16V，Synchronous Step-Down Converter

GENERAL DESCRIPTION

The PW2162 is a fully integrated, high– efficiency 2A synchronous rectified step-down converter. The PW2162 operates at high efficiency over a wide output current load range. This device offers two operation modes, PWM control and PFM Mode switching control, which allows a high efficiency over the wider range of the load. The PW2162 requires a minimum number of readily available standard external components and is available in an 6-pin SOT23 ROHS compliant package.

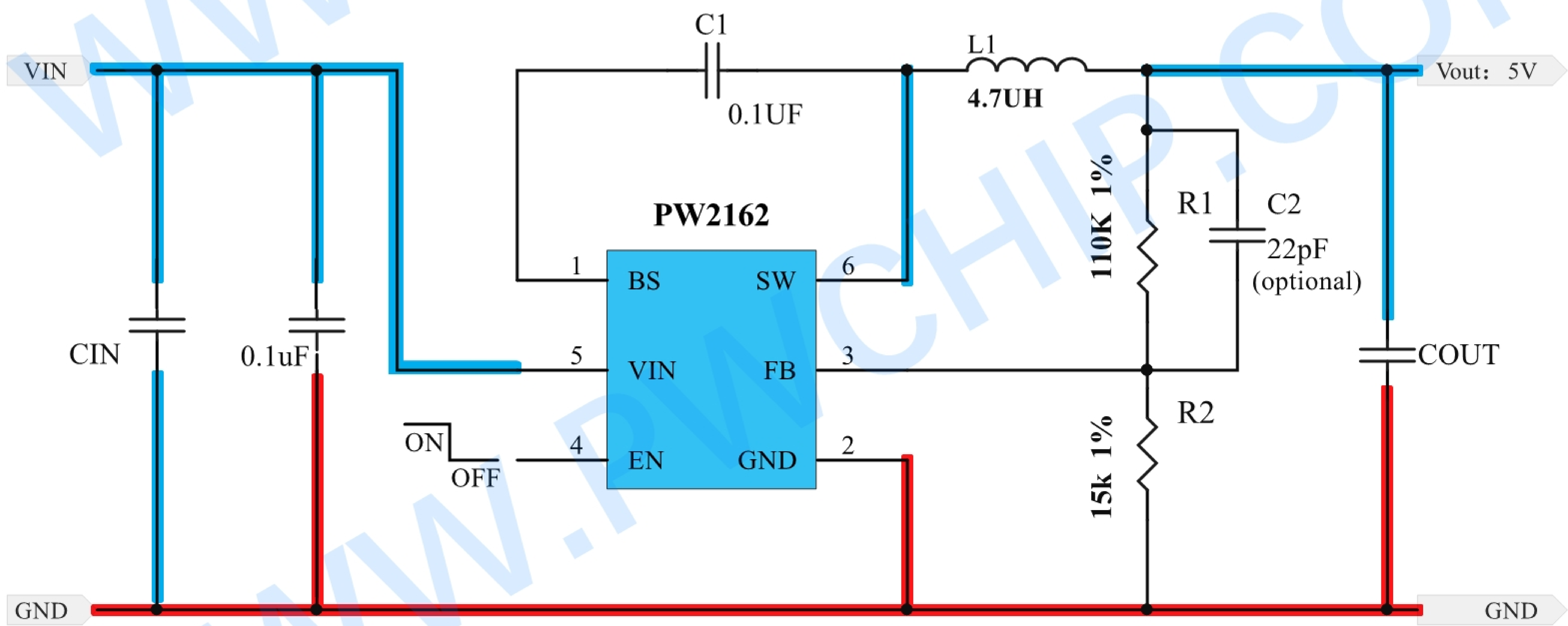
FEATURES

- High Efficiency: Up to 96%
- 600KHz Frequency Operation
- 2A Output Current
- EN rising threshold >1.5V（Min)
- 4.5V to 16V Input Voltage Range
- 0.6V Reference
- Slope Compensated Current Mode Control for Excellent Line and Load Transient Response
- Integrated internal compensation
- Stable with Low ESR Ceramic Output Capacitors
- Over Current Protection with Hiccup-Mode
- Thermal Shutdown
- Inrush Current Limit and Soft Start
- Available in SOT23-6 Package
- -40°C to +85°C Temperature Range

APPLICATIONS

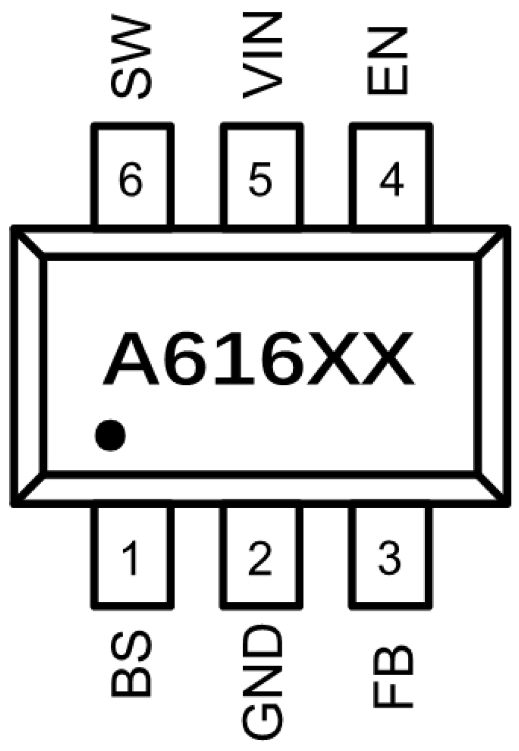
- Distributed Power Systems
- Digital Set Top Boxes
- Flat Panel Television and Monitors
- Wireless and DSL Modems
- Notebook Computer

TYPICAL APPLICATION CIRCUIT



VOUT	R1	R2	L1	CIN <12V	CIN ≥12V	COUT
1V	10KΩ	15KΩ	2.2μH	20-47uF	10uF+100uF（EC+)	20-68uF
1.05V	11.3KΩ	15KΩ	2.2μH	20-47uF	10uF+100uF（EC+)	20-68uF
1.2V	15KΩ	15KΩ	3.3μH	20-47uF	10uF+100uF（EC+)	20-68uF
1.5V	22.6KΩ	15KΩ	3.3μH	20-47uF	10uF+100uF（EC+)	20-68uF
3.32V	68.1KΩ	15KΩ	4.7μH	20-47uF	10uF+100uF（EC+)	20-68uF
5.0V	110KΩ	15KΩ	4.7μH	20-47uF	10uF+100uF（EC+)	20-68uF

PIN ASSIGNMENT/DESCRIPTION



Pin Number	Pin Name	Function
1	BS	Bootstrap. A capacitor connected between SW and BS pins is required to form a floating supply across the high-side switch driver.
2	GND	IC Ground
3	FB	Adjustable version feedback input. Connect FB to the center point of the external resistor divider.
4	EN	Drive this pin to a logic-high to enable the IC. Drive to a logic-low to disable the IC and enter micro-power shutdown mode.
5	VIN	Power supply Pin
6	SW	Switching Pin

Absolute Maximum Ratings (note1)

ITEMS	VALUE	Unit
Input Supply Voltage	-0.3 to 17	V
EN Voltages	-0.3 to 17	V
FB Voltages	-0.3 to 6	V
SW Voltage	-0.3 to (V_{IN}+0.5)	V
BS Voltage	(V_{SW}-0.3) to (V_{SW}+5)	V
Power Dissipation	0.6	W
Thermal Resistance θ_{JC}	130	°C / W
Thermal Resistance θ_{JA}	170	°C / W
Junction Temperature(Note2)	150	°C
Operating Temperature Range	-40 to 85	°C
Lead Temperature(Soldering,10s)	300	°C
Storage Temperature Range	-65 to 150	°C
ESD HBM(Human Body Mode)	2000	V
ESD MM(Machine Mode)	200	V

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + (P_D) \times (170°C/W)$.

PCB Layout Recommendations

PCB layout is very important to achieve stable operation. It is highly recommended to duplicate EVB layout for optimum performance. If change is necessary, please follow these guidelines and take Figure for reference.

(1) Keep the path of switching current short and minimize the loop area formed by Input capacitor, high-side MOSFET and low-side MOSFET.

(2) Bypass ceramic capacitors are suggested to be put close to the VIN Pin.

(3) Ensure all feedback connections are short and direct. Place the feedback resistors and compensation components as close to the chip as possible.

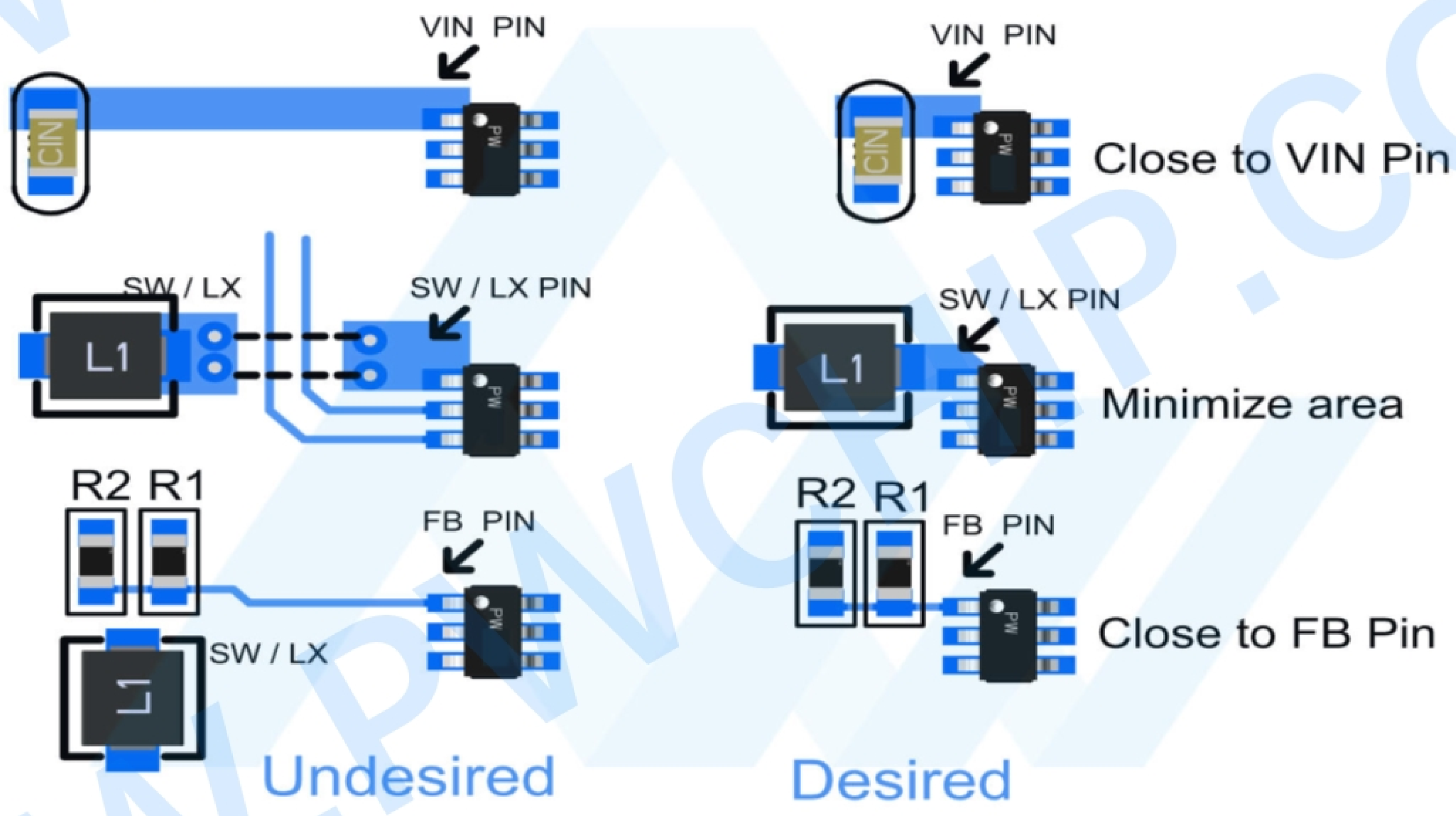
(4) VOUT, SW away from sensitive analog areas such as FB.

(5) Connect VIN, SW, and especially GND respectively to a large copper area to cool the chip to improve thermal performance and long-term reliability.

(6) An example of 2-layer PCB layout is shown in Figure for reference.

(7) The CIN ground terminal and GND PIN should be as short as possible.

PCB layout

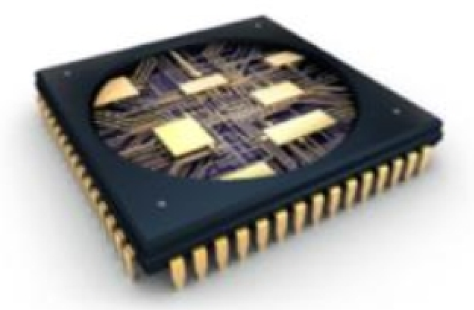


Products

Reel /outer anti-static packaging

NO：1, QR code content: WWW.PWCHIP.COM;
2. Product: PWCHIP product model name;
3. Lot No: wafer batch code/internal system production code (customers can send this code to support@pwchip.com to verify product information and confirm);
4. D/C: packaging cycle;
5. QTY: packaging quantity (box/disc);
6. Data: packaging time.

Product	
PW2162	
Brand	**Package**
平芯微/PWCHIP	SOT23-6L
Specification	**Qty per reel**
Taping & Reel	3000 PCS
Marking	
A616XX Device code: A616； Lot number code: XX .	



Product Center

MOSFET OVP/OCP Protection Li-ion Charger Li-ion Protector Li-ion charge-discharge LDO

Voltage Detector DC-DC Boost DC-DC Buck DC-DC Boost-Buck USB Fast charging LED driver

Product Title	MODE	Vin Range	Vout Range	Iout MAX	FOSC	Iq typ	Package	Link
PW2052B	Synchronous	2.3V～6V	0.6V～5V	2A	1.5MHZ	150uA	SOT23-6L	Detail
PW2335	Synchronous	4.5V~30V	ADJ	3A	500KHZ	600uA	SOP8-EP	Detail
PW2312A	Synchronous	4.5V～55V	ADJ	0.6A	1.2MHZ	250uA	SOT23-6L	Detail
PW2458	Synchronous	3.8V～36V	0.8V～35V	5A	0.1-1.1MHZ	25uA	SOP8-EP	Detail
PW2153	Asynchronous	8V~150V	5V~30V	10A	140KHZ	1mA	SOP8	Detail
PW2902	Asynchronous	8V~90V	5V~30V	2A	140KHZ	1mA	SOP8-EP	Detail
PW2906	Asynchronous	12V～90V	1.3V～20V	0.6A	150KHZ	2.5mA	SOP8-EP	Detail
PW2815	Asynchronous	4.5V～80V	ADJ	1.5A	480KHZ	0.73mA	SOP8-EP	Detail

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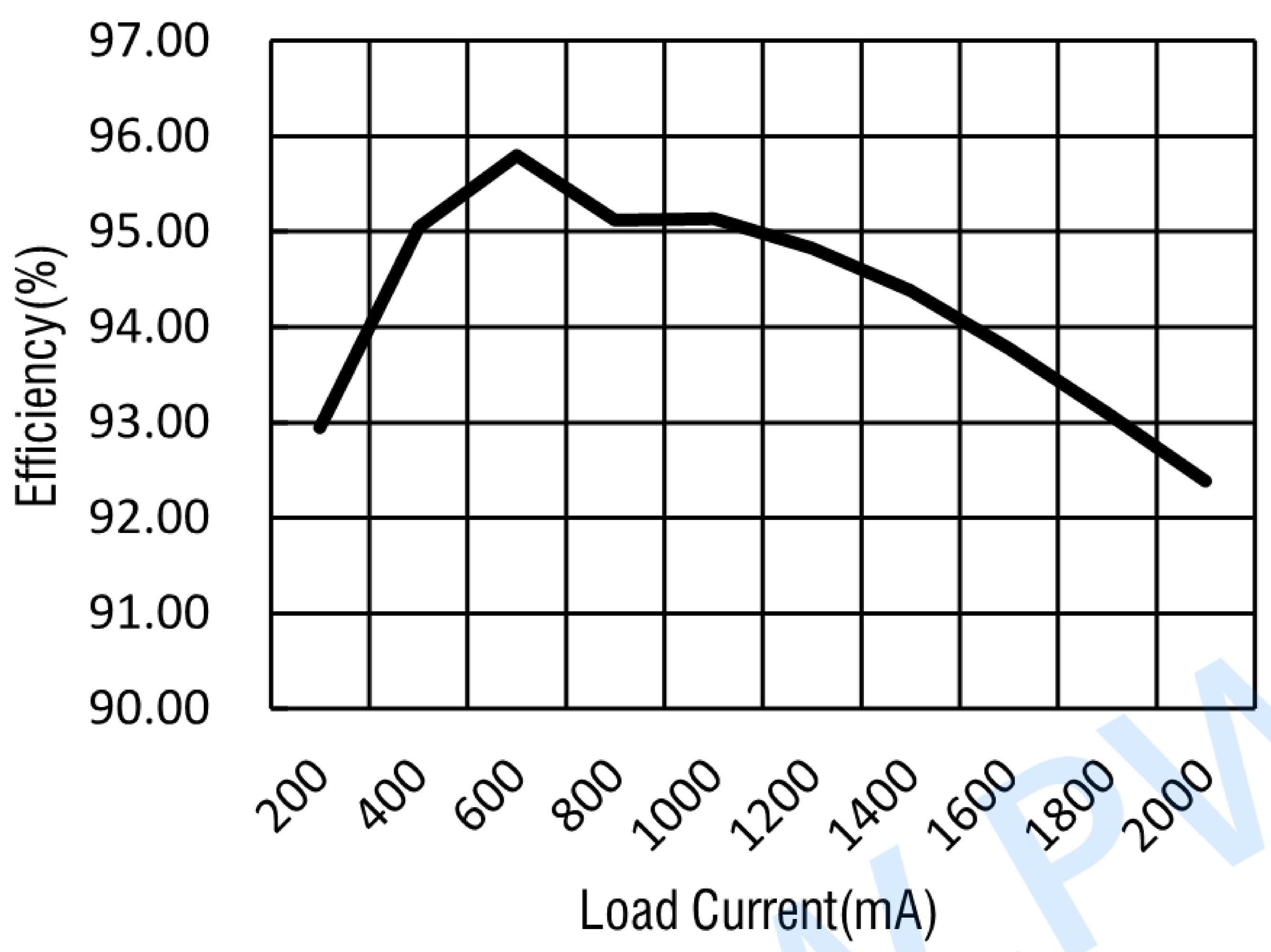
ELECTRICAL CHARACTERISTICS

(VIN=12V, VOUT=5V, TA = 25°C, unless otherwise noted.)

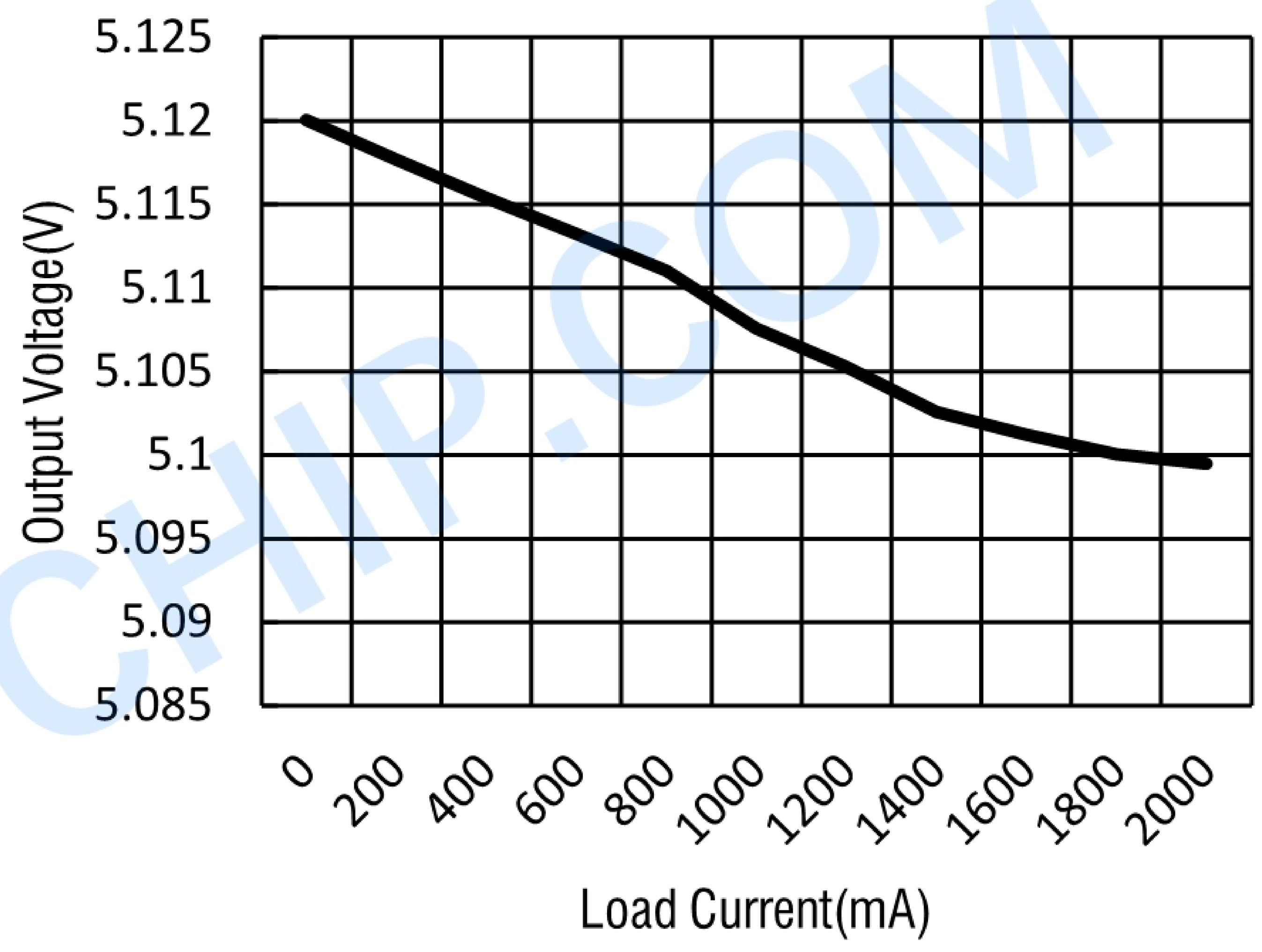
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Range		4.5		16	V
Supply Current in Operation	V_{EN}=2.0V, V_{FB}=1.1V		0.3	0.6	mA
Supply Current in Shutdown	V_{EN} =0 or EN = GND		3	10	μA
Regulated Feedback Voltage	T_A = 25°C, 4.5V≤ V_{IN} ≤18V	0.588	0.6	0.612	V
High-Side Switch On-Resistance			90		mΩ
Low-Side Switch On-Resistance			70		mΩ
High-Side Switch Leakage Current	V_{EN}=0V, V_{SW}=0V		0	10	μA
Upper Switch Current Limit	Minimum Duty Cycle		3		A
Oscillation Frequency			0.6		MHz
Maximum Duty Cycle	V_{FB}=0.6V		92		%
Minimum On-Time			60		nS
Thermal Shutdown			160		℃
Input UVLO threshold			3.8		V

Note：100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization

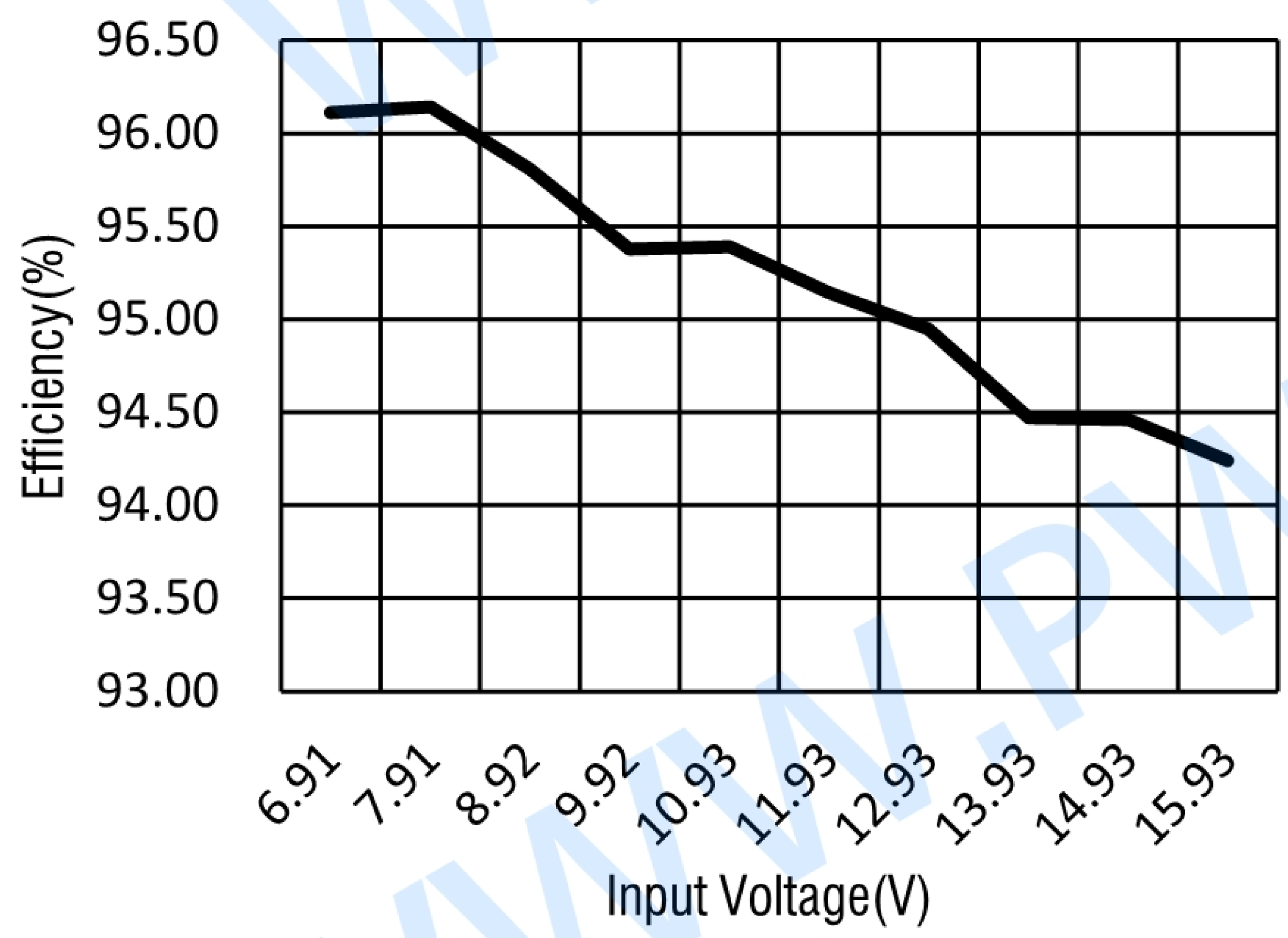
TYPICAL PERFORMANCE CHARACTERISTICS



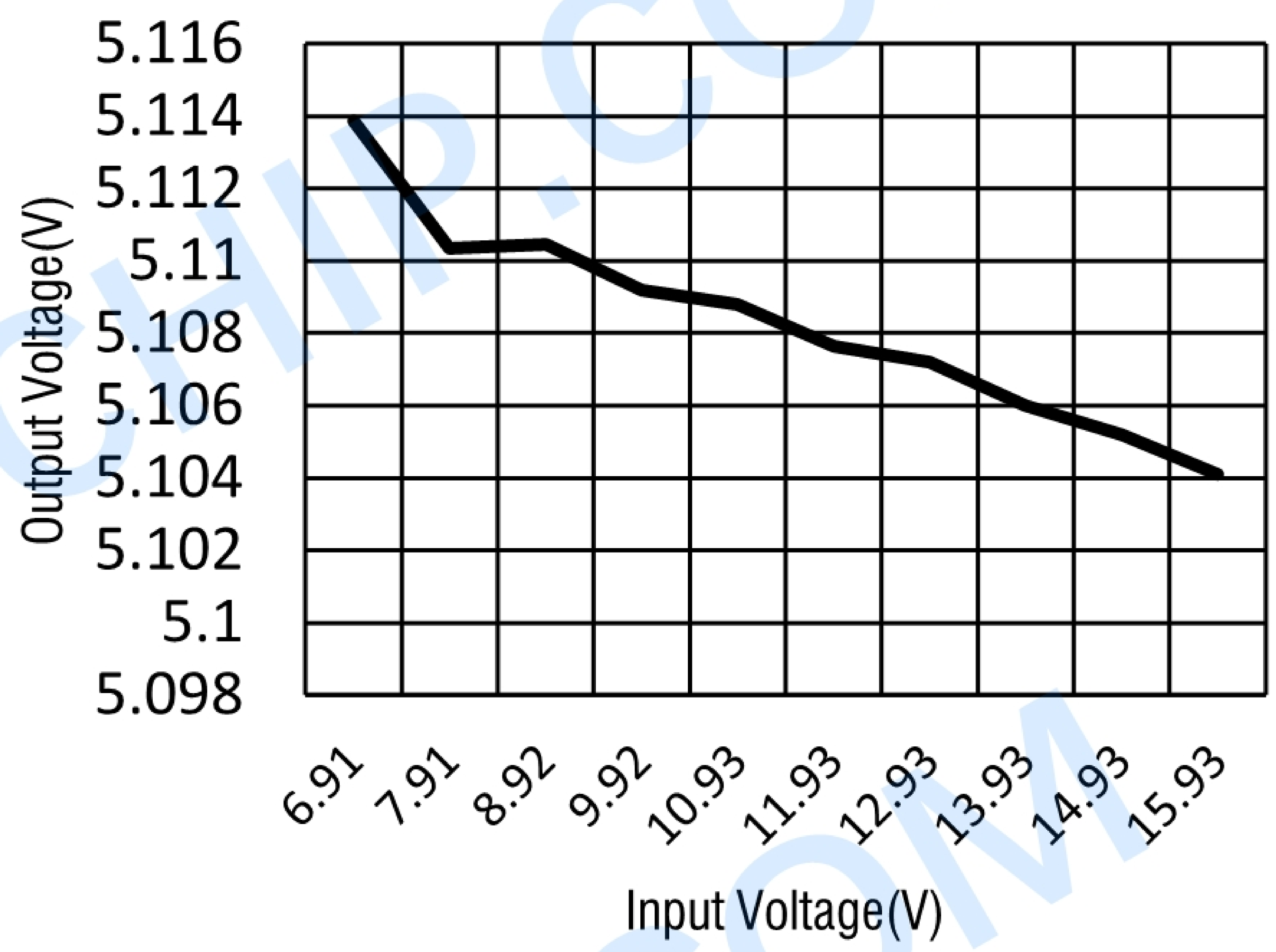
Efficiency vs. Load Current



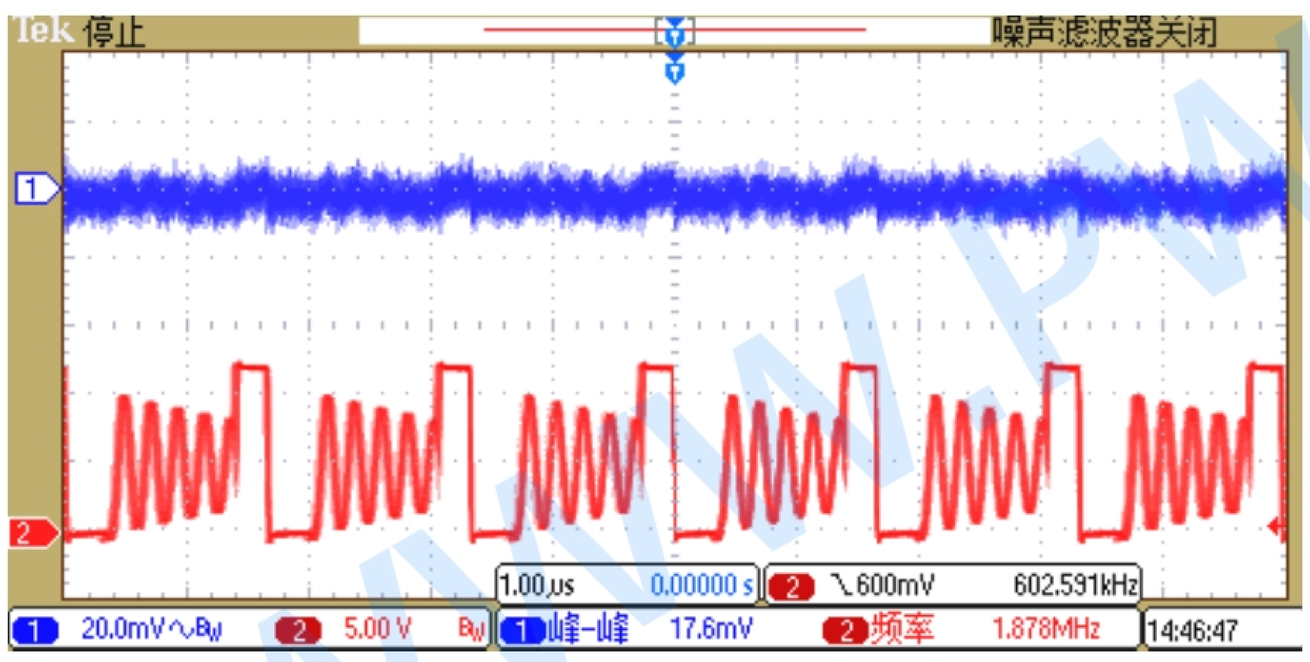
Load Regulation



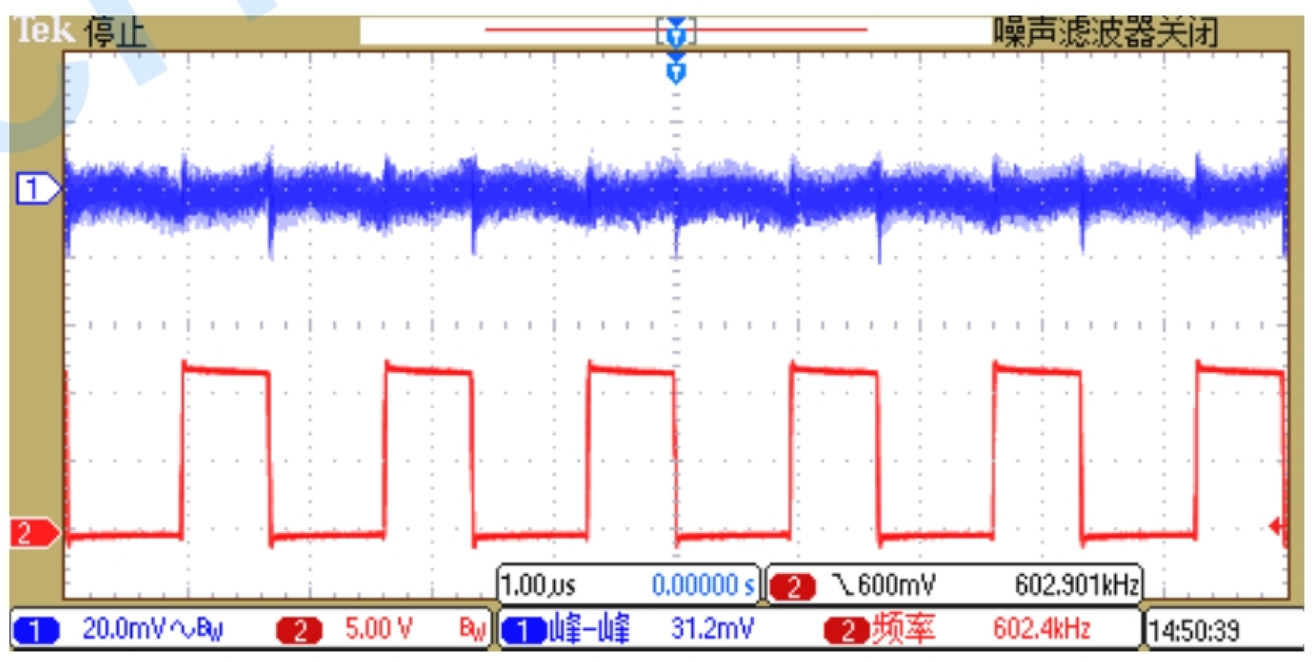
Efficiency vs. Input Voltage



Line Regulation



PFM MODE (CH1:VOUT(ripple) CH2:VSW)



PFM MODE (CH1:VOUT(ripple) CH2:VSW)

Function Description

Internal Regulator

The PW2162 is a current mode step down DC/DC converter that provides excellent transient response with no extra external compensation components. This device contains an internal, low resistance, high voltage power MOSFET, and operates at a high 600K operating frequency to ensure a compact, high efficiency design with excellent AC and DC performance.

Error Amplifier

The error amplifier compares the FB pin voltage with the internal FB reference (VFB) and outputs a current proportional to the difference between the two. This output current is then used to charge or discharge the internal compensation network to form the COMP voltage, which is used to control the power MOSFET current.The optimized internal compensation network minimizes the external component counts and simplifies the control loop design.

Internal Soft-Start

The soft-start is implemented to prevent the converter output voltage from overshooting during startup. When the chip starts, the internal circuitry generates a soft-start voltage (SS) ramping up from 0V to 0.6V. When it is lower than the internal reference (REF), SS overrides REF so the error amplifier uses SS as the reference. When SS is higher than REF, REF regains control. The SS time is internally fixed to 1 ms.

Over-Current-Protection and Hiccup

The PW2162 has cycle-by-cycle over current limit when the inductor current peak value exceeds the set current limit threshold. Meanwhile, output voltage starts to drop until FB is below the Under-Voltage (UV) threshold, typically 30% below the reference. Once a UV is triggered, the PW2162 enters hiccup mode to periodically restart the part. This protection mode is especially useful when the output is dead-short to ground. The average short circuit current is greatly reduced to alleviate the thermal issue and to protect the regulator. The PW2162 exits the hiccup mode once the over current condition is removed.

Startup and Shutdown

If both VIN and EN are higher than their appropriate thresholds, the chip starts. The reference block starts first, generating stable reference voltage and currents, and then the internal regulator is enabled. The regulator provides stable supply for the remaining circuitries. Three events can shut down the chip: EN low, VIN low and thermal shutdown. In the shutdown procedure, the signaling path is first blocked to avoid any fault triggering. The COMP voltage and the internal supply rail are then pulled down. The floating driver is not subject to this shutdown command.

Application Information

Setting the Output Voltage

The external resistor divider is used to set the output voltage (see Typical Application on page 1). The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. Choose R1 to be around 100kΩ for optimal transient response. R2 is then given by:

$$\left(1+\frac{R1}{R2}\right) * 0.6V = Vout$$

Inductor Selection

A 4.7μH to 22μH inductor with a DC current rating of at least 25% percent higher than the maximum load current is recommended for most applications. For highest efficiency, the inductor DC resistance should be less than 15mΩ . For most designs, the inductance value can be derived from the following equation.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where Δ IL is the inductor ripple current. Choose inductor ripple current to be approximately 30% if the maximum load current, 2A. The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Input Capacitor Selection

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 22μF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

Output Capacitor Selection

The output capacitor (COUT) is required to maintain the DC output voltage. Ceramic, tantalum, or low ESR electrolytic capacitors are recommended. Low ESR capacitors are preferred to keep the output voltage ripple low. The output voltage ripple can be estimated by:

$$\Delta V_{OUT} = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(R_{ESR} + \frac{1}{8 \times f_{OSC} \times C_{OUT}}\right)$$

Where L is the inductor value and RESR is the equivalent series resistance (ESR) value of the output capacitor. In the case of ceramic capacitors, the impedance at the switching frequency is dominated by the capacitance. The output voltage ripple is mainly caused by the capacitance. For simplification, the output voltage ripple can be estimated by:

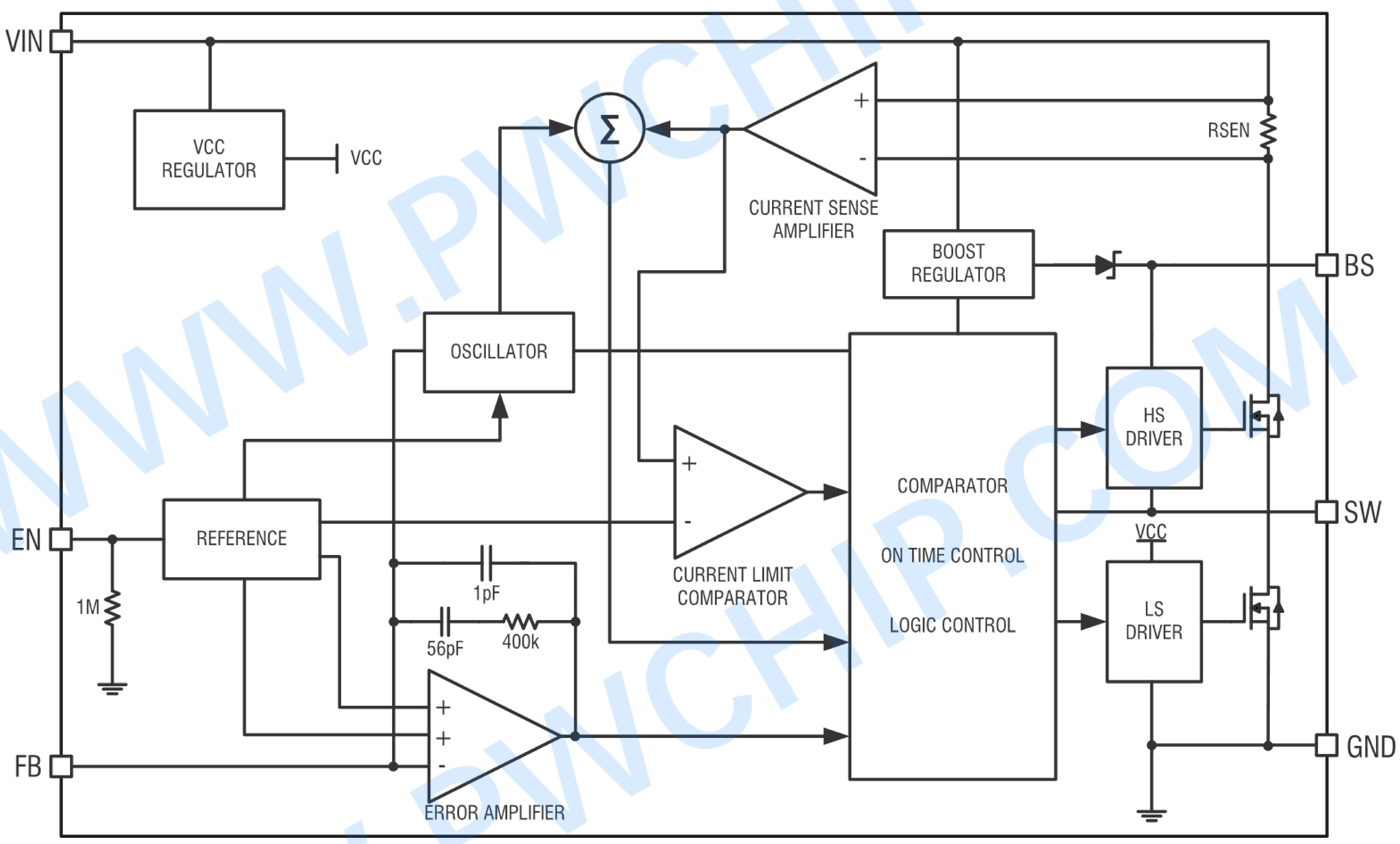
$$\Delta V_{OUT} = \frac{V_{OUT}}{8 \times f_{OSC}^{2} \times L \times C_{OUT}} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

In the case of tantalum or electrolytic capacitors, the ESR dominates the impedance at the switching frequency. For simplification, the output ripple can be approximated to:

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_{OSC} \times L} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right) \times R_{ESR}$$

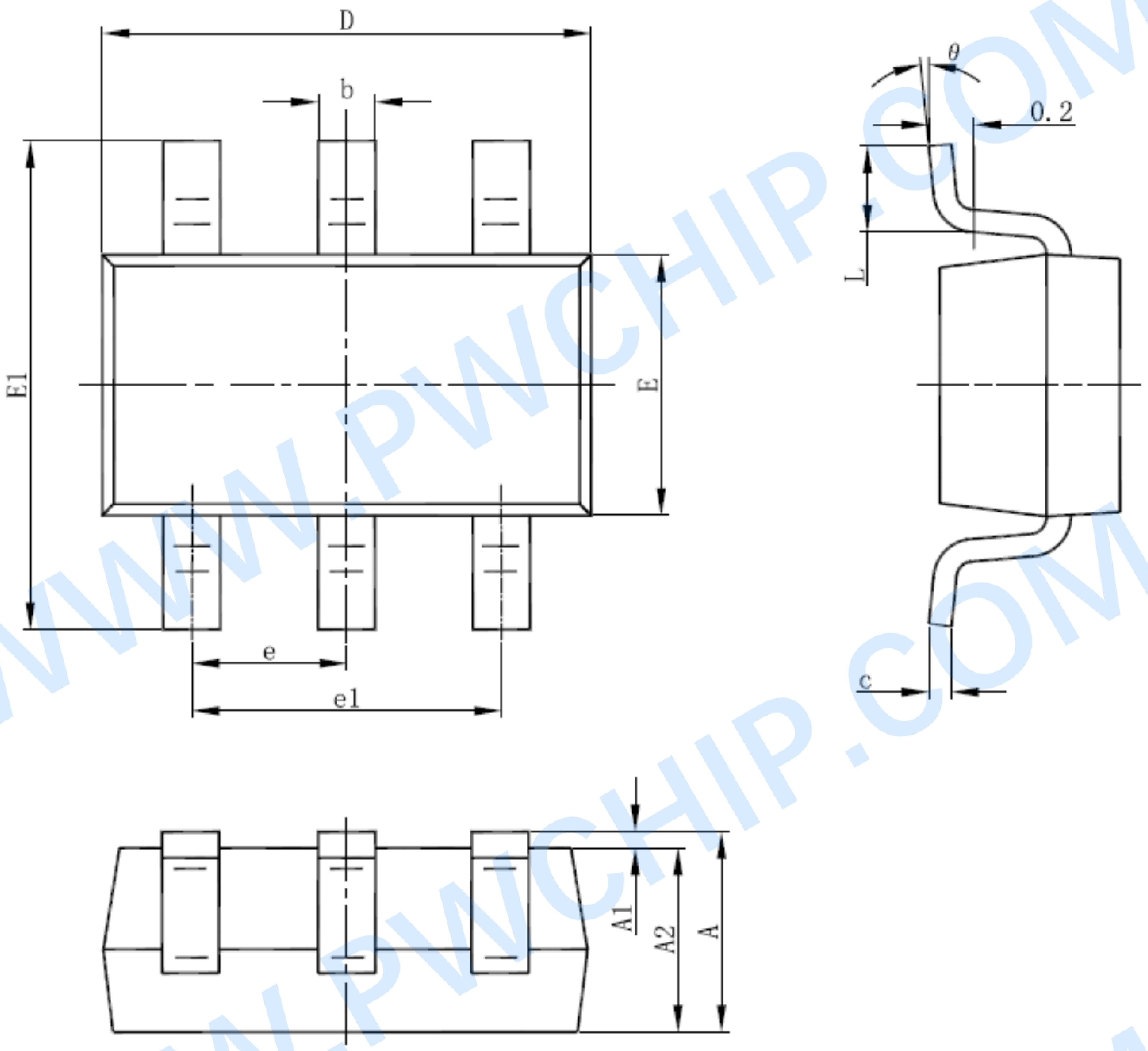
The characteristics of the output capacitor also affect the stability of the regulation system. The PW2162 can be optimized for a wide range of capacitance and ESR values.

Function Block Diagram



PACKAGE DESCRIPTION

SOT23-6L



Symbol	Dimensions In Millimeters	
	Min	Max
A	0.900	1.450
A1	0.000	0.150
A2	0.900	1.300
b	0.300	0.500
c	0.100	0.200
D	2.800	3.000
E	1.500	1.700
E1	2.650	2.950
e	0.950(BSC)	
e1	1.800	2.000
L	0.300	0.600
θ	0°	8°

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