

# ADVANCE INFORMATION

All information in this data sheet is preliminary and subject to change.

8/93

EVALUATION KIT AVAILABLE



## Low-Voltage-Input, Step-Up DC-DC Converters

### General Description

The MAX777/MAX778/MAX779 are pulse-skipping, DC-DC converters that step-up from low-voltage inputs (1V, guaranteed). They require only three external components—an inductor (typically 22 $\mu$ H), and two capacitors. The MAX777 delivers a 5V output, the MAX778 generates pin-selectable voltages of 3.0V or 3.3V, and the MAX779 output can be adjusted from 1V to 6V via an external resistor divider.

The devices include an active rectifier that eliminates the need for an external catch diode. It also permits regulation even when the input is greater than the output. And, unlike other step-up converters, the MAX777/MAX778/MAX779's active rectifier is disabled in shutdown mode. When disabled, the active rectifier appears as a very high impedance in series with the input, inductor, and load. This high impedance effectively stops current drain associated with conventional step-up converters in the shutdown state.

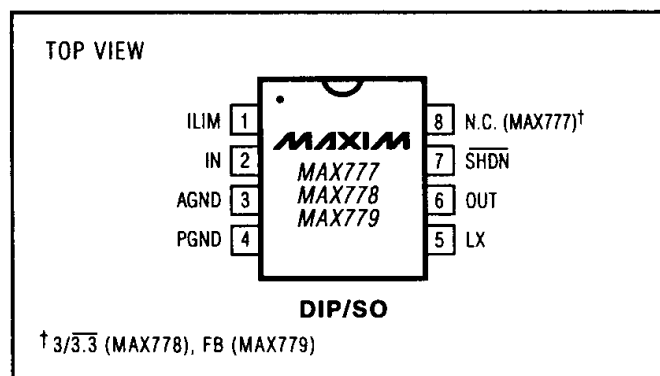
The high-frequency operation of these devices (up to 300kHz) allows the use of small surface-mount inductors with values of 10 $\mu$ H or less. Supply current is 220 $\mu$ A under no load and only 20 $\mu$ A in the standby mode. Supply voltage can range from 1V to 6.2V (1 to 4 cells). With a 2V input, these devices can deliver 200mA at 5V or 300mA at 3V.

For step-up/step-down applications (where the input can be both above and below the output), refer to the MAX877/MAX878/MAX879 data sheet.

### Applications

- Single Battery-Cell (1V), Step-Up Voltage Conversion
- Efficient, High-Power Step-Up Regulation from Low Input Voltages
- Pagers
- Portable Instruments & Handy-Terminals
- Laptop and Palmtop Computers

### Pin Configuration



### Features

- ◆ 1V to 6.2V Input Guaranteed Start-Up Under Load
- ◆ Up to 240mA Outputs
- ◆ 85% Typical Efficiency
- ◆ Also Regulates When Input Voltage is Above the Output Voltage
- ◆ Internal 1A Power Switch
- ◆ Adjustable Current-Limit
- ◆ Internal 1A Active Rectifier with Input-to-Load Disconnect in Shutdown
- ◆ 220 $\mu$ A Quiescent Supply Current
- ◆ 20 $\mu$ A Shutdown Supply Current
- ◆ 3V/3.3V, 5V, and Adjustable Output-Voltage Versions

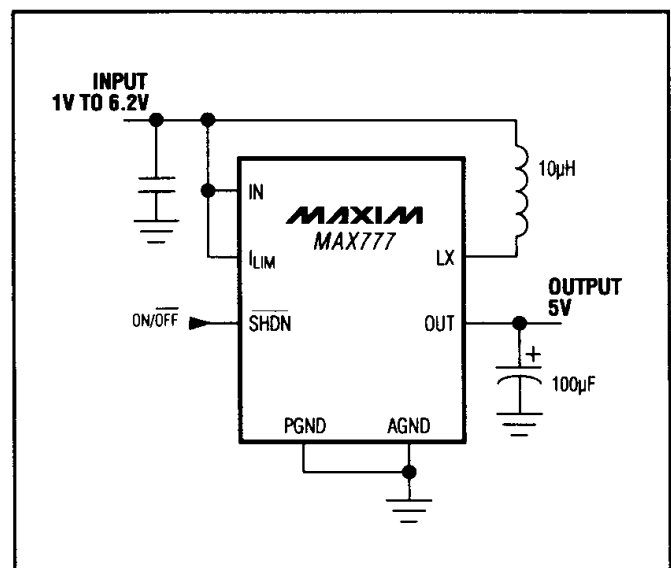
### Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX777CPA	0°C to +70°C	8 Plastic DIP
MAX777CSA	0°C to +70°C	8 SO
MAX777C/D	0°C to +70°C	Dice*
MAX777EPA	-40°C to +86°C	8 Plastic DIP
MAX777ESA	-40°C to +85°C	8 SO
MAX777MJA	-55°C to +125°C	8 CERDIP

Ordering Information continued on last page.

\* Contact factory for dice specifications.

### Typical Operating Circuit



# Low-Voltage-Input, 3V/3.3V/5V/Adjustable-Output, Step-Up DC-DC Converters

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = 2.5V$ ,  $I_{LOAD} = 0mA$ ,  $L_X = 22\mu H$ ,  $C_F = 100\mu F$ ,  $\overline{SHDN}$  and  $I_{LIM}$  connected to IN,  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Output Voltage MAX778	0mA < $I_{LOAD}$ < 100mA	3V/3.3V = open: 1.0V < $V_{IN}$ < 3V ( $T_A = +25^\circ C$ ), 1.1V < $V_{IN}$ < 3V (C temp range), 1.2V < $V_{IN}$ < 3V (E temp range)	2.88	3.00	3.12	V
		3V/3.3V = 0V: 1.0V < $V_{IN}$ < 3.3V ( $T_A = +25^\circ C$ ), 1.1V < $V_{IN}$ < 3.3V (C temp range), 1.2V < $V_{IN}$ < 3.3V (E temp range)	3.17	3.30	3.43	
	0mA < $I_{LOAD}$ < 240mA	3V/3.3V = open: 1.8V < $V_{IN}$ < 3V ( $T_A = T_{MIN}$ to $T_{MAX}$ )	2.88	3.00	3.12	
		3V/3.3V=0V: 1.8V < $V_{IN}$ < 3V ( $T_A = T_{MIN}$ to $T_{MAX}$ )	3.17	3.30	3.43	
Output Voltage MAX777	0mA < $I_{LOAD}$ < 60mA	1.0V < $V_{IN}$ < 5V ( $T_A = +25^\circ C$ ), 1.1V < $V_{IN}$ < 5V (C temp range), 1.2V < $V_{IN}$ < 5V (E temp range)	4.8	5.0	5.2	V
	0mA < $I_{LOAD}$ < 150mA	1.8V < $V_{IN}$ < 5V ( $T_A = T_{MIN}$ to $T_{MAX}$ )	4.8	5.0	5.2	
Efficiency	$I_{LOAD} = 100mA$ , $V_{IN} = 2.5V$		86			%
No-Load Supply Current	$T_A = T_{MIN}$ to $T_{MAX}$ , $I_{LOAD} = 0mA$		220 310			$\mu A$
Shutdown Supply Current	$T_A = T_{MIN}$ to $T_{MAX}$ , $0V < \overline{SHDN} < V_{STH}$		0	20	30	$\mu A$
SHDN Bias Current	$T_A = T_{MIN}$ to $T_{MAX}$	$0V < \overline{SHDN} < V_{STH}$	100			nA
		$V_{STH} < \overline{SHDN} < 5V$	40			$\mu A$
SHDN Threshold (VSTH)	$T_A = T_{MIN}$ to $T_{MAX}$	$V_{IN} = 1V$	0.55	0.90		V
		$V_{IN} = 2.5V$	1.20	1.60		
		$V_{IN} = 5V$	2.00	2.80		
SHDN Enable Delay			150			$\mu s$
Current Limit			1.0			A
Current Limit Tempco			-0.3			%/ $^\circ C$
Switch Saturation Voltage	$I_{SW} = 400mA$		0.275			V
	$I_{SW} = 600mA$		0.350			
	$I_{SW} = 1000mA$		0.550			
Switch-Off Leakage Current	$T_A = T_{MIN}$ to $T_{MAX}$ , $0V < \overline{SHDN} < V_{STH}$		0.4	2.0		$\mu A$
Maximum Switch-On Time	$V_{IN} = 2.5V$		4.0			$\mu s$
	$V_{IN} = 1.8V$		5.9			
	$V_{IN} = 1V$		12.6			
Minimum Switch-Off Time	MAX778		2.5			$\mu s$
	MAX777		1.5			
Rectifier Forward Voltage Drop	$I_{OUT} = 400mA$		0.21			V
	$I_{OUT} = 600mA$		0.31			
	$I_{OUT} = 1000mA$		0.50			

## Low-Voltage-Input, 3V/3.3V/5V/Adjustable-Output, Step-Up DC-DC Converters

### ELECTRICAL CHARACTERISTICS (continued)

( $V_{IN} = 2.5V$ ,  $I_{LOAD} = 0mA$ ,  $LX = 22\mu H$ ,  $CF = 100\mu F$ ,  $\overline{SHDN}$  and  $IN$  connected to  $V_{IN}$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Current in Shutdown	$0V < \overline{SHDN} < V_{STH}$ , $T_A = T_{MIN}$ to $T_{MAX}$	MAX778, $V_{OUT} = 3V$	10	20	$\mu A$
		MAX777, $V_{OUT} = 5V$	10	20	
Reverse Leakage Current into LX	$0V < \overline{SHDN} < V_{STH}$ , $T_A = T_{MIN}$ to $T_{MAX}$	MAX778, $V_{OUT} = 3V$	0.1	3.0	$\mu A$
		MAX777, $V_{OUT} = 5V$	0.1	3.0	
Operating Input Voltage MAX778	3V/3.3V = open	$T_A = +25^\circ C$	1.0	6.2	V
		C temp. range	1.1	6.2	
		E temp. range	1.2	6.2	
	3V/3.3V = 0V	$T_A = +25^\circ C$	1.0	6.2	
		C temp. range	1.1	6.2	
		E temp. range	1.3	6.2	
Operating Input Voltage MAX777		$T_A = +25^\circ C$	1.0	6.2	V
		C temp. range	1.1	6.2	
		E temp. range	1.2	6.2	
Error Comparator Trip Point	Over operating input voltage, $T_A = T_{MIN}$ to $T_{MAX}$	0.195	0.200	0.205	V
FB Pin Bias Current	MAX779, $T_A = T_{MIN}$ to $T_{MAX}$		10	40	nA

### Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
MAX778CPA	0°C to +70°C	8 Plastic DIP
MAX778CSA	0°C to +70°C	8 SO
MAX778C/D	0°C to +70°C	Dice*
MAX778EPA	-40°C to +85°C	8 Plastic DIP
MAX778ESA	-40°C to +85°C	8 SO
MAX778MJA	-55°C to +125°C	8 CERDIP
MAX779CPA	0°C to +70°C	8 Plastic DIP
MAX779CSA	0°C to +70°C	8 SO
MAX779C/D	0°C to +70°C	Dice*
MAX779EPA	-40°C to +85°C	8 Plastic DIP
MAX779ESA	-40°C to +85°C	8 SO
MAX779MJA	-55°C to +125°C	8 CERDIP

\* Contact factory for availability and dice specifications.

