

Wide Input Voltage Range 10_mA Ultra-Low Iq

High PSRR Linear Regulator

The ZCC2785 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 10 mA.

Ideal for high input voltage applications such as industrial and home metering, home appliances. The ZCC2785 family offers $\pm 5\%$ initial accuracy, extremely high-power supply rejection ratio and ultra-low quiescent current. The ZCC2785 is optimized for high-voltage line and load transients, making this part ideal for harsh environment applications.

The ZCC2785 is offered in fixed output voltage options 2.7V, 3.3 V, and 5.0 V. 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 μ F capacitor)
- 10 mA Guaranteed Output Current
- Ultra Low Quiescent Current: Typ. 10 μ A ($V_{OUT} \leq 5$ 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 μ 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

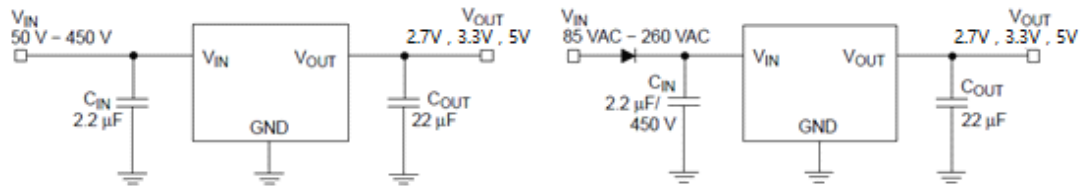


Figure 1. Typical Applications

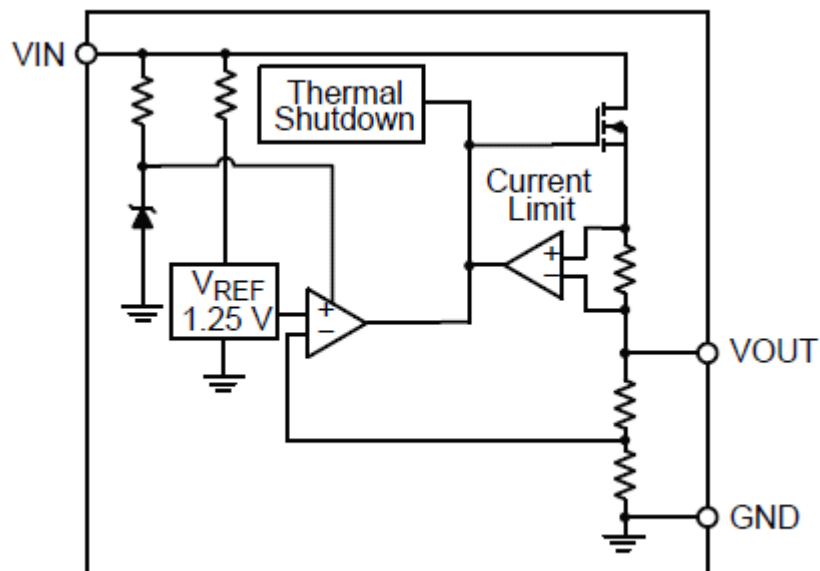


Figure 2. Simplified Internal Block Diagram

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 22µF or larger MLCC capacitor from VOUT to GND.
7	VIN	Supply Voltage Input. Connect 2.2µF capacitor from VIN to GND.

Table 2. ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage	VIN	-0.3 to 650	V
Output Voltage	VOUT	-0.3 to 8	V
Maximum Junction Temperature	TJ(MAX)	150	°C
Storage Temperature	TSTG	-55 to 150	°C
ESD Capability, Human Body Model (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, VOUT = 2.7V (-40°C ≤ TJ ≤ 85°C; VIN = 340 V; IOUT = 100μA, CIN = 2.2μF, COUT = 22μF, unless otherwise noted. Typical values are at TJ = +25°C.)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage DC		VIN	50		450	V
Output Voltage Accuracy	TJ = 25°C, IOUT = 100μA, 50 V ≤ Vin ≤ 450 V	VOUT	2.5785	2.7	2.8215	V
	-40°C ≤ TJ ≤ 85°C, IOUT = 100 μA, 50V ≤ Vin ≤ 450 V	VOUT	2.565	2.7	2.835	V
Line Regulation	50 V ≤ Vin ≤ 450 V, IOUT = 100 μA	RegLINE	-0.5	0.1	+0.5	%/V
Load Regulation	100 μA ≤ IOUT ≤ 10 mA, Vin = 50 V	RegLOAD	-1.0	0.66	+1.0	%
Maximum Output Current	50 V ≤ Vin ≤ 450 V	IOUT	10.5			mA
Quiescent Current	IOUT = 0, 50 V ≤ Vin ≤ 450 V	IQ		16	25	μA
Ground Current	50 V ≤ Vin ≤ 450 V 0 < IOUT ≤ 10 mA	IGND			28	μA
Power Supply Rejection Ratio	Vin = 340 VDC +1 Vpp modulation, IOUT = 100μA f = 1 kHz	PSRR		70		dB
Noise	f = 100 Hz to 100 kHz Vin = 340 VDC, IOUT = 100μA	VNOISE		420		μVrms
Thermal	Temperature increasing from TJ =	TSD		145		°C

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Shutdown Temperature	+25°C					
Thermal Shutdown Hysteresis	Temperature falling from TSD	TSDH	-	10	-	°C

Table 5. ELECTRICAL CHARACTERISTICS, VOUT = 3.3 V (−40°C ≤ TJ ≤ 85°C; VIN = 340 V; IOUT = 100μA, CIN = 2.2μF, COUT = 22μF, unless otherwise noted. Typical values are at TJ = +25°C.)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage DC		VIN	50		450	V
Output Voltage Accuracy	TJ = 25°C, IOUT = 100μA, 50 V ≤ VIN ≤ 450 V	VOUT	3.1515	3.3	3.4485	V
	−40°C ≤ TJ ≤ 85°C, IOUT = 100 μA, 50 V ≤ VIN ≤ 450 V	VOUT	3.135	3.3	3.465	V
Line Regulation	50 V ≤ VIN ≤ 450 V, IOUT = 100μA	RegLINE	−0.5	0.2	+0.5	%
Load Regulation	100 μA ≤ IOUT ≤ 10 mA, VIN = 50 V	RegLOAD	−1.0	0.6	+1.0	%
Maximum Output Current	50 V ≤ VIN ≤ 450 V	IOUT	10.5			mA
Quiescent Current	IOUT = 0, 50 V ≤ VIN ≤ 450 V	IQ		16	25	μA
Ground Current	50 V ≤ VIN ≤ 450 V 0 < IOUT ≤ 10 mA	IGND			28	μA
Power Supply Rejection Ratio	VIN = 340 VDC +1 Vpp modulation, IOUT = 100μA f = 1 kHz	PSRR		70		dB
Noise	f = 100 Hz to 100 kHz VIN = 340 VDC, IOUT = 100μA	VNOISE		240		μVrms
Thermal Shutdown Temperature	Temperature increasing from TJ = +25°C	TSD		145		°C
Thermal Shutdown Hysteresis	Temperature falling from TSD	TSDH	-	10	-	°C

Table 6. ELECTRICAL CHARACTERISTICS, VOUT = 5.0 V (−40°C ≤ TJ ≤ 85°C; VIN = 340 V; IOUT = 100μA, CIN = 2.2μF, COUT = 22μF, unless otherwise noted. Typical values are at TJ = +25°C.)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Operating Input Voltage DC		VIN	50		450	V
Output Voltage	TJ = 25°C, IOUT = 100μA, 50 V ≤ VIN ≤	VOUT	4.775	5.0	5.225	V

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Accuracy	450 V					
	$-40^{\circ}\text{C} \leq T_J \leq 85^{\circ}\text{C}$, $I_{\text{out}} = 100\mu\text{A}$, $50\text{ V} \leq V_{\text{in}} \leq 450\text{ V}$	V_{OUT}	4.75	5.0	5.25	V
Line Regulation	$50\text{ V} \leq V_{\text{in}} \leq 450\text{ V}$, $I_{\text{out}} = 100\mu\text{A}$	RegLINE	-0.5	0.2	+0.5	%
Load Regulation	$100\mu\text{A} \leq I_{\text{OUT}} \leq 10\text{ mA}$, $V_{\text{in}} = 50\text{ V}$	RegLOAD	-1.0	0.62	+1.0	%
Maximum Output Current	$50\text{ V} \leq V_{\text{in}} \leq 450\text{ V}$	I_{OUT}	10.5			mA
Quiescent Current	$I_{\text{OUT}} = 0$, $50\text{ V} \leq V_{\text{in}} \leq 450\text{ V}$	I_{Q}		16	25	μA
Ground Current	$50\text{ V} \leq V_{\text{in}} \leq 450\text{ V}$ $0 < I_{\text{OUT}} \leq 10\text{ mA}$	I_{GND}			28	μA
Power Supply Rejection Ratio	$V_{\text{in}} = 340\text{ VDC} + 1\text{ Vpp}$ modulation, $I_{\text{out}} = 100\mu\text{A}$	$f = 1\text{ kHz}$	PSRR		70	dB
Noise	$f = 100\text{ Hz to } 100\text{ kHz}$ $V_{\text{in}} = 340\text{ VDC}$, $I_{\text{out}} = 100\mu\text{A}$	V_{NOISE}		300		μVrms
Thermal Shutdown Temperature	Temperature increasing from $T_J = +25^{\circ}\text{C}$	TSD		145		$^{\circ}\text{C}$
Thermal Shutdown Hysteresis	Temperature falling from TSD	TSDH	-	10	-	$^{\circ}\text{C}$

APPLICATION INFORMATION

The typical application circuit for the ZCC2785 device is shown below.

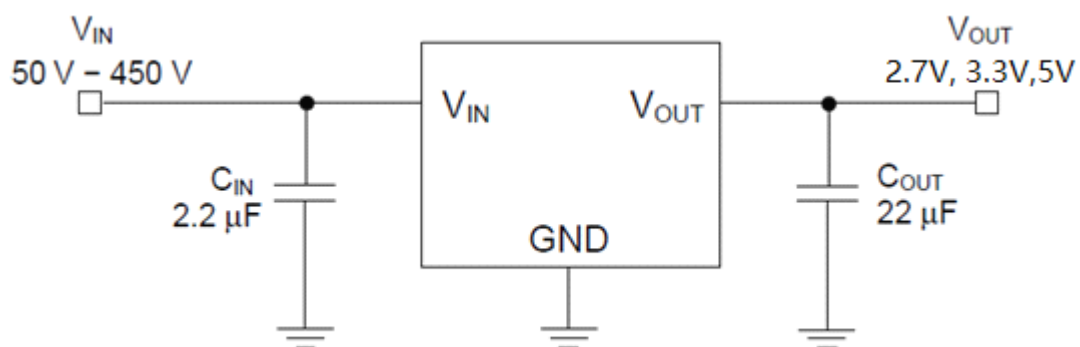


Figure 3. Typical Application Schematic

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 ZCC2785. 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 ZCC2785 Regulator does not require any specific Equivalent Series Resistance (ESR). Thus capacitors exhibiting ESRs ranging from a few $m\Omega$ up to 0.5Ω can be used safely. The minimum decoupling value is $22\mu F$. 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

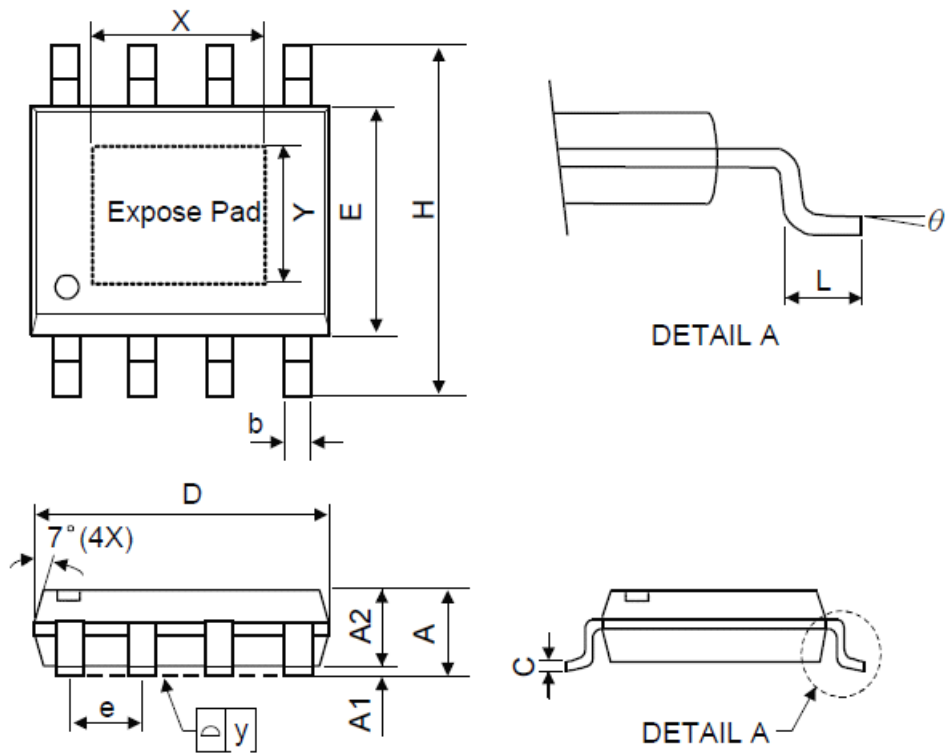
Please be sure the VIN and GND lines are sufficiently wide. When the impedance of these lines is high, there is a chance to pick up noise or to cause the malfunction of regulator.

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 ZCC2785 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 ZCC2785 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°