SMC6605

SemTron Microtech Corporation

500mA Low noise, High PSRR, Fast Transient Response LDO

DESCRIPTION

The SMC6605 is a 500mA low noise and fast transient response liner regulator with adjustable output voltage and ultra-low dropout voltage. Its output voltage is programmed by a resistor divider, and can be as low as 0.8V, which satisfies the most advanced ICs which may require supply voltage to be 0.9V –1.2V.

SMC6605 is consists of a precise voltage reference, an error amplifier, a compensation network and alow ON-resistance power P-MOSFET. It also integrates many protection circuitry, like current limit and over-temperature protection module.

FEATURES

- ◆Low Consumption Current: 38µA
- ◆Shutdown Current <1µA
- ◆Low Dropout Voltage: 370mV(Typical)@500mA
- ◆Thermal Overload Shutdown Protection
- ◆Short-circuit Protection.
- ◆High PSRR: 70dB
- ◆Low ESR Capacitor Compatible

APPLICATIONS

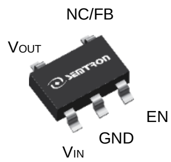
- ◆Battery Powered Equipment
- ◆Set-Top Box
- ◆PCMCIA & New Card
- ◆Mini PCI & PCI-Express Cards
- ◆Laptop, Palmtops, Notebook Computers

PART NUMBER INFORMATION

SMC 6605 - XX SR – TR G

a b c d e f

a: Company name.
b: Product Serial number.
c: Voltage Code XX:12=1.2V, 18=1.8V, 33=3.3V, A=ADJ
d: Package code SR: SOT-23-5L
e: Handling code TR:Tape&Reel
f: Green produce code G:*RoHS Compliant*



SOT-23-5L

ABSOLUTE MAXIMUM RATINGS (TA=25°C Unless otherwise noted)

Symbol	Parameter	Rating	Units
V_{IN}	Input Voltage	-0.3~+6.5V	V
V_{OUT}	EN, FB, SW Pin Voltage	V_{IN}-0.3~V_{IN}+0.3	V
T_J	Operating Temperature Range	-40~+85	°C
T_{STG}	Storage Temperature Range	-55~+150	°C
ESD	HBM (Human Body Mode)	2	KV
	MM (Machine Mode)	200	V
T_{SDR}	Maximum Lead Soldering Temperature (10 Seconds)	260	°C

Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.

THERMAL RESISTANCE

Symbol	Parameter	Typ	Max	Units
$R_{\theta JA}$	Thermal Resistance Junction to Ambient		163	°C/W
$R_{\theta JC}$	Thermal Resistance Junction to Case		55	

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PIN DESCRIPTION

Symbol	Pin	Description
V_{IN}	1	Input Voltage supply pin
GND	2	Ground pin
EN	3	Enable pin. drive it high to enable, drive it low to disable. EN can be connected to IN if not used.
NC	4	fixed output voltage, not connected
V_{FB}		adjustable output voltage feedback pin, feedback voltage is set to be 0.8V. output voltage is programmed by a resistor divider from Vout. $V_{OUT}=0.8V \times (\frac{R1+R2}{R2})$
V_{OUT}	5	Output Voltage of regulator

ELECTRICAL CHARACTERISTICS *(Typical values are at T_A=25°C)*

V_{IN} = V_{OUT}+1V, C_{IN}=2.2μF, C_{OUT}=1μF, unless otherwise specified.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range [A]		1.6		6.0	V
V_{OUT}	Output Voltage Range		0.8		V_{IN}	%V
	Output Voltage Accuracy	I_{OUT}=30mA	-2		+2	%V
V_{REF}	Feedback	ADJ Pin Reference Voltage	0.78	0.8	0.82	V
V_{LINE}	Line Regulation	V_{OUT} + 1V ≤ V_{IN} ≤ 6V			0.2	%/V
V_{LOAD}	Load Regulation	0μA< I_{OUT}<200mA		20		mV
V_{DROP}	Dropout Voltage (Fixed output voltage)	I_{OUT}=300mA, V_{OUT}=1.2V		850	1000	mV
		I_{OUT}=300mA, V_{OUT}=1.8V		550	700	
		I_{OUT}=300mA, V_{OUT}=3.0V		350	500	
		I_{OUT}=300mA, V_{OUT}=3.3V		330	450	
	Dropout Voltage (Adjustable output voltage)	I_{OUT}=300mA, V_{OUT}=1.8V		350	450	
		I_{OUT}=300mA, V_{OUT}=3.3V		225	265	
		I_{OUT}=500mA, V_{OUT}=3.3V		370	440	
V_{IH}	EN Pin Input Voltage "H" Fixed output voltage	1.8V ≤ V_{IN} ≤ 6V	1.5			V
V_{IH}	EN Pin Input Voltage "H" Adjustable output voltage		1.5			V
V_{IL}	EN Pin Input Voltage "L" Fixed output voltage				0.4	V
V_{IL}	EN Pin Input Voltage "L" Adjustable output voltage				0.4	V
I_{CL}	Current Limit	V_{OUT}=95%		500		mA
I_{OUT}	Maximum Outpur Current[B]	V_{IN}-V_{OUT}=1V		500		mA
I_Q	Quiescent Current	No Load		38	-	μA
I_{SC}	Shutdown Current	V_{IN}=V_{OUT}+1V, V_{EN}=0V, No load			1	μA
Tst	Start-up time			30		μS
T_{SD}	Thermal Shutdown Temperature			150	-	°C
PSRR	Ripple Rejection Ratio	f=1KHz, I_{OUT}=30mA		70	-	dB

Note: A. Minimum V_{IN} is 2.0Vor V_{OUT}+ $V_{DROPOUT}$, whichever is greater.
B. not limited by heat dissipation of package and dropout

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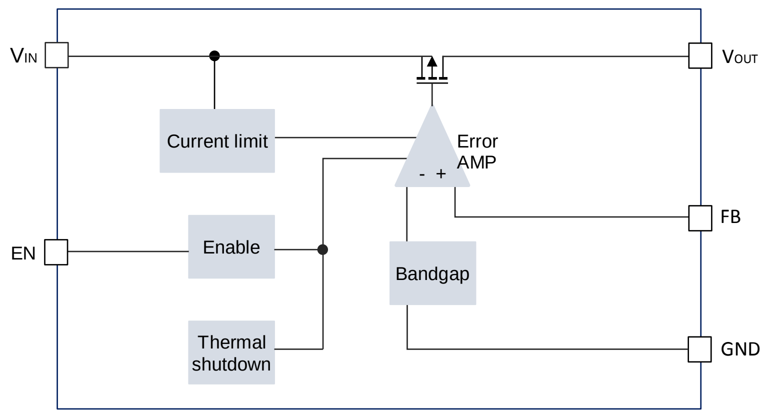
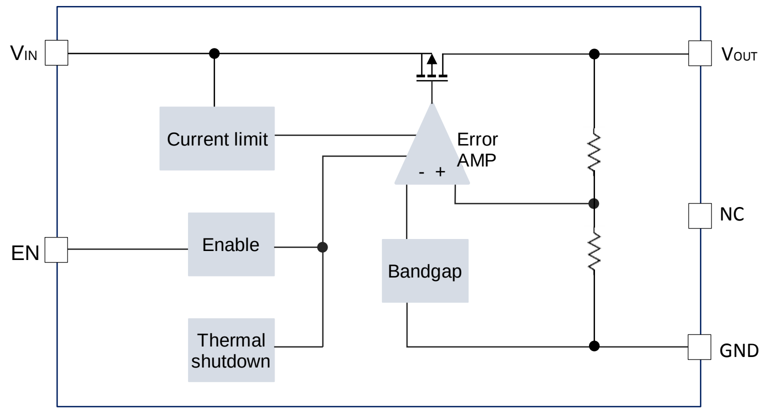
■FUNCTIONAL BLOCK DIAGRAM

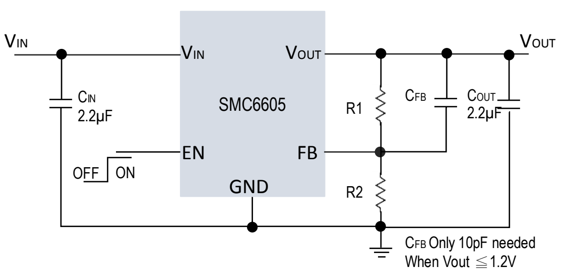


Adjustable

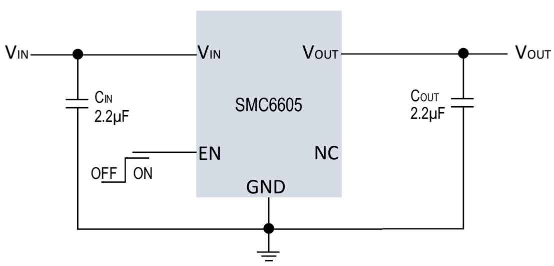


Fixed

■TYPICAL APPLICATIONS



Adjust



Fixed

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APPLICATION INFORMATION

◆ Detail Description

The SMC6605 is a low-dropout linear regulator. The device provides preset 1.2V, 1.8V, and 3.3V output voltages for output current up to 500mA. Adjustable output voltage and other mask options for special output voltages are also available, it consists of an error amplifier, a P-channel pass transistor and an internal feedback voltage divider.

The bandgap reference for fixed voltage types is connected to the error amplifier, which compares this reference with the feedback voltage and amplifies the voltage difference. If the feedback voltage is lower than the reference voltage, the pass-transistor gate is pulled lower, which allows more current to pass to the output pin and increases the output voltage. If the feedback voltage is too high, the pass transistor gate is pulled up to decrease the output voltage.

The output voltage is feed back through an internal resistive divider (or external resistive divider for adjustable output voltage type) connected to out pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

◆ Internal P-channel Pass Transistor

The SMC6605 features a P-channel MOSFET pass transistor. Unlike similar designs using PNP pass transistors, P-channel MOSFETs require no base drive, which reduces quiescent current. PNP-based regulators also waste considerable current in dropout when the pass transistor saturates, and use high base-drive currents under large loads. The SMC6605 does not suffer from these problems and consumes only 38μA (Typ.) of current consumption under heavy loads as well as in dropout conditions.

◆ Enable Function

EN pin starts and stops the regulator. When the EN pin is switched to the power off level, the operation of all internal circuit stops, the build-in P-channel MOSFET output transistor between pins V_{IN} and V_{OUT} is switched off, allowing current consumption to be drastically reduced. The V_{OUT} pin enters the GND level through the internal discharge path between V_{OUT} and GND pins.

◆ Fast Discharge Function

The SMC6605 fixed type has fast discharge Function on EN pin disable. When user turns off the device, its internal pull-low resistor will discharge output capacitor charge. It'll avoid other device to arise wrong motions.

◆ Output Voltage Selection

For fixed voltage type of SMC6605, the output voltage is preset at an internally trimmed voltage. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example, the SMC6605-33 has a preset 3.3V output voltage. For adjustable voltage type of SMC6605, the output voltage is set by comparing the feedback voltage at adjust terminal to the internal bandgap reference voltage. The reference voltage V_{REF} is 0.8V. The output voltage is given by the equation:

$$V_{OUT}=V_{REF} * (1+R_1/R_2)$$

(See Typical Application Schematic.)

◆ Current Limit

The SMC6605 also includes a fold back current limiter. It monitors and controls the pass transistor's gate voltage, estimates the output current, and limits the output current within 500mA.

◆ Thermal Overload Protection

Thermal overload protection limits total power dissipation in the SMC6605. When the junction temperature exceeds T_J=+150°C, a thermal sensor turns off the pass transistor, allowing the IC to cool down. The thermal sensor turns the pass transistor on again after the junction temperature cools down by 20°C, resulting in a pulsed output during continuous thermal overload conditions.

Thermal overload protection is designed to protect the SMC6605 in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of T_J=+125°C hould not be exceeded.

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◆ Operating Region and Power Dissipation

Maximum power dissipation of the SMC6605 depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The power dissipation across the devices is $P = I_{OUT} * (V_{IN}-V_{OUT})$.

The resulting maximum power dissipation is:

$$P_{MAX} = (T_J - T_A) / (\theta_{JC} + \theta_{CA}) = (T_J - T_A) / \theta_{JA}$$

Where (T_J-T_A) is the temperature difference between the SMC6605 die junction and the surrounding air, θ_{JC} is the thermal resistance of the package chosen, and θ_{JA} is the thermal resistance through the printed circuit board, copper traces and other materials to the surrounding air. For better heat-sinking, the copper area should be equally shared between the IN, OUT, and GND pins.

◆ Dropout Voltage

A regulator's minimum input-output voltage differential, or dropout voltage, determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. The SMC6605 use a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on-resistance $R_{DS(ON)}$ multiplied by the load current.

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} * I_{OUT}$$

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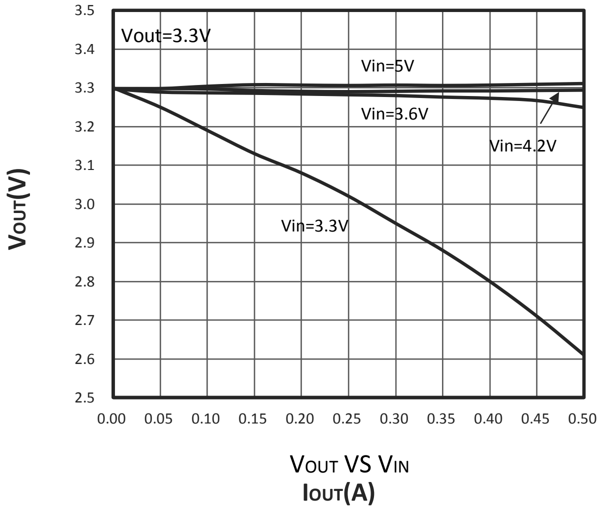
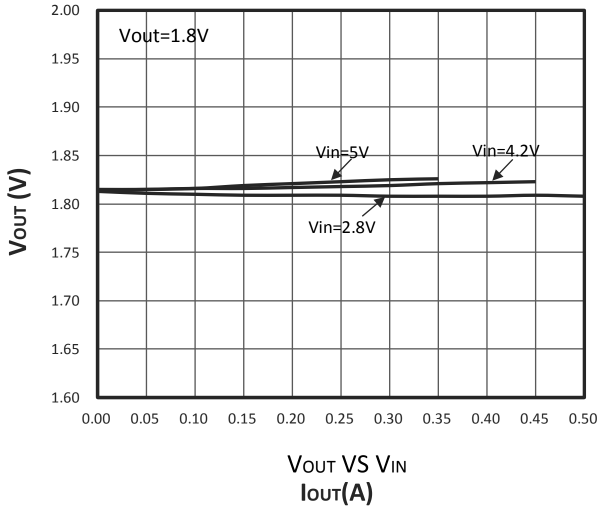
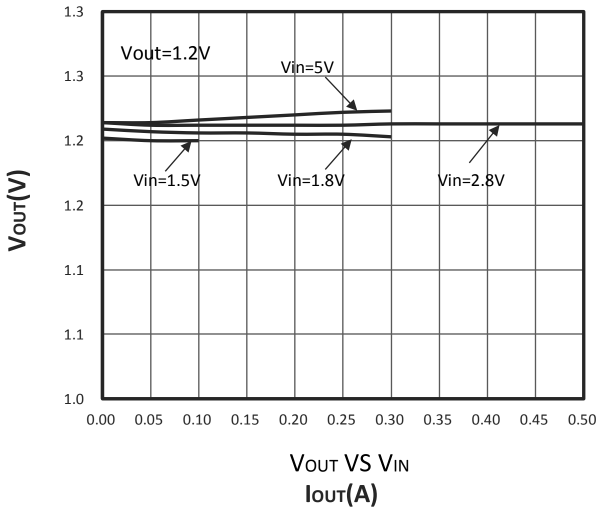
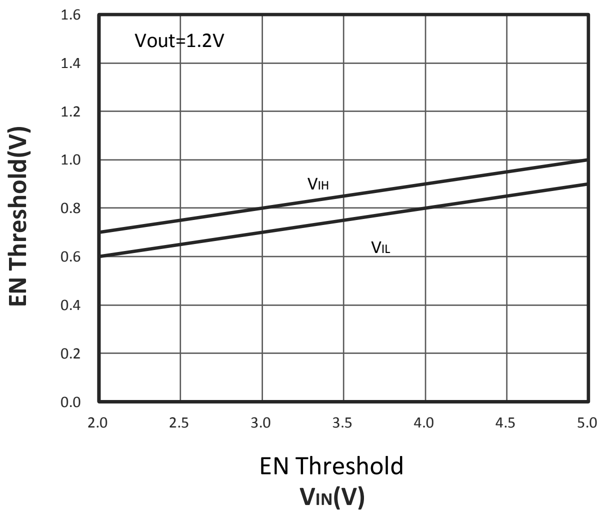
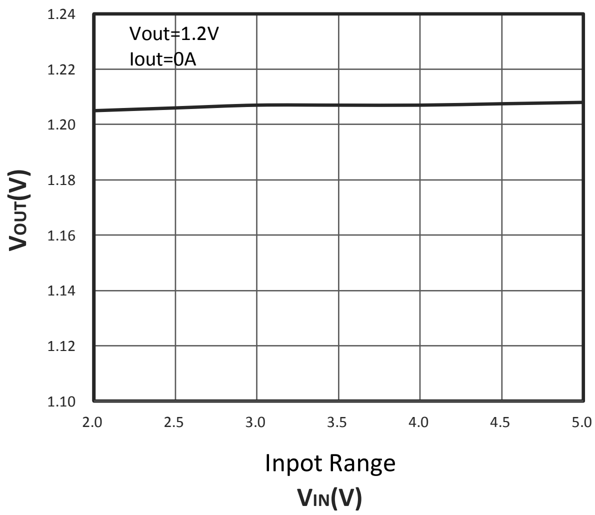
TYPICAL OPERATING CHARACTERISTICS *(TA=25°C unless otherwise noted)*

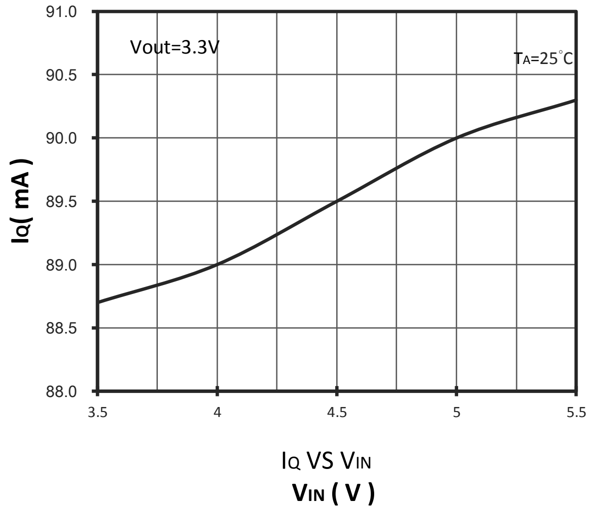












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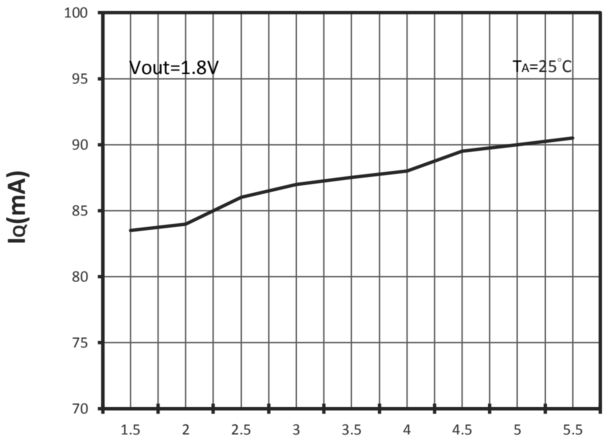
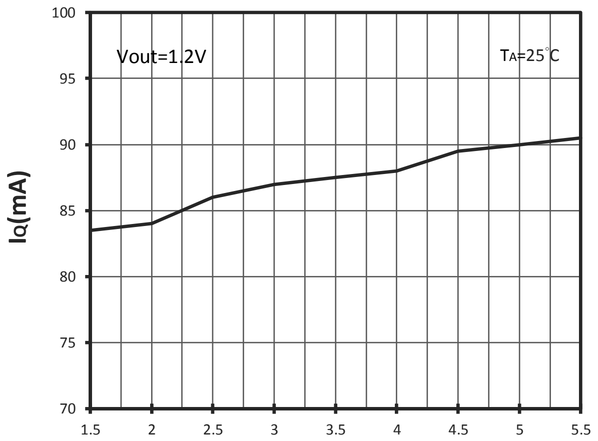
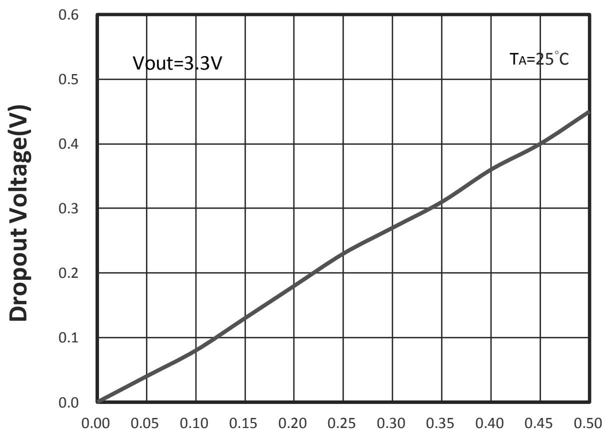
■*TYPICAL OPERATING CHARACTERISTICS*(*TA=25°C unless otherwise noted)*



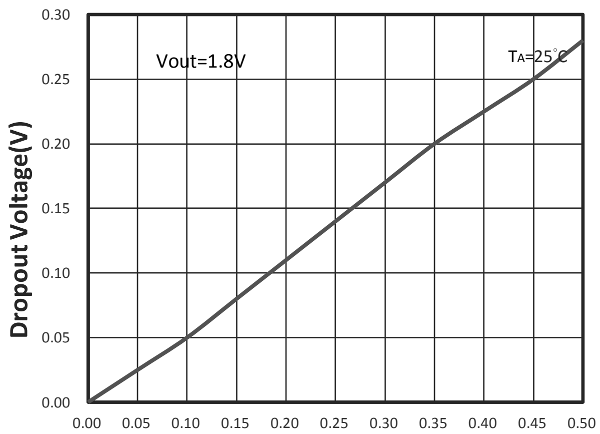
IQ VS VIN
VIN (V)



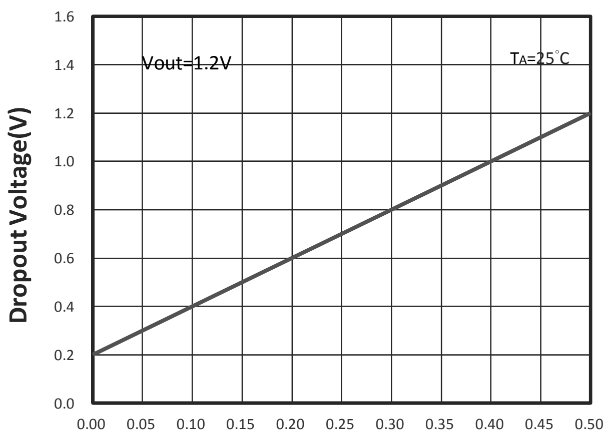
IQ VS VIN
VIN (V)



Dropout VS IOUT
IOUT(A)



Dropout VS IOUT
IOUT(A)



Dropout VS IOUT
IOUT(A)

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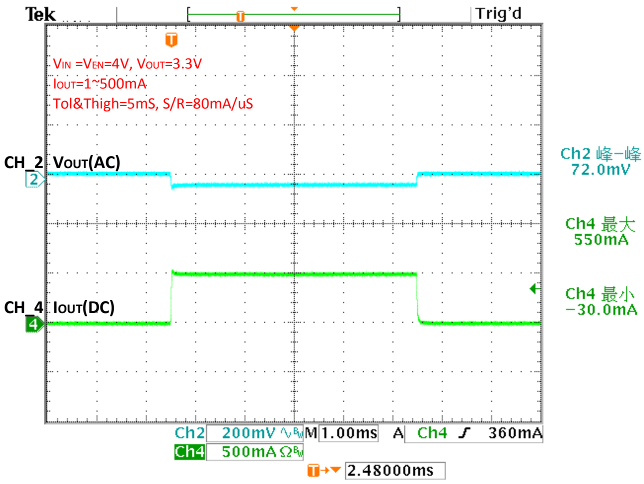
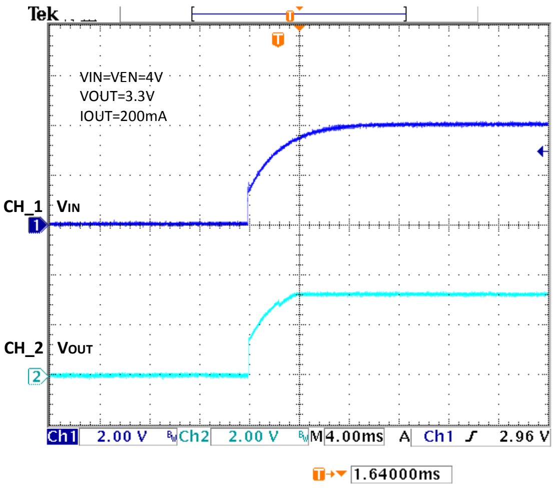
OPERATING WAVEFORMS*(Typical values are at T_A=25°C unless otherwise noted)*



Load Transient Response



Start-up Waveform

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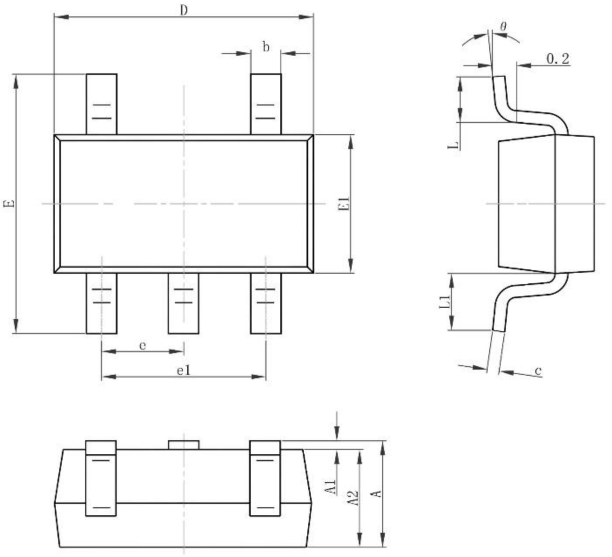
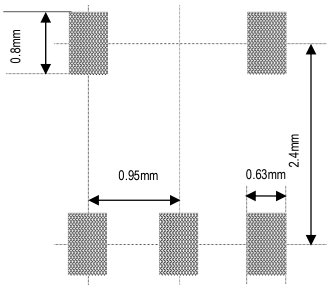
SOT-23-5L PACKAGE DIMENSIONS





Recommended Land Pattern

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	-	1.250	-	0.049
A1	0.040	0.100	0.002	0.004
A2	1.000	1.200	0.039	0.047
b	0.330	0.410	0.013	0.016
c	0.150	0.190	0.006	0.007
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.600	3.000	0.102	0.118
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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