ETQ61H41ADJY1 - High Input Very-Low I_Q 150mA LDO

General Description

The ETQ61H41ADJY1 is a low dropout with 150mA load ability with enable function LDO. It operates from 3V ~ 40V. The quiescent current is 5.5uA 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.

ETQ61H41ADJY1 is available in the DFN8 (3mm × 3mm) package.

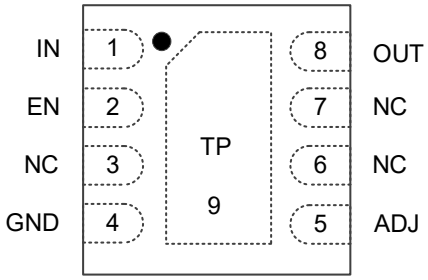
Features

- Input Voltage Range from 3V to 40V
- Output Current are up to 150mA
- Very Low I_Q of 5.5μA Typical
- ADJ Output Voltage Range 1.8V to 15V
- Low Dropout is 220mV at 150mA Load@V_{OUT} = 5V
- Built-in I_{LIMIT} Protection and Thermal Shutdown Circuit
- Automotive AEC-Q100 Grade 1 Qualified
  -- Ambient Temperature Range of -40°C to 125°C
  -- ESD HBM ±2000V PASS
  -- ESD CDM ±1500V PASS
  -- Latch Up Current to ±200mA PASS
- Part No. and Package Information

ETQ61H41 ADJ Y1

ADJ Output Voltage		Package		Packing Option	MSL
ADJ	Adjustable Output Voltage 1.8V to 15V	Y1	DFN8 (3mm × 3mm)	Tape and Reel,3K/Reel	1

Pin Configuration



DFN8

Figure1. Pin Configuration

Pin Function

Pin No. DFN8 ETQ61H41ADJY1	Pin Name	Pin Function
1	IN	Input Pin
2	EN	Enable Input Pin
3,6,7	NC	No Connect
4	GND	Ground Pin
5	ADJ	FB Voltage
8	OUT	Output Pin
9	TP	Thermal Pad

Block Diagram

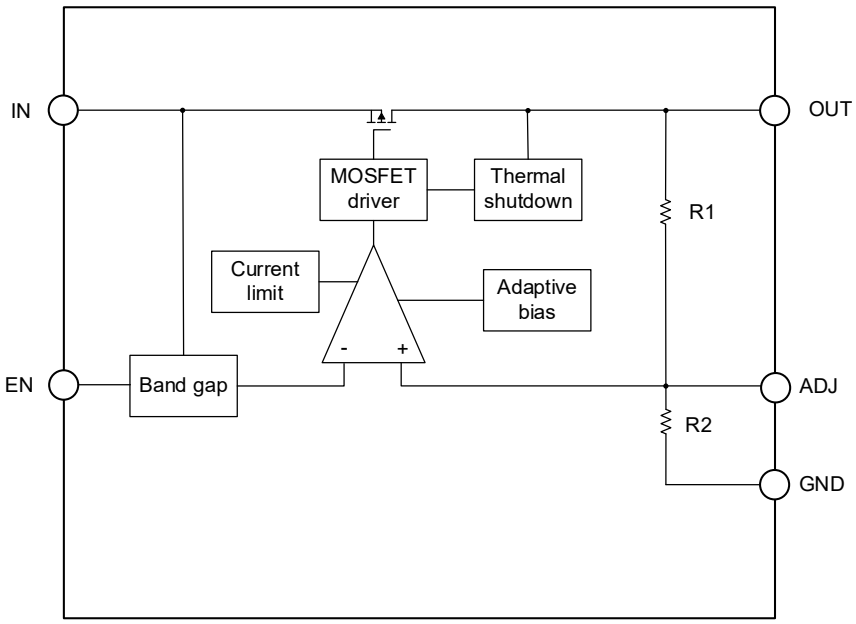


Figure2. Block Diagram

Functional Description

Input Capacitor

A 1μF~10uF ceramic capacitor is recommended to connect between 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 IN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 1μF 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.

Dropout Voltage

TheETQ61H41ADJY1 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.

Feedback Voltage

One can select an output voltage between 1.8V to 15V by using an external resistor divider. Calculate the output voltage using the following equation, where V_{ADJ} = 1.215V, R2 ≥ 1MΩ.

$$\mathbf{V_{OUT} = V_{ADJ} \times (1 + R1/R2)}$$

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 135°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.

Current-Limit Protection

TheETQ61H41ADJY1 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.

ON/OFF Input Operation

The ETQ61H41ADJY1 is turned on by setting the EN pin higher than V_{IH} threshold, and is turned off by pulling it lower than V_{IL} threshold. IN port needs to be powered on before the EN port. The recommended sequence diagram:



Figure3. Recommended Sequence Diagram

Absolute Maximum Ratings

Symbol	Rating		Value	Unit
V_{IN}	Input Voltage(1)		-0.3~45 & V_{IN}>V_{EN}	V
V_{EN}	EN Voltage		-0.3~12	V
V_{OUT}	Output Voltage		-0.3~18	V
V_{ADJ}	FB Voltage		-0.3~6	V
$T_{J(MAX)}$(2)	Maximum Junction Temperature		150	°C
T_{STG}	Storage Temperature		-65~150	°C
V_{ESD}	ESD Classification	Human Body Model (3)	±2000	V
		Charged Device Model (4)	±1500	V
L_U	Latch up Current Maximum Rating(5)		±200	mA

Stresses exceeding those listed in this 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.

Note2: When T_J > 125°C, there will be a large deviation in voltage accuracy.

Note3: HBM tested per AEC-Q100-002(JEDEC JS-001);

Note4: CDM tested per AEC-Q100-011(JEDEC JS-002);

Note5: Latch up Current Maximum Rating tested per AEC-Q100-004(JEDEC JESD78F).

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	DFN8	Thermal Characteristics, Thermal Resistance, Junction-to-Air	50	°C/W
P_D	DFN8	Max Power Dissipation @25°C	2.0	W

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	3 to 40	V
V_{EN}	EN Voltage	3 to 10	V
I_{OUT}	Output Current	0 to 150	mA
T_A	Operating Ambient Temperature	-40 to 125	°C
C_{IN}	Input Capacitor Value	1 to 10	uF
C_{OUT}	Output Capacitor Value	1 to 10	uF
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} = 1.0μF, T_A = -40°C~125°C unless otherwise noted. Typical values are at T_A = 25°C.) (6)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating Input Voltage(7)		3.0		40	V
V_{OUT}	Output Voltage	T_A = 25°C	-2.0%		+2.0%	V
		-40°C ≤ T_A ≤ 125°C	-3.5%		+3.5%	
I_Q	Quiescent Current(8)	I_{OUT} = 0mA		5.5	10	μA
I_{Q_OFF}	Standby Current	V_{EN} = 0V, T_A = 25°C		0.1	1	μA
V_{ADJ}	Feedback Voltage	T_A = 25°C	1.191	1.215	1.239	V
V_{DROP}	Dropout Voltage(9)	I_{OUT} = 150mA, V_{OUT} = 5V T_A = 25°C		220	350	mV
Reg_{Line}	Line Regulation	V_{OUT} + 2V ≤ V_{IN} ≤ 40V I_{OUT} = 10mA		0.01	0.05	%/V
Reg_{Load}	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA, V_{OUT} = 5V V_{IN} = V_{OUT} + 2V		10	30	mV
I_{LMT}	Current Limit	V_{IN} = V_{OUT} + 2V	200	350	500	mA
PSRR	Power Supply Rejection Ratio(10)	f = 1kHz, V_{IN} = V_{OUT} + 2V, V_{OUT} = 5V, I_{OUT} = 20mA		70		dB
V_{ENH}	EN Pin Threshold Voltage	EN Input Voltage “H”	1.4			V
V_{ENL}	EN Pin Threshold Voltage	EN Input Voltage “L”			0.4	V
e_N	Output Noise Voltage(10)	V_{IN} = V_{OUT} + 2V, I_{OUT} = 1mA, f = 10Hz to 100KHz, C_{OUT} = 1μF		45* V_{OUT}		μVrms
T_{TSD}	Thermal Shutdown Temperature(10)	Temperature Increasing from T_A = 25°C	135	155		°C
T_{HYS}	Thermal Shutdown Hysteresis(10)	Temperature Falling from T_{TSD}		20		°C

Note6: Here V_{IN} means internal circuit can work normal. If V_{IN} < V_{OUT}, Output voltage follow V_{IN} (I_{OUT} = 1mA), circuit is safety.

Note7: The minimum operating voltage is 3.0V. V_{DROP} = $V_{IN(min)}$ - V_{OUT}.

Note8: R2 needs to be greater than or equal to 1MΩ.

Note9: V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET} + $V_{DROPMAX}$ with 150mA output current.

Note10: Guaranteed by design and characterization. not a FT item.

Application Circuits

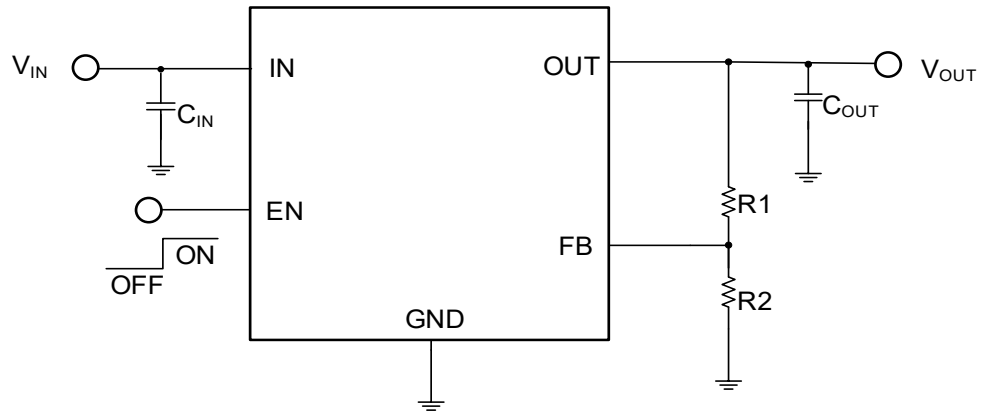


Figure4. Adjustable Voltage Typical Application Circuit

Note: V_{OUT} = 1.215 × (1 + R1/R2), R2 ≥ 1MΩ.

PCB Layout Guide

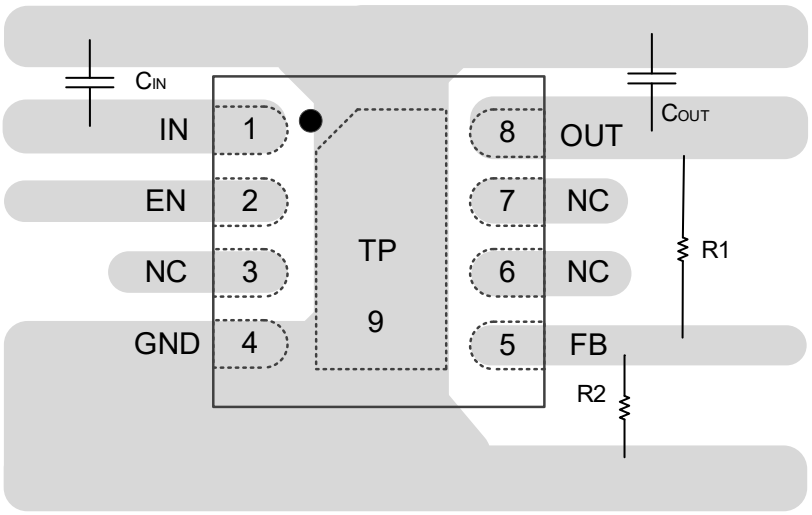
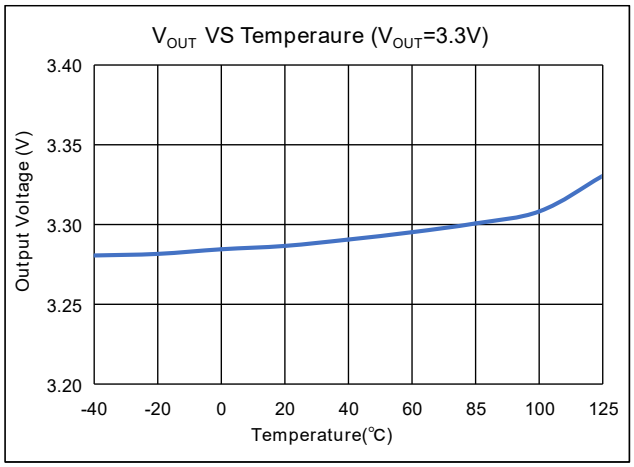


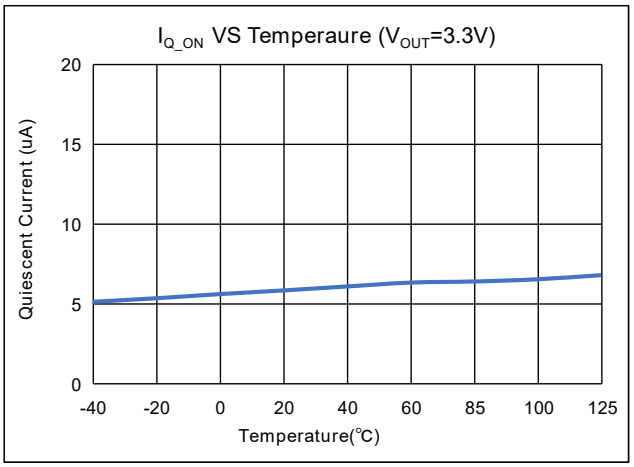
Figure5. PCB Layout Guide

Typical Characteristics

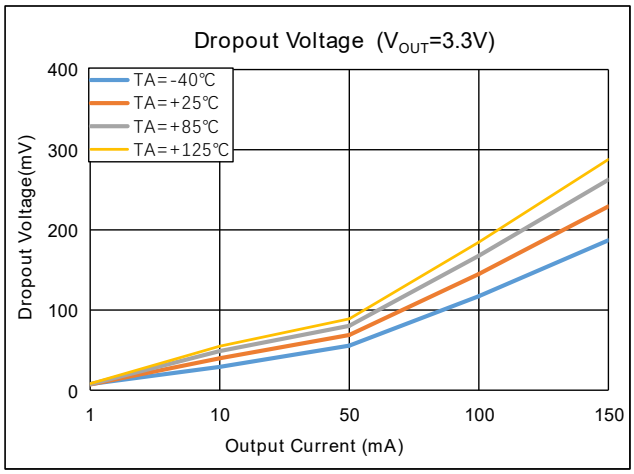
(V_{OUT} = 3.3V, V_{IN} = 5.3V, I_{OUT} = 10mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF, T_A = 25°C)



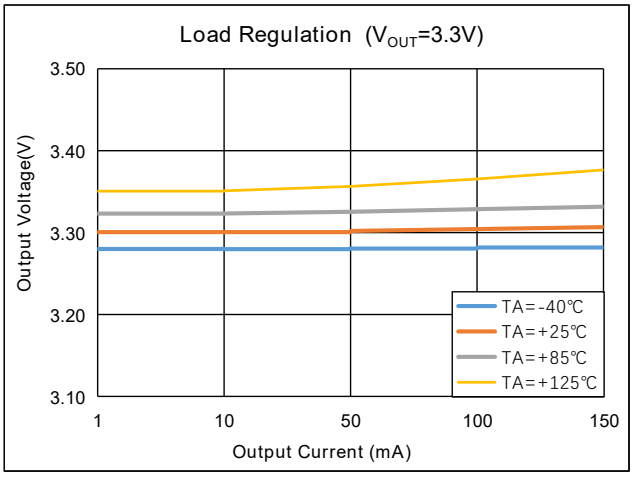
Output Voltage VS Temperature



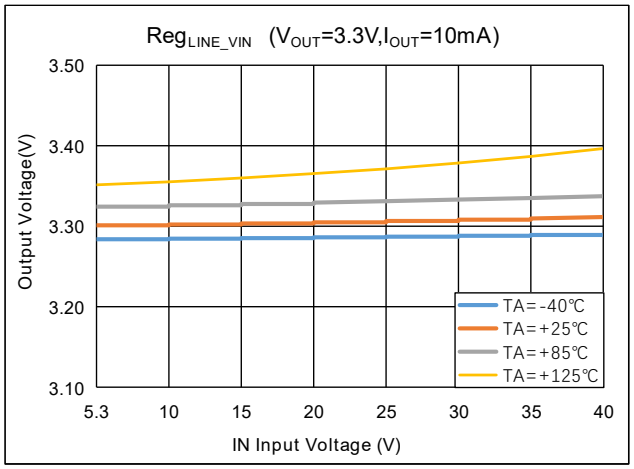
Supply Current VS Temperature



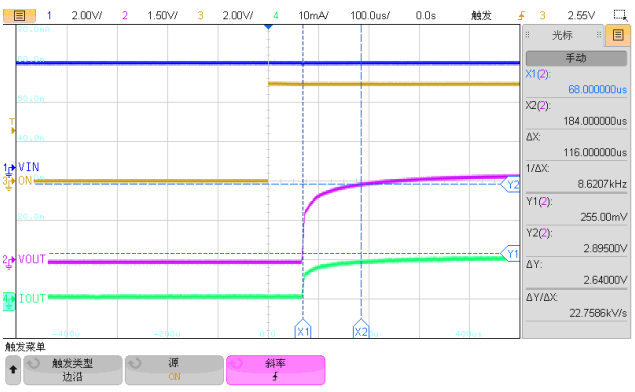
Dropout Voltage VS Output Current



Output Voltage VS Output Current



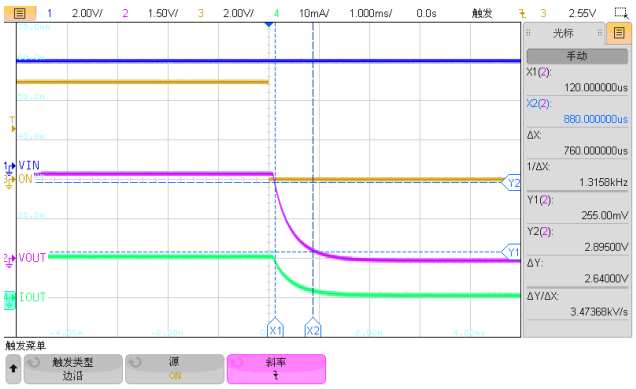
Output Voltage VS V_{IN} Input Voltage



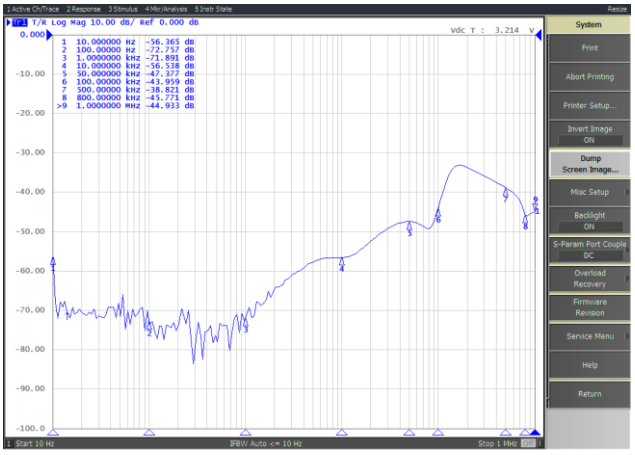
T_{ON}

Typical Characteristics(Continued)

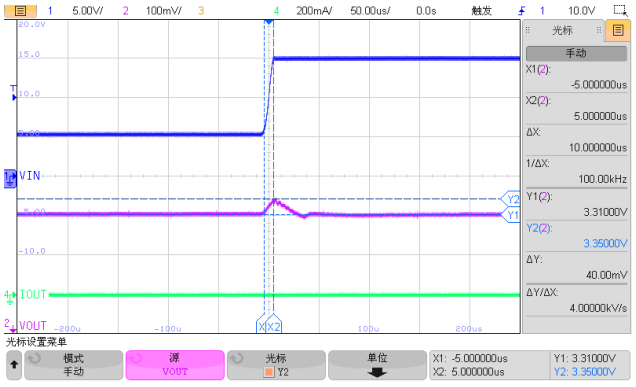
(V_{OUT} = 3.3V, V_{IN} = 5.3V, I_{OUT} = 10mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF, T_A = 25°C)



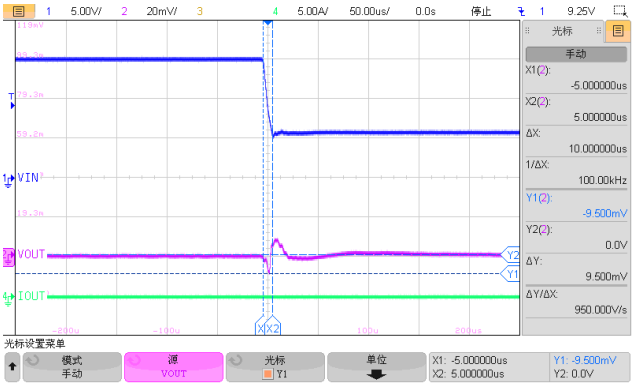
T_{OFF}



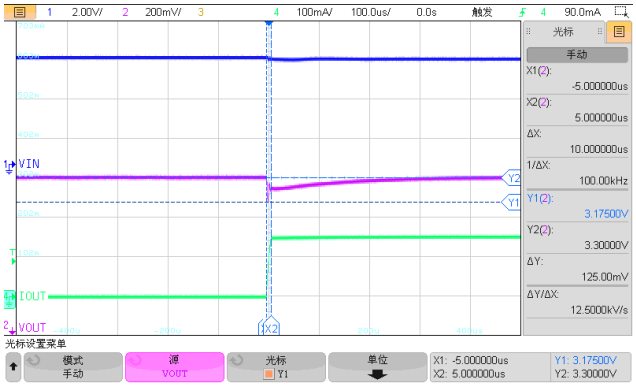
PSRR(I_{OUT} = 20mA)



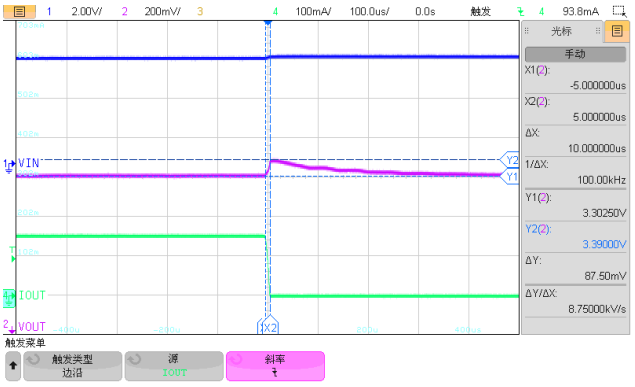
Input Transient(5.3V~22V t = 10us 1mA)



Input Transient(14V~22V t = 10us 1mA)



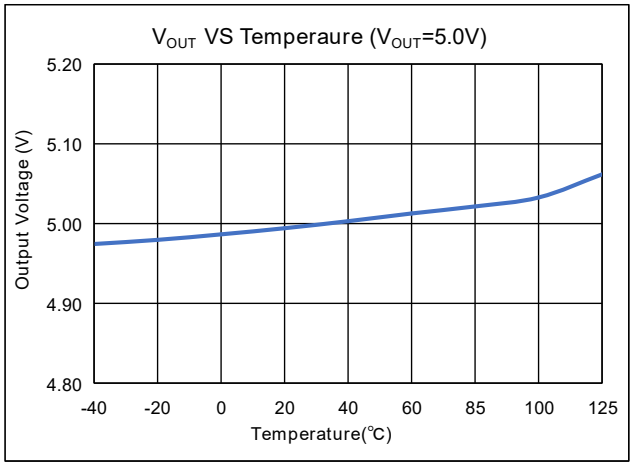
Load Transient(1mA~150mA t = 10us)



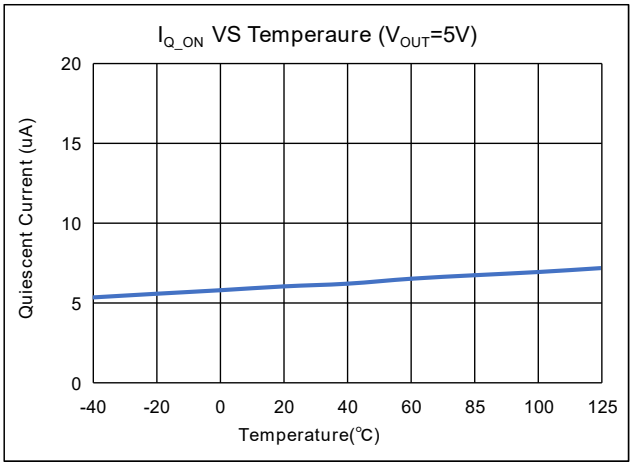
Load Transient(150mA~1mA t = 10us)

Typical Characteristics(Continued)

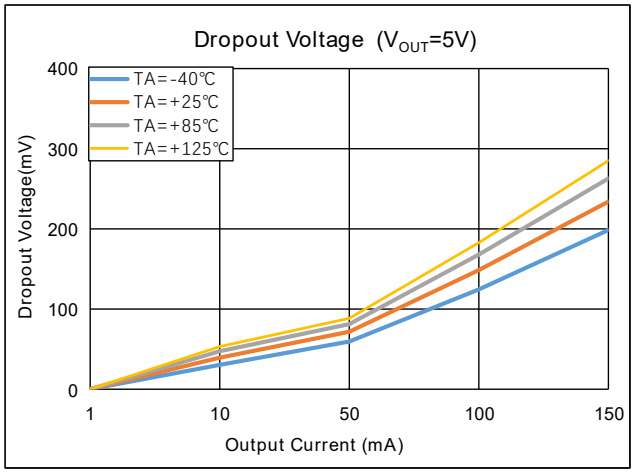
(V_{OUT} = 5V, V_{IN} = 7V, I_{OUT} = 10mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A = 25°C)



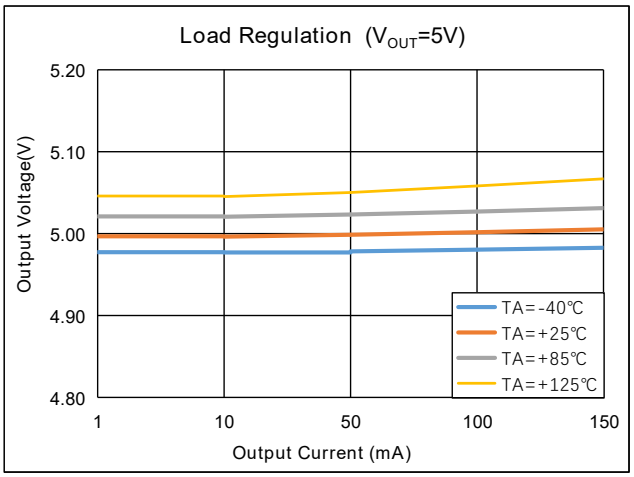
Output Voltage VS Temperature



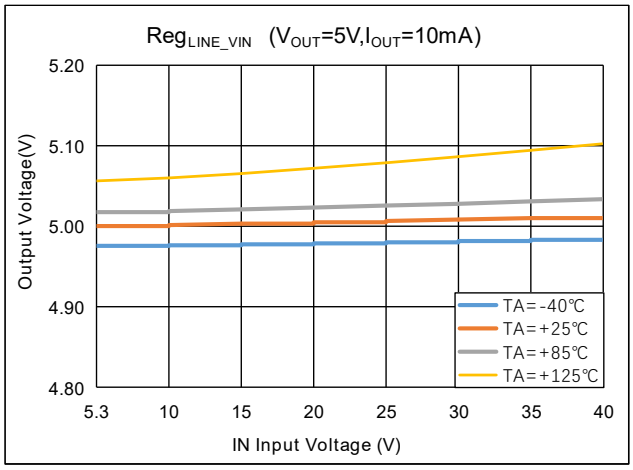
Supply Current VS Temperature



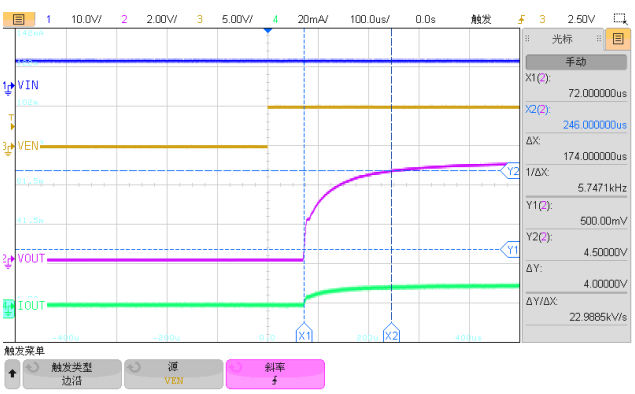
Dropout Voltage VS Output Current



Output Voltage VS Output Current



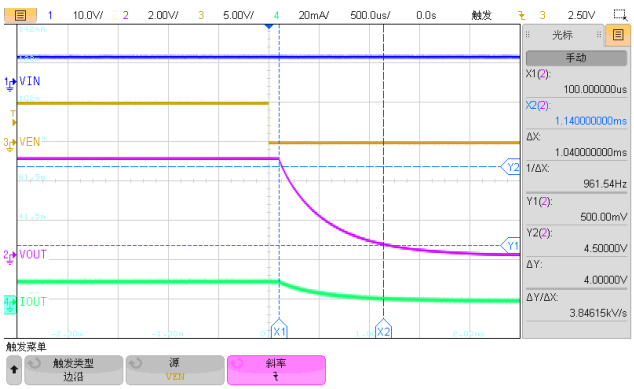
Output Voltage VS V_{IN} Input Voltage



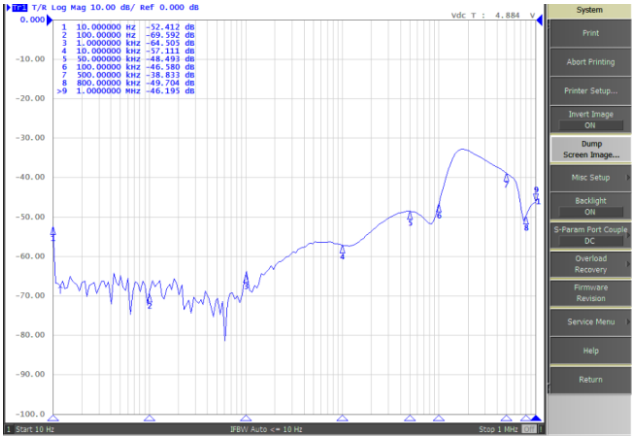
T_{ON}

Typical Characteristics(Continued)

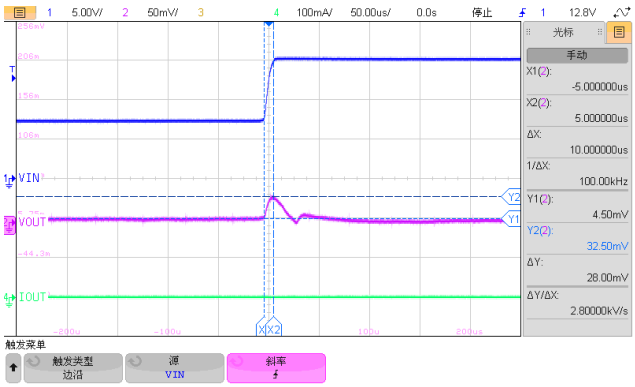
(V_{OUT} = 5V, V_{IN} = 7V, I_{OUT} = 10mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF, T_A = 25°C)



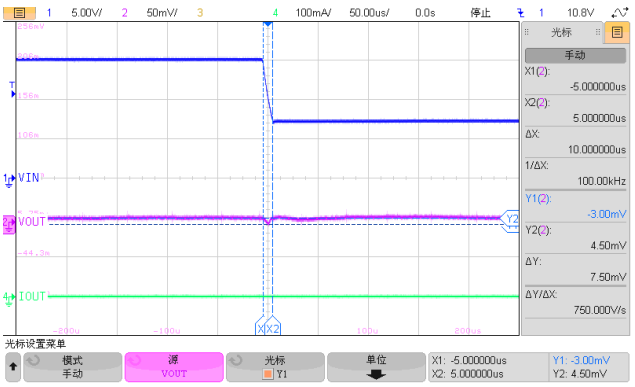
T_{OFF}



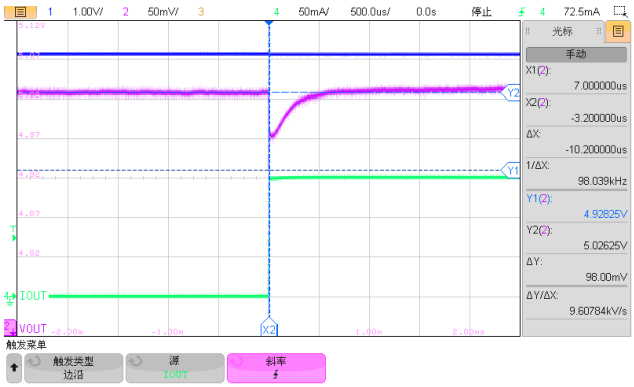
PSRR(I_{OUT} = 20mA)



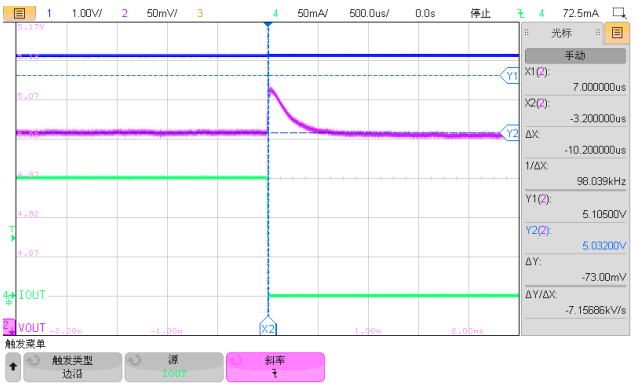
Input Transient(7V~15V t = 10us 1mA)



Input Transient(7V~15V t = 10us 1mA)



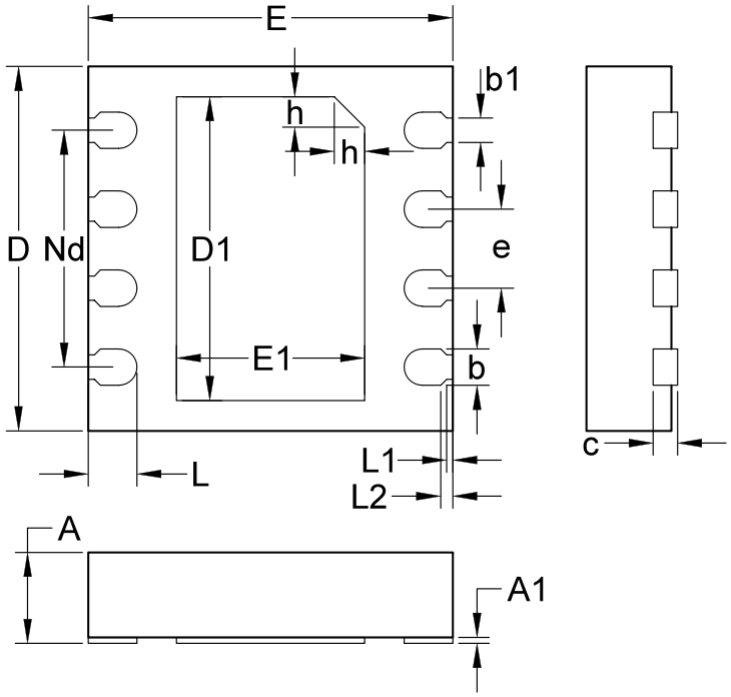
Load Transient(1mA~150mA t = 10us)



Load Transient(150mA~1mA t = 10us)

Package Dimension

DFN8 (3mm × 3mm)



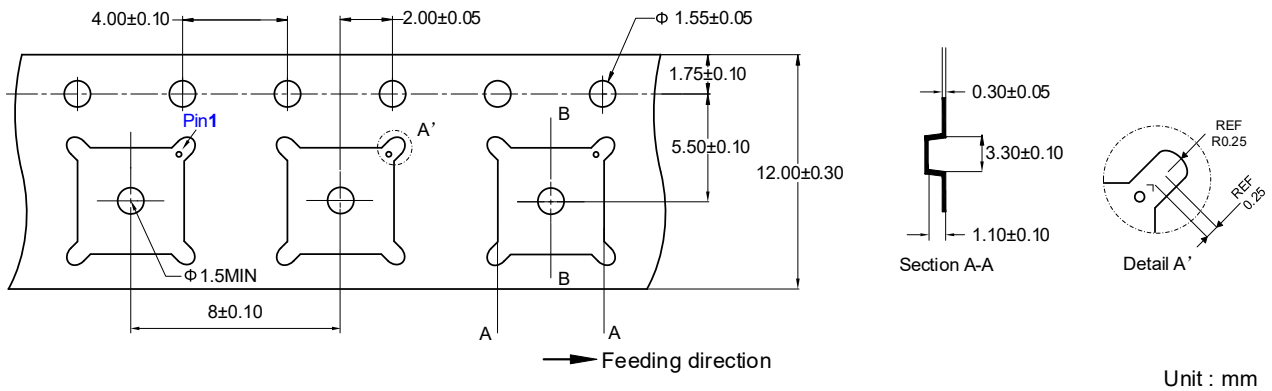
COMMON DIMENSIONS

(Unit: mm)

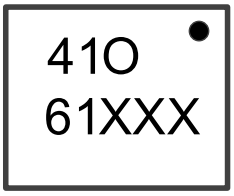
SYMBOL	MIN	NOM	MAX
A	0.70	-	0.95
A1	0.00	0.02	0.05
b	0.25	0.30	0.35
b1		0.20REF	
c	0.18	0.20	0.25
D	2.90	3.00	3.10
D1	2.40	2.50	2.60
e		0.65BSC	
Nd		1.95BSC	
E	2.90	3.00	3.10
E1	1.45	1.55	1.65
L	0.30	0.40	0.50
L1		0.05REF	
L2		0.10REF	
h	0.20	0.25	0.30

Tape Information

DFN8 (3mm × 3mm)



Marking Information



41O = Part Number

61XXX = Track Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2023-09-15	Preliminary Version	Tugz	Guj,Liuxm	Liujy
0.1	2024-11-15	Update AMR	Wangar	Guj,Liuxm	Liujy
1.0	2024-11-20	Add Characteristic curve	Wangar	Guj,Liuxm	Liujy
1.1	2024-11-28	Update EC table and Package Dimension	Wangar	Guj,Liuxm	Liujy
1.2	2024-12-3	Update Marking and Tape	Wangar	Guj,Liuxm	Liujy
1.3	2025-06-04	Update EC table	Wangar	Yangxx	Liujy
1.4	2025-08-08	Update AMR and EC table	Wangar	Yangxx	Liujy
1.5	2026-05-20	Update AMR and Format	Xut	Yangxx	Liujy
1.5.a	2026-10-23	Update Tape and Marking	Xut	Yangxx	Liujy