

## 0.5A Step-Down Switching Regulator

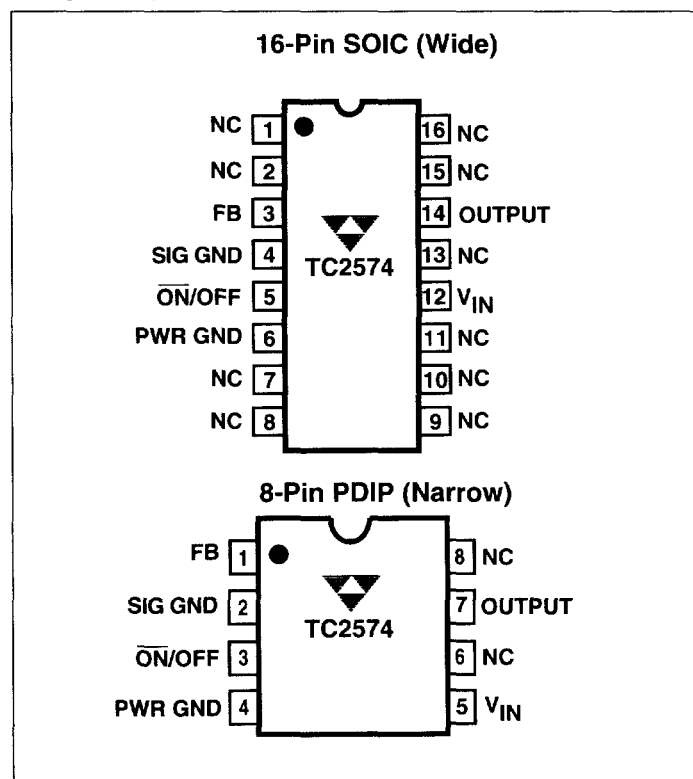
### FEATURES

- 3.3V, 5.0V, 12V and Adjustable Output Versions
- Adjustable Version Output Voltage Range, 1.23 to 37 V  $\pm 4\%$  Max Over Line and Load Conditions
- Guaranteed 0.5 A Output Current
- Wide Input Voltage Range: 4.75 to 40V
- Requires Only 4 External Components
- 52kHz Fixed Frequency Internal Oscillator
- TTL Shutdown Capability, Low Power Standby Mode
- High Efficiency
- Uses Readily Available Standard Inductors
- Thermal Shutdown and Current Limit Protection

### APPLICATIONS

- Simple and High-Efficiency Step-Down (Buck) Regulator
- Efficient Pre-Regulator for Linear Regulators
- On-Card Switching Regulators
- Positive to Negative Converters (Buck-Boost)
- Negative Step-Up Converters
- Power Supply for Battery Chargers

### PIN CONFIGURATIONS



### GENERAL DESCRIPTION

The TC2574 series of regulators are monolithic integrated circuits ideally suited for easy and convenient design of a step-down switching regulator (buck converter). All circuits of this series are capable of driving a 0.5A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5.0V, 12V and an adjustable output version.

These regulators were designed to minimize the number of external components to simplify the power supply design. Standard series of inductors optimized for use with the TC2574 are offered by several different inductor manufacturers.

Since the TC2574 converter is a switch-mode power supply, its efficiency is significantly higher in comparison with popular three-terminal linear regulators, especially with higher input voltages. In most cases, the power dissipated by the TC2574 regulator is so low, that the copper traces on the printed circuit board are normally the only heatsink needed and no additional heatsinking is required.

The TC2574 features include a guaranteed  $\pm 4\%$  tolerance on output voltage within specified input voltages and output load conditions, and  $\pm 10\%$  on the oscillator frequency ( $\pm 2\%$  over  $0^\circ\text{C}$  to  $+125^\circ\text{C}$ ). External shutdown is included, featuring 60 $\mu\text{A}$  (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

### ORDERING INFORMATION

Part Number	Package	Temperature Range
TC2574-3.3VPA	8-Pin PDIP (Narrow)	-40 to +125°C
TC2574-5.0VPA	8-Pin PDIP (Narrow)	-40 to +125°C
TC2574-12.0VPA	8-Pin PDIP (Narrow)	-40 to +125°C
TC2574-VPA*	8-Pin PDIP (Narrow)	-40 to +125°C
TC2574-VOE*	16-Pin SOIC (Wide)	-40 to +125°C

Note: \*ADJ = 1.23 To 37V.

# PART III

## New Product Data Sheets

### 0.5A Step-Down Switching Regulator

#### TC2574

##### ABSOLUTE MAXIMUM RATINGS\*

Maximum Supply Voltage .....	$V_{IN} = 45V$
ON/OFF Pin Input Voltage .....	$-0.3V \leq V \leq +V_{IN}$
Output Voltage to Ground (Steady State) .....	$-1.0V$
Max Power Dissipation (SOIC) .....	(Internally Limited)
Thermal Resistance, Junction-to-Ambient .....	$145^{\circ}C/W$
Max Power Dissipation (PDIP) .....	(Internally Limited)
Thermal Resistance, Junction-to-Ambient .....	$100^{\circ}C/W$
Thermal Resistance, Junction-to-Case .....	$5.0^{\circ}C/W$
Storage Temperature Range .....	$-65^{\circ}C$ to $+150^{\circ}C$

Minimum ESD Rating .....	2.0kV
(Human Body Model: $C = 100\text{ pF}$ , $R = 1.5\text{ k}$ )	
Lead Temperature (Soldering, 10 seconds) .....	$260^{\circ}C$
Maximum Junction Temperature .....	$150^{\circ}C$
Operating Junction Temperature Range .....	$-40$ to $+125^{\circ}C$
Supply Voltage .....	40V

\*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:** Unless otherwise specified,  $V_{IN} = 12V$  for the 3.3V, 5.0V, and Adjustable version,  $V_{IN} = 25V$  for the 12V version.  $I_{LOAD} = 100mA$ . For typical values  $T_J = 25^{\circ}C$ , for min/max values  $T_J$  is the operating junction temperature range that applies (Note 2), unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>TC2574-3.3 [( Note 1) Test Circuit Figure 2]</b>						
$V_{OUT}$	Output Voltage	$V_{IN} = 12V$ , $I_{LOAD} = 100mA$ , $T_J = 25^{\circ}C$ $4.75V \leq V_{IN} \leq 40V$ , $0.1A \leq I_{LOAD} \leq 0.5A$ $T_J = 25^{\circ}C$ $T_J = -40^{\circ}C$ to $+125^{\circ}C$	3.234 3.168 3.135	3.3 3.3 —	3.366 3.432 3.465	V
$\eta$	Efficiency	$V_{IN} = 12V$ , $I_{LOAD} = 0.5A$	—	72	—	%
<b>TC2574-5 [( Note 1) Test Circuit Figure 2]</b>						
$V_{OUT}$	Output Voltage	$V_{IN} = 12V$ , $I_{LOAD} = 100mA$ , $T_J = 25^{\circ}C$ $7.0V \leq V_{IN} \leq 40V$ , $0.1A \leq I_{LOAD} \leq 0.5A$ $T_J = 25^{\circ}C$ $T_J = -40^{\circ}C$ to $+125^{\circ}C$	4.9 4.8 4.75	5.0 5.0 —	5.1 5.2 5.25	V
$\eta$	Efficiency	$V_{IN} = 12V$ , $I_{LOAD} = 0.5A$	—	77	—	%
<b>TC2574-12 [( Note 1) Test Circuit Figure 2]</b>						
$V_{OUT}$	Output Voltage	$V_{IN} = 25V$ , $I_{LOAD} = 100mA$ , $T_J = 25^{\circ}C$ $15V \leq V_{IN} \leq 40V$ , $0.1A \leq I_{LOAD} \leq 0.5A$ $T_J = 25^{\circ}C$ $T_J = -40^{\circ}C$ to $+125^{\circ}C$	11.76 11.52 11.4	10 12 —	12.24 12.48 12.6	V
$\eta$	Efficiency	$V_{IN} = 15V$ , $I_{LOAD} = 0.5A$	—	88	—	%
<b>TC2574-Adjustable Version [( Note 1) Test Circuit Figure 2]</b>						
$V_{FB}$	Feedback Voltage	$V_{IN} = 12V$ , $I_{LOAD} = 100mA$ , $V_{OUT} = 5.0V$ , $T_J = 25^{\circ}C$	1.217	1.23	1.243	V
$V_{FBT}$	Feedback Voltage	$7.0V \leq V_{IN} \leq 40V$ , $0.1A \leq I_{LOAD} \leq 0.5A$ $V_{OUT} = 5.0V$ $T_J = 25^{\circ}C$ $T_J = -40^{\circ}C$ to $+125^{\circ}C$	1.193 1.18	1.23 —	1.267 1.28	
$\eta$	Efficiency	$V_{IN} = 12V$ , $I_{LOAD} = 0.5A$ , $V_{OUT} = 5.0V$	—	77	—	%

- NOTES:** 1. External components such as the catch diode, inductor, input and output capacitors can affect the switching regulator system performance. When the TC2574 is used as shown in the Figure 2 test circuit, the system performance will be as shown in the system parameters section of the Electrical Characteristics.
2. Tested junction temperature range for the TC2574:  $T_{LOW} = -40^{\circ}C$   $T_{HIGH} = +125^{\circ}C$

**ELECTRICAL CHARACTERISTICS:** Unless otherwise specified,  $V_{IN} = 12V$  for the 3.3V, 5.0V, and Adjustable version,  $V_{IN} = 25V$  for the 12V version.  $I_{LOAD} = 100mA$ . For typical values  $T_J = 25^\circ C$ , for min/max values  $T_J$  is the operating junction temperature range that applies (Note 2), unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>TC2574-ADJUSTABLE VERSION [(Note 1) Test Circuit Figure 2]</b>						
$I_b$	Feedback Bias Current	$V_{OUT} = 5.0V$ (Adjustable Version Only) $T_J = 25^\circ C$ $T_J = -40^\circ C$ to $+125^\circ C$	— —	25 —	100 200	nA
$f_o$	Oscillator Frequency (Note 3)	$T_J = 25^\circ C$ $T_J = 0$ to $+125^\circ C$ $T_J = -40$ to $+125^\circ C$	— 47 42	52 52 —	— 58 63	kHz
$V_{SAT}$	Saturation Voltage	$I_{OUT} = 0.5 A$ , (Note 4) $T_J = 25^\circ C$ $T_J = -40$ to $+125^\circ C$	— —	1.0 —	1.2 1.4	V
DC	Max Duty Cycle ("on") [Note 5]		93	98	—	%
$I_{CL}$	Current Limit Peak Current (Notes 3 and 4)	$T_J = 25^\circ C$ $T_J = -40$ to $+125^\circ C$	0.7 0.65	1.0 —	1.6 1.8	A
$I_L$	Output Leakage Current (Notes 6 and 7), $T_J = 25^\circ C$	Output = 0 V Output = - 1.0 V	— —	0.6 10	2.0 30	mA
$I_Q$	Quiescent Current (Note 6)	$T_J = 25^\circ C$ $T_J = -40$ to $+125^\circ C$	— —	5.0 —	9.0 11	mA
$I_{STBY}$	Standby Quiescent Current	ON/OFF Pin = 5.0 V ("off") $T_J = 25^\circ C$ $T_J = -40$ to $+125^\circ C$	— —	60 —	200 400	$\mu A$
$V_{IH}$	ON/OFF Pin Logic Input Level	$V_{OUT} = 0V$ $T_J = 25^\circ C$ $T_J = -40$ to $+125^\circ C$	2.2 2.4	1.4 —	— —	V
$V_{IL}$	Nominal Output Voltage	$T_J = 25^\circ C$ $T_J = -40$ to $+125^\circ C$	— —	1.2 —	1.0 0.8	
$I_{IH}$	ON/OFF Pin Input Current mA	ON/OFF Pin = 5.0V ("off"), $T_J = 25^\circ C$	—	15	30	$\mu A$
$I_{IL}$	ON/OFF Pin Input Current mA	ON/OFF Pin = 0 ("on"), $T_J = 25^\circ C$	—	0	5.0	$\mu A$

- NOTES:**
- External components such as the catch diode, inductor, input and output capacitors can affect the switching regulator system performance. When the TC2574 is used as shown in the Figure 2 test circuit, the system performance will be as shown in the system parameters section of the Electrical Characteristics.
  - Tested junction temperature range for the TC2574:  $T_{LOW} = -40^\circ C$   $T_{high} = +125^\circ C$
  - The oscillator frequency reduces to approximately 18kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.
  - Output (Pin 2) sourcing current. No diode, inductor or capacitor connected to the output pin.
  - Feedback (Pin 4) removed from output and connected to 0 V.
  - Feedback (Pin 4) removed from output and connected to 12V for the Adjustable, 3.3V, and 5.0V versions, and 25V for the 12V version, to force the output transistor OFF.
  - $V_{IN} = 40 V$ .

# PART III

## New Product Data Sheets

### 0.5A Step-Down Switching Regulator

#### TC2574

#### PIN DESCRIPTION

Pin No. 8-Pin PDIP	Pin No 16-Pin SOIC	Symbol	Description
5	12	$V_{IN}$	This pin is the positive input supply for the TC2574 step-down switching regulator. In order to minimize voltage transients and to supply the switching currents needed by the regulator, a suitable input bypass capacitor must be present ( $C_{IN}$ in Figure 1).
7	14	Output	This is the emitter of the internal switch. The saturation voltage $V_{SAT}$ of this output switch is typically 1.0V. It should be kept in mind that the PCB area connected to this pin should be kept to a minimum in order to minimize coupling to sensitive circuitry.
2	4	SIG Gnd	Circuit signal ground pin. See the information about the printed circuit board layout.
4	6	PWR GND	Circuit power ground pin. See the information about the printed circuit board layout.
1	3	FB	This pin senses regulated output voltage to complete the feedback loop. The signal is divided by the internal resistor divider network R2, R1 and applied to the non-inverting input of the internal error amplifier. In the adjustable version of the TC2574 switching regulator, this pin is the direct input of the error amplifier and the resistor network R2, R1 is connected externally to allow programming of the output voltage.
3	5	ON/OFF	It allows the switching regulator circuit to be shut down using logic level signals, thus dropping the total input supply current to approximately 80 $\mu$ A. The input threshold voltage is typically 1.5V. Applying a voltage above this value (up to $+V_{IN}$ ) shuts the regulator off. If the voltage applied to this pin is over than 1.5 V or if this pin is left open, the regulator will be in the "on" condition.

#### REPRESENTATIVE BLOCK DIAGRAM AND TYPICAL APPLICATION

