

## Wide Input Voltage Range 10mA Ultra-Low Iq

### High PSRR Linear Regulator

The SSP7785 is a high-performance linear regulator, offering a very wide operating input voltage range of up to 450 V DC, with an output current of up to 10mA.

Ideal for high input voltage applications such as industrial and home metering, home appliances. The SSP7785 family offers  $\pm 5\%$  initial accuracy, extremely high-power supply rejection ratio and ultra-low quiescent current. The SSP7785 is optimized for high-voltage line and load transients, making this part ideal for harsh environment applications.

The SSP7785 is offered in fixed output voltage options 2.7V, 3.3V, and 5.0V.

ESOP8 package offers good thermal performance and help to minimize the solution size.

#### Features

- Wide Input Voltage Range:  
DC: Up to 450 V  
AC: 85 V to 260 V (half-wave rectifier and 2.2  $\mu\text{F}$  capacitor)
- 10 mA Guaranteed Output Current
- Ultra Low Quiescent Current: Typ. 10  $\mu\text{A}$  ( $V_{\text{OUT}} \leq 5\text{V}$ )
- $\pm 5\%$  Accuracy Over Full Load, Line and Temperature Variations
- Ultra-high PSRR: 70 dB at 60 Hz, 90 dB at 100 kHz
- Stable with Ceramic Output Capacitor 22  $\mu\text{F}$  MLCC
- Thermal Shutdown and Current Limit Protection
- Available in Thermally Enhanced ESOP8 Package
- This is a Pb-Free Device

#### Typical Applications

- Industrial Applications, Home Appliances
- Home Metering / Network Application
- Off-line Power Supplies

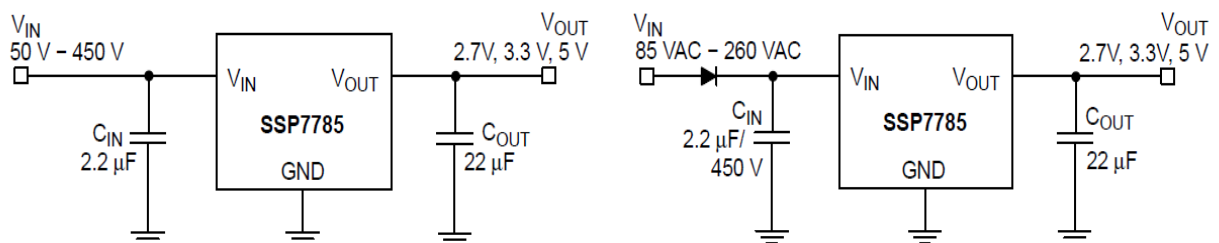


Figure 1. Typical Applications

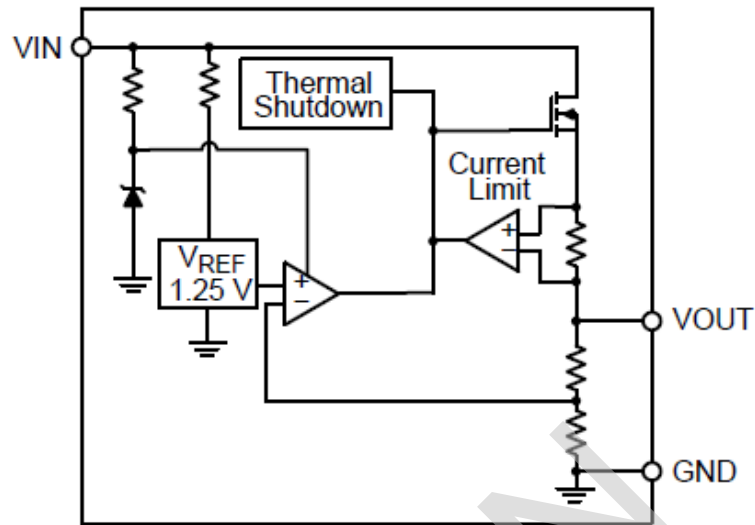


Figure 2. Simplified Internal Block Diagram

### Pin Configuration

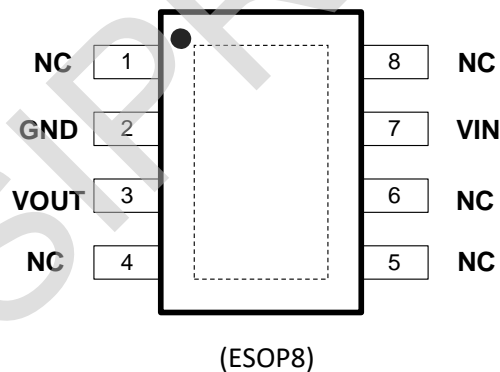


Table 1. PIN FUNCTION DESCRIPTION

Pin No.	Pin Name	Description
1/4/5/6/8	NC	Not Connect.
2	GND	Ground connection.
3	VOUT	Regulator Output. Connect 22 $\mu$ F or larger MLCC capacitor from VOUT to GND.
7	VIN	Supply Voltage Input. Connect 2.2 $\mu$ F capacitor from VIN to GND.

**Table 2. ABSOLUTE MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Input Voltage	V <sub>IN</sub>	-0.3 to 650	V
Output Voltage	V <sub>OUT</sub>	-0.3 to 8	V
Maximum Junction Temperature	TJ(MAX)	150	°C
Storage Temperature	TSTG	-55 to 150	°C
ESD Capability, HBM (All pins except HV pin no.1)	ESDHBM	2000	V
ESD Capability, Machine Model	ESDMM	200	V

**Table 3. THERMAL CHARACTERISTICS**

Rating	Symbol	Value	Unit
Thermal Resistance, Junction-to-Air	ReJA	40	°C/W

**Table 4. ELECTRICAL CHARACTERISTICS, V<sub>OUT</sub> = 2.7V** ( $-40^{\circ}\text{C} \leq T_J \leq 85^{\circ}\text{C}$ ; V<sub>IN</sub> = 340 V; I<sub>OUT</sub> = 100 $\mu$ A, C<sub>IN</sub> = 2.2 $\mu$ F, C<sub>OUT</sub> = 22 $\mu$ F, unless otherwise noted. Typical values are at T<sub>J</sub> = +25 $^{\circ}$ C.)

Parameter	Test Conditions		Symbol	Min	Typ	Max	Unit
Operating Input Voltage DC			V <sub>IN</sub>	50		450	V
Output Voltage Accuracy	T <sub>J</sub> = 25 $^{\circ}$ C, I <sub>out</sub> = 100 $\mu$ A, 50 V $\leq$ V <sub>in</sub> $\leq$ 450 V		V <sub>OUT</sub>	2.5785	2.7	2.8215	V
	$-40^{\circ}\text{C} \leq T_J \leq 85^{\circ}\text{C}$ , I <sub>out</sub> = 100 $\mu$ A, 50V $\leq$ V <sub>in</sub> $\leq$ 450 V		V <sub>OUT</sub>	2.565	2.7	2.835	V
Line Regulation	50 V $\leq$ V <sub>in</sub> $\leq$ 450 V, I <sub>out</sub> = 100 $\mu$ A		Reg <sub>LINE</sub>	-0.5	0.1	+0.5	%/V
Load Regulation	100 $\mu$ A $\leq$ I <sub>OUT</sub> $\leq$ 10 mA, V <sub>in</sub> =50 V		Reg <sub>LOAD</sub>	-1.0	0.66	+1.0	%
Maximum Output Current	50 V $\leq$ V <sub>in</sub> $\leq$ 450 V		I <sub>OUT</sub>	10.5			mA
Quiescent Current	I <sub>OUT</sub> = 0, 50 V $\leq$ V <sub>in</sub> $\leq$ 450 V		I <sub>Q</sub>		16	25	$\mu$ A
Ground Current	50 V $\leq$ V <sub>in</sub> $\leq$ 450 V 0 < I <sub>OUT</sub> $\leq$ 10 mA		I <sub>GND</sub>			28	$\mu$ A
Power Supply Rejection Ratio	V <sub>in</sub> = 340 VDC +1V <sub>pp</sub> modulation, I <sub>out</sub> =100 $\mu$ A	f=1 kHz	PSRR		70		dB
Noise	f = 100 Hz to 100 kHz V <sub>in</sub> = 340 VDC, I <sub>out</sub> = 100 $\mu$ A		V <sub>NOISE</sub>		420		$\mu$ V <sub>rms</sub>
Thermal Shutdown Temperature	Temperature increasing from F <sub>J</sub> =+25 $^{\circ}$ C		T <sub>SD</sub>		145		$^{\circ}$ C
Thermal Shutdown Hysteresis	Temperature falling from TSD		T <sub>SDH</sub>	-	10	-	$^{\circ}$ C

**Table 5. ELECTRICAL CHARACTERISTICS, V<sub>OUT</sub> = 3.3 V** (–40°C ≤ T<sub>J</sub> ≤ 85°C; V<sub>IN</sub> = 340 V; I<sub>OUT</sub> = 100μA, C<sub>IN</sub> = 2.2μF, C<sub>OUT</sub> = 22μF, unless otherwise noted. Typical values are at T<sub>J</sub> = +25°C.)

Parameter	Test Conditions		Symbol	Min	Typ	Max	Unit
Operating Input Voltage DC			V <sub>IN</sub>	50		450	V
Output Voltage Accuracy	T <sub>J</sub> = 25°C, I <sub>out</sub> = 100μA, 50 V ≤ V <sub>in</sub> ≤ 450 V		V <sub>OUT</sub>	3.1515	3.3	3.4485	V
	–40°C ≤ T <sub>J</sub> ≤ 85°C, I <sub>out</sub> = 100μA, 50 V ≤ V <sub>in</sub> ≤ 450 V		V <sub>OUT</sub>	3.135	3.3	3.465	V
Line Regulation	50 V ≤ V <sub>in</sub> ≤ 450 V, I <sub>out</sub> = 100μA		Reg <sub>LINE</sub>	–0.5	0.2	+0.5	%
Load Regulation	100 μA ≤ I <sub>OUT</sub> ≤ 10 mA, V <sub>in</sub> = 50 V		Reg <sub>LOAD</sub>	–1.0	0.6	+1.0	%
Maximum Output Current	50 V ≤ V <sub>in</sub> ≤ 450 V		I <sub>OUT</sub>	10.5			mA
Quiescent Current	I <sub>OUT</sub> = 0, 50 V ≤ V <sub>in</sub> ≤ 450 V		I <sub>Q</sub>		16	25	μA
Ground Current	50 V ≤ V <sub>in</sub> ≤ 450 V 0 < I <sub>OUT</sub> ≤ 10 mA		I <sub>GND</sub>			28	μA
Power Supply Rejection Ratio	V <sub>in</sub> = 340VDC +1V <sub>pp</sub> modulation, I <sub>out</sub> = 100μA	f = 1 kHz	PSRR		70		dB
Noise	f = 100 Hz to 100 kHz V <sub>in</sub> = 340 VDC, I <sub>out</sub> = 100μA		V <sub>NOISE</sub>		240		μV <sub>rms</sub>
Thermal Shutdown Temperature	Temperature increasing from T <sub>J</sub> =+25°C		T <sub>SD</sub>		145		°C
Thermal Shutdown Hysteresis	Temperature falling from TSD		T <sub>SDH</sub>	–	10	–	°C

**Table 6. ELECTRICAL CHARACTERISTICS,  $V_{OUT} = 5.0\text{ V}$  ( $-40^{\circ}\text{C} \leq T_J \leq 85^{\circ}\text{C}$ ;  $V_{IN} = 340\text{ V}$ ;  $I_{OUT} = 100\mu\text{A}$ ,  $C_{IN} = 2.2\mu\text{F}$ ,  $C_{OUT} = 22\mu\text{F}$ , unless otherwise noted. Typical values are at  $T_J = +25^{\circ}\text{C}$ .)**

Parameter	Test Conditions		Symbol	Min	Typ	Max	Unit
Operating Input Voltage DC			$V_{IN}$	50		450	V
Output Voltage Accuracy	$T_J = 25^{\circ}\text{C}$ , $I_{out} = 100\mu\text{A}$ , $50\text{ V} \leq V_{in} \leq 450\text{ V}$		$V_{OUT}$	4.775	5.0	5.225	V
	$-40^{\circ}\text{C} \leq T_J \leq 85^{\circ}\text{C}$ , $I_{out} = 100\mu\text{A}$ , $50\text{ V} \leq V_{in} \leq 450\text{ V}$		$V_{OUT}$	4.75	5.0	5.25	V
Line Regulation	$50\text{ V} \leq V_{in} \leq 450\text{ V}$ , $I_{out} = 100\mu\text{A}$		$\text{Reg}_{LINE}$	-0.5	0.2	+0.5	%
Load Regulation	$100\mu\text{A} \leq I_{OUT} \leq 10\text{ mA}$ , $V_{in} = 50\text{ V}$		$\text{Reg}_{LOAD}$	-1.0	0.62	+1.0	%
Maximum Output Current	$50\text{ V} \leq V_{in} \leq 450\text{ V}$		$I_{OUT}$	10.5			mA
Quiescent Current	$I_{OUT} = 0$ , $50\text{ V} \leq V_{in} \leq 450\text{ V}$		$I_Q$		16	25	$\mu\text{A}$
Ground Current	$50\text{ V} \leq V_{in} \leq 450\text{ V}$ $0 < I_{OUT} \leq 10\text{ mA}$		$I_{GND}$			28	$\mu\text{A}$
Power Supply Rejection Ratio	$V_{in} = 340\text{VDC} + 1\text{V}_{pp}$ modulation, $I_{out} = 100\mu\text{A}$	$f = 1\text{ kHz}$	PSRR		70		dB
Noise	$f = 100\text{ Hz to } 100\text{ kHz}$ $V_{in} = 340\text{ VDC}$ , $I_{out} = 100\mu\text{A}$		$V_{NOISE}$		300		$\mu\text{V}_{rms}$
Thermal Shutdown Temperature	Temperature increasing from $T_J = +25^{\circ}\text{C}$		$T_{SD}$		145		$^{\circ}\text{C}$
Thermal Shutdown Hysteresis	Temperature falling from TSD		$T_{SDH}$	-	10	-	$^{\circ}\text{C}$

## APPLICATION INFORMATION

The typical application circuit for the SSP7785 device is shown below.

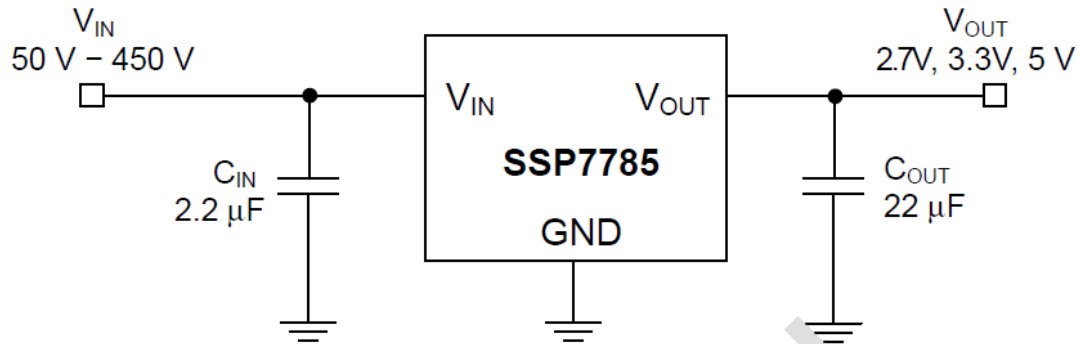


Figure 3. Typical Application Schematic

### Input Decoupling (C1)

A 1  $\mu\text{F}$  capacitor either ceramic or electrolytic is recommended and should be connected close to the input pin of SSP7785. Higher value 2.2  $\mu\text{F}$  is necessary to sustain the required minimum input voltage at full load for AC voltage as low as 85 V with half wave rectifier.

### Output Decoupling (C2)

The SSP7785 Regulator does not require any specific Equivalent Series Resistance (ESR). Thus capacitors exhibiting ESRs ranging from a few  $\text{m}\Omega$  up to 0.5  $\Omega$  can be used safely. The minimum decoupling value is 22  $\mu\text{F}$ . The regulator accepts ceramic chip capacitors as well as tantalum devices or low ESR electrolytic capacitors. Larger values improve noise rejection and load transient response.

### Layout Recommendations

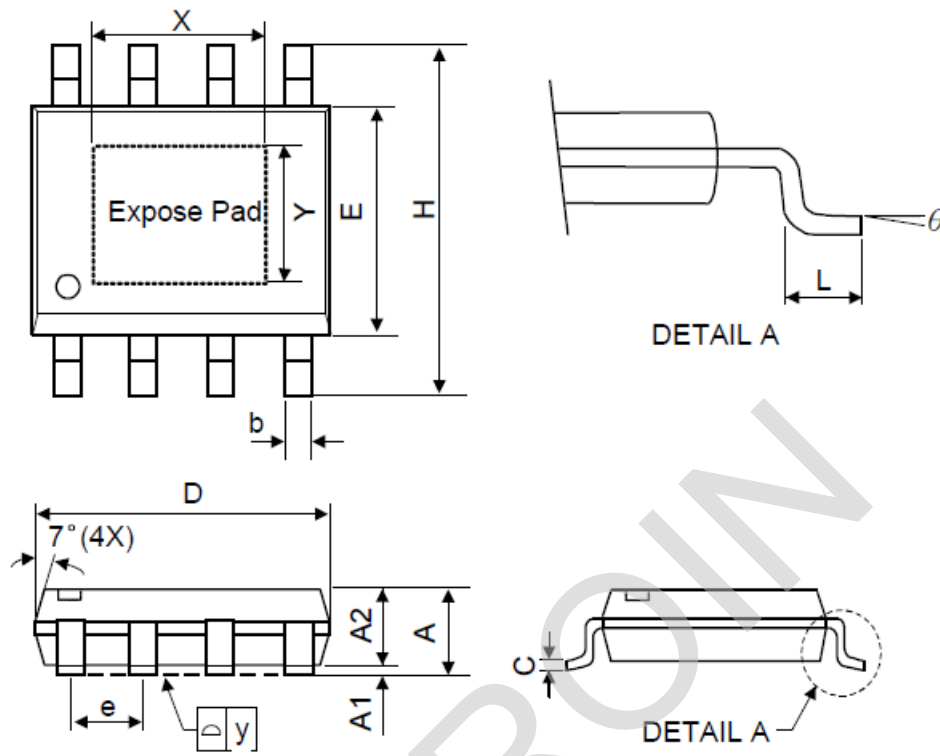
Please be sure the  $V_{IN}$  and GND lines are sufficiently wide. When the impedance of these lines is high, there is a chance to pick up noise or to cause the malfunction of regulator.

Set external components, especially the output capacitor, as close as possible to the circuit, and make leads as short as possible.

### Thermal

As power across the SSP7785 increases, it might become necessary to provide some thermal relief. The maximum power dissipation supported by the device is dependent upon board design layout and used package. Mounting pad configuration on the PCB, the board material, and also the ambient temperature affect the rate of temperature rise for the part. This is stating that when the SSP7785 has good thermal conductivity through the PCB, the junction temperature will be relatively low with high power dissipation applications.

PACKAGE DIMENSIONS



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.75	-	-	0.069
A1	0	-	0.15	0	-	0.06
A2	1.25	-	-	0.049	-	-
C	0.1	0.2	0.25	0.0075	0.008	0.01
D	4.7	4.9	5.1	0.185	0.193	0.2
E	3.7	3.9	4.1	0.146	0.154	0.161
H	5.8	6	6.2	0.228	0.236	0.244
L	0.4	-	1.27	0.015	-	0.05
b	0.31	0.41	0.51	0.012	0.016	0.02
e	1.27 BSC			0.050 BSC		
y	-	-	0.1	-	-	0.004
X	-	2.34	-	-	0.092	-
Y	-	2.34	-	-	0.092	-
θ	0°	-	8°	0°	-	8°