ET63HS42XX - High Input Very-Low I_Q 300mA LDO

General Description

The ET63HS42XX is a low dropout with 300mA load ability with enable function LDO. It operates from 3V ~ 40V. The quiescent current is 5μA with no load. The devices feature integrated short-circuit and over-current protection. They are quite suitable for standby microprocessor control-unit systems, especially in automotive applications.

ET63HS42XX are available in the ESOP8 package.

Features

- Input Voltage Range from 3V to 40V
- 300mA Load Current
- I_Q is 7μA Typical
- Low Dropout is 500mV at 300mA Load@V_{OUT}=3.3V
- Power-Good Feature is Available
- Over-Temperature Protection
- Current-Limit Protection
- Part No. and Package

Part No.	Package	Packing Option	MSL
ET63HS42XX	ESOP8	Tape and Reel, 4K	3

Pin Configuration

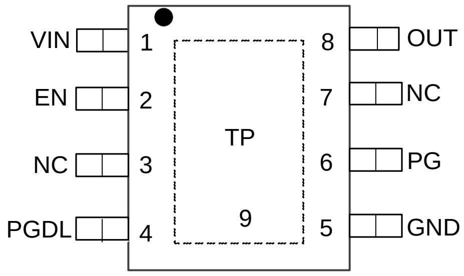


Fig1.TOP VIEW

Pin Function

Pin No.	Pin Name	Pin Function
1	VIN	Input Pin
2	EN	Enable Input Pin
3,7	NC	No Connect
4	PGDL	PG Delay Pin
5	GND	Ground Pin
6	PG	Power Good Pin
8	OUT	Output Pin
9	TP	Thermal Pad

Block Diagram

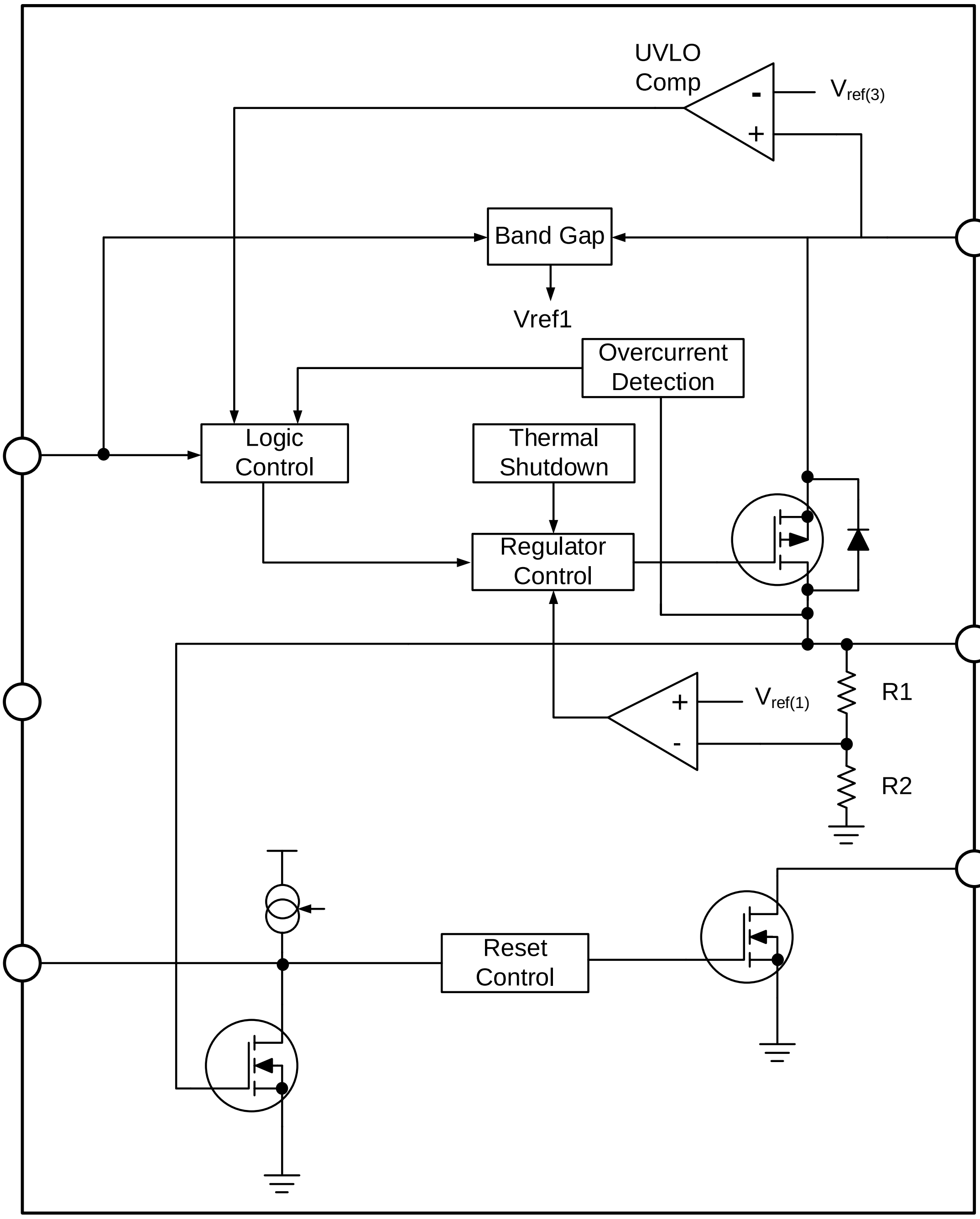


Fig2.Functional block diagram

Functional Description

Input Capacitor

A 2.2µF~10µF ceramic capacitor is recommended to connect between V_{IN} and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both V_{IN} and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 2.2µF to 10µF, Equivalent Series Resistance (ESR) is from 5mΩ to 100mΩ, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to OUT and GND pins.

Enable

TheET63HS42XX delivers the output power when it is set to enable state. When it works in disable state, there is no output power and the operation quiescent current is almost zero. The enable pin (EN) is active high.

Dropout Voltage

The ET63HS42XX uses a PMOS pass transistor to achieve low dropout. When (V_{IN} – V_{OUT}) is less than the dropout voltage (V_{DROP}), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass element. V_{DO} scales approximately with output current because the PMOS device behaves like a resistor in dropout mode. As with any linear regulator, PSRR and transient response degrade as (V_{IN} – V_{OUT}) approaches dropout operation.

Power Good

The ET63HS42XX provides an open-collector PG Pin. The pin indicating output voltage regulation can be connected to VOUT through an external resistor. When VOUT is higher than the power on reset threshold, after a power on reset delay time, VPG is pulled up to a high level through an external resistor.

If it is not necessary to only regulate the output voltage, the pin can be open.

Power Good Delay

The external capacitor on PGDL pin sets a timer delay before releasing the reset pin high level. A constant output current charges the external capacitor until the voltage exceeds the threshold to trip the internal comparator. If the pin is open, the default delay time is 400µs (typical value). After setting the PG pin low, the capacitor on this pin discharges, allowing the capacitor to charge from approximately 0.2 V, delaying the timing for the next power on reset. When V_{OUT} rises 90% of V_{OUT}, the PG Pin is pulled to high by V_{OUT}. The delay time (t_{PGDL}) can be defined by adding a capacitor (C_{PGDL}) on PGDL through below equation:

$$t_{PGDL}=C_{PGDL} \times 1V / 20nA$$

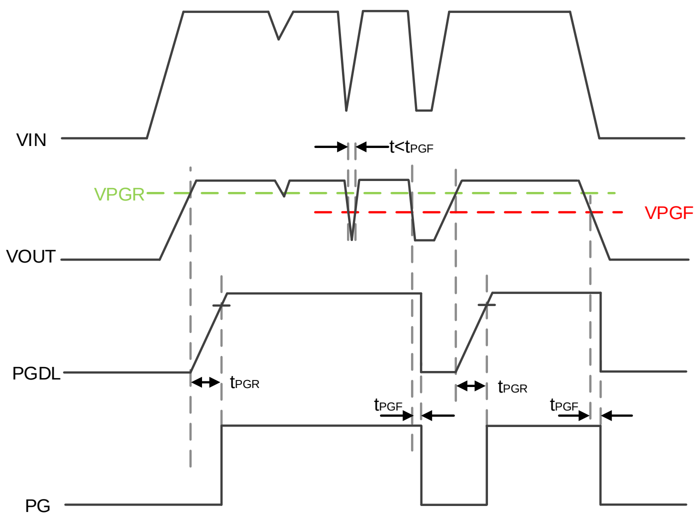


Fig3.Power Good Timing

Thermal Shutdown

Thermal shutdown protection disables the output when the junction temperature rises to approximately 155°C. Disabling the device eliminates the power dissipated by the device, allowing the device to cool. When the junction temperature cools to approximately 130°C, the output circuitry is again enabled.

Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits regulator dissipation, protecting the LDO from damage as a result of overheating. Activating the thermal shutdown feature usually indicates excessive power dissipation as a result of the product of the (V_{IN} – V_{OUT}) voltage and the load current. For reliable operation, limit junction temperature to 150°C maximum.

Thermal Considerations

For continuous operation, do not exceed 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 by the following formula:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance. For recommended operating conditions the maximum junction temperature is 150°C and T_A is the ambient temperature. The junction to ambient thermal resistance, θ_{JA} is layout dependent. The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance(θ_{JA}).

Current-Limit Protection

The ET63HS42XX provides current limit function to prevent the device from damages during over-load or shorted-circuit condition. This current is detected by an internal sensing transistor.

Layout Guidelines

- Place input and output capacitors as close to the device as possible.
- Use copper planes for device connections in order to optimize thermal performance.
- Place thermal vias around the device to distribute heat.

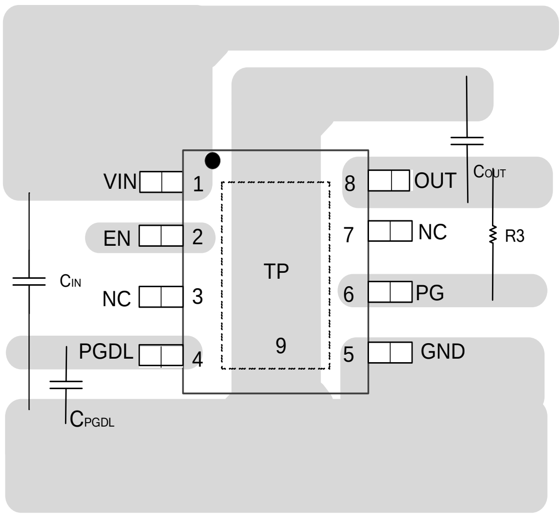


Fig4.Layout Guidelines

Absolute Maximum Ratings

Symbol	Rating	Value	Unit
V_{IN}	Input Voltage[1]	-0.3~45 & V_{IN}>V_{EN}	V
V_{OUT}	Output Voltage	-0.3~40	V
V_{EN}	Chip Enable Input Voltage	-0.3~V_{IN}	V
V_{PG}	Power Good Voltage	-0.3~V_{OUT}	V
V_{PGDL}	Power Good Delay Voltage	-0.3~5	V
$T_{J(MAX)}$	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65~150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Note1. Refer to Electrical Characteristics and Application Information for Safe Operating Area and IN port needs to be powered on before the EN port.

Thermal Characteristics

Symbol	Ratings	Value	Unit
$R_{\theta JA}$	Thermal Characteristics, Thermal Resistance, Junction-to-Air	60	°C/W
P_D	Max Power Dissipation @25°C	2	W

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	3 to 40	V
I_{OUT}	Output Current	0 to 300	mA
T_J	Operating Junction Temperature	-40 to 125	°C
C_{IN}	Input Capacitor Value	2.2 to 10	μF
C_{OUT}	Output Capacitor Value	2.2 to 10	μF
R_{PG}	Pull-up resistor of Power-Good	1 to 100	kΩ
ESR	Input and Output Capacitor Equivalent Series Resistance (ESR)	5 to 100	mΩ

Electrical Characteristics

(V_{IN} = V_{OUT} + 2V; I_{OUT} = 10mA, C_{IN} = C_{OUT} = 2.2μF, T_J = -40°C ~125°C unless otherwise noted. Typical values are at T_A = +25°C.) [3]

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating Input Voltage[4]		3.0		40	V
V_{UVLO}	Under Voltage Lock Out	V_{IN} Rising, I_{OUT}=300mA		2.5		V
V_{UVLO_HYS}		Hysteresis		300		mV
I_Q	Quiescent Current	I_{OUT} = 0mA		7		μA
I_{Q_OFF}	Standby Current	V_{EN} = 0V, V_{IN} = 4 V, T_A = 25°C		1	1.7	μA
		V_{EN} = 0V, V_{IN} = 40V, T_A = 25°C		1.5	4	
V_{DROP}	Dropout Voltage[5]	I_{OUT}=300mA, V_{OUT}=3.3V T_A = +25°C		500	780	mV
		I_{OUT}=300mA, V_{OUT}=5V T_A = +25°C		480	760	
$Line_{REG}$	Line Regulation	V_{OUT}+2V≤V_{IN} ≤40V I_{OUT} = 10mA		0.1		%/V
$Load_{REG}$	Load Regulation	1mA ≤ I_{OUT} ≤ 300mA V_{IN} =V_{OUT}+2V		15		mV
I_{LMT}	Current Limit	V_{IN} =V_{OUT}+2V		530		mA
V_{ENH}	EN Pin Threshold Voltage	EN Input Voltage “H”		1.3		V
V_{ENL}	EN Pin Threshold Voltage	EN Input Voltage “L”		1.0		V
I_{EN}	EN Leakage Current	V_{EN} =V_{EN_MAX}, I_{OUT}=300mA		0.2		μA
T_{ON}	Soft Start Time	From Enable to 90%V_{OUT_normal}		600		us
PSRR	Power Supply Rejection Ratio[6]	f = 100Hz, V_{IN} =V_{OUT}+2V, V_{OUT}=3.3V， I_{OUT} = 30mA		100		dB
		f = 1 kHz, V_{IN} =V_{OUT}+2V, V_{OUT}=3.3V， I_{OUT} = 30mA		105		dB
		f = 10 kHz, V_{IN} =V_{OUT}+2V, V_{OUT}=3.3V， I_{OUT} = 30mA		70		dB
e_N	Output Noise Voltage[6]	V_{IN} = V_{OUT}+2V, I_{OUT} = 1mA, f = 10Hz to 100KHz, C_{OUT} = 1μF		30		μVrms
V_{PG_R}	PG Rising Threshold	V_{OUT}/ V_{OUT_SET}, when V_{OUT} rising		90		%
t_{D_PGR}	PG Rising Delay	From V_{OUT} = 90%×$V_{OUT(normal)}$ to PG=High, C_{PGDL}=0nf		400		μs
T_{SD}	Thermal Shutdown Temperature[6]	Temperature Increasing from T_A=+25°C		145		°C
T_{SDH}	Thermal Shutdown Hysteresis[6]	Temperature Falling from T_{SD}		30		°C

Note3. Here V_{IN} means internal circuit can work normal. If $V_{IN}<V_{OUT}$, Output voltage follows V_{IN}(I_{OUT}=1mA), circuit is safety.

Note4. The minimum operating voltage is 3.0V. $V_{DROP}=V_{IN(min)}-V_{OUT}$.

Note5. V_{DROP} FT test method: test the V_{OUT} voltage at $V_{SET}+V_{DROPMAX}$ with 300mA output current.

Note6. Guaranteed by design and characterization. not a FT item.

Application Circuits

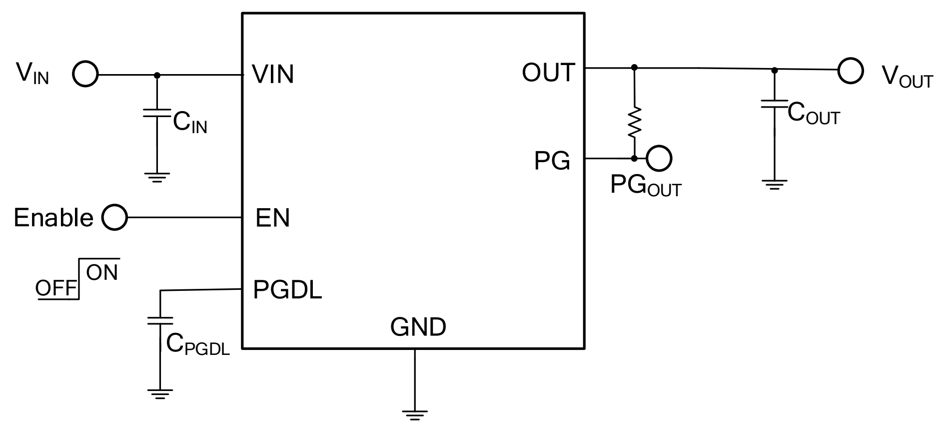
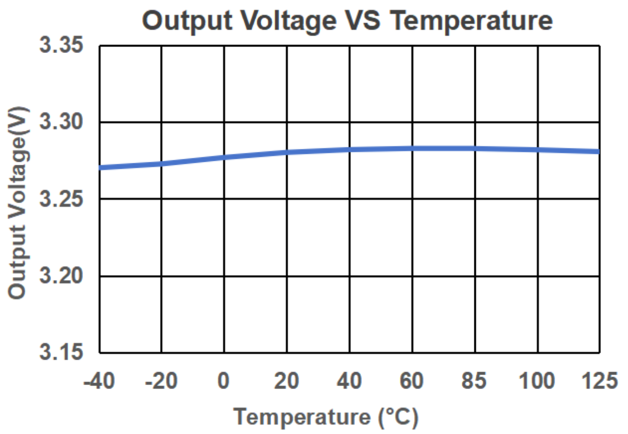


Fig5.Adjustable Voltage Typical Application Circuit

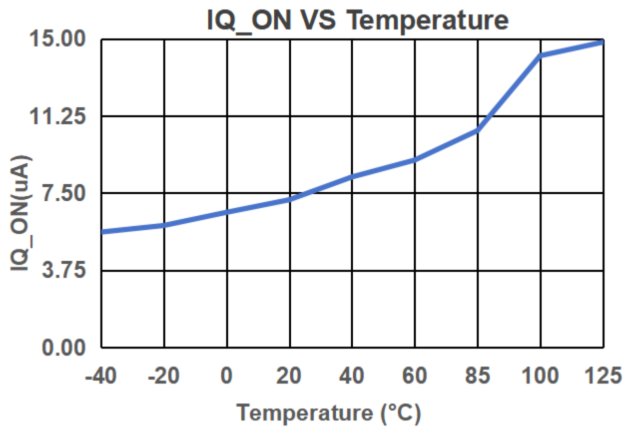
Typical Characteristics

V_{OUT} = 3.3V

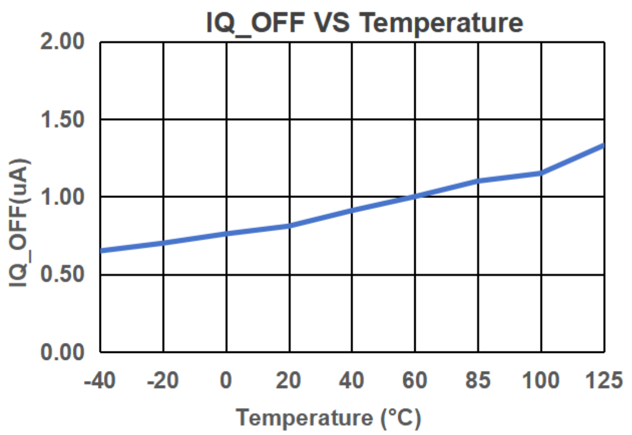
($V_{IN} = V_{OUT} + 2V$; I_{OUT} = 10mA, $C_{IN} = C_{OUT}$ = 2.2μF, T_J = -40°C ~125°C unless otherwise noted. Typical values are at T_A = +25°C.)



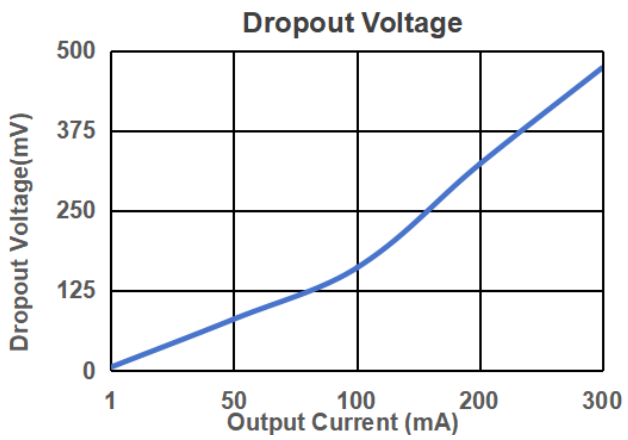
Output Voltage VS Temperature



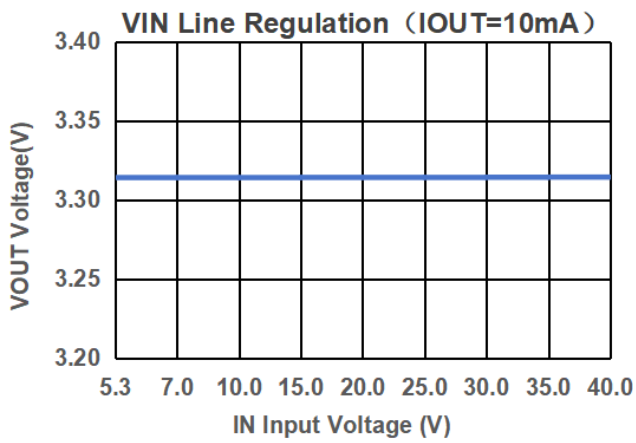
Supply Current VS Temperature



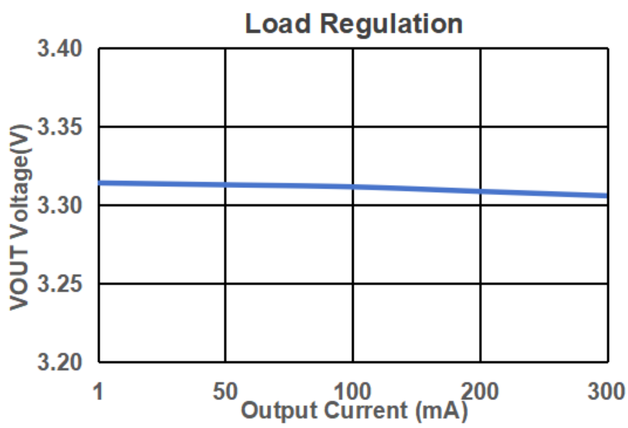
Shutdown Current VS Temperature



Dropout Voltage VS Output Current



Output Voltage VS Input Voltage

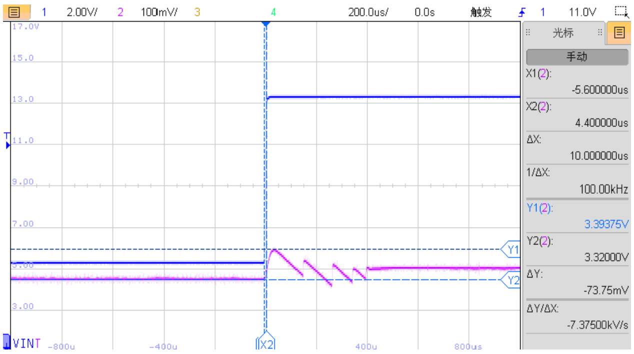


Output Voltage VS Output Current

Typical Characteristics (Continued)

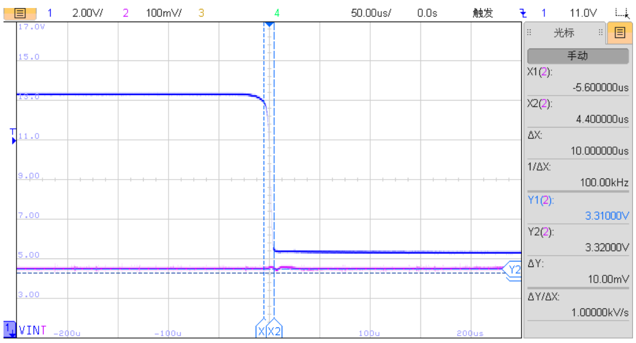
V_{OUT} = 3.3V

($V_{IN} = V_{OUT} + 2V$;$C_{IN} = C_{OUT} = 2.2\mu F$, T_J = -40°C ~125°C unless otherwise noted. Typical values are at T_A = +25°C.)



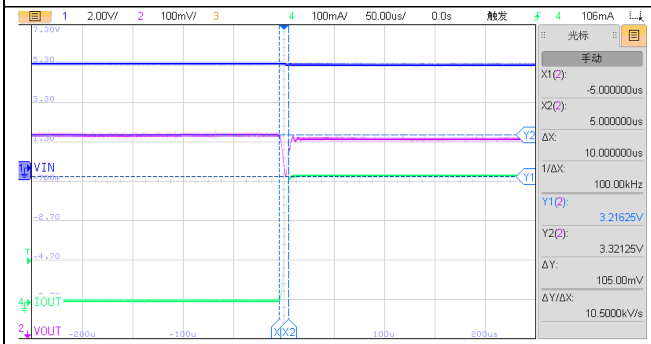
Line Transient Response

V_{IN}=5.3V~15V, V_{OUT}=3.3V, I_{OUT}=10mA



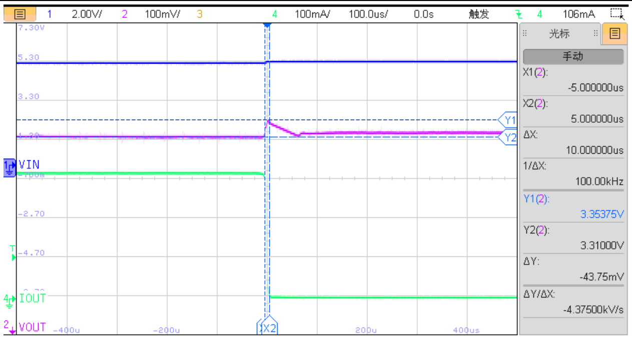
Line Transient Response

V_{IN}=15V~5.3V, V_{OUT}=3.3V, I_{OUT}=10mA



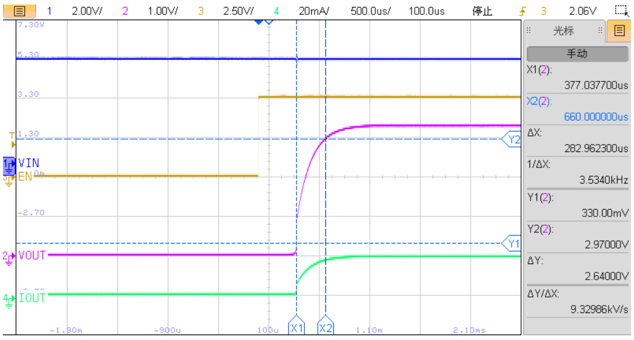
Load Transient Response

V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=1mA~300mA



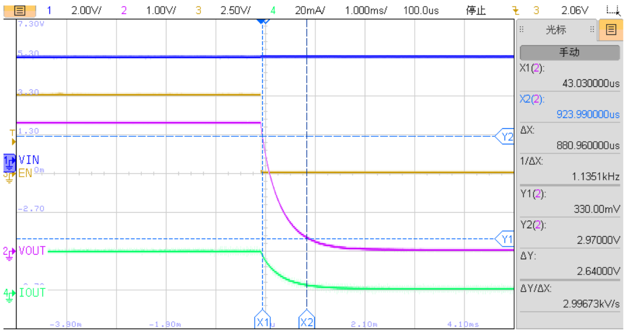
Load Transient Response

V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=300mA~1mA



Ton

V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=20mA



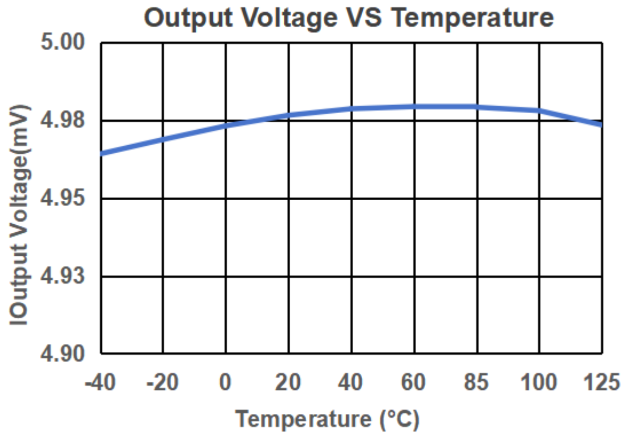
Toff

V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=20mA

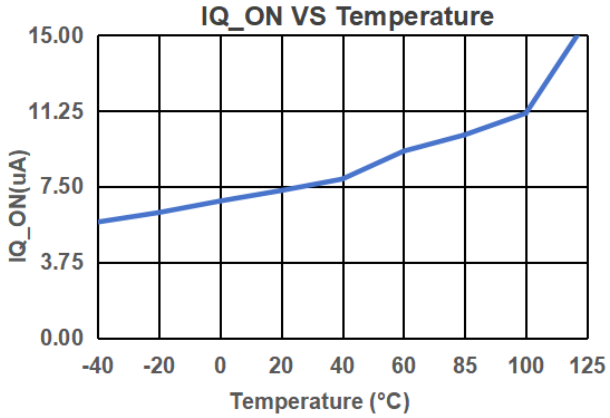
Typical Characteristics(Continued)

V_{OUT} = 5.0V

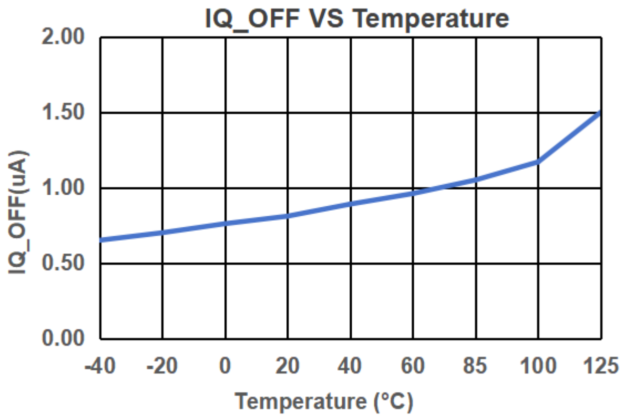
(V_{IN} = V_{OUT} + 2V; C_{IN} = C_{OUT} = 2.2μF, T_J = -40°C ~125°C unless otherwise noted. Typical values are at T_A = +25°C.)



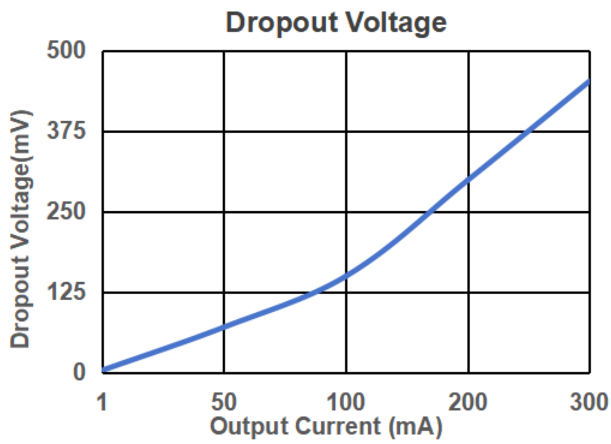
Output Voltage VS Temperature



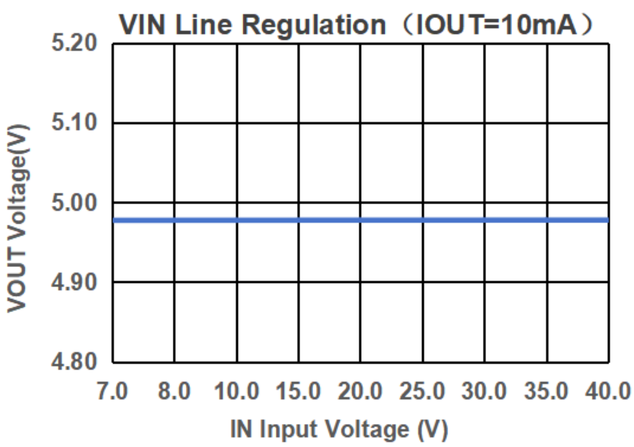
Supply Current VS Temperature



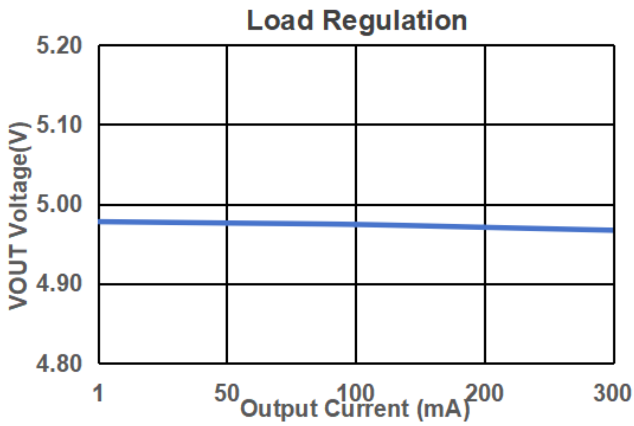
Shutdown Current VS Temperature



Dropout Voltage VS Output Current



Output Voltage VS Input Voltage

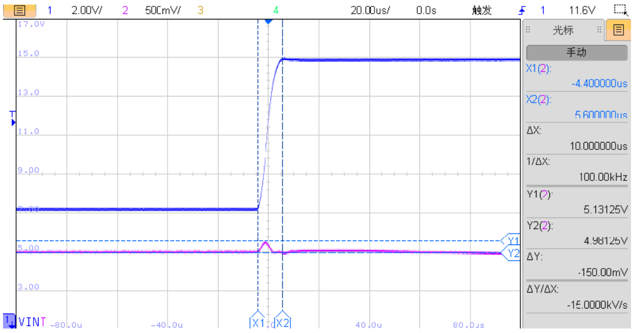


Output Voltage VS Output Current

Typical Characteristics (Continued)

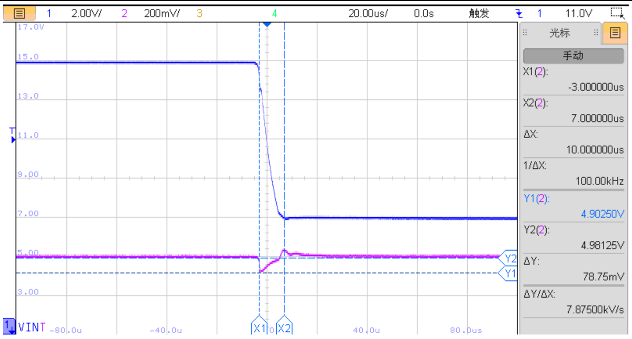
V_{OUT} = 5.0V

(V_{IN} = V_{OUT} + 2V; I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1.0μF, T_J = -40°C ~125°C unless otherwise noted. Typical values are at T_A = +25°C.)



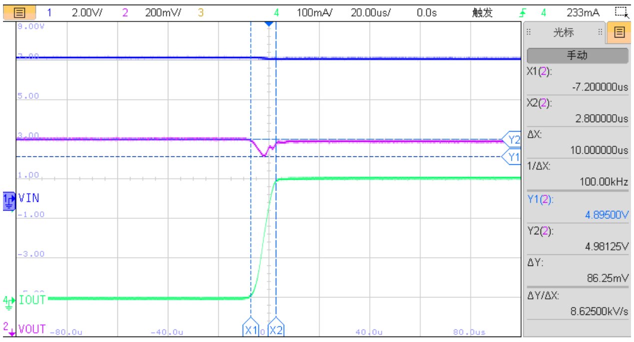
Line Transient Response

V_{IN}=7V~10V, V_{OUT}=5V, I_{OUT}=10mA



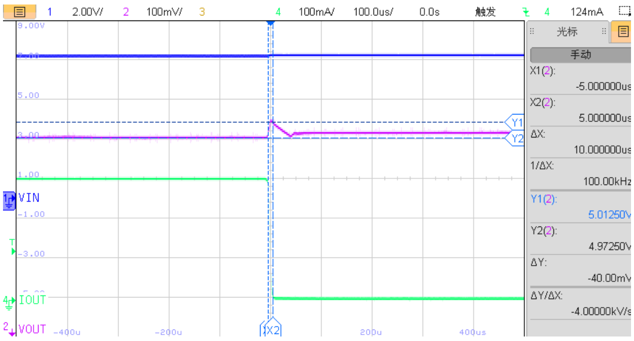
Line Transient Response

V_{IN}=15V~5.3V, V_{OUT}=5V, I_{OUT}=10mA



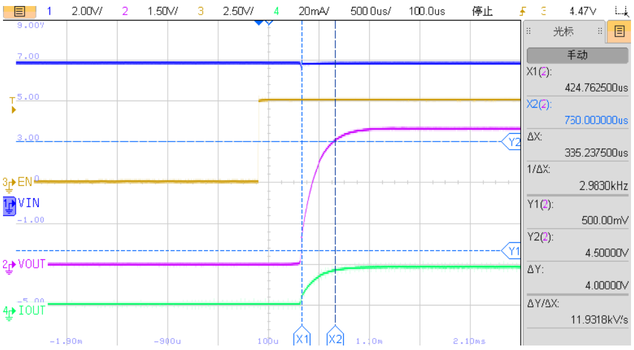
Load Transient Response

V_{IN}=7V, V_{OUT}=5V, I_{OUT}=1mA~300mA



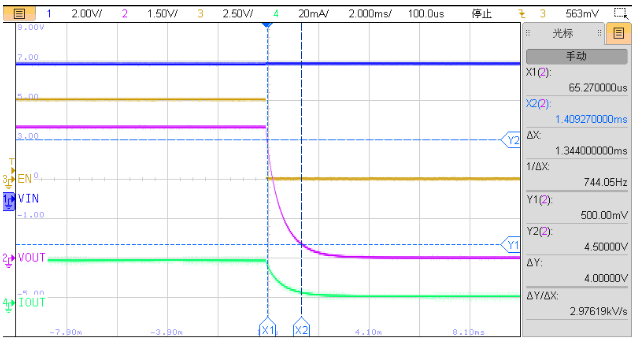
Load Transient Response

V_{IN}=7V, V_{OUT}=5V, I_{OUT}=300mA~1mA



Ton

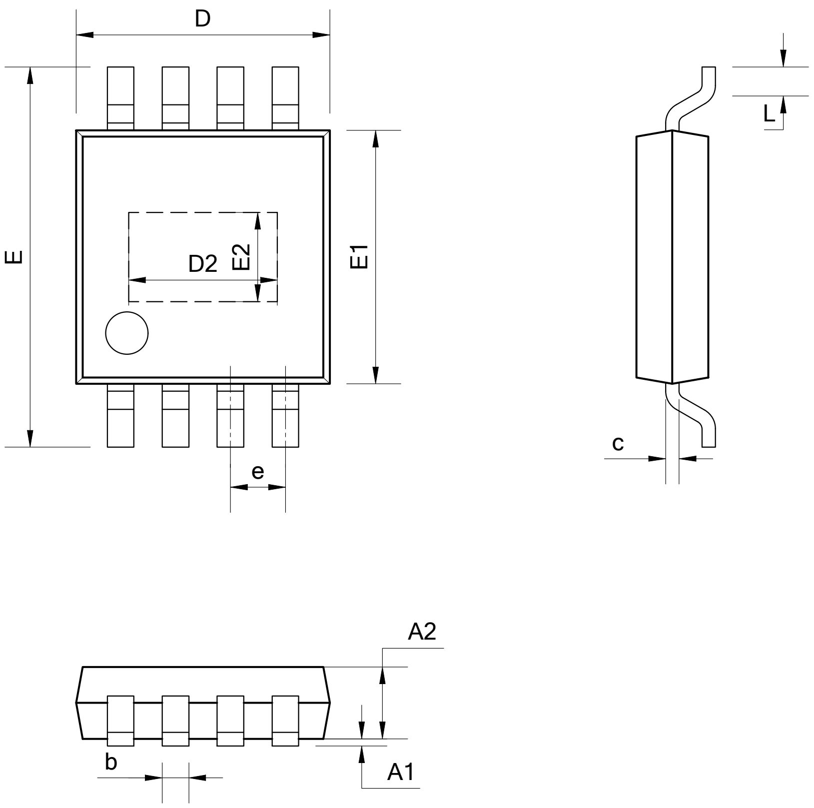
V_{IN}=7V, V_{OUT}=5V, I_{OUT}=20mA



Toff

V_{IN}=7V, V_{OUT}=5V, I_{OUT}=20mA

Package Dimension



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A1	0.00	-	0.15
A2	1.35	1.40	1.50
b	0.38	-	0.47
c	0.17	-	0.25
D	4.80	4.90	5.00
E	5.80	6.00	6.20
D2	3.02	3.17	3.32
E1	3.80	3.90	4.00
E2	2.13	2.28	2.43
e	1.17	1.27	1.37
L	0.45	0.60	0.80

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2025-07-01	Original Version	Hucy	Yangxx	Liujy