Features

- Input voltage: 3.6V to 23V
- Output voltage: 0.8V to V_{CC}.
- Duty ratio: 0% to 100% PWM control
- Oscillation frequency: 300kHz typ.
- Current Limit, Enable function
- Thermal Shutdown function
- Built-in internal SW P-channel MOS
- SOP-8L Pb-Free Package
- SOP-8L: Available in "Green" Molding Compound (No Br, Sb)
- Lead Free Finish/RoHS Compliant (Note 1)

General Description

AP1510 consists of step-down switching regulator with PWM control. These devices include a reference voltage source, oscillation circuit, error amplifier and internal PMOS.
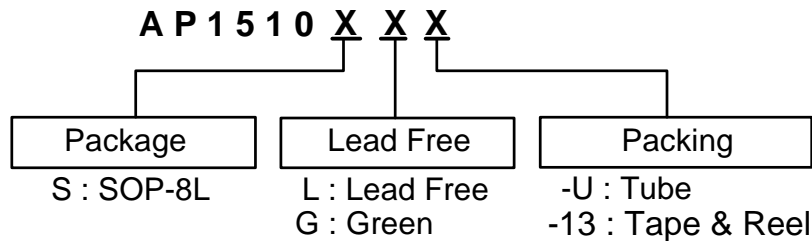
AP1510 provides low-ripple power, high efficiency and excellent transient characteristics. The PWM control circuit is able to vary the duty ratio linearly from 0 up to 100%. This converter also contains an error amplifier circuit. An enable function, an over current protection and a short circuit protection are built inside, when OCP or SCP happens, the operation frequency will be reduced from 300kHz to 30kHz. Also, an internal compensation block is built in to minimum external component count.

With the addition of an internal P-channel Power MOS, a coil, capacitors, and a diode connected externally, these ICs can function as step-down switching regulators. They serve as ideal power supply units for portable devices when coupled with the SOP-8L package, providing such outstanding features as low current consumption. Since this converter can accommodate an input voltage up to 23V, it is also suitable for the operation via an AC adapter.

Applications

- Cellular Phones
- PC Motherboard
- LCD Monitor
- Graphic Card
- DVD-Video Player
- Telecom Equipment
- ADSL Modem
- Printer and other Peripheral Equipment
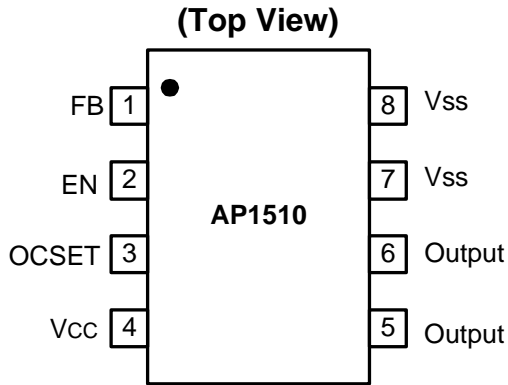- Microprocessor core supply
- Networking power supply

Ordering Information

A P 1 5 1 0 <u>X</u> <u>X</u> <u>X</u>

Package	Lead Free	Packing
S : SOP-8L	L : Lead Free G : Green	-U : Tube -13 : Tape & Reel

Device	Package Code	Packaging (Note 2)	Tube		13" Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AP1510S	S	SOP-8L	100	- U	2500/Tape & Reel	-13

Notes: 1. RoHS revision 13.2.2003. Glass and High Temperature Solder Exemptions Applied, see *EU Directive Annex Notes 5 and 7*.
2. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

Pin Assignments

(Top View)

```
      ┌───────────────┐
FB  1 │ ●             │ 8  Vss
EN  2 │               │ 7  Vss
      │    AP1510     │
OCSET 3│               │ 6  Output
Vcc 4 │               │ 5  Output
      └───────────────┘
```

Pin Descriptions

Name	Pin	Description
FB	1	Feedback pin.
EN	2	Enable Input pin H: Normal operation (Step-down operation) L: Step-down operation stopped (All circuits deactivated)
OCSET	3	Add an external resistor to set max output current.
V_{CC}	4	IC power supply pin
Output	5, 6	Switch Pin. Connect external inductor/diode here. Minimize trace area at this pin to reduce EMI.
V_{SS}	7, 8	GND Pin

Block Diagram
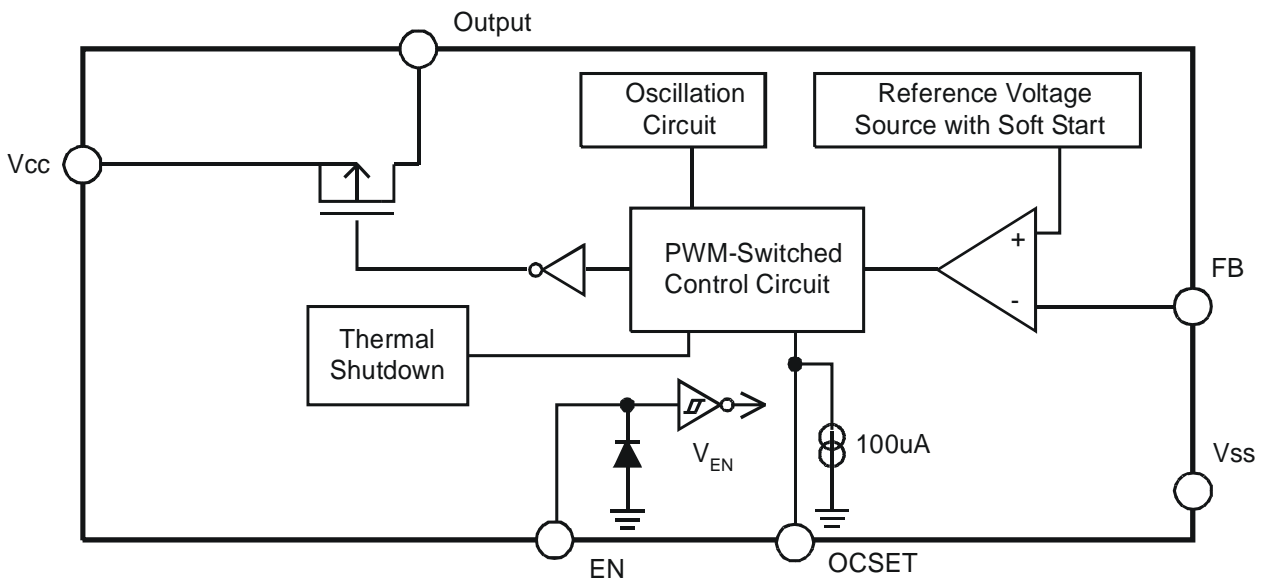
Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{CC}	V_{CC} Pin Voltage	V_{SS} - 0.3 to V_{SS} + 25	V
V_{FB}	Feedback Pin Voltage	V_{SS} - 0.3 to V_{CC}	V
V_{EN}	EN Pin Voltage	V_{SS} - 0.3 to V_{IN} + 0.3	V
V_{OUT}	Switch Pin Voltage	V_{SS} - 0.3 to V_{IN} + 0.3	V
P_D	Power Dissipation	Internally limited	mW
T_{OP}	Operating Junction Temperature Range	-20 to +125	^{o}C
T_{ST}	Storage Temperature Range	-65 to +150	^{o}C

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

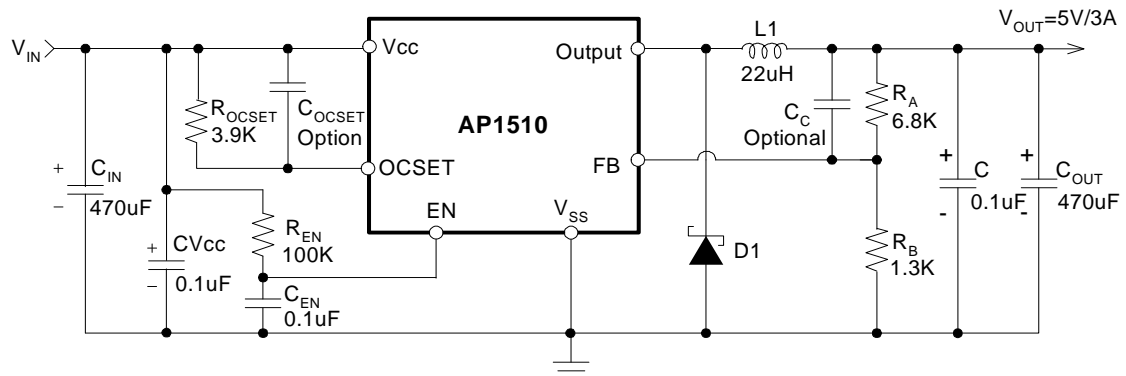## Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	3.6	23	V
I_{OUT}	Output Current	0	3	A
T_A	Operating Ambient Temperature	-25	85	^{o}C

PWM CONTROL 3A STEP-DOWN CONVERTER

Electrical Characteristics (V$_{IN}$ = 12V, T$_a$ = 25°C, unless otherwise specified)

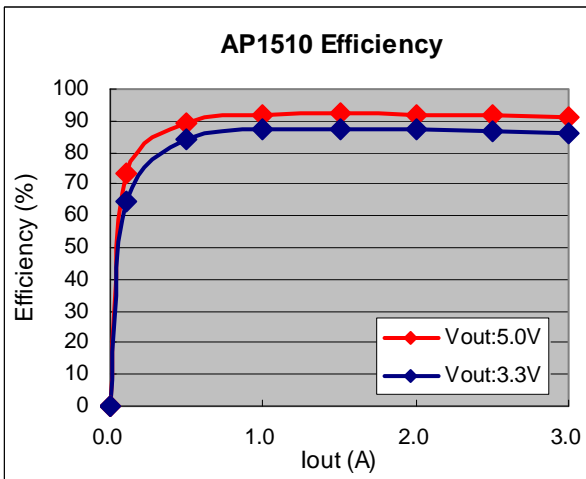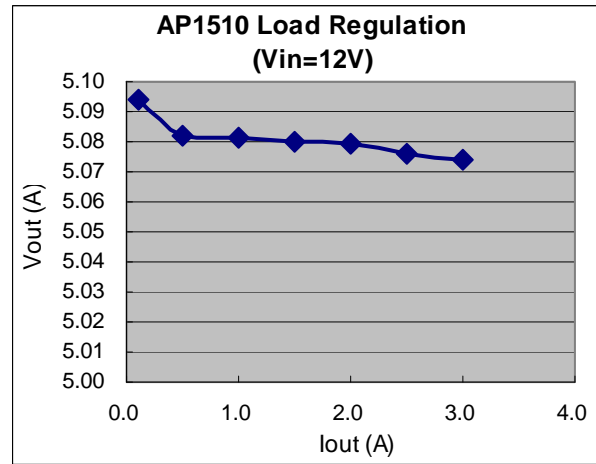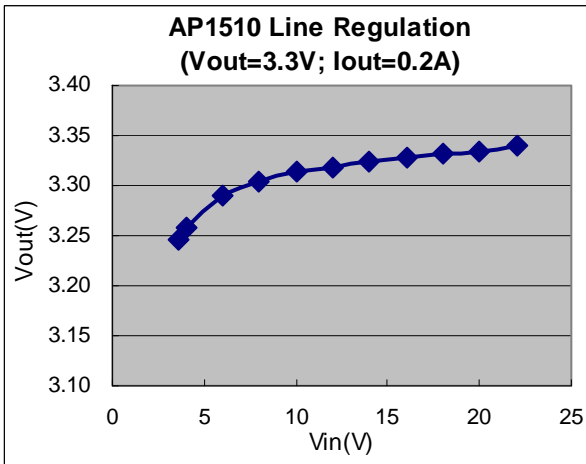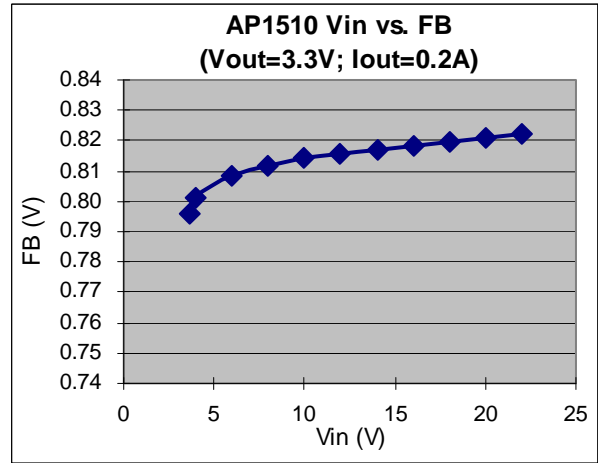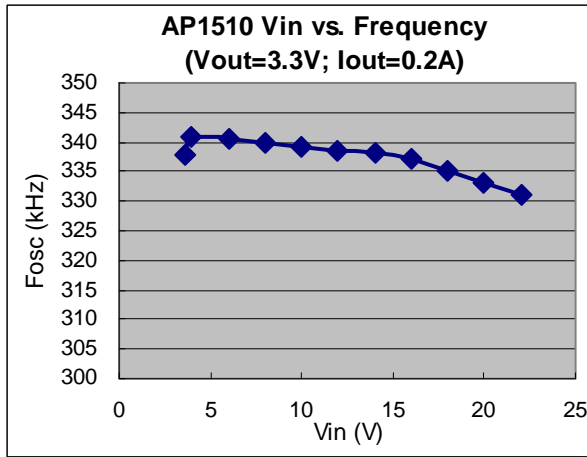| Symbol	Parameter	Conditions	Min	Typ.	Ma.	Unit
V$_{FB}$	Feedback Voltage	I$_{OUT}$ = 0.1A	0.784	0.8	0.816	V
I$_{FB}$	Feedback Bias Current	I$_{OUT}$ = 0.1A	-	0.1	0.5	µA
I$_{SW}$	Switch Current	--	3.5	-	-	A
I$_{SHDN}$	Current Consumption During Power Off	V$_{EN}$ = 0V	-	10	-	µA
ΔV$_{OUT}$ /V$_{IN}$	Line Regulation	V$_{IN}$ = 5V~23V, I$_{OUT}$ = 0.2A	-	1	2	%
ΔV$_{OUT}$ /V$_{OUT}$	Load Regulation	I$_{OUT}$ = 0.1 to 3A	-	0.2	0.5	%
f$_{OSC}$	Oscillation Frequency	Measure waveform at SW pin	240	300	360	kHz
f$_{OSC1}$	Frequency of Current Limit or Short Circuit Protect	Measure waveform at SW pin	10	-	-	kHz
V$_{IH}$	EN Pin Input Voltage	Evaluate oscillation at SW pin	2.0	-	-	V
V$_{IL}$		Evaluate oscillation stop at SW pin	-	-	0.8	
I$_{ENH}$	EN Pin Input Leakage Current	--	-	20	-	µA
I$_{ENL}$		--	-	-10	-	µA
I$_{OCSET}$	OCSET Pin Bias Current	--	75	90	105	µA
T$_{SS}$	Soft-Start Time	--	0.3	2	5	ms
T$_{SHDN}$	Thermal shutdown threshold		-	150	-	°C
T$_{HYS}$	Thermal shutdown hysteresis		-	55	-	°C
R$_{DSON}$	Internal MOSFET Rdson	V$_{IN}$ = 5V, V$_{FB}$ = 0V	-	110	150	mΩ
		V$_{IN}$ =12V, V$_{FB}$ = 0V	-	70	100	
EFFI	Efficiency	V$_{IN}$ = 12V, V$_{OUT}$ = 5V I$_{OUT}$ = 3A	-	91	-	%
θ$_{JA}$	Thermal Resistance Junction-to-Ambient	SOP-8L (Note 3)	-	134	-	°C/W
θ$_{JC}$	Thermal Resistance Junction-to-Case	SOP-8L (Note 3)	-	22	-	°C/W

Notes: 3. Test condition: Device mounted on FR-4 substrate 2oz copper, minimum recommended pad layout, single side.
For better thermal performance, please arrange larger copper pad of layout for heatsink.

Typical Application Circuit

Note: V$_{OUT}$ = V$_{FB}$ x (1+R$_A$/R$_B$)
R$_B$=0.7K~5K ohm

Typical Performance Characteristics

AP1510 Vin vs. Frequency (Vout=3.3V; Iout=0.2A)

AP1510 Vin vs. FB (Vout=3.3V; Iout=0.2A)

AP1510 Line Regulation (Vout=3.3V; Iout=0.2A)

AP1510 Load Regulation (Vin=12V)

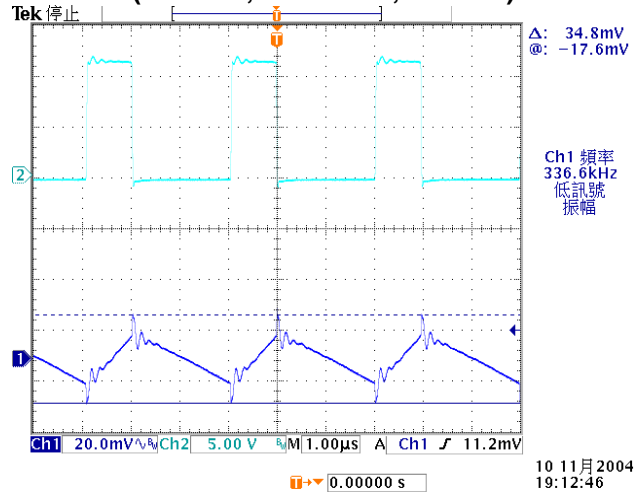**AP1510 Efficiency**

Vout:5.0V
Vout:3.3V

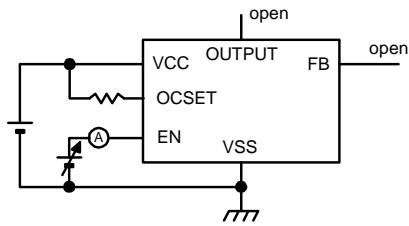## Typical Performance Characteristics   (Continued)

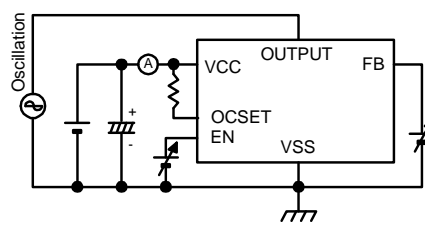**AP1510 Vout Ripple
(Vin=12V; Vout=3.3V; Iout=0.1A)**
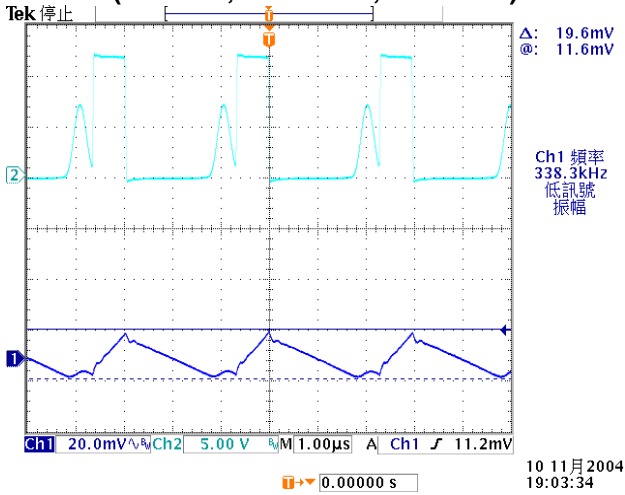
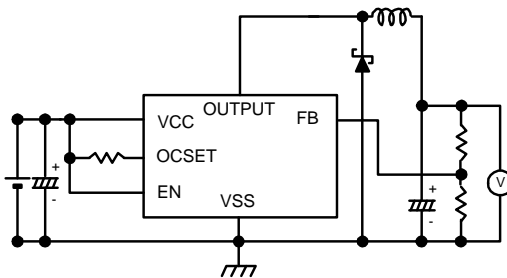**AP1510 Vout Ripple
(Vin=12V; Vout=3.3V; Iout=3A)**

Test Circuit

Enable function test

Feedback function test

Operation function test

Function Description

PWM Control
The AP1510 is a DC/DC converter that employs pulse width modulation (PWM) scheme. Its pulse width varies in the range of 0% to 99%, based on the output current loading. The output ripple voltage caused by the PWM high frequency switching can easily be reduced through an output filter. Therefore, this converter provides a low ripple output supply over a broad range of input voltage & output current loading

Under Voltage Lockout
The under voltage lockout circuit of the AP1510 assures that the high-side MOSFET driver remains in the off state whenever the supply voltage drops below 3.3V. Normal operation resumes once V_{CC} rises above 3.5V.

Current Limit Protection
The current limit threshold is set by external resistor R_{OCSET} connected from V_{CC} supply to OCSET pin. The internal sink current I_{OCSET} (90uA typical) across this resistor sets the voltage at OCSET pin. When the PWM voltage is less than the voltage at OCSET, an over-current condition is triggered.

The current limit threshold is given by the following equation:

$$I_{PEAK} \times R_{DS(ON)} = I_{OCSET} \times R_{OCSET}$$

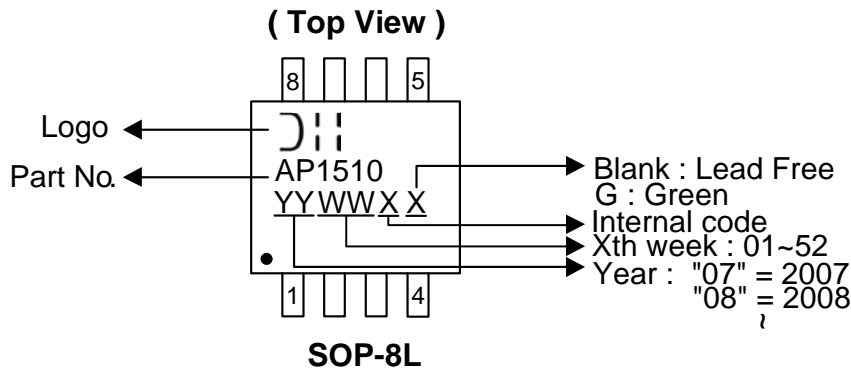$$I_{PEAK} > I_{OUT\,(MAX)} + \frac{(\Delta I)}{2}$$

where,

$$\Delta I = \frac{V_{IN} - V_{OUT}}{F_S x L} x \frac{V_{OUT}}{V_{IN}}$$

I_{PEAK} is the output peak current; $R_{DS\,(ON)}$ is the MOSFET ON resistance. F_S is the PWM frequency (300KHz typical). Also, the inductor value will affect the ripple current ΔI.

The above equation is recommended for input voltage range of 5V to 18V. For input voltage lower than 5V, higher than 18V or ambient temperature over 100°C, high R_{OCSET} is recommended.
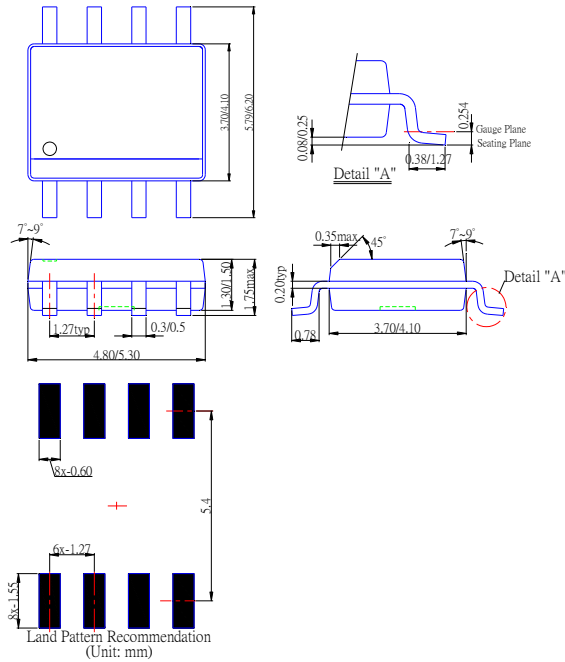
The maximum R_{OCSET} value should not exceed AP1510 maximum current output.

Marking Information

(Top View)

SOP-8L

Logo
Part No.
AP1510
YY WW X X

Blank : Lead Free
G : Green
Internal code
Xth week : 01~52
Year : "07" = 2007
"08" = 2008

Package Information (All Dimensions in mm)

Package Type: SOP-8L

Land Pattern Recommendation
(Unit: mm)

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