

SK6513

40V Low Quiescent Current, High Reliability LDO

GENERAL DESCRIPTION

The SK6513 series is a high accuracy, high input voltage low quiescent current, high speed, and low dropout linear regulator with high ripple rejection.

The SK6513 input voltage is up to 40V and load current is up to 300mA at $V_{OUT}=5V$ & $V_{IN}=7V$. The device is manufactured with BCD process.

The SK6513 offers over-current limit, soft start and over temperature protection to ensure the device working in well conditions.

The SK6513 regulators is available in standard SOT89-3L, SOT23-5L and SOT23-3L packages, and Standard products are Pb-free and Halogen-free.

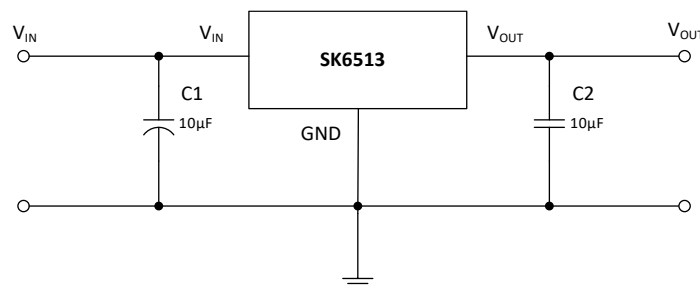
FEATURES

- Input voltage: 4.75V~40V
- Output voltage: 1.8V~5.7V
- Output accuracy: $\leq \pm 2\%$
- Output current: 150mA (Typ.)
Up to 300mA@ $V_{IN}=7V$, $V_{OUT}=5V$, SOT89-3
- PSRR: 60dB@100Hz
- Dropout voltage: 600mV@ $I_{OUT}=100mA$
- Quiescent current: 4.2 μA @ $V_{IN}=12V$ (Typ.)
- ESD HBM: 8KV
- Recommend capacitor: 10 μF

APPLICATIONS

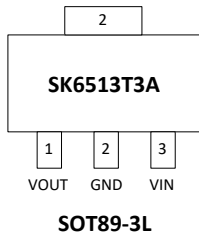
- Smart electric meter
- In-car entertainment
- Electric bicycle

TYPICAL APPLICATION CIRCUIT

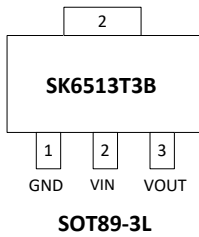


In plugging application, C1 is recommended to use 10 μF electrolytic capacitor or 10 μF MLCC with 2 Ω series resistors to prevent chip burning due to the large input voltage spike when plugging. See APPLICATION INFORMATION for more information. C2 is recommend to use 10 μF , and 1 μF to 10 μF can be used by customer according to special application.

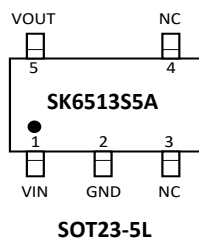
PIN CONFIGURATION AND DESCRIPTION



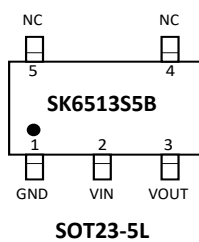
PIN NO	SYMBOL	I/O	DESCRIPTION
SK6513T3A			
1	VOUT	O	Output
2	GND	Ground	Ground
3	VIN	Power	Input



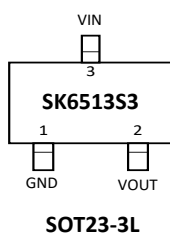
PIN NO	SYMBOL	I/O	DESCRIPTION
SK6513T3B			
1	GND	Ground	Ground
2	VIN	Power	Input
3	VOUT	O	Output



PIN NO	SYMBOL	I/O	DESCRIPTION
SK6513S5A			
1	VIN	Power	Input
2	GND	Ground	Ground
3	NC	-	Not connect
4	NC	-	Not connect
5	VOUT	O	Output



PIN NO	SYMBOL	I/O	DESCRIPTION
SK6513S5B			
1	GND	Ground	Ground
2	VIN	Power	Input
3	VOUT	O	Output
4	NC	-	Not connect
5	NC	-	Not connect



PIN NO	SYMBOL	I/O	DESCRIPTION
SK6513S3			
1	GND	Ground	Ground
2	VOUT	O	Output
3	VIN	Power	Input

ORDERING INFORMATION

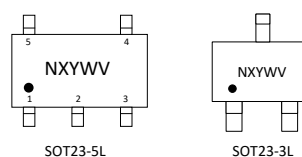
PART NO	ACCURACY	PACKAGE	TEMPERATURE	TAPE & REEL
SK6513T3A-XX	2%	SOT89-3L	-40 ~ +85℃	2500/REEL
SK6513T3B-XX	2%	SOT89-3L	-40 ~ +85℃	2500/REEL
SK6513S5A-XX	2%	SOT23-5L	-40 ~ +85℃	3000/REEL
SK6513S5B-XX	2%	SOT23-5L	-40 ~ +85℃	3000/REEL
SK6513S3-XX	2%	SOT23-3L	-40 ~ +85℃	3000/REEL

"XX": several fixed output voltages ranging from 1.8V to 5.7V. E.g. "33": $V_{OUT} = 3.3V$

PART NUMBER RULES

Code	Description
1	Package: S3: SOT23-3L S5A/S5B: SOT23-5L T3A/T3B: SOT89-3L
2	Voltage version: XX: several fixed output voltages ranging from 1.8V to 5.7V Example: 33: 3.3V
3	Voltage accuracy code: Blank: 2% A: 1%

MARKING DESCRIPTION



"N": Product Code.

"O" stands for "SK6513S3",
"Q" stands for "SK6513S5A",
"P" stands for "SK6513S5B".

"X": Internal Control Code

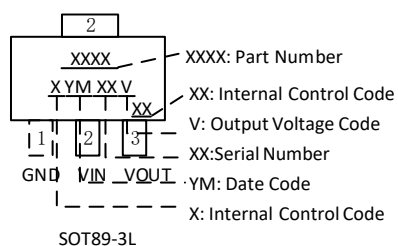
"Y": Internal Control Code

"W": Week of manufacturing.

"A" stands for week 1, "Z" stands for week 26,

"a" stands for week 27, "z" stands for week 52.

"V": Output voltage code.



TYPICAL OUTPUT VOLTAGE CODE TABLE

V_{OUT}	CODE	V_{OUT}	CODE
3.0V	G	3.3V	H
3.6V	I	5.0V	K

ABSOLUTE MAXIMUM RATINGS (Note)

SYMBOL	ITEMS		VALUE	UNIT
V_{IN}	Input Voltage		-0.3~45	V
V_{OUT}	Output Voltage		-0.3~6.5	V
P_{DMAX}	Power Dissipation		OTP Limited	/
$R_{\theta JA}$	Junction to Ambient Thermal Resistance	SOT23-3	220	°C/W
		SOT23-5	200	°C/W
		SOT89-3	160	°C/W
T_J	Junction Temperature		-40~150	°C
T_{STG}	Storage Temperature		-55 to 150	°C
T_{SOLDER}	Package Lead Soldering Temperature (10s)		260	°C
ESD MM	Machine Mode		200	V
ESD HBM	Human Body Mode		8000	V

Note: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

RECOMMENDED OPERATING RANGE

SYMBOL	ITEMS		VALUE	UNIT
V_{IN}	V_{IN} Supply Voltage		4.75 to 40	V
$R_{\theta JA}$	Thermal Resistance on Application PCB		45	°C/W
T_{OPT}	Operating Temperature		-40 to +85	°C
C_{IN}	Electrolytic capacitor		≥10	μF
	Ceramic capacitor		0.1 to 10	μF
C_O	Electrolytic capacitor		≥10	μF
	Ceramic capacitor		1 to 10	μF

ELECTRICAL CHARACTERISTICS

The following specifications apply for $V_{IN} = 12V$, $T_A = 25^\circ C$, $C_{IN} = C_{OUT} = 10\mu F$, unless specified otherwise.

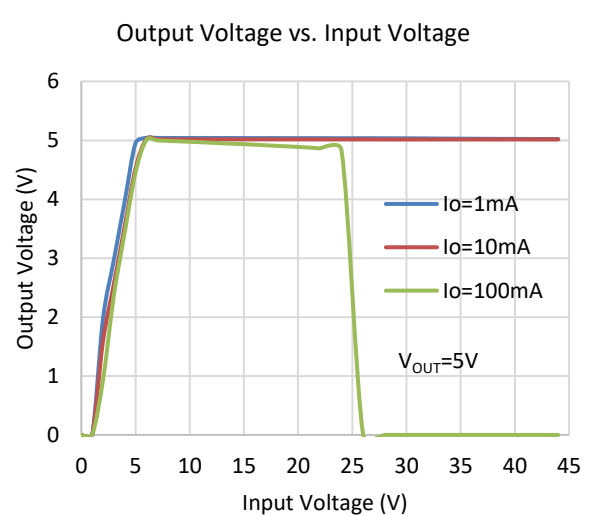
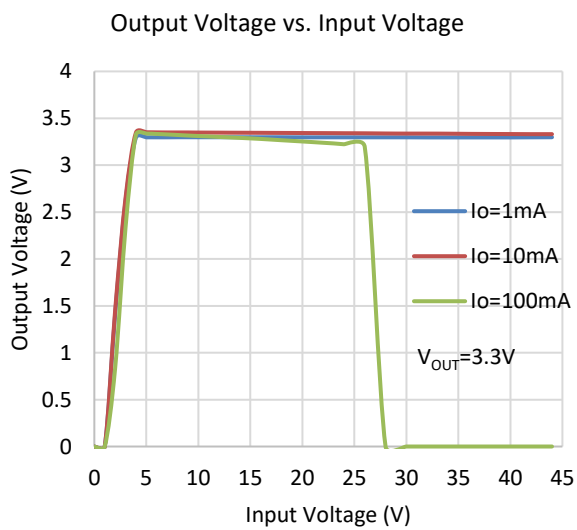
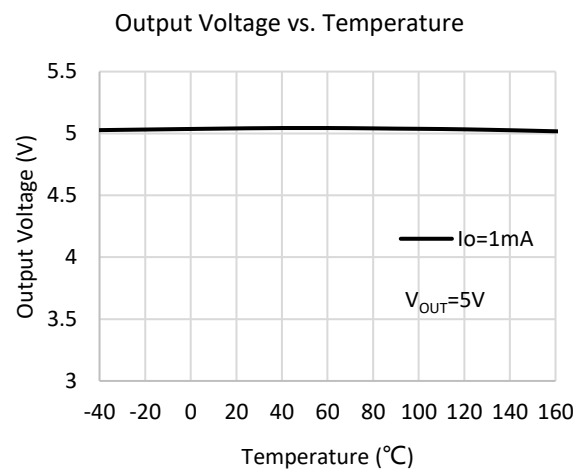
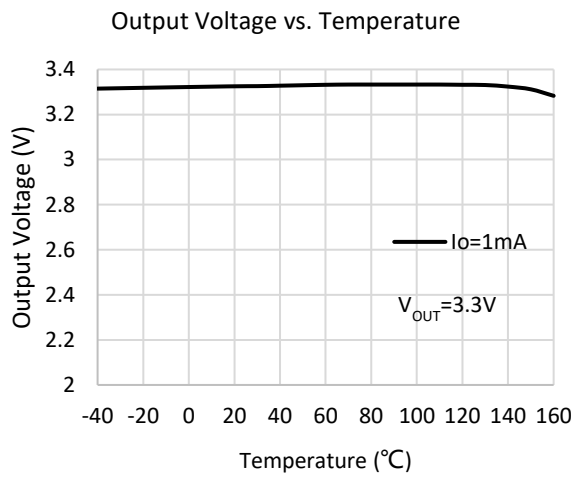
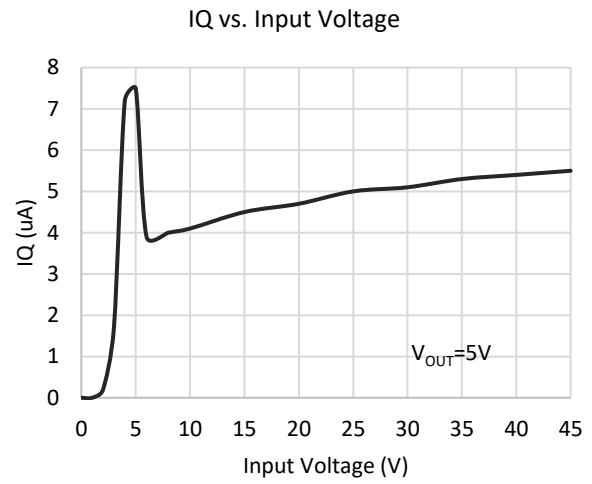
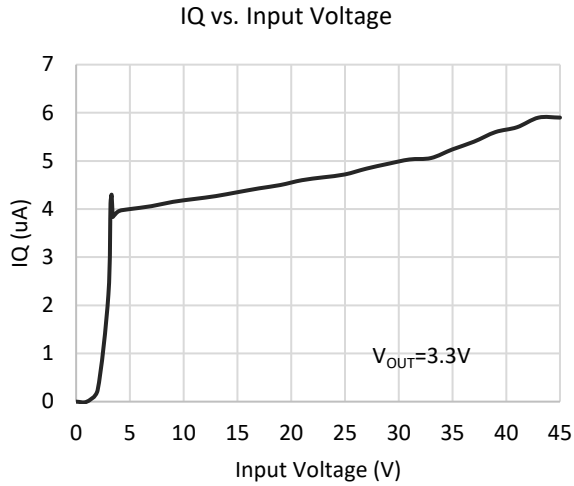
SYMBOL	ITEMS	CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}	Input Range	$I_{OUT} = 10mA$	4.75		40	V
V_{OUT}	Output Range	$I_{OUT} = 10mA$	$V_{OUT} \times 0.98$	V_{OUT}	$V_{OUT} \times 1.02$	V
ΔV_{OUT}	Output Voltage	$V_{IN} = 12V, I_{OUT} = 10mA$	4.9	5	5.1	V
			3.234	3.3	3.366	
			2.94	3.0	3.06	
I_Q	Quiescent Current	$V_{IN} = 7V, I_{OUT} = 0$		4	6	μA
		$V_{IN} = 24V, I_{OUT} = 0$		4.6	6.7	
		$V_{IN} = 40V, I_{OUT} = 0$		5.4	8.2	
I_{OUT}	Maximum Output Current ⁽¹⁾			150	300	mA
V_{DROP}	Dropout Voltage	$I_{OUT} = 10mA$		60	90	mV
		$I_{OUT} = 100mA$		600	900	
ΔV_{LINE}	Line Regulation	$V_{IN} = 7 \sim 24V, V_{OUT} = 5V, I_{OUT} = 1mA$		0.02	0.03	%/V
		$V_{IN} = 7 \sim 45V, V_{OUT} = 5V, I_{OUT} = 1mA$		0.08	0.1	
ΔV_{LOAD}	Load Regulation	$V_{IN} = 7V, I_{OUT} = 1 \sim 100mA$		19	37	mV
I_{SHORT}	Short Current	V_{OUT} Short to GND with 1Ω (1ms pulse), $V_{IN} = 12V$		180		mA
PSRR	Power Supply Rejection Rate	$V_{IN} = 10V,$ $V_{PP} = 0.5V,$ $I_{OUT} = 1mA$	$F = 100Hz$	60		dB
			$F = 1kHz$	50		
			$F = 10kHz$	40		
e_{NO}	Output Noise Voltage	10Hz to 100kHz, $C_{OUT} = 10\mu F,$ $I_{OUT} = 10mA$		± 100		μV_{RMS}
T_{SD}	Thermal Shutdown Protection	$V_{IN} = 12V, I_{OUT} = 1mA$		165		$^\circ C$
T_{SD_HYS}	OTP Hysteresis			25		$^\circ C$
$\Delta V_O / \Delta T$	Temperature Coefficient			± 0.5		mV/ $^\circ C$

NOTES:

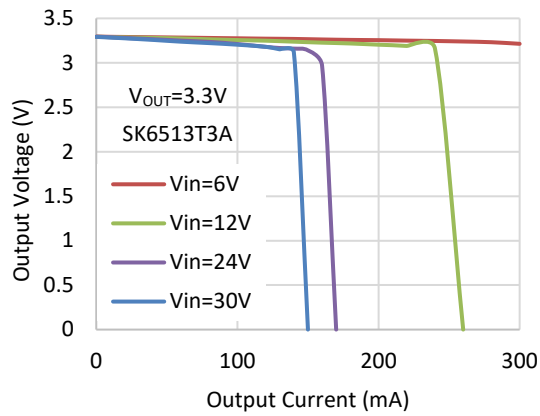
Maximum output current is affected by the gap between V_{in} and V_{out} , the package type (different power dissipation), the PCB layout, size of metal trace, the thermal conduction between metal layers, ambient temperature and the other system environment factors.

TYPICAL PERFORMANCE CHARACTERISTICS

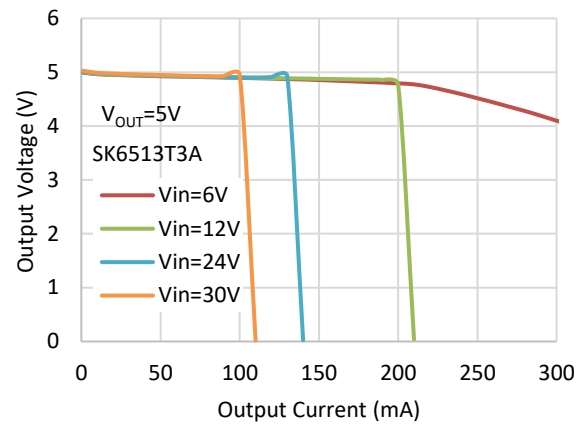
SK6513T3A(SOT89-3L), $C_{IN} = 10\mu F$, $C_{OUT} = 10\mu F$, $T_A = 25^\circ C$, unless specified otherwise.



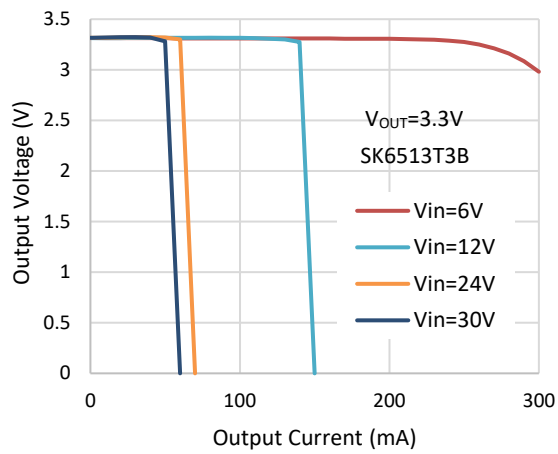
Output Voltage vs. Output Current



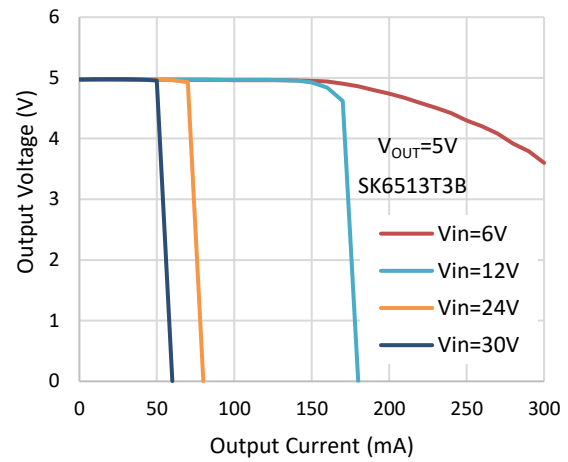
Output Voltage vs. Output Current



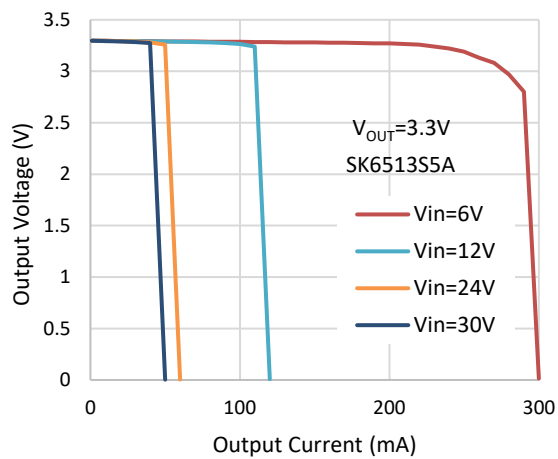
Output Voltage vs. Output Current



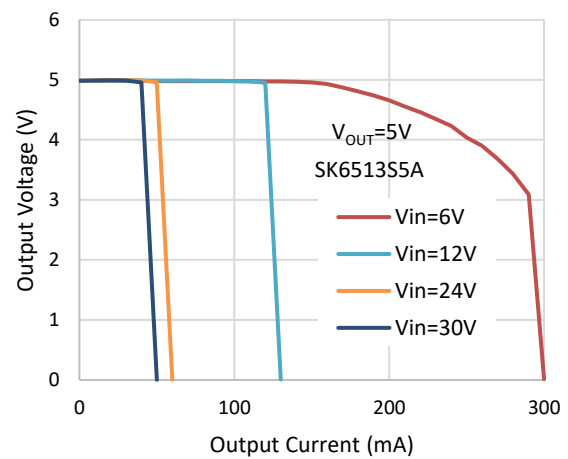
Output Voltage vs. Output Current



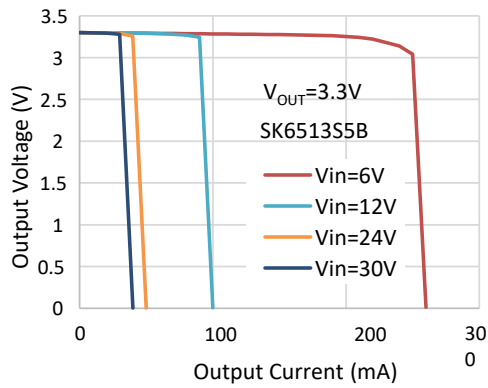
Output Voltage vs. Output Current



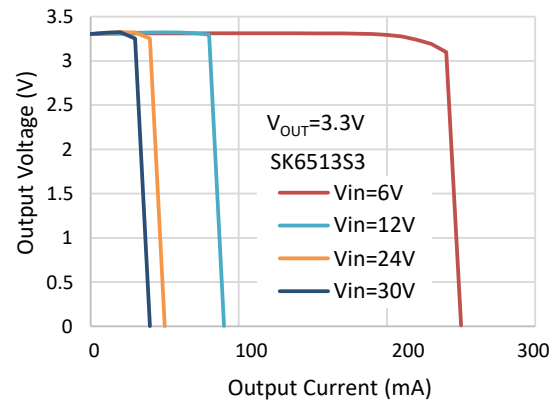
Output Voltage vs. Output Current



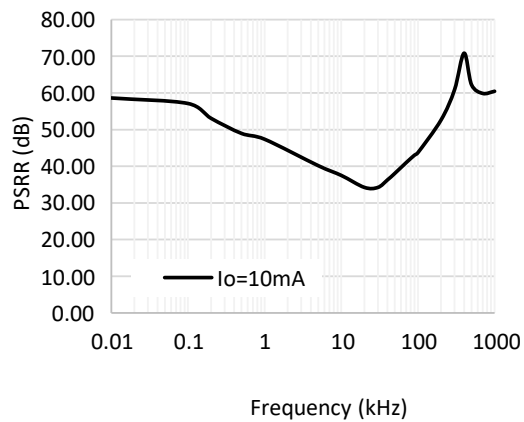
Output Voltage vs. Output Current



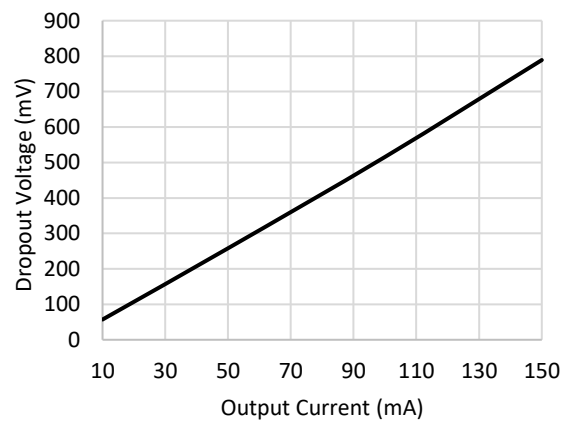
Output Voltage vs. Output Current



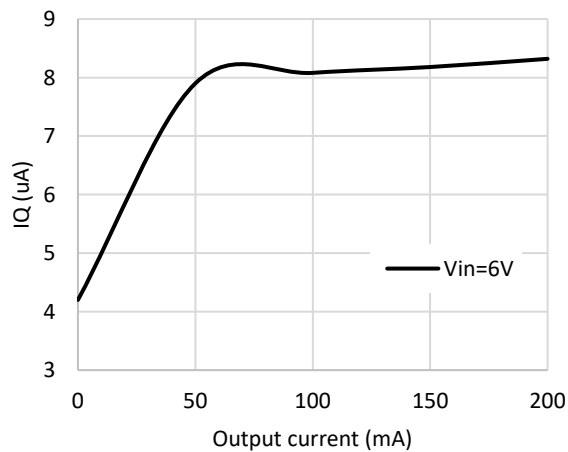
PSRR vs. Frequency



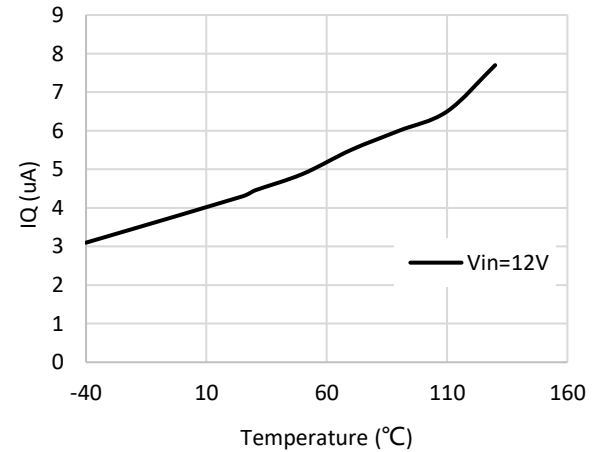
Dropout Voltage vs. Output Current



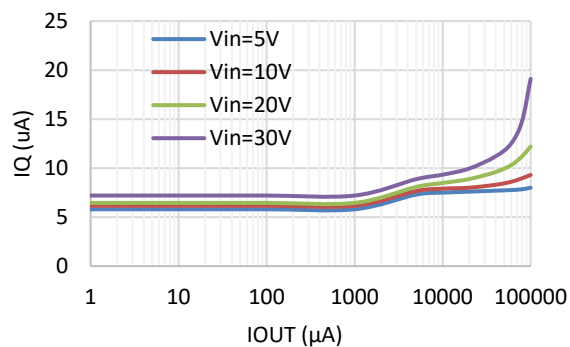
IQ vs. Output current



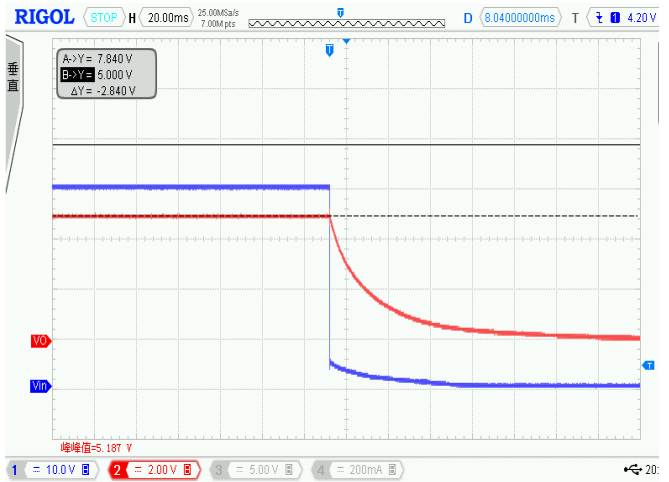
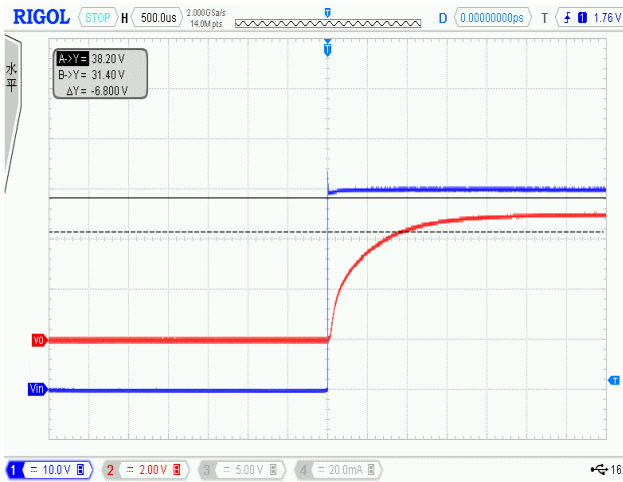
IQ vs. Temperature



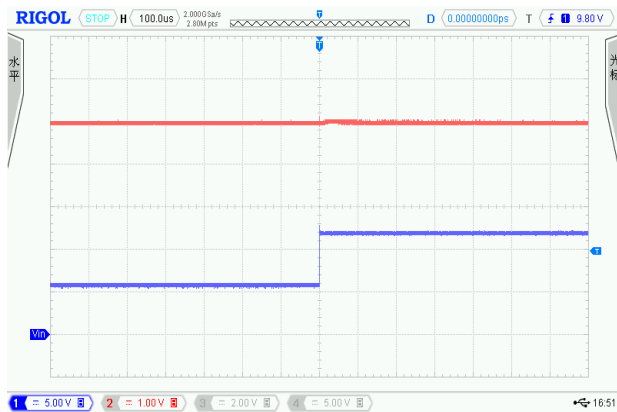
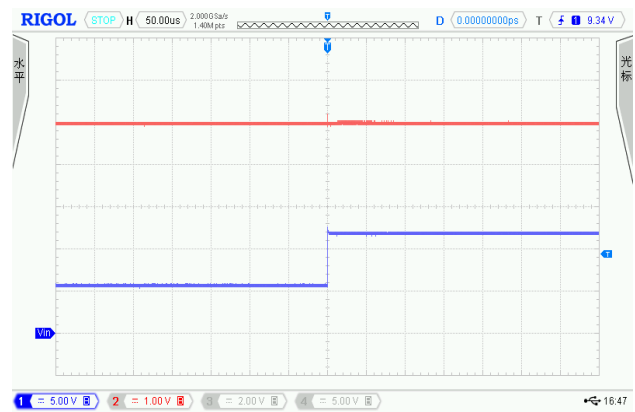
IQ vs. IOUT



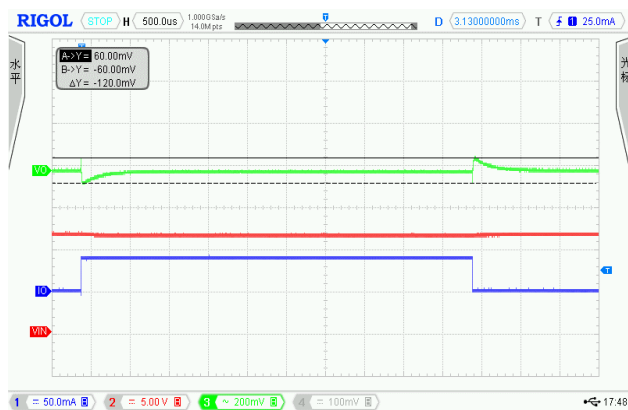
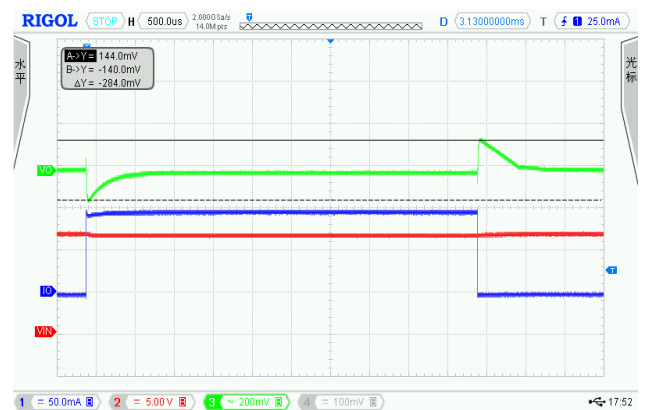
Power ON/OFF

CH1: V_{IN} CH2: V_{OUT} $V_{IN}=40V$ $I_{OUT}=1mA$ $V_{OUT}=5V$ 

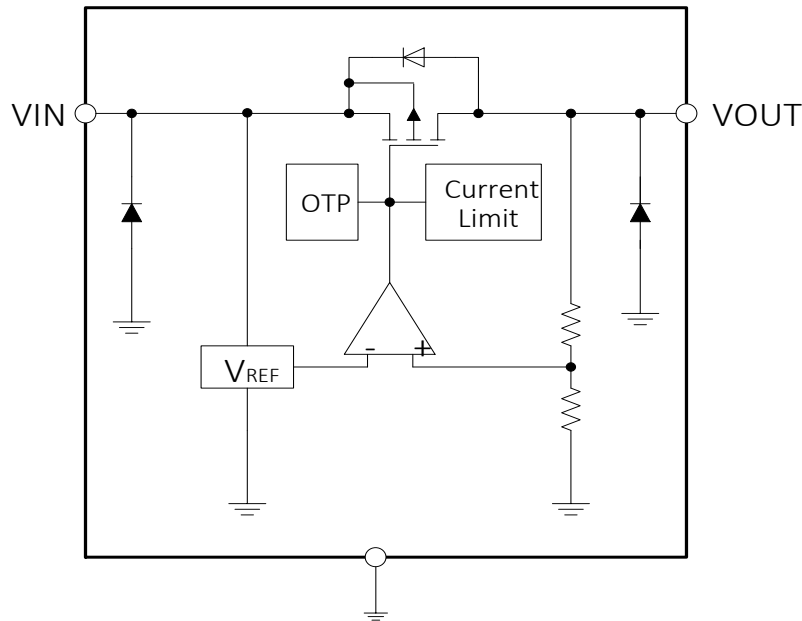
Line Transient

CH1: V_{IN} CH2: V_{OUT} $V_{IN}=6V-12V$ $I_{OUT}=1mA$ $V_{OUT}=5V$  $V_{IN}=6V-12V$ $I_{OUT}=10mA$ $V_{OUT}=5V$ 

Load Transient

CH1: I_{OUT} CH2: V_{IN} CH3: V_{OUT} $V_{IN}=12V$ $I_{OUT}=1mA$ to 40mA $V_{OUT}=3.3V$  $V_{IN}=12V$ $I_{OUT}=1mA$ to 100mA $V_{OUT}=3.3V$ 

SIMPLIFIED BLOCK DIAGRAM



APPLICATION INFORMATION

INPUT CAPACITOR

An input capacitor of 10 μ F is required between the VIN and GND pin. The capacitor shall be placed as close as possible to VIN pin, and the use of electrolytic capacitors is recommended. The tolerance and temperature coefficient must be considered in order to ensure the capacitor work within the operation range over the full range of temperature and operating conditions.

OUTPUT CAPACITOR

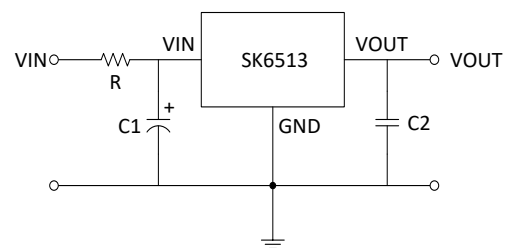
In applications, it is important to select the output capacitor for stable operation. The minimum capacitance for stable operation and correct operation is 1 μ F. The capacitance tolerance should be $\pm 30\%$ or better over the operation temperature range. The recommended capacitor type is MLCC.

NO-LOAD STABILITY

The SK6513 will remain stable and in regulation with no external load. This is especially important in CMOS RAM keep-alive applications.

TYPICAL CIRCUIT

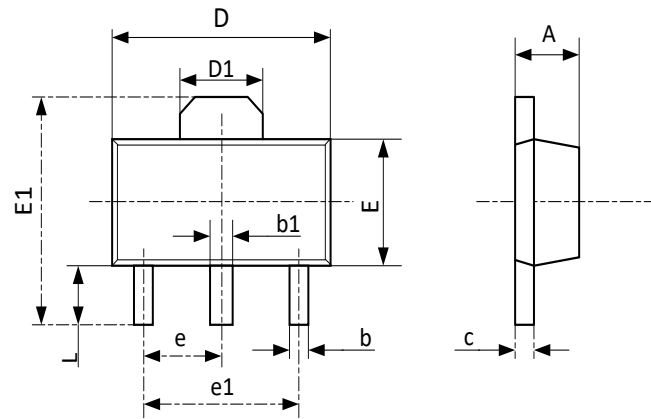
The following figure shows a typical application circuit for the SK6513 devices. The value of external components shall be chosen carefully, depending on the application. In plugging application, because the overshoot caused by the insertion and withdrawal of power on the chip may damage the chip, it is recommended that VIN be less than 30V and the input voltage spike should not exceed 45V.



In plugging application, it is suggested that R, C1 are selected as following:

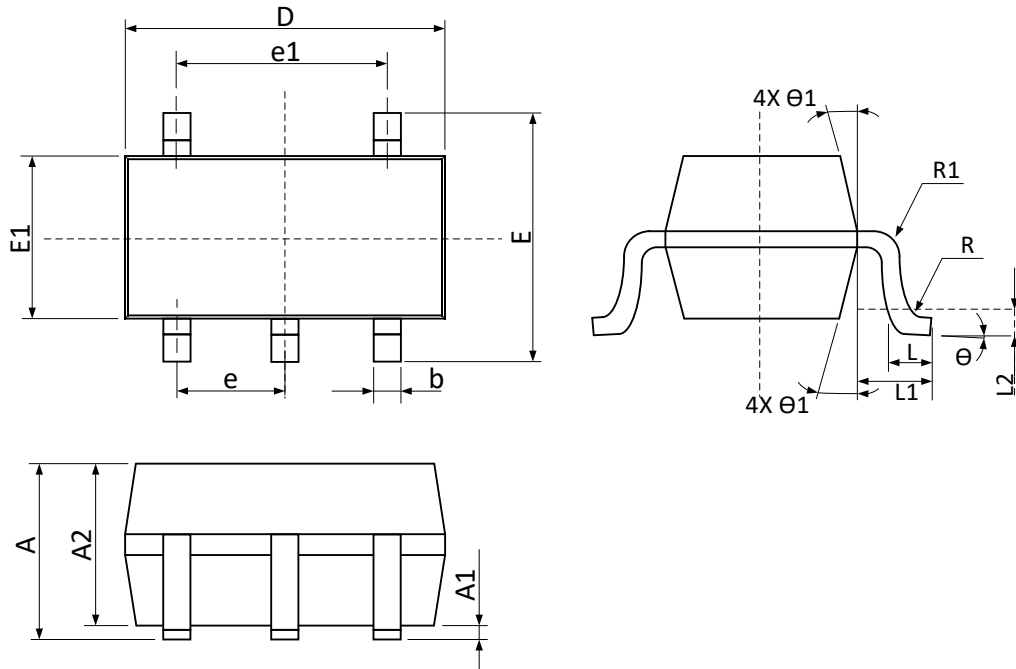
1. C1=10 μ F to 100 μ F electrolytic capacitor with maximum voltage greater than 50V, R=0
2. C1=1 μ F to 10 μ F MLCC with maximum voltage greater than 50V and R=2 Ω in the type of 1206 – the resistor shall be carefully chosen to make sure enough margin to sustain the surge current during plugging.

PACKAGE DIMENSIONS: SOT89-3L



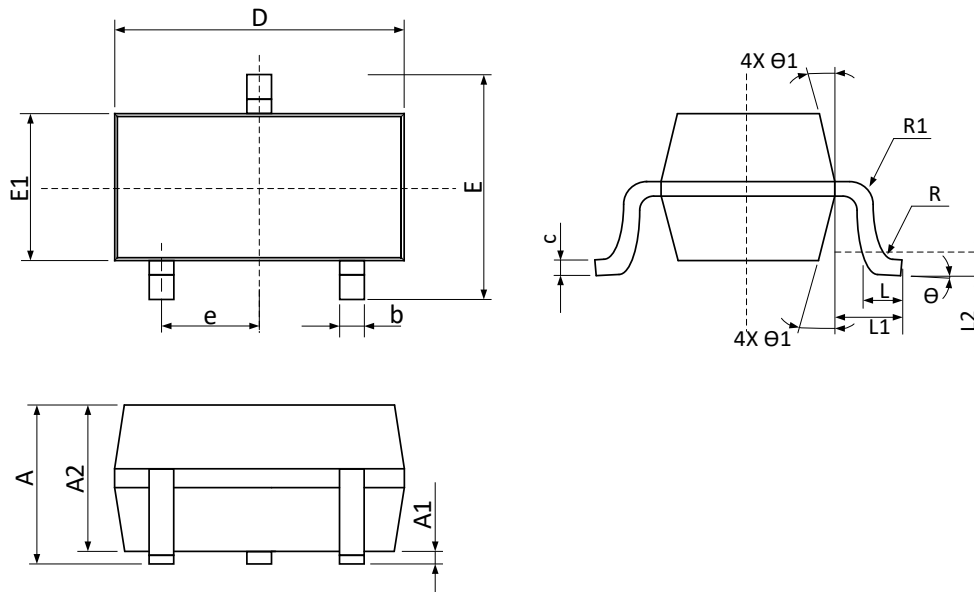
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.350	0.520	0.013	0.197
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.350	2.550	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060 TYP	
e1	3.000 TYP		0.118 TYP	
L	0.900	1.100	0.035	0.047

PACKAGE DIMENSIONS: SOT23-5L



DIMENSIONS IN MILLIMETERS			
SYMBOL	MINIMUM	NOMINAL	MAXIMUM
A	-	-	1.35
A1	0.00	-	0.15
A2	1.00	1.10	1.20
b	0.30	-	0.50
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.30	0.45	0.60
L1	0.60 REF		
L2	0.25 REF		
R	0.10	-	-
R1	0.10	-	0.25
Θ	0°	4°	8°
Θ1	5°	10°	15°

PACKAGE DIMENSIONS: SOT23-3L



DIMENSIONS IN MILLIMETERS			
SYMBOL	MINIMUM	NOMINAL	MAXIMUM
A	-	-	1.35
A1	0.00	-	0.15
A2	1.00	1.10	1.20
b	0.30	-	0.50
c	0.1	-	0.2
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.30	0.45	0.60
L1	0.60 REF		
L2	0.25 REF		
R	0.10	-	-
R1	0.10	-	0.25
Θ	0°	4°	8°
Θ1	5°	10°	15°