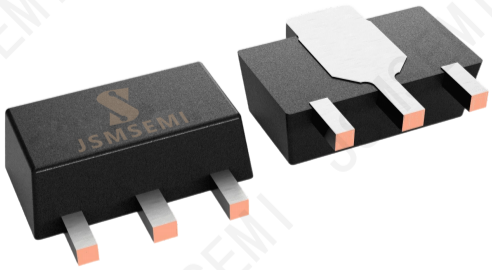
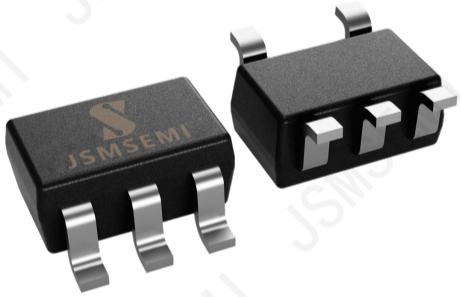
General Description

The LDK320A series are a group of low-dropout (LDO) voltage regulators offering the benefits of wide input voltage range, low dropout voltage, low power consumption, and miniaturized packaging. Quiescent current of only 1.5μA makes these devices ideal for powering the battery-powered, always-on systems that require very little idle-state power dissipation to a longer service life. There is a shutdown mode by pulling the EN pin low. The shutdown current in this mode goes down to only 100nA (typical).

The LDK320A series of linear regulators are stable with the ceramic output capacitor over its wide input range from 2V to 23V and the entire range of output load current (0mA to 500mA).





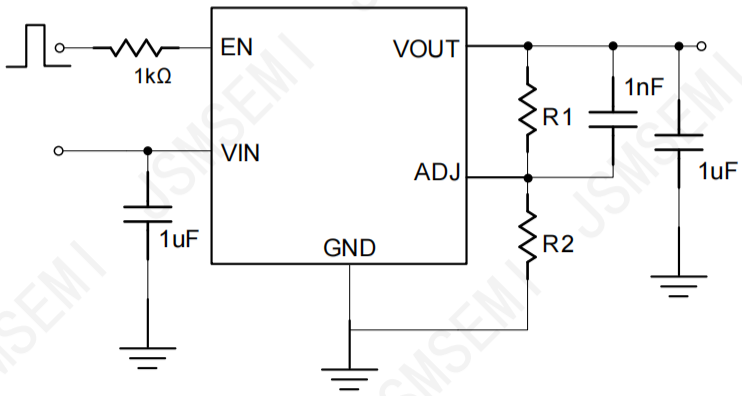
Features

- 1.5μA Ground Current at no Load
- ±1% Output Accuracy
- 500mA Output Peak Current
- 100nA Disable Current
- Wide Operating Input Voltage Range: 2V to 23V
- Dropout Voltage: 0.35V at 100mA / V_{OUT} 5V
- Support Fixed Output Voltage 1.8V, 2.5V, 3.0V, 3.3V, 5V
- Adjustable Output Voltage Available by Specific Application
- Stable with Ceramic or Tantalum Capacitor
- Current Limit Protection
- Over-Temperature Protection
- SOT-23-5 & SOT-89-3L Package Available

Applications

- Portable, Battery Powered Equipment
- Low Power Microcontrollers
- Laptop, Palmtops and PDAs
- Wireless Communication Equipment
- Audio/Video Equipment
- Car Navigation Systems
- Industrial Controls
- Weighting Scales

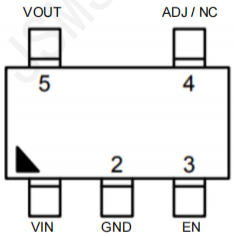
Simplified Schematic



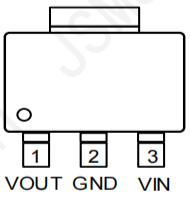
Notes : V_{OUT} = (R1 + R2) / R2 X 1.8V , And **R2 < 36KΩ** .

Description of Functional Pins

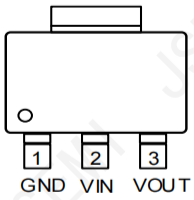
SOT-23-5



SOT-89-3(U)



SOT-89-3(UD)



Pin No			Pin Name	Pin Function
SOT-23-5	SOT-89-3 (U)	SOT-89-3 (UD)		
1	3	2	VIN	Input of Supply Voltage.
2	2	1	GND	Ground
3			EN	Enable Control Input.
4			NC/ADJ	Adjustable pin on ADJ version, not connected on fixed version.
5	1	3	VOUT	Output of the Regulator

Ordering Information

Order number	Package	Marking	Operation Temperature Range	MSL Grade	Ship,Quantity	Green
LDK320AM-R-JSM	SOT-23-5L	AAED	-40 to 85°C	3	TR&3000	Rohs
LDK320AM18R-JSM	SOT-23-5L	AADW	-40 to 85°C	3	TR&3000	Rohs
LDK320AM25R-JSM	SOT-23-5L	AAGU	-40 to 85°C	3	TR&3000	Rohs
LDK320AM30R-JSM	SOT-23-5L	AAFR	-40 to 85°C	3	TR&3000	Rohs
LDK320AM33R-JSM	SOT-23-5L	AAEU	-40 to 85°C	3	TR&3000	Rohs
LDK320AM50R-JSM	SOT-23-5L	AADX	-40 to 85°C	3	TR&3000	Rohs
LDK320ADU18R-JSM	SOT-89-3L	AA**	-40 to 85°C	3	TR&1000	Rohs
LDK320ADU25R-JSM	SOT-89-3L	AA**	-40 to 85°C	3	TR&1000	Rohs
LDK320ADU30R-JSM	SOT-89-3L	AAFU	-40 to 85°C	3	TR&1000	Rohs
LDK320ADU33R-JSM	SOT-89-3L	AAEY	-40 to 85°C	3	TR&1000	Rohs
LDK320ADU50R-JSM	SOT-89-3L	AAF1	-40 to 85°C	3	TR&1000	Rohs
LDK320AU50R-JSM	SOT-89-3L	AAFP	-40 to 85°C	3	TR&1000	Rohs

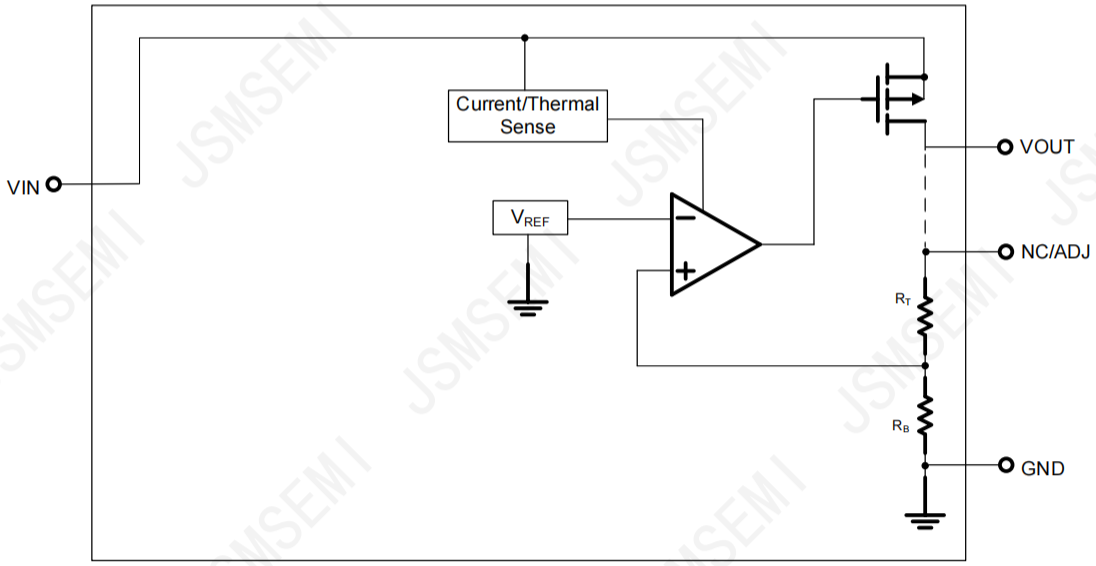
Absolute Maximum Ratings

Symbol	Definition		MIN.	MAX.	Units
VIN	DC input voltage		-0.3	28	V
VOUT	VOUT to GND		-0.3	6.5	V
	VOUT to VIN		-27	0.3	V
T_S	Storage Temperature		-40	125	°C
T_A	Operating Temperature		-40	85	°C
T_J	Junction Temperature		-	150	°C
Rth_{JA}	Thermal Resistance, Junction to Ambient	SOT-23-5L	-	220	°C/W
		SOT-89-3L	-	150	
T_L	Lead Temperature (Soldering, 10s)		-	260	°C

ESD rating

Symbol	Definition	MIN.	MAX.	Units
ESD	HBM Model		2000	V
	Machine Model		200	V

Function Block Diagram



Electrical Characteristics

(V_{IN} =12V, V_{EN} =5V, T_A=25°C unless otherwise specified)

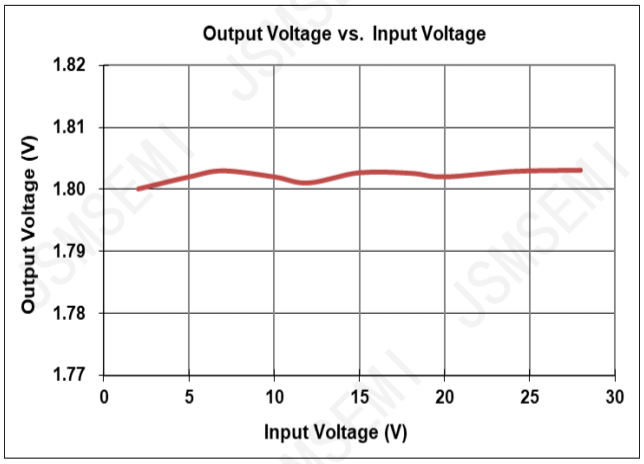
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{IN}		2		23	V
DC Output Voltage Accuracy		I_{LOAD} = 0.1mA	-1		1	%
Dropout Voltage (I_{LOAD} =100mA)	V_{DROP}	V_{OUT} ≥ 5V		0.35		V
	$V_{DROP_3.3V}$	V_{OUT} = 3.3V		0.42		
	$V_{DROP_1.8V}$	V_{OUT} = 1.8V		0.5		
Ground Current (I_{LOAD} = 0mA) (Note 3)	I_Q	V_{IN} > V_{OUT}		1.5		μA
Shutdown Ground Current	I_{SD}	V_{EN} = 0V, V_{OUT} = 0V		0.1	0.5	μA
ADJ Input Current	I_{ADJ}	ADJ = V_{OUT} V_{OUT} ≤ 5V		0.7		μA
Enable Threshold Voltage	V_{IH}	EN Rising	1.1			V
	V_{IL}	EN Falling			0.4	
EN Input Current	I_{EN}	V_{EN} = 23V		10	100	nA
Line Regulation	ΔLINE	I_{LOAD} = 1mA, 10V ≤ V_{IN} ≤ 20V	--	0.5		%
Load Regulation	ΔLOAD	10mA ≤ I_{LOAD} ≤ 0.2A		0.3		%
Output Peak Loading Current	I_{OUT}	V_{IN} = V_{OUT} + 1.8V		500		mA
Output Current Limit	I_{LIM}	V_{OUT} = 0V	501	700		mA
Power Supply Rejection Ratio	PSRR	V_{OUT} = 5V, I_{LOAD} = 30mA, V_{IN} = 12V, f = 1KHz		70		dB
Thermal Shutdown Temperature	T_{SD}	I_{LOAD} = 10mA	--	160	--	°C
Thermal Shutdown Hysteresis	ΔT_{SD}			15		°C

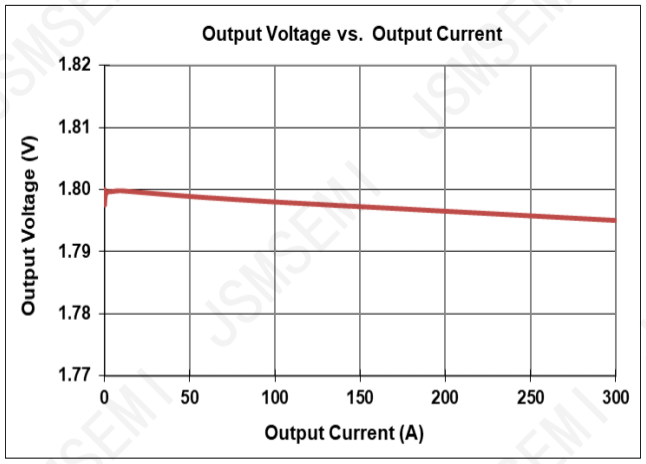
Note 1. Stresses beyond those listed "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

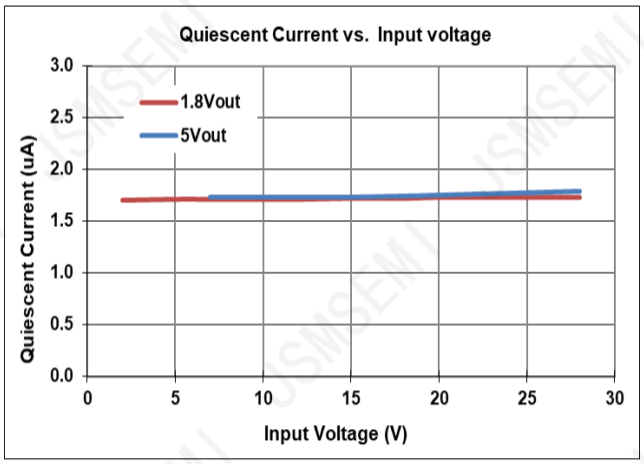
Note 2. θ_{JA} is measured at T_A = 25°C on a JSMSEMI EVB board.

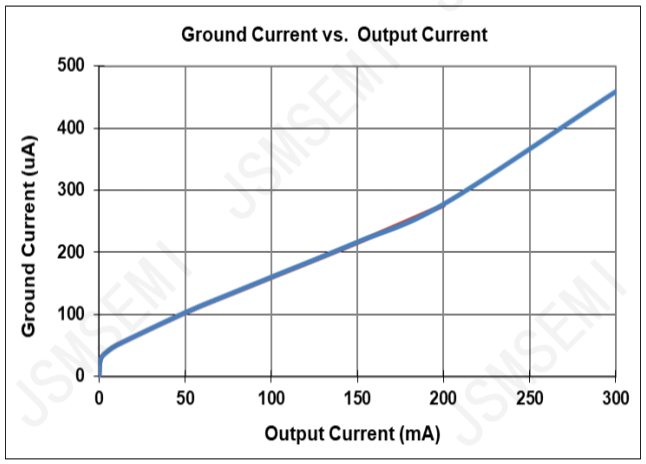
Note 3. When V_{IN} > V_{OUT}, the quiescent current is the normal specification value, but when V_{IN} ≤ V_{OUT}, the quiescent current will be greater than the specification value.

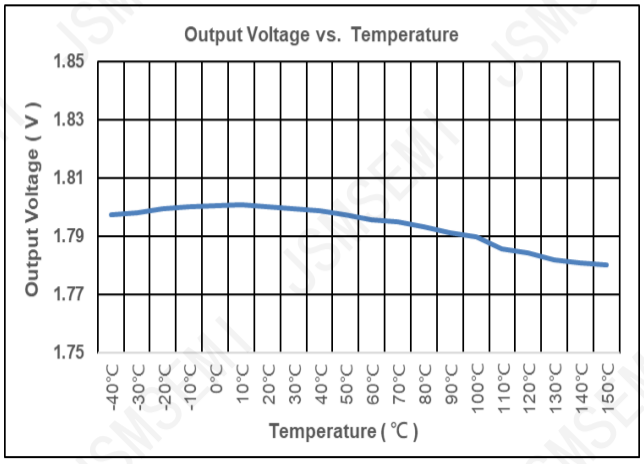
Typical Characteristics

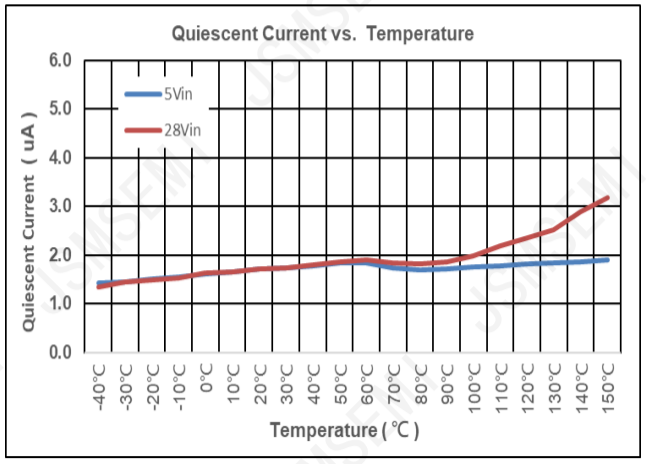


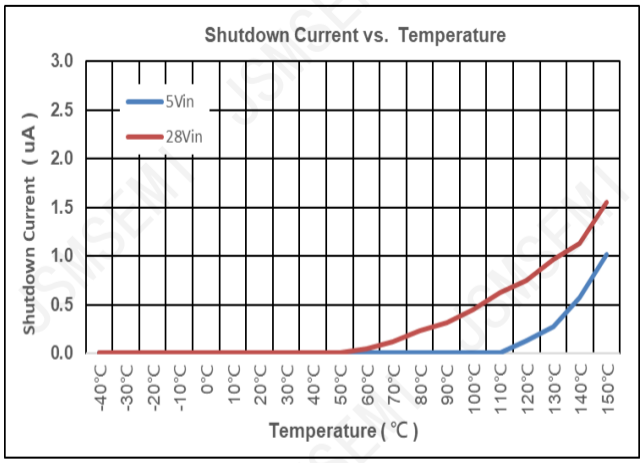




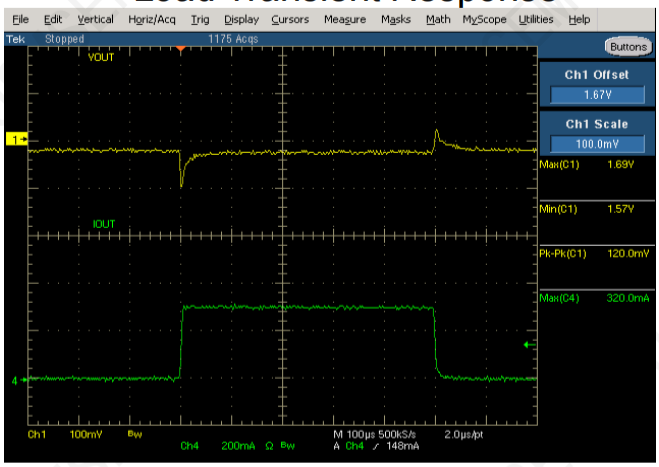




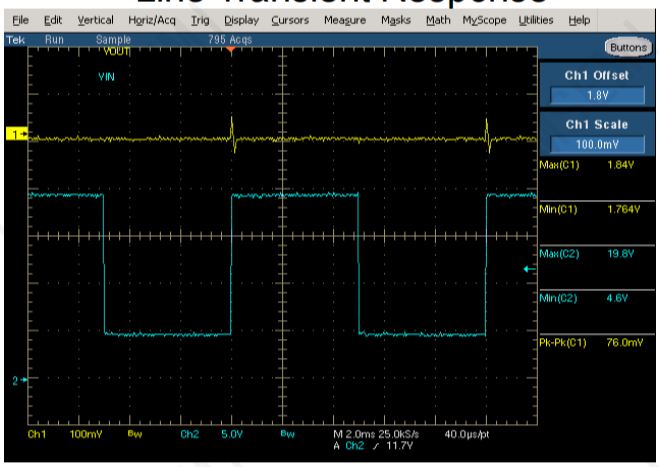




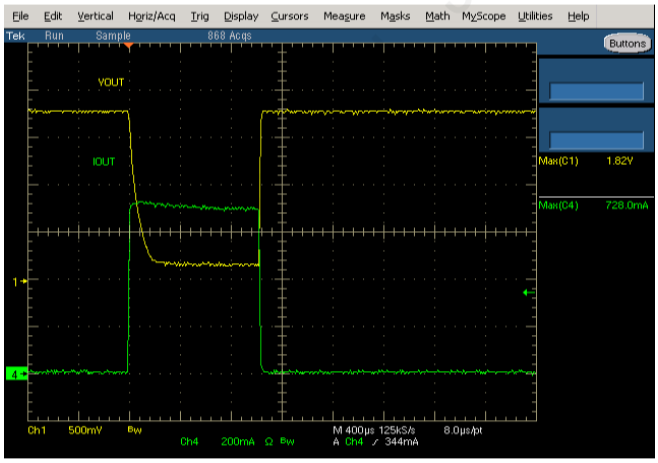
Load Transient Response

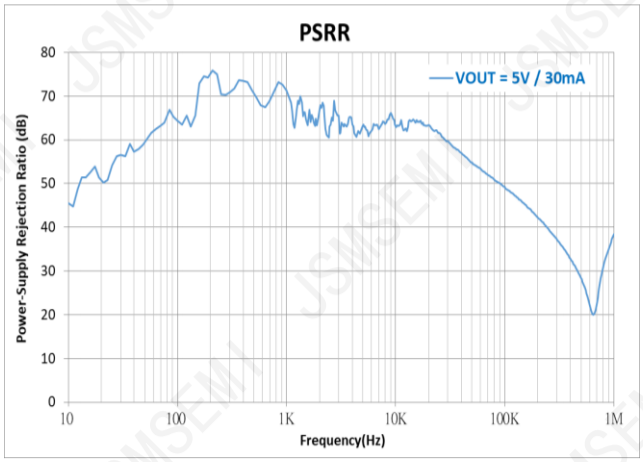


Line Transient Response



Current Limit





Typical Application Circuits

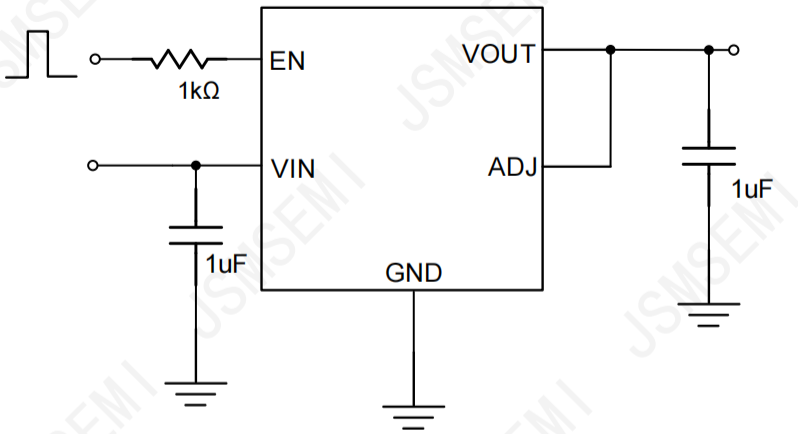


Figure 1: Application circuit of Fixed V_{OUT} LDO with enable and sense functions

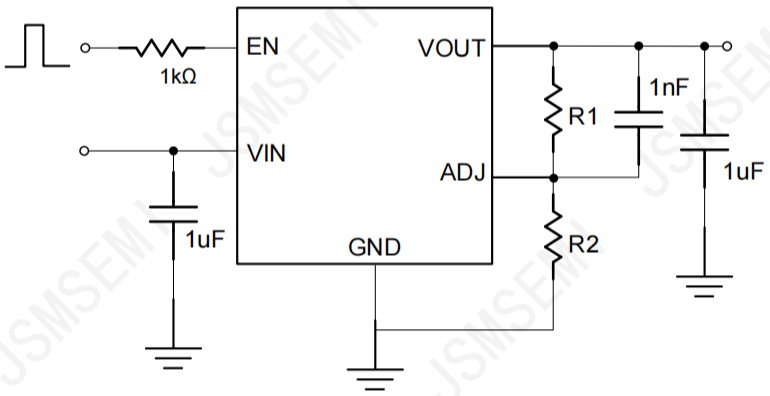


Figure 2: Adjustable output voltage LDO application circuit by LDK320AM-R

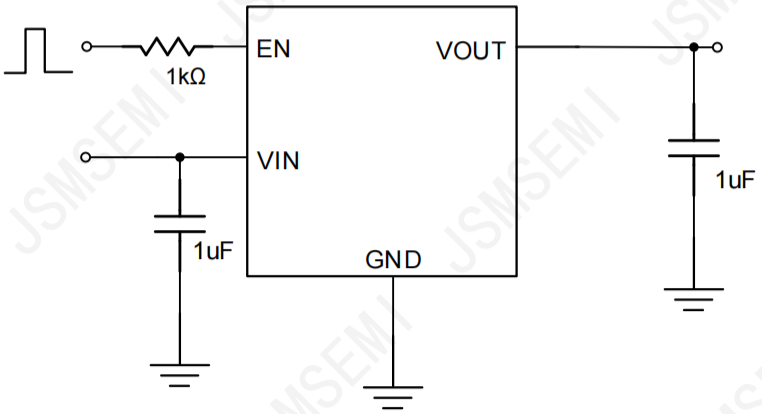


Figure 3: Application circuit of Fixed VOUT LDO with enable function

Application Guideline

Input and Output Capacitor Requirements

The external input and output capacitors of LDK320A series must be properly selected for stability and performance. Use a 1μF or larger input capacitor and place it close to the IC's VIN and GND pins. Any output capacitor meeting the minimum 1mΩ ESR (Equivalent Series Resistance) and effective capacitance between 1μF and 22μF requirement may be used. Place the output capacitor close to the IC's VOUT and GND pins. Increasing capacitance and decreasing ESR can improve the circuit's PSRR and line transient response.

Current Limit

The LDK320A series contain the current limiter of output power transistor, which monitors and controls the transistor, limiting the output current to 700mA (typical). The output can be shorted to ground indefinitely without damaging the part.

Dropout Voltage

The LDK320A series use a PMOS pass transistor to achieve low dropout. When (VIN – VOUT) is less than dropout voltage (V_{DROP}), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the RDS(ON) of the PMOS pass element. V_{DROP} scales approximately with the output current because the PMOS device behaves as a resistor in dropout condition.

As any linear regulator, PSRR and transient response are degraded as (VIN – VOUT) approaches dropout condition.

Adjustable Output Voltage Application

The LDK320A with ADJ pin also can work as an adjustable output voltage LDO. Figure 2 gives the connections for the adjustable output voltage application. The resistor divider from VOUT to ADJ sets the output voltage when in regulation.

The voltage on the ADJ pin sets the output voltage and is determined by the values of R1 and R2. In order to keep a good temperature coefficient of output voltage, the values of R1 and R2 should be selected carefully to ignore the temperature effect of input current at the ADJ pin. A current greater than 50μA in the resistor divider is recommended to meet the above requirement. The adjustable output voltage can be calculated using the formula given in equation 1:

$$V_{OUT} = \frac{R1+R2}{R2} \times V_{ADJ} \quad (1)$$

where V_{ADJ} is determined by the output voltage selections in the ordering information of LDK320A .

The maximum adjustable output voltage is 5V. Generally, to maximize the available adjustable output voltage range, LDK320A is recommended (V_{ADJ} is 1.8V in formula 1 now).

The minimum recommended 50μA in the resistor divider makes the application no longer a 1.5μA low quiescent LDO.

Furthermore, a CFF capacitor is required for this application. Figure 2 suggests a 1nF capacitor value in the circuit, and the CFF capacitor value can be adjusted according to different output voltage applications.

OTP (Over Temperature Protection)

The over temperature protection function of LDK320A series will turn off the P-MOSFET when the junction temperature exceeds 160°C (typ.). Once the junction temperature cools down by approximately 15°C, the regulator will automatically resume operation.

Thermal Application

For continuous operation, do not exceed the absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated as below:

T_A=25°C, JSMSEMI PCB,

The max PD (Max)= (125°C − 25°C) / (220°C/W) = 0.45W for SOT-23-5 packages.

The max PD(Max)= (125°C − 25°C) / (130°C/W) = 0.77W for SOT-89-3 package

Power dissipation (PD) is equal to the product of the output current and the voltage drop across the output pass element, as shown in the equation below:

PD = (VIN – VOUT) × IOUT

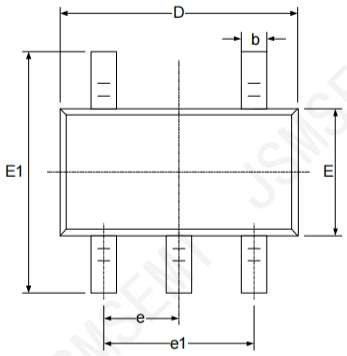
Layout Consideration

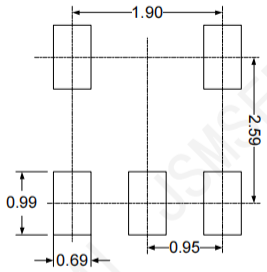
By placing input and output capacitors on the same side of the PCB as the LDO, and placing them as close as is practical to the package can achieve the best performance. The ground connections for input and output capacitors must be back to the LDK320A ground pin using as wide and as short of a copper trace as is practical.

Connections using long trace lengths, narrow trace widths, and/or connections through via must be avoided. These add parasitic inductances and resistance that results in worse performance especially during transient conditions.

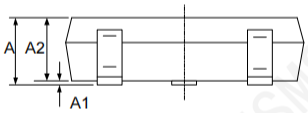
Package Information

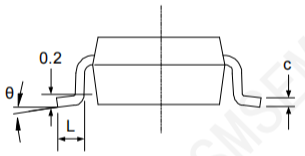
SOT-23-5L





RECOMMENDED LAND PATTERN (Unit: mm)

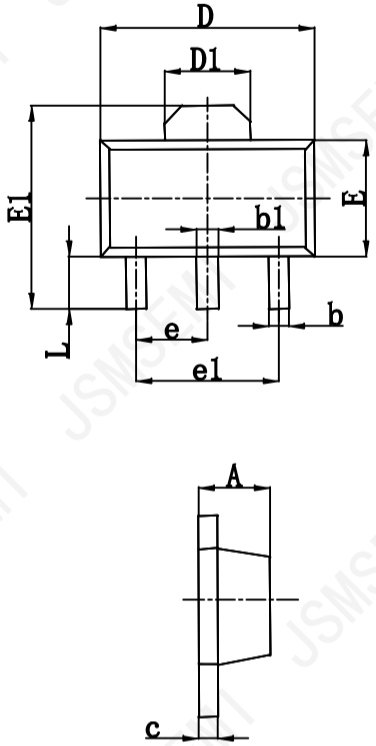


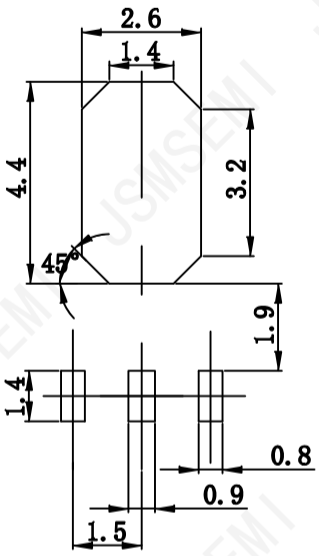


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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

Package Information

SOT-89-3L





Note:
1.Controlling dimension:in millimeters.
2.General tolerance:±0.05mm.
3.The pad layout is for reference purposes only.

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		0.060 TYP	
e1	3.000 TYP		0.118 TYP	
L	0.900	1.200	0.035	0.047

Revision History

Rev.	Change	Date
V1.0	Initial version	6/27/2021
V2.0	Version update, adding ordering information	4/13/2023

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