Ultra-low Power Consumption LDO HL53xx Series

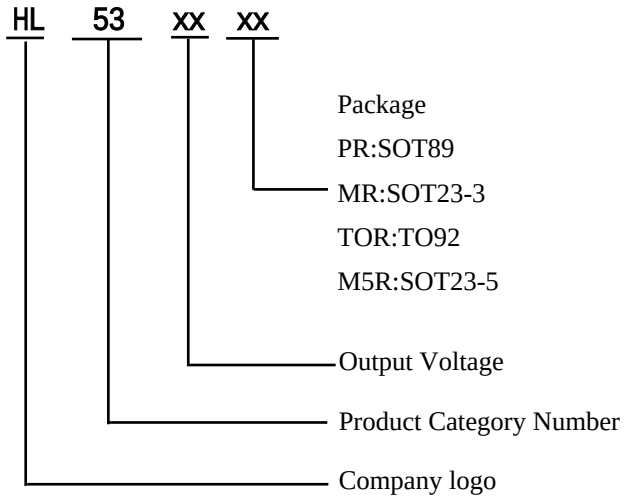
CMOS Voltage Regulator 500mA

HL53xx is ultra-low power consumption low dropout voltage regulator (LDO) manufactured in CMOS processes. It can deliver up to 500mA of current while consuming only 1.2μA of quiescent current. It consists of a reference voltage generator, an error amplifier, a current foldback circuit, and a phase compensation circuit plus a driver transistor. The HL53xx is designed specifically for applications where very-low I_Q is a critical parameter. This device maintains low quiescent current consumption even in dropout mode to further increase the battery life.

■ Features:

- Ultra-low Quiescent Current: 1.2μA
- Highly Accurate: ±2%
- Dropout Voltage: 500mV@I_{OUT}=500mA
- Maximum Output Current: 500mA
- Input Voltage Range: 2.2V~10V
- Temperature Stability: ±50ppm/℃
- ON/OFF Logic = Enable High
- Protections Circuits: Current Limiter, Short Circuit, Foldback
- Output Capacitor: Low ESR Ceramic Capacitor Compatible

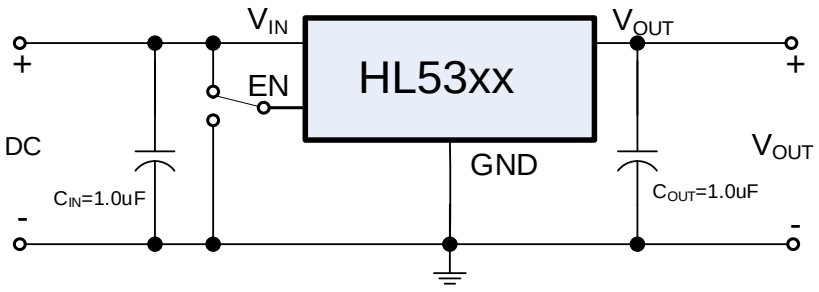
■ Selection Guide



■ Applications:

- Smart wearer
- Long-life battery-powered devices
- Portable mobile devices, such as mobile phones, cameras, and so on
- Wireless communication equipment

■ Typical Applications:



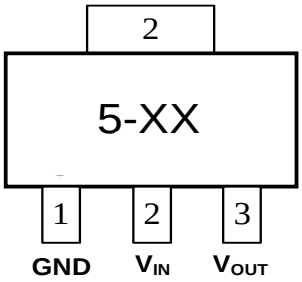
■ Notes on Use:

Input Capacitor (C_{IN}): 1.0μF above

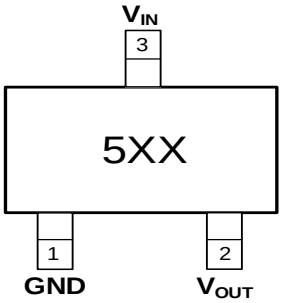
Output Capacitor (C_{OUT}):1.0μF above

Pin Configuration:

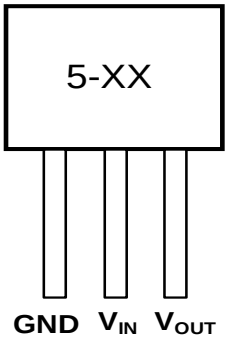
SOT89-3L
Top View



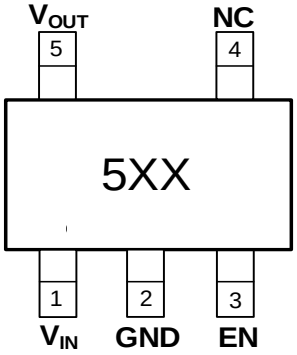
SOT23-3L
Top View



TO-92
Top View



SOT23-5L
Top View



Product Selections:

Product Name	V_{OUT} (V)	Package	Marking	Package Information
HL5312	1.2	SOT89-3L	5-12	Tape and Reel, 1000pcs
HL5315	1.5	SOT89-3L	5-15	
HL5318	1.8	SOT89-3L	5-18	
HL5321	2.1	SOT89-3L	5-21	
HL5325	2.5	SOT89-3L	5-25	
HL5327	2.7	SOT89-3L	5-27	
HL5328	2.8	SOT89-3L	5-28	
HL5330	3.0	SOT89-3L	5-30	
HL5333	3.3	SOT89-3L	5-33	
HL5336	3.6	SOT89-3L	5-36	
HL5340	4.0	SOT89-3L	5-40	
HL5344	4.4	SOT89-3L	5-44	
HL5350	5.0	SOT89-3L	5-50	
HL5312	1.2	SOT23-3L	512	
HL5315	1.5	SOT23-3L	515	
HL5318	1.8	SOT23-3L	518	
HL5321	2.1	SOT23-3L	521	

HL5325	2.5	SOT23-3L	525	Tape and Reel, 3000pcs
HL5328	2.8	SOT23-3L	528	
HL5330	3.0	SOT23-3L	530	
HL5333	3.3	SOT23-3L	533	
HL5336	3.6	SOT23-3L	536	
HL5340	4.0	SOT23-3L	540	
HL5344	4.4	SOT23-3L	544	
HL5350	5.0	SOT23-3L	550	
HL5312	1.2	SOT23-5L	512	
HL5315	1.5	SOT23-5L	515	
HL5318	1.8	SOT23-5L	518	
HL5321	2.1	SOT23-5L	521	
HL5325	2.5	SOT23-5L	525	
HL5328	2.8	SOT23-5L	528	
HL5330	3.0	SOT23-5L	530	
HL5333	3.3	SOT23-5L	533	
HL5336	3.6	SOT23-5L	536	
HL5340	4.0	SOT23-5L	540	
HL5344	4.4	SOT23-5L	544	
HL5350	5.0	SOT23-5L	550	
HL5312	1.2	TO-92	512	Bag, 1000pcs
HL5315	1.5	TO-92	515	
HL5318	1.8	TO-92	518	
HL5321	2.1	TO-92	521	
HL5325	2.5	TO-92	525	
HL5328	2.8	TO-92	528	
HL5330	3.0	TO-92	530	
HL5333	3.3	TO-92	533	
HL5336	3.6	TO-92	536	
HL5340	4.0	TO-92	540	
HL5344	4.4	TO-92	544	
HL5350	5.0	TO-92	550	

Notes: 1* Customer can request to customize the output voltage ranged from 1.2V to 5V if desired voltage is not found in the selections.

2* Customer can request customization of package choice.

3* Please pay attention to the MARKING of the product package type.

■ Absolute Maximum Ratings:

(Unless otherwise indicated: T_a=25℃)

PARAMETER	SYMBOL	RATINGS		UNITS
Input Voltage	V_{IN}	-0.3 ~ 12		V
Output Voltage	V_{OUT}	Vss-0.3 ~ VIN+0.3V		
Power Dissipation	P_D	SOT-89	1000	mW
		TO-92	300	
		SOT-23	250	
Thermal Resistance	$R_{\theta JA}$	SOT-89	100	℃/W
		TO-92	250	
		SOT-23	200	
Operating Ambient Temperature	T_{opr}	-40 ~ +85		℃
Storage Temperature	T_{stg}	-40 ~ +125		
ESD Protection	ESD HBM	2000		V

Note: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

■ Electrical Characteristics:

HL53xx Series (Unless otherwise indicated: T_a=25℃)

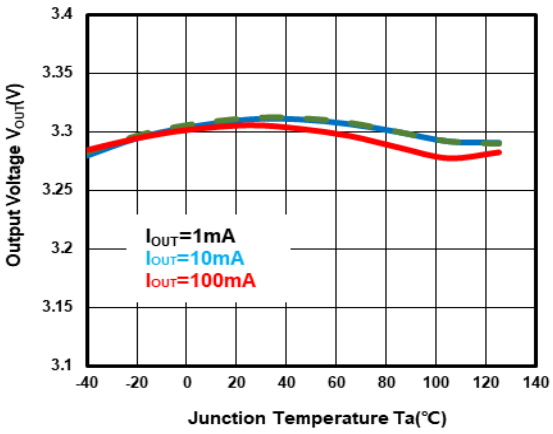
PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.	MAX.	UNIT
Output Voltage*1	$V_{OUT(S)}$	V_{IN}= V_{OUT}+1V I_{OUT}=40mA		V_{OUT} ×0.98	$V_{OUT(S)}$	V_{OUT} ×1.02	V
Dropout Voltage*2	V_{DROP}	I_{OUT}=500mA	V_{OUT}=3.3V		490	1000	mV
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \bullet V_{OUT(s)}}$	V_{OUT}+1V≤V_{IN}≤10V I_{OUT}=1mA			0.05	0.1	%/V
Load Regulation	ΔV_{OUT2}	V_{IN}=$V_{OUT(S)}$+1V 1mA≤I_{OUT}≤500mA			70	100	mV
Temperature Stability	$\frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT(s)}}$	V_{IN}=V_{OUT}+1V I_{OUT}=1mA -40℃≤Ta≤125℃			±50	±100	ppm/℃
GND Current (V_{EN}=V_{IN})	I_{GND}	no load			1.2	2.5	μA
Input Voltage	V_{IN}	---				10	V
Maximum Output Current	I_{OUTMAX}	V_{IN}=$V_{OUT(S)}$+1.0V			500		mA
Current Limit*3	I_{LIM}	V_{IN}= $V_{OUT(S)}$+1V, V_{OUT}= 0.95 ×$V_{OUT(S)}$			1000		mA
Short Circuit Current	I_{SHORT}	V_{IN}=$V_{OUT(S)}$+1.0V V_{OUT}=0V			70	100	mA
Power Supply Rejection Ratio	PSRR	f=100Hz, I_{OUT}=10mA			47		dB
		f=1kHz, I_{OUT}=10mA			28		
EN 'H' Level Voltage	V_{ENH}	---		1.8		10	V
EN 'L' Level Voltage	V_{ENL}	---		0		0.5	
EN 'H' Level Current	I_{ENH}	V_{IN}=10.0V, V_{EN}=V_{IN}		-0.1		0.1	uA
EN 'L' Level Current	I_{ENL}	V_{IN}=10.0V, V_{EN}=0		-0.1		0.1	

Notes:

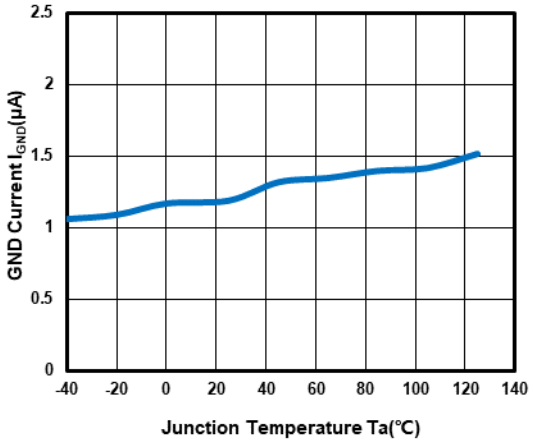
1. $V_{OUT(S)}$: Output voltage when V_{IN}=V_{OUT}+1V, I_{OUT}=40 mA.
2. V_{DROP}=V_{IN1} -（$V_{OUT(S)}$× 0.98）where V_{IN1} is the input voltage when V_{OUT} = $V_{OUT(S)}$× 0.98.
3. I_{LIM}: Output current when V_{IN}=$V_{OUT(S)}$+1V and V_{OUT} = 0.95*$V_{OUT(S)}$.

Typical Performance Characteristics:

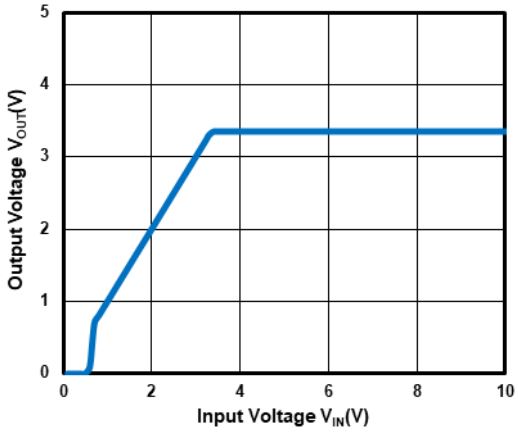
Test Conditions: V_{IN}=V_{OUT}+1.0V, C_{IN}=1.0μF, C_{OUT}=1.0μF, T_a=25℃, unless otherwise indicated.



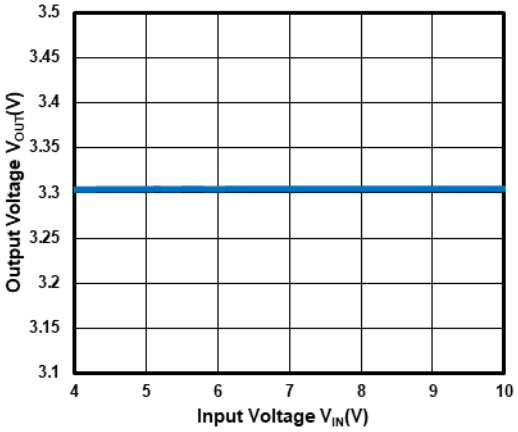
Output Voltage vs. Temperature at V_{OUT}=3.3V



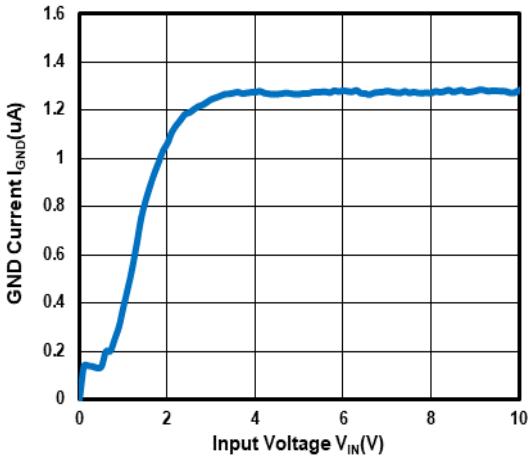
GND Current vs. Temperature at V_{OUT}=3.3V



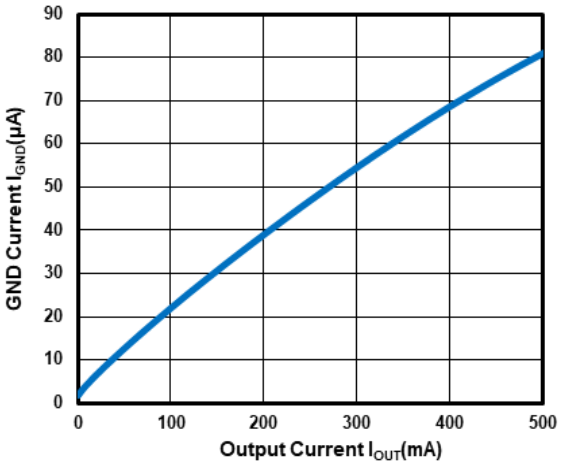
Output Voltage vs. Input Voltage at V_{OUT}=3.3V



Output Voltage vs. Input Voltage at V_{OUT}=3.3V



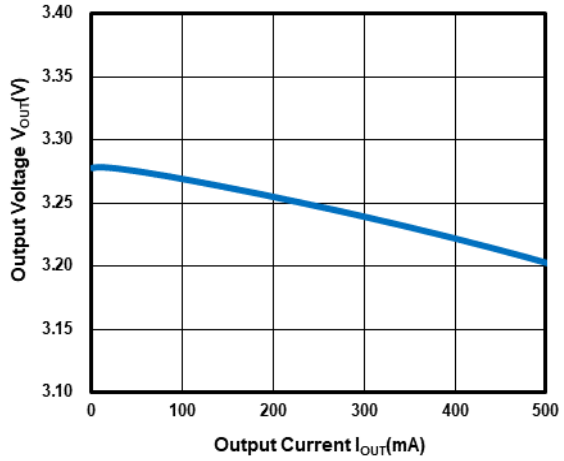
GND Current vs. Input Voltage at V_{OUT}=3.3V



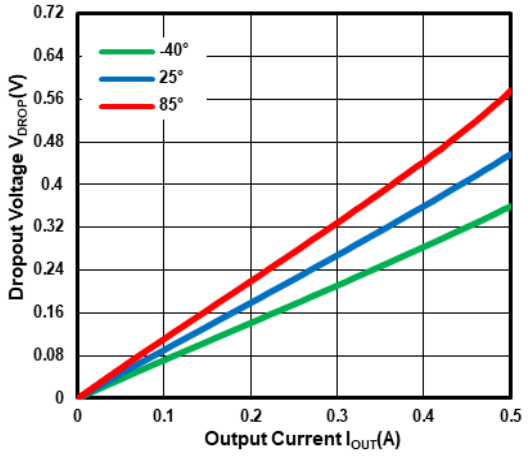
GND Current vs Output Current at V_{OUT}=3.3V

■ Typical Performance Characteristics (Continued):

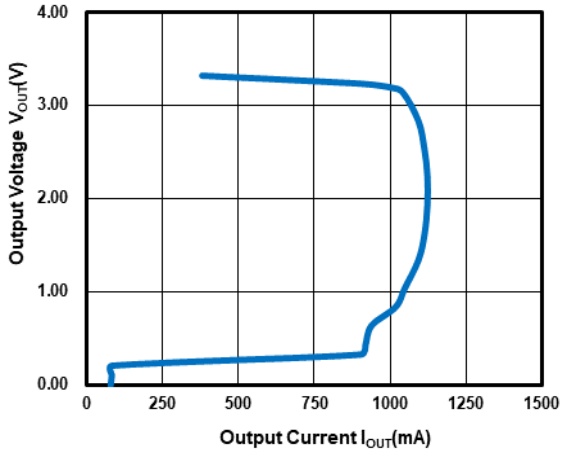
Test Conditions: V_{IN}=V_{OUT}+1.0V, C_{IN}=1.0μF, C_{OUT}=1.0μF, T_a=25℃, unless otherwise indicated.



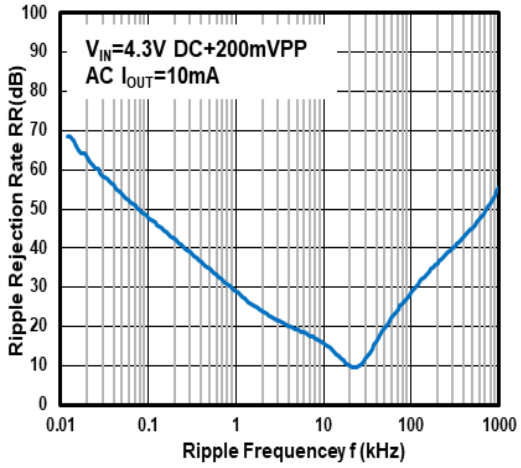
Output Voltage vs Output Current at V_{OUT}=3.3V



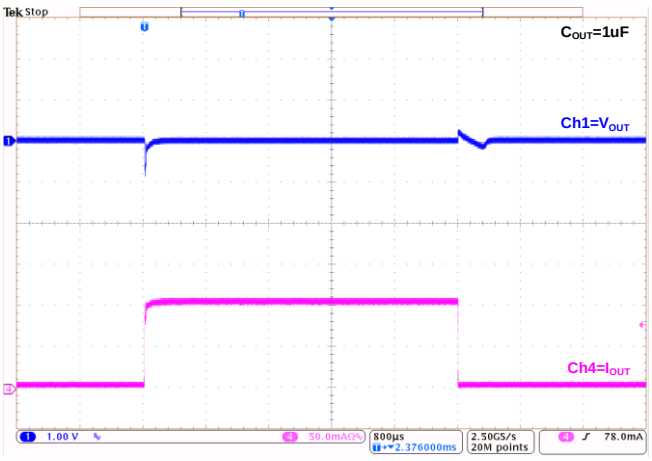
Dropout Voltage vs. Output Current at VOUT=3.3V



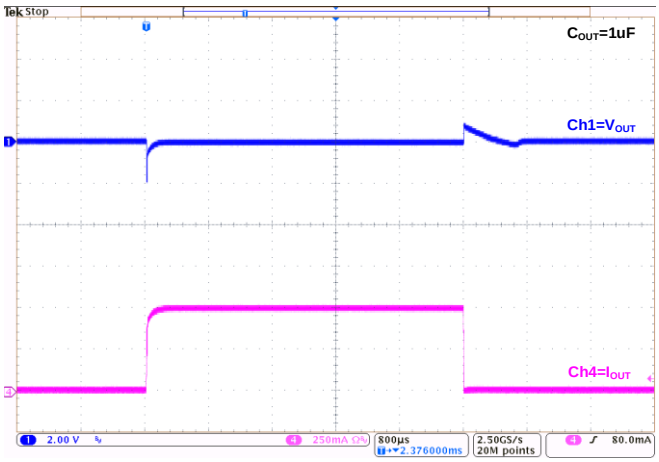
Output Current Fold-back at VOUT=3.3V



Power Supply Rejection Ratio at V_{OUT}=3.3V



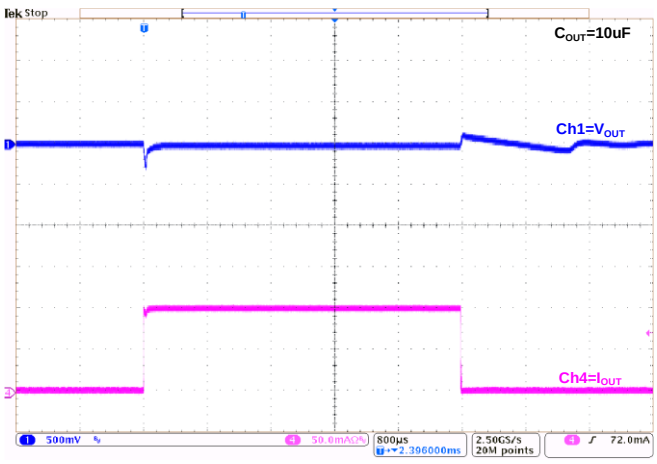
Load Transient at VOUT=3.3V:
(IOUT=1mA~100mA~1mA)



Load Transient at VOUT=3.3V:
(IOUT=1mA~500mA~1mA)

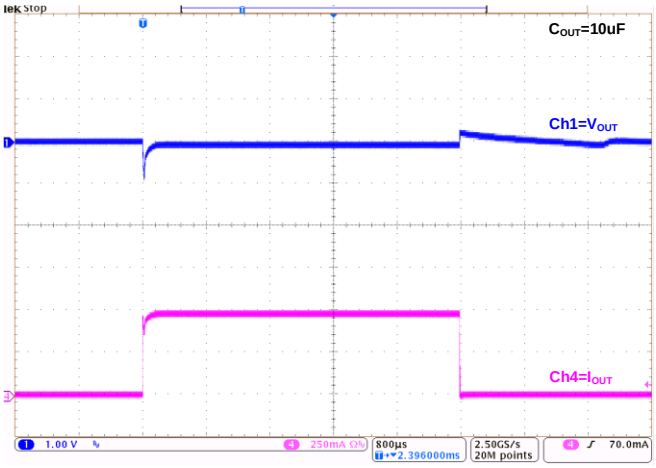
■ Typical Performance Characteristics (Continued):

Test Conditions: $V_{IN}=V_{OUT}+1.0V$, $C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $T_a=25℃$, unless otherwise indicated.



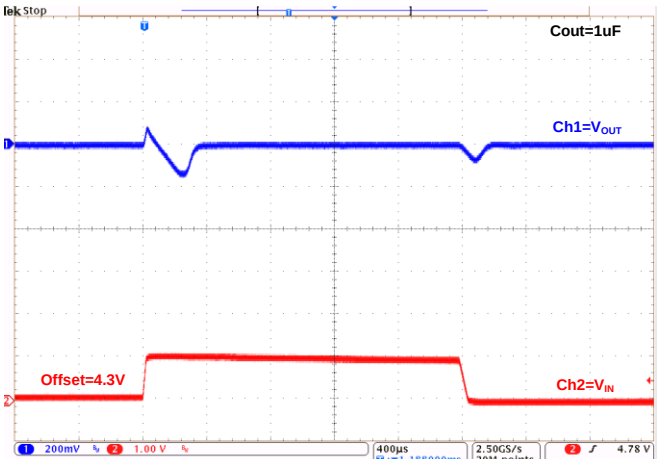
Load Transient at VOUT=3.3V:

(IOUT=1mA~100mA~1mA)



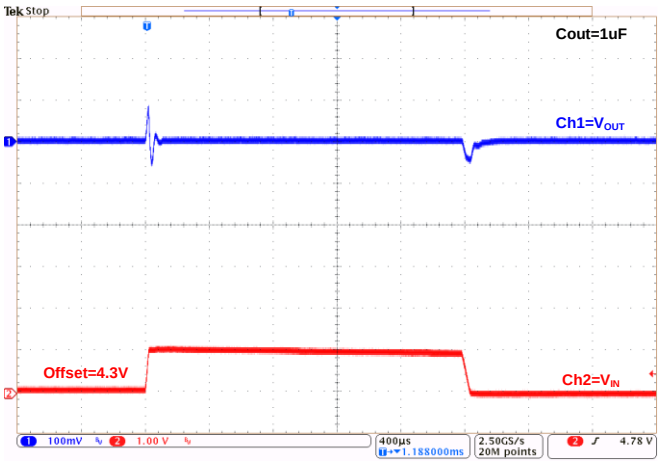
Load Transient at V_{OUT}=3.3V:

(I_{OUT}=1mA~500mA~1mA)



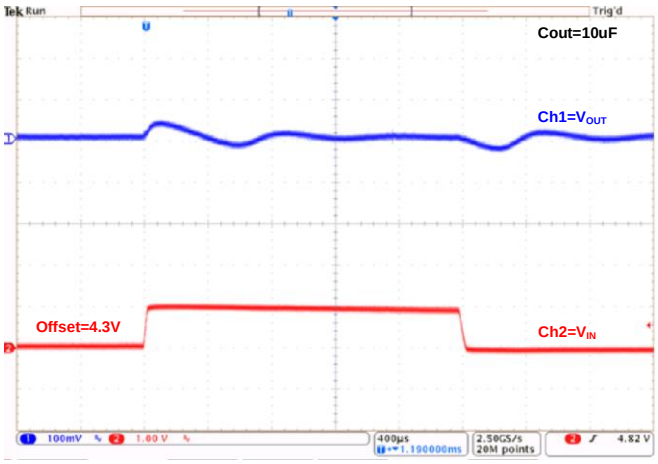
Line Transient at V_{OUT}=3.3V:

(I_{OUT}=1mA)



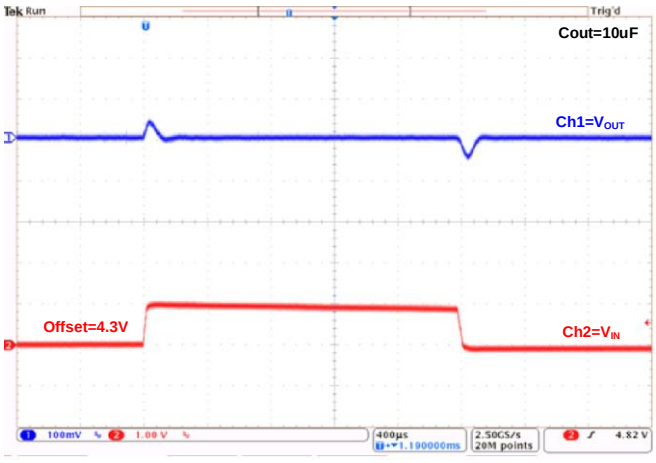
Line Transient at V_{OUT}=3.3V:

(I_{OUT}=10mA)



Line Transient at V_{OUT}=3.3V:

(I_{OUT}=10mA)

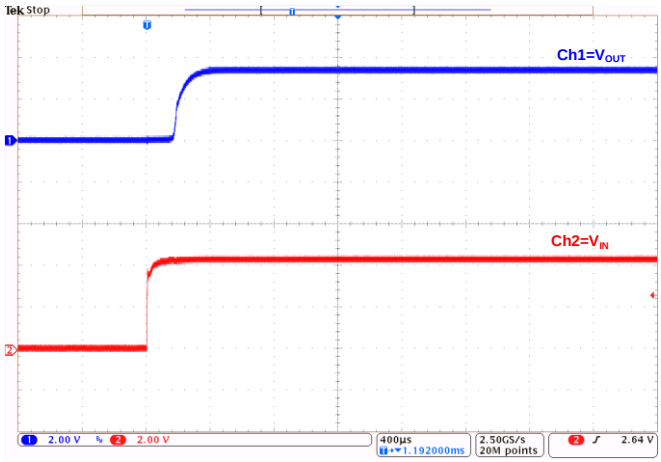


Line Transient at V_{OUT}=3.3V:

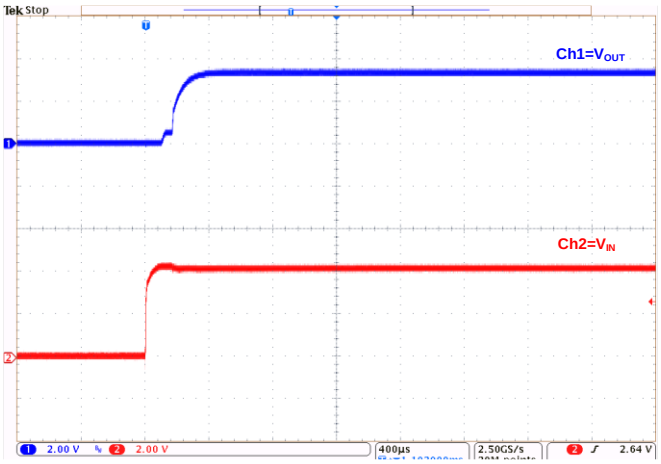
(I_{OUT}=10mA)

■ Typical Performance Characteristics (Continued):

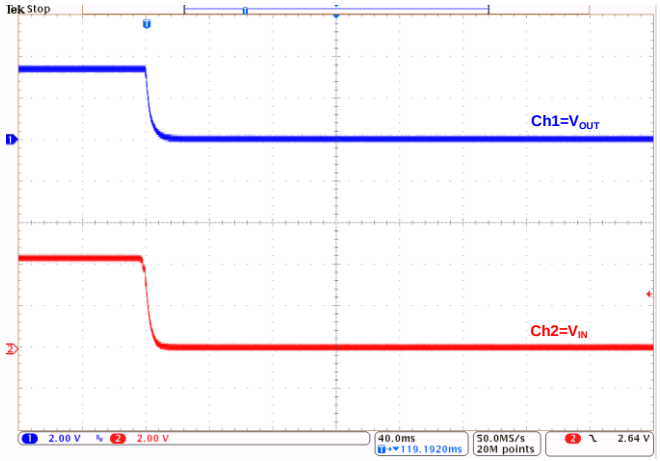
Test Conditions: $V_{IN}=V_{OUT}+1.0V$, $C_{IN}=1.0\mu F$, $C_{OUT}=1.0\mu F$, $T_a=25℃$, unless otherwise indicated.



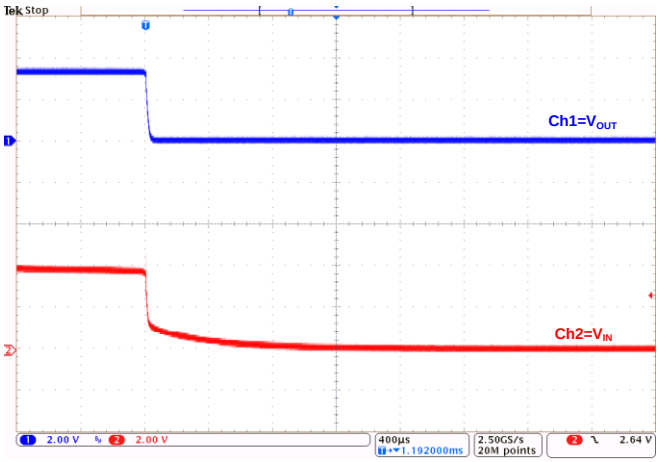
Power-Up at V_{OUT}=3.3V:
(I_{OUT}=1mA)



Power-Up at V_{OUT}=3.3V:
(I_{OUT}=500mA)



Power-Down at V_{OUT}=3.3V:
(I_{OUT}=1mA)

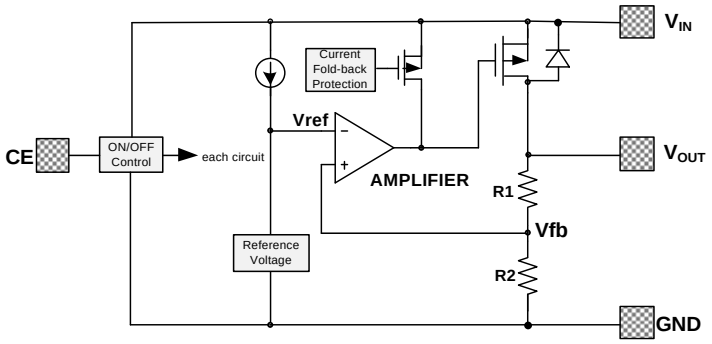


Power-Down at V_{OUT}=3.3V:
(I_{OUT}=500mA)

■ Operational Explanation：

1. Output voltage control

The voltage divided by resistors R1 and R2 is compared with the internal reference voltage by the error amplifier. The amplifier output then drives the P-channel MOSFET connected to the V_{OUT} pin. The output voltage at the V_{OUT} pin is regulated by this negative feedback system. The current limit circuit and short protect circuit operate in relation to output current level. Further, the IC's internal circuitry can be in operation or shutdown modes controlled by the EN pin's signal.



2. Pass transistor

The pass transistor with low turn-on resistance used in HL53xx is a P-channel MOSFET. If the potential on V_{OUT} pin is higher than VIN, it is possible that IC will be destroyed due to reverse current which is caused by parasitic diodes between V_{IN} and V_{OUT}. Therefore, the V_{OUT} pin potential exceeds V_{IN}+0.3V is not allowed.

3. Current foldback and short circuit protection

The HL53xx series includes a combination of a fixed current limiter circuit and a foldback circuit, which aid the operations of the current limiter and circuit protection. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, output voltage drops further and output current decreases. The short circuit current is about 70mA (typical value). This design can prevent the chip be damaged due to over temperature, moreover, the heat dissipation is limited by the package type.

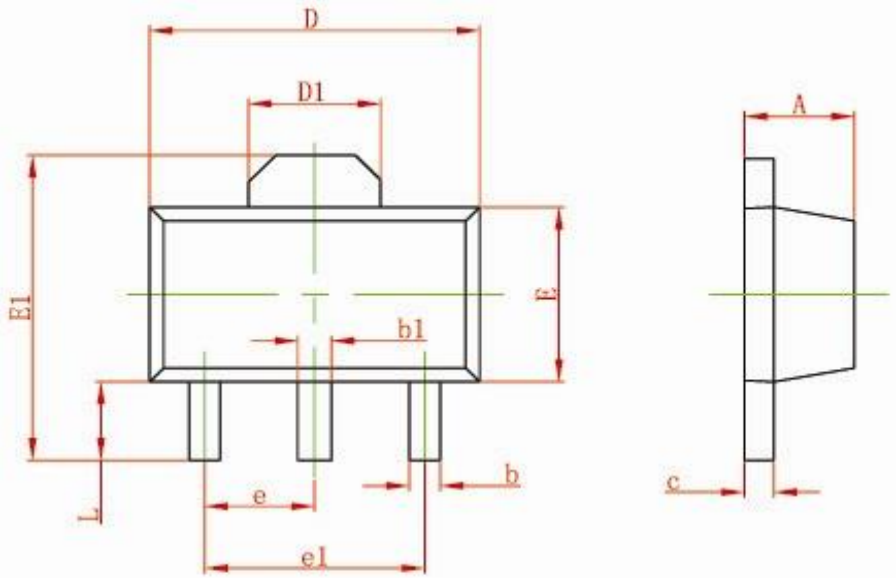
Special attention should be paid to that the product of the dropout voltage on the chip and the output current must be smaller than the heat dissipation.

■ Notes:

1. The input and output capacitors should be placed as close as possible to the IC.
2. If the impedance of the power supply is high, which is caused by forgetting installing input capacitor or installing too small value capacitor, the oscillation may occur.
3. Pay attention to the operation conditions of input and output voltage and load current, such that the power consumption in the IC should not exceed the allowable power consumption of the package even though the chip has short circuit protection.
4. IC has a built-in anti-static protection (ESD) circuit, but please do not add excessive stress to the IC.

PACKAGING INFORMATION:

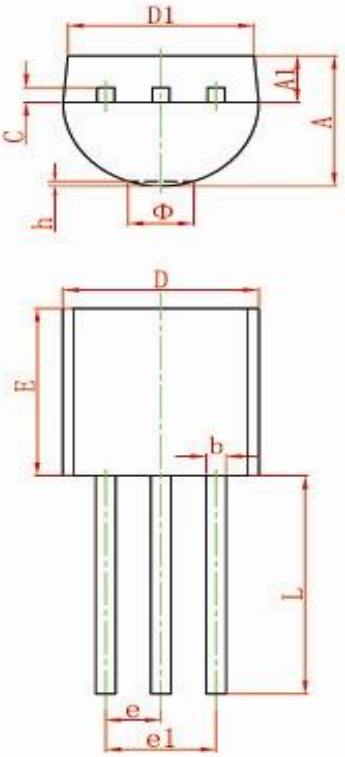
SOT-89-3L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	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	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060TYP	
e1	3.000 TYP		0.118TYP	
L	0.900	1.200	0.035	0.047

■ PACKAGING INFORMATION(Continued):

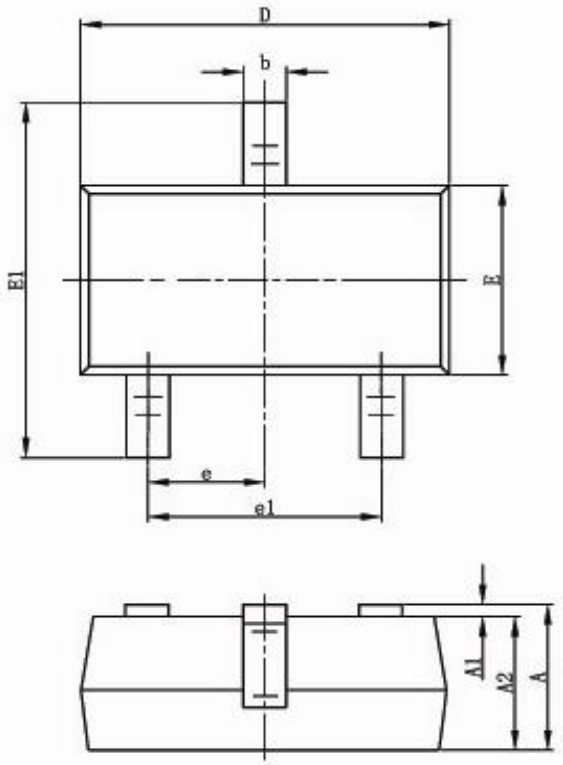
TO-92 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.400	4.700	0.173	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015

■ PACKAGING INFORMATION(Continued):

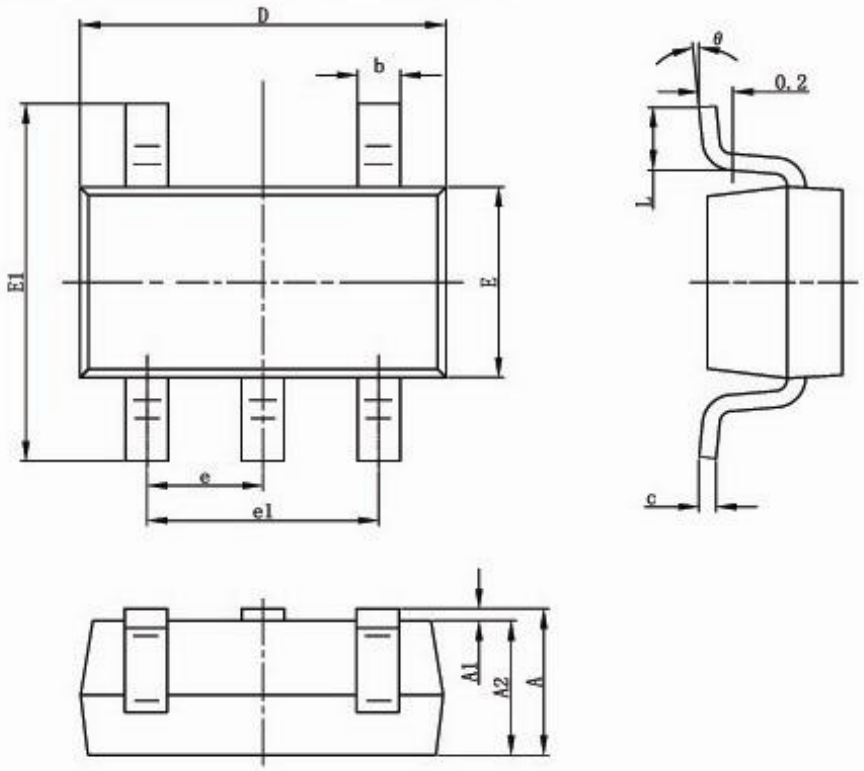
SOT-23-3L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

■ ACKAGING INFORMATION(Continued):

SOT-23-5L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°