High Input Voltage Adjustable 3-Terminal Linear Regulator

Features

- 12V to 450V input voltage range
- Adjustable 1.20V to 440V output regulation
- 5% output voltage tolerance
- Output current limiting
- 10µA typical ADJ current
- Internal junction temperature limiting

Applications

- Off-line SMPS startup circuits
- Adjustable high voltage constant current source
- Industrial Controls
- Motor controls
- Battery chargers
- Power supplies

General Description

The FRR8 is a high voltage, low output current, adjustable linear regulator. It has a wide operating input voltage range of 12V to 450V. The output voltage can be adjusted from 1.20V to 440V provided that the input voltage is at least 10V greater than the output voltage. The output voltage can be adjusted by means of two external resistors R1 and R2 as shown in the typical application circuits. The AnR8 regulates the voltage difference between V_{OUT} and ADJ pins to a nominal value of 1.20V. The 1.20V is amplified by the external resistor ratio R1 and R2. An internal constant bias current of typically 10uA is cnnnected to ADJ pin. This increases V_{OUT} by a constant viltage of 10uA times R2.

The AnR8 has current limiting and temperature limiting. The output current limit is typically 15mA and the minimum temperature limit is 125℃. An output short circuit current will therefore be limited to 15mA. When the junction temperature reaches its temperature limit, the output current and/or output voltage will decrease to keep the junction temperature from exceeding its temperature limit. For SMPS start-up circuit applications, the AnR8 turns off when an external voltage greater than the output voltage of the FRR8 is applied to V_{OUT} of the AnR8. To maintain stability, a bypass capacitor of 1.0uF or larger and a minimum DC output current of 500uA are required.

The device is available in SOT-89 and TO-252 packages.

FRR8 Block Diagram and Typical Application

*Required for conditions where V_{IN} is less than V_{OUT}.
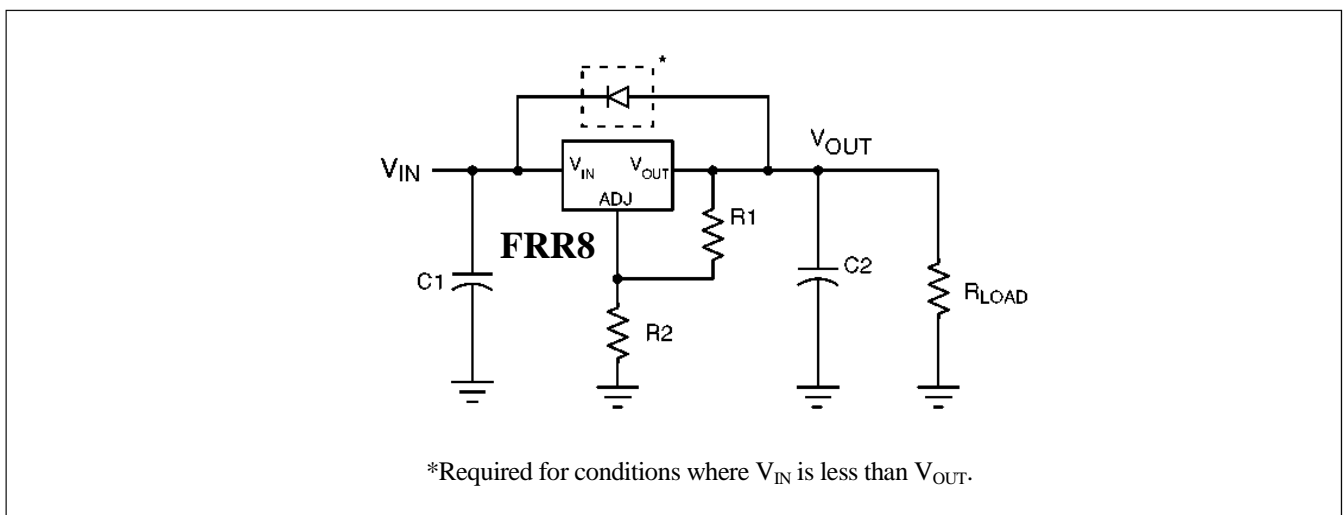
Thermal Characteristics

Package	Power Dissipation @ T_A=25°C	θ_{JC} °C/W	θ_{JA} °C/W
TO-92	0.74W	125	170
TO-243AA	1.6W	15	78†
TO-252	2.5W	6.25	50†

† Mounted on FR4 board, 25mm x 25mm x 1 57mm
Significant P_D increase possible on ceramic substrate

Absolute Maximum Ratings

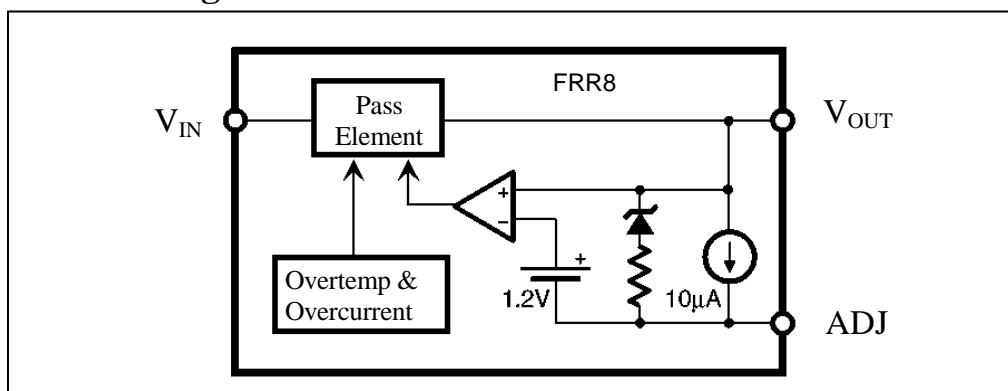|	
V_{IN} Input Voltage	-0.5V to +480V*
Output Voltage Range	-0.5V to +470V
Operating Ambient Temperature Range	−40°C to +85°C
Operating Junction Temperature Range	−40°C to +125°C
Storage Temperature Range	−40°C to +150°C

*Voltages referenced to ADJ

Pin Configurations

	V_{IN}	V_{OUT}	ADJ
TO-92	1	2	3
TO-243AA	1	2, TAB	3
TO-252	1	2 (TAB)	3

Electrical Characteristics

Test conditions unless otherwise specified: -40°C < T_A < 85°C.

Symbol	Parameter	Min	Typ	Max	Units	Test Conditions
V_{IN} - V_{OUT}	Input to Output Voltage Difference	12		450	V	
V_{OUT}	Overall Output Voltage Regulation	1.14	1.20	1.26	V	12V< V_{IN} <400V, R1=2.4KΩ, R2=0
V_{OUT}	Overall Output Voltage Regulation	375	400	425	V	R1=2.4KΩ, R2=782KΩ
ΔV_{OUT}	Line Regulation		0.003	0.01	%/V	15V< V_{IN} <400V, V_{OUT} =5V, I_{OUT} =0.5mA
ΔV_{OUT}	Load Regulation		1.4	3.0	%	V_{IN} =15V, V_{OUT} =5V, 0.5mA< I_{OUT} <10mA
ΔV_{OUT}	Temperature Regulation	-1		+1	%	V_{IN} =15V, V_{OUT}=5V, I_{OUT}=10mA, -40°C< T_A<85°C
I_{OUT}	Output Current Limit	10		20	mA	T_J < 85°C, V_{IN} - V_{OUT} = 10V
I_{OUT}	Output Current Limit			0.5	mA	T_J > 125°C, V_{IN} - V_{OUT} = 450V
I_{OUT}	Minimum Output Current		0.3	0.5	mA	Includes R1 and load current
I_{ADJ}	Adjust Output Current	5	10	15	µA	
C2	Minimum Output Load Capacitance	1			µF	
DV_{OUT}/DV_{IN}	Ripple Rejection Ratio	50	60		dB	120Hz, V_{OUT} = 5V
T_{LIMIT}	Junction Temperature Limit	125			°C	

Functional Block Diagram

2

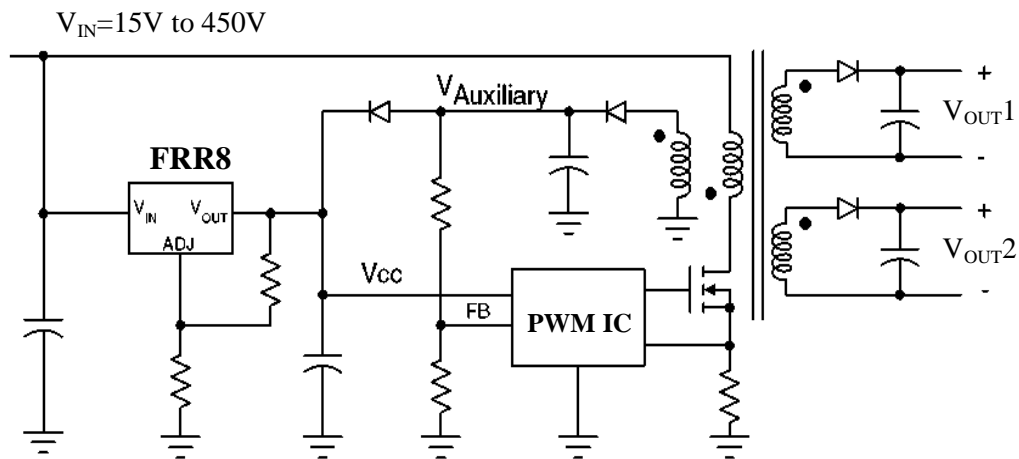## Typical Application Circuits

$$V_{OUT} = 1.20V\left(1+\frac{R2}{R1}\right) + I_{ADJ}R2$$
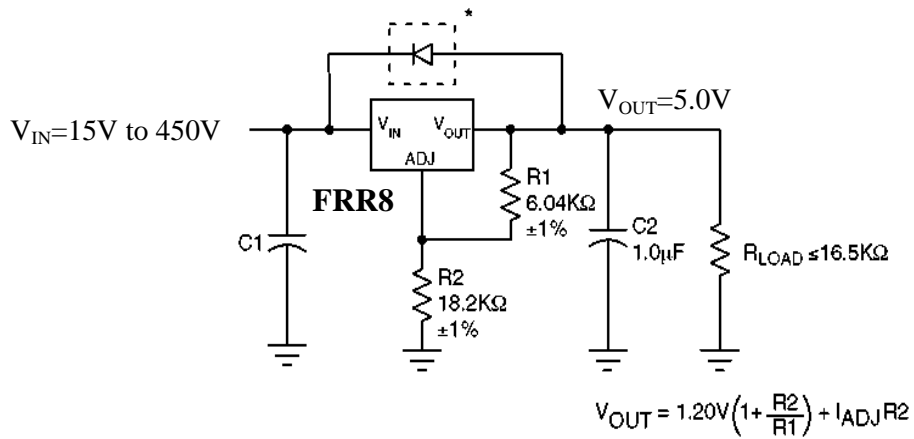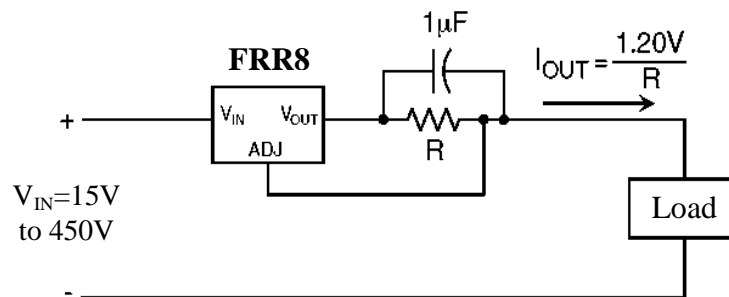
Figure 1: High Input Voltage, 5.0V Output Linear Regulator

* **Required for conditions where V_{IN} is less than V_{OUT}.**

Figure 2: SMPS Start-Up Circuit

Figure 3: High Voltage Adjustable Constant Current Source