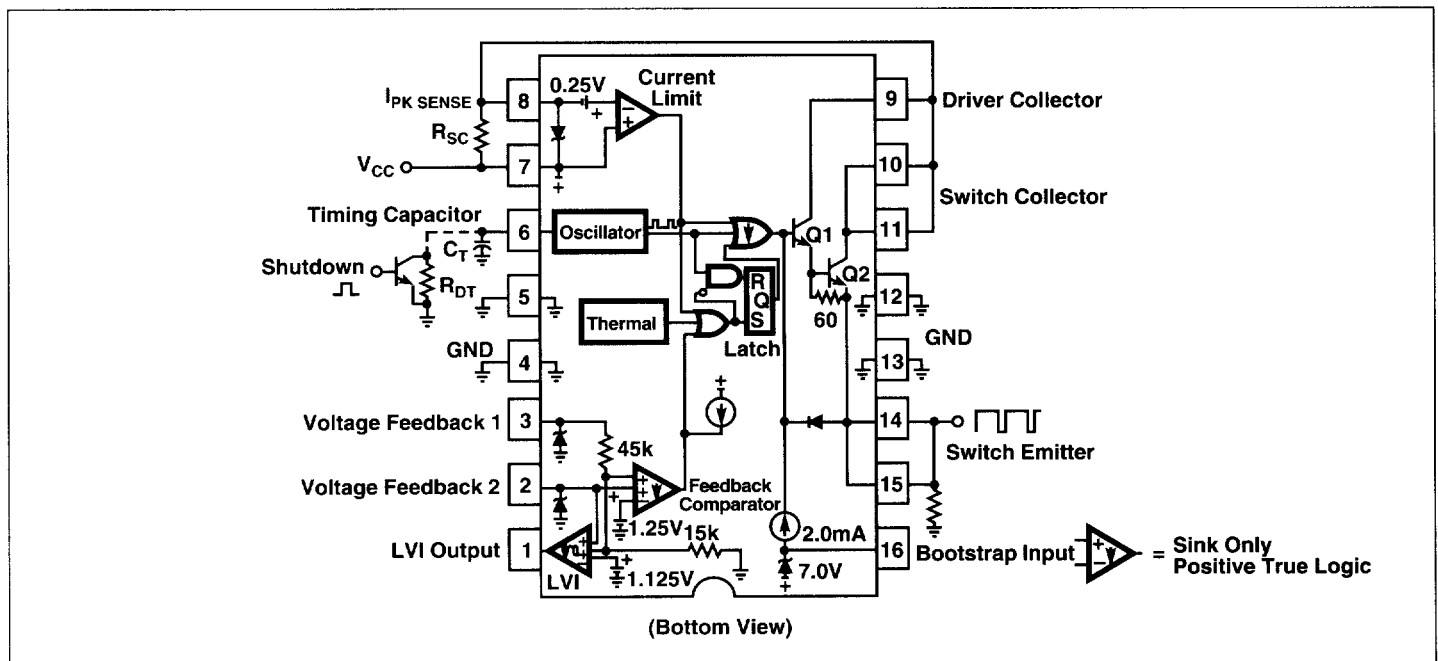


Figure 1. Representative Block Diagram

PART III

New Product Data Sheets

TC33163

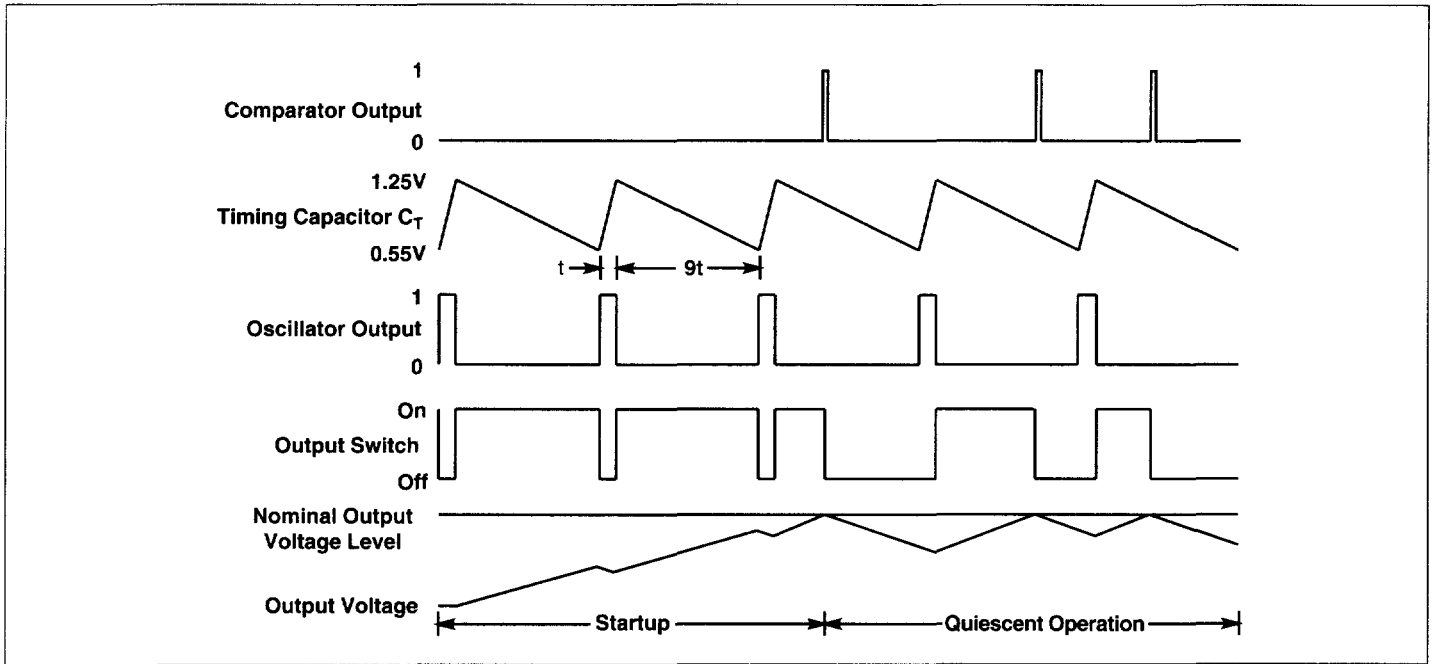


Figure 2. Typical Operating Waveforms