TECH PUBLIC
台舟电子

LM2596 Series

3A / 150kHz Step-Down DC-DC Converter

www.sot23.com.tw

GENERAL DESCRIPTION

The LM2596 Series are step-down switching regulator s with all required active functions. It is capable of driving 3A load with excellent line and load regulations. These devices are available in fixed output voltages of 3.3V, 5V, and an adjustable output version.

The LM2596 series operates at a switching frequency of 150kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. It substantially not only reduces the area of board size but also the size of heat sink, and in some cases no heat sink is required. The ±4% tolerance on output voltage within specified input voltages and output load conditions is guaranteed. Also, the oscillator frequency accuracy is within ±10%. External shutdown is included. Featuring 100μA (typical) standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown for full protection under fault conditions.

Features

- Output voltage: 3.3V, 5V & adjustable version
- Adjustable output voltage range 1.23V~38.5V
- 150kHz fixed switching frequency
- Voltage mode Non-synchronous PWM control
- Thermal shutdown and current limit protection
- ON/OFF shutdown control input
- Short circuit protect (SCP)
- Operating voltage can be up to 40V
- Output load current 3A

Applications

- Simple High-efficiency Step down Regulator
- On-Card Switching Regulators
- Positive to Negative Converter

TYPICAL APPLICATION

OUTPUT VOLTAGE	PART NO.	PACKAGE	PACKING
3.3V	LM2596S-3.3	TO-263-5L (D^2PAK)	500pcs / 13" Reel
5.0V	LM2596S-5.0	TO-263-5L (D^2PAK)	500pcs / 13" Reel
ADJ	LM2596S-ADJ	TO-263-5L (D^2PAK)	500pcs / 13" Reel

Marking:

LM2596S-3.3

TECH PUBLIC
LM2596S
-3.3 P+

LM2596S-5.0

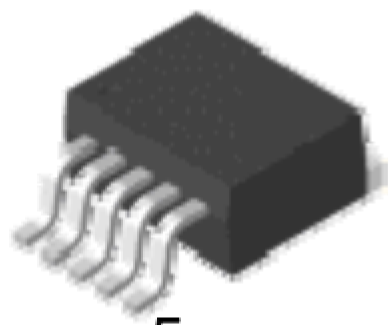
TECH PUBLIC
LM2596S
-5.0 P+

LM2596S-ADJ

TECH PUBLIC
LM2596S
-ADJ P+

PIN CONFIGURATION

TO-263-5L (D^2PAK)



Pin Definition:
1. Input
2. SW Output
3. Ground
4. Feedback
5. Enable

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	LIMIT	UNIT
Maximum Supply Voltage	V_{CC}	+45	V
Recommend Operating Supply Voltage	V_{OP}	+4.5 to +40	V
SW, EN Pin Input Voltage	V_{SW}, V_{EN}	-0.3 to +40	V
Feedback Pin Voltage	V_{FB}	-0.3 to +12	V
Power Dissipation	P_D	Internally Limited	W
Output Voltage to Ground	V_{OUT}	-1	V
Storage Temperature Range	T_{ST}	-65 ~ +150	°C
Operating Temperature Range	T_{OP}	-40 ~ +125	°C
ESD Susceptibility (HBM)		2	kV

THERMAL INFORMATION

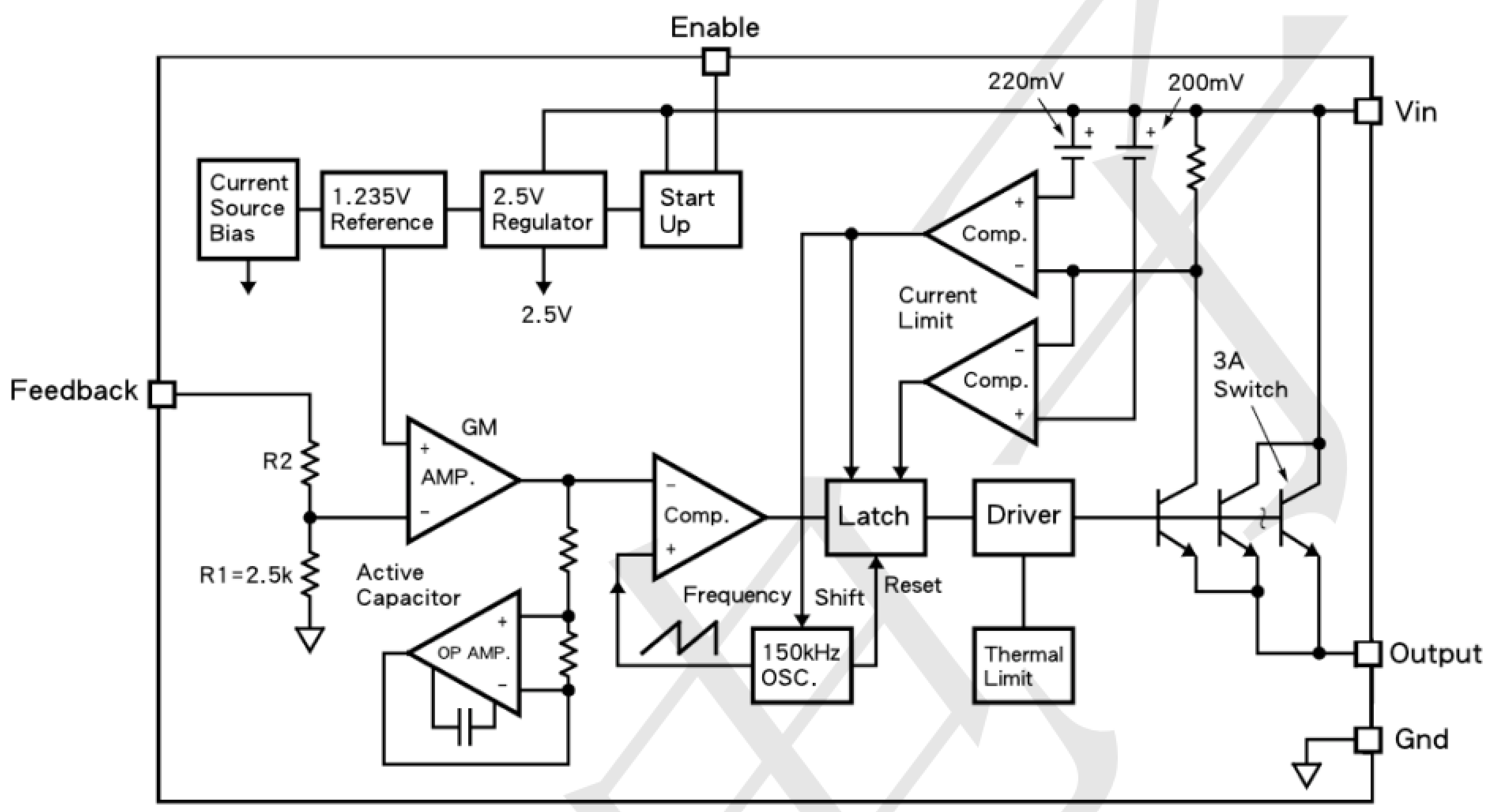
PARAMETER	SYMBOL	LIMIT	UNIT
Junction to Case Thermal Resistance	$R_{\theta JC}$	2	°C/W
Junction to Ambient Thermal Resistance	$R_{\theta JA}$	50	°C/W

Electrical Characteristics (T_A=25 C unless otherwise noted)

(V_{IN} = 12V for 3.3V, 5V, Adjustable Version, I_{LOAD} = 0.3A, T_A = 25°C unless otherwise noted)

PARAMETER		CONDITION	SYMBOL	MIN	TYP	MAX	UNIT
Output Feedback	ADJ	4.5V ≤ V_{IN} ≤ 40V 0.2A ≤ I_{LOAD} ≤ 3A	V_{FB}	1.180	1.23	1.280	V
Efficiency		V_{IN} = 12V, I_{LOAD} = 3A, V_{OUT} = 5V	η	--	77	--	%
Output Feedback	3.3V	4.75V ≤ V_{IN} ≤ 40V 0.2A ≤ I_{LOAD} ≤ 3A	V_{FB}	3.135	3.3V	3.465	V
Efficiency		V_{IN} = 12V, I_{LOAD} = 3A	η	--	75	--	%
Output Feedback	5V	7V ≤ V_{IN} ≤ 40V 0.2A ≤ I_{LOAD} ≤ 3A	V_{FB}	4.75	5	5.25	V
Efficiency		V_{IN} = 12V, I_{LOAD} = 3A	η	--	80	--	%
Feedback Bias Current		V_{FB} =1.3V (Adj version only)	I_{FB}	--	10	100	nA
Oscillator Frequency			F_{OSC}	127	150	173	kHz
Soft-Start Time		Rising edge of EN on to I_{CL}	T_{SS}	--	3	--	ms
Current Limit		Pear Current, no outside circuit V_{FB} =0V force driver on	I_{CL}	3.3	--	--	A
Oscillator Frequency of Short Circuit Protect		When current limit occurred and V_{FB} <0.5V, Ta = 25°C	F_{SCP}	110	150	173	KHz
Saturation Voltage		I_{OUT}=3A, No outside circuit V_{FB} =0V force driver on	V_{SAT}	--	1.15	1.50	V
ON/OFF Pin Logic Input Threshold Voltage		Low (regulator ON)	V_{IL}	--	1.3	0.6	V
		High (regulator OFF)	V_{IH}	2.0	1.3	--	V
ON/OFF Pin Logic Input Current		V_{LOGIC} =2.5V (OFF)	I_H	--	5	15	μA
		V_{LOGIC} =0.5V (ON)	I_L	--	0.02	5	
Maximum Duty Cycle (ON)		V_{FB} =0V force driver on	DC	--	100	--	%
Maximum Duty Cycle (OFF)		V_{FB} =12V force driver off		--	0	--	
Quiescent Current		V_{FB} =12V force driver off	I_Q	--	5	10	mA
Standby Quiescent Current		ON/OFF pin=5V	I_{STBY}	--	80	200	μA
		V_{IN} =40V		--		250	
SW Pin Leakage Current	SW pin = 0	No outside circuit, V_{FB} =12V force driver off	I_{SWL}	--	0.3	2	mA
	SW pin = -1	V_{IN} =12V		--	7.5	30	mA

BLOCK DIAGRAM



PIN FUNCTION DESCRIPTION

V_{CC}

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be presented at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

Ground

Circuit ground

SW Output

Internal switch. The voltage at this pin switches between ($+V_{CC} – V_{SAT}$) and approximately – 0.5V, with a duty cycle of approximately V_{OUT} / V_{CC}. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be minimized.

Feedback

Sense the regulated output voltage to complete the feedback loop.

Enable

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 100μA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of V_{CC}) shuts the regulator down. If this shutdown feature is not needed, the EN pin can be wired to the ground pin.

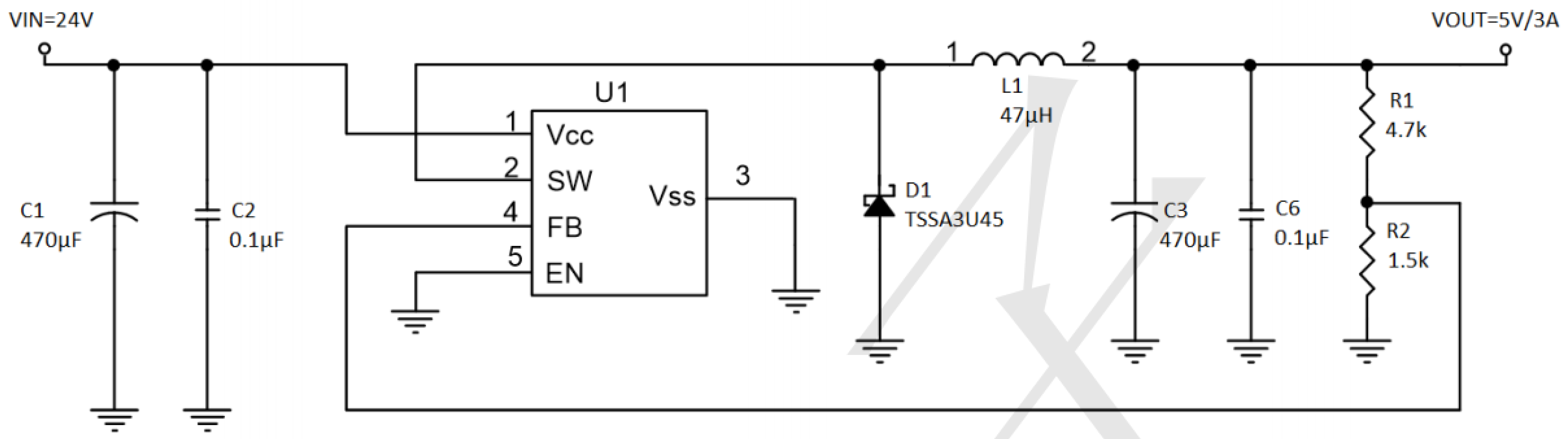
Thermal Considerations

The LM2596 (TO-263-5L package) junction temperature rise above ambient temperature with a 3A load for various input and output voltages. This data was taken with the circuit operating as a buck switching regulator with all components mounted on a PC board to simulate the junction temperature under actual operating conditions. This curve can be used for a quick check for the approximate junction temperature for various conditions, but be aware that there are many factors that can affect the junction temperature. When load currents higher than 3A are used, double sided or multilayer PC boards with large copper areas and/or airflow might be needed, especially for high ambient temperatures and high output voltages.

For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (Once exception to this is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

TYPICAL APPLICATIN CIRCUIT

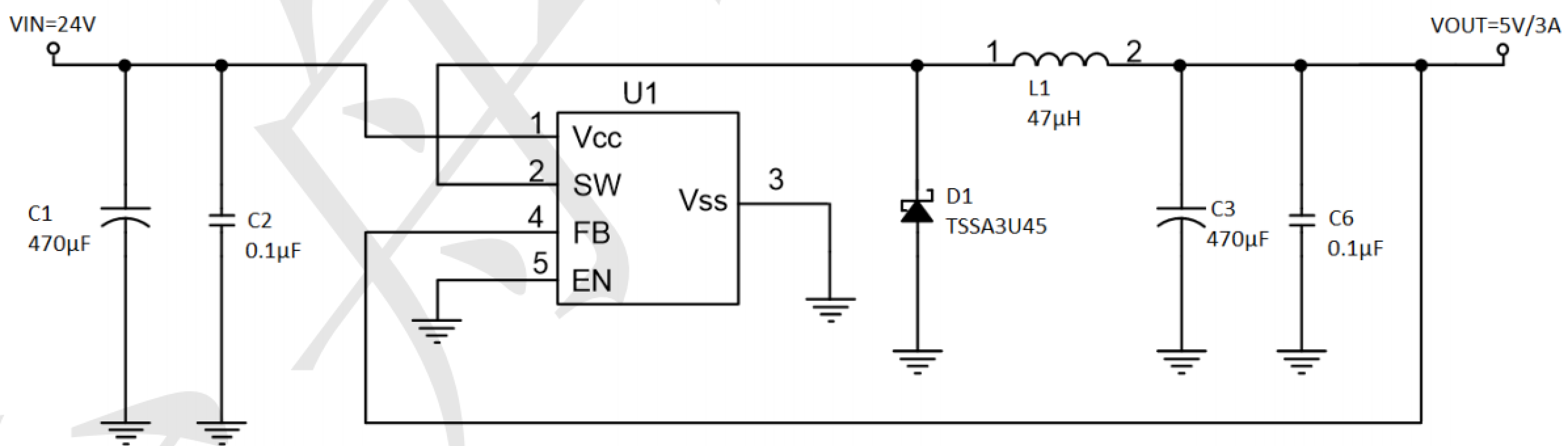
Adjustable Output Voltage Version



$$V_{OUT} = V_{FB} \times (1 + \frac{R1}{R2}),\ V_{FB} = 1.23V,\ R2 = 0.7k \sim 3k$$

V_{OUT}	R2	R1
5.0V	1.5kΩ	4.7kΩ
3.3V	1.5kΩ	2.5kΩ
2.5V	1.5kΩ	1.5kΩ

Fixed Output Voltage Version



L1 recommend value (I_{OUT}=3A,)				
V_{OUT}	2.5V	3.3V	5V	12V
V_{IN}=12V	33μH	33μH	33~47μH	NA
V_{IN}=24V	33μH	33μH	47μH	68μH

ELECTRICAL CHARACTERISTICS CURVES

(T_C = 25°C unless otherwise noted)

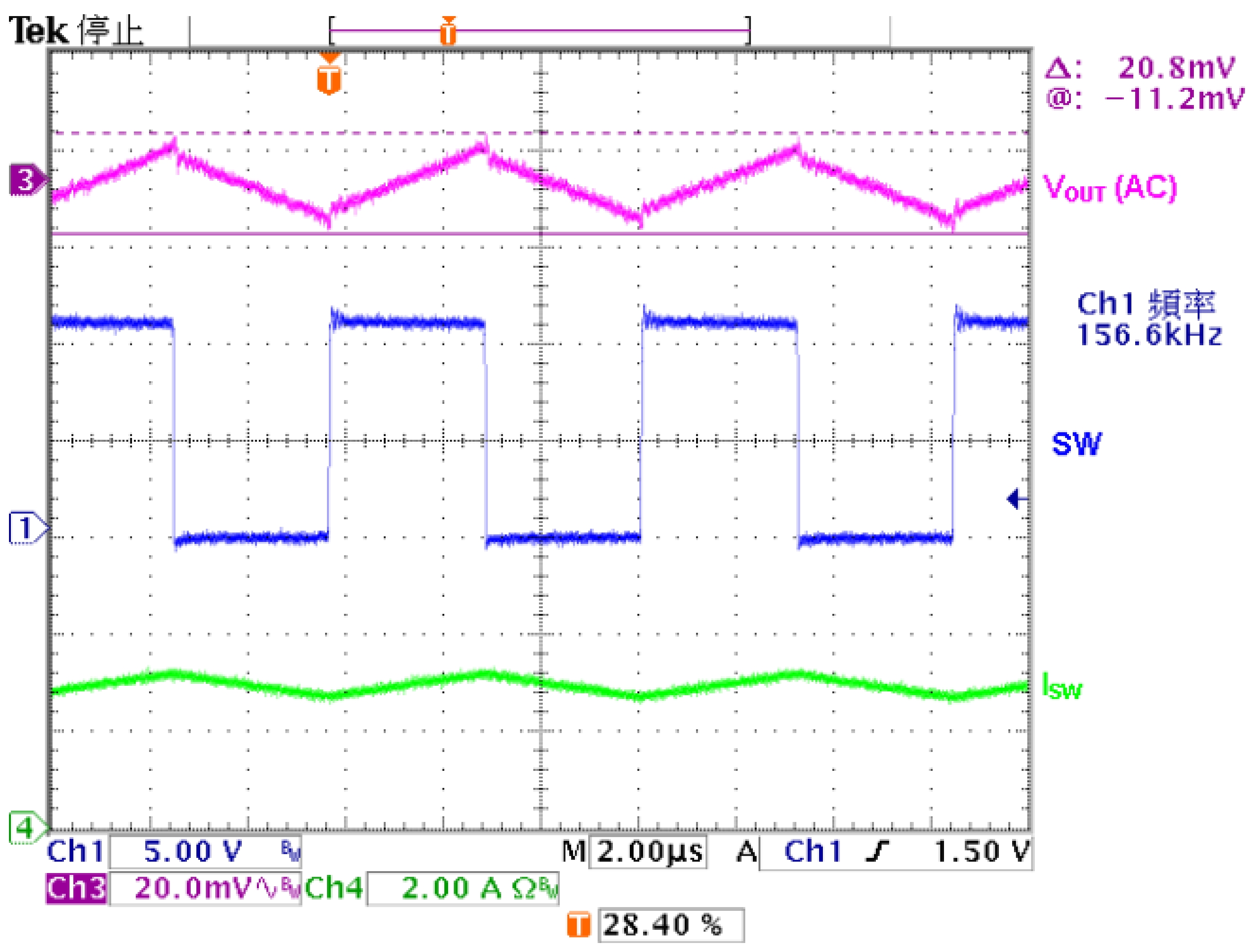


Figure 1. Output Ripple

(V_{IN}=12V, V_{OUT}=5V, I_O=3A)

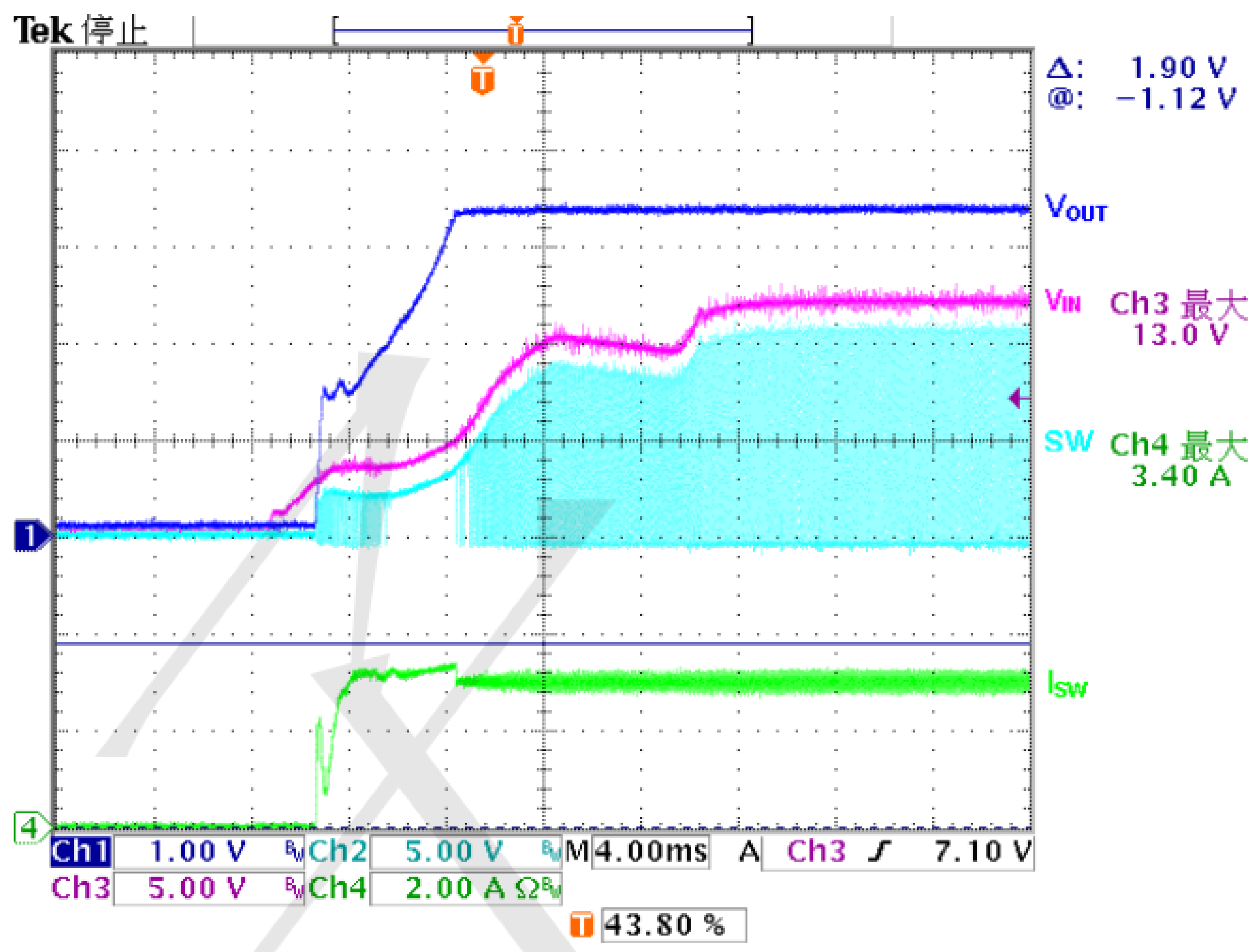


Figure 2. Power On Test Wave

(V_{IN}=12V, V_{OUT}=5V, I_O=3A)

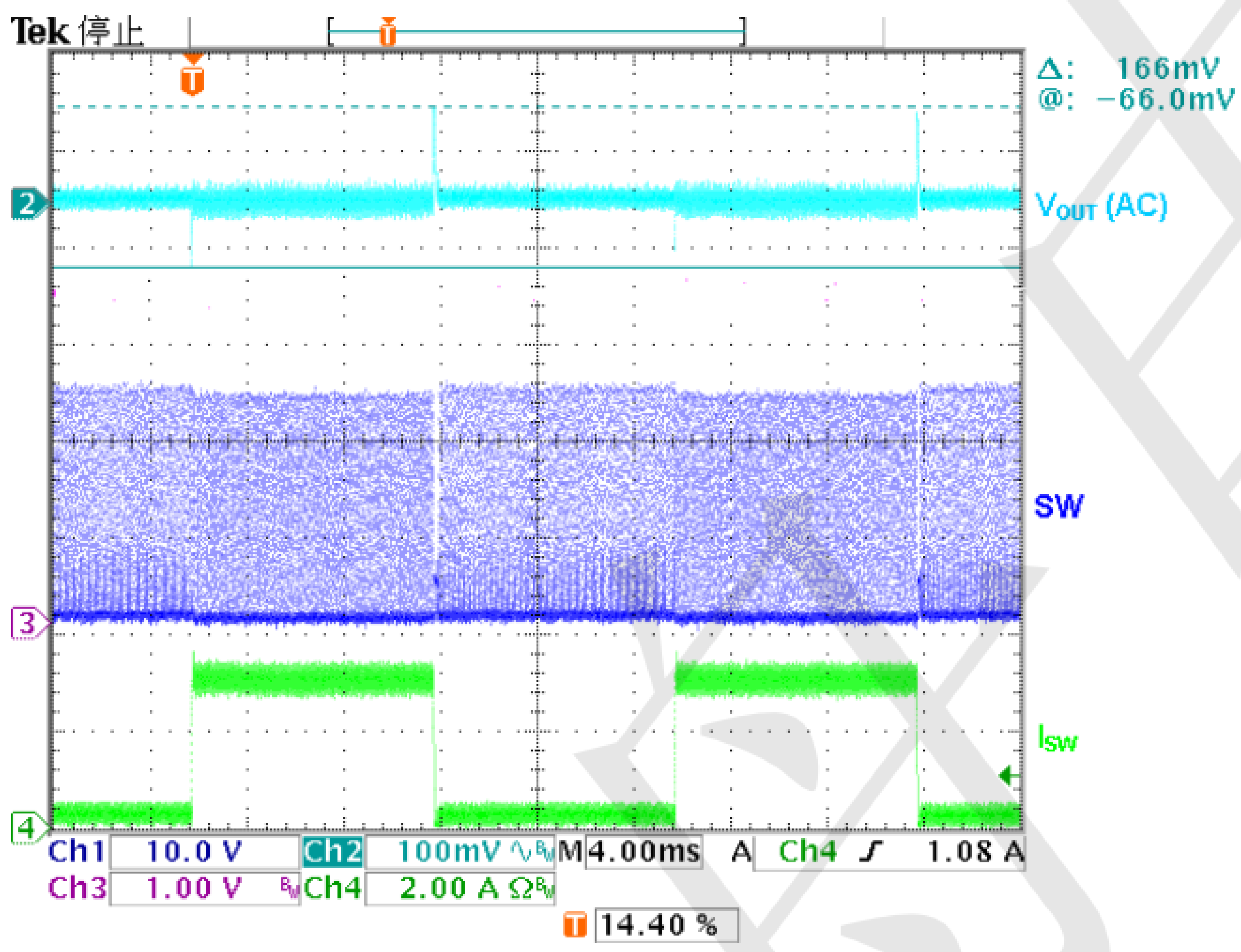


Figure 3. Load Transient Response

(V_{IN}=12V, V_{OUT}=5V, I_O=0.2~3A)

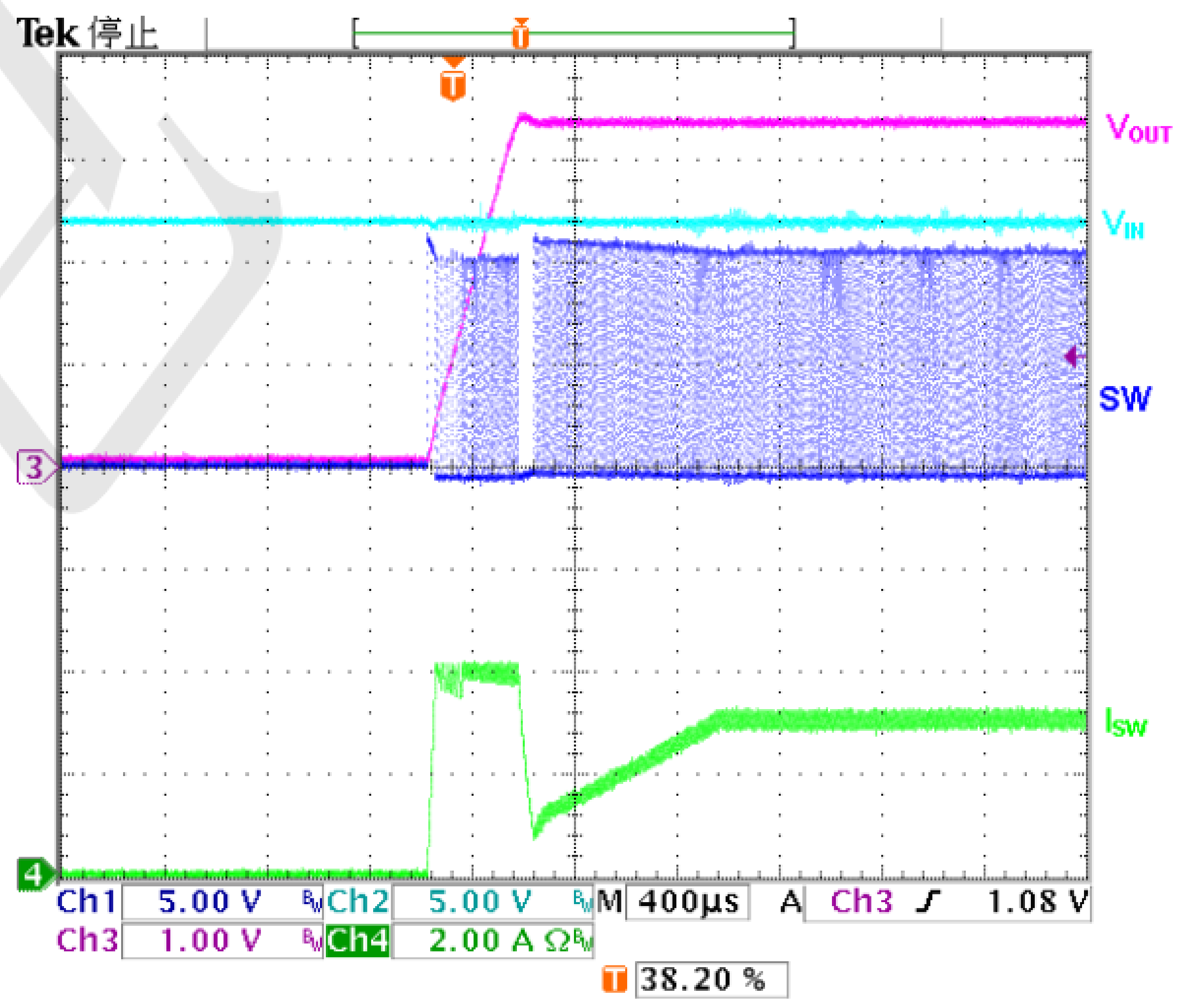


Figure 4. EN On Test Wave

(V_{IN}=12V, V_{OUT}=5V, I_O=3A)

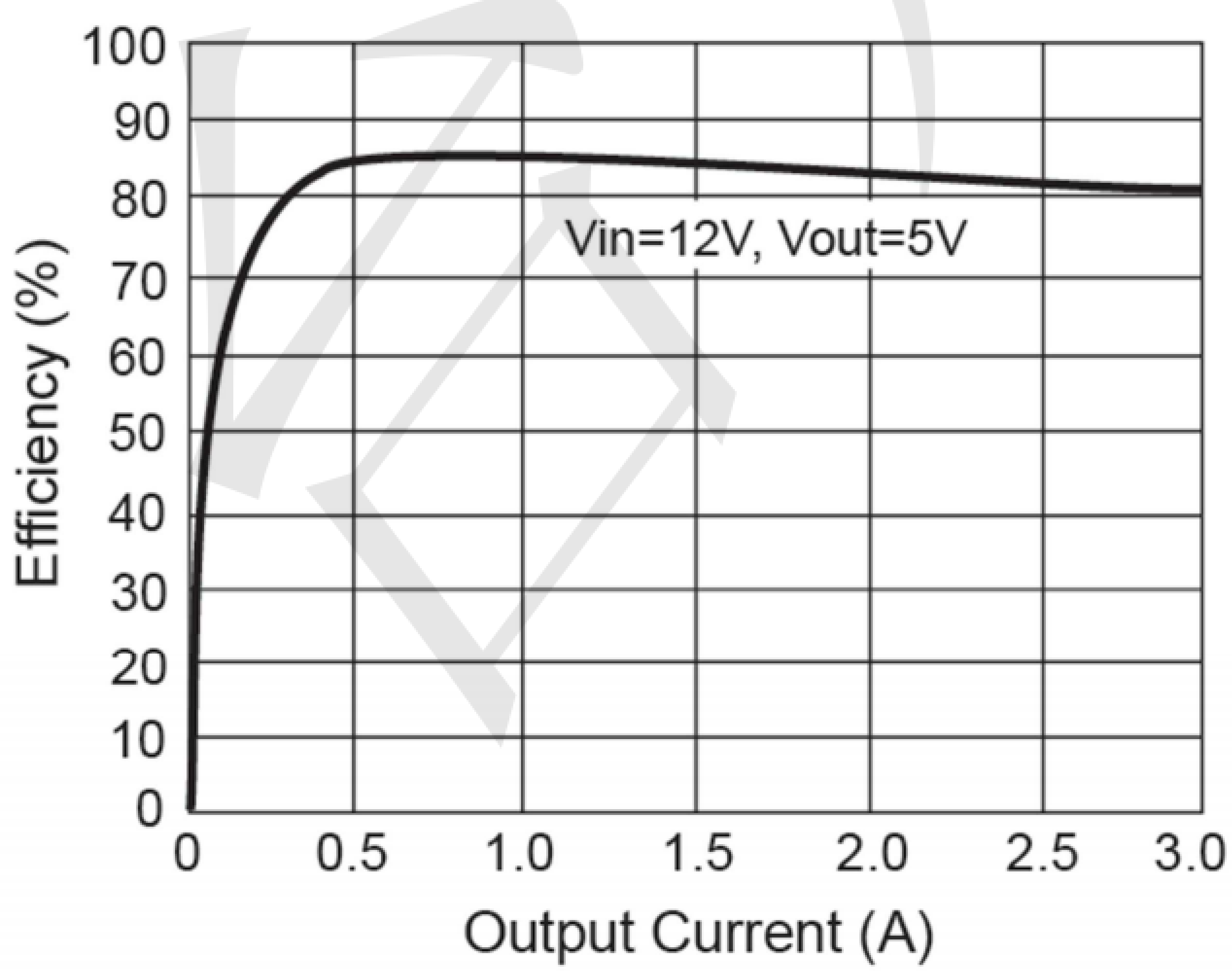


Figure 5. Efficiency

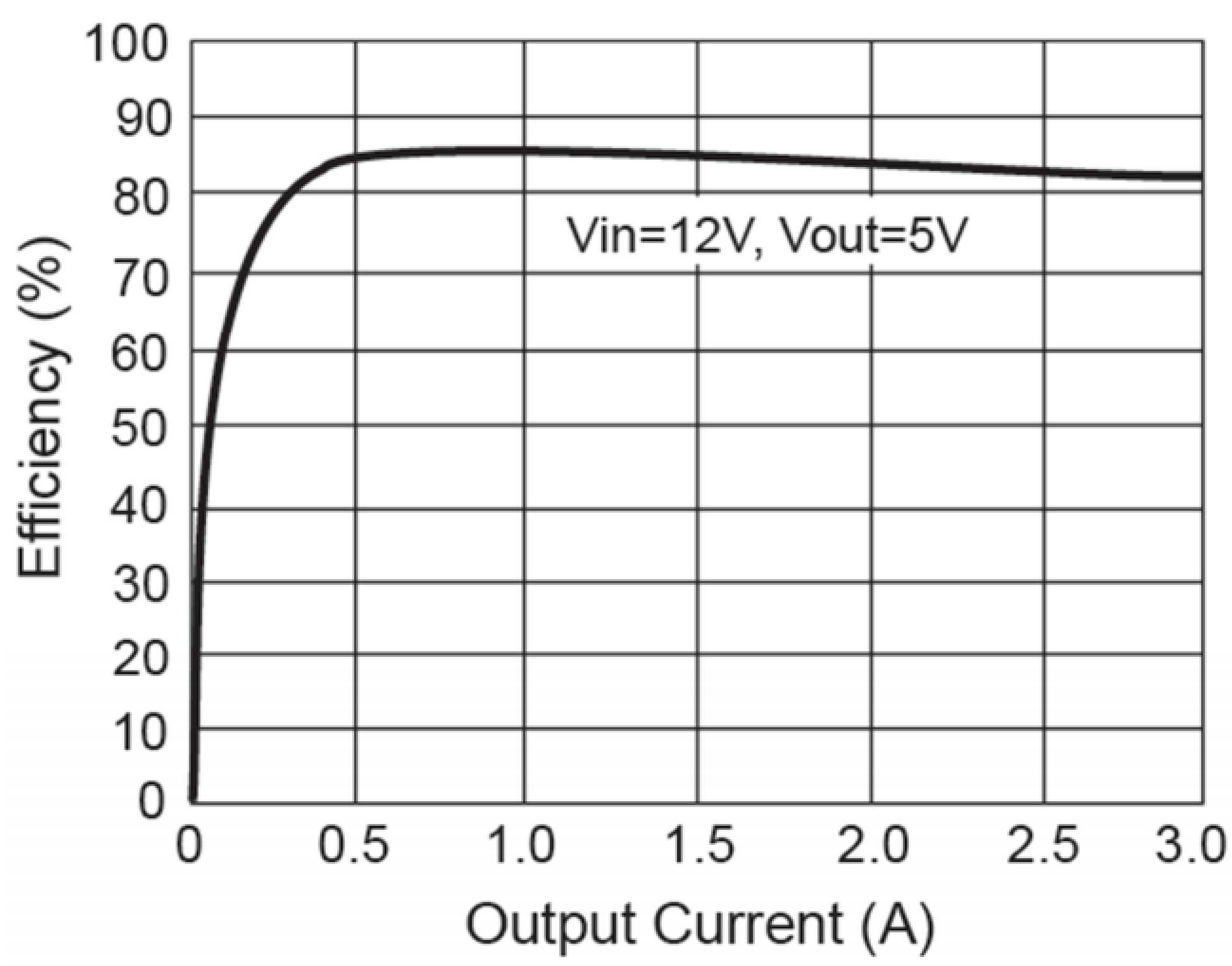
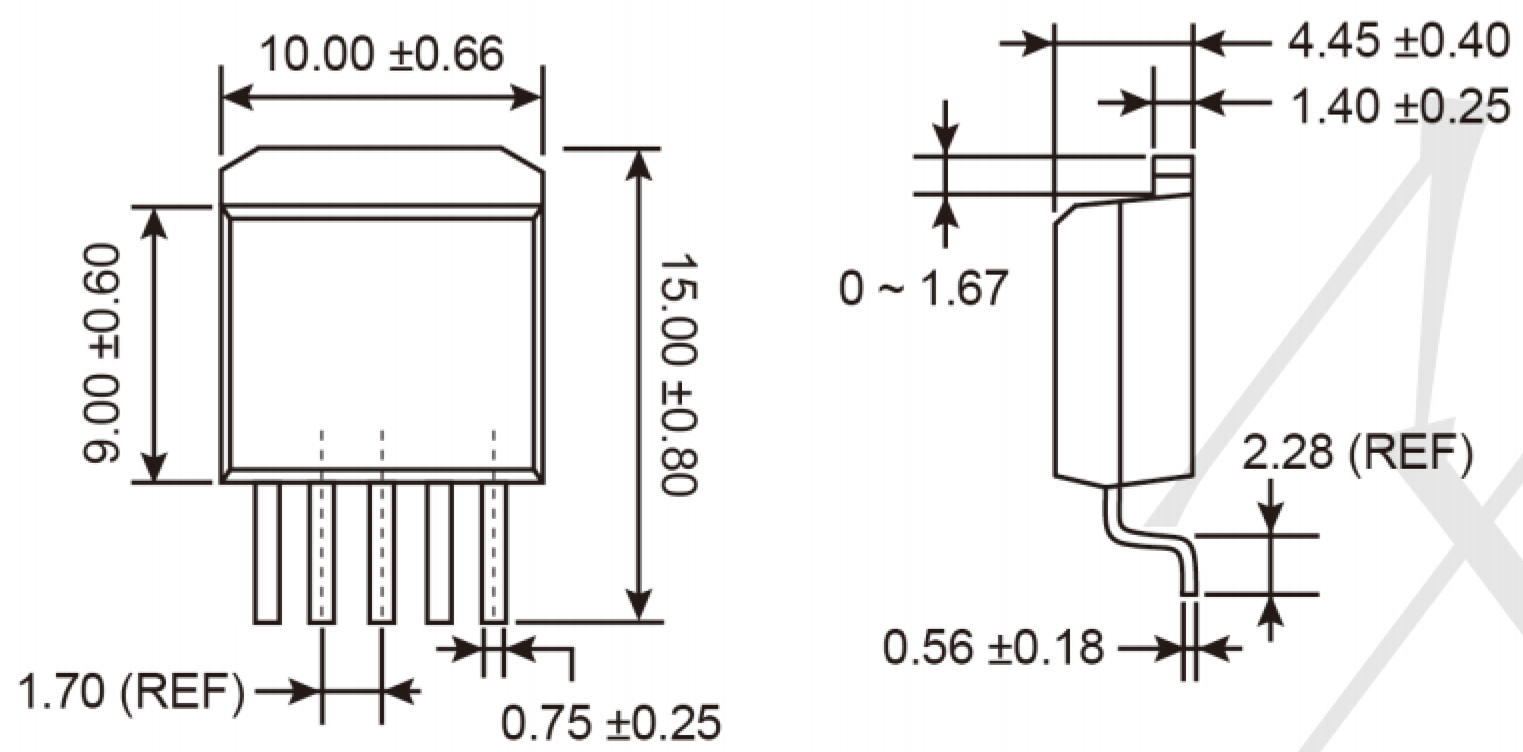


Figure 6. Efficiency

PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

TO-263-5L (D²PAK)



SUGGESTED PAD LAYOUT (Unit: Millimeters)