GENERAL DESCRIPTION

The LW59XX Series is a Sub-μA power consumption, high accuracy, low drop-out voltage regulator with Chip Enable Pin, high ripple rejection and fast discharge function.

The current limiter's fold-back circuit operates as a short circuit protection as well as the output current limiter for the output pin.

Output voltage is selectable from 0.8V to 5.0V which fixed by laser trimming technologies, Step=100mV.

The LW59XX is available in SOT23, SOT23-3L, SOT23-5L, SOT-323, SOT-353, DFN1x1-4L and SOT89-3L packages.

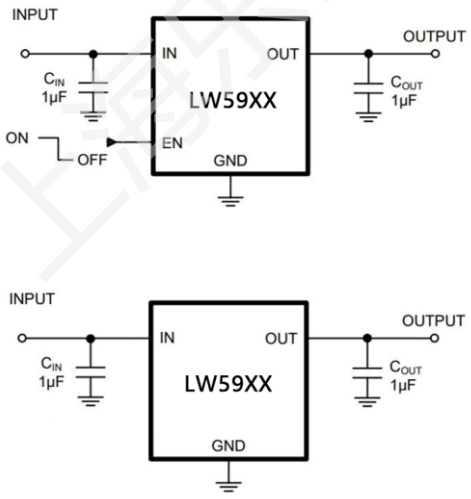
FEATURES

- Ultra-Low Quiescent Current: 0.65μA(Typ.)
- Operating Voltage Range: from 1.6V to 7.0V
- Output Voltage Range: from 0.8V to 5.0V
- Maximum Output Current: 400mA
- Output Accuracy: ±1.5% @+25℃
- Low Dropout Voltage:470mV@400mA/3.3V
- Current Limiting Protection
- Output Short-Circuit Protection
- Over-Temperature Protection
- Fast Discharge Function
- Stable with 1μF Output Capacitor

APPLICATIONS

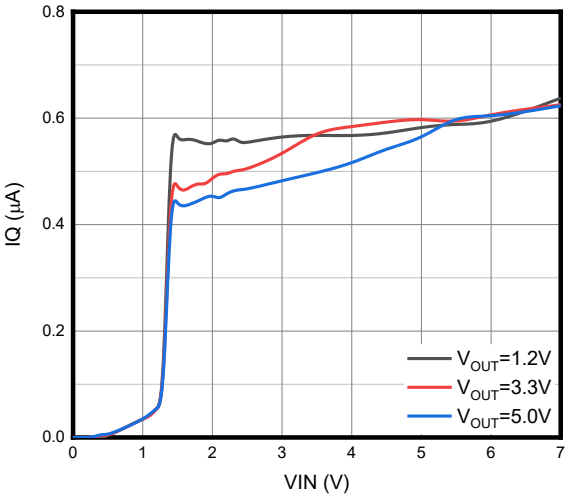
- Battery-Powered Devices
- Reference Voltage Sources
- Other Low Voltage Power Suppliers

TYPICAL APPLICATION CIRCUIT



Note: EN must NOT be left floating.

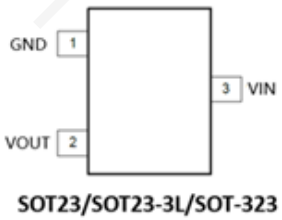
TYPICAL PERFORMANCE CHARACTERISTICS



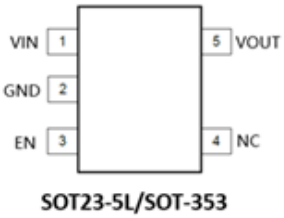
PIN DESCRIPTION:

PIN No				SYMBOL	DESCRIPTTION
SOT23/ SOT23-3L/ SOT-323	SOT23-5L /SOT-353	DFN1x1-4L	SOT89-3L (Type-A)		
3	1	4	2、TAB	VIN	Input pin. For best transient response and to minimize input impedance, use the recommended value or larger ceramic capacitor from IN to ground as listed in the Recommended Operating Conditions table and the Input and Output Capacitor Requirements section. Place the input capacitor as close to the output of the device as possible.
1	2	2	1	GND	Ground pin.
--	3	3	--	EN	Enable pin. Drive EN greater than $V_{EN(HI)}$ to turn on the regulator. Drive EN less than $V_{EN(LO)}$ to put the low-dropout regulator (LDO) into shutdown mode.
--	4	--	--	NC	No internal connection. Ground this pin for better thermal performance.
2	5	1	3	VOUT	Regulated output voltage pin. Connect a low-equivalent series resistance (ESR) capacitor to this pin. For best transient response, use the nominal recommended value or larger capacitor from OUT to GND. An internal pulldown resistor prevents a charge from remaining on OUT when the regulator is in shutdown mode ($V_{EN} < V_{EN(LOW)}$).
--	--	Thermal Pad	--	Pad	The thermal pad is electrically connected to the GND node. Connect to the GND plane for improved thermal performance.

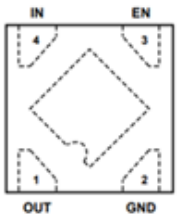
PIN ASSIGNMENT



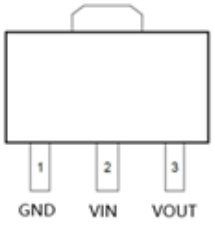
SOT23/SOT23-3L/SOT-323



SOT23-5L/SOT-353



DFN1x1-4L



SOT89-3L(Type-A)

MARK INFORMATION：

SOT23/SOT-323/SOT-353

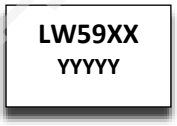
XX: VOLTAGE

YY: DATE CODE

SOT23-3L/SOT23-5L/SOT89-3L

XX: VOLTAGE

YY: DATE CODE



DFN1x1-4L

X: VOLTAGE

0.8V	0.9V	1.0V	1.2V	1.5V	1.8V	2.5V	2.8V	3.0V	3.3V	3.6V	4.2V	5.0V
A	R	B	C	D	G	H	J	L	M	P	S	T

ABSOLUTE MAXIMUM RATINGS (1):

(T_A =25℃, unless otherwise specified.)

SYMBOL	ITEM		RATING	UNIT
V_{IN}	Supply Voltage		-0.3~9.0	V
V_{EN}	EN Pin Voltage		-0.3~9.0	V
V_{OUT}	VOUT pin Voltage		-0.3~ (V_{IN}+0.3)	V
$V_{(ESD)}$	ESD Susceptibility, HBM(2)		±4000	V
$R_{\theta JA}$	Junction-to-ambient Thermal Resistance(3)	SOT23	363	℃/W
		SOT-323	400	
		SOT-353	395	
		SOT23-3L	330	
		SOT23-5L	325	
		DFN1x1-4L	320	
		SOT89-3L	125	
T_J	Junction Temperature Range		-40~150	℃
T_{STG}	Storage Temperature Range		-40~150	℃
T_{SOLDER}	Lead Temperature (Soldering)		260℃, 10s	

Note:

1. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability

2. per ANSI/ESDA/JEDEC JS-001

3. Device mounted on FR-4 PCB, Refer to JESD51-3 for detailed information on the board construction

RECOMMANDED OPERATING RANGE:

SYMBOL	ITEM	VALUE	UNIT
V_{IN}	VIN Supply Voltage	1.6~7.0	V
V_{EN}	EN Pin Voltage	0~7.0	V
V_{OUT}	V_{OUT} Pin Voltage	0.8~5.0	V
I_{OUT}	Output Current	0~400	mA
T_J	Junction Temperature Range	-40~125	℃

ELECTRICAL CHARACTERISTICS:

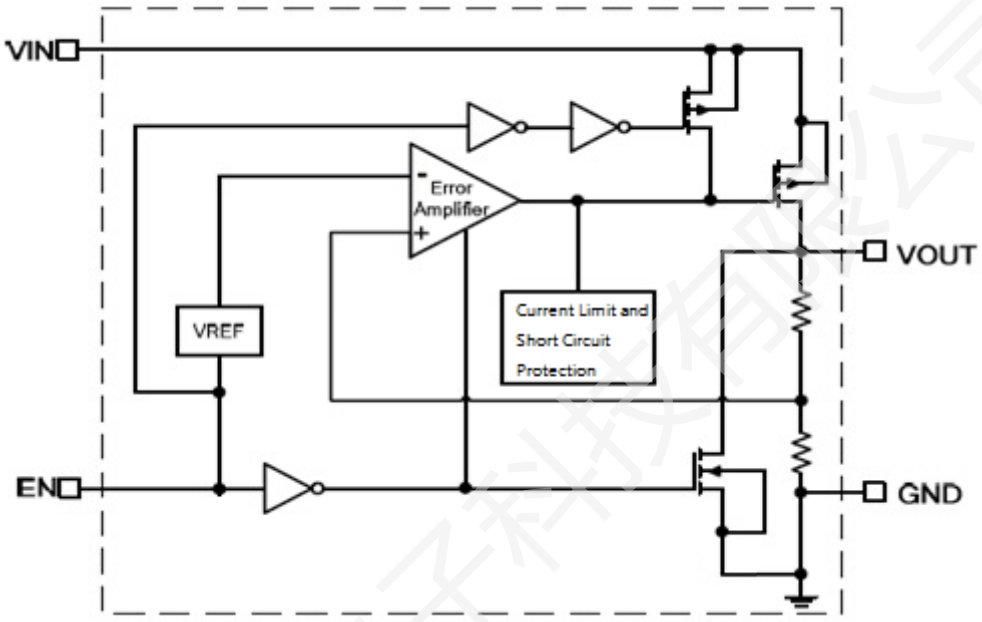
(V_{IN}=$V_{OUT(NOM)}$+1V, whichever is greater, C_{IN}= C_{OUT}=1μF, unless otherwise specified, typical values are at T_A= 25℃.)

Symbol	Parameter	Test Conditions		MIN	TYP	MAX	Unit
V_{IN}	Input Voltage			1.6		7.0	V
V_{OUT}	Output Accuracy	I_{OUT}= 1mA		-1.5		1.5	%
I_{LIM}	Current Limit(1)			410	530		mA
I_Q	Quiescent Current	V_{IN}= V_{EN}= V_{OUT} +1V, No Load			0.65	1.0	μA
I_{SHD}	Shutdown Current	V_{IN}=7.0V, V_{EN}=0V				0.1	μA
V_{DROP}	Dropout Voltage(1) (2)	I_{OUT}=100mA	V_{OUT} =3.3V		100		mV
		I_{OUT}=200mA			210		
		I_{OUT}=400mA			470		
		I_{OUT}=100mA	V_{OUT} =5.0V		95		
		I_{OUT}=200mA			200		
		I_{OUT}=400mA			440		
ΔV_{OUT}/ (ΔV_{IN}*$V_{OUT(NOM)}$)	Line Regulation	V_{IN}= V_{OUT} +1.0V to 7.0V, I_{OUT}=1mA			0.1	0.3	%/V
ΔV_{OUT}	Load Regulation	1mA≤I_{OUT}≤400mA			30	70	mV
I_{SHORT}	Short Current(1)	V_{OUT}=0V			100		mA
V_{ENH}	EN High Voltage	V_{IN}=1.8V to 7.0V, I_{OUT}=1mA		1.5			V
V_{ENL}	EN Low Voltage					0.6	V
T_{STR}	Startup Time	From V_{EN} 'L'→'H' to 95%*V_{OUT}, C_{OUT}=1μF, No Load			800		μs
PSRR	Power Supply Rejection Ratio	V_{IN}= 4.3V, V_{OUT}=3.3V, V_{PP}=0.5V, C_{OUT}=1μF, C_{IN}=none, I_{OUT}=10mA	f=217Hz		55		dB
			f=1kHz		45		
			f=10kHz		35		
T_{SD}	Thermal Shutdown	Temperature rising			155		℃
$\triangle T_{SD}$	TSD Hysteresis	Temperature falling			20		℃
R_{DSCHG}	Output Discharge Resistance	V_{IN}= 7.0V, V_{EN}=0V			250		Ω

NOTES:

1. Guaranteed by design
2. The dropout voltage is defined as V_{IN} - V_{OUT}, when V_{OUT} =95%*$V_{OUT(NOM)}$

SIMPLIFIED BLOCK DIAGRAM:



DETAIL OPERATION DESCRIPTION:

The LW59XX is a low power consumption low drop-out voltage regulator. It consists of a current limiter circuit, a driver transistor, a precision voltage reference and an error correction circuit, and is compatible with low ESR ceramic capacitors. The current limiter's fold-back circuit operates as a short circuit protection as well as the output current limiter.

Current Limiting and Short-Circuit Protection

The current limit circuitry prevents damage to the MOSFET switch and the hub downstream port but can deliver load current up to the current limit threshold through the switch. When a heavy load or short circuit is applied to an enabled switch, a large transient current may flow until the current limit circuitry responds. Once this current limit threshold is exceeded the device enters constant current mode until the thermal shutdown occurs or the fault is removed.

TYPICAL OPERATING CHARACTERISTICS:

（*Tested under* T_A =*25*°C, C_{IN}=C_{OUT}=1μF, unless otherwise specified）

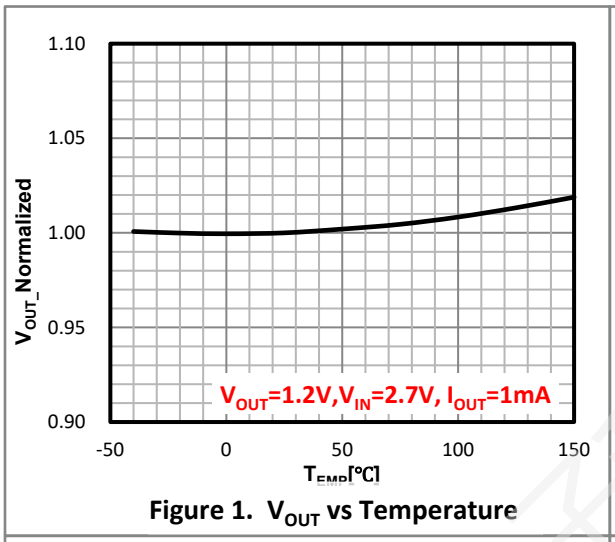


Figure 1. V_{OUT} vs Temperature

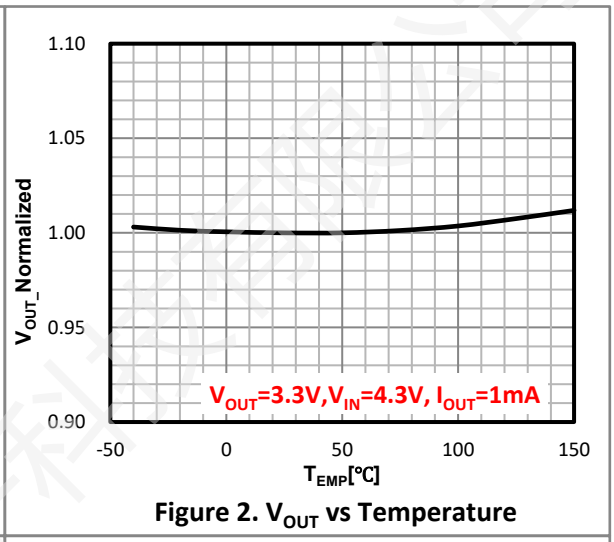


Figure 2. V_{OUT} vs Temperature

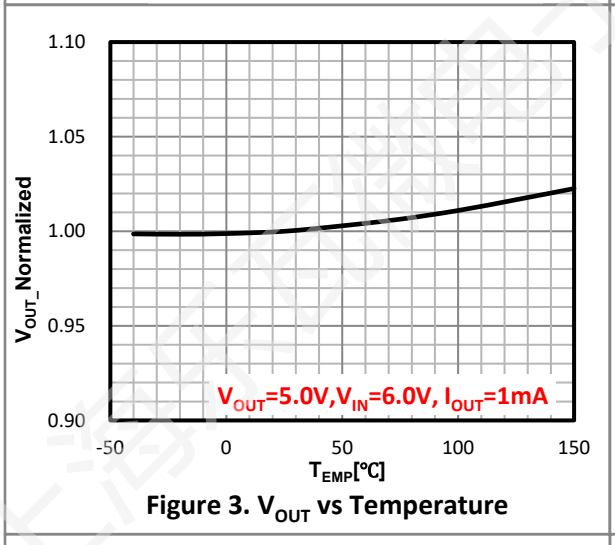


Figure 3. V_{OUT} vs Temperature

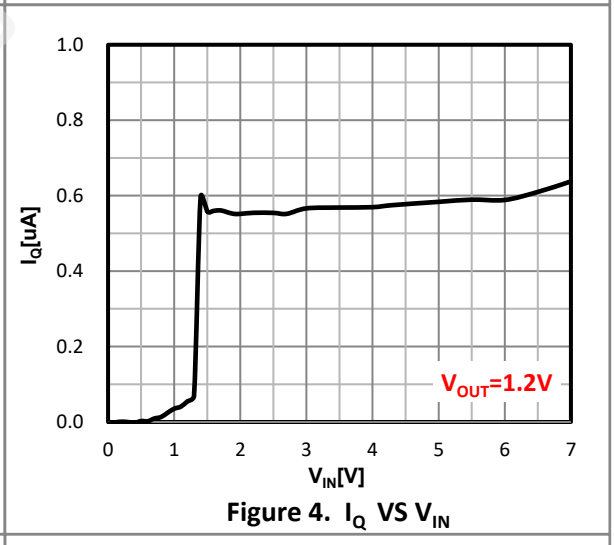


Figure 4. I_Q VS V_{IN}

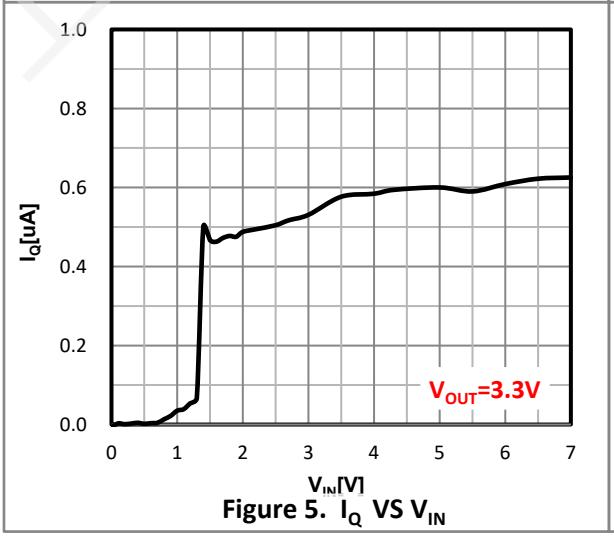


Figure 5. I_Q VS V_{IN}

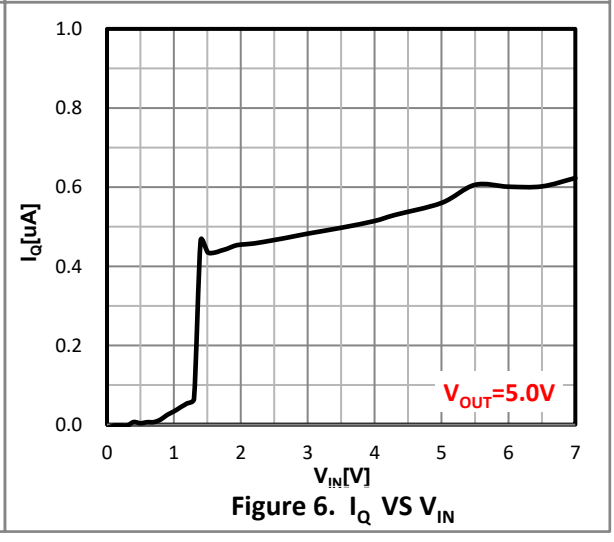


Figure 6. I_Q VS V_{IN}

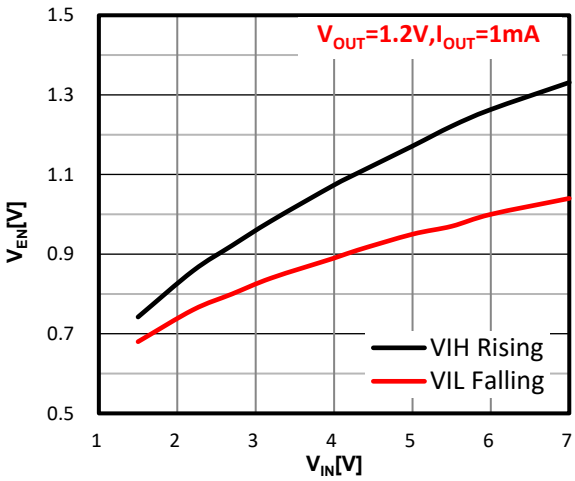


Figure 7. V_{EN} vs V_{IN}

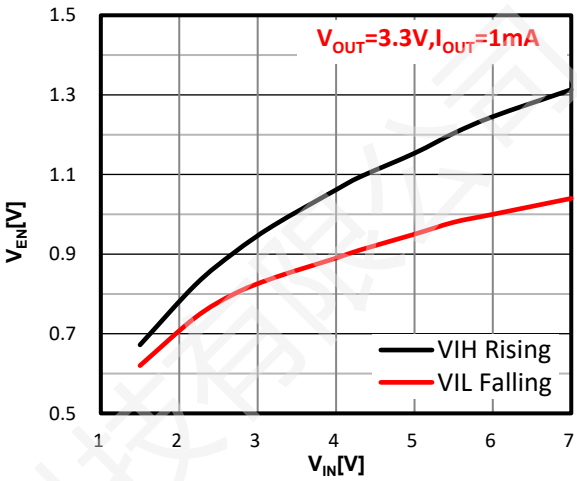


Figure 8. V_{EN} vs V_{IN}

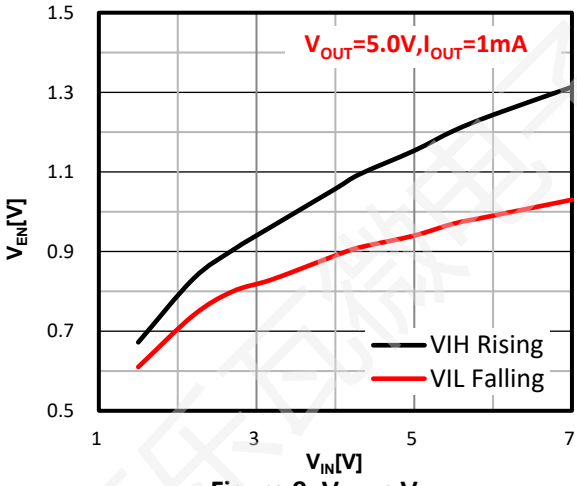


Figure 9. V_{EN} vs V_{IN}

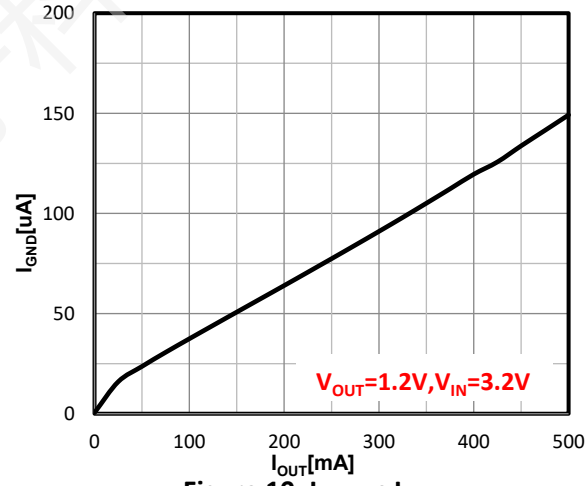


Figure 10. I_{GND} vs I_{OUT}

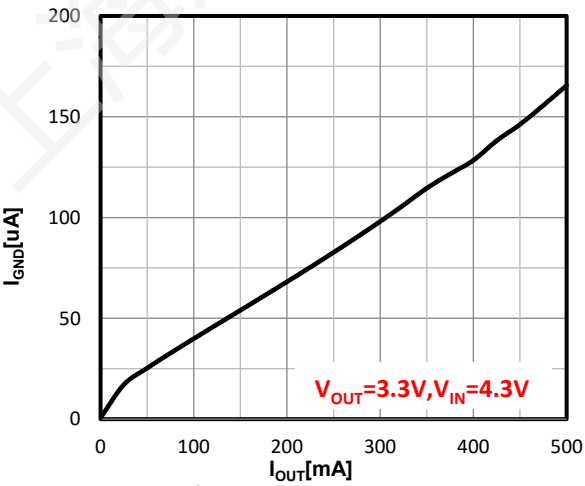


Figure 11. I_{GND} vs I_{OUT}

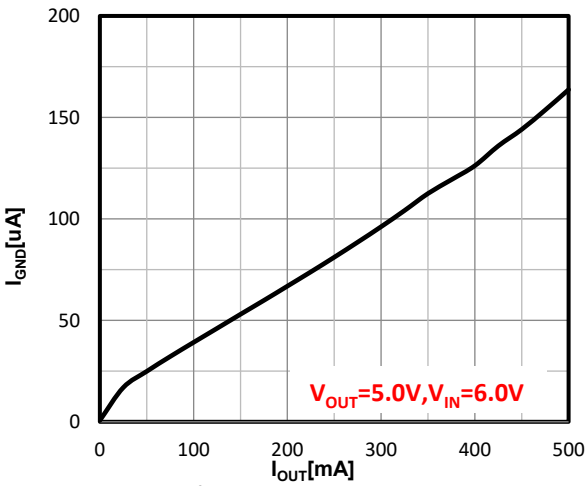


Figure 12. I_{GND} vs I_{OUT}

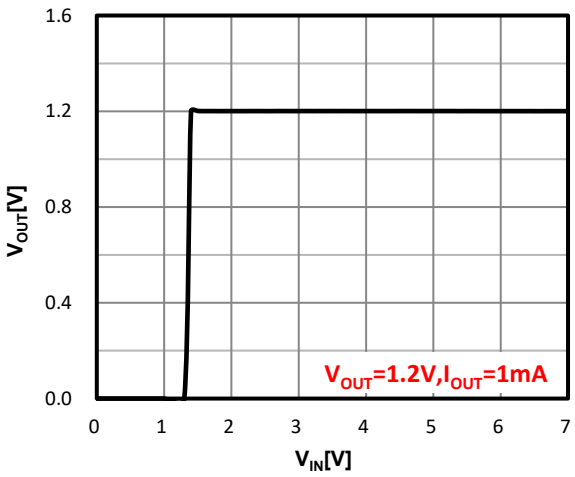


Figure 13. V_{OUT} vs V_{IN}

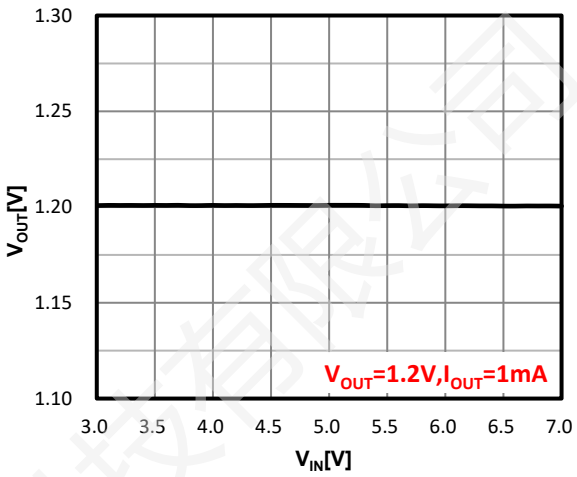


Figure 14. Line Regulation

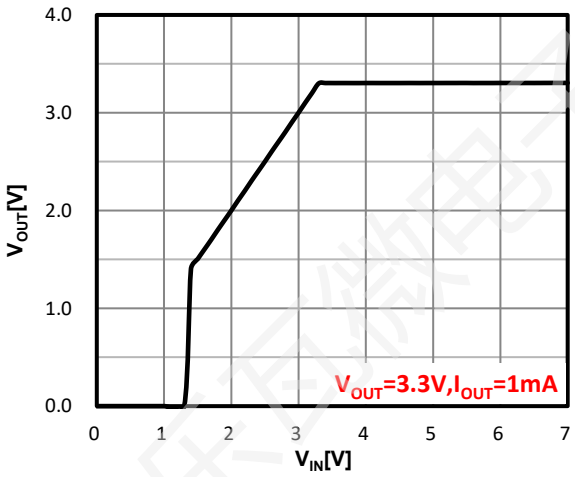


Figure 15. V_{OUT} vs V_{IN}

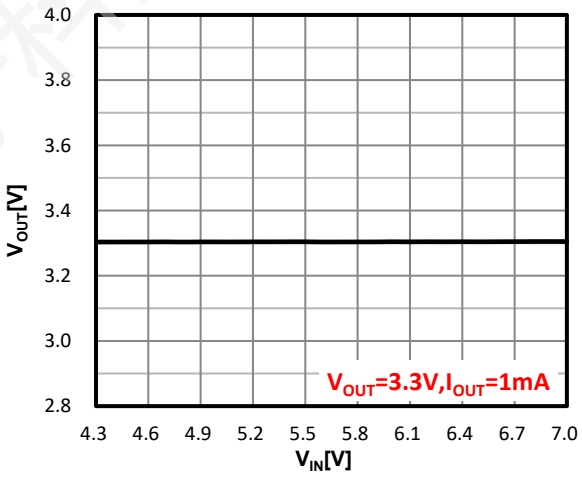


Figure 16. Line Regulation

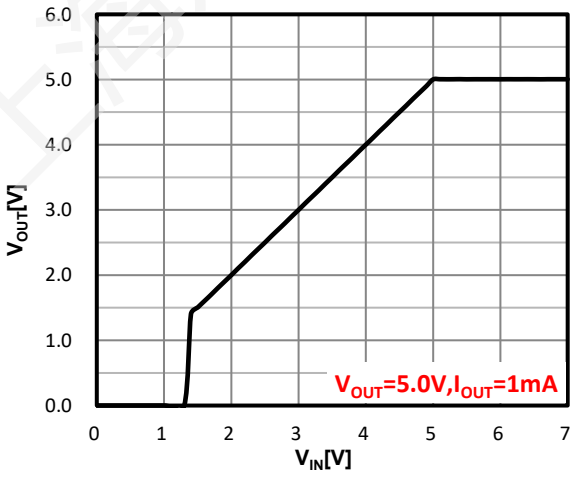


Figure 17. V_{OUT} vs V_{IN}

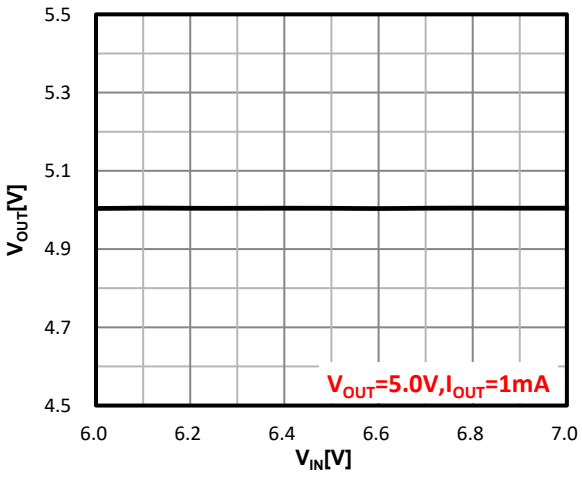


Figure 18. Line Regulation

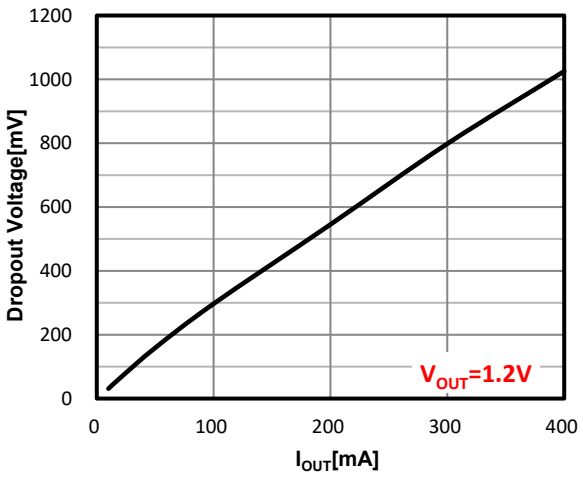


Figure 19. Dropout Voltage VS I_{OUT}

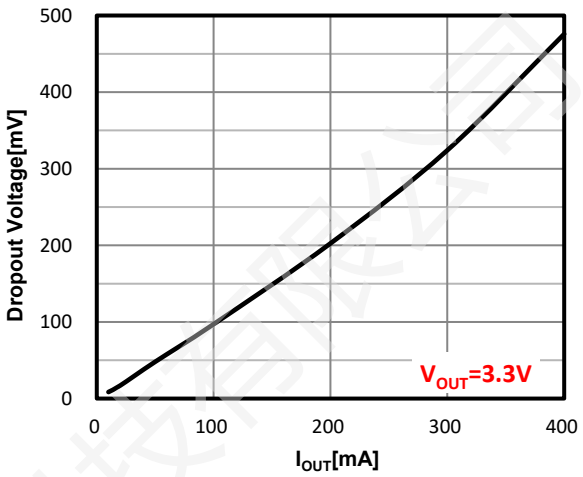


Figure 20. Dropout Voltage VS I_{OUT}

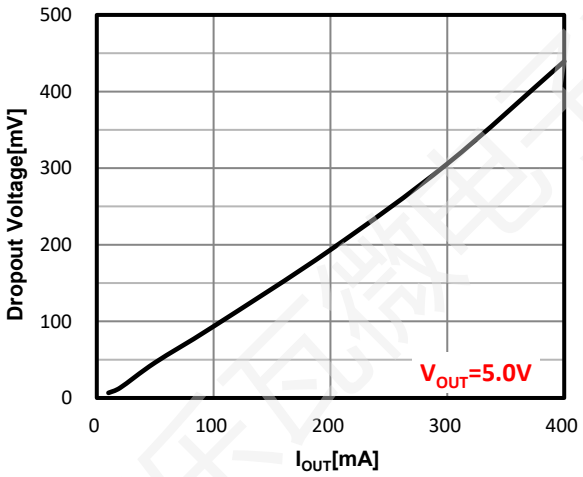


Figure 21. Dropout Voltage VS I_{OUT}

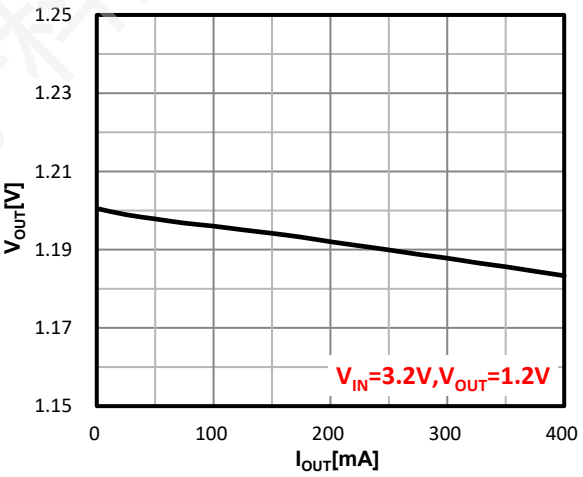


Figure 22. Load Regulation

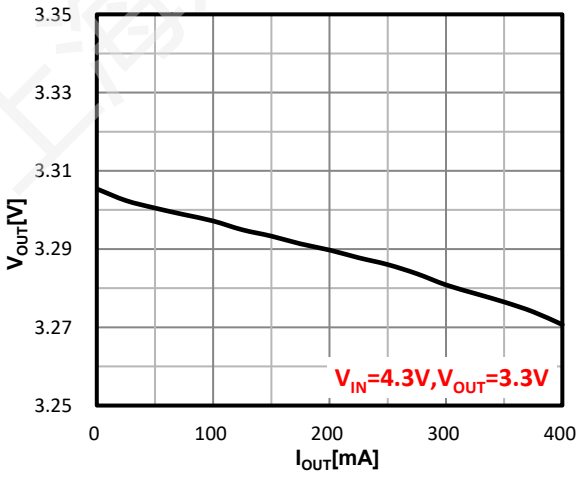


Figure 23. Load Regulation

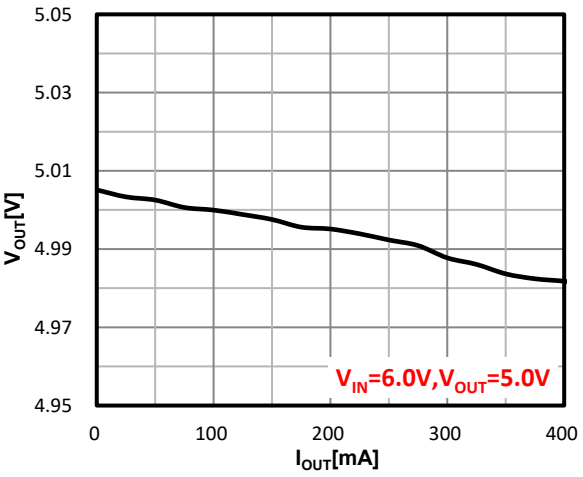
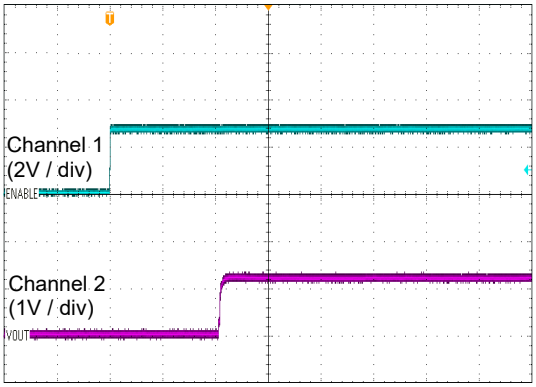


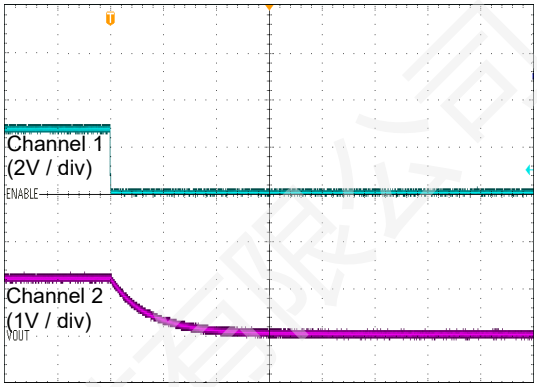
Figure 24. Load Regulation



Time (400 µs / div)

Channel 1 = En, channel 2 =V_{OUT}, V_{IN}=2.7V, EN=0→2.7V, V_{OUT}=1.2V, C_{IN}=C_{OUT}=1µF, No Load

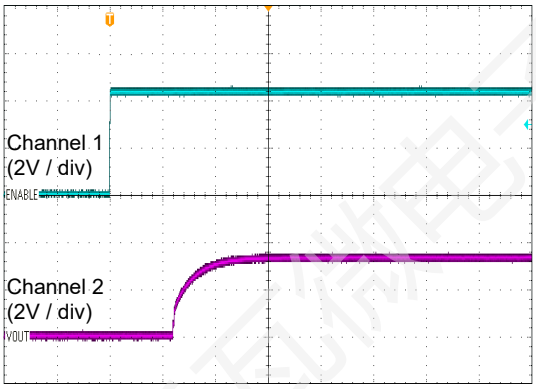
Figure 25. Power-Up with Enable



Time (400 µs / div)

Channel 1 = En, channel 2 =V_{OUT}, V_{IN}=2.7V, EN=2.7→0V, V_{OUT}=1.2V, C_{IN}=C_{OUT}=1µF, No Load

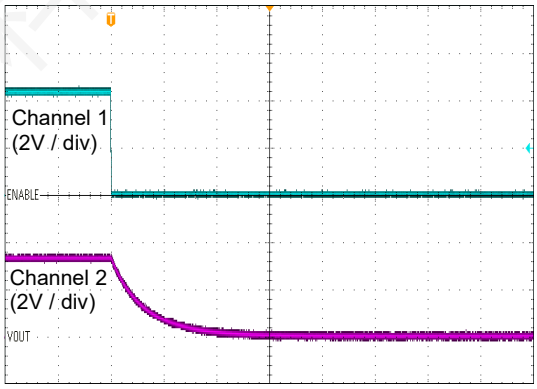
Figure 26. Shut-Down with Enable



Time (400 µs / div)

Channel 1 = En, channel 2 =V_{OUT}, V_{IN}=4.3V, EN=0→4.3V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=1µF, No Load

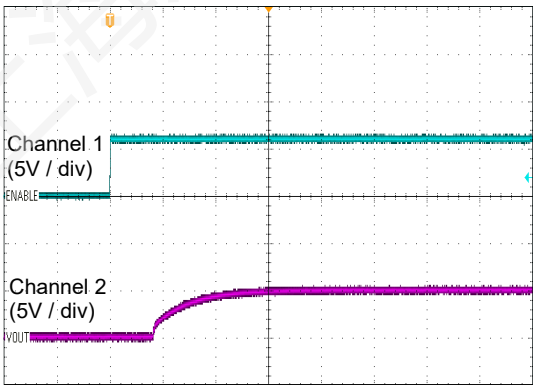
Figure 27. Power-Up with Enable



Time (400 µs / div)

Channel 1 = En, channel 2 =V_{OUT},V_{IN}=4.3V, EN=4.3→0V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=1µF, No Load

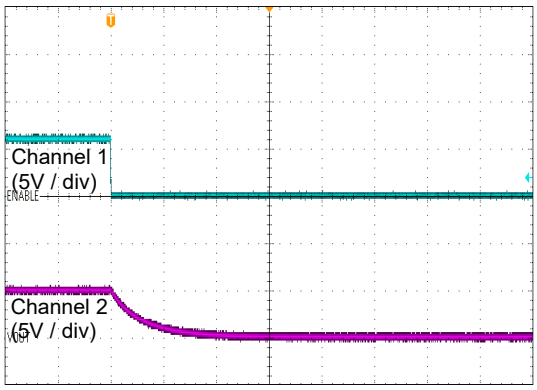
Figure 28. Shut-Down with Enable



Time (400 µs / div)

Channel 1 = En, channel 2 =V_{OUT}, V_{IN}=6.0V, EN=0→6.0V, V_{OUT}=5.0V, C_{IN}=C_{OUT}=1µF, No Load

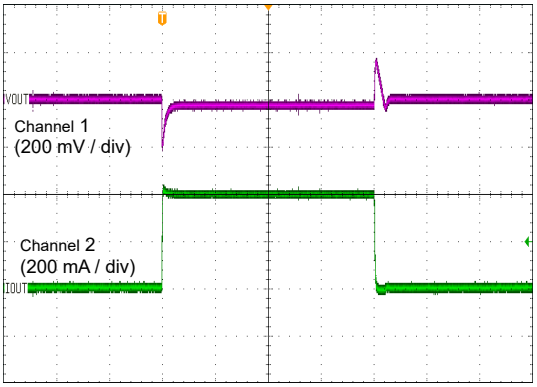
Figure 29. Power-Up with Enable



Time (400 µs / div)

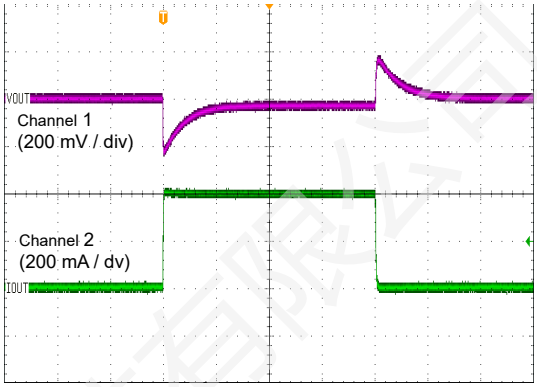
Channel 1 = En, channel 2 =V_{OUT}, V_{IN}=6.0V,EN=6.0→0V, V_{OUT}=5.0V, C_{IN}=C_{OUT}=1µF, No Load

Figure 30. Shut-Down with Enable



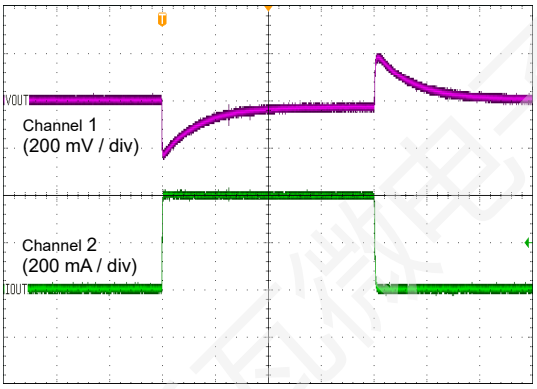
Channel 1 = V_{OUT}, channel 2 =I_{OUT}, V_{IN}=2.7V, V_{OUT}=1.2V
C_{IN}=C_{OUT}=1µF

Figure 31. Load Transient (1 mA → 400 mA)



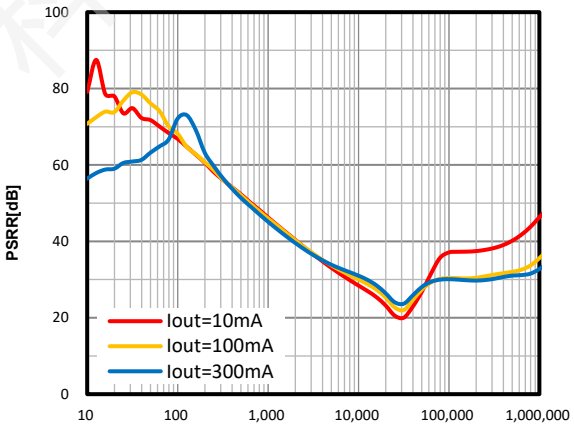
Channel 1 = V_{OUT}, channel 2 =I_{OUT}, V_{IN}=4.3V, V_{OUT}=3.3V
C_{IN}=C_{OUT}=1µF

Figure 32. Load Transient (1 mA → 400 mA)



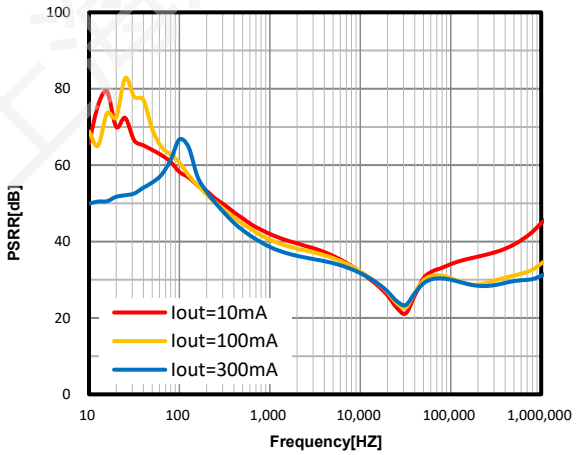
Channel 1 = V_{OUT}, channel 2 =I_{OUT}, V_{IN}=6.0V, V_{OUT}=5.0V
C_{IN}=C_{OUT}=1µF

Figure 33. Load Transient (1 mA → 400 mA)



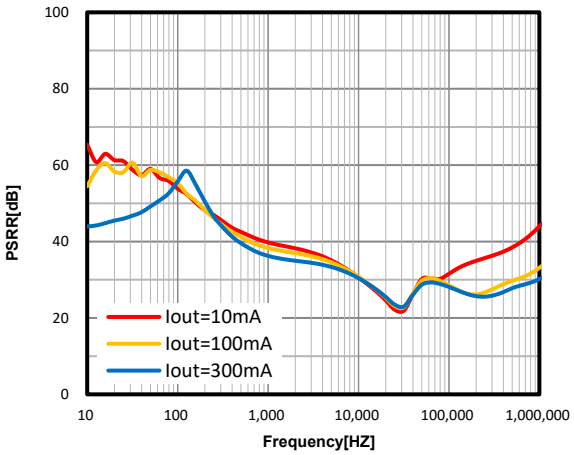
V_{OUT}=1.2V, V_{IN}=3.0V, V_{PP}=0.5V, C_{IN}=none,C_{OUT}=1µF

Figure 34. PSRR vs Frequency



V_{OUT}=3.3V, V_{IN}=4.3V, V_{PP}=0.5V, C_{IN}=none,C_{OUT}=1µF

Figure 35. PSRR vs Frequency



V_{OUT}=5.0V, V_{IN}=6.0V, V_{PP}=0.5V,C_{IN}=none,C_{OUT}=1µF

Figure 36. PSRR vs Frequency

APPLICATION INFORMATION:

- **Input Capacitor Selection**

Like any low-dropout regulator, the external capacitors used with the LW59XX Series must be carefully selected for regulator stability and performance. Using a capacitor whose value is ≥1μF on the LW59XX Series input and the amount of capacitance can be increased without limit. The input capacitor must be located a distance less than 0.5 inch from the input pin of the IC and returned to a clean analog ground. Any good quality ceramic or tantalum can be used for this capacitor. The capacitor with larger value and lower ESR (equivalent series resistance) provides better PSRR and line-transient response.

- **Output Capacitor Selection**

The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDOs application. The LW59XX Series is designed specifically to work with low ESR ceramic output capacitor in space-saving and performance consideration. Using a ceramic capacitor whose value is at least 1μF on the LW59XX Series output ensures stability. An appropriate output capacitor can reduce noise and improve load transient response and PSRR. The output capacitor should be located not more than 0.5 inch from the V_{OUT} pin of the LW59XX Series and returned to a clean analog ground.

- **Layout considerations**

To improve ac performance such as PSRR, output noise, and transient response, it is recommended that the PCB be designed with separate ground planes for VIN and VOUT, with each ground plane connected only at the GND pin of the device.

ORDER INFORMATION:

LW59①②③④⑤⑥

Designator	Item	Symbol	Description
①②	Output Voltage	08~50	e.g.2.8V→①=2,②=8
③④⑤⑥	Packages	N23C	SOT23
		N23D	SOT23-3L
		A23E	SOT23-5L
		NW2C	SOT-323
		NW5E	SOT-353
		N11E	DFN1x1-4L
		A89C	SOT89-3L(Type-A)

Part #	Output Voltage	Package	Shipping
LW5908N23C	0.8V	SOT23	3000 Pcs/ Tape & Reel
LW5912N23C	1.2V		
LW5915N23C	1.5V		
LW5918N23C	1.8V		
LW5920N23C	2.0V		
LW5925N23C	2.5V		
LW5928N23C	2.8V		
LW5930N23C	3.0V		
LW5933N23C	3.3V		
LW5936N23C	3.6V		
LW5942N23C	4.2V		
LW5950N23C	5.0V		
LW5908N23D	0.8V	SOT23-3L	3000 Pcs/ Tape & Reel
LW5912N23D	1.2V		
LW5915N23D	1.5V		
LW5918N23D	1.8V		
LW5920N23D	2.0V		
LW5925N23D	2.5V		
LW5928N23D	2.8V		
LW5930N23D	3.0V		
LW5933N23D	3.3V		
LW5936N23D	3.6V		
LW5942N23D	4.2V		
LW5950N23D	5.0V		

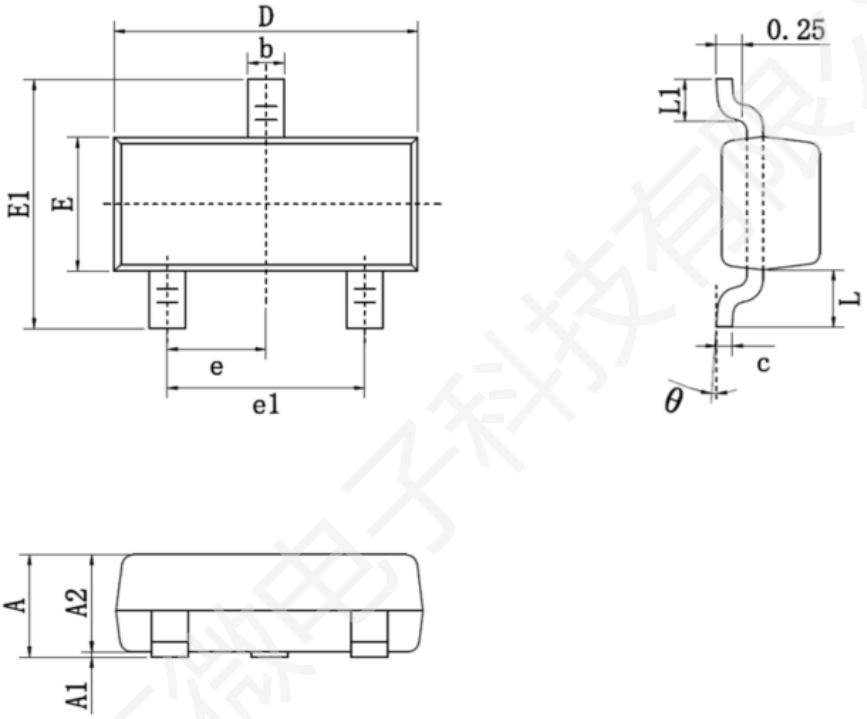
Part #	Output Voltage	Package	**Shipping**
LW5908A23E	0.8V	SOT23-5L	3000 Pcs/ Tape & Reel
LW5912A23E	1.2V		
LW5915A23E	1.5V		
LW5918A23E	1.8V		
LW5920A23E	2.0V		
LW5925A23E	2.5V		
LW5928A23E	2.8V		
LW5930A23E	3.0V		
LW5933A23E	3.3V		
LW5936A23E	3.6V		
LW5942A23E	4.2V		
LW5950A23E	5.0V		
LW5908NW2C	0.8V	SOT-323	3000 Pcs/ Tape & Reel
LW5912NW2C	1.2V		
LW5915NW2C	1.5V		
LW5918NW2C	1.8V		
LW5920NW2C	2.0V		
LW5925NW2C	2.5V		
LW5928NW2C	2.8V		
LW5930NW2C	3.0V		
LW5933NW2C	3.3V		
LW5936NW2C	3.6V		
LW5942NW2C	4.2V		
LW5950NW2C	5.0V		
LW5908NW5E	0.8V	SOT-353	3000 Pcs/ Tape & Reel
LW5912NW5E	1.2V		
LW5915NW5E	1.5V		
LW5918NW5E	1.8V		
LW5920NW5E	2.0V		
LW5925NW5E	2.5V		
LW5928NW5E	2.8V		
LW5930NW5E	3.0V		
LW5933NW5E	3.3V		
LW5936NW5E	3.6V		
LW5942NW5E	4.2V		
LW5950NW5E	5.0V		

Part #	Output Voltage	Package	**Shipping**
LW5908N11E	0.8V	DFN1x1-4L	10000 Pcs/ Tape & Reel
LW5912N11E	1.2V		
LW5915N11E	1.5V		
LW5918N11E	1.8V		
LW5920N11E	2.0V		
LW5925N11E	2.5V		
LW5928N11E	2.8V		
LW5930N11E	3.0V		
LW5933N11E	3.3V		
LW5936N11E	3.6V		
LW5942N11E	4.2V		
LW5950N11E	5.0V		
LW5908A89C	0.8V	SOT89-3L (Type-A)	1000 Pcs/ Tape & Reel
LW5912A89C	1.2V		
LW5915A89C	1.5V		
LW5918A89C	1.8V		
LW5920A89C	2.0V		
LW5923A89C	2.3V		
LW5925A89C	2.5V		
LW5928A89C	2.8V		
LW5930A89C	3.0V		
LW5933A89C	3.3V		
LW5936A89C	3.6V		
LW5942A89C	4.2V		
LW5950A89C	5.0V		

If customers have special output voltage requirements, please contact us.

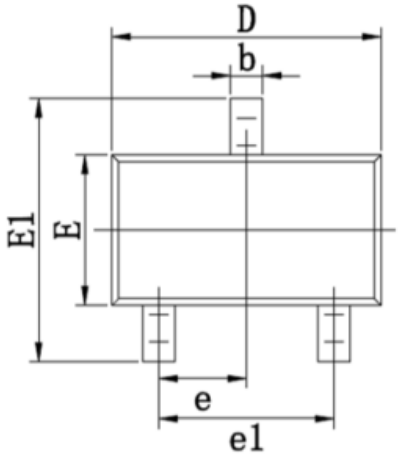
PACKAGE OUTLINE:

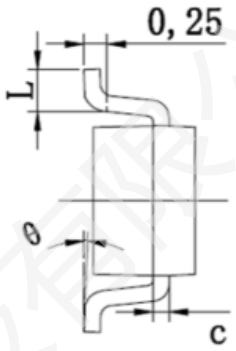
SOT23 Package

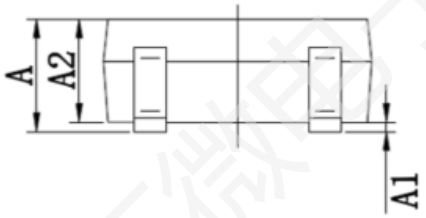


COMMON IN DIMENSION (MM)			
Symbol	Min.	Nom.	Max.
A	—	—	1.150
A1	0.000	—	0.100
A2	0.900	0.950	1.050
b	0.300	0.400	0.500
c	0.100	0.150	0.200
D	2.800	2.900	3.000
E	1.200	1.300	1.400
E1	2.250	2.400	2.550
e	0.950 TYP		
e1	1.800	1.900	2.000
L	0.550 REF		
L1	0.290	—	0.500

SOT23-3L Package

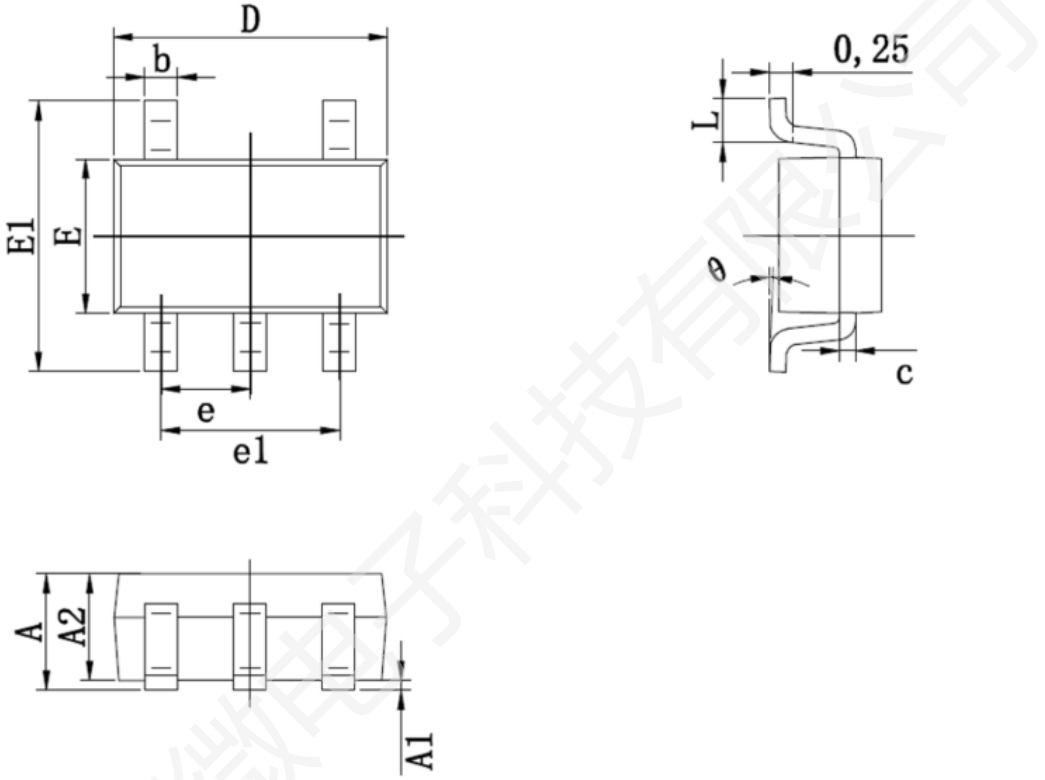






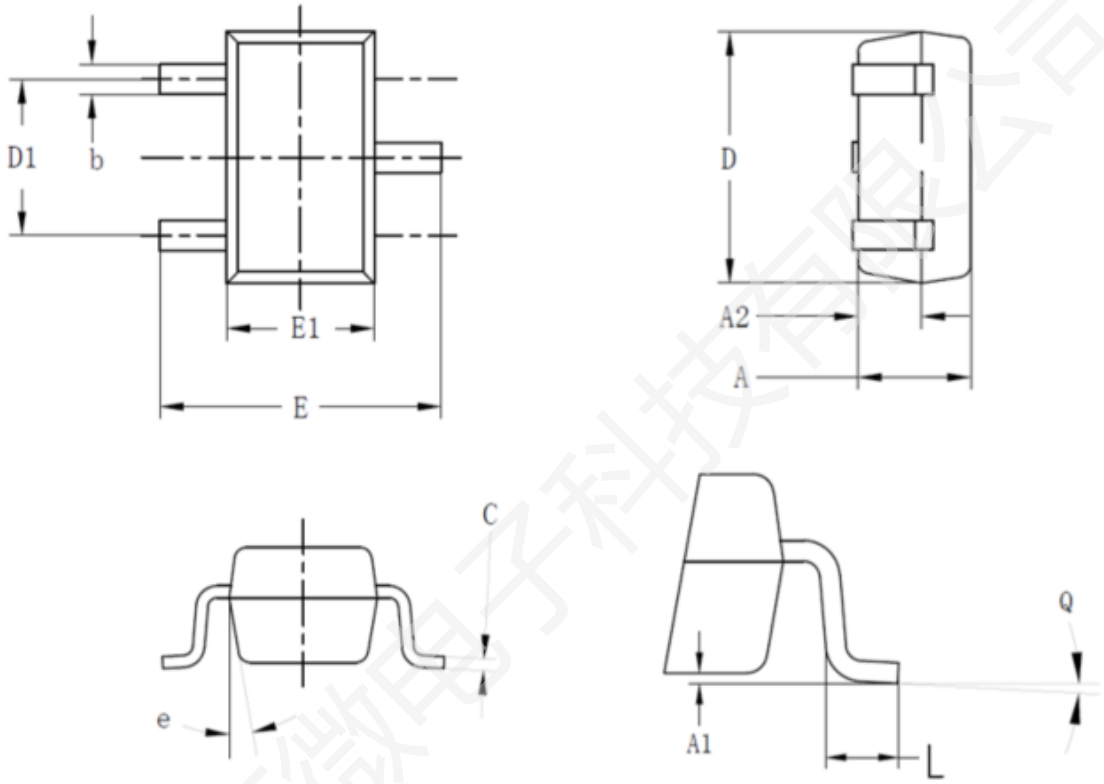
COMMON DIMENSION (MM)			
PKG	SOT23-3L		
Symbol	MIN	NOM	MAX
A	—	—	1.300
A1	0.010	—	0.150
A2	1.050	1.100	1.150
b	0.300	0.350	0.400
c	0.125	0.150	0.175
D	2.870	2.920	2.980
E	1.550	1.610	1.670
E1	2.650	2.850	3.000
e	0.95 BSC		
e1	1.800	1.900	2.000
L	0.300	0.450	0.600
θ	0°	4°	8°

SOT23-5L Package



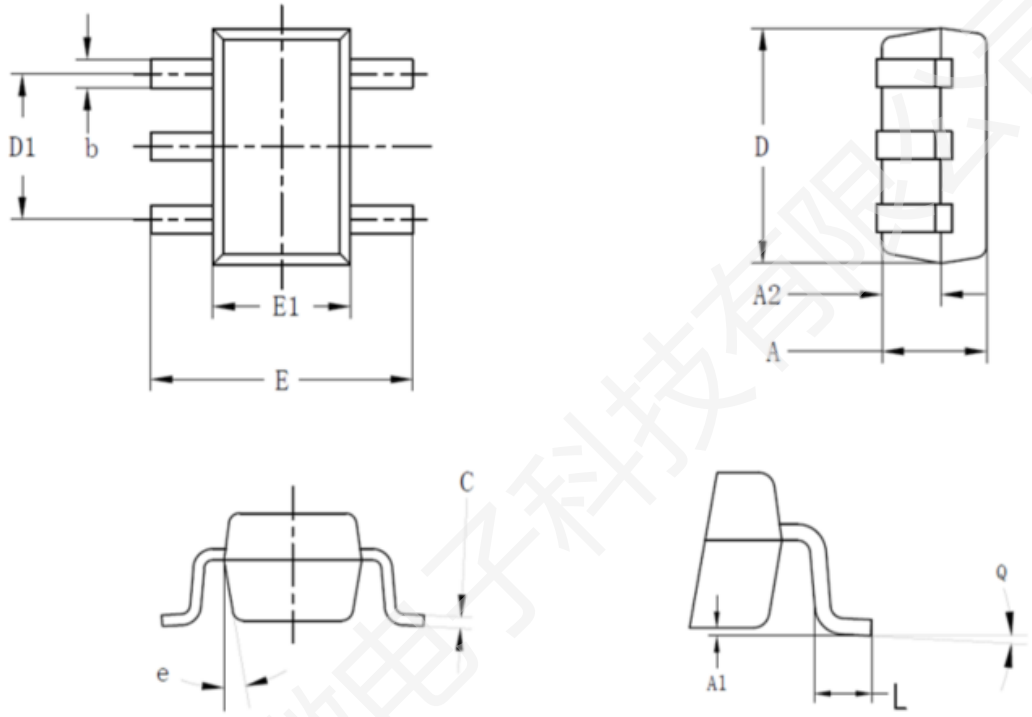
COMMON DIMENSION (MM)			
PKG	SOT23-5L		
Symbol	MIN	NOM	MAX
A	—	—	1.300
A1	0.010	—	0.150
A2	1.050	1.100	1.150
b	0.300	0.350	0.400
c	0.125	0.150	0.175
D	2.870	2.920	2.980
E	1.550	1.610	1.670
E1	2.650	2.850	3.000
e	0.95 BSC		
e1	1.800	1.900	2.000
L	0.300	0.450	0.600
θ	0°	4°	8°

SOT-323 Package



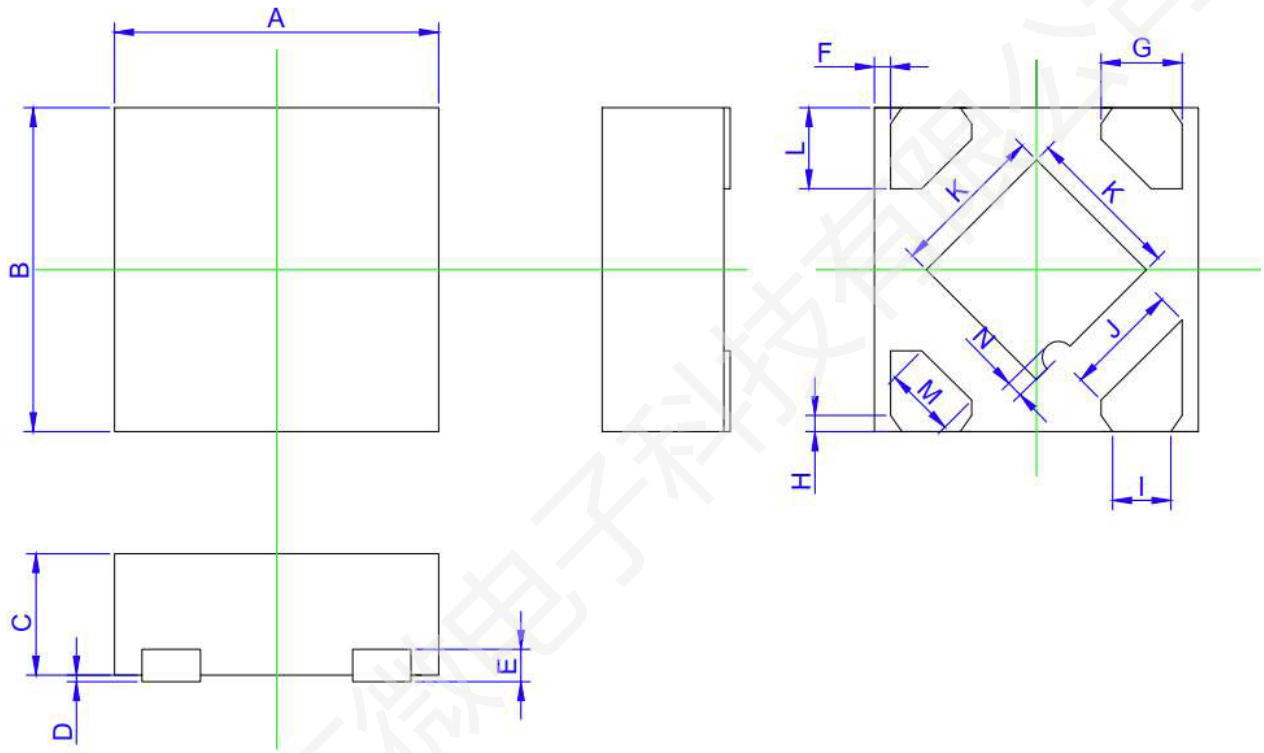
COMMON IN DIMENSION (MM)			
PKG	SOT-323		
Symbol	Min	Nom	Max
A	0.910	0.960	1.010
A1	0.010	0.060	0.150
A2	0.500	0.540	0.600
b	0.200	0.250	0.310
C	0.100	0.110	0.120
D	2.050	2.100	2.250
D1	1.250	1.300	1.350
E	2.300	2.400	2.500
E1	1.200	1.260	1.350
L	0.260	0.360	0.460
e	10°		
Q	0°	4°	8°

SOT-353 Package



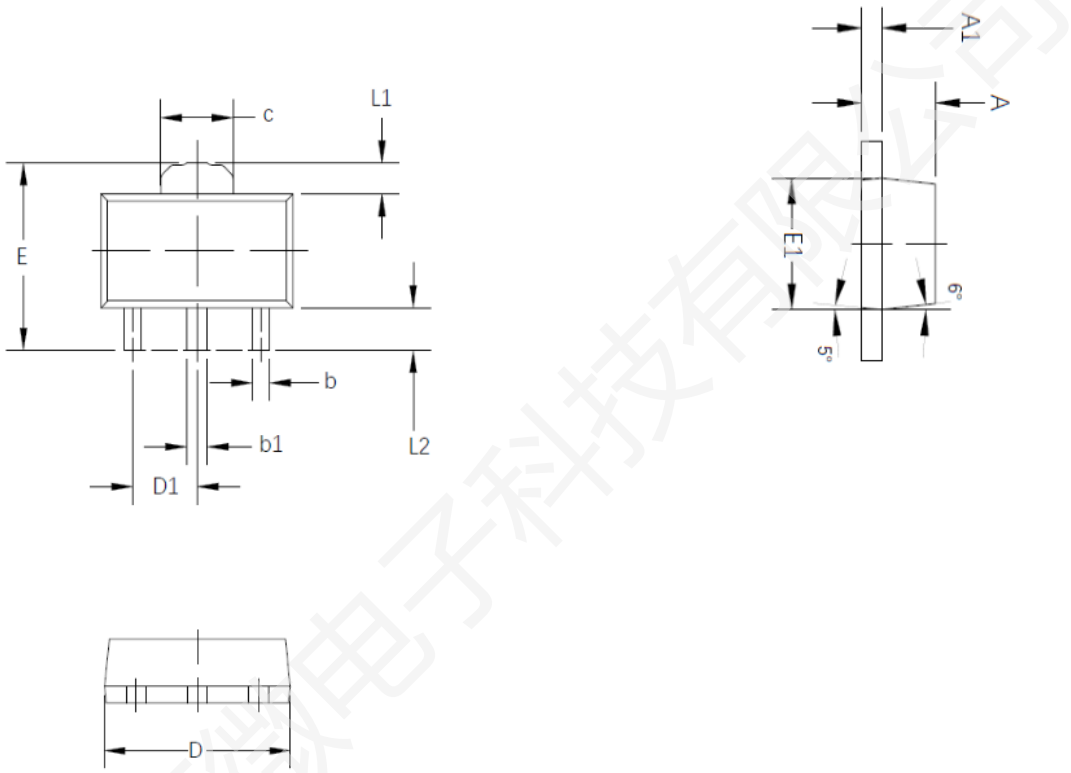
COMMON IN DIMENSION (MM)			
PKG	SOT-353		
Symbol	Min	Nom	Max
A	0.910	0.960	1.010
A1	0.010	0.060	0.150
A2	0.500	0.540	0.600
b	0.200	0.250	0.310
C	0.100	0.110	0.120
D	2.050	2.100	2.250
D1	1.250	1.300	1.350
E	2.300	2.400	2.500
E1	1.200	1.260	1.350
L	0.260	0.360	0.460
e	10°		
Q	0°	4°	8°

DFN1x1-4L Package



符号	标准	下公差	上公差	下限值	上限值
A	1.0	0.03	0.03	0.97	1.03
B	1.0	0.03	0.03	0.97	1.03
C	0.375	0.03	0.03	0.345	0.405
D	0.02	0.005	0.02	0.015	0.04
E	0.10REF				
F	0.05REF				
G	0.25REF				
H	0.05REF				
I	0.18REF				
J	0.34REF				
K	0.48REF				
L	0.25REF				
M	0.245REF				
N	0.06REF				

SOT89-3L Package



COMMON DIMENSION (MM)			
PKG	SOT89-3L		
Symbol	MIN	NOM	MAX
A	1.450	1.500	1.550
A1	0.350	0.400	0.450
b	0.350	0.430	0.500
b1	0.430	0.500	0.570
C	1.650	1.700	1.750
D	4.450	4.550	4.700
D1	1.470	1.500	1.550
E	4.100	4.200	4.300
E1	2.450	2.550	2.650
L1	0.630	0.700	0.770
L2	0.900	0.950	1.000

Revision History:

Revision	Date	Descriptions
Rev 1.0	Dec.2020	Initial Version
Rev 1.1	Apr.2021	Update Electrical Characteristics and Typical Operating Characteristics
Rev 1.2	May.2021	Update Typical Operating Characteristics Based on Mass Lot Data
Rev 1.3	Jan.2022	Redefine Order Information
Rev 1.4	Mar.2022	Update layout
Rev 1.5	Jun.2022	Adjust Typical Operating Characteristics 7-9
Rev 1.6	Aug.2022	Update Typical Operating Characteristics 10-15
Rev 1.7	Sep.2022	Adjust Order Information
Rev 1.8	Jun.2023	Update Typical Operating Characteristics
Rev 1.9	Jun.2024	Update New Packages
Rev 2.0	Sep.2025	Update New Packages
Rev 2.1	May.2026	Redraft the specification

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