HOLTEK

30V, 150mA TinyPower™ LDO

HT75Rxx-1

Revision: V1.00 Date: May 13, 2025

Table of Contents

Features

- Low power consumption
- Low voltage dropout
- Low temperature coefficient
- Maximum input voltage: 30V
- Output voltage accuracy: ±1%
- Low Quiescent Current: 1μA (typ.)
- High output current: 150mA
- Soft start function
- Allow 1μF ceramic type output capacitor
- Package types: 3-pin SOT89, 5-pin SOT23

Applications

- Battery-powered equipment
- Communication equipment
- Audio/Video equipment

General Description

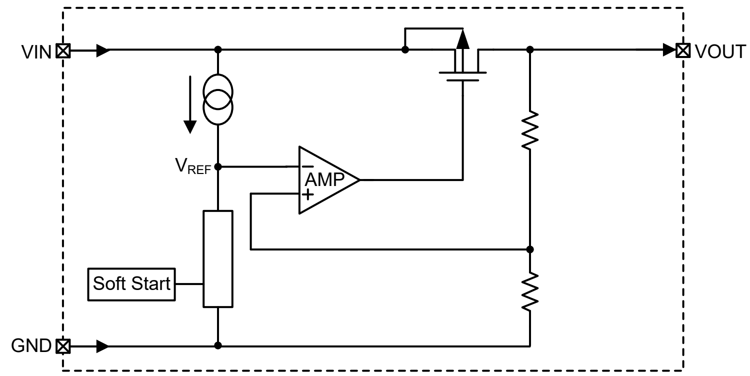
The HT75Rxx-1 series of devices are three-terminal low-power high-voltage regulators implemented in CMOS technology, which ensures low voltage dropout and low quiescent current. They can deliver 150mA output current and allow an input voltage as high as 30V. They are available with several fixed output voltages ranging from 2.1V to 12.0V.

The devices include a soft start function, which is used to control the output slew rate to prevent the overshooting phenomenon when power on. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain variable voltages and currents. The soft start function inhibits the output overshooting when power on.

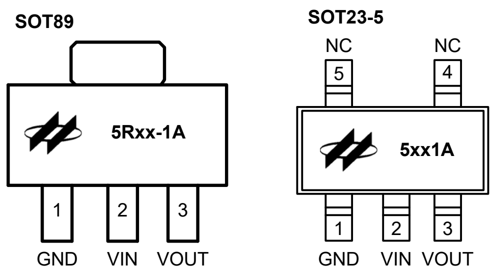
Selection Table

Part No.	Output Voltage(V)	Package	Marking
HT75R21-1A	2.1	SOT89	5R21-1A
HT75R30-1A	3.0		5R30-1A
HT75R33-1A	3.3		5R33-1A
HT75R36-1A	3.6		5R36-1A
HT75R50-1A	5.0		5R50-1A
HT75RC0-1A	12.0		5RC0-1A
HT75R21-1A	2.1	SOT23-5	5211A
HT75R30-1A	3.0		5301A
HT75R33-1A	3.3		5331A
HT75R36-1A	3.6		5361A
HT75R50-1A	5.0		5501A
HT75RC0-1A	12.0		5C01A

Block Diagram



Pin Assignment



Pin Description

Pin No.		Pin Name	Pin Description
SOT89	SOT23-5		
1	1	GND	Ground pin
2	2	VIN	Input pin
3	3	VOUT	Output pin
—	4	NC	No connection
—	5	NC	No connection

Absolute Maximum Ratings

Parameter		Value	Unit
V_{IN}		-0.3 to 33	V
Operating Temperature Range, Ta		-40 to 105	°C
Maximum Junction Temperature, $T_{J(MAX)}$		150	°C
Storage Temperature Range		-60 to 150	°C
ESD Susceptibility	Human Body Model	±2000	V
	Machine Model	±200	V
Junction-to-Ambient Thermal Resistance, θ_{JA}	SOT89	200	°C/W
	SOT23-5	500	°C/W
Power Dissipation, P_D	SOT89	0.5	W
	SOT23-5	0.2	W

Note: P_D is measured at Ta = 25°C.

Recommended Operating Range

Parameter	Value	Unit
V_{IN}	3.1 to 30	V

Electrical Characteristics

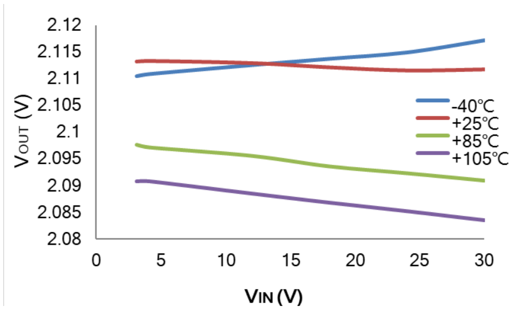
Ta=25°C, $V_{IN}=V_{OUT}+2V$, $C_{IN}=C_{OUT}=1\mu F$, unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage	—	—	—	30	V
V_{OUT}	Output Voltage	—	2.1	—	12.0	V
V_O	Output Voltage Accuracy	I_{OUT}=10mA	–1	—	1	%
I_{OUT}	Output Current	—	150	—	—	mA
ΔV_{OUT}	Load Regulation	$1mA \leq I_{OUT} \leq 50mA$	—	15	45	mV
V_{DIF}	Dropout Voltage	I_{OUT}=1mA, V_{OUT} drop=2% (Note)	—	10	30	mV
I_{SS}	Quiescent Current	I_{OUT}=0mA	—	1.0	1.5	μA
$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times \Delta V_{OUT}}$	Line Regulation	$V_{OUT}+1V \leq V_{IN} \leq 30V$, I_{OUT}=1mA	—	0.1	0.2	%/V
$\frac{\Delta V_{OUT}}{\Delta T_a \times \Delta V_{OUT}}$	Temperature Coefficient	I_{OUT}=10mA, -40°C < Ta < 85°C	—	±100	—	ppm/°C

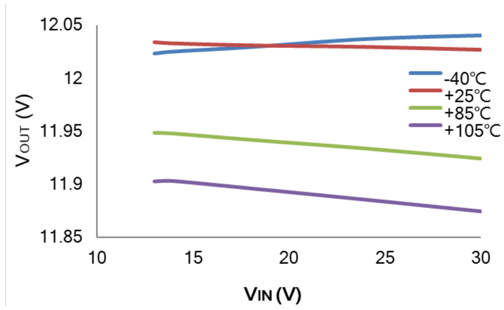
Note: The dropout voltage is defined as the input voltage minus the output voltage that produces a 2% change in the output voltage from the value at $V_{IN}=V_{OUT}+2V$ with a fixed load.

Typical Performance Characteristic

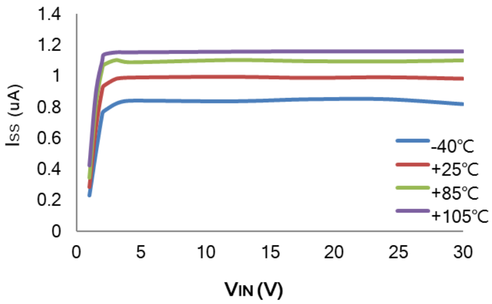
Test Condition: $V_{IN}=V_{OUT}+2V$, $I_{OUT}=10mA$, $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, Ta=25ºC, unless otherwise noted



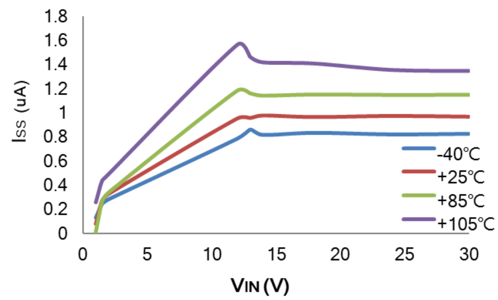
Line Regulation: HT75R21-1(I_{OUT}=10mA)



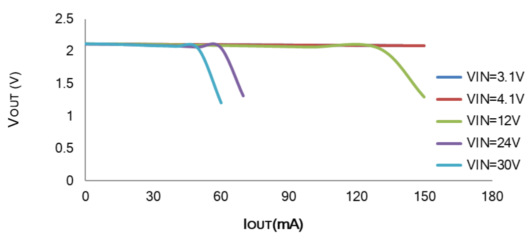
Line Regulation: HT75RC0-1(I_{OUT}=10mA)



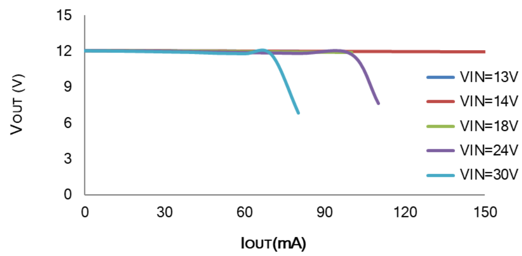
I_{SS} vs V_{IN}: HT75R21-1(I_{OUT}=0mA)



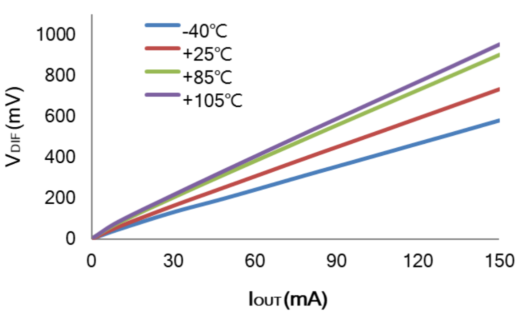
I_{SS} vs V_{IN}: HT75RC0-1(I_{OUT}=0mA)



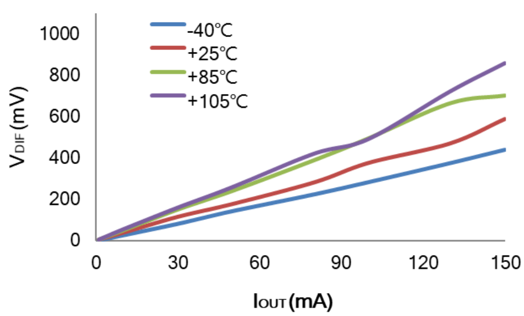
V_{OUT} vs I_{OUT}: HT75R21-1



V_{OUT} vs I_{OUT}: HT75RC0-1

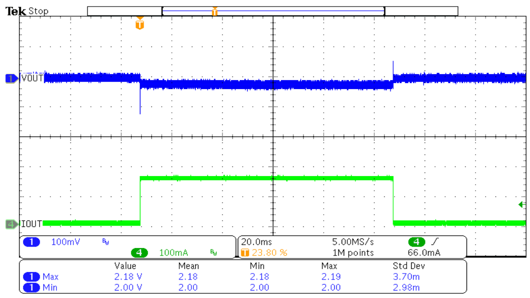


Dropout Voltage: HT75R21-1

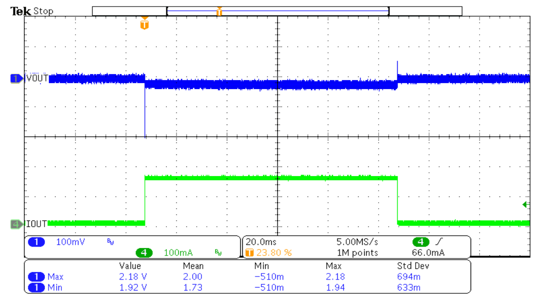


Dropout Voltage: HT75RC0-1

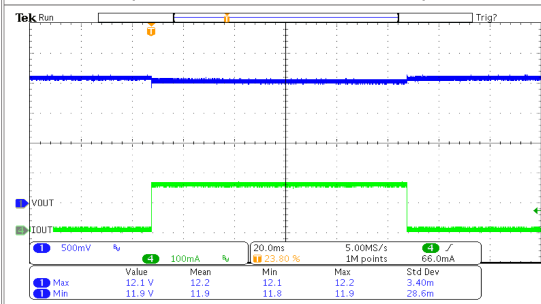
Load Transient Response



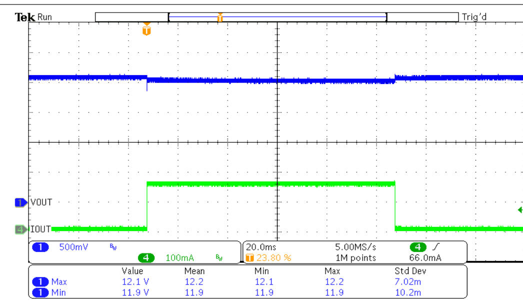
Load Transient Response: HT75R21-1
(V_{IN}=4.1V, I_{OUT}=1mA to 150mA)



Load Transient Response: HT75R21-1
(V_{IN}=4.1V, I_{OUT}=0mA to 150mA)

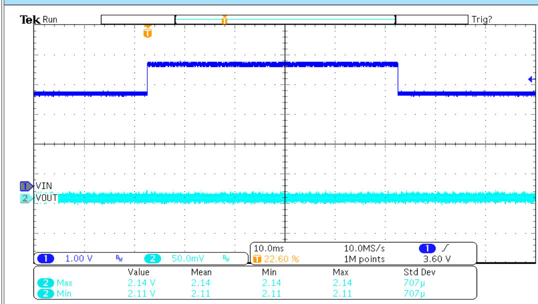


Load Transient Response: HT75RC0-1
(V_{IN}=14V, I_{OUT}=1mA to 150mA)

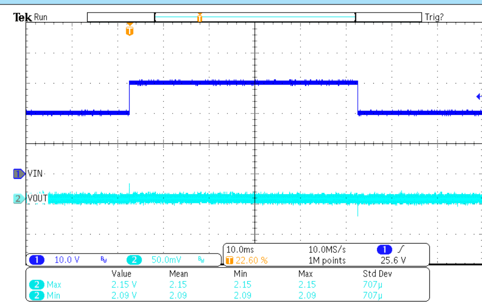


Load Transient Response: HT75RC0-1
(V_{IN}=14V, I_{OUT}=0mA to 150mA)

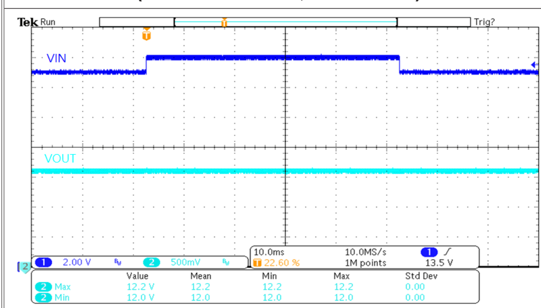
Line Transient Response



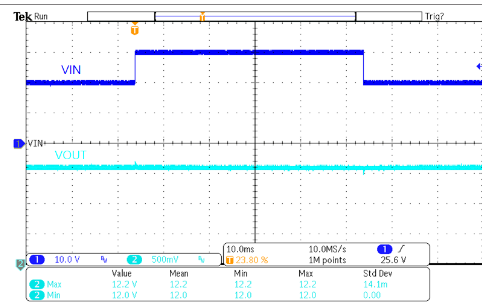
Line Transient Response: HT75R21-1
(V_{IN}=3.1V to 4.1V, I_{OUT}=10mA)



Line Transient Response: HT75R21-1
(V_{IN}=20V to 30V, I_{OUT}=10mA)

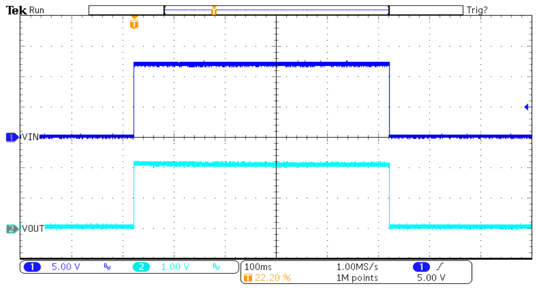


Line Transient Response: HT75RC0-1
(V_{IN}=13V to 14V, I_{OUT}=10mA)

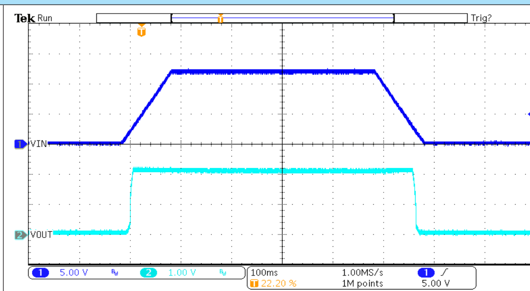


Line Transient Response: HT75RC0-1
(V_{IN}=20V to 30V, I_{OUT}=10mA)

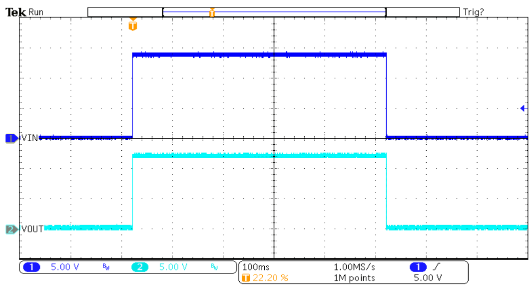
Power ON/OFF Response (I_{OUT}=150mA)



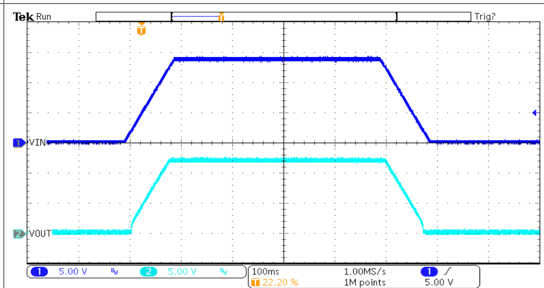
Power On/Off Response: HT75R21-1
(V_{IN}=12V, I_{OUT}=150mA, T_{RISE}=T_{FALL}=0.1ms)



Power On/Off Response: HT75R21-1
(V_{IN}=12V, I_{OUT}=150mA, T_{RISE}=T_{FALL}=100ms)

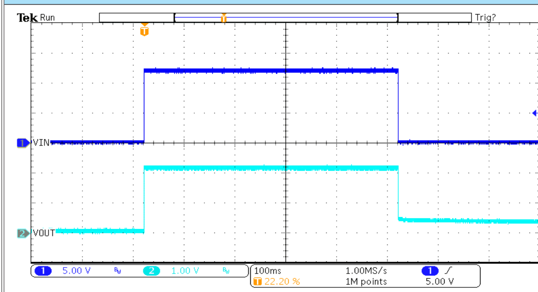


Power On/Off Response: HT75RC0-1
(V_{IN}=14V, I_{OUT}=150mA, T_{RISE}=T_{FALL}=0.1ms)

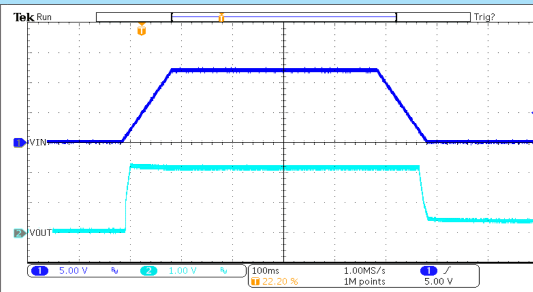


Power On/Off Response: HT75RC0-1
(V_{IN}=14V, I_{OUT}=150mA, T_{RISE}=T_{FALL}=100ms)

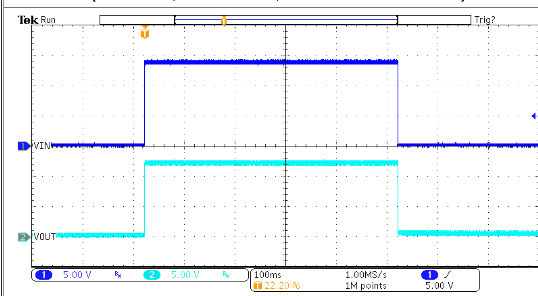
Power ON/OFF Response (I_{OUT}=0mA)



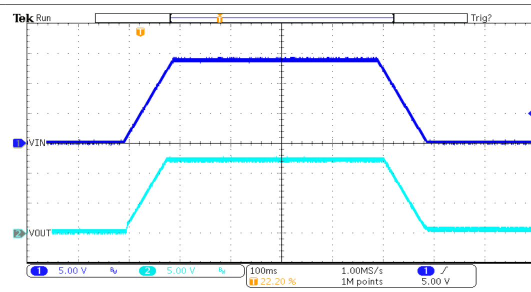
Power On/Off Response: HT75R21-1
(V_{IN}=12V, I_{OUT}=0mA, T_{RISE}=T_{FALL}=0.1ms)



Power On/Off Response: HT75R21-1
(V_{IN}=12V, I_{OUT}=0mA, T_{RISE}=T_{FALL}=100ms)



Power On/Off Response: HT75RC0-1
(V_{IN}=14V, I_{OUT}=0mA, T_{RISE}=T_{FALL}=0.1ms)

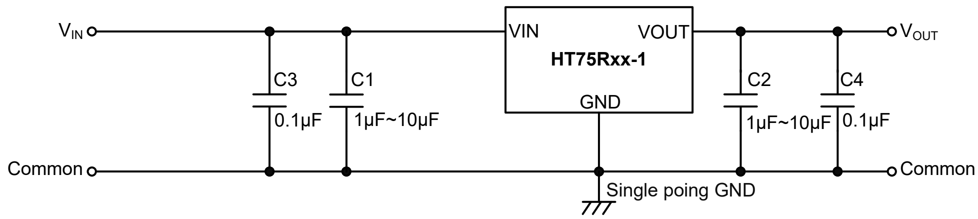


Power On/Off Response: HT75RC0-1
(V_{IN}=14V, I_{OUT}=0mA, T_{RISE}=T_{FALL}=100ms)

Application Circuits

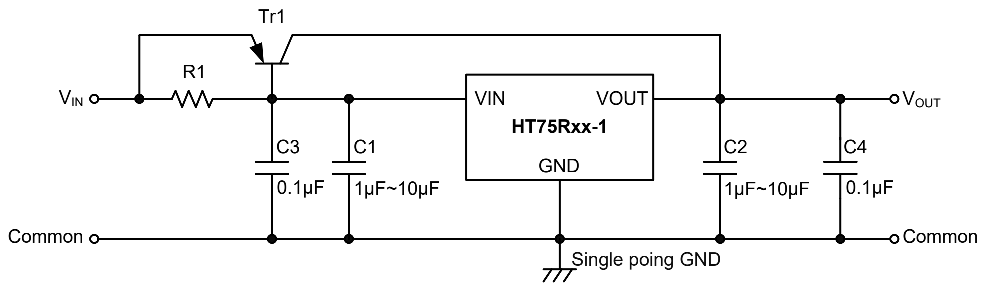
Basic Circuit

C_{IN}=C1, C_{OUT}=C2



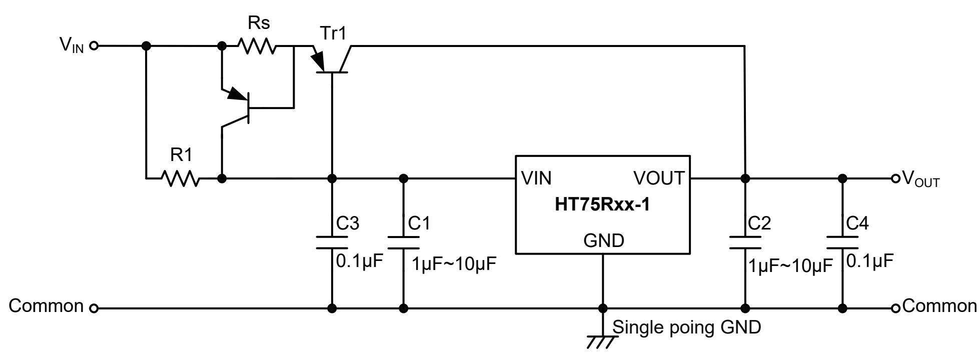
High Output Current Positive Voltage Regulator

C_{IN}=C1, C_{OUT}=C2



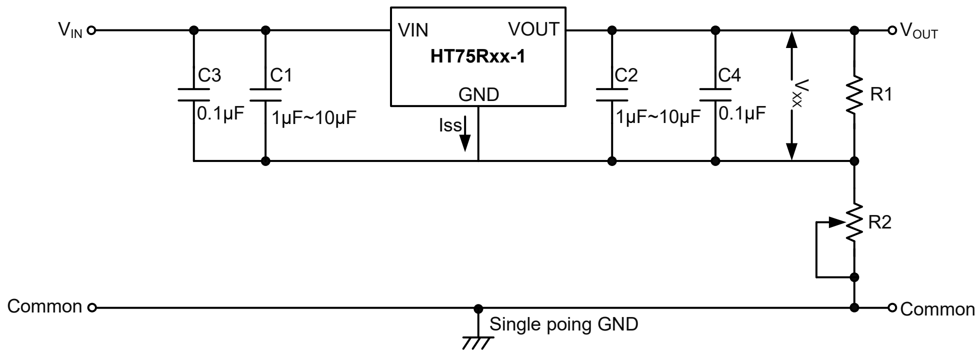
Short-Circuit Protection by Tr1

C_{IN}=C1, C_{OUT}=C2

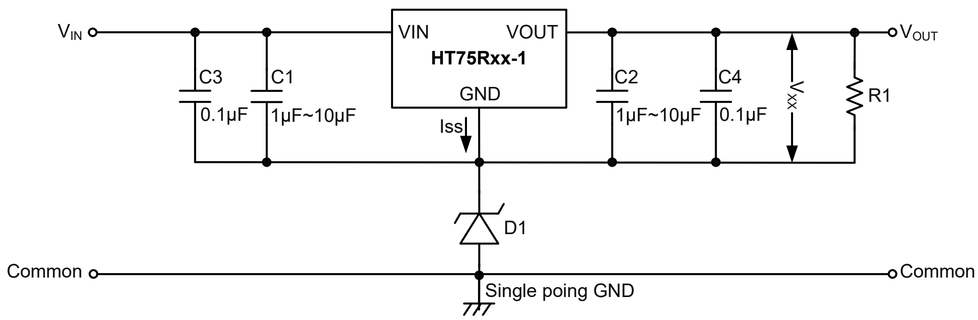


Circuit for Increasing Output Voltage

C_{IN}=C1, C_{OUT}=C2, $V_{OUT}=V_{XX}\times(1+R2/R1)+I_{SS}\times R2$

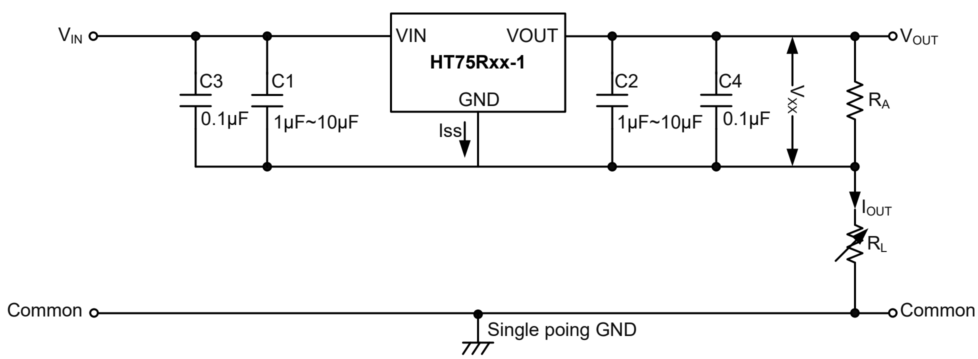


C_{IN}=C1, C_{OUT}=C2, $V_{OUT}=V_{XX}+V_{D1}$



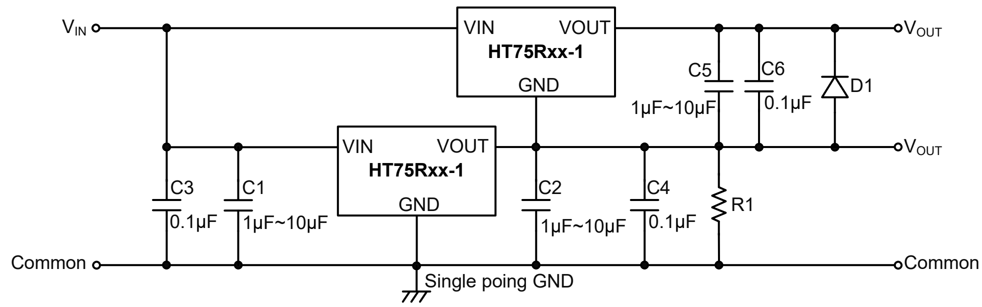
Constant Current Regulator

C_{IN}=C1, C_{OUT}=C2, $I_{OUT}=V_{XX}/R_A+I_{SS}$



Dual Supply Circuit

C_{IN}=C1, C_{OUT}=C2



Application Information

When using this series of regulators, it is important that the following application points are noted if correct operation is to be achieved.

External Circuit

It is important that external capacitors are connected to both the input and output pins. For the input pin, suitable bypass capacitors as shown in the application circuits should be connected, especially in situations where a battery power source is used which may have a higher impedance. For the output pin, a suitable capacitor should also be connected especially in situations where the load has a transient nature, in which case larger capacitor values should be selected to limit any output transient voltages.

Input Capacitor C_{IN} Considerations

It is recommended that the input capacitor is at least 1μF and is ceramic type for better temperature coefficient and lower ESR (Equivalent Series Resistance).

Output Capacitor C_{OUT} Considerations

The output capacitance plays an important role in keeping the output voltage stable. For the ceramic type capacitor, the capacitance should be at least 1.0μF. For E-cap type capacitor, the capacitance should be at least 2.2μF.

Thermal Considerations

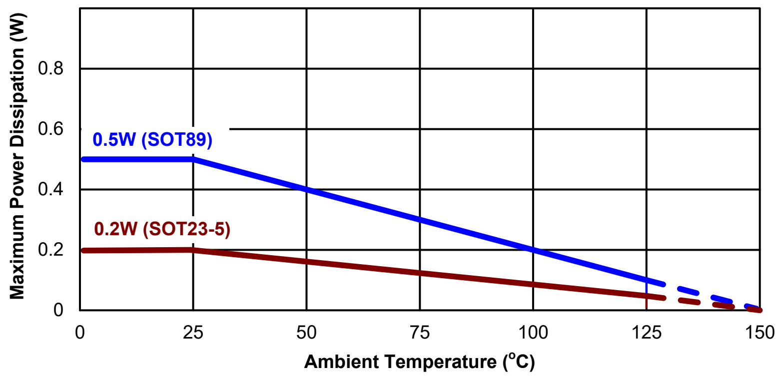
The maximum power dissipation depends on the thermal resistance of the package, the PCB layout, the rate of the surrounding airflow and the difference between the junction and ambient temperature. The maximum power dissipation can be calculated using the following formula:

$$P_{D(MAX)} = (T_{J(MAX)} - Ta) / \theta_{JA}$$

Where $T_{J(MAX)}$ is the maximum junction temperature, Ta is the ambient temperature and θ_{JA} is the junction-to-ambient thermal resistance of the device package in degrees per watt. The following table shows the θ_{JA} values for various package types.

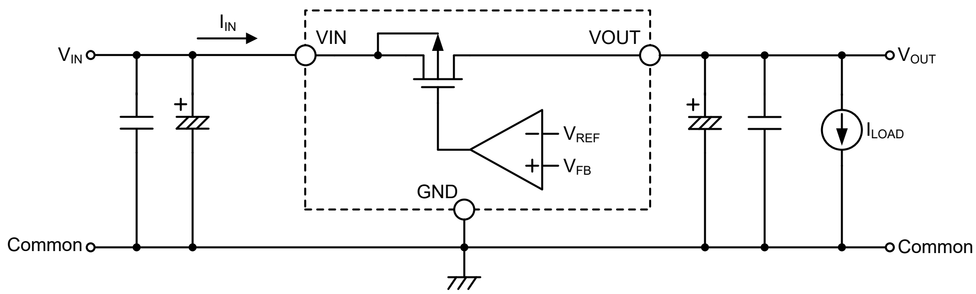
Package Type	θ_{JA} (°C/W)
SOT89	200°C/W
SOT23-5	500°C/W

For maximum operating rating conditions, the maximum junction temperature is 150°C. However, it is recommended that the maximum junction temperature does not exceed 125°C during normal operation to maintain an adequate margin for device reliability. The de-rating curves of different packages for maximum power dissipation are as follows:

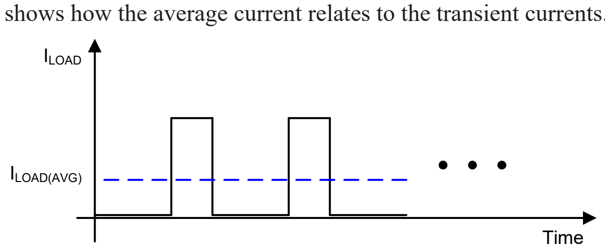


Power Dissipation Calculation

In order to keep the devices within their operating limits and to maintain a regulated output voltage, the power dissipation of the devices, given by P_D, must not exceed the Maximum Power Dissipation, given by $P_{D(MAX)}$. Therefore $P_D \leq P_{D(MAX)}$. From the diagram it can be seen that almost all of this power is generated across the pass transistor which is acting like a variable resistor in series with the load to keep the output voltage constant. This generated power, which will appear as heat, must never allow the devices to exceed their maximum junction temperature.



In practical applications, the regulator may be required to provide both steady state and transient currents due to the transient nature of the load. Although the devices may be working well within their limits with their steady state current, care must be taken with transient loads which may cause the current to rise close to their maximum current value. This will result in device junction temperature rises which however must not exceed the maximum junction temperature. With both steady state and transient currents, the important current to consider is the average or more precisely the RMS current, which is the value of current that will appear as heat generated in the devices. The following diagram shows how the average current relates to the transient currents.



As the quiescent current of the devices is very small, it can generally be ignored and as a result the input current can be assumed to be equal to the output current. Therefore the power dissipation of the devices, P_D, can be calculated as the voltage dropout across the input and output multiplied by the current, given by the equation, $P_D = (V_{IN} – V_{OUT}) \times I_{IN.}$ As the input current is also equal to the load current the power dissipation $P_D = (V_{IN} – V_{OUT}) \times I_{LOAD.}$ However, with transient load currents, $P_D = (V_{IN} – V_{OUT}) \times I_{LOAD(AVG)}$ as shown in the figure.

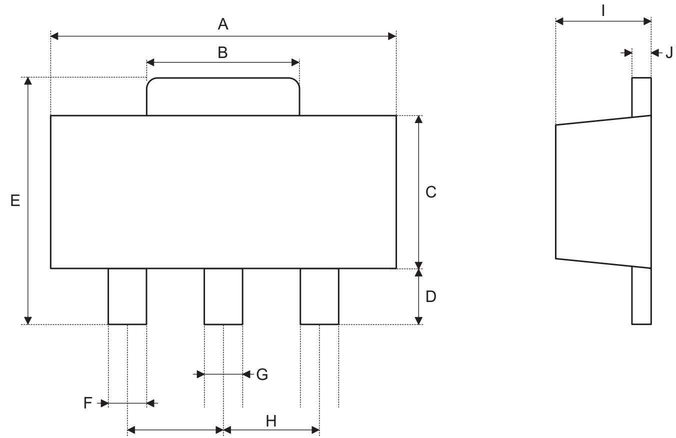
Package Information

Note that the package information provided here is for consultation purposes only. As this information may be updated at regular intervals users are reminded to consult the Holtek website for the latest version of the Package/Carton Information.

Additional supplementary information with regard to packaging is listed below. Click on the relevant section to be transferred to the relevant website page.

- Package Information (include Outline Dimensions, Product Tape and Reel Specifications)
- The Operation Instruction of Packing Materials
- Carton information

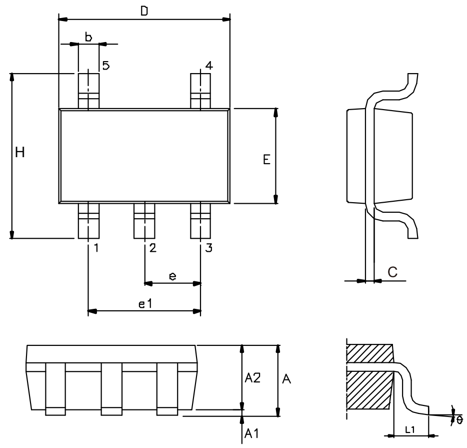
3-pin SOT89 Outline Dimensions



Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	0.173	—	0.185
B	0.053	—	0.072
C	0.090	—	0.106
D	0.031	—	0.047
E	0.155	—	0.173
F	0.014	—	0.019
G	0.017	—	0.022
H	0.059 BSC		
I	0.055	—	0.063
J	0.014	—	0.017

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	4.40	—	4.70
B	1.35	—	1.83
C	2.29	—	2.70
D	0.80	—	1.20
E	3.94	—	4.40
F	0.36	—	0.48
G	0.44	—	0.56
H	1.50 BSC		
I	1.40	—	1.60
J	0.35	—	0.44

5-pin SOT23 Outline Dimensions



Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	—	—	0.057
A1	—	—	0.006
A2	0.035	0.045	0.051
b	0.012	—	0.020
C	0.003	—	0.009
D	0.114 BSC		
E	0.063 BSC		
e	0.037 BSC		
e1	0.075 BSC		
H	0.110 BSC		
L1	0.024 BSC		
θ	0°	—	8°

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	—	—	1.45
A1	—	—	0.15
A2	0.90	1.15	1.30
b	0.30	—	0.50
C	0.08	—	0.22
D	2.90 BSC		
E	1.60 BSC		
e	0.95 BSC		
e1	1.90 BSC		
H	2.80 BSC		
L1	0.60 BSC		
θ	0°	—	8°