HKT1117

The HKT1117 series of adjustable and fixed voltage regulators are designed to provide 1A output current and to operate down to 1V input-to-output differential. The dropout voltage of the device is guaranteed maximum 1.3V at maximum output current, decreasing at lower load currents.

On-chip trimming adjusts the reference voltage to 1%. Current limit is also trimmed, minimizing the stress under overload conditions on both the regulator and power source circuitry.

The HKT1117 devices are pin compatible with other three-terminal SCSI regulators and are offered in the low profile surface mount SOT-223 package, in the TO-220 package and in the TO-252 (DPAK) plastic package.

1. ADJ/GND
2. OUTPUT   SOT-223
3. INPUT

1. ADJ/GND
2. OUTPUT   TO-220
3. INPUT

1. ADJ/GND
2. OUTPUT
3. INPUT   TO-252

FEATURES

• Three Terminal Adjustable or Fixed Voltages*

  1.5V, 1.8V, 2.5V, 2.85V, 3.3V and 5.0V

• Output Current of   1A

• Operates Down to 1V Dropout

• Line Regulation: 0.2% Max.

• Load Regulation: 0.4% Max.

• SOT-223, TO-252 and TO-220   package available

APPLICATIONS

• High Efficiency Linear Regulators

• Post Regulators for Switching Supplies

• 5V to 3.3V Linear Regulator

• Battery Chargers

• Active SCSI Terminators

• Power Management for Notebook

• Battery Powered Instrumentation
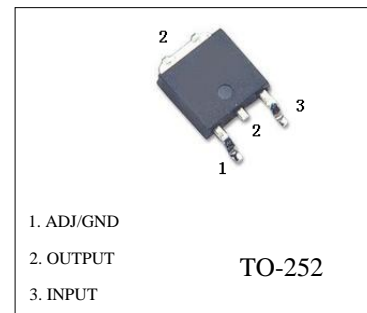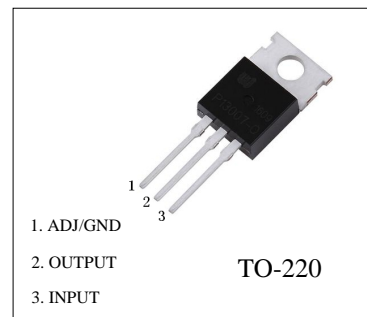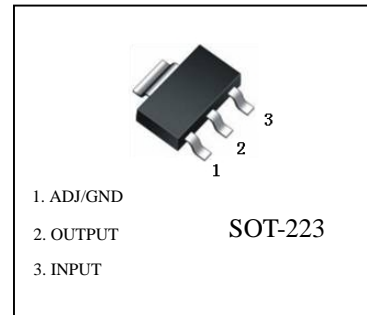
MAXIMUM RATINGS (TA=25℃ unless otherwise noted)

Symbol	Description	Max	Units
VIN (Notes 1)	Input Voltage	15	V
IOUT	DC Output Current	PD/(VIN-VO)	mA
TJ	Operating Junction Temperature Range	-40 to 125	℃
ΘJA	Thermal Resistance (SOT-223)	150	℃/W
ΘJA	Thermal Resistance (TO-252)	80	℃/W
ΘJA	Thermal Resistance (TO-220)	60	℃/W
PD	Maximum Power Dissipation (SOT-223)	Internally Limited	mW
PD	Maximum Power Dissipation (TO-252)		mW
PD	Maximum Power Dissipation (SOT-220)		mW

ELECTRICAL CHARACTERISTICS

HKT1117

Electrical Characteristics at I_{OUT} = 0 mA, and T_J = +25 ℃ unless otherwise specified.

Parameter	Device	Conditions	Min	Typ	Max	Units
Reference Voltage (Note 2)	HKT1117	IOUT = 10 mA 10mA IOUT 1A, 1.5V (VIN - VOUT) 12V	1.238 1.225	1.250 1.250	1.262 1.270	V
Reference Voltage (Note 2)	HTK1117-1.5	0 IOUT 1A , 3.0V VIN 12V	1.485 1.476	1.500 1.500	1.515 1.524	V
	HKT1117-1.8	0 IOUT 1A , 3.3V VIN 12V	1.782 1.773	1.800 1.800	1.818 1.827	V
	HKT1117-2.5	0 IOUT 1A , 4.0V VIN 12V	2.475 2.460	2.500 2.500	2.525 2.560	V
	HKT1117-2.85	0 IOUT 1A , 4.35V VIN 12V	2.82 2.79	2.850 2.850	2.88 2.91	V
	HKT1117-3.3	0 IOUT 1A , 4.75V VIN 12V	3.267 3.235	3.300 3.300	3.333 3.365	V
	HKT1117-5.0	0 IOUT 1A , 6.5V VIN 12V	4.950 4.900	5.000 5.000	5.050 5.100	V
Line Regulation	HKT1117	ILOAD = 10 mA , 1.5V (VIN - VOUT) 12V		0.015 0.035	0.2 0.2	%
	HKT1117-1.5	3.0V VIN 12V		0.3 0.6	5 6	mV
	HKT1117-1.8	3.3V VIN 12V		0.3 0.6	5 6	mV
	HKT1117-2.5	4.0V VIN 12V		0.3 0.6	6 6	mV
	HKT1117-2.85	4.35V VIN 12V		0.3 0.6	6 6	mV
	HKT1117-3.3	4.75V VIN 12V		0.5 1.0	10 10	mV
	HKT1117-5.0	6.5V VIN 12V		0.5 1.0	10 10	mV
Load Regulation (Notes 2, 3)	HKT1117	(VIN - VOUT) =3V, 10mA IOUT 1A		0.1 0.2	0.3 0.4	%
	HKT1117-1.5	VIN = 5V, 0 IOUT 1A		3 6	10 20	mV
	HKT1117-1.8	VIN = 5V, 0 IOUT 1A		3 6	10 20	mV
	HKT1117-2.5	VIN = 5V, 0 IOUT 1A		3 6	12 20	mV

ELECTRICAL CHARACTERISTICS

HKT1117

Electrical Characteristics at IOUT = 0 mA, and TJ = +25 ℃ unless otherwise specified.

Parameter	Device	Conditions	Min	Typ	Max	Units
Load Regulation (Notes 2, 3)	HKT1117-2.85	V_{IN} = 5V, 0 ≤ I_{OUT} ≤ 1A		3 **6**	12 **20**	mV mV
	HKT1117-3.3	V_{IN} = 5V, 0 ≤ I_{OUT} ≤ 1A		3 **7**	15 **25**	mV mV
	HKT1117-5.0	V_{IN} = 8V, 0 ≤ I_{OUT} ≤ 1A		5 **10**	20 **35**	mV mV
Dropout Voltage (V_{IN} - V_{OUT})	HKT1117-1.5/-1.8/-2.5/-2.85/-3.3/-5.0	V_{OUT} , V_{REF} = 1%, I_{OUT} = 1A (Note 4)		**1.1**	**1.3**	V
Current Limit	HKT1117-1.5/-1.8/-2.5/-2.85/-3.3/-5.0	(V_{IN} - V_{OUT}) = 5V	900	**1,100**	**1,500**	mA
Minimum Load Current	HKT1117	(V_{IN} - V_{OUT}) = 12V (Note 5)		**5**	**10**	mA
Quiescent Current	HKT1117-1.5/-1.8/-2.5/-2.85/-3.3/-5.0	V_{IN} ≤ 12V		**5**	**10**	mA
Ripple Rejection	HKT1117	f =120Hz , C_{OUT} = 22µF Tantalum, I_{OUT} = 1A, (V_{IN}-V_{OUT}) = 3V, C_{ADJ} =10µF	**60**	**75**		dB
	HKT1117-1.5/-1.8/-2.5/-2.85	f =120Hz , C_{OUT} = 22µF Tantalum, I_{OUT} = 1A, V_{IN} = 6V	**60**	**72**		dB
	HKT1117-3.3	f =120Hz , C_{OUT} = 22µF Tantalum, I_{OUT} = 1A, V_{IN} = 6.3V	**60**	**72**		dB
	HKT1117-5.0	f =120Hz , C_{OUT} = 22µF Tantalum, I_{OUT} = 1A, V_{IN} = 8V	**60**	**68**		dB
Thermal Regulation	HKT1117	T_A = 25°C, 30ms pulse		0.008	0.04	%W
Adjust Pin Current	HKT1117	10mA ≤ I_{OUT} ≤ 1A , 1.5V ≤ (V_{IN} - V_{OUT}) ≤ 12V		55	**120**	µA µA
Adjust Pin Current Change	HKT1117	10mA ≤ I_{OUT} ≤ 1A , 1.5V ≤ (V_{IN} - V_{OUT}) ≤ 12V		**0.2**	**5**	µA
Temperature Stability				**0.5**		%
Long Term Stability		T_A =125°C, 1000Hrs		0.3	1	%
RMS Output Noise (% of V_{OUT})		T_A = 25°C , 10Hz ≤ f ≤ 10kHz		0.003		%
Thermal Resistance Junction-to-Case					15	°C/W

OParameters identified with **boldface type** apply over the full operating temperature range.

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed.

Note 2: Line and Load regulation are guaranteed up to the maximum power dissipation of 1.2 W. Power dissipation is determined by the input/output differential and the output current. Guaranteed maximum power dissipation will not be available over the full input/output range.

Note 3: See thermal regulation specifications for changes in output voltage due to heating effects. Line and load regulation are measured at a constant junction temperature by low duty cycle pulse testing. Load regulation is measured at the output lead ~1/8" from the package.

Note 4: Dropout voltage is specified over the full output current range of the device.

Note 5: Minimum load current is defined as the minimum output current required   to maintain regulation. When 1.5V ≤ (VIN - VOUT) ≤ 12V the device is guaranteed to regulate if the output current is greater than 10mA.
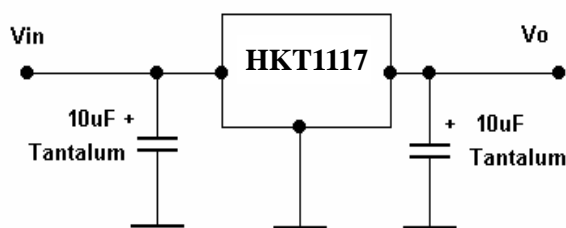
HKT1117

Block Diagram
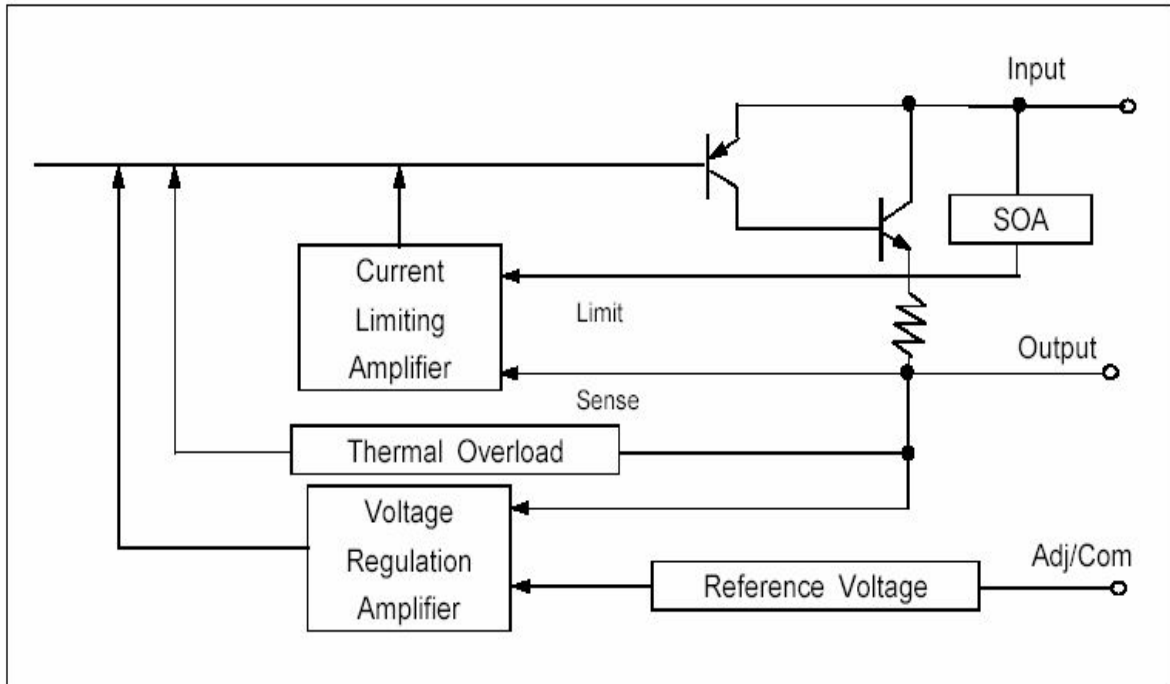
Application Information

FIGURE 1. Fixed-Voltage Model
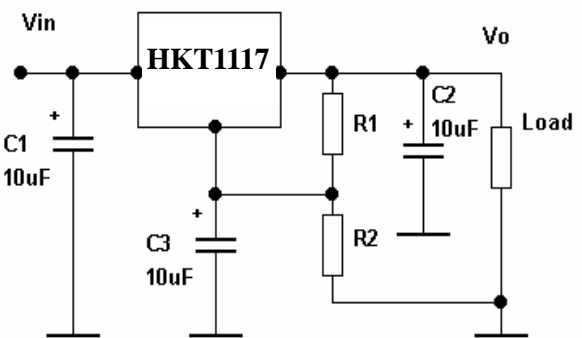—Basic Connections.   --Basic Connections.

FIGURE 2. Adjustable-Voltage Model

Vo=Vref(1+R2/R1)+Iadj*R2

Output voltage adjustment

HKT1117

Like most regulators, the HTK1117 regulates the output by comparing the output voltage to an internally gen- erated reference voltage. On the adjustable version as shown in Fig.4, the V_{REF} is available externally as 1.25V between V_{OUT} and ADJ. The voltage ratio formed by R1 and R2 should be set to conduct 10mA (mi- numum output load).

The output voltage is given by the following equation:

$$V_{OUT} = V_{REF} \left(1+ \frac{R1}{R2}\right) + I_{ADJ} \times R_2$$

On fixed versions of   HKT1117, the voltage divider is provided internally
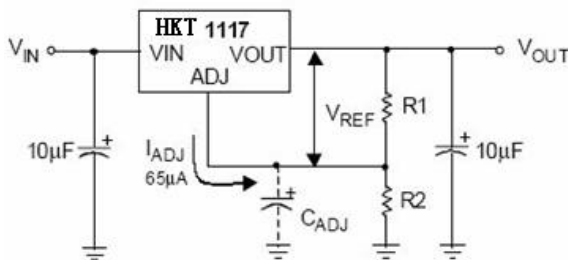
Input Bypass Capacitor

An input capacitor is recommended. A 10μF tantalum on the input is a suitable input bypassing for almost all applications.

Adjust Terminal Bypass Capacitor

The adjust terminal can be bypassed to ground with a bypass capacitor (CADJ) to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. At any ripple frequency, the impedance of the CADJ should be less than R1 to prevent the ripple from being amplified:

$$(2\pi * f_{RIPPLE} * C_{ADJ}) < R1$$

The R1 is the resistor between the output and the adjust pin. Its value is normally in the range of 100- 200Ω. For example, with R1 = 124Ω and fRIPPLE = 120Hz, the CADJ should be > 11Mf

Output Capacitor

HKT1117 requires a capacitor from VOUT to GND to provide compensation feedback to the internal gain stage. This is to ensure stability at the output terminal. Typically, a 10μF tantalum or 50μF aluminum electrolytic is sufficient.

Note: It is important that the ESR for this capacitor does not exceed 0.5 Ω.

The output capacitor does not have a theoretical upper limit and increasing its value will increase stability. $C_{OUT} = 100$μF or more is typical for high current regulator design.

Load Regulation

When the adjustable regulator is used (Fig.5), the best load regulation is accomplished when the top of the resistor divider (R1) is connected directly to the output pin of the HKT1117. When so connected, RP is not multiplied by the divider ratio. For Fixed output version, the top of R1 is internally connected to the output and ground pins can be connected to low side of the load.
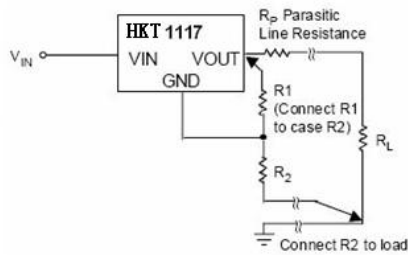
HKT1117

Figure 5. Best Load Regulation Using Adjustable Output Regulator

Thermal Protection

HKT1117 has thermal protection which limits junction temperature to 150℃. However, device functionality is only guaranteed to a maximum junction temperature of +125℃. The power dissipation and junction tem- perature for HKT1117 in DPAK package are given by

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

$$T_{JUNCTION} = T_{AMBIENT} + (P_D \times \theta_{JA})$$

Note: $T_{JUNCTION}$ must not exceed 125℃

Current Limit Protection

HKT1117 is protected against overload conditions. Current protection is triggered at typically 1.6A.

Thermal Consideration

The HKT1117 series contain thermal limiting circuitry designed to protect itself from over-temperature condi- tions. Even for normal load conditions, maximum junction temperature ratings must not be exceeded. As mention in thermal protection section, we need to consider all sources of thermal resistance between junc- tion and ambient. It includes junction-tocase, case-to-heat-sink interface, and heat sink thermal resistance itself.

Junction-to-case thermal resistance is specified from the IC junction to the bottom of the case directly below the die. Proper mounting is required to ensure the best possible thermal flow from this area of the package to the heat sink. The case of all devices in this series is electrically connected to the output. Therefore, if the case of the device must be electrically isolated, a thermally conductive spacer is recommended.
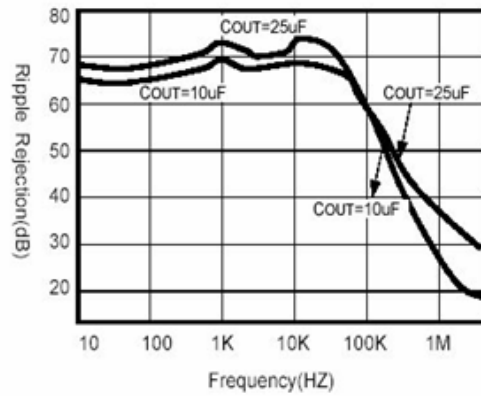
Hottech Semiconductor

HKT1117

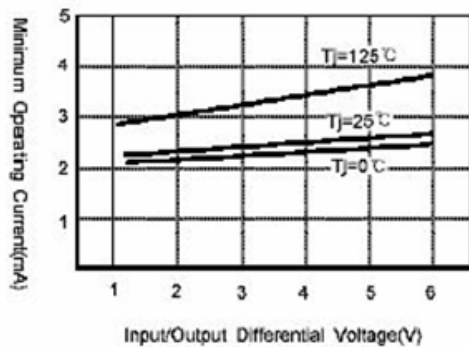Typical Characteristics

Temperature Stability
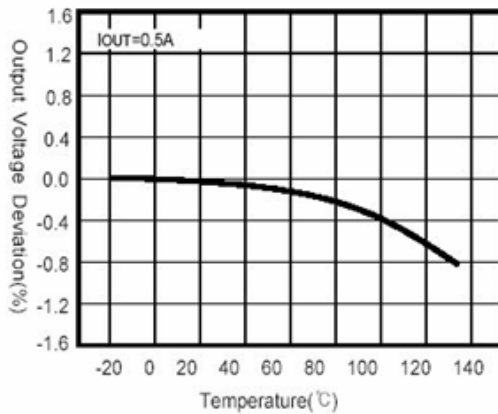
Ripple Rejection(with C$_{adj}$ 25uF)
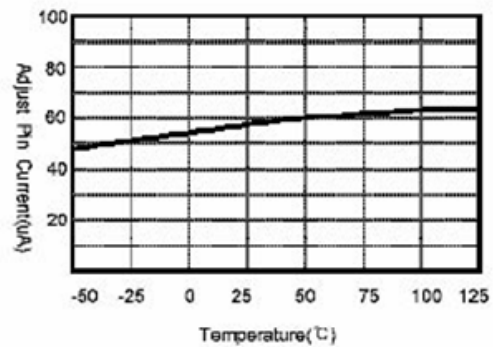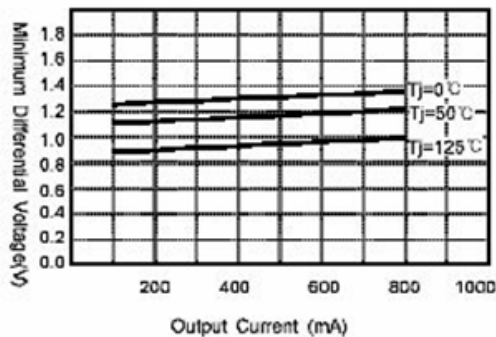

Minimum Load Current(Adjustable)

Adjust Pin Current

Dropout Voltage

Dropout Voltage - Temperature