

19-4667; Rev 0; 9/92



Switched-Capacitor Voltage Converters

General Description

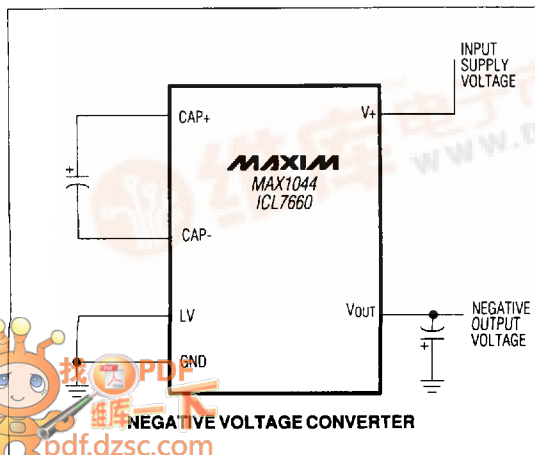
The MAX1044 and ICL7660 are monolithic, CMOS switched-capacitor voltage converters that invert, double, divide, or multiply input voltage. They are pin compatible with the industry-standard ICL7660. Operation is guaranteed to 10V with no external diode over the full temperature range. The MAX1044 has a BOOST pin that raises the oscillator frequency above the audio band and also reduces external capacitor size.

The MAX1044/ICL7660 combine low quiescent current with high efficiency. Oscillator control circuitry and four power MOS switches are included on-chip. Applications include generating a -5V supply from a +5V logic supply to power analog circuitry. When used as doublers, these devices generate 6V from a single 3V lithium cell, or 3V from a single 1.5V alkaline cell. For applications requiring more power, the MAX660 can deliver up to 100mA with a voltage drop of less than 0.65V.

Applications

- 5V Supply from +5V Logic Supply
- Personal Communication Equipment
- Op-Amp Power Supplies
- EIA/TIA-232E and EIA/TIA-562 Power Supplies
- Data-Acquisition Systems
- Hand-Held Instruments
- Panel Meters

Typical Operating Circuit



Features

- ◆ 1.5V to 10.0V Operating Supply Voltage Range
- ◆ 95% Min Power-Conversion Efficiency
- ◆ Invert, Double, Divide, or Multiply Input Voltage
- ◆ BOOST Pin Increases Switching Frequencies (MAX1044)
- ◆ No-Load Supply Current: 200µA Max at 5V
- ◆ No External Diode Required for Higher Voltage Operation

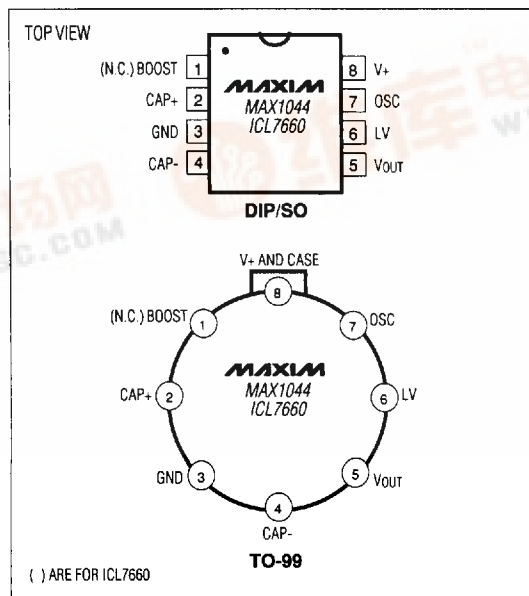
Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|------------|----------------|---------------|
| MAX1044CPA | 0°C to +70°C | 8 Plastic DIP |
| MAX1044CSA | 0°C to +70°C | 8 SO |
| MAX1044CTV | 0°C to +70°C | 8 TO-99 |
| MAX1044C/D | 0°C to +70°C | Dice* |
| MAX1044EPA | -40°C to +85°C | 8 Plastic DIP |
| MAX1044ESA | -40°C to +85°C | 8 SO |
| MAX1044ETV | -40°C to +85°C | 8 TO-99 |

Ordering Information continued on last page.

* Contact factory for dice specifications.

Pin Configurations



MAX1044/ICL7660

MAX1044/ICL7660

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ABSOLUTE MAXIMUM RATINGS

| | | | |
|--|--------------------------------------|---|-----------------|
| Supply Voltage (V+ to GND, or GND to Vout) | 10.5V | CERDIP (derate 8.00mW/°C above +70°C) | 640mW |
| Input Voltage on Pins 1, 6, and 7 | | TO-99 (derate 6.67mW/°C above +70°C) | 533mW |
| (Note 1) | $-0.3V \leq V_{IN} \leq (V+ + 0.3V)$ | Operating Temperature Ranges: | |
| LV Input Current (Note 1) | 20 μ A | MAX1044C_/ICL7660C | 0°C to +70°C |
| Output Short-Circuit Duration (V+ \leq 5.5V) | Continuous | MAX1044I_/ICL7660I | -25°C to +85°C |
| Continuous Power Dissipation (TA = +70°C) | | MAX1044E_/ICL7660E | -40°C to +85°C |
| Plastic DIP (derate 9.09mW/°C above +70°C) | 727mW | MAX1044M_/ICL7660M | -55°C to +125°C |
| SO (derate 5.88mW/°C above +70°C) | 471mW | Storage Temperature Range | -65°C to +150°C |
| | | Lead Temperature (soldering, 10 sec) | +300°C |

Note 1: Connecting any input terminal to voltages greater than V+ or less than ground may cause latchup. Do not apply any inputs from sources operating from external supplies before device power-up.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(Circuit of Figure 1, V+ = 5.0V, LV pin = 0V, BOOST pin = open, ILOAD = 0mA, TA = TMIN to TMAX, unless otherwise noted.)

| PARAMETER | CONDITIONS | MAX1044 | | ICL7660 | | UNITS |
|-----------------------------------|--|-------------------------------|---------|---------|---------|------------|
| | | MIN | TYP MAX | MIN | TYP MAX | |
| Supply Current | RL = ∞ , pins 1 and 7 no connection, LV open | TA = +25°C | | 30 | 200 | μ A |
| | | TA = 0°C to +70°C | | 200 | | |
| | | TA = -40°C to +85°C | | 200 | | |
| | | TA = -55°C to +125°C | | 200 | | |
| | RL = ∞ , pins 1 and 7 = V+ = 3V | | 10 | | | |
| Supply Voltage Range (Note 1) | RL = 10k Ω , LV open | | | 3.0 | 10.0 | V |
| | RL = 10k Ω , LV to GND | 1.5 | 10 | 1.5 | 3.5 | |
| Output Resistance | IL = 20mA, fOSC = 5kHz, LV open | TA = +25°C | | 65 | 100 | Ω |
| | | TA = 0°C to +70°C | | 130 | | |
| | | TA = -40°C to +85°C | | 130 | | |
| | | TA = -55°C to +125°C (Note 2) | | 150 | 150 | |
| | fOSC = 2.7kHz (ICL7660), fOSC = 1kHz (MAX1044), V+ = 2V, IL = 3mA, LV to GND | TA = +25°C | | 325 | 250 | |
| | | TA = 0°C to +70°C | | 325 | 300 | |
| | | TA = -40°C to +85°C | | 325 | 300 | |
| | | TA = -55°C to +125°C | | 400 | 400 | |
| Oscillator Frequency | COSC = 1pF, LV to GND (Note 3) | V+ = 5V | | 5 | 10 | kHz |
| | | V+ = 2V | | 1 | | |
| | | | | | | |
| Power Efficiency | RL = 5k Ω , TA = +25°C, fOSC = 5kHz, LV open | 95 | 98 | 95 | 98 | % |
| Voltage Conversion Efficiency | RL = ∞ , TA = +25°C, LV open | 97.0 | 99.9 | 99.0 | 99.9 | % |
| Oscillator Sink or Source Current | VOSC = 0V or V+, LV open | Pin 1 = 0V | | 3 | | μ A |
| | | Pin 1 = V+ | | 20 | | |
| Oscillator Impedance | TA = +25°C | V+ = 2V | | 1.0 | 1.0 | M Ω |
| | | V+ = 5V | | 100 | 100 | k Ω |
| | | | | | | |

Note 1: The Maxim ICL7660 and MAX1044 can operate without an external output diode over the full temperature and voltage ranges. The Maxim ICL7660 can also be used with the external output diode DX when replacing the Intersil ICL7660. Tests performed with DX out of circuit.

Note 2: Maxim ICL7660A and MAX1044 only.

Note 3: fOSC is tested with COSC = 100pF to minimize the effects of test fixture capacitance loading. The 1pF frequency is correlated to this 100pF test point, and is intended to simulate pin 7's capacitance when the device is plugged into a test socket with no external capacitor. For this test, the LV pin is connected to GND for comparison to the original manufacturer's device, which automatically connects this pin to GND for (V+ > 3V).

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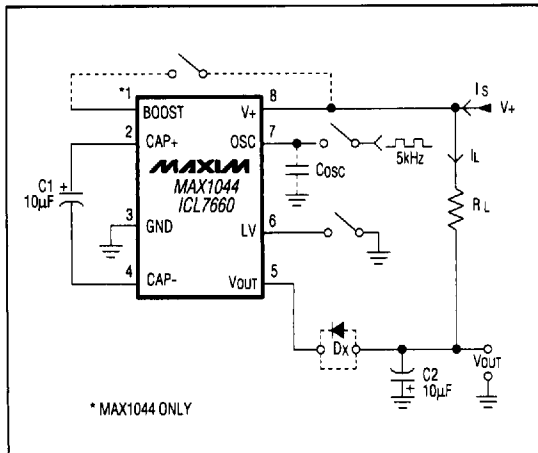


Figure 1. Maxim ICL7660 and MAX1044 Test Circuit (C1 and C2 should be increased to 100µF if C_{osc} exceeds 10pF). Note: Dx not required with Maxim ICL7660 or MAX1044.

Ordering Information (continued)

| PART | TEMP. RANGE | PIN-PACKAGE |
|-------------|-------------------|---------------|
| MAX1044MJA | -55°C to +125°C | 8 CERDIP** |
| MAX1044MTV | -55°C to +125°C | 8 TO-99** |
| ICL7660CPA | 0°C to +70°C | 8 Plastic DIP |
| ICL7660CSA | 0°C to +70°C | 8 SO |
| ICL7660CTV | 0°C to +70°C | 8 TO-99 |
| ICL7660C/D | 0°C to +70°C | Dice* |
| ICL7660IPA | -20°C to +85°C | 8 Plastic DIP |
| ICL7660ISA | -20°C to +85°C | 8 SO |
| ICL7660IJA | -20°C to +85°C | 8 CERDIP |
| ICL7660ITV | -20°C to +85°C | 8 TO-99 |
| ICL7660EPA | -40°C to +85°C | 8 Plastic DIP |
| ICL7660ESA | -40°C to +85°C | 8 SO |
| ICL7660EJA | -40°C to +85°C | 8 CERDIP |
| ICL7660ETV | -40°C to +85°C | 8 TO-99 |
| ICL7660MTV | Order ICL7660AMTV | |
| ICL7660AMJA | -55°C to +125°C | 8 CERDIP** |
| ICL7660AMTV | -55°C to +125°C | 8 TO-99** |

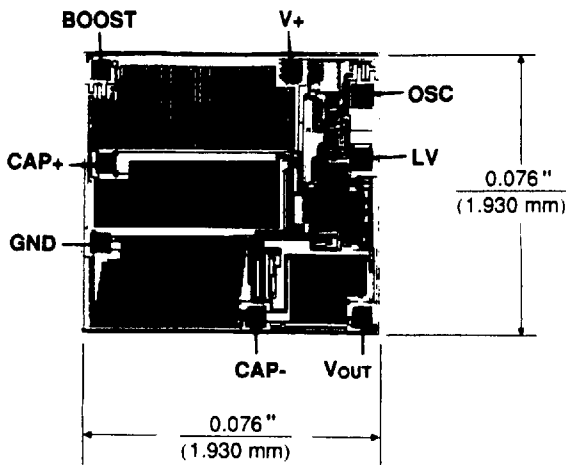
* Contact factory for dice specifications.

** Contact factory for availability and processing to MIL-STD-883.

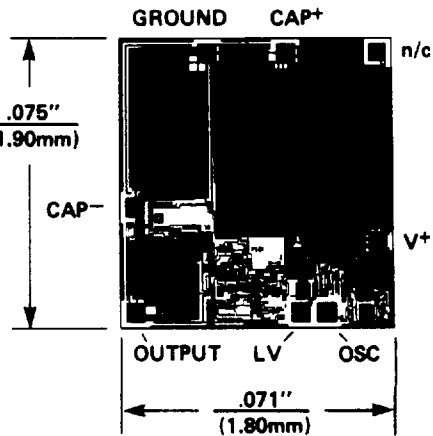
MAX1044/ICL7660

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Chip Topographies



MAX1044



ICL7660