VS78L Series Three Terminal Positive Regulators

NOT RECOMMENDED FOR NEW DESIGN, USE ***VS78L00* Series***

1 Introduction

The VS78L series is a group of three-terminal positive voltage linear regulators with a fixed voltage output. It can support a maximum input voltage of 30V (or 35V) and provide an output current of 100mA with good heat dissipation. The VS78L series eliminates the need for peripheral resistors to define voltage outputs, which improves the space efficiency of printed circuit boards (PCBs). In addition, the VS78L series integrates internal current limiting, short-circuit protection, and thermal shutdown, making it virtually unaffected by overload. Therefore, the VS78L series is widely used in a variety of scenarios, such as card monitoring, to eliminate noise and distribution issues related to single-point monitoring. When used as an alternative to the Zener diode-resistor combination, the VS78L series can effectively increase the output impedance and reduce the bias current.

2 Available Packages

PART NUMBER	PACKAGE
VS78L Series	SOT-23-3L
	SOT-89-3L
	TO-92

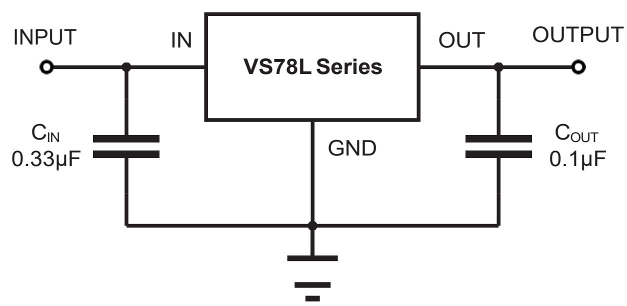
Note: For all available packages, please refer to the part *Orderable Information*.

3 Features

- Available Output Voltage:
  5.0V, 6.0V, 8.0V, 9.0V, 12V and 15V
- Maximum Input Voltage:
  30V for V_{OUT} < 10V products
  35V for V_{OUT} > 10V products
- Maximum Output Current:
  Exceed 100mA at T_J = 25°C
- Output Tolerances at T_J = 25°C:
  ±3% for Conventional Device
  ±2% can be Customized
- Output Tolerances of ±5% over the Operating Junction Temperature
- Build-in Current Limit
- Short Circuit Protection
- Thermal Shutdown Protection
- No External Components

4 Applications

- TV Board
- Air Conditioner
- Vehicle Mounted Radar
- Charging Device



Typical Application Circuit

5 Orderable Information

MODEL	DEVICE	PACKAGE	OP T_J	ECO PLAN	MSL	PACKING OPTION	SORT
VS78L-5.0	VS78L05-TA	TO-92	-40 ~ 125°C	RoHS & Green	N / A for Pkg Type	Ammo 2000 Units / Box	NoRD
VS78L-6.0	78L06-TA	TO-92	-40 ~ 125°C	RoHS & Green	N / A for Pkg Type	Ammo 2000 Units / Box	NoRD
VS78L-8.0	VS78L08-TA	TO-92	-40 ~ 125°C	RoHS & Green	N / A for Pkg Type	Ammo 2000 Units / Box	NoRD
VS78L-9.0	VS78L09-TA	TO-92	-40 ~ 125°C	RoHS & Green	N / A for Pkg Type	Ammo 2000 Units / Box	NoRD
VS78L-12	VS78L12-TA	TO-92	-40 ~ 125°C	RoHS & Green	N / A for Pkg Type	Ammo 2000 Units / Box	NoRD
VS78L-15	VS78L15-TA	TO-92	-40 ~ 125°C	RoHS & Green	N / A for Pkg Type	Ammo 2000 Units / Box	NoRD

Note:

ECO PLAN: For the RoHS and Green certification standards of this product, please refer to the official report provided by JSVS.

MSL: Moisture Sensitivity Level. Determined according to JEDEC industry standard classification.

SORT: Specifically defined as follows:

Active: Recommended for new products;

Customized: Products manufactured to meet the specific needs of customers;

Preview: The device has been released and has not been fully mass produced. The sample may or may not be available;

NoRD: It is not recommended to use the device for new design. The device is only produced for the needs of existing customers;

Obsolete: The device has been discontinued.

7 Specifications

7.1 Absolute Maximum Ratings

(over operating free-air temperature range, unless otherwise specified)

CHARACTERISTIC		SYMBOL	VALUE	UNIT
Maximum input voltage(2)	VS78L05	$V_{IN\ MAX}$	30	V
	78L06			
	VS78L08			
	VS78L09			
	VS78L12		35	
	VS78L15			
Maximum power dissipation	SOT-23-3L	$P_{D\ Max}$	Internally Limited(3)	W
	SOT-89-3L			
	TO-92			
Maximum junction temperature		$T_{J\ Max}$	150	°C
Storage temperature range		T_{stg}	- 65 ~ 150	°C
Soldering temperature & time		T_{solder}	260°C, 10s	-

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to network ground terminal.
(3) Refer to *Thermal Information* for details.

7.2 Recommended Operating Conditions

PARAMETER	SYMBOL	MIN.	NOM.	MAX.	UNIT
Operating junction temperature	T_J	-40	-	125	°C
Operating ambient temperature	T_A	-	-	-	°C

7.3 ESD Ratings

ESD RATINGS		SYMBOL	VALUE	UNIT
Electrostatic discharge(4)	Human body model	$V_{ESD\text{-}HBM}$	2000	V
	Machine model	$V_{ESD\text{-}MM}$	400	

(4) ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body mode (HBM) electrostatic discharge test is based on the JESD22-114D test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5kΩ. The electrostatic discharge test in mechanical mode (MM) is based on the JESD22-115-A test standard and uses a 200pF capacitor to discharge directly to each pin of the device.

7 Specifications

7.4 Thermal Information

THERMAL METRIC(5)	SYMBOL	VS78L Series			UNIT
		SOT-23-3L	SOT-89-3L	TO-92	
Junction-to-ambient thermal resistance	$R_{\Theta JA}$	257.1	116.5	178.2	°C/W
Junction-to-case thermal resistance	$R_{\Theta JC}$	63.8	29.1	42.2	°C/W
Reference maximum power dissipation for continuous operation	$P_{D\ Ref}$	0.38	0.83	0.56	W

(5) Thermal metric is measured in still air with T_A = 25°C and installed on a 1 in^2 FR-4 board covered with 2 ounces of copper.

7.5 Electrical Characteristics

VS78L05 (V_{IN} = 10V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, T_J = 25°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS(6)		MIN.	TYP.	MAX.	UNIT
Input voltage	V_{IN}	-		-	-	30	V
Output voltage	V_{OUT}	T_J = 25°C	±3% grade(7)	4.85	5.00	5.15	V
			±2% grade(7)	4.90		5.10	
		V_{IN} = 7 to 20V, I_{OUT} = 1 to 40mA		4.75		5.25	
		I_{OUT} = 1 to 70mA		4.75		5.25	
Output current	I_{OUT}	-		100	-	-	mA
Quiescent current	I_Q	I_{OUT} = 0mA		-	3.8	6.0	mA
Quiescent current change	ΔI_Q	V_{IN} = 8 to 20V		-	-	1.5	mA
		I_{OUT} = 1 to 40mA		-	-	0.1	mA
Dropout voltage	V_{DO}(8)	-		-	1.7	-	V
Line regulation	ΔV_{LINE}	V_{IN} = 7 to 20V		-	32	150	mV
		V_{IN} = 8 to 20V		-	26	100	
Load regulation	ΔV_{LOAD}	I_{OUT} = 1 to 100mA		-	15	60	mV
		I_{OUT} = 1 to 40mA		-	8	30	
Output noise voltage	V_N	f = 10 to 100kHz		-	42	-	μV/V_{OUT}
Ripple rejection	RR	V_{IN} = 8 to 20V, f = 120Hz		41	49	-	dB

7 Specifications

7.5 Electrical Characteristics (continued)

78L06 (V_{IN} = 11V, I_{OUT} = 40mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, T_J = 25°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS(6)		MIN.	TYP.	MAX.	UNIT
Input voltage	V_{IN}	-		-	-	30	V
Output voltage	V_{OUT}	T_J = 25°C	±3% grade(7)	5.82	6.00	6.18	V
			±2% grade(7)	5.88		6.12	
		V_{IN} = 8 to 20V, I_{OUT} = 1 to 40mA		5.70		6.30	
		I_{OUT} = 1 to 70mA		5.70		6.30	
Output current	I_{OUT}	-		100	-	-	mA
Quiescent current	I_Q	I_{OUT} = 0mA		-	3.9	6.0	mA
Quiescent current change	ΔI_Q	V_{IN} = 9 to 20V		-	-	1.5	mA
		I_{OUT} = 1 to 40mA		-	-	0.1	mA
Dropout voltage	V_{DO}(8)	-		-	1.7	-	V
Line regulation	ΔV_{LINE}	V_{IN} = 8 to 20V		-	35	175	mV
		V_{IN} = 9 to 20V		-	29	125	
Load regulation	ΔV_{LOAD}	I_{OUT} = 1 to 100mA		-	16	80	mV
		I_{OUT} = 1 to 40mA,		-	9	40	
Output noise voltage	V_N	f = 10 to 100kHz		-	46	-	µV/V_{OUT}
Ripple rejection	RR	V_{IN} = 9 to 19V, f = 120Hz		40	48	-	dB

VS78L08 (V_{IN} = 14V, I_{OUT} = 40mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, T_J = 25°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS(6)		MIN.	TYP.	MAX.	UNIT
Input voltage	V_{IN}	-		-	-	30	V
Output voltage	V_{OUT}	T_J = 25°C	±3% grade(7)	7.76	8.00	8.24	V
			±2% grade(7)	7.84		8.15	
		V_{IN} = 10.5 to 23V, I_{OUT} = 1 to 40mA		7.60		8.40	
		I_{OUT} = 1 to 70mA		7.76		8.40	
Output current	I_{OUT}	-		100	-	-	mA
Quiescent current	I_Q	I_{OUT} = 0mA		-	4.0	6.0	mA
Quiescent current change	ΔI_Q	V_{IN} = 11 to 23V		-	-	1.5	mA
		I_{OUT} = 1 to 40mA		-	-	0.1	mA
Dropout voltage	V_{DO}(8)	-		-	1.7	-	V
Line regulation	ΔV_{LINE}	V_{IN} = 10.5 to 23V		-	42	175	mV
		V_{IN} = 11 to 23V		-	36	125	
Load regulation	ΔV_{LOAD}	I_{OUT} = 1 to 100mA		-	18	80	mV
		I_{OUT} = 1 to 40mA		-	10	40	
Output noise voltage	V_N	f = 10 to 100kHz		-	54	-	µV/V_{OUT}
Ripple rejection	RR	V_{IN} = 13 to 23V, f = 120Hz		37	46	-	dB

7 Specifications

7.5 Electrical Characteristics (continued)

VS78L09 (V_{IN} = 16V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, T_J = 25°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS[6]		MIN.	TYP.	MAX.	UNIT
Input voltage	V_{IN}	-		-	-	30	V
Output voltage	V_{OUT}	T_J = 25°C	±3% grade[7]	8.73	9.00	9.27	V
			±2% grade[7]	8.82		9.18	
		V_{IN} = 12 to 24V, I_{OUT} = 1 to 40mA		8.55		9.45	
		I_{OUT} = 1 to 70mA		8.55		9.45	
Output current	I_{OUT}	-		100	-	-	mA
Quiescent current	I_Q	I_{OUT} = 0mA		-	4.1	6.0	mA
Quiescent current change	ΔI_Q	V_{IN} = 13 to 24V		-	-	1.5	mA
		I_{OUT} = 1 to 40mA		-	-	0.1	mA
Dropout voltage	V_{DO}[8]	-		-	1.7	-	V
Line regulation	ΔV_{LINE}	V_{IN} = 12 to 24V		-	45	175	mV
		V_{IN} = 13 to 24V		-	40	125	
Load regulation	ΔV_{LOAD}	I_{OUT} = 1 to 100mA		-	19	90	mV
		I_{OUT} = 1 to 40mA		-	11	40	
Output noise voltage	V_N	f = 10 to 100kHz		-	58	-	μV/V_{OUT}
Ripple rejection	RR	V_{IN} = 15 to 25V, f = 120Hz		37	45	-	dB

VS78L12 (V_{IN} = 19V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, T_J = 25°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS[6]		MIN.	TYP.	MAX.	UNIT
Input voltage	V_{IN}	-		-	-	35	V
Output voltage	V_{OUT}	T_J = 25°C	±3% grade[7]	11.64	12.00	12.36	V
			±2% grade[7]	11.76		12.24	
		V_{IN} = 14 to 27V, I_{OUT} = 1 to 40mA		11.40		12.60	
		I_{OUT} = 1 to 70mA		11.40		12.60	
Output current	I_{OUT}	-		100	-	-	mA
Quiescent current	I_Q	I_{OUT} = 0mA		-	4.3	6.5	mA
Quiescent current change	ΔI_Q	V_{IN} = 14.5 to 27V		-	-	1.5	mA
		I_{OUT} = 1 to 40mA		-	-	0.1	mA
Dropout voltage	V_{DO}[8]	-		-	1.7	-	V
Line regulation	ΔV_{LINE}	V_{IN} = 14.5 to 27V		-	55	250	mV
		V_{IN} = 16 to 27V		-	49	200	
Load regulation	ΔV_{LOAD}	I_{OUT} = 1 to 100mA		-	22	100	mV
		I_{OUT} = 1 to 40mA		-	13	50	
Output noise voltage	V_N	f = 10 to 100kHz		-	70	-	μV/V_{OUT}
Ripple rejection	RR	V_{IN} = 15 to 25V, f = 120Hz		37	42	-	dB

7 Specifications

7.5 Electrical Characteristics (continued)

VS78L15 (V_{IN} = 23V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, T_J = 25°C, unless otherwise specified)

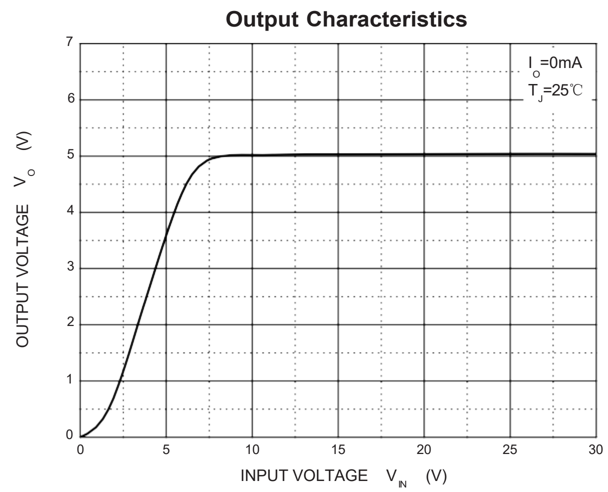
CHARACTERISTIC	SYMBOL	TEST CONDITIONS(6)		MIN.	TYP.	MAX.	UNIT
Input voltage	V_{IN}	-		-	-	35	V
Output voltage	V_{OUT}	T_J = 25°C	±3% grade(7)	14.55	15.00	15.45	V
			±2% grade(7)	14.70		15.30	
		V_{IN} = 17.5 to 30V, I_{OUT} = 1 to 40mA		14.25		15.75	
		I_{OUT} = 1 to 70mA		14.25		15.75	
Output current	I_{OUT}	-		100	-	-	mA
Quiescent current	I_Q	I_{OUT} = 0mA		-	4.6	6.5	mA
Quiescent current change	ΔI_Q	V_{IN} = 19 to 30V		-	-	1.5	mA
		I_{OUT} = 1 to 40mA		-	-	0.1	mA
Dropout voltage	V_{DO}(8)	-		-	1.7	-	V
Line regulation	ΔV_{LINE}	V_{IN} = 17.5 to 30V		-	65	300	mV
		V_{IN} = 19 to 30V		-	58	250	
Load regulation	ΔV_{LOAD}	I_{OUT} = 1 to 100mA		-	25	150	mV
		I_{OUT} = 1 to 40mA		-	15	75	
Output noise voltage	V_N	f = 10 to 100kHz		-	82	-	μV/V_{OUT}
Ripple rejection	RR	V_{IN} = 18.5 to 28.5V, f = 120Hz		34	39	-	dB

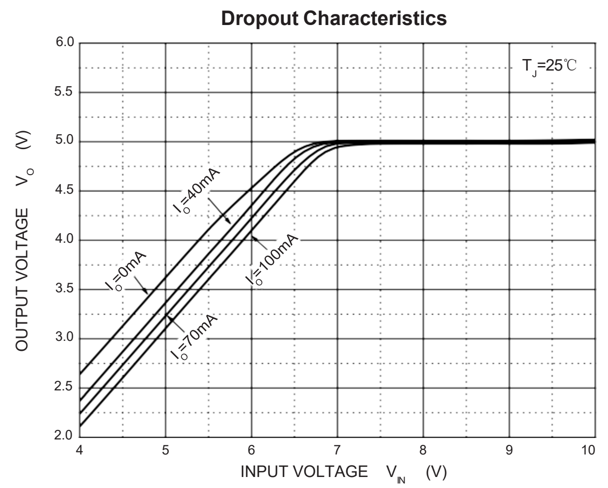
(6) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.
(7) Output voltage tolerances of ±3% for conventional device, ±2% can be customized.
(8) Test the difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT}.

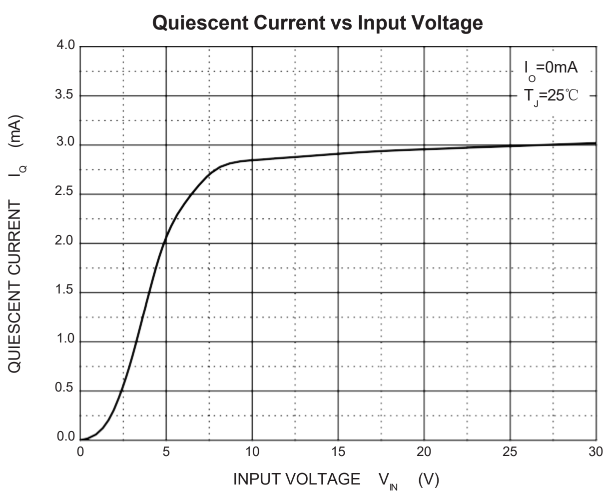
7 Specifications

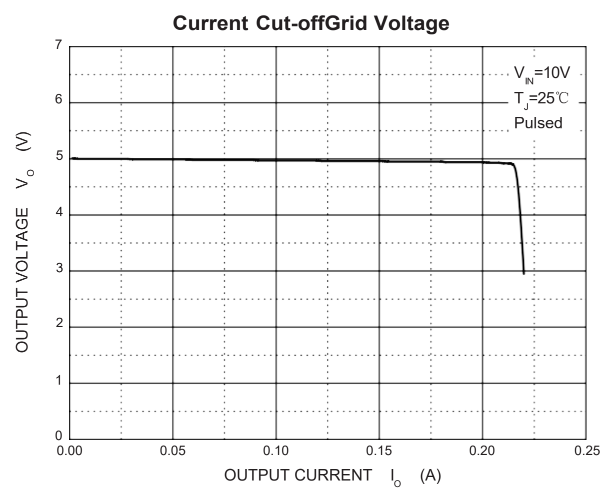
7.6 Typical Characteristics

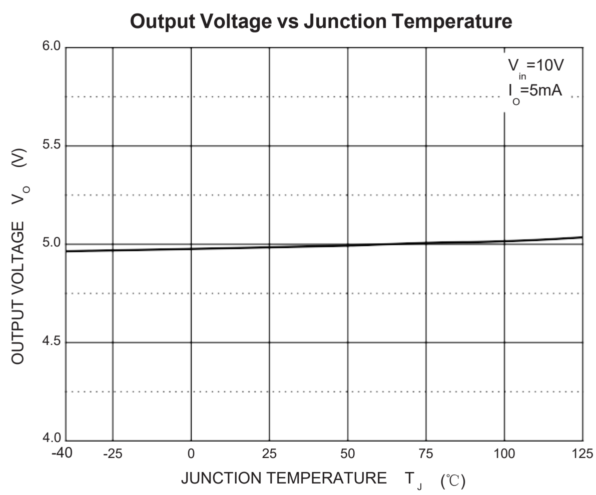
VS78L05 (V_{OUT} = 5.0V, T_J = 25°C, unless otherwise specified)

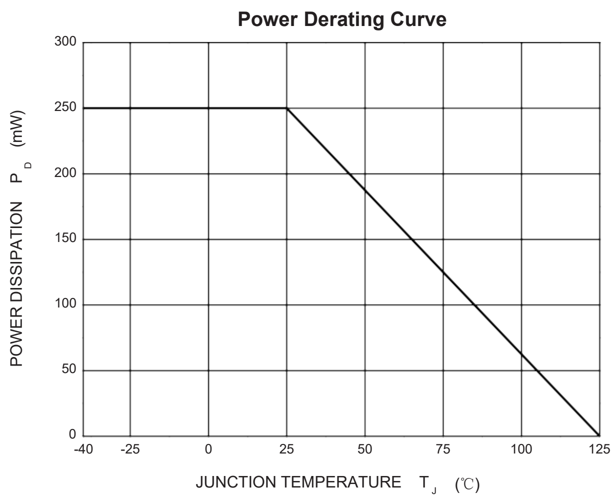










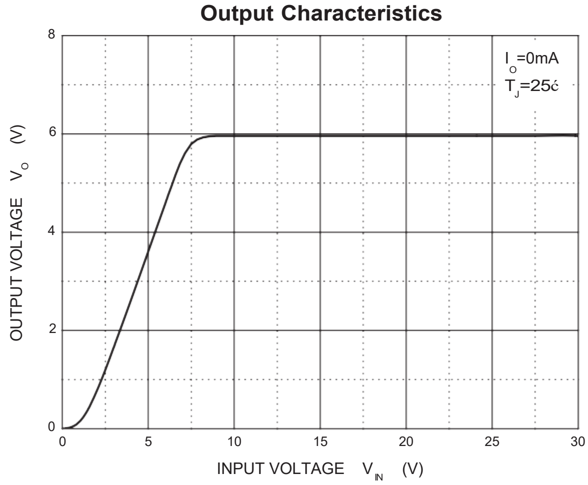


7 Specifications

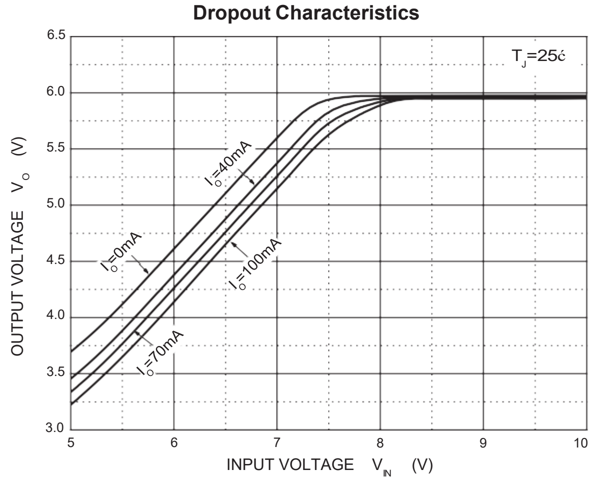
7.6 Typical Characteristics (continued)

78L06 (V_{OUT} = 6.0V, T_J = 25°C, unless otherwise specified)

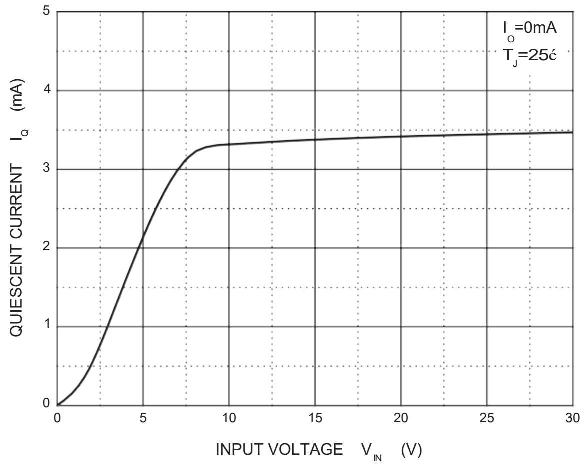
Output Characteristics



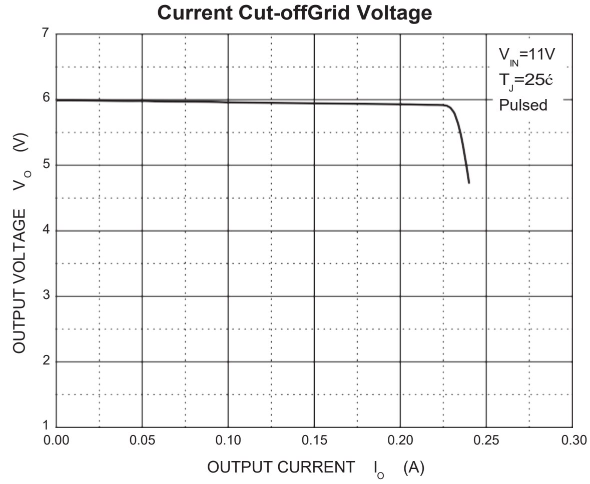
Dropout Characteristics



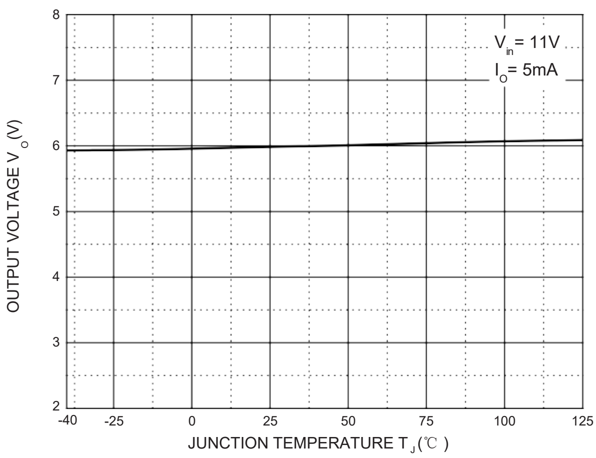
Quiescent Current



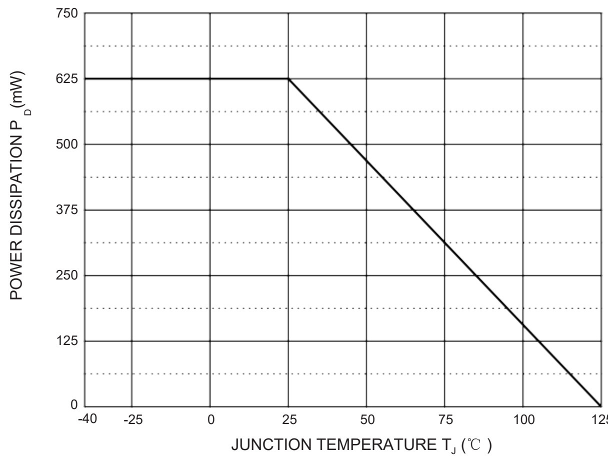
Current Cut-offGrid Voltage



Output Voltage vs Junction Temperature



Power Derating Curve

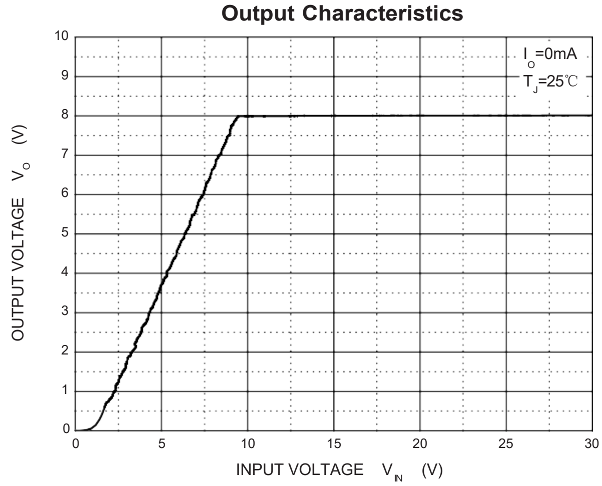


7 Specifications

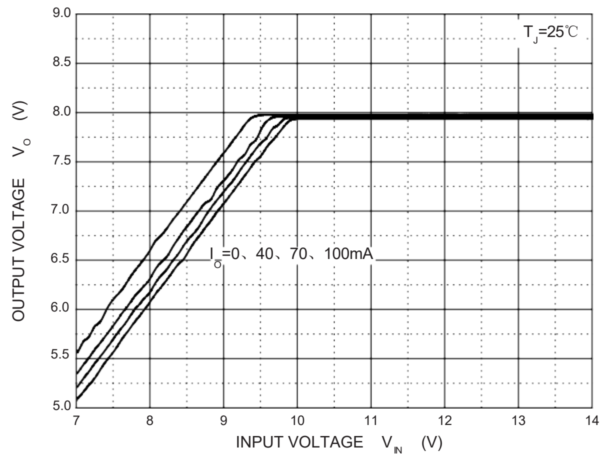
7.6 Typical Characteristics (continued)

VS78L08 (V_{OUT} = 8.0V, T_J = 25°C, unless otherwise specified)

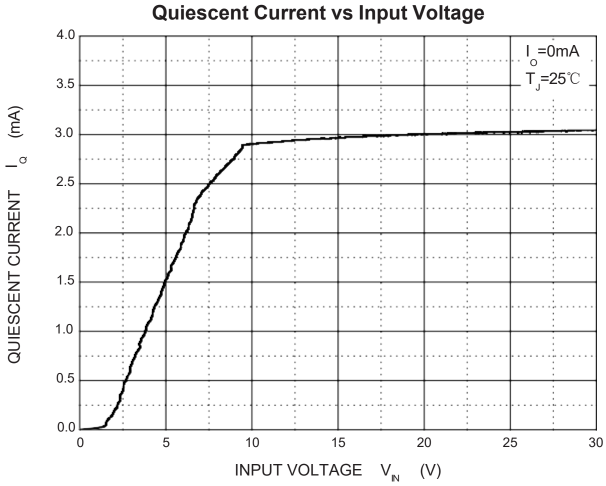
Output Characteristics



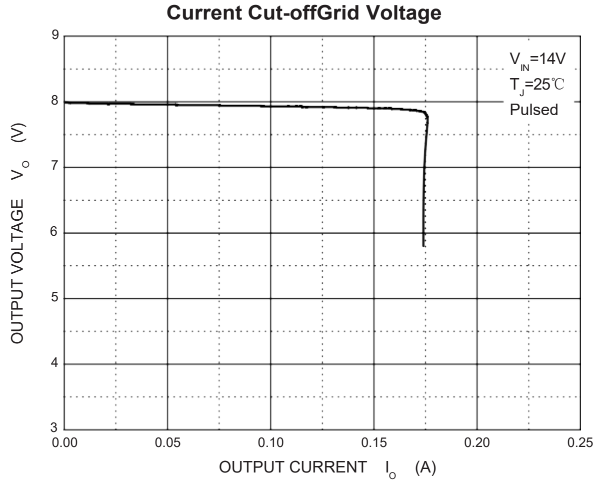
Dropout Characteristics



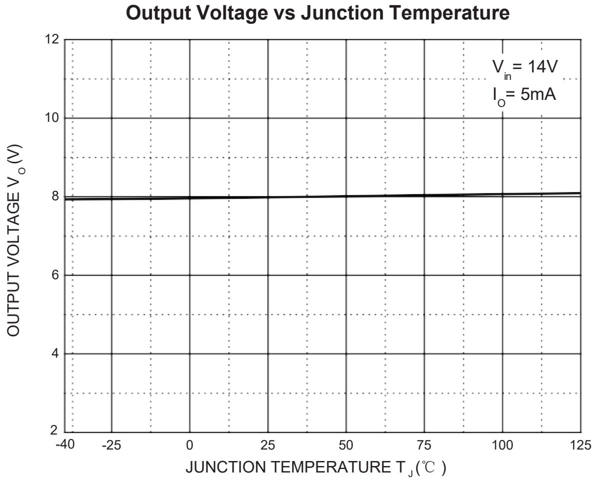
Quiescent Current vs Input Voltage



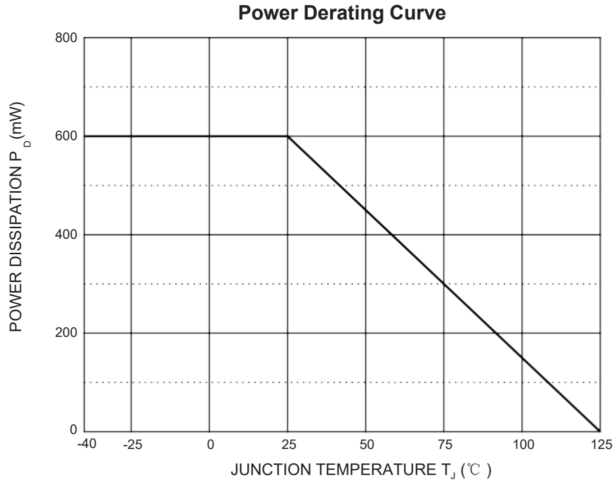
Current Cut-offGrid Voltage



Output Voltage vs Junction Temperature



Power Derating Curve

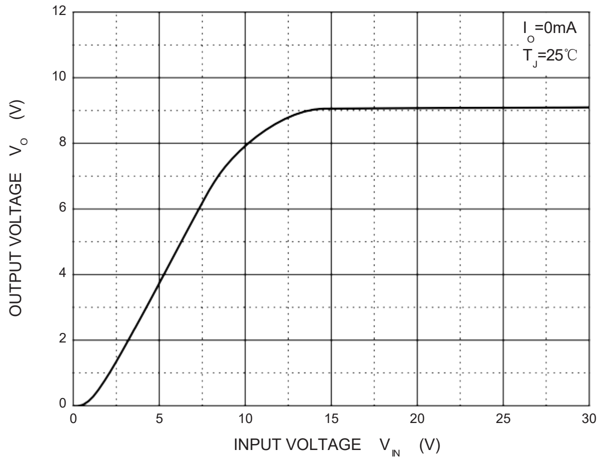


7 Specifications

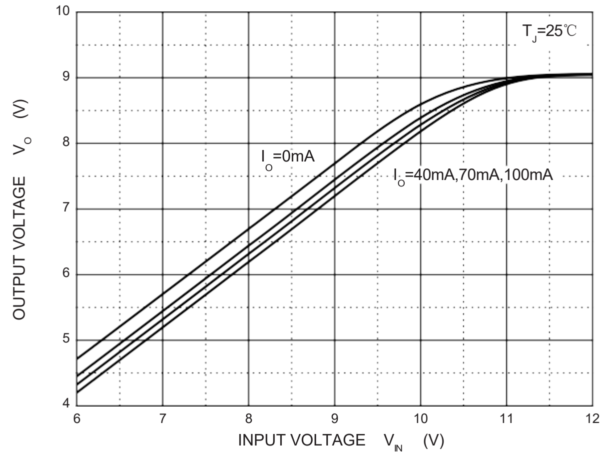
7.6 Typical Characteristics (continued)

VS78L09 (V_{OUT} = 9.0V, T_J = 25°C, unless otherwise specified)

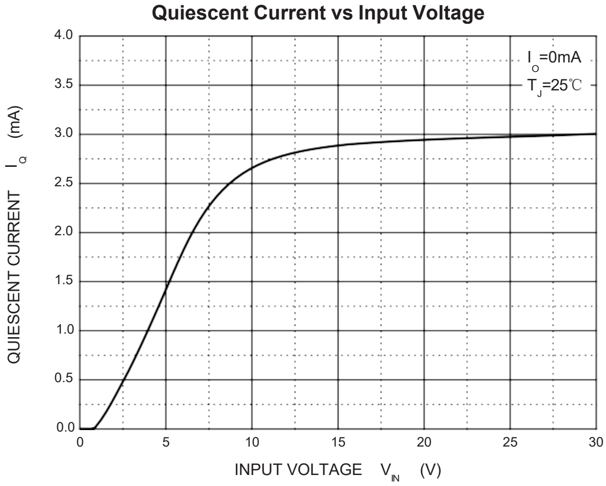
Output Characteristics



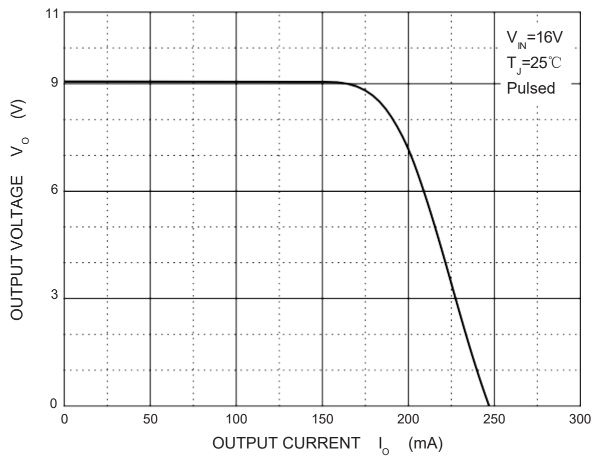
Dropout Characteristics



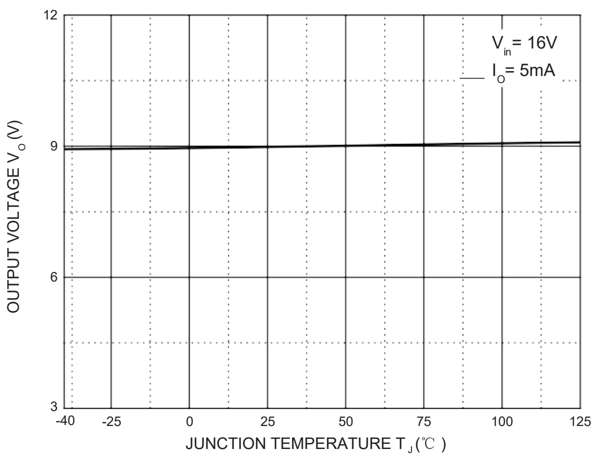
Quiescent Current vs Input Voltage



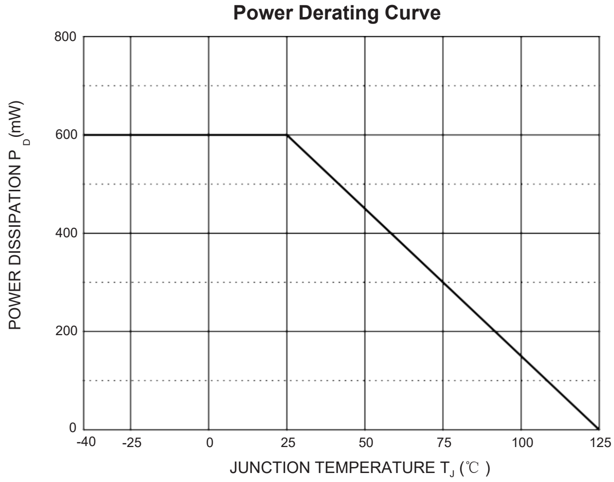
Current Cut-offGrid Voltage



Output Voltage vs Junction Temperature



Power Derating Curve

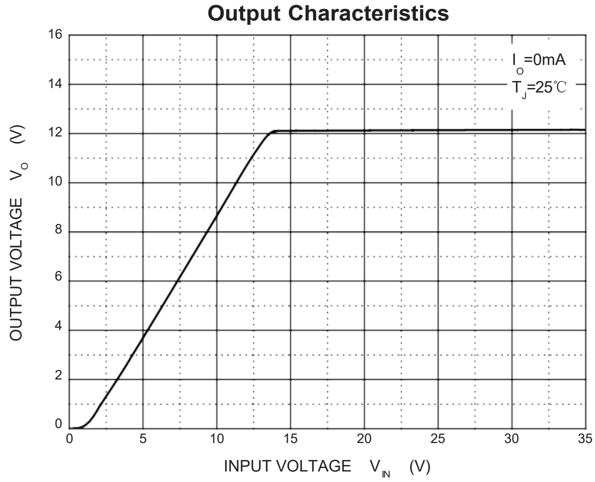


7 Specifications

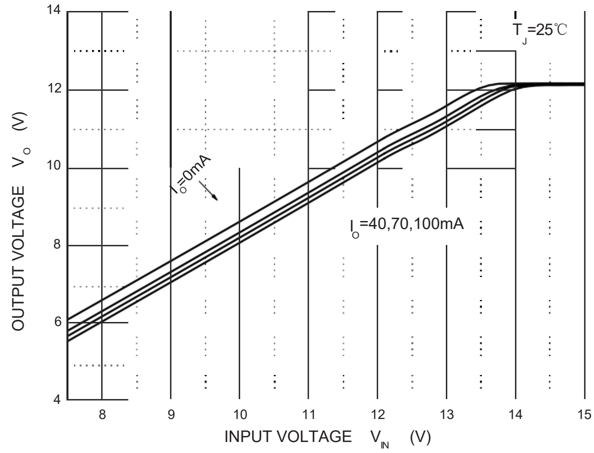
7.6 Typical Characteristics (continued)

VS78L12 (V_{OUT} = 12V, T_J = 25°C, unless otherwise specified)

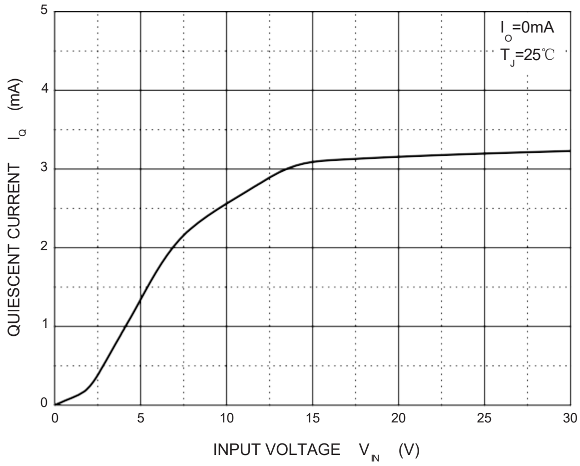
Output Characteristics



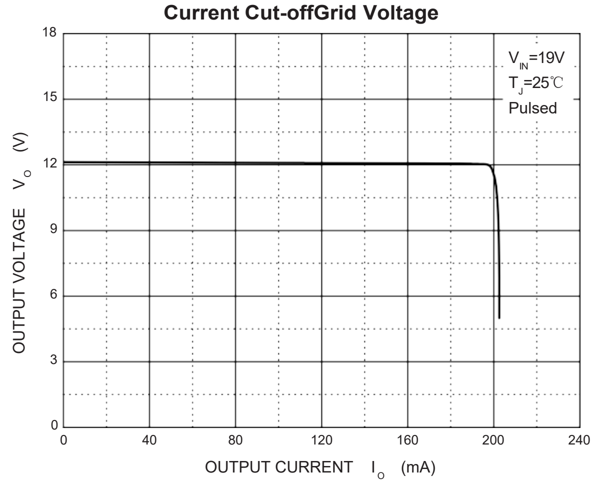
Dropout Characteristics



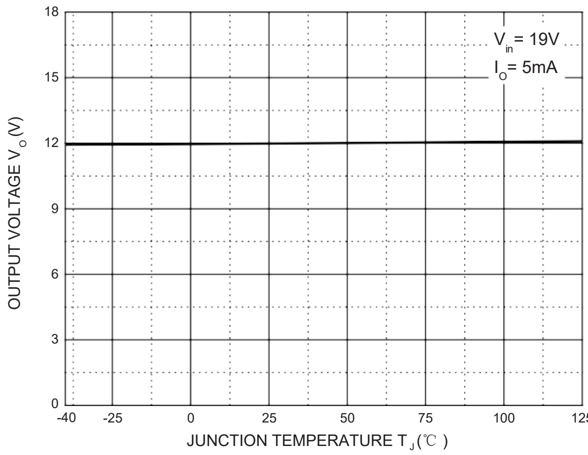
Quiescent Current



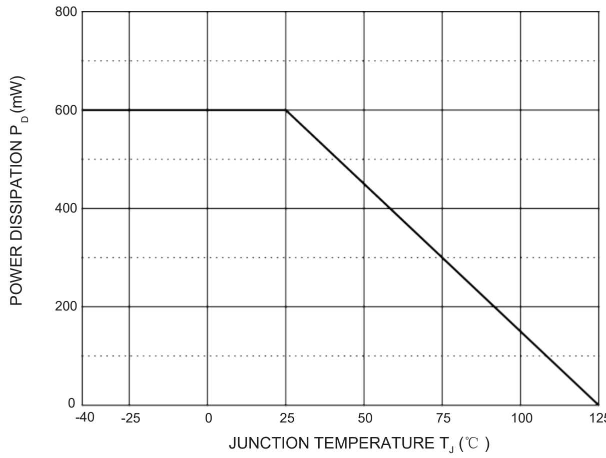
Current Cut-offGrid Voltage



Output Voltage vs Junction Temperature



Power Derating Curve

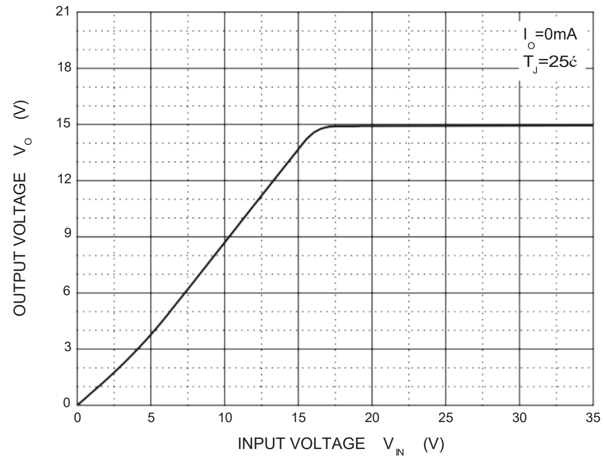


7 Specifications

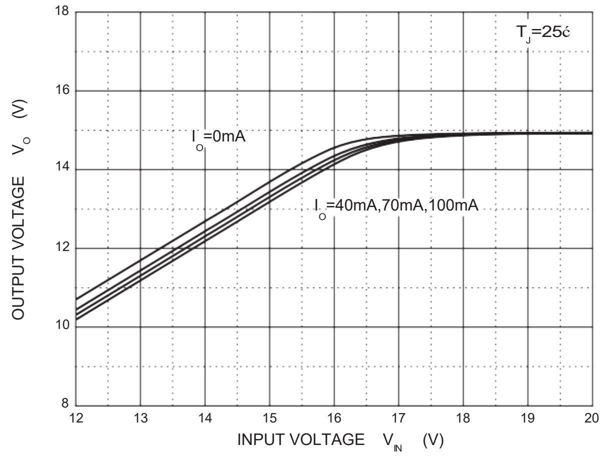
7.6 Typical Characteristics (continued)

VS78L15 (V_{OUT} = 15V, T_J = 25°C, unless otherwise specified)

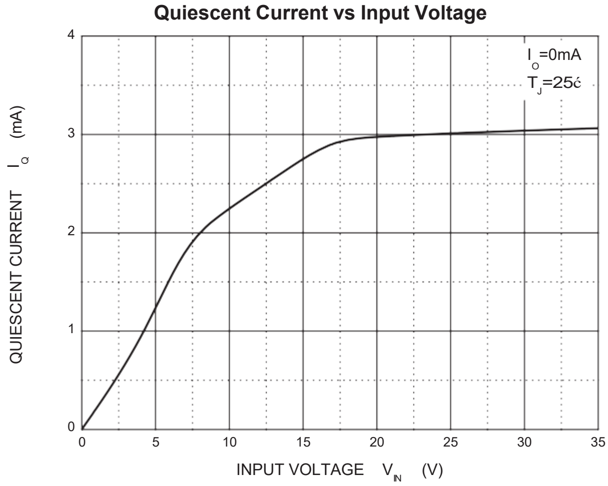
Output Characteristics



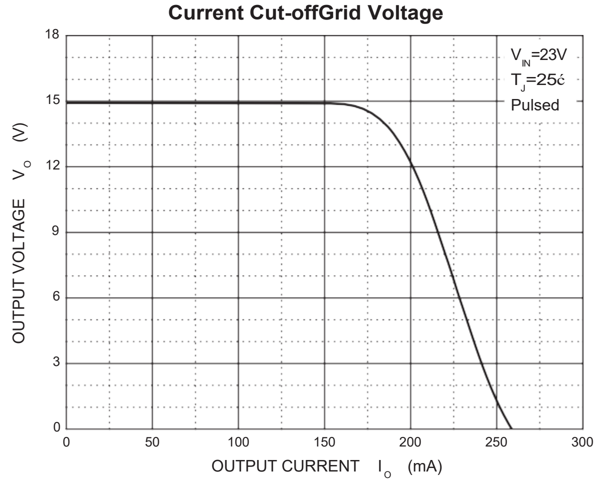
Dropout Characteristics



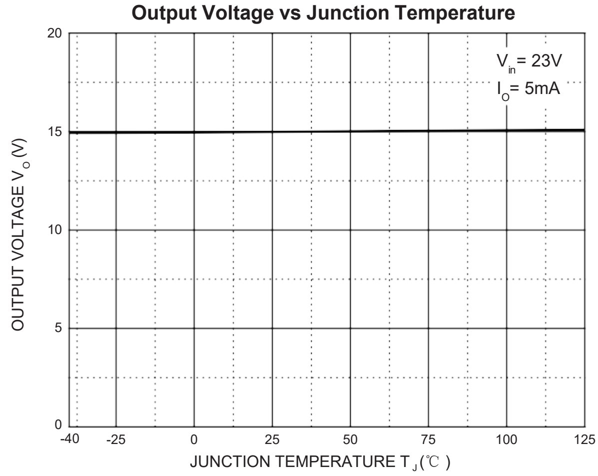
Quiescent Current vs Input Voltage



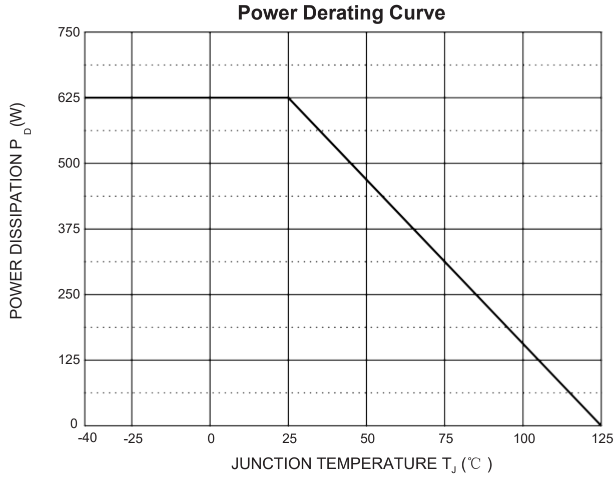
Current Cut-offGrid Voltage



Output Voltage vs Junction Temperature



Power Derating Curve

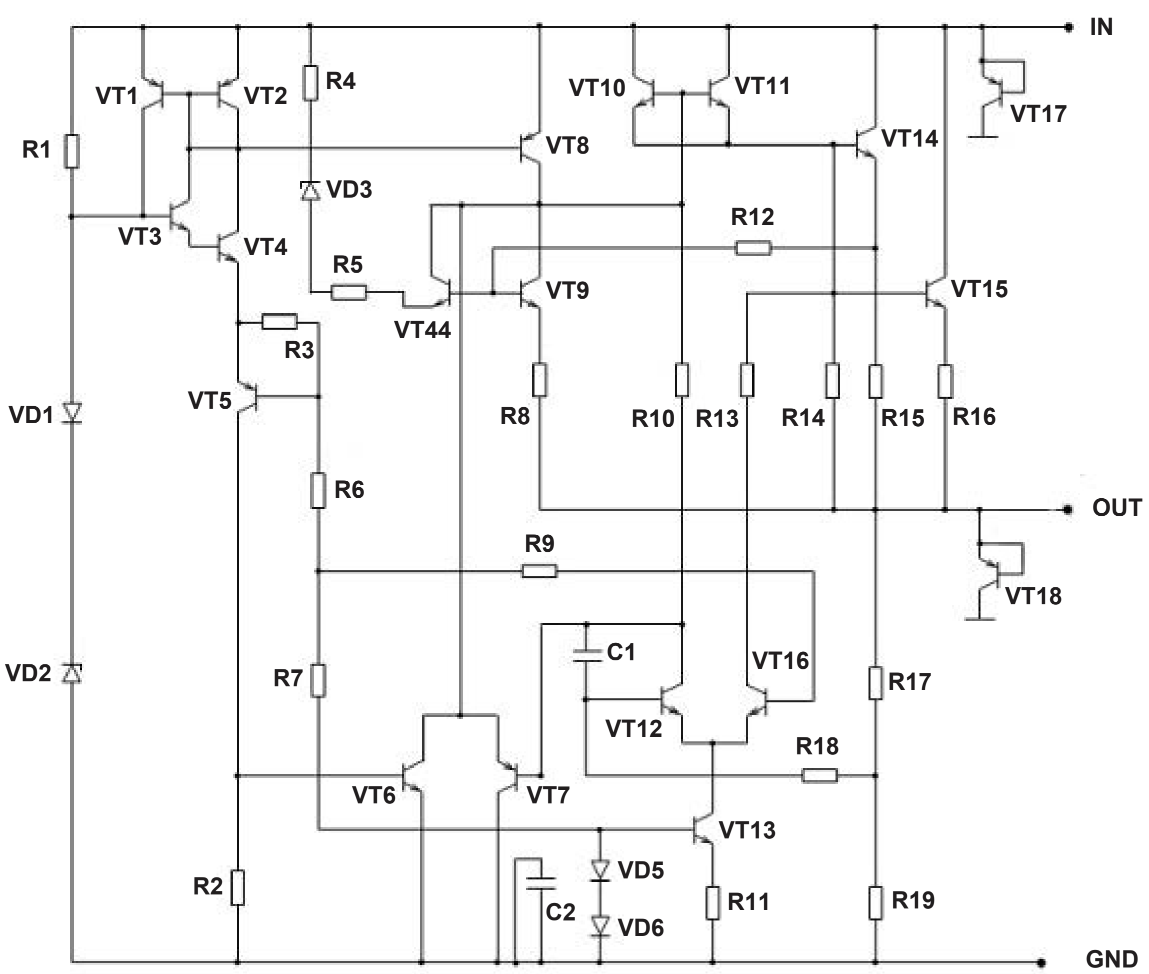


8 Detailed Description

8.1 Description

The VS78L series integrates current limit, short circuit protection and thermal shutdown to reduce the possibility of circuit overload. The VS78L series has a fixed output voltage version, which allows the fixed output VS78L series to be used as an output circuit with adjustable voltage by setting two peripheral resistors.

8.2 Representative Schematic Diagram



8 Detailed Description

8.3 Feature Description

Input Voltage

When the input voltage is lower than the rated range of the data sheet, the device will lose the regulation function of stabilizing the output voltage, that is, it is unable to maintain the output voltage within the rated range. At this time, compared with normal operation, the quiescent current of the device may exceed the rated range, and the transient response performance of the device may be seriously degraded.
When the input voltage is higher than the rated range of the data sheet, the device may cause irreversible damage or failure due to exceeding the maximum rated range of electrical stress.

Output Current

When the circuit design is appropriate, the VS78L series can reach the maximum load capacity of at least 100mA. According to the heat dissipation power consumption of the package and the effective connection thermal resistance with the environment, selecting the appropriate package for the circuit design can make the device emit more heat energy.

Thermal Shutdown

The VS78L series has thermal shutdown protection mechanism. When the junction temperature exceeds the rated temperature range for normal operation in the data sheet, the device will enter the thermal shutdown state. At this time, the output voltage of the device will be reduced to prevent catastrophic damage to the chip due to accidental heat. When the junction temperature decreases and no longer remains too high, the device will release the thermal shutdown and output normally.
To ensure reliable operation, please limit the junction temperature to the specified range of *Recommended Operating Conditions* in the data sheet. Applications that exceed the recommended temperature range may cause the equipment to exceed its operating specifications. Although the internal protection circuitry of the device is designed to protect against thermal overall conditions, this circuitry is not intended to replace proper heat sinking. Continuously running the device into thermal shutdown or above the maximum recommended junction temperature reduces long-term reliability.

Current Limit & Short Circuit Protection

The VS78L series has current limiting and short circuit protection mechanism. When the output current of the device is too high, the output of the device will be shut down. When the output of the device is short circuited to ground, the output of the device will also be shut down and the output current will be maintained within a certain range.

9 Application and Implementation

9.1 Risk Alert and Precautions

The VS78L series is designed for thermal protection, output short circuit protection and built-in current limit. However, like any IC regulator, precautions are necessary to reduce the possibility of accidental damage to the regulator. The following describes the possible causes of unit damage or failure:

Electrostatic Discharge (ESD) and Instantaneous Electrical Surge

Electrostatic discharge (ESD) is a common near-field hazard source. It comes from many sources, such as human body, mechanical equipment and electronic components themselves. ESD can cause phenomena such as high voltage and instantaneous high current in a very short time, resulting in damage or failure of the device due to electric shock.

In some applications, a short duration but high energy spike may occur in the circuit, including peak voltage and surge current. They may cause unstable operation of the regulator, accelerated aging and potential hazards, and even damage or malfunction of the regulator. These peaks are usually more likely to occur in hot-plug, switch inductance, heavy-load, and other types of circuits.

Precautions for ESD and Electrical Surge

In the practical application of the circuit, adopting the following suggestions can reduce the possibility of device failure due to the above reasons to a certain extent.

Using TVS:

Place a TVS between the IN and GND of the voltage regulator to absorb the peak voltage that may be generated due to ESD or other reasons. As shown in Figure 9-4;

Using Input Resistor:

Place a resistor with appropriate resistance in series before the IN of the voltage regulator, which can help the voltage regulator share part of the energy in case of surge. The resistance value of the resistance should not be too large. The specific resistance value depends on the application of the circuit. Generally, the resistance value of this resistance does not exceed 20Ω. As shown in Figure 9-5;

Using Electrolytic Capacitor:

For the application circuit using the low ESR multilayer ceramic capacitor (MLCC) type input capacitor, the LC resonant voltage spike caused by hot plugging or power transmission line inductance can be suppressed by using RC suppression circuit for parallel connection of the input capacitor. A very simple method is to parallel a suitable electrolytic capacitor to the input capacitor. As shown in Figure 9-6. For most 100μF/25V electrolytic capacitor has an ESR of about 0.2Ω at 100kHz. This can completely suppress the overshoot phenomenon of the input and minimize the possibility of IC damage due to input voltage spikes.

Figure 9-1 and Figure 9-2 show the impact of not using electrolytic capacitor [Test circuit is shown in Figure 9-3] and using 100μF/25V electrolytic capacitor parallel to the input capacitor [Test circuit is shown in Figure 9-6] on suppressing surge voltage. As shown in Figure 9-1., when the input is powered on from 0 to 10V, a peak voltage of up to 23V (shown in the RED part) is generated in front of the input terminal of the device. When the electrolytic capacitor is used, as shown in Figure 9-2., the peak voltage generated by power on is effectively suppressed (shown in the GREEN part).

9 Application and Implementation

9.1 Risk Alert and Precautions (continued)

Test Condition: VS78L05, C_{IN} = 10μF (MLCC), C_{OUT} = 100μF, V_{IN} = 0 ~ 10V, I_{OUT} = 100mA, CH_1: V_{IN}, CH_2: V_{OUT}.

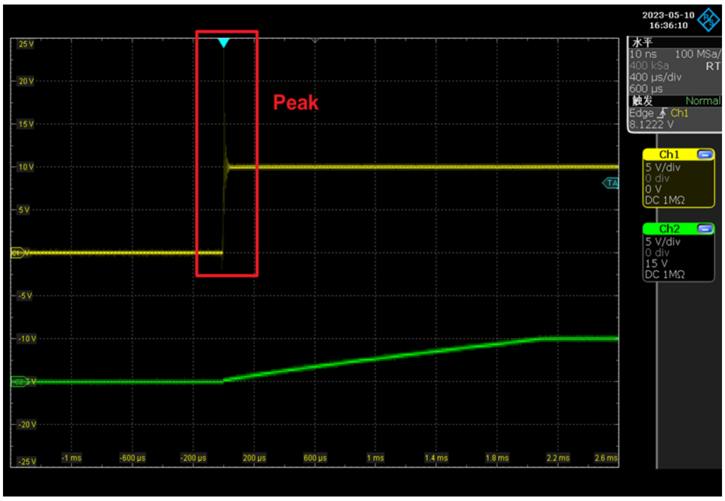


Figure 9-1. Test with the conventional circuit

[Test Circuit is shown in Figure 9-3]

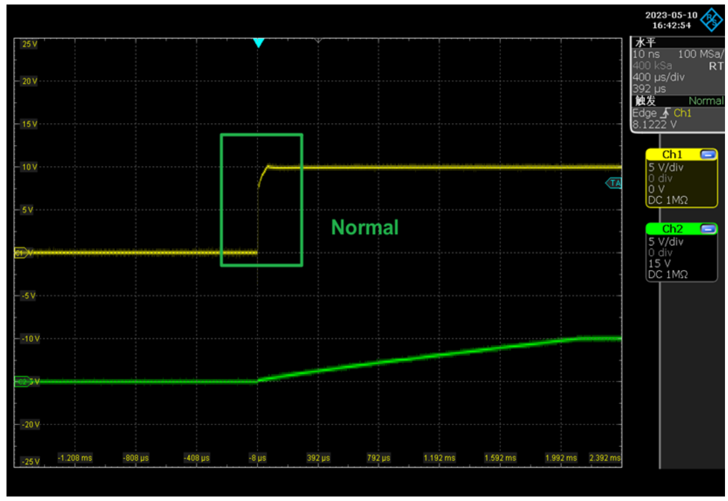


Figure 9-2. Test with the circuit that a 100μF/25V electrolytic capacitor parallel to the C_{IN}
[Test Circuit is shown in Figure 9-6]

For the VS78L05, 78L06, VS78L08, VS78L09, it is recommended that the input voltage should not exceed 16V and the peak voltage should not exceed 30V. For the VS78L12, VS78L15, it is recommended that the input voltage should not exceed 18V and the peak voltage should not exceed 35V. **When the input voltage of the operating circuit may not meet the application conditions described above, it is recommended to adopt the circuit layout shown in Figure 9-5 in the circuit design.**

Large Output Capacitance

The VS78L series can obtain better transient response with the help of output capacitance. However, if the output capacitor is relatively large, the surge current generated by the charging of the output capacitor will also be large at the moment of power on of the regulator, and the large surge current passing through the regulator may damage the internal circuit. When the output capacitance is large, adopting the circuit design shown in Figure 9-2 will reduce the possibility of damage to the device due to large surge current to a certain extent. It is recommended that the selection of output capacitor should not exceed 20μF. **If the selection of output capacitor exceeds 20μF, it is recommended to adopt the circuit design in Figure 9-5 to reduce the possibility of accidental failure of the device due to large surge current during power on.**

9.2 Typical Application Circuits

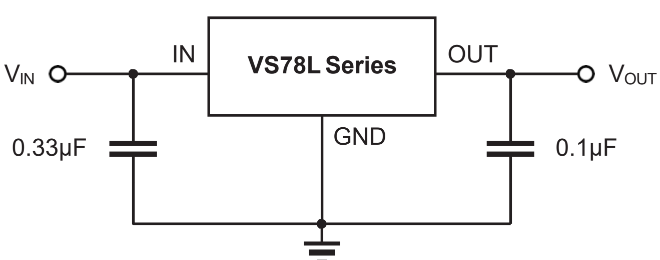


Figure 9-3. Conventional Circuit

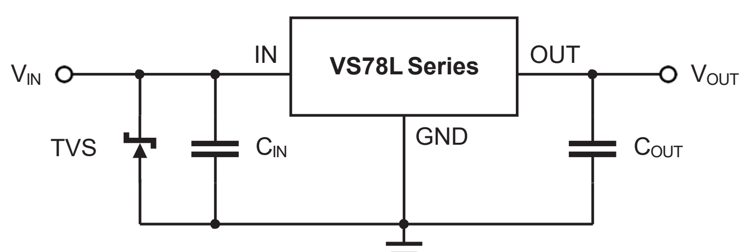


Figure 9-4. TVS is used at IN