Low Dropout 3 Ampere Linear Regulator Family

FEATURES

- Precision Positive Series Pass Voltage Regulation
- 0.45V Dropout at 3A
- 50mV Dropout 10mA
- Quiescent Current Under 400µA Irrespective of Load
- Adjustable (5 Lead) Output Voltage Version
- Fixed (3 Lead) Versions for 3.3V and 5V Outputs
- Logic Shutdown Capability
- Short Circuit Power Limit of 3% • V_{IN} • I_{SHORT}
- Low V_{OUT} to V_{IN} Reverse Leakage
- Thermal Shutdown

DESCRIPTION

The UCC283-3/-5/-ADJ family of positive linear series pass regulators are tailored for low drop out applications where low quiescent power is important. Fabricated with a BiCMOS technology ideally suited for low input to output differential applications, the UCC283-5 will pass 3A while requiring only 0.45V of typical input voltage headroom (guaranteed 0.6V dropout). These regulators include reverse voltage sensing that prevents current in the reverse direction. Quiescent current is always less than 650µA. These devices have been internally compensated in such a manner that the need for a minimum output capacitor has been eliminated.

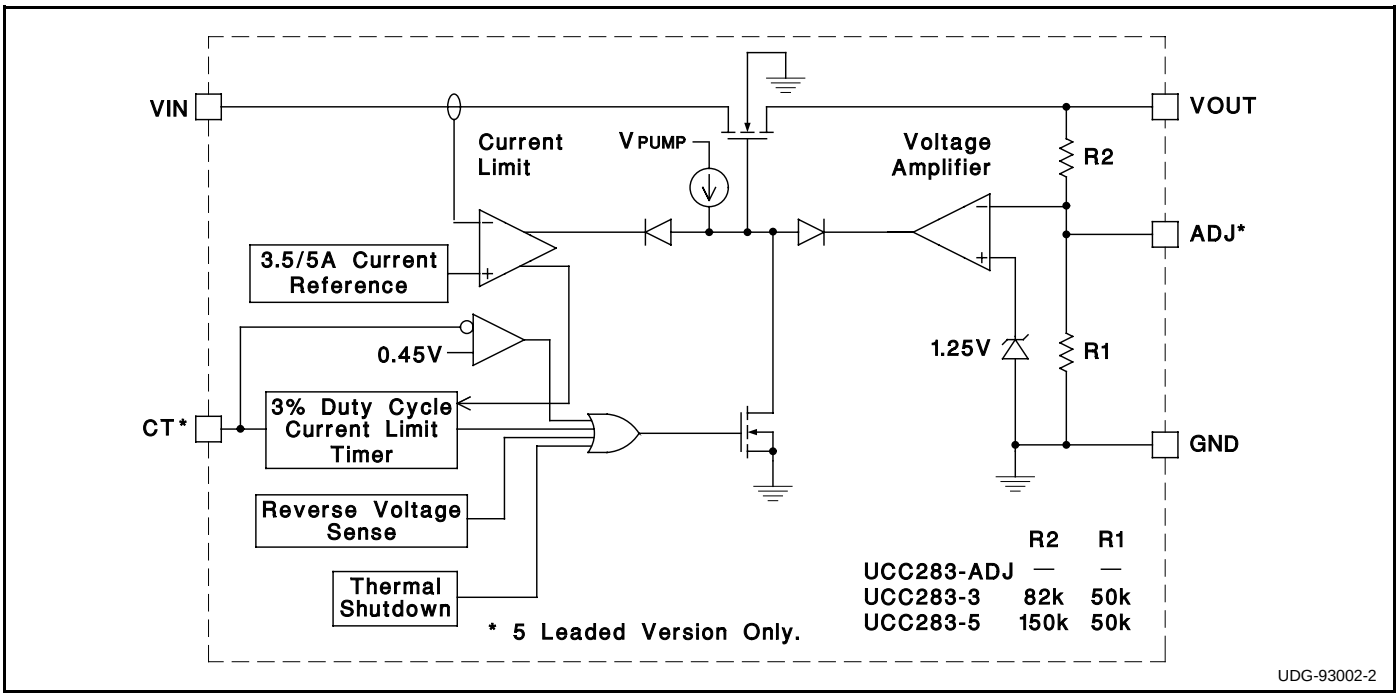
UCC283-3 and UCC283-5 versions are in 3 lead packages and have preset outputs at 3.3V and 5.0V respectively. The output voltage is regulated to 1.5% at room temperature. The UCC283-ADJ version, in a 5 lead package, regulates the output voltage programmed by an external resistor ratio.

Short circuit current is internally limited. The device responds to a sustained overcurrent condition by turning off after a T_{ON} delay. The device then stays off for a period, T_{OFF}, that is 32 times the T_{ON} delay. The device then begins pulsing on and off at the $T_{ON}/(T_{ON}+T_{OFF})$ duty cycle of 3%. This drastically reduces the power dissipation during short circuit and means heat sinks need only accommodate normal operation. On the 3 leaded versions of the device T_{ON} is fixed at 750µs, on the adjustable 5 leaded versions an external capacitor sets the on time -- the off time is always 32 times T_{ON}. The external timing control pin, CT, on the five leaded versions also serves as a shutdown input when pulled low.

Internal power dissipation is further controlled with thermal overload protection circuitry. Thermal shutdown occurs if the junction temperature exceeds 165°C. The chip will remain off until the temperature has dropped 20°C.

The UCC283 series is specified for operation over the industrial range of –40°C to +85°C, and the UCC383 series is specified from 0°C to +70°C. These devices are available in 3 and 5 pin TO-220 and TO-263 power packages.

BLOCK DIAGRAM



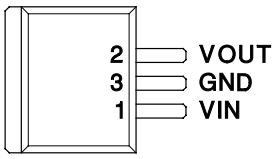
ABSOLUTE MAXIMUM RATINGS

VIN 9V
CT . . . . . –0.3 to 3V
ADJ . . . . . –0.3 to 9V
Storage Temperature . . . . . –65°C to +150°C
Junction Temperature . . . . . –55°C to +150°C
Lead Temperature (Soldering, 10 sec.) . . . . . +300°C

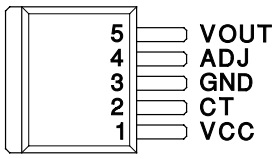
Currents are positive into, negative out of the specified terminal. Consult Packaging Section of Databook for thermal limitations and considerations of packages. All voltages are referenced to GND.

CONNECTION DIAGRAMS

3-PIN TO-263
(Front View)
TD Package

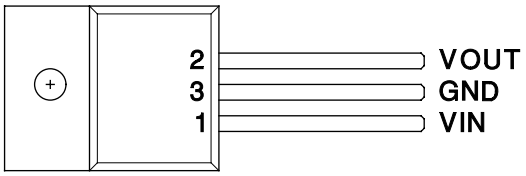


5-PIN TO-263
(Front View)
TD Package



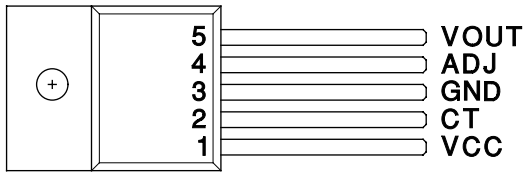
See Note 1

3-PIN TO-220
(Front View)
T Package



See Note 1

5-PIN TO-220
(Front View)
T Package



See Note 1

NOTE 1: Tab = GND

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications hold for T_A = 0°C to 70°C for the UCC383-X series, –40°C to +85°C for the UCC283-X, VIN = VOUT + 1.5V, I_{OUT} = 10mA, C_{IN} = 10µF, C_{OUT} = 22µF, CT = 1500pF for the UCC283-ADJ, $T_J = T_A$.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
UCC283-5 Fixed 5V, 3A Family					
Output Voltage	T_J = 25°C	4.925	5	5.075	V
	Over Temperature	4.875		5.125	V
Line Regulation	VIN = 5.15V to 9V		2	10	mV
Load Regulation	I_{OUT} = 10mA to 3A		10	20	mV
Output Noise Voltage	T_J = 25°C, BW = 10Hz to 10kHz		200		µVrms
Dropout Voltage, $V_{DROPOUT}$ = VIN – VOUT	I_{OUT} = 3A, VOUT = 4.85V		0.45	0.6	V
	I_{OUT} = 10mA, VOUT = 4.85V		50	150	mV
Peak Current Limit	VOUT = 0V	4	5	6	A
Overcurrent Threshold		3	4	5	A
Current Limit Duty Cycle	VOUT = 0V		3	5	%
Overcurrent Time Out, T_{ON}	VOUT = 0V	400	750		µs
Quiescent Current	I_{OUT} = 10mA to 3A		400	650	µA
Reverse Leakage Current	0V < VIN < VOUT, VOUT < 5.1V, at VOUT		25	650	µA
	0V < VIN < VOUT, VOUT < 5.1V, at VIN	–50	0		mA
UCC283-3 Fixed 3.3V, 3A Family					
Output Voltage	T_J = 25°C	3.25	3.3	3.35	mA
	Over Temperature	3.22		3.38	V
Line Regulation	VIN = 3.45V to 9V		2	7	mV
Load Regulation	I_{OUT} = 10mA to 3A		7	15	mV
Output Noise Voltage	T_J = 25°C, BW = 10Hz to 10kHz		200		µVrms

ELECTRICAL CHARACTERISTICS (cont.): Unless otherwise stated, these specifications hold for T_A = 0°C to 70°C for the UCC383-X series, -40°C to +85°C for the UCC283-X, VIN = VOUT + 1.5V, I_{OUT} = 10mA, C_{IN} = 10µF, C_{OUT} = 22µF, CT = 1500pF for the UCC283-ADJ, $T_J = T_A$.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
UCC283-3 Fixed 3.3V, 3A Family (cont.)					
Dropout Voltage, $V_{DROPOUT}$ = VIN – VOUT	I_{OUT} = 3A, VOUT = 3.15V		0.7	1	V
	I_{OUT} = 1.5A, VOUT = 3.15V		0.45	0.6	V
	I_{OUT} = 10mA, VOUT = 3.15V		50	150	mV
Peak Current Limit	VOUT = 0V	4	5	6	A
Overcurrent Threshold		3	4	5	A
Current Limit Duty Cycle	VOUT = 0V		3	5	%
Overcurrent Time Out, T_{ON}	VOUT = 0V	400	750		µs
Quiescent Current	I_{OUT} = 10mA to 3A		400	650	µA
Reverse Leakage Current	0V < VIN < VOUT, VOUT < 3.35V, at VOUT		25	650	µA
	0V < VIN < VOUT, VOUT < 3.35V, at VIN	–50	0		mA
UCC283-ADJ Adjustable Output, 3A Family					
Regulating Voltage at ADJ Pin	T_J = 25°C	1.23	1.25	1.27	mA
	Over Temperature	1.22		1.28	V
Line Regulation, at ADJ Input	VIN = VOUT + 150mV to 9V		1	3	mV
Load Regulation, at ADJ Input	I_{OUT} = 10mA to 3A		2	5	mV
Output Noise Voltage	T_J = 25°C, BW = 10Hz to 10kHz		200		µVrms
Dropout Voltage, $V_{DROPOUT}$ = VIN – VOUT	VIN > 4V, I_{OUT} = 3A		0.45	0.6	V
	VIN > 3V, I_{OUT} = 1.5A		0.45	0.6	V
	VIN > 3V, I_{OUT} = 10mA		50	150	mV
Peak Current Limit	VOUT = 0V, VIN = 6.5V	4	5	6	A
Overcurrent Threshold	VIN = 6.5V	3	4	5	A
Current Limit Duty Cycle	VOUT = 0V		3	5	%
Overcurrent Time Out, T_{ON}	VOUT = 0V, CT = 1500pF		750		µs
Reverse Leakage Current	0V < VIN < VOUT, VOUT < 9V, at VOUT		25	650	µA
	0V < VIN < VOUT, VOUT < 9V, at VIN	–50	0		mA
Bias current at ADJ Input			100	250	nA
Quiescent Current	I_{OUT} = 10mA to 3A		400	650	µA
Shutdown Threshold	At CT Input	0.25	0.45		V
Quiescent Current in Shutdown	VIN = 10V		10	25	µA

PIN DESCRIPTIONS

ADJ: Adjust pin for the UCC283-ADJ version only. Feedback pin for the linear regulator. Program the output voltage with R1 connected from ADJ to GND and R2 connected from VOUT to ADJ. Output voltage is given by:

$$VOUT = \frac{1.25V \bullet (R1 + R2)}{R1}$$

CT: Short circuit timing capacitor and shutdown input for the UCC283-ADJ version. Pulling CT below 0.25V turns off the regulator and places it in a low quiescent current mode. A timing capacitor, C, from CT to GND programs the duration of the pulsed short circuit on-time. On-time, T_{ON}, is approximately given by: T_{ON} = 500k • C.

GND: Reference ground.

VIN: Input voltage, This pin must be bypassed with a low ESL/ESR 1µF or larger capacitor to GND. VIN can range from (VOUT + $V_{DROPOUT}$) to 9V. If VIN is reduced to zero while VOUT is held high, the reverse leakage from VOUT to VIN is less than 50µA.

VOUT: Regulated output voltage. A bypass capacitor is not required at VOUT, but may be desired for good transient response. The bypass capacitor must not exceed a maximum value in order to insure the regulator can start. At startup, the bypass capacitor appears as a short circuit to the regulator. The combination of the minimum value of

PIN DESCRIPTIONS (cont.)

the peak current limit less the current taken by the load must be sufficient to charge the bypass capacitor in less than TON (the pulse width of the short circuit current). Otherwise the UCC283 will not start.

If the load is resistive, the minimum value of the bypass capacitor, COUT, is:

$$COUT < \frac{TON}{RL \bullet \ln \bullet \left(\frac{4A \bullet RL}{VOUT}\right)}$$

If the load behaves as a current source, IL, with zero volt compliance, then COUT can be no larger than:

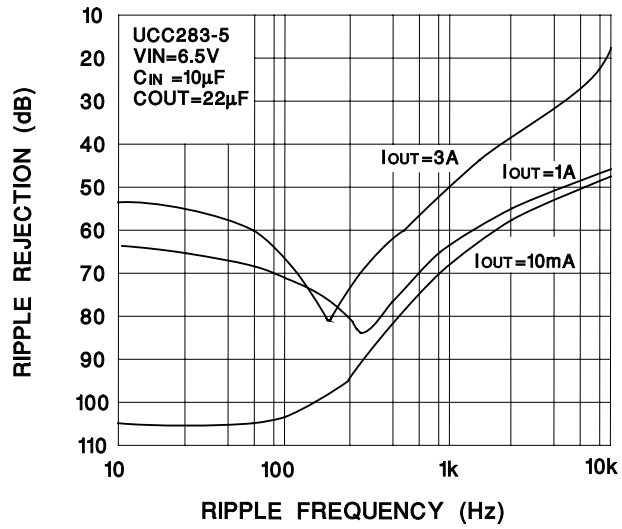
$$COUT < \frac{(4A - IL) \bullet TON}{VOUT}$$

If VOUT is shorted to GND, the regulator delivers peak current pulses with a width of TON at a 3% typical duty cycle. In most cases, under short circuit conditions the short circuit power dissipation is less than the nominal power dissipation under normal conditions. During the short circuit, the average power dissipation is given by:

$$P_D \text{ (short circuit)} = VIN \bullet I_{PEAK} \bullet \text{Duty Cycle}$$

For worst case values of 9V, 6A, and 5%, PD(short circuit) = 2.7W.

Ripple Rejection vs. Frequency



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ORDERING INFORMATION

UCC□83□-□
- Output Voltage
- Package
- Temperature Range

Temperature Range	Package	Output Voltage
2: –40°C to +85°C	T: TO-220	3: 3.3V
3: 0°C to +70°C	TD: TO-263	5: 5V
		ADJ: Adjustable

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