Data Sheet | January 2004 | FN3179.3

Super Voltage Converter

The ICL7660S Super Voltage Converter is a monolithic CMOS voltage conversion IC that guarantees significant performance advantages over other similar devices. It is a direct replacement for the industry standard ICL7660 offering an **extended** operating supply voltage range up to 12V, with **lower** supply current. **No external diode** is needed for the ICL7660S. In addition, a **Frequency Boost pin** has been incorporated to enable the user to achieve lower output impedance despite using smaller capacitors. All improvements are highlighted in the Electrical Specifications section. **Critical parameters are guaranteed over the entire commercial, industrial and military temperature ranges.**

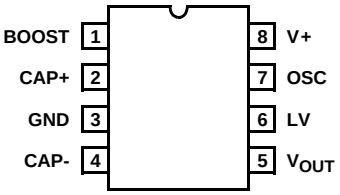
The ICL7660S performs supply voltage conversion from positive to negative for an input range of 1.5V to 12V, resulting in complementary output voltages of -1.5V to -12V. Only 2 non-critical external capacitors are needed for the charge pump and charge reservoir functions. The ICL7660S can be connected to function as a voltage doubler and will generate up to 22.8V with a 12V input. It can also be used as a voltage multiplier or voltage divider.

The chip contains a series DC power supply regulator, RC oscillator, voltage level translator, and four output power MOS switches. The oscillator, when unloaded, oscillates at a nominal frequency of 10kHz for an input supply voltage of 5.0V. This frequency can be lowered by the addition of an external capacitor to the “OSC” terminal, or the oscillator may be over-driven by an external clock.

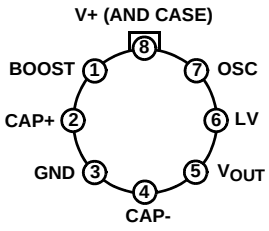
The “LV” terminal may be tied to GND to bypass the internal series regulator and improve low voltage (LV) operation. At medium to high voltages (3.5V to 12V), the LV pin is left floating to prevent device latchup.

Pinouts

ICL7660S (PDIP, SOIC)
TOP VIEW



ICL7660S (CAN)
TOP VIEW



Features

- Guaranteed Lower Max Supply Current for All Temperature Ranges
- Wide Operating Voltage Range 1.5V to 12V
- 100% Tested at 3V
- No External Diode Over Full Temperature and Voltage Range
- Boost Pin (Pin 1) for Higher Switching Frequency
- Guaranteed Minimum Power Efficiency of 96%
- Improved Minimum Open Circuit Voltage Conversion Efficiency of 99%
- Improved SCR Latchup Protection
- Simple Conversion of +5V Logic Supply to ±5V Supplies
- Simple Voltage Multiplication $V_{OUT} = (-)nV_{IN}$
- Easy to Use - Requires Only 2 External Non-Critical Passive Components
- Improved Direct Replacement for Industry Standard ICL7660 and Other Second Source Devices
- Available in Lead Free

Applications

- Simple Conversion of +5V to ±5V Supplies
- Voltage Multiplication $V_{OUT} = \pm nV_{IN}$
- Negative Supplies for Data Acquisition Systems and Instrumentation
- RS232 Power Supplies
- Supply Splitter, $V_{OUT} = \pm V_S/2$

Ordering Information

PART #	TEMP. RANGE (^oC)	PACKAGE	PKG. DWG. #
ICL7660SCBA	0 to 70	8 Ld SOIC (N)	M8.15
ICL7660SCPA	0 to 70	8 Ld PDIP	E8.3
ICL7660SIBA	-40 to 85	8 Ld SOIC (N)	M8.15
ICL7660SIBAZ (Note 1)	-40 to 85	8 Ld SOIC (N) (lead-free)	M8.15
ICL7660SIBAZT (Note 1)	-40 to 85	8 Ld SOIC (N) (lead-free) Tape and Reel	M8.15
ICL7660SIPA	-40 to 85	8 Ld PDIP	E8.3
ICL7660SMTV (Note 2)	-55 to 125	8 Pin Metal Can	T8.C

NOTES:

1. Intersil Lead Free products employ special lead free material sets; molding compounds / die attach materials and 100% matte tin plate termination finish, which is compatible with both SnPb and lead free soldering operations. Intersil Lead Free products are MSL classified at lead free peak reflow temperatures that meet or exceed the lead free requirements of IPC/JEDEC J Std-020B.
2. Add /883B to part number if 883B processing is required.

Absolute Maximum Ratings

Supply Voltage . . . . . +13.0V
LV and OSC Input Voltage (Note 3)
V+ < 5.5V . . . . . -0.3V to V+ + 0.3V
V+ > 5.5V . . . . . V+ -5.5V to V+ +0.3V
Current into LV (Note 3)
V+ > 3.5V 20μA
Output Short Duration
$V_{SUPPLY} \leq 5.5V$ . . . . . Continuous
Storage Temperature Range . . . . . -65^oC to 150^oC

Operating Conditions

Temperature Range
ICL7660SM . . . . . -55^oC to 125^oC
ICL7660SI . . . . . -40^oC to 85^oC
ICL7660SC . . . . . 0^oC to 70^oC

Thermal Information

Thermal Resistance (Typical, Note 4)	θ_{JA} ($^oC/W$)	θ_{JC} ($^oC/W$)
PDIP	110	N/A
Plastic SOIC	160	N/A
Metal Can	160	70

Maximum Lead Temperature (Soldering 10s) . . . . . 300^oC
(SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

3. Connecting any terminal to voltages greater than V+ or less than GND may cause destructive latchup. It is recommended that no inputs from sources operating from external supplies be applied prior to "power up" of ICL7660S.
4. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications

V+ = 5V, $T_A = 25^oC$, OSC = Free running, Test Circuit Figure 12, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current (Note 7)	I+	$R_L = \infty$, 25^oC	-	80	160	μA
		$0^oC < T_A < +70^oC$	-	-	180	μA
		$-40^oC < T_A < 85^oC$	-	-	180	μA
		$-55^oC < T_A < 125^oC$	-	-	200	μA
Supply Voltage Range - High (Note 8)	$V+_H$	R_L = 10K, LV Open, $T_{MIN} < T_A < T_{MAX}$	3.0	-	12	V
Supply Voltage Range - Low	$V+_L$	R_L = 10K, LV to GND, $T_{MIN} < T_A < T_{MAX}$	1.5	-	3.5	V
Output Source Resistance	R_{OUT}	I_{OUT} = 20mA	-	60	100	Ω
		I_{OUT} = 20mA, $0^oC < T_A < 70^oC$	-	-	120	Ω
		I_{OUT} = 20mA, $-25^oC < T_A < 85^oC$	-	-	120	Ω
		I_{OUT} = 20mA, $-55^oC < T_A < 125^oC$	-	-	150	Ω
		I_{OUT} = 3mA, V+ = 2V, LV = GND, $0^oC < T_A < 70^oC$	-	-	250	Ω
		I_{OUT} = 3mA, V+ = 2V, LV = GND, $-40^oC < T_A < 85^oC$	-	-	300	Ω
		I_{OUT} = 3mA, V+ = 2V, LV = GND, $-55^oC < T_A < 125^oC$	-	-	400	Ω
Oscillator Frequency (Note 7)	f_{OSC}	C_{OSC} = 0, Pin 1 Open or GND	5	10	-	kHz
		C_{OSC} = 0, Pin 1 = V+	-	35	-	kHz
Power Efficiency	P_{EFF}	$R_L = 5k\Omega$	96	98	-	%
		$T_{MIN} < T_A < T_{MAX}$ $R_L = 5k\Omega$	95	97	-	-
Voltage Conversion Efficiency	$V_{OUT}EFF$	$R_L = \infty$	99	99.9	-	%

Electrical Specifications V+ = 5V, T_A = 25°C, OSC = Free running, Test Circuit Figure 12, Unless Otherwise Specified **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Oscillator Impedance	Z_{OSC}	V+ = 2V	-	1	-	MΩ
		V+ = 5V	-	100	-	kΩ

NOTES:

5. Derate linearly above 50°C by 5.5mW/°C
6. In the test circuit, there is no external capacitor applied to pin 7. However, when the device is plugged into a test socket, there is usually a very small but finite stray capacitance present, of the order of 5pF.
7. The Intersil ICL7660S can operate without an external diode over the full temperature and voltage range. This device will function in existing designs which incorporate an external diode with no degradation in overall circuit performance.
8. All significant improvements over the industry standard ICL7660 are highlighted.

Typical Performance Curves (Test Circuit Figure 12)

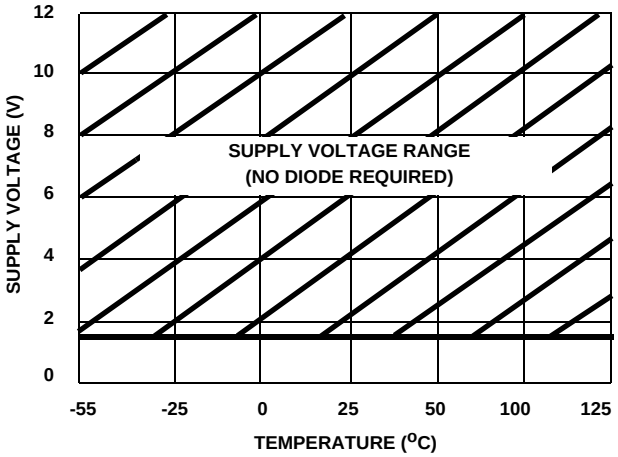


FIGURE 1. OPERATING VOLTAGE AS A FUNCTION OF TEMPERATURE

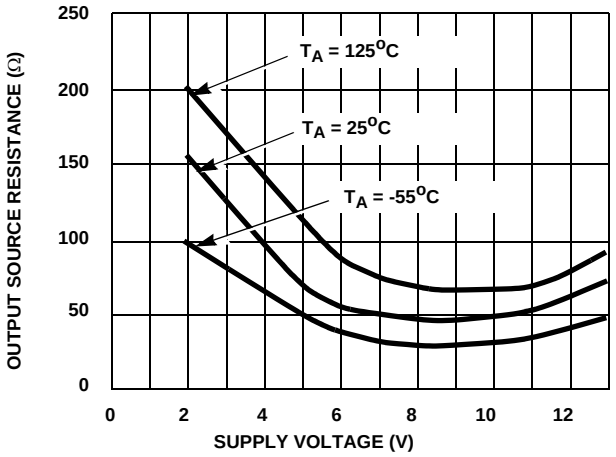


FIGURE 2. OUTPUT SOURCE RESISTANCE AS A FUNCTION OF SUPPLY VOLTAGE

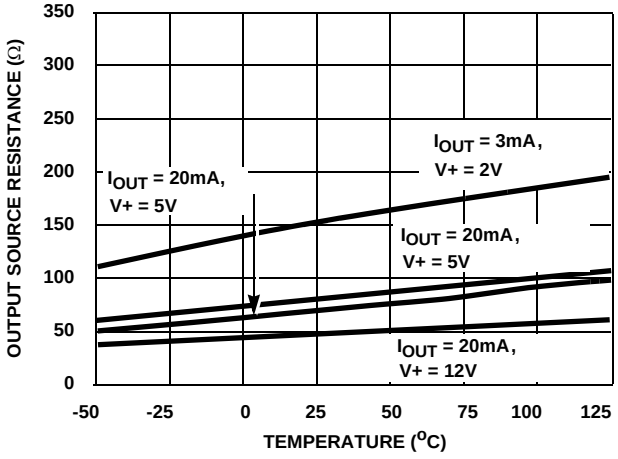


FIGURE 3. OUTPUT SOURCE RESISTANCE AS A FUNCTION OF TEMPERATURE

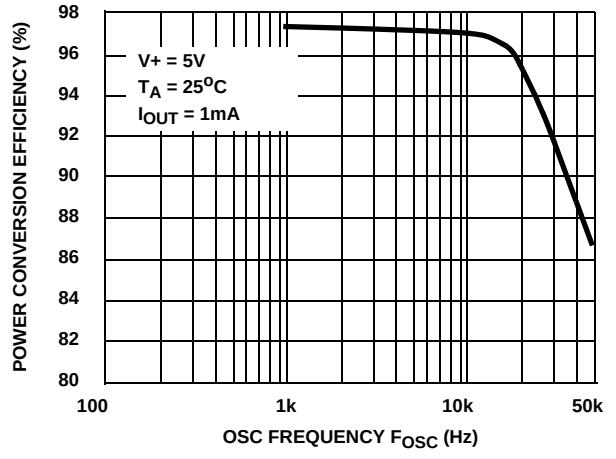
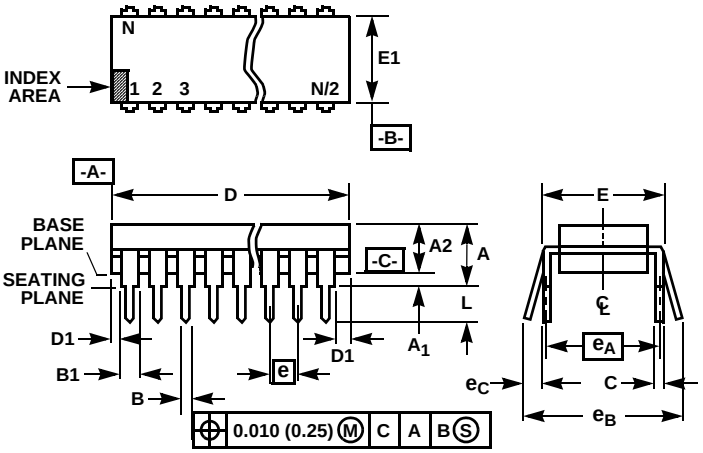


FIGURE 4. POWER CONVERSION EFFICIENCY AS A FUNCTION OF OSCILLATOR FREQUENCY

Dual-In-Line Plastic Packages (PDIP)



NOTES:

1. Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication No. 95.
4. Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
5. D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
6. E and e_A are measured with the leads constrained to be perpendicular to datum -C-.
7. e_B and e_C are measured at the lead tips with the leads unconstrained. e_C must be zero or greater.
8. B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
9. N is the maximum number of terminal positions.
10. Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3, E42.6 will have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

E8.3 (JEDEC MS-001-BA ISSUE D)
8 LEAD DUAL-IN-LINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8, 10
C	0.008	0.014	0.204	0.355	-
D	0.355	0.400	9.01	10.16	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	5
e	0.100 BSC		2.54 BSC		-
e_A	0.300 BSC		7.62 BSC		6
e_B	-	0.430	-	10.92	7
L	0.115	0.150	2.93	3.81	4
N	8		8		9

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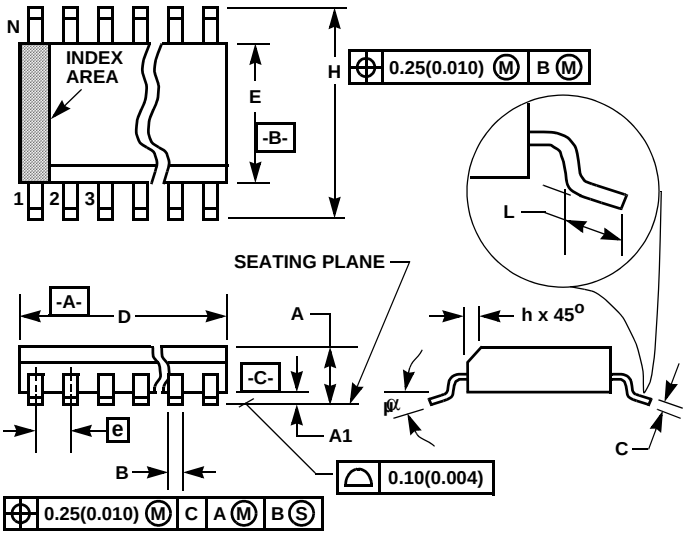
Small Outline Plastic Packages (SOIC)



NOTES:

1. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension “E” does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. “L” is the length of terminal for soldering to a substrate.
7. “N” is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. The lead width “B”, as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

M8.15 (JEDEC MS-012-AA ISSUE C)
8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.0532	0.0688	1.35	1.75	-
A1	0.0040	0.0098	0.10	0.25	-
B	0.013	0.020	0.33	0.51	9
C	0.0075	0.0098	0.19	0.25	-
D	0.1890	0.1968	4.80	5.00	3
E	0.1497	0.1574	3.80	4.00	4
e	0.050 BSC		1.27 BSC		-
H	0.2284	0.2440	5.80	6.20	-
h	0.0099	0.0196	0.25	0.50	5
L	0.016	0.050	0.40	1.27	6
N	8		8		7
α	0^o	8^o	0^o	8^o	-

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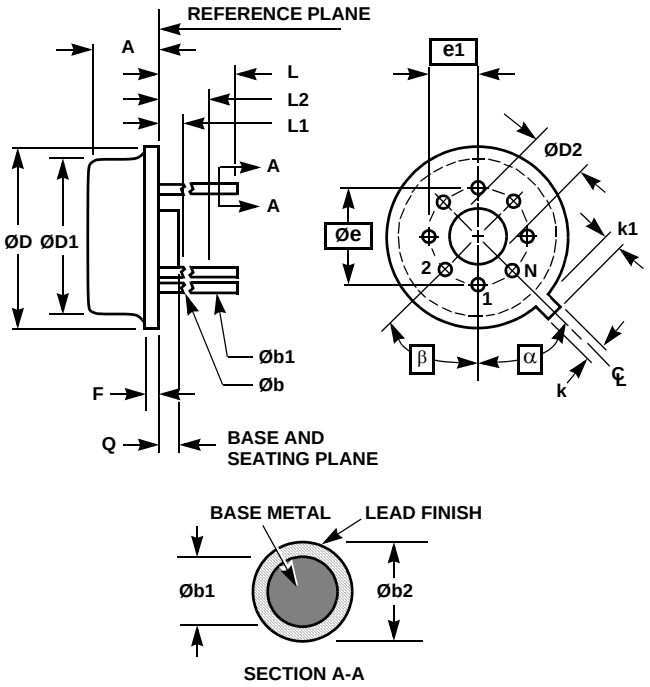
Metal Can Packages (Can)



T8.C MIL-STD-1835 MACY1-X8 (A1)
8 LEAD METAL CAN PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.165	0.185	4.19	4.70	-
Øb	0.016	0.019	0.41	0.48	1
Øb1	0.016	0.021	0.41	0.53	1
Øb2	0.016	0.024	0.41	0.61	-
ØD	0.335	0.375	8.51	9.40	-
ØD1	0.305	0.335	7.75	8.51	-
ØD2	0.110	0.160	2.79	4.06	-
e	0.200 BSC		5.08 BSC		-
e1	0.100 BSC		2.54 BSC		-
F	-	0.040	-	1.02	-
k	0.027	0.034	0.69	0.86	-
k1	0.027	0.045	0.69	1.14	2
L	0.500	0.750	12.70	19.05	1
L1	-	0.050	-	1.27	1
L2	0.250	-	6.35	-	1
Q	0.010	0.045	0.25	1.14	-
α	45^o BSC		45^o BSC		3
β	45^o BSC		45^o BSC		3
N	8		8		4

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NOTES:

1. (All leads) Øb applies between L1 and L2. Øb1 applies between L2 and 0.500 from the reference plane. Diameter is uncontrolled in L1 and beyond 0.500 from the reference plane.
2. Measured from maximum diameter of the product.
3. α is the basic spacing from the centerline of the tab to terminal 1 and β is the basic spacing of each lead or lead position (N -1 places) from α, looking at the bottom of the package.
4. N is the maximum number of terminal positions.
5. Dimensioning and tolerancing per ANSI Y14.5M - 1982.
6. Controlling dimension: INCH.