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Unique Lower EMI 5.0V to 23V Input, 1.0-A Synchronous Step-Down Converter

For details, check for samples: INN9259

Features

- **Lower Noise/EMI** Comes From **Proprietary No Spike Switching Signal Technology** Under Full Frequency Bandwidth Testing
- **Lower Noise**:
  - ■ Noise < +/-30mV @3.3V 800mA output, 150MHz BWL testing
- Up to 23V Synchronous Converter In SOT23
- SOT23-6 Package
- No Schottky Rectifier Diode
- 1.0-A Peak Output Current
- Fixed 1.4MHz High Switching Frequency
- Integrated Two Power FETs Optimized for portable application:
  125mΩ (High side) and 70mΩ (Low side)
- High Efficiency
  Up to 90% Efficiency @ 12V Input, 5.0V Output
- Wide Input Voltage Range: 5.0V to 23V
- Wide Output Voltage Range: 0.81V to 14V
  - ■ 3.3V 1.0A Continuous Current Output
- Low Output Ripple and Allows Ceramic Output Capacitor
- Thermal Shutdown Protection
- Cycle By Cycle Over Current Limit
- Over Voltage Protection
- Internal Compensation
- Minimum Number of External Component
- Smaller PCB Size due to no Schottky Diode
- Supports large inductor value variation:
  - ■ 2.2μH → 47.0μH

Applications

Lower Noise Specially for **Sensor**'s Power Supply

- ■ CCD/CMOS Image Sensor
- ■ Audio SENSOR
- ■ Other SENSOR

- WIFI power supply application
- xDSL Cable Modem/EPON/GPON
- Digital STB
- Ideal for Portable Applications
- Long Life LED Cooling Motor Power Supply

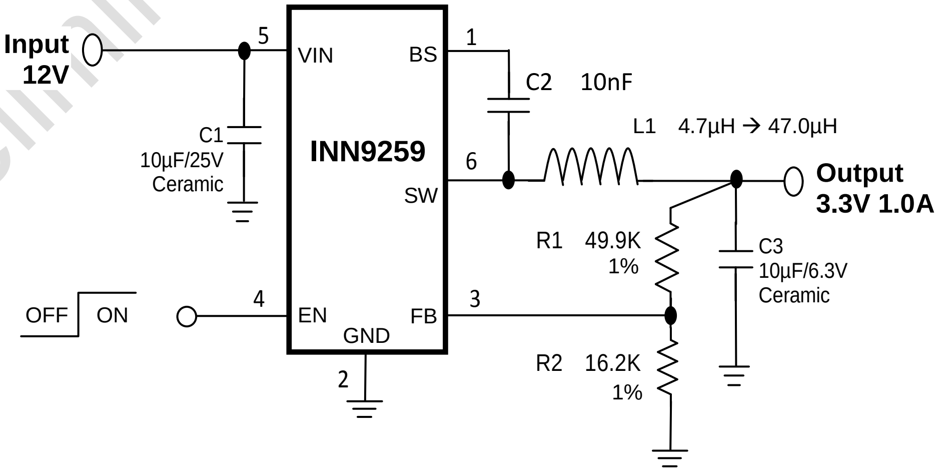
Descriptions

The INN9259 is a current mode synchronous buck converter with integrated high side and low side power mosfets, and has excellent transient load and line regulation with lower EMI. It enables the device to adopt to both low ESR output capacitors, such as POSCAP or SP-CAP, and ultra-low ESR ceramic capacitors.

The INN9259 operates from 5.0-V to 23-V Vin input, and the output voltage can be programmed between 0.81v to 14v with 0.8 A (3.3V 1.0A) output current, and +/-2.5% high accuracy output voltage.

Due to 125mΩ (High side) and 70mΩ (Low side) integrated FETs, the INN9259 works in high efficiency (up to 90% @12V Input, 5.0V 0.6A output) with SOT23-6 package .

Typical Application



ORDERING INFORMATION

TA	PACKAGE	ORDERING PART NUMBER	PIN	TRANSPORT MEDIA, QUANTITY	ECO PLAN
-40℃ to 85℃	SOT23-6	INN9259	6	Tape and Reel, 3000	Green (RoHS & no Sb/Br)

ABOSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range (unless otherwise noted)

ITEMS	NAME	VALUE	UNIT
Voltage Range	IN	-0.3 to 24	V
	BS	-0.3 to 27	V
	SW	-2 to 24	V
	SW (10 ns transient)	-2.5 to 25	V
	FB,	-0.3 to 6.0	V
	EN	-0.3 to 20	V
TJ	Operation Junction	-40 to +150	℃
Tstg	Storage temperature	-55 to +150	℃

DISSIPATION RATINGS

(2oz. trace and copper pad)

PACKAGE	θ_{JA}	θ_{JC}	UNIT
SOT23-6	220	110	℃/W

RECOMMENDED OPERATING CONDITIONS

Over operating free-air temperature range(unless otherwise noted)

		MIN	MAX	UNIT
Voltage	Supply input voltage range	5.0	23	V
	BS	-0.1	26	V
	SS, FB	-0.1	5	V
	EN	-0.1	20	V
	GND	-0.1	+0.1	V
T_A	Operating free-air temperature	-40	85	℃
T_J	Operating junction temperature	-40	125	℃

ELECTRICAL CHARACTERISTICS

Over operating free-air temperature range(unless otherwise noted)

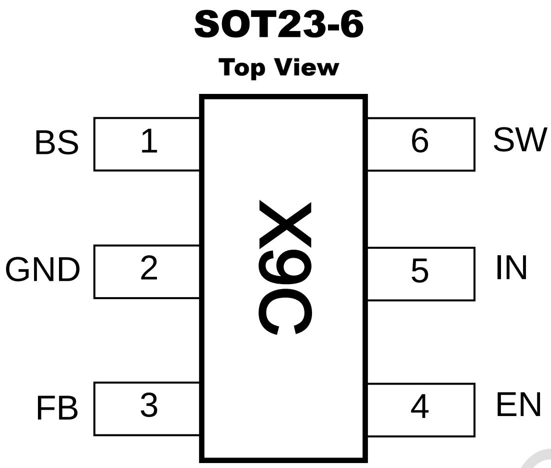
VIN=12V, TA=25℃

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Current						
Iin	Operating-non-switching supply current	VIN current, TA=25℃, EN=1.8V, VFB=1.0V		1.1	2.0	mA
ISDN	Shut Down Supply Current	VEN=0V, VIN=8.4V		20		µA
VFB	Feedback Voltage	6.0V ≤VIN≤23V	0.790	0.810	0.830	V
IFB	Feedback Input Current	VFB=2V			1	µA
OVP	Feedback Overvoltage Threshold			0.923		V
RDS(on)_1	High Side Switch ON Resistance			125		mΩ
RDS(on)_2	Low Side Switch ON Resistance	MOSFET's RDS_ON		70		mΩ
Ileakgae	High Side Switch Leakage Current	VEN=0V, VSW=0V			10	µA
ILM_H	High Side Switch Current Limit	Minimum Duty Cycle	1.3	1.8		A
ILM_L	Low Side Switch Current Limit	From Drain to Source	200			mA
FSW_1	Switching Frequency			1.4		MHz
FSW_2	Short Circuit Switching Frequency	VFB=0V		660		KHz
Dmax	Maximum Duty Cycle	VFB=0.70		85		%
ton_min	Minimum ON Time(1)			120		Ns
VEN_H	EN Input High Voltage	VEN Rising	1.2			V
VEN_L	EN Input Low Voltage	VEN Falling			0.8	V
IEN	EN pin input current				150	µA
VUVLO	Input Under Voltage Lockout Threshold	VIN Rising	3.80	4.30	4.75	V
VHys_UV	Input Under Voltage Lockout Threshold Hysteresis			500		mV
TSD	Thermal Shutdown			160		℃

Note:

(1) Guaranteed by design

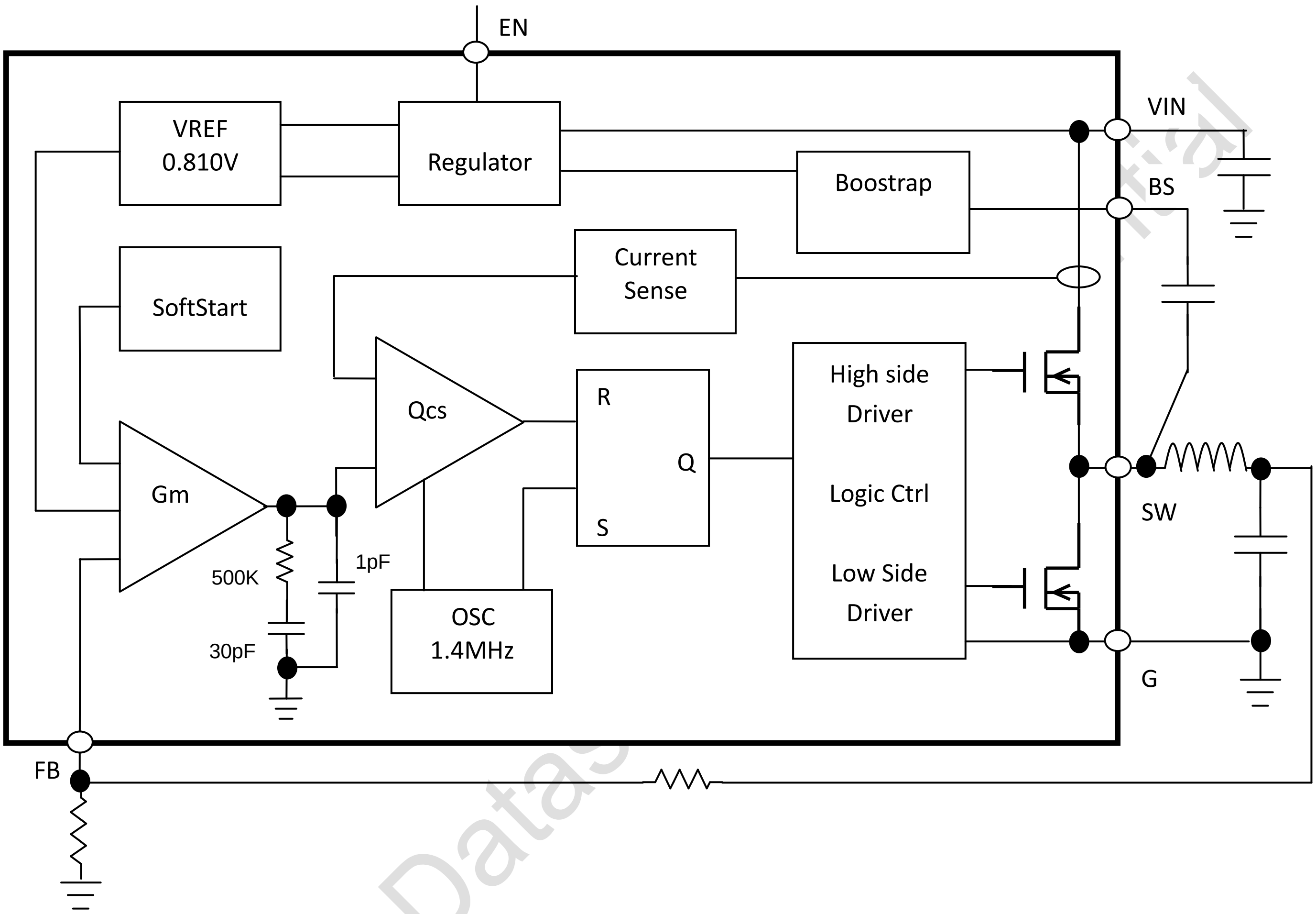
PIN ARRANGEMENT



PIN FUNCTIONS

PIN		Description
NAME	NO.	Deatails
BS	1	Supply input for high-side NFET gate driver (boost terminal). Connect capacitor from this pin to SW pin.
GND	2	Signal ground pin, also serve as ground returns for low-side NFET.
FB	3	Converter feedback input. Connect with feedback resistor divider.
EN	4	Enable control input
IN	5	Power input and connected to high side NFET drain
SW	6	Switch node connection between high-side NFET and low-side NFET. Also serve as inputs to current comparators.

FUNCTIONAL BLOCK DIAGRAM



Detail Description

OPERATION

INN9259 is a synchronous rectifying step-down switching converter that achieves faster transient response by employing current control mode system with typically 1.4MHz fixed frequency pulse width modulation, targets to less EMI and lower noise application, like acting as sensor's power supply. .

It reduces EMI and Noise by using Proprietary No Spike Switching Signal Technology Under Full Bandwidth Scan.

It reduces the power dissipated by using internal lower Rds-on MOSFET as a rectifier instead of a diode rectifier externally connected to a conventional DC/DC converter IC.

For PWM operation, at the beginning of each clock cycle initiated by the clock signal, the High Side MOSFET switch is turned on. The current flows now from the input capacitor via the High Side MOSFET switch through the inductor to the output capacitor and load. During this phase, the current ramps up until the PWM comparator trips and the control logic will turn off the switch. The current limit comparator will also turn off the switch in case the current limit of the High Side MOSFET switch is exceeded. After a dead time preventing shoot through current, the Low Side MOSFET rectifier is turned on and the inductor current will ramp down. The current flows now from the inductor to the output capacitor and to the load. It returns back to the inductor through the Low Side MOSFET rectifier. The next cycle will be initiated by the clock signal again turning off the Low Side MOSFET rectifier and turning on the on the High Side MOSFET switch.

UNDERVOLTAGE LOCKOUT

The undervoltage lockout circuit prevents the device from malfunctioning at low input voltages and from excessive discharge of the battery and disables the output stage of the converter. The undervoltage lockout threshold is typically 3.75V with falling VIN.

ENABLE

The device is enabled setting EN pin to high. The EN input can be used to control power sequencing in a system with various DC/DC converters. The EN pin can be connected to the output of another converter, to drive the EN pin high and getting a sequencing of supply rails. With EN = GND, the device enters shutdown mode in which all internal circuits are disabled. A external 100KΩ resistor pulls up EN pin to VIN supply to enable it if there is no other control method.

SHORT CIRCUIT PROTECTION

The High Side and Low Side MOSFET switches are short-circuit protected with maximum switch current = ILIMF. The current in the switches is monitored by current limit comparators. Once the current in the High Side MOSFET switch exceeds the threshold of it's current limit comparator, it turns off and the Low Side MOSFET switch is activated to ramp down the current in the inductor and High Side MOSFET switch. The High Side MOSFET switch can only turn on again, once the current in the Low Side MOSFET switch has decreased below the threshold of its current limit comparator.

THERMAL SHUTDOWN

As soon as the junction temperature, TJ, exceeds 160°C (typical) the device goes into thermal shutdown. In this mode, the High Side and Low Side MOSFETs are turned-off. The device continues its operation when the junction temperature falls below the thermal shutdown hysteresis.

OUTPUT VOLTAGE SETTING

The output voltage can be calculated to:

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

To keep the network robust against noise, **the sum of R1 and R2 should not exceed 100KΩ**.

INDUCTOR SELECTION

The inductor value has a direct effect on the ripple current. The selected inductor has to be rated for its dc resistance and saturation current. The inductor ripple current (ΔIL) decreases with higher inductance and increases with higher VIN or VOUT.

$$\Delta I_L= V_{OUT} \times (1-V_{OUT}/V_{IN}) /(L \times f) \qquad (1)$$

$$I_{Lmax}= I_{outmax}+\Delta I_L \qquad (2)$$

With:
f = Switching Frequency (340KHz typical)
L = Inductor Value
ΔI_L = Peak to Peak inductor ripple current
I_{Lmax} = Maximum Inductor current

Equation 1 calculates the maximum inductor current in PWM mode under static load conditions. The saturation current of the inductor should be rated higher than the maximum inductor current as calculated with Equation 2.This is recommended because during heavy load transient the inductor current will rise above the calculated value.

OUTPUT CAPACITOR SELECTION

The current mode control scheme of the INN9259 allows the use of tiny ceramic capacitors. Ceramic capacitors with low ESR values have the lowest output voltage ripple and are recommended. The output capacitor requires either an X7R or X5R dielectric. Y5V and Z5U dielectric capacitors, aside from their wide variation in capacitance over temperature, become resistive at high frequencies.
At nominal load current, the device operates in PWM mode and the RMS ripple current is calculated as:

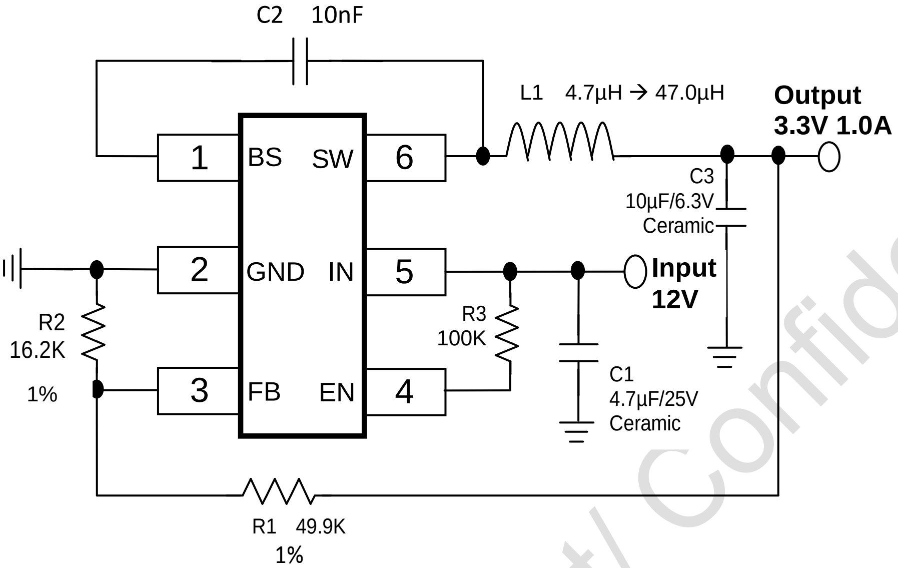
$$I_{RMSCout}=V_{OUT} \times (1-V_{OUT}/V_{IN})/(L \times f) * 0.289$$

INPUT CAPACITOR SELECTION

An input capacitor is required for best input voltage filtering, and minimizing the interference with other circuits caused by high input voltage spikes. For most applications, a 4.7µF to 10µF ceramic capacitor is recommended. The input capacitor can be increased without any limit for better input voltage filtering.

Application Circuit

12V Input and Output 3.3V 1.0A



Notes: To further reduce EMI and Output Noise, a 100pF capacitor can be connected between SW pin and GND pin

LOWER EMI

Lower EMI comes from **Proprietary No Spike Switching Signal Technology**.(**Full Frequency Bandwidth Testing**)

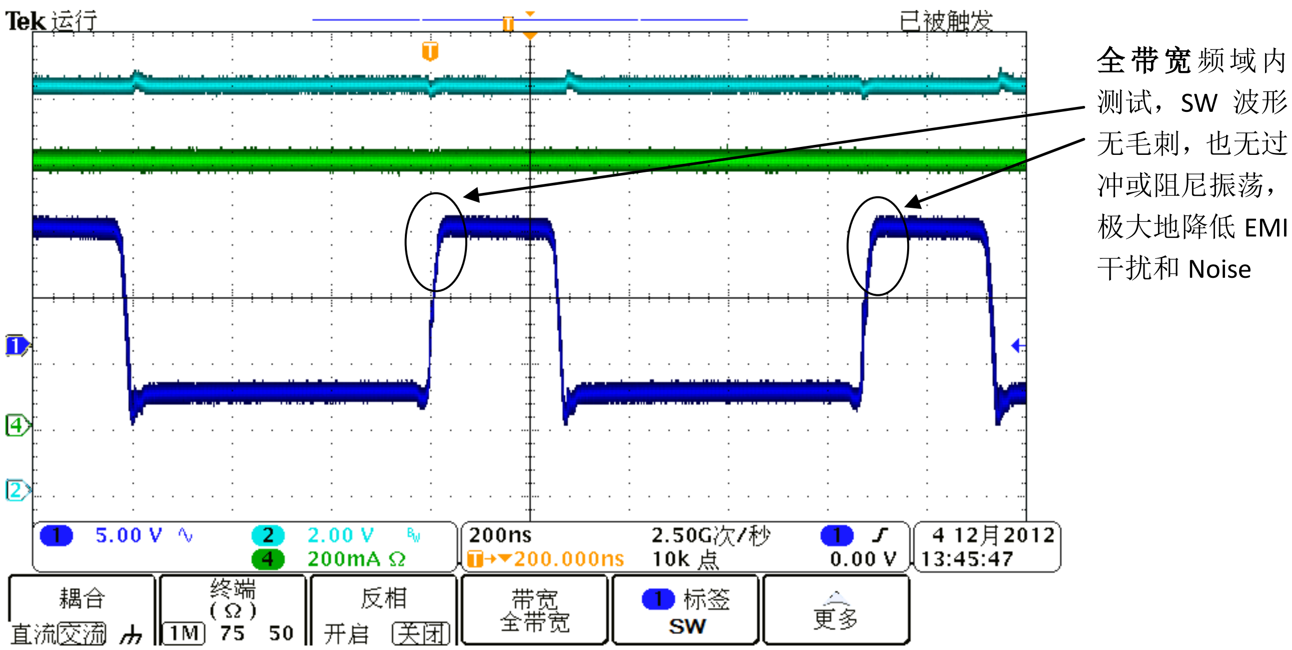


Fig1. Switching Waveform under 3.3V 800mA Loading @12V Vin

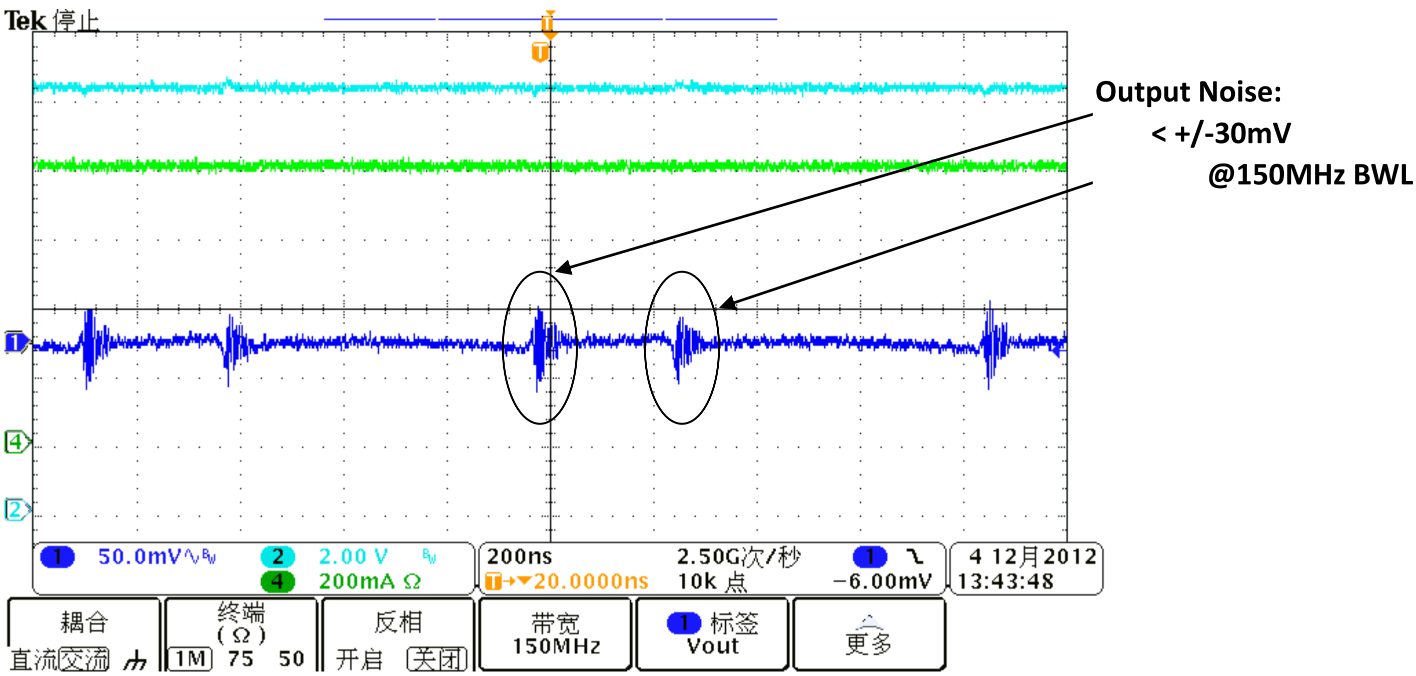
LOWER OUTPUT NOISE

Lower Output Noise also comes from **Proprietary No Spike Switching Signal Technology. (Full Frequency Bandwidth Testing**)

Testing Condition:

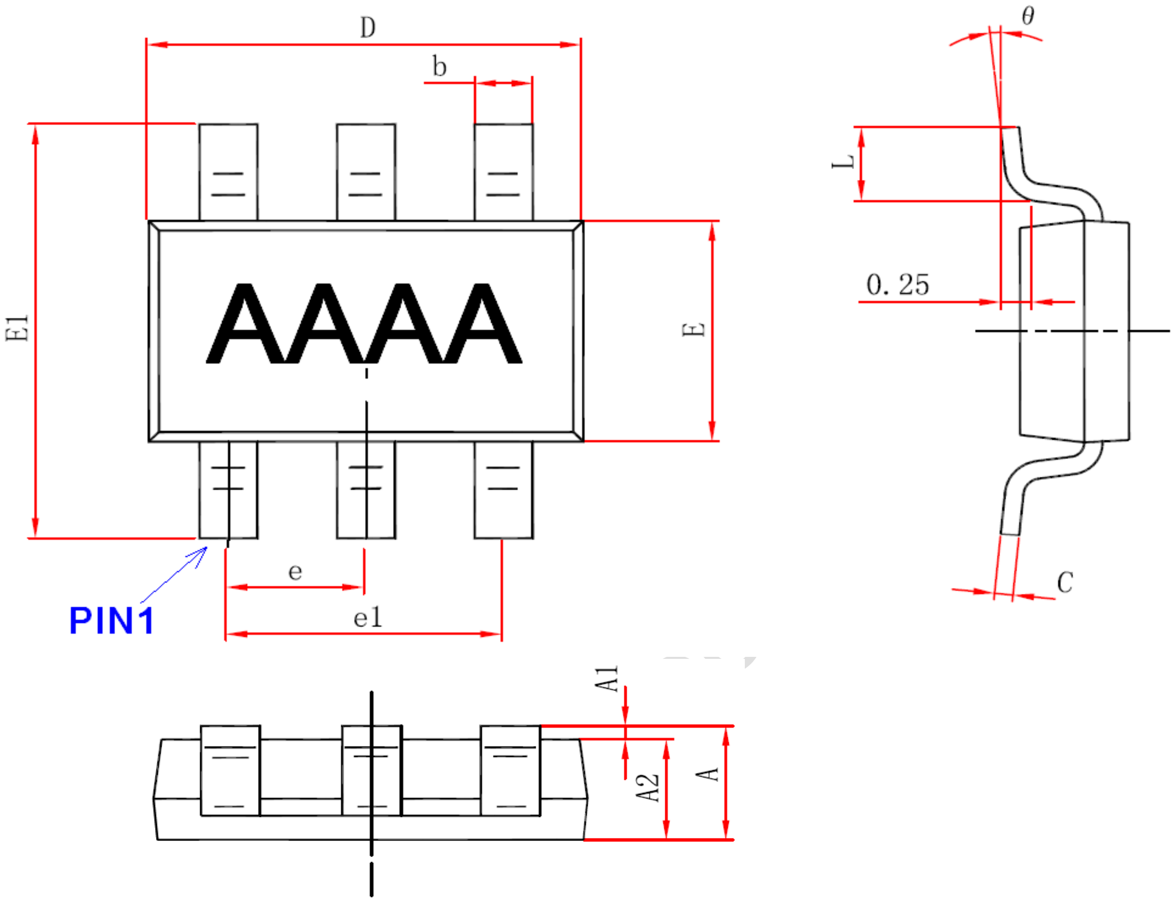
1) Output Cap: 10μF/6.3V
2) Input Cap: 10μF/25V
3) Output: 3.30V 800mA
4) Input Voltage: 12.0V
5) Inductor: 47.0μH

Output Noise: < +/-30mV @ 150MHz BWL testing, 3.3V 800mA output



PACKAGE INFORMATION

SOT23-6



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.900	0.028	0.035
A1	0.000	0.100	0.000	0.004
A2	0.700	0.800	0.028	0.031
b	0.350	0.500	0.014	0.020
c	0.080	0.200	0.003	0.008
D	2.820	3.020	0.111	0.119
E	1.600	1.700	0.063	0.067
E1	2.650	2.950	0.104	0.116
e	0.95（BSC）		0.037(BSC)	
e1	1.90（BSC）		0.075(BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°