500mA Dual-rail Very Low Dropout LDO

General Description

The ET55511YB is a CMOS-based low-dropout, low-power linear regulators, offering 500mA with NMOS pass transistor and a separate bias supply voltage (VBIAS) . The device provides very stable, accurate output voltage with low noise, high ripple rejection and low supply current suitable for space constrained, noise sensitive application. The ET55511YB consist of an accurate voltage-reference block, an error amplifier, a thermal-shutdown circuit, and a current limit circuit.

The ET55511YB is available in the DFN4(1.2mm×1.2mm) package.

Features

- Wide VIN Input Voltage Range: 1.1V to 5.5V
- Wide VBIAS Voltage Range: 2.7V to 5.5V
- Output Voltage : 1.1V (Fixed)
- Very Low VBIAS Input Current of Typ. 80μA
- Ultra Low Dropout: Typ. 120mV at 500mA, 3.3V Bias
- Built-in Over Current Protection and Thermal Shutdown Circuit
- Built-in Auto-discharging Circuit
- Built-in Under Voltage Lock-out
- Stable with a 2.2μF Ceramic Capacitor
- Package: DFN4(1.2mm × 1.2mm × 0.4mm)
- MSL: Level1

Applications

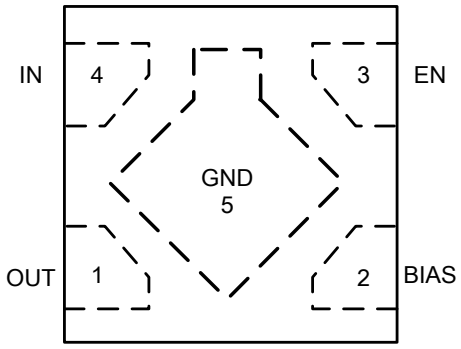
- Constant-voltage power supply for battery-powered device
- Constant-voltage power supply for smartphones, tablets
- Constant-voltage power supply for cameras, DVRs, STB and camcorders

Device information

ET 555 11 Y B

11 Output Voltage		**Y** Package		**B** Auto-discharge Function	
Fixed	1.1V	Y	DFN4 -1.2×1.2	B	Auto-discharge

Pin Configuration

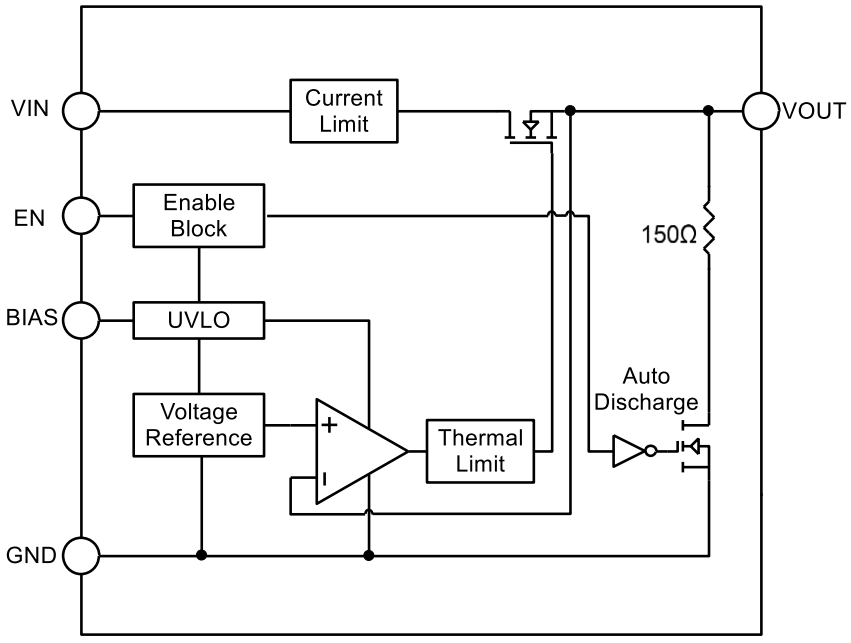


DFN4 (Top View)

Pin Function

Pin No.	Symbol	Pin Description
1	OUT	The power output of the device.
2	BIAS	Input voltage for controlling circuit.
3	EN	Enable Input.
4	IN	Input voltage Pin. Large bulk capacitance should be placed closely to this pin. A 1μF ceramic capacitor is recommended at this pin.
5	GND	Ground pin. Thermal PAD.

Block Diagram



Functional Description

The ET55511YB dual−rail very low dropout voltage regulator is using NMOS pass transistor for output voltage regulation from V_{IN} voltage. All the low current internal control circuitry is powered from the V_{BIAS} voltage.

The use of an NMOS pass transistor offers several advantages in applications. Unlike PMOS topology devices, the output capacitor has reduced impact on loop stability. V_{IN} to V_{OUT} operating voltage difference can be very low compared with standard PMOS regulators in very low V_{IN} applications.

The ET55511YB offers smooth monotonic start-up.

Input and output Capacitor

The device is designed to be stable for ceramic output capacitors with Effective capacitance in the range from 2.2μF to 4.7μF. The device is also stable with multiple capacitors in parallel, having the total effective capacitance in the specified range. In applications where no low input supplies impedance available (PCB inductance in VIN and/or VBIAS inputs as example), the recommended C_{IN} = 1uF and C_{BIAS}= 0.1uF or greater.

Enable Pin Operation

The ET55511YB is turned on by setting the EN pin to “H”. The threshold limits are covered in the electrical characteristics table in this datasheet. When the EN pin is not used, connect the EN pin with VBIAS to keep the LDO in operating mode.

Current Limit Protection

When output current of VOUT pin is higher than current limit threshold or the VOUT pin is direct short to GND, the current limit protection will be triggered and clamp the output current at a predesigned level to prevent over-current and thermal damage.

Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately +165°C, allowing the device to cool down. When the junction temperature reduces to approximately +145°C the output circuit is enabled again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the heat dissipation of the regulator, protecting it from damage due to overheating.

Auto Discharging

When the EN pin set to “L”, the output circuit will be disable immediately, and the Auto-Discharging circuit will be turned on to discharge the electric charge on output capacitor, and decrease the voltage of V_{OUT} in very short time.

Absolute Maximum Ratings

Item	Rating	Unit
Input Voltage(VIN Pin)	-0.3 to 6.0	V
Input Voltage (VBIAS Pin)	-0.3 to 6.0	V
Input Voltage (EN Pin)	-0.3 to 6.0	V
Output Voltage	-0.3 to 6.0	V
Maximum Power Consumption	640	mW
Storage Temperature Range	-65 to +150	ºC
Operating Junction Temperature	-40 to +150	ºC
ESD HBM	4000	V
ESD CDM	1500	V

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	IN Input Voltage	V_{OUT}+ V_{DROP} to 5.5	V
V_{BIAS}	BIAS Input Voltage	2.7 to 5.5 & V_{BIAS}>=V_{OUT}+1.4V	V
I_{OUT}	Output Current	0 to 500	mA
T_A	Operating Ambient Temperature	-40 to 85	ºC
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 10	μF
C_{BIAS}	Effective Input Ceramic Capacitor Value	0.047 to 4.7	μF
C_{OUT}	Effective Output Ceramic Capacitor Value	1 to 10	μF
ESR	Input and Output Capacitor Equivalent Series Resistance	5 to 100	mΩ

Electrical Characteristics

(Unless otherwise noted , V_{IN}=1.4V,V_{BIAS}=3.3V,I_{OUT}=1mA, C_{IN}=1μF,C_{OUT}=2.2μF,C_{BIAS}=0.1uF, T_A= -40ºC~85ºC.Typical values are at. T_A=25ºC)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}(1)	V_{IN}>V_{OUT}	V_{OUT}+ V_{DROP}		5.5	V
V_{BIAS} Voltage Range	V_{BIAS}	V_{BIAS}≥V_{OUT}+1.6V	2.7		5.5	V
Under-voltage lock-out	V_{UVLO}	V_{BIAS} Rising/Hysteresis		1.6/0.2		V
V_{BIAS} Current	I_{Q_ON}(4)	Active mode: V_{EN}=H		80	110	μA
	I_{Q_OFF}	V_{EN}=L		0.5	1.0	μA
Output Voltage	V_{OUT}	I_{OUT}=1mA~500mA, T_A=25 ºC	1.078		1.122	V
Dropout Voltage	V_{DROP}(2)	I_{OUT}=500mA		120	180	mV
		I_{OUT}=300mA		72	108	
Current Limit	I_{LIM}	V_{OUT}=90%V_{OUT}	600	1150	1550	mA
Load Regulation	Reg_{LOAD}	1mA≤ I_{OUT} ≤500mA		2	20	mV
V_{IN} Line Regulation	Reg_{LINE}	1.4≤V_{IN}≤5 V (V_{BIAS}=3.3V, I_{OUT}=1mA)		0.01	0.1	%/V
V_{BIAS} Line Regulation		2.7< V_{BIAS} < 5.5 V (V_{IN}=1.4V, I_{OUT}=1mA)		0.01	0.1	%/V
Ripple Rejection	PSRR(3)	V_{IN} to V_{OUT},f=1kHz, Ripple 0.2Vp-p,I_{OUT}=30mA		80		dB
		V_{BIAS} to V_{OUT},f=1kHz, Ripple 0.2Vp-p, I_{OUT}=30mA		80		
Output Noise	e_N(3)	V_{IN}=1.6V,V_{OUT}=1.1V, f= 10 Hz to 100 kHz		40		μ_{VRMS}
EN Pull-down Current	I_{EN}	V_{EN}=5.5V		0.5	1	μA
EN Input Voltage High	V_{ENH}		0.9			V
EN Input Voltage Low	V_{ENL}				0.4	V
Output Resistance of Auto Discharge at Off State	R_{DIS}	V_{EN}=0V, V_{OUT}=0.5V		150		Ω
Line Transient	V_{TRLN}(3)	V_{IN}=1.4V to 5.5V in 10us,I_{OUT}=1mA,T_A=25ºC		18	30	mV
		V_{IN}= 5.5V to 1.4V in 10us, I_{OUT}=1mA,T_A=25ºC		18	30	mV
Load Transient	V_{TRLD}(3)	I_{OUT}=1mA to 500mA in 10us V_{IN}=1.6V,T_A=25ºC		75	115	mV
		I_{OUT}=500mA to 1mA in 10us V_{IN}=1.6V,T_A=25ºC		50	75	mV

Electrical Characteristics(Continued)

(Unless otherwise noted , V_{IN}=1.5V,V_{BIAS}=3.3V,I_{OUT}=1mA, C_{IN}=1μF,C_{OUT}=2.2μF,C_{BIAS}=0.1uF, T_A= -40ºC~85ºC.Typical values are at. T_A=25ºC)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Turn-On Time	T_{ON}	From assertion of V_{EN} to V_{OUT}=98%$V_{OUT(NOM)}$		120		μs
Thermal Shutdown Temperature	T_{TSD}(3)	Temperature increasing		165		℃
Thermal Shutdown Released Temperature	T_{TSR}(3)	Temperature decreasing		145		℃

Notes:

1:The maximum input voltage should take into account the maximum power consumption ($P_{D(MAX)}$).The calculation formula is as follows:

$$P_{D(MAX)} = (V_{IN(MAX)} - V_{OUT}) \times I_{OUT}$$

The maximum power consumption of the circuit is 640mW.

$$V_{IN(MAX)} = 640mW / I_{OUT} + V_{OUT}$$

For example:

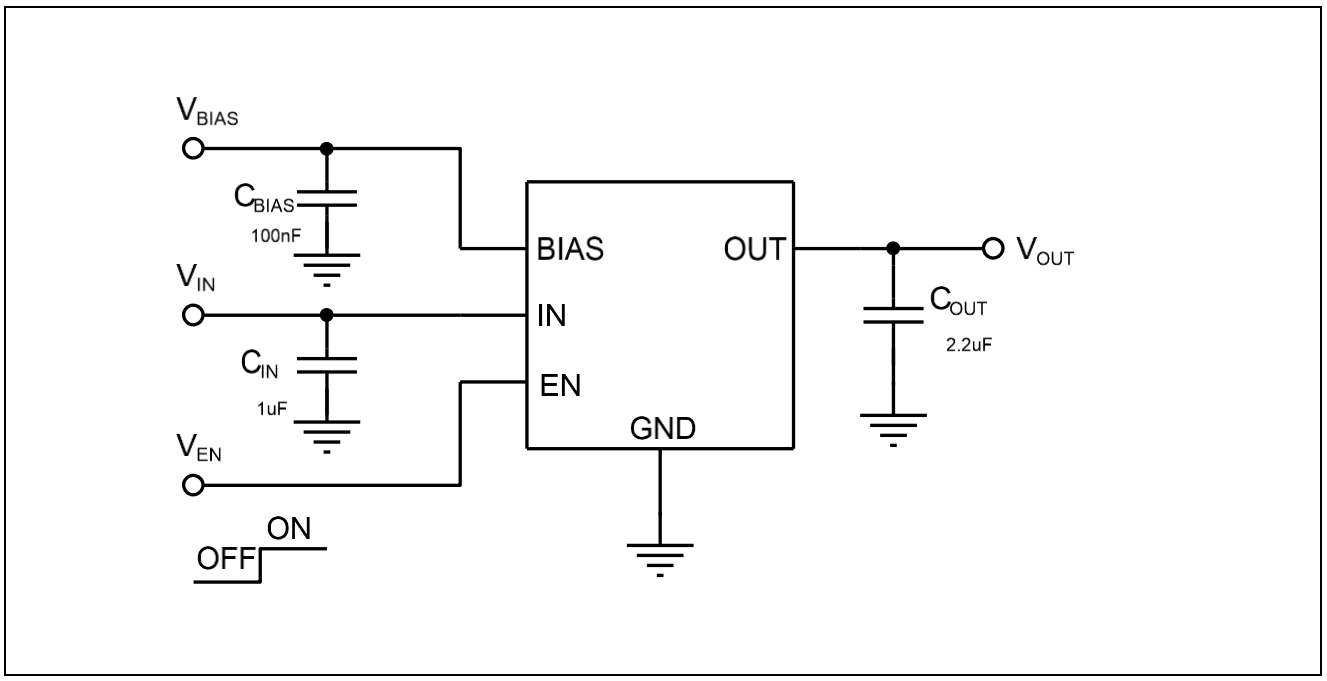
If V_{OUT}= 1.1V,I_{OUT}=500mA, The maximum input voltage is $V_{IN(MAX)}$=640mW / 500mA+1.1=2.38V

2: V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET} +$V_{DROPMAX}$ with output current.

3: Guaranteed by design and characterization. not a FT item.

4: Since the power on process of BIAS needs a large current, the BIAS input voltage should have a current driving capacity of more than 120mA.

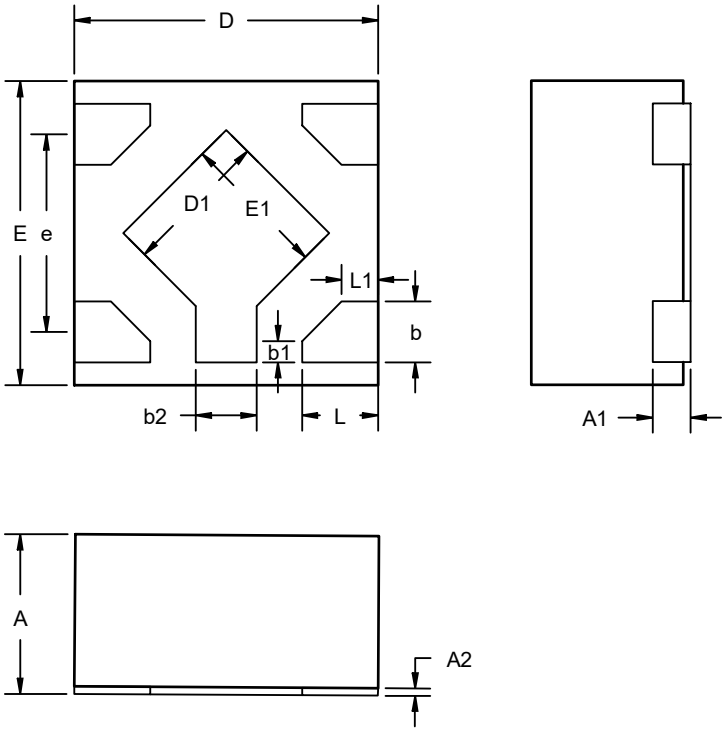
Application Circuits



Note*: The feedforward capacitor CFF is optional for the optimization of transient response.
If BIAS input series resistor is used, it is recommended no greater than 20Ω.

Package Dimension

DFN4(1.2x1.2)

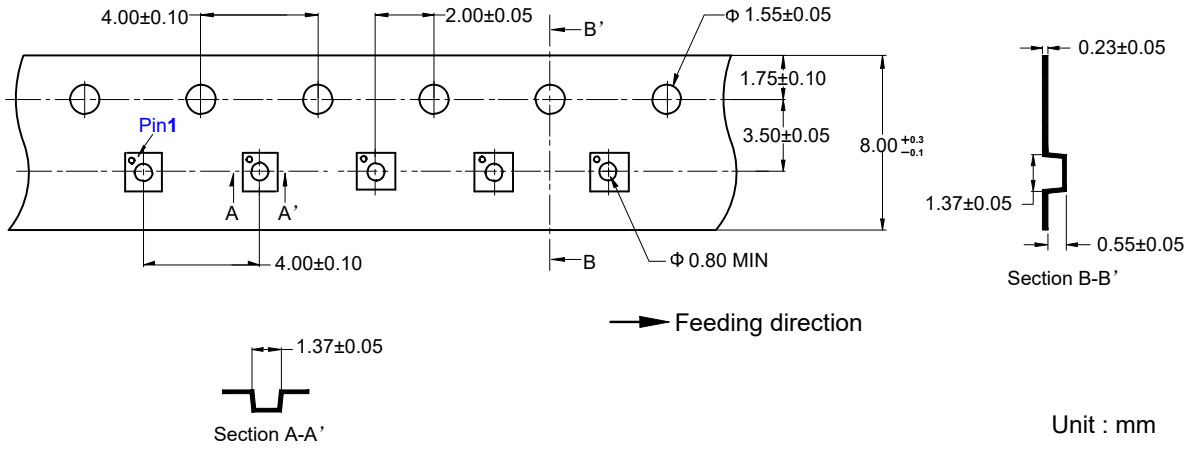


COMMON DIMENSIONS

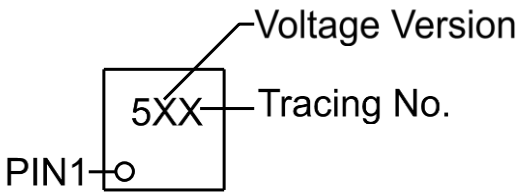
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.35	0.40	0.45
A1		0.13REF	
A2	0.00	0.02	0.05
b	0.25	0.30	0.35
b1		0.12REF	
b2	0.15	0.20	0.25
D	1.15	1.20	1.25
D1	0.58	0.63	0.68
E	1.15	1.20	1.25
E1	0.58	0.63	0.68
e		0.8BSC	
L	0.25	0.30	0.35
L1		0.12REF	

Reel



Marking Information



X Voltage Version		X
I	1.1V	Tracing Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2019-04-03	Original Version	Liuyg	Liuyg	Zhujl
1.1	2019-04-28	Add Marking	Zhujl	Zhujl	Zhujl
1.2	2020-03-06	Update package dimension	Liuyg	Liuyg	Liujy
1.3	2020-08-04	Update value of Load transient	Liuyg	Liuyg	Liujy
1.4	2021-3-11	Update Package Graph	Shib	Shib	Liujy
1.5	2023-6-02	Update Typeset	Shibo	Liuyg	Liujy