300mA High Speed LDO Regulator with ON/OFF Switch

Features

- Maximum Output Current: 300mA
- Input Voltage Range: 1.6V~5.5V
- Dropout Voltage: 200mV @300mA, VOUT=3V
- Maximum Operating Voltage: 6V
- Output Voltage: 1.2V ~ 4.0V
  (Accuracy ±2%) 0.1V increments
- Low Power Consumption: 100μA (TYP.)
- Stand-by Current: 0.1uA
- High Ripple Rejection: 80dB@f=1kHz
- Current Limit Protection: 400mA
- Low ESR Capacitor: C_{IN}=1uF, C_L=1uF
  CE Function: Active High, CL High Speed Discharge
- Operating Ambient Temperature: -40℃~ +85℃
- Available in SOT-25J, SOT-353 and DFN1x1-4L Package
- EU ROHS Compliant, Pb Free

General Description

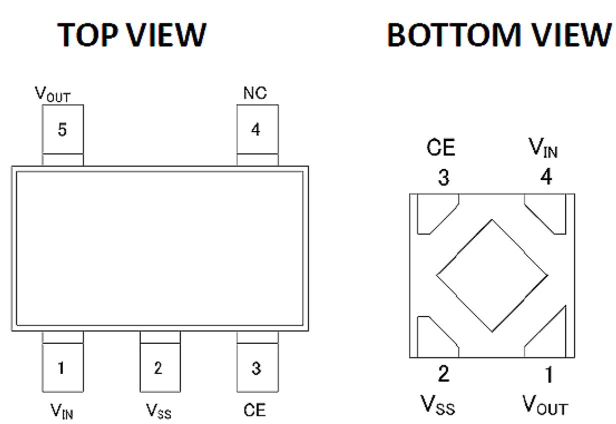
The LPL1228 series is a high speed LDO regulator that features high accurate, low noise, high ripple rejection, low dropout and low power consumption.

The series consists of a voltage reference, an error amplifier, a driver transistor, a current limiter, a phase compensation circuit. The CE function enables the circuit to be in stand-by mode by inputting low level signal. In the stand-by mode, the series enables the electric charge at the output capacitor CL to be discharged via the internal switch, and as a result the VOUT pin quickly returns to the VSS level. The output stabilization capacitor CL is also compatible with low ESR ceramic capacitors. The output voltage is selectable from 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.1V, 3.3V which fixed by laser trimming technologies. The over current protection circuit is built-in. This protection circuit will operate when the output current reaches current limit level.

Applications

- Mobile devices
- Wireless communications
- Modules
- Mobile phones

Pin Configuration



Typical Application Circuit

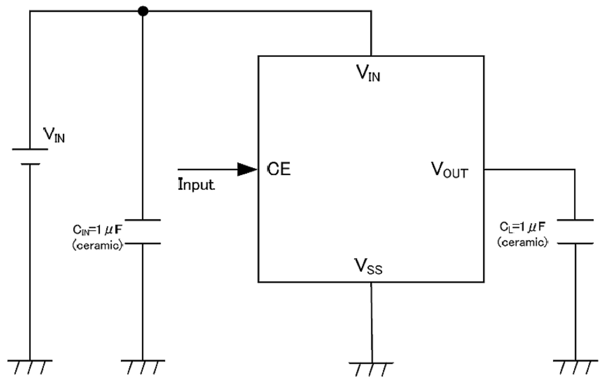


Figure.1 Typical Application Circuit

Pin Function Description

Pin#			Pin Name	Pin Description
DFN1x1-4L	SOT-353	SOT-25J		
1	5	5	V_{OUT}	Regulator output. Connecting a 1uF ceramic bypass capacitor between VOUT and GND.
2	2	2	V_{SS}	Ground.
3	3	3	CE	Chip On/Off Control. Tied H to Active and L to Stand-by. Default Internal Pull-Down Resistor to L.
4	1	1	V_{IN}	Power Supply Input. Connecting a 1uF ceramic bypass capacitor between VIN and GND to eliminate noise.
	4	4	NC	

Absolute Maximum Ratings

Parameter	RATINGS		UNITS
Input Voltage	V_{SS}-0.3～Vss+7.0		V
Output Current	500 (*1)		mA
Output Voltage	V_{SS}-0.3 ~ V_{IN} + 0.3		V
Power Dissipation	SOT-25J	200	mW
		500(40mm x 40mm Standard board) (*2)	
	SOT-353	150	
		500(40mm x 40mm Standard board) (*2)	
	DFN1x1-4L	100	
		550(40mm x 40mm Standard board) (*2)	
Operating Ambient Temperature	- 40 ~ + 85		℃
Storage Temperature	- 55 ~ + 125		℃

(*1) $I_{OUT} \leqq$ Pd / (VIN-VOUT)

(*2) The power dissipation figure shown is PCB mounted and is for reference only. As for the mounting condition, please refer to PACKAGING INFORMATION..

Electrical Characteristic

(T_A = 25℃, unless otherwise specified)

Parameter	Symbol	Test Conditions (*1)	Min	Typ	Max	Unit
Input Voltage	V_{IN}		1.6		5.0	V
Output Voltage	$V_{OUT(E)}$ (*1)	I_{OUT}=10mA, V_{CE}= VIN	$V_{OUT(T)}$ (*2) x0.98	$V_{OUT(T)}$ (*2)	$V_{OUT(T)}$ (*2) x1.02	V
Supply Current	I_{SS}	V_{CE}= V_{IN}	-	100	200	μA
Stand-by Current	I_{STB}	V_{CE}= V_{GND}	-	0.01	0.4	μA
Load Regulation	ΔV_{OUT}	V_{CE}= V_{IN}, 0.1mA≦I_{OUT}≦300mA	-	25	45	mV
Dropout Voltage	Vdif(*3)	V_{CE}= V_{IN}, I_{OUT}=300mA	-	E-1		mV
Power Supply Rejection Ratio	PSRR	$V_{OUT(T)}$<2.5V V_{IN}=3.0VDC+0.5VPPAC V_{CE}= V_{IN} +1.0V I_{OUT}=30mA, Freq=1kHz $V_{OUT(T)}$ ≧2.5V V_{IN}= {$V_{OUT(T)}$ +1.0} V_{DC}+0.5VPP_{AC} VCE= VIN +1.0V IOUT=30mA, Freq=1kHz	-	80	-	dB
Line Regulation	ΔV_{OUT}/ (ΔV_{IN}・V_{OUT})	$V_{OUT(T)}$+0.5V≦V_{IN}≦5.5V VCE= V_{IN}, I_{OUT}=50mA	-	0.01	0.1	%/V
Maximum Output Current	I_{OUTMAX}	V_{CE}= V_{IN}	300		-	mA
Current Limit	I_{LIM}	V_{CE}= V_{IN}	310	400	-	mA
Short Circuit Current	I_{SHORT}	V_{CE}= V_{IN}, V_{OUT} = V_{GND}		150		mA
CE High Level Voltage	V_{CEH}	-	1.0	-	5.5	V
CE High Level Voltage	V_{CEL}	-	0	-	0.3	V
CE High Level Current	I_{CEH}	V_{IN}= V_{CE}= 5.5V	3.0	5.5	9.0	μA
CE Low Level Current	I_{CEL}	V_{CE} = V_{GND}	-0.1	-	0.1	μA
Inrush Current (Type H)	I_{RUSH}	V_{IN}= 5.5V, V_{CE}= 0V→5.5V	-	150	-	mA
CL Discharge Resistance		V_{IN}= 5.5V, V_{OUT}= 2.0V, V_{CE}= V_{GND}		300		Ω
Output Voltage Temperature Characteristics	ΔV_{OUT}/ (ΔTopr*V_{OUT})	I_{OUT}=10mA, -40℃≦T_A≦85℃	-	±100	-	ppm/℃

NOTE:

(*1) $V_{OUT(E)}$: Effective output voltage.
(i.e. the output voltage when "$V_{OUT(T)}$+1.0V" is provided at the V_{IN} pin while maintaining a certain I_{OUT} value.)
(*2) $V_{OUT(T)}$: Nominal voltage.
(*3) Vdif =V_{IN1}(*2) -V_{OUT1}(*5), (V_{IN1}≧1.6V)
V_{OUT1}: A voltage equal to 98% of the output voltage whenever an amply stabilized {$V_{OUT(T)}$ + 1.0V} is input with each I_{OUT}.
V_{IN1}: The input voltage when V_{OUT1} appears as input voltage is gradually decreased.
(*4) V_{IN1}=The input voltage when V_{OUT1} appears as input voltage is gradually decreased.
(*5) V_{OUT1}=A voltage equal to 98% of the output voltage whenever an amply stabilized $V_{OUT(T)}$+1.0V is input for every I_{OUT}.
(*6) Unless otherwise stated regarding input voltage conditions, V_{IN}=$V_{OUT(T)}$＋1.0V.

OUTPUT VOLTAGE CHART

NOMINAL OUTPUT VOLTAGE (V)	OUTPUT VOLTAGE (±2%) (V)		DROPOUT VOLTAGE (mV) E-1	
VOUT(T)	VOUT(E)		Vdif	
	Min	Max	Min	Max
1.20	1.176	1.224	480	630
1.30	1.274	1.326	440	580
1.40	1.372	1.428	420	520
1.50	1.470	1.530	420	460
1.60	1.568	1.632	400	440
1.70	1.666	1.734		
1.80	1.764	1.836	300	410
1.90	1.862	1.938		
2.00	1.960	2.040	270	380
2.10	2.058	2.142		
2.20	2.156	2.244		
2.30	2.254	2.346		
2.40	2.352	2.448		
2.50	2.450	2.550	240	350
2.60	2.548	2.652		
2.70	2.646	2.754		
2.80	2.744	2.856		
2.90	2.842	2.958		
3.00	2.940	3.060	200	305
3.10	3.038	3.162		
3.20	3.136	3.264		
3.30	3.234	3.366		
3.40	3.332	3.468		
3.50	3.430	3.570		
3.60	3.528	3.672		
3.70	3.626	3.774		
3.80	3.724	3.876		
3.90	3.822	3.978		
4.00	3.920	4.080		

Functional Block Diagram

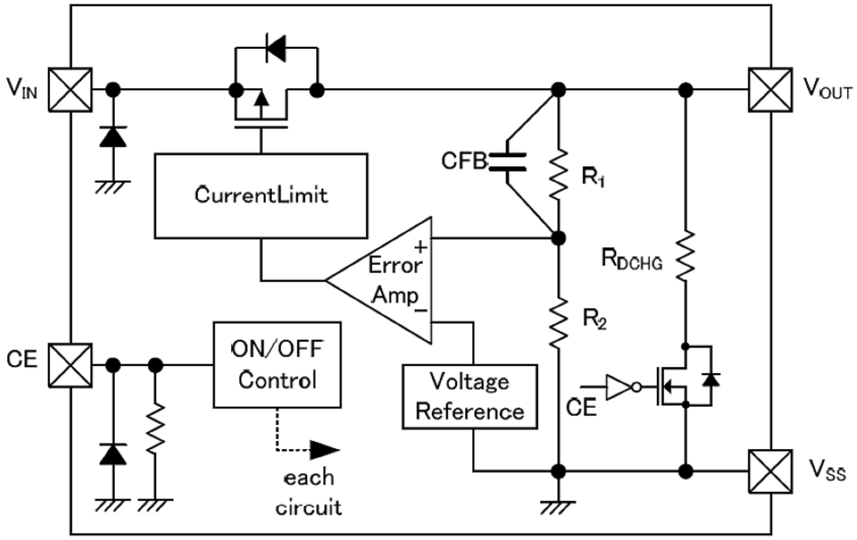


Figure.1 LPL1228D Functional Block Diagram

*Diodes inside the circuit are an ESD protection diode and a parasitic diode.

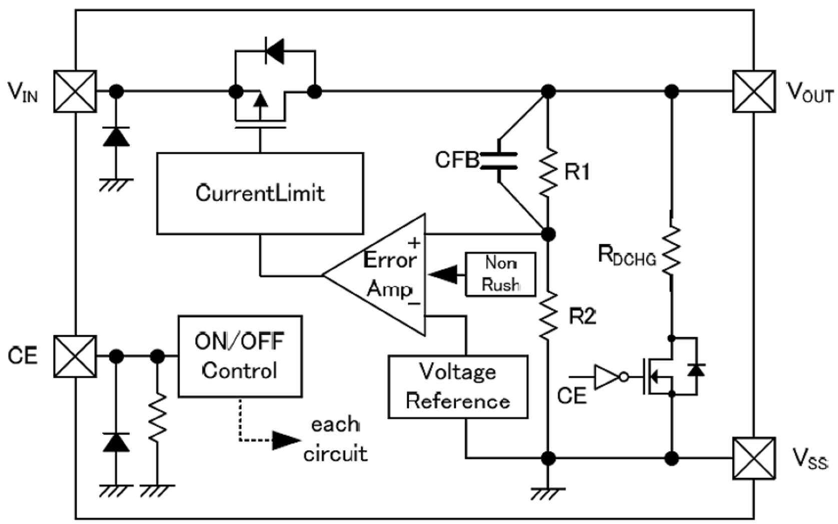


Figure. 3 LPL1228H Functional Block Diagram

*Diodes inside the circuit are an ESD protection diode and a parasitic diode.

PRODUCT CLASSIFICATION

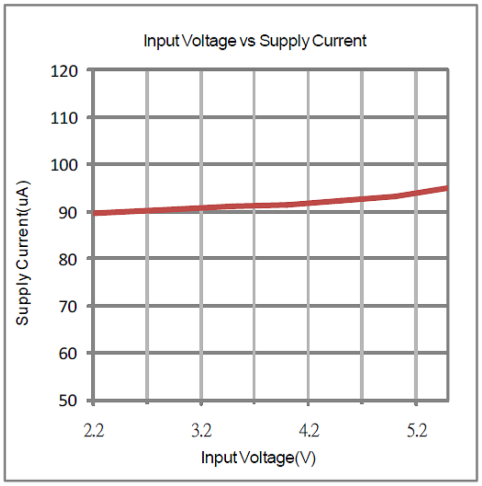
- Ordering Information
  LPL1228①②③④⑤

DESIGNATOR	CONTENTS	SYMBOL	DESCRIPTIONS
①	Regulator Type	D H	D:No Inrush Current Control H:Inrush Current Prevention Circuit Built-in
②③	VOUT	12～40	e.g. Vout:3.3v→33; 2.0v→20
④	Accuracy	2	2%
⑤⑥	Package （MOQ）	M5 S5 N4	SOT-25J(3,000pcs/Reel) SOT-353(3,000pcs/Reel) DFN1x1-4L(5,000pcs/Reel)

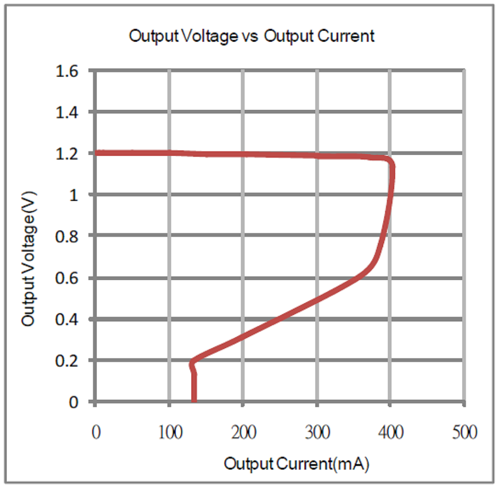
Typical Operating Characteristics

CIN = 1uF, CL = 1uF, TA = +25℃, VOUT=1.2V, unless otherwise noted.

IQ

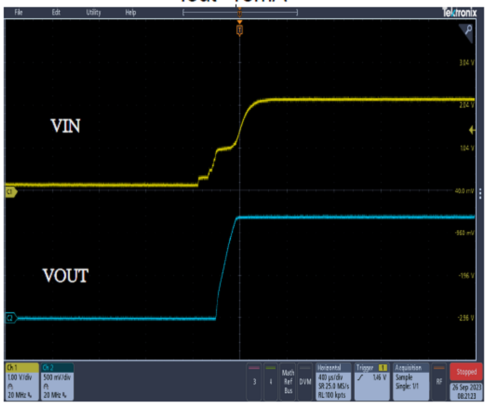


Current Fold Back



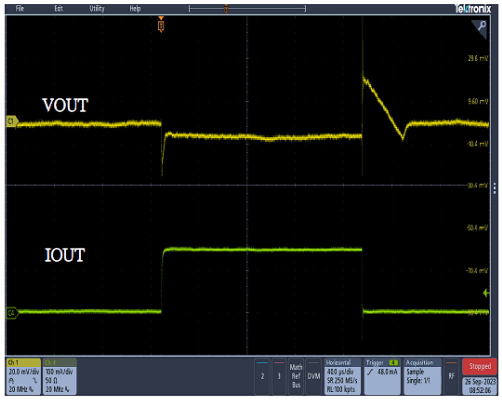
Start-up

Iout=10mA



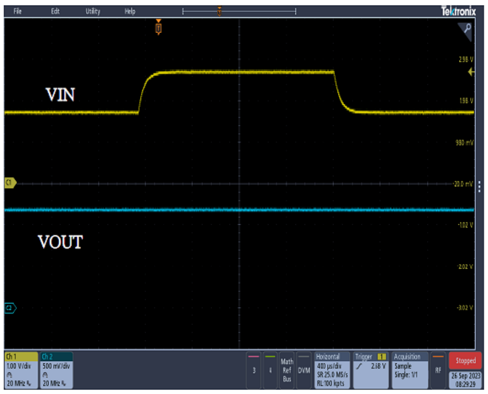
Dynamic loading

Vin=2.2V,Iout=1 to 150mA



Input Transient Response

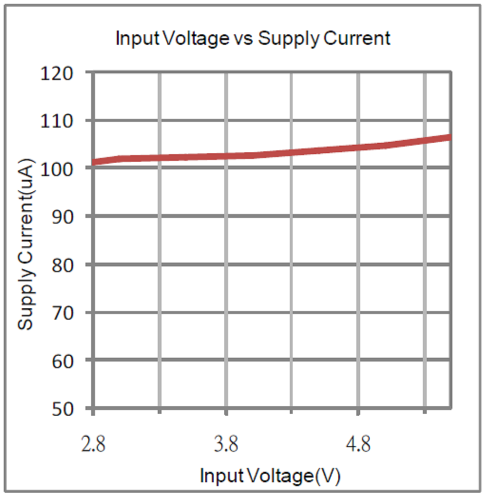
Iout=10mA



Typical Operating Characteristics

CIN = 1uF, CL = 1uF, TA = +25℃, VOUT=1.8V, unless otherwise noted.

IQ



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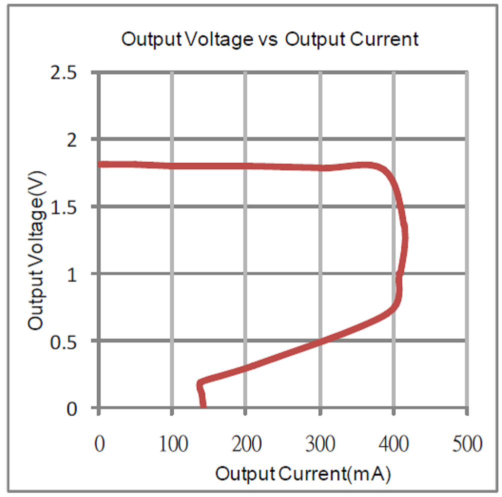
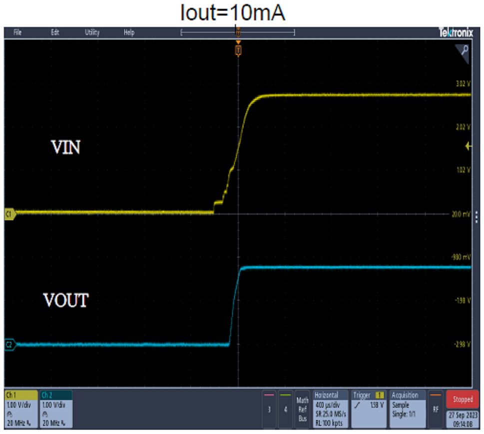


Start-up

Iout=10mA

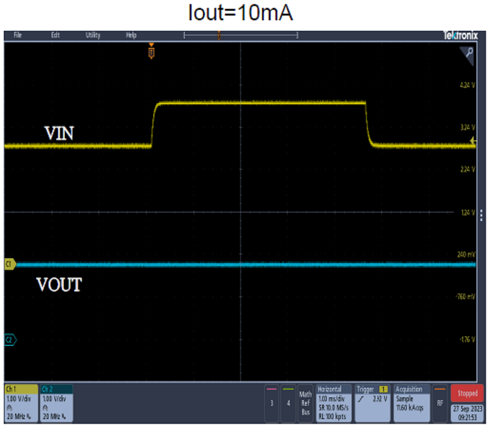


Dynamic loading

Vin=2.8V,Iout=1 to 150mA

Input Transient Response

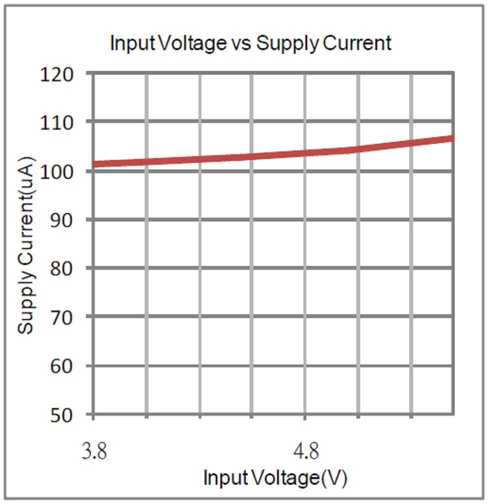
Iout=10mA



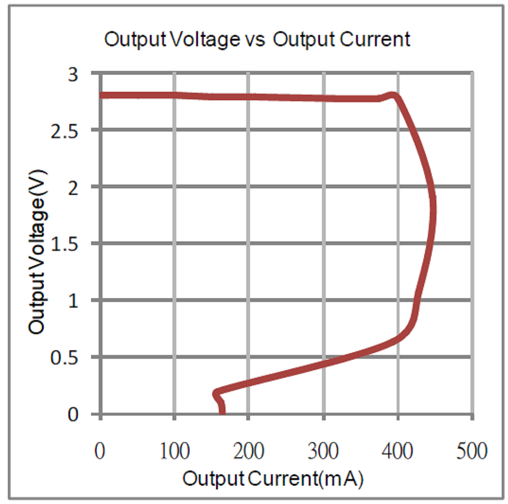
Typical Operating Characteristics

CIN = 1uF, CL = 1uF, TA = +25℃, VOUT=2.8V, unless otherwise noted.

IQ

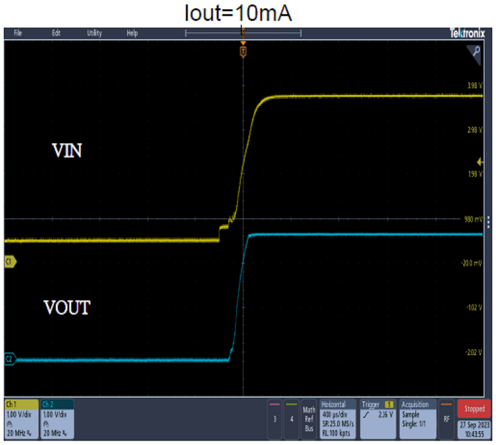


Current Fold Back



Start-up

Iout=10mA

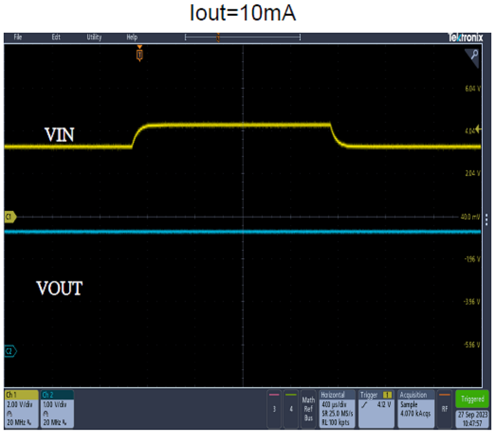


Dynamic loading

Vin=3.8V,Iout=1 to 150mA

Input Transient Response

Iout=10mA



Function Description:

From LPL1228 block diagram, the voltage divided by resistors R1 & R2 is compared with the internal reference voltage by the error amplifier. The P-channel MOSFET which is connected to the VOUT pin is then driven by the subsequent output signal. The output voltage at the VOUT pin is controlled and stabilized by a system of negative feedback. The current limit circuit and short circuit protection operate in relation to the level of output current and heat dissipation. Further, the IC's internal circuitry can be shutdown via the CE pin signal.

The LPL1228 series needs an output capacitor CL for phase compensation. Please place an output capacitor (CL) at the output pin (VOUT) and the ground pin (VSS) as close as possible. Please use the output capacitor (CL) is 1.0μF or larger. For a stable power input, please connect an input capacitor (CIN) of 1.0μF between the VIN pin and the VSS pin.

The LPL1228 has current limiter and droop shape of fold-back circuit. When the load current reaches the current limit, the droop current limiter circuit operates and the output voltage drops. When the output voltage dropped, the fold-back circuit operates and the output current goes to decrease. The output current finally falls at the level of 50mA when the output pin is short-circuited.

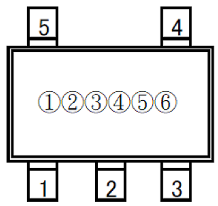
The IC's internal circuitry can be shutdown via the signal from the CE pin. In shutdown mode, the LPL1228 series enables the electric charge at the output capacitor (CL) to be discharged via the internal switch located between the VOUT and VSS pins, and as a result the VOUT pin quickly returns to the VSS level. The LPL1228 series has a pull-down resistor at the CE pin inside, so that the CE pin input current flows.

The inrush current protection circuit is built in the LPL1228H. When the IC starts to operate, the protection circuit limits the inrush current from input pin (VIN) to output pin (VOUT) to charge CL capacitor.

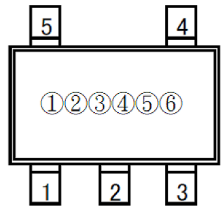
NOTES ON USE:

1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. Where wiring impedance is high, operations may become unstable due to the noise and/or phase lag depending on output current. Please strengthen VIN and VSS wiring in particular.
3. The input capacitor CIN and the output capacitor CL should be placed to the as close as possible with a shorter wiring.
4. The IC is controlled with constant current start-up. Start-up sequence control is requested to draw a load current after even nominal output voltage rising up the output voltage.
5. LFC places an importance on improving our products and its reliability. However, by any possibility, we would request user fail-safe design and post-aging treatment on system or equipment.

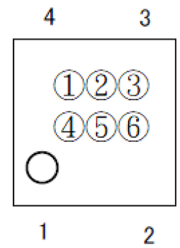
MARKING RULE



SOT-25J
(TOP VIEW)



SOT-353
(TOP VIEW)



DFN1x1-4L

① represents product number

Mark	Product Series
B	LPL1228H*****
D	LPL1228D*****

②③ represents output voltage

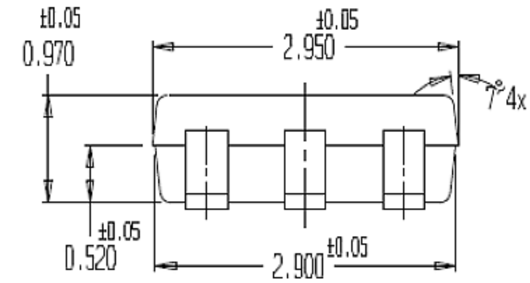
Mark	Vout (v)
12	12
15	1.5
18	1.8
25	2.5
28	2.8
30	3.0
33	3.3
36	3.6
50	5.0
XX	X.X

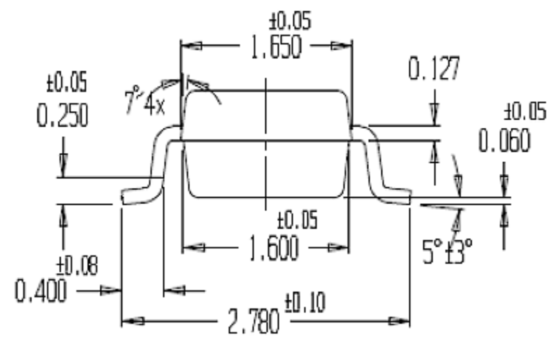
④⑤⑥represents production lot number

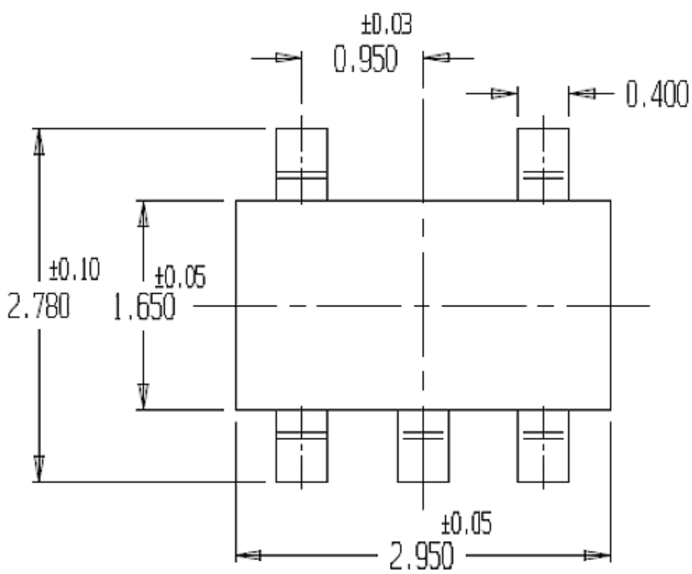
0 to 9, A to Z repeated.

Package Information

SOT-25J
UNIT: mm

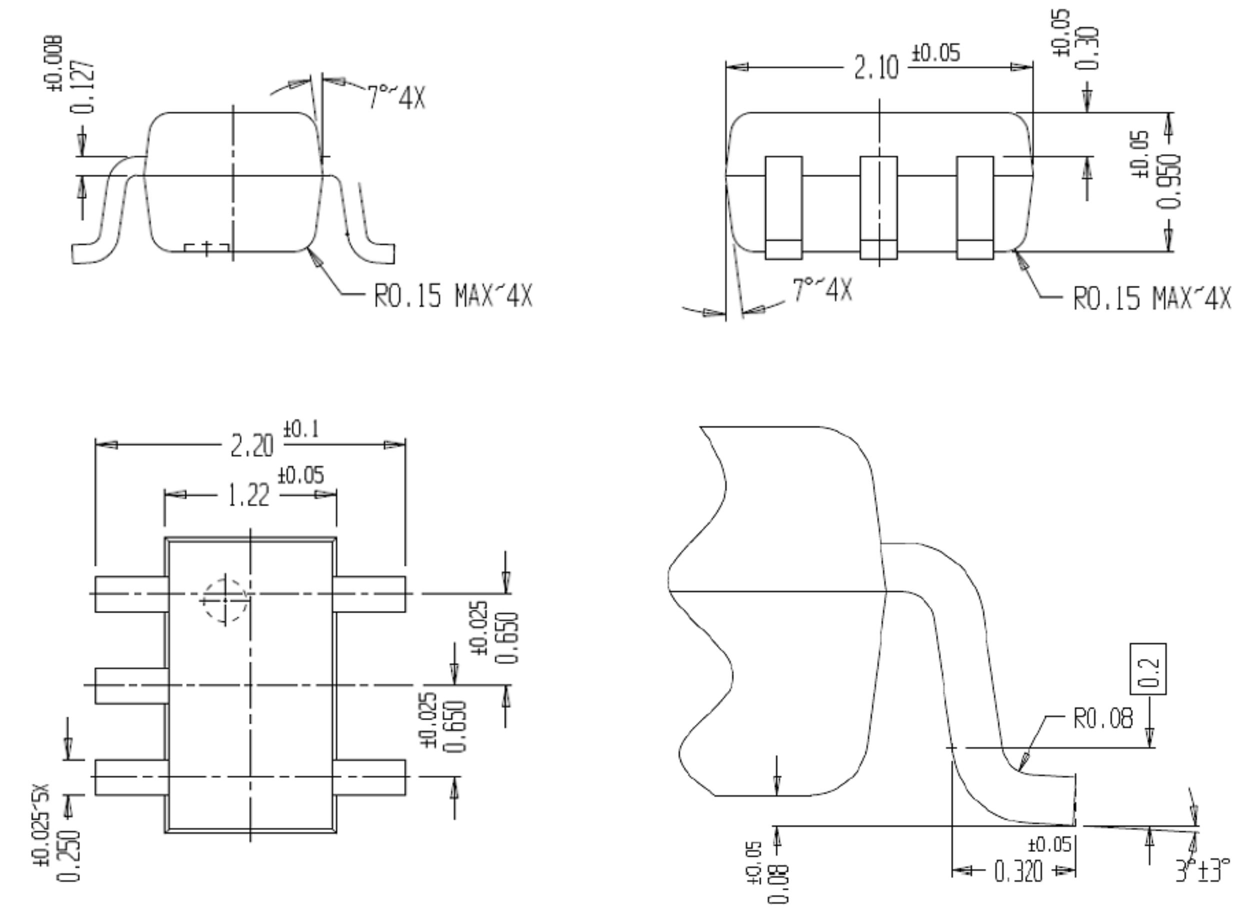






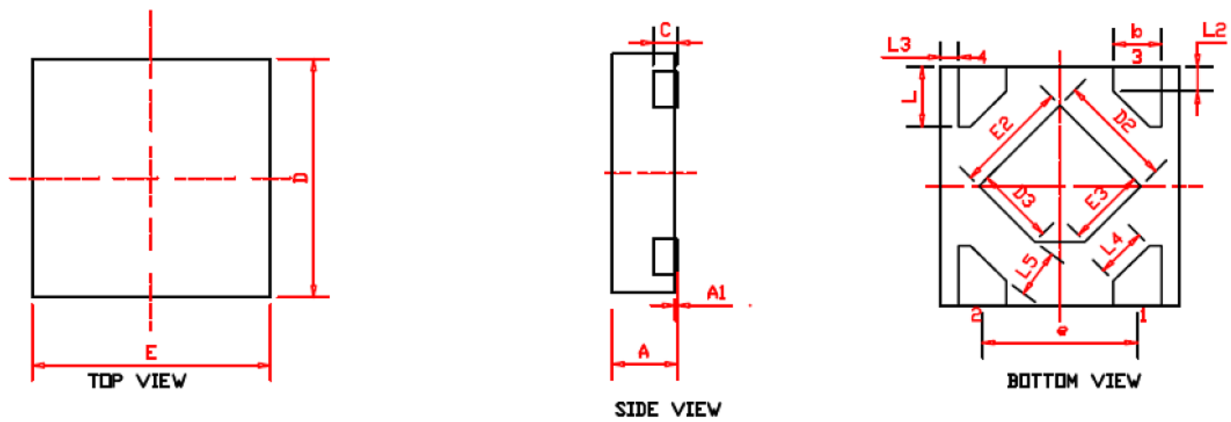
Package Information

SOT-354
UNIT: mm



Package Information

DFN1X1-4L



UNIT:MM

SYMBOLS	Min	Typ	Max
A	0.35	0.40	0.45
A1	0.00	0.02	0.05
C	0.127REF		
b	0.15	0.20	0.25
D	0.95	1.0	1.05
E	0.95	1.0	1.05
e	0.650 BSC		
D2	0.38	0.48	0.58
D3	0.23	0.33	0.43
E2	0.38	0.48	0.58
E3	0.23	0.33	0.43
L	0.20	0.25	0.30
L2	0.103REF		
L3	0.075REF		
L4	0.208REF		
L5	0.200REF		

1. The product and product specifications contained herein are subject to change without notice to improve performance characteristics. Consult us, or our representatives before use, to confirm that the information in this datasheet is up to date.

2. The information in this datasheet is intended to illustrate the operation and characteristics of our products. We neither make warranties or representations with respect to the accuracy or completeness of the information contained in this datasheet nor grant any license to any intellectual property rights of ours or any third party concerning with the information in this datasheet.

3. Applicable export control laws and regulations should be complied and the procedures required by such laws and regulations should also be followed, when the product or any information contained in this datasheet is exported.

4. The product is neither intended nor warranted for use in equipment of systems which require extremely high levels of quality and/or reliability and/or a malfunction or failure which may cause loss of human life, bodily injury, serious property damage including but not limited to devices or equipment used in 1) nuclear facilities, 2) aerospace industry, 3) medical facilities, 4) automobile industry and other transportation industry and 5) safety devices and safety equipment to control combustions and explosions. Do not use the product for the above use unless agreed by us in writing in advance.

5. Although we make continuous efforts to improve the quality and reliability of our products; nevertheless Semiconductors are likely to fail with a certain probability. So in order to prevent personal injury and/or property damage resulting from such failure, customers are required to incorporate adequate safety measures in their designs, such as system fail safes, redundancy and fire prevention features.

6. Our products are not designed to be Radiation-resistant.

7. Please use the product listed in this datasheet within the specified ranges.

8. We assume no responsibility for damage or loss due to abnormal use.

9.