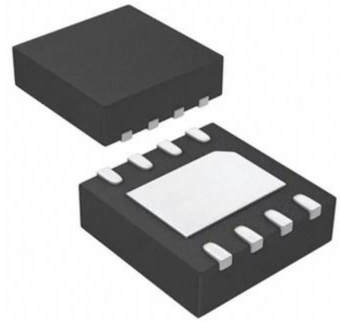
MORNSUN®

SCM1111A Constant Input & Wide-Range Input Power Chip

Features

- 6.5V to 36V Input Range
- 3.3V to 24V Output Range
- Support AHBF closed-loop primary feedback and closed-loop primary floating-ground feedback control application
- Support open loop fixed 50% duty cycle output, can be used in open loop symmetrical HB/LLC solution
- 100mΩ/110mΩ(High side/Low side) $R_{DS\text{-}ON}$
- Close loop adjustable Switching Frequency
- Open loop 200KHz fixed frequency
- Peak Current Mode Control PWM mode and FCCM mode
- Adjustable compensation
- Internal Soft-Start
- With large capacitance load capacity
- Thermal,(High side/Low side) over-current ,and short protection
- DFN_8L Package(with hate dissipation pad)

Packaging



Product Package: DFN_8L

(see "Ordering information" for details)

Application

- Communication equipment
- Instruments and apparatuses
- Industrial electrics

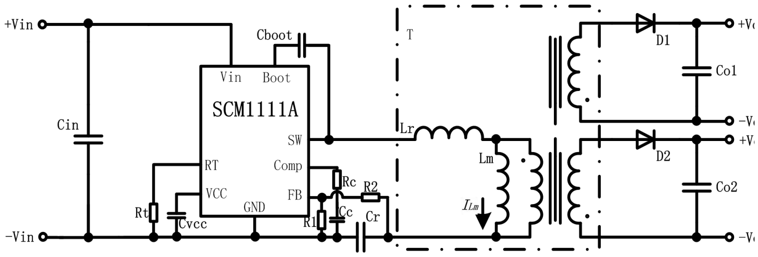
Description

SCM1111A is a synchronous,step-down DCDC converter ,with a wide input range from 6.5v to 36v.By reusing external pin,SCM1111A is compatible with both close and open control modes.The SCM1111A closed-loop mode has an externally adjustable switching frequency,operates in FCCM mode, adjustable compensation, offer excellent output precision. By matching transformer turn ratio,SCM1111A open-loop mode use 50% fixed duty cycle control,which can output the output voltage corresponding the same percent to the input voltage.

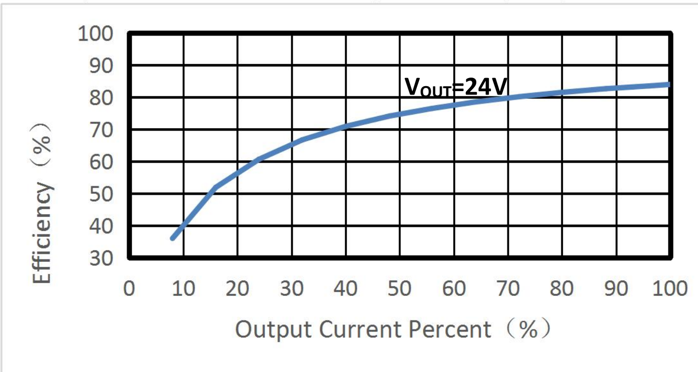
SCM1111A feedback voltage is 1V , and is available in the DFN-8L package(4mm ×4mm ×0.75mm).

SCM1111A is a DC-DC power converter specially designed for ultra-small volume applications. It supports both AHBF closed-loop primary side feedback applications and open-loop symmetrical HB / open-loop LLC applications. It can expand multi-channel output by optimizing transformer design.

Simplified Schematic



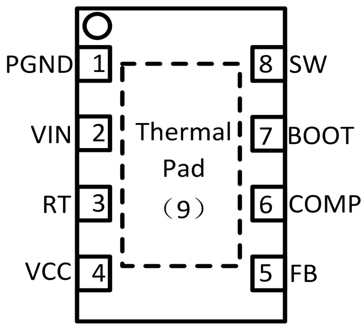
Efficiency vs. Output Current
(V_{IN}=24V, f_{sw}=550kHz,close-loop AHBF-3W system)



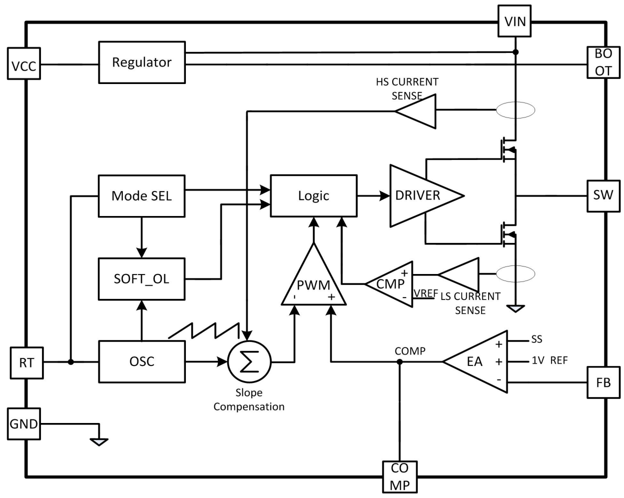
Contents

Pins

DFN-8L package
(Top view)



Functional Block Diagram



Pin Description

Pin No.	Pin Name	I/O	DESCRIPTION
1	PGND	G	Power Gnd Pin
2	VIN	I	Power input voltage pin
3	RT	I	Connect a resistor from this pin to ground,closed-loop control mode,set the switching frequency; Connect this pin to VCC,open-loop control mode
4	VCC	O	Internal 5V LDO output
5	FB	I	Feedback Pin
6	COMP	O	Compensation Pin
7	BOOT	I	Bootstrap capacitor connection for high-side MOSFET driver. Connect Cboot cap between BOOT and SW
8	SW	O	Switching node. Connect to inductor and CBOOT cap
9	Thermal PAD	G	Major heat dissipation path of the die. Must be connected to ground plane on PCB

Absolute Maximum Ratings

General test conditions: free-air, normal operation temperature range (unless otherwise noted).

Parameters		MIN	MAX	UNIT
Voltages	V_{IN} to GND	-0.3	38	V
	FB to GND	-0.3	6	
	SW to GND	-0.3	V_{IN}+0.3	
	SW to PGND (less than 100ns transient)	-1	V_{IN}+0.3	V
	BOOT to SW	-0.3	6	
	VCC to GND	-0.3	6	V
Operating junction temperature	T_J	-40	150	℃
Storage temperature range	T_{STG}	-55	150	
Electrostatic discharge (ESD)	Human body model (HBM)		2000	V
	Charged device model (CDM)		1000	

Note: Stresses at or beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute maximum rated conditions for extended periods may affect device reliability. All voltage values are based on the ground.

Recommended Operating Conditions

T_A=+25℃, unless otherwise noted.

Parameters		MIN	MAX	UNIT
Input Voltage	V_{IN} to PGND	6.5	36	V
Buck regulator	V_{IN}	6.5	36	V
	CB		41	
	CB to SW		5	
	SW	-0.7	36	
	FB	0	5	
Operating junction temperature	T_J	-40	125	℃
V_{Cr} voltage range	$V_{Cr}=V_{in}\times D$	3	22	V
Average value of excitation inductance current	$I_{Lm\_avg}=I_{o1}/N$	0	3	A

Electrical Characteristics

T_A=+25℃ , V_{IN}=24V unless otherwise noted.

Symbol		PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
VIN (INPUT POWER SUPPLY)							
V_{IN}		Minimum operating input voltage				6.5	V
I_Q		Quiescent current(no switch)	V_{FB} =1.2V		540	800	μA
V_{UVLO}		Under-voltage lockout thresholds	Rising			5.3	V
			Hysteresis		0.35		
INTERNAL POWER SUPPLY							
VCC		Internal LDO output voltage	6.5≤V_{IN}≤36	4.85	5	5.35	V
$V_{BOOT-UVLO}$		Bootstrap under-voltage lockout thresholds			2.8		
VOLTAGE REFERENCE (FB PIN)							
V_{FB}		Feedback voltage		0.975	1	1.025	V
I_{FB}		FB pin current	V_{FB}=1V		0.2	50	nA
CURRENT LIMIT							
I_{SC+}		High side current limit	V_{FB} =1V		4.5		A
I_{SC-}		Low side current limit			-4		
SOFT START							
t_{SS}		Internal soft start(closed-loop)	Cout=470uF		25		ms
		Internal soft start(open-loop)	Cout=470uF		45		ms
SWITCHING FREQUENCY							
FRE-jitter	f_{jitter}				±3		%
Closed-loop	f_{SW_CL}	Switching frequency	R_T=49.9kΩ , V_{FB}=1V	450	550	650	kHz
	D_{MAX}	Maximum duty cycle	V_{FB} =1V、I_{OUT}=1A		60		%
Open-loop	f_{SW_OL}	Switching frequency	V_{FB} =1V	170	200	230	kHz
	D	Duty cycle	V_{FB} =0V	48	50	52	%
	SD	Duty cycle stability	Single chip full state duty cycle stability			5	%
POWER MOSFET							
R_{DSON_H}		High side R_{DSON}	V_{IN}=12V		100	150	mΩ
R_{DSON_L}		Low side R_{DSON}			110	150	
Timing sequence							
t_{ONMIN_CL}		Closed-loop minimum on time	V_{IN}=12V		300		ns
t_{ONMIN_OL}		Open-loop minimum on time			120		ns
PROTECT CHARACTERISTICS							
V_{HC}		Enter the hiccup mode FB			0.6		V

	pin detected value					
t_{HC}	Hiccup sleep time			94		ms
T_{SD}	Thermal shutdown threshold(1)			162		℃
	Hysteresis(1)			10		℃

Note(1): Guaranteed by design.

Thermal Information

PARAMETER(1)		数值	UNIT
Junction to ambient thermal resistance	θ_{JA}	59	℃/W
Junction to top characterization parameter	Ψ_{JT}	10	℃/W

Note(1): All numbers apply for packages soldered directly onto a 7.62cm x 7.62cm PC board with 4 layers in still air.

Typical Curves

1: AHBF closed-loop primary feedback application：T_A=+25℃，R_T=47k，f_{sw}=565kHz，C_{OUT} = 10μF .

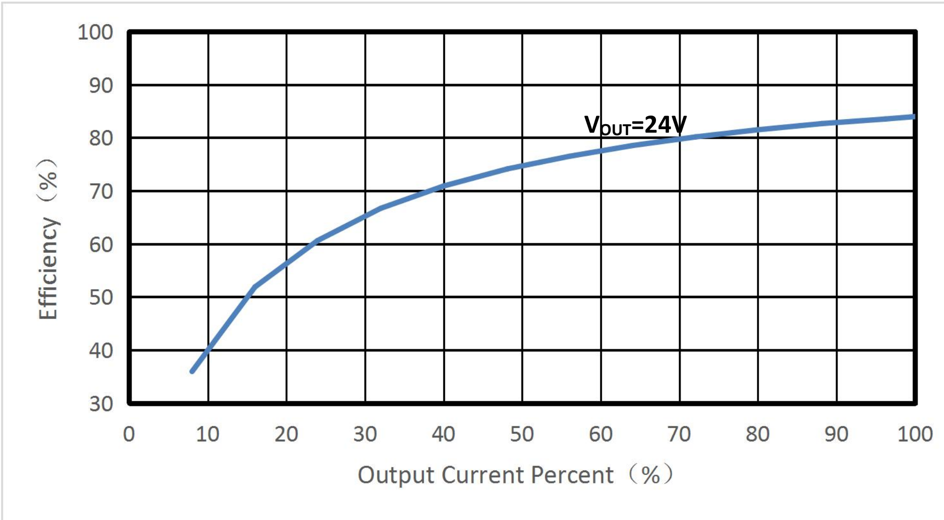
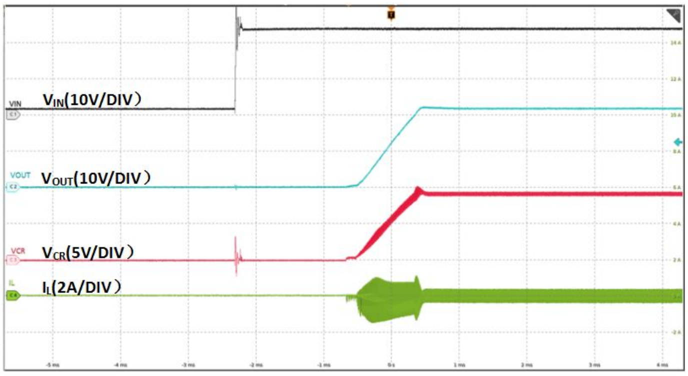


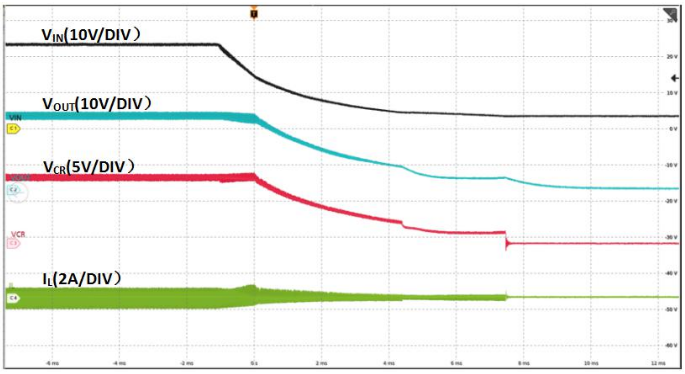
Figure 1. Efficiency vs. Load Current
(V_{IN}=24V P_max=3W)



Time(1ms/DIV)

Figure 2. V_{IN} Start-up Waveform

(V_{IN}=24V, V_{OUT}=24V, I_O=0.1A)



Time(2ms/DIV)

Figure 3. V_{IN} Shutdown Waveform

(V_{IN}=24V, V_{OUT}=24V,I_O=0.1A)

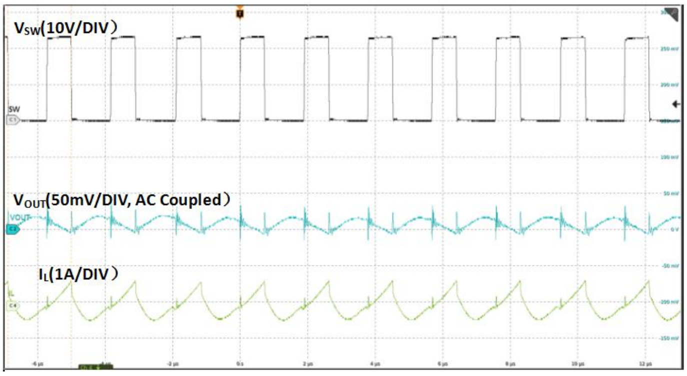


Figure 4. Switching Node and Output Voltage Waveform

(V_{IN}=24V, V_{OUT}=24V, I_O=0.1A)

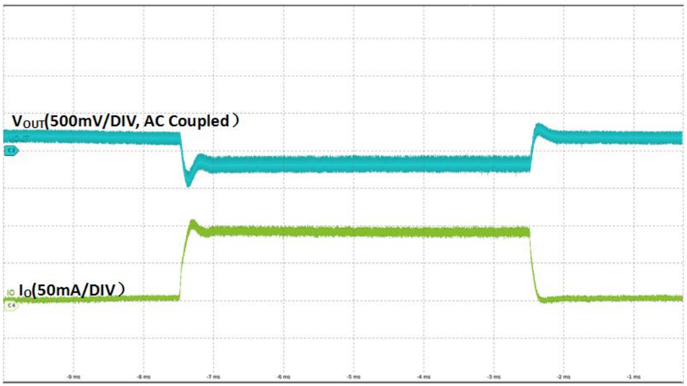


Figure 5. Load Transient Between 10mA and 100mA

(V_{IN}=24V, V_{OUT}=24V, Slew rate=3A/us)

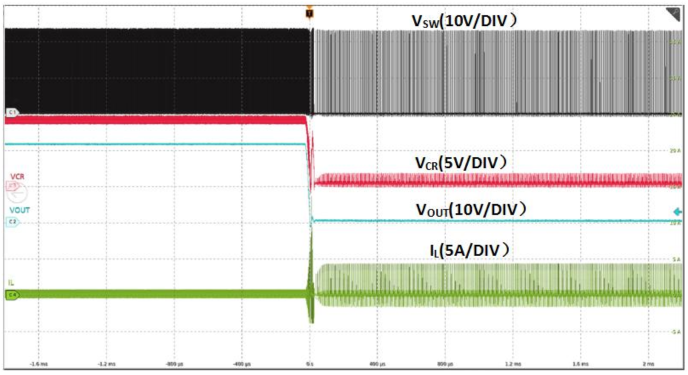


Figure 6. Short Circuit Test Waveform

(V_{IN}=24V, V_{OUT}=24V)

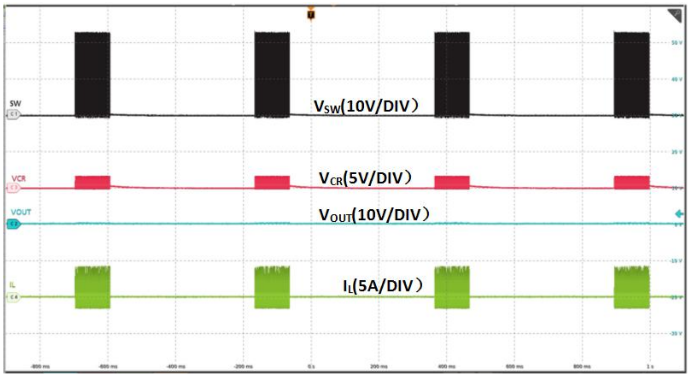


Figure 7. Hiccup Waveform

(V_{IN}=24V, V_{OUT}=24V)

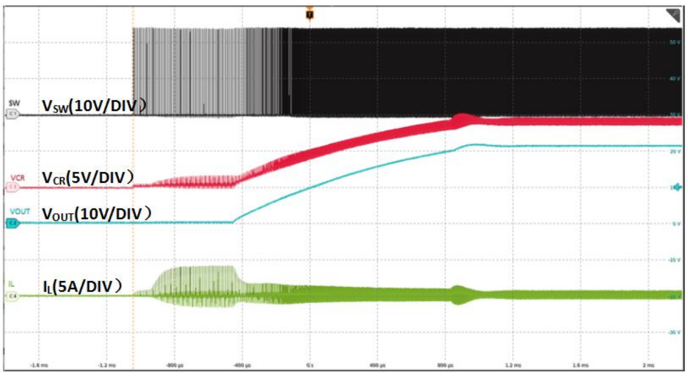


Figure 8. Short Circuit Recovery Waveform

(V_{IN}=24V, V_{OUT}=24V)

2: AHBF closed-loop primary floating-ground （ACF） feedback control application：T_A=+25℃，R_T=47k，f_{sw}=565kHz，C_{OUT} = 10µF。

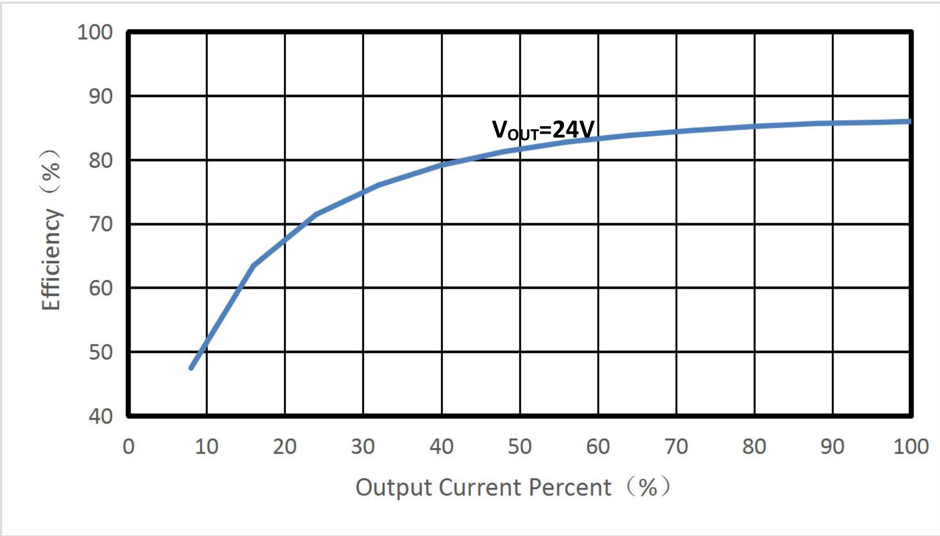
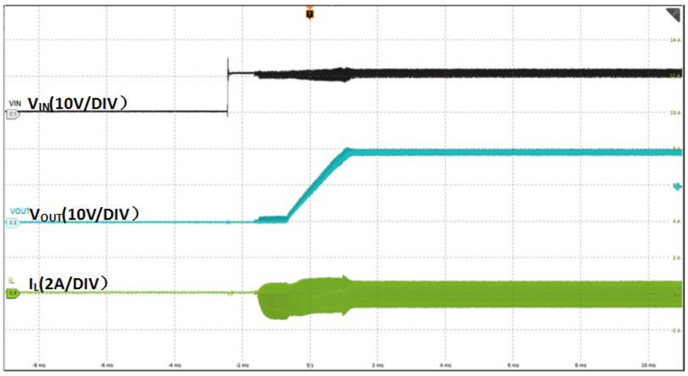


Figure 9. Efficiency vs. Load Current

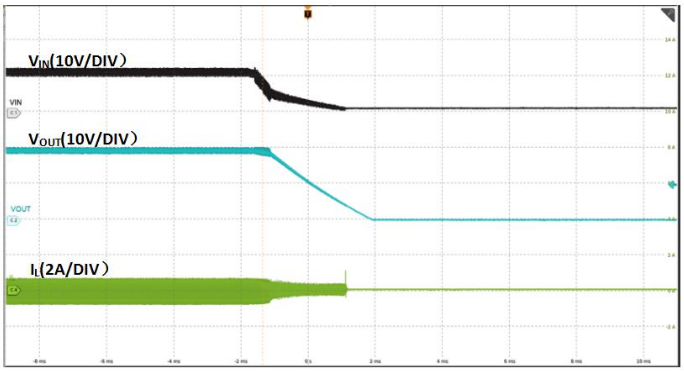
(V_{IN}=12V，P_max=3W)



Time(2ms/DIV)

Figure 10. VIN Start-up Waveform

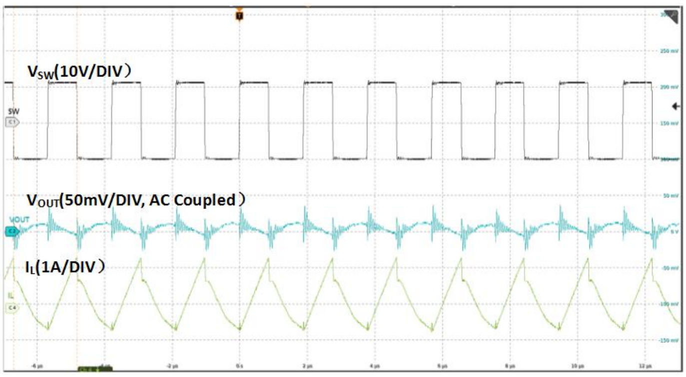
(V_{IN}=12V, V_{OUT}=24V, I_O=0.1A)



Time(2ms/DIV)

Figure 11. VIN Shutdown Waveform

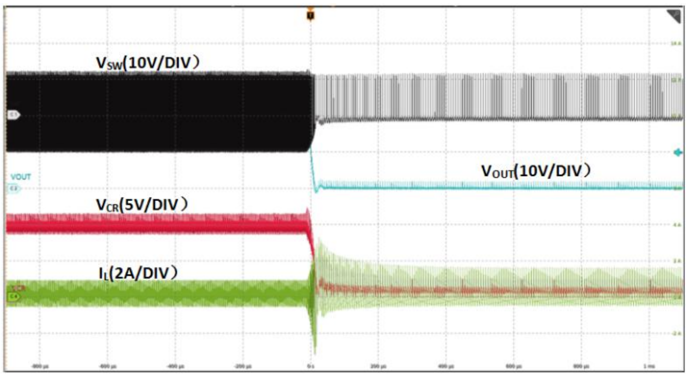
(V_{IN}=12V, V_{OUT}=24V,I_O=0.1A)



Time(2µs/DIV)

Figure 12. Switching Node and Output Voltage Waveform

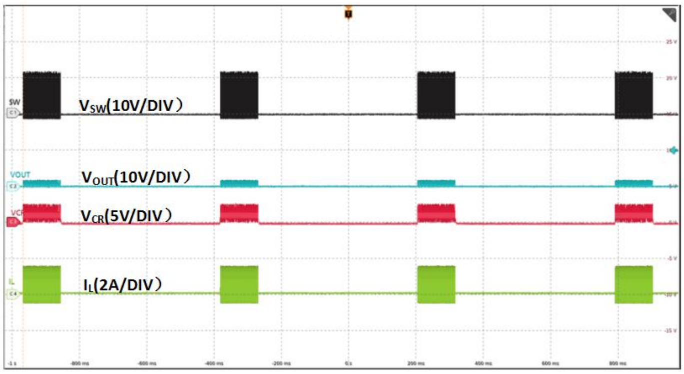
(V_{IN}=12V, V_{OUT}=24V, I_O=0.1A)



Time(200µs/DIV)

Figure 13. Short Circuit Test Waveform

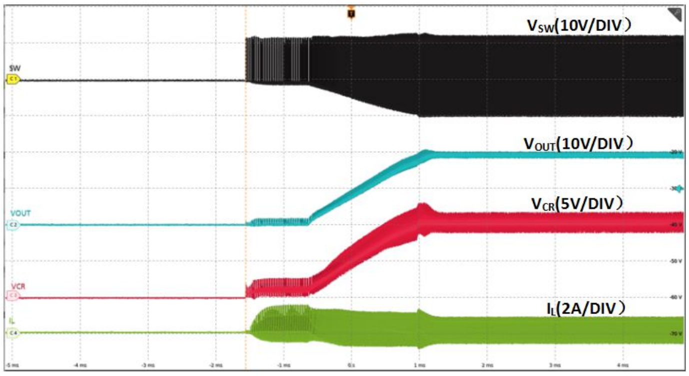
(V_{IN}=12V, V_{OUT}=24V)



Time(200ms/DIV)

Figure 14. Hiccup Waveform

(V_{IN}=12V, V_{OUT}=24V)



Time(1ms/DIV)

Figure 15. Short Circuit Recovery Waveform

(V_{IN}=12V, V_{OUT}=24V)

3: Open loop symmetrical HB application：T_A=+25℃，f_{sw}=200kHz，C_{OUT} = 10μF。

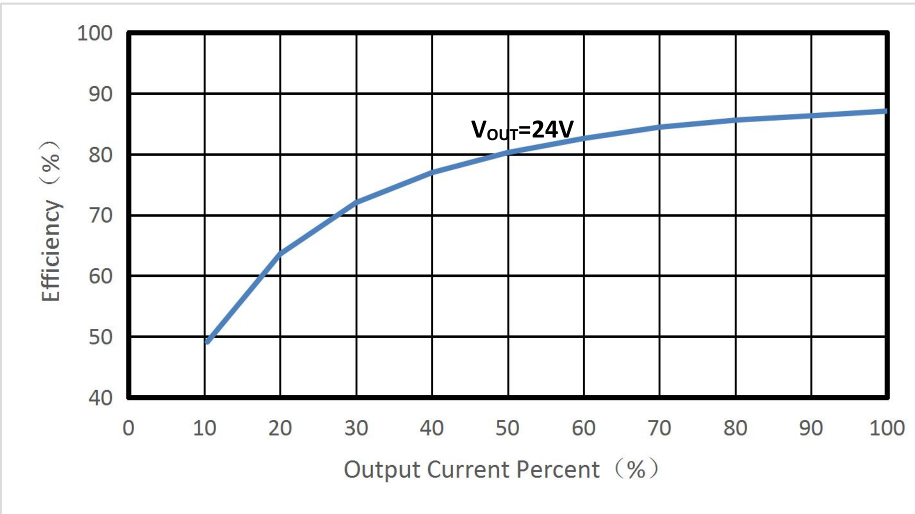
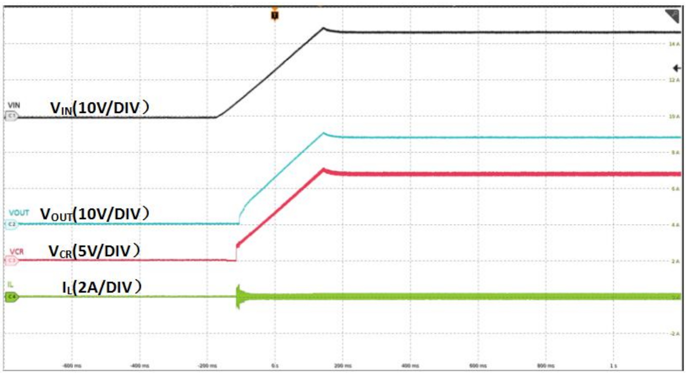


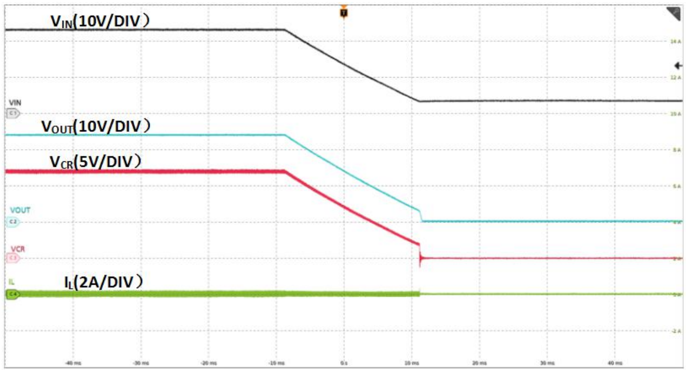
Figure 16. Efficiency vs. Load Current
(V_{IN}=24V,P_max=2.4W)



Time(200ms/DIV)

Figure 17. V_{IN} Start-up Waveform

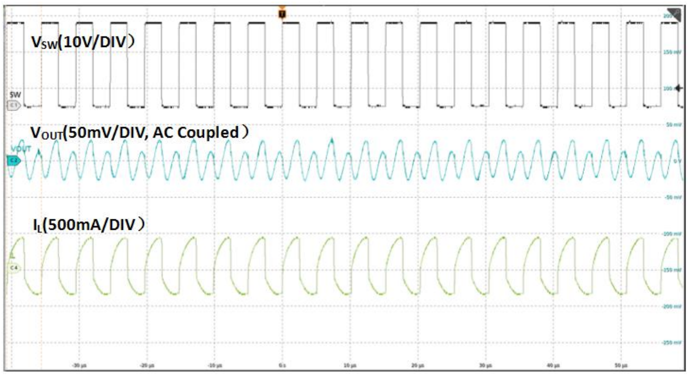
(V_{IN}=24V, V_{OUT}=24V,I_O=50mA)



Time(10ms/DIV)

Figure 18. V_{IN} Shutdown Waveform

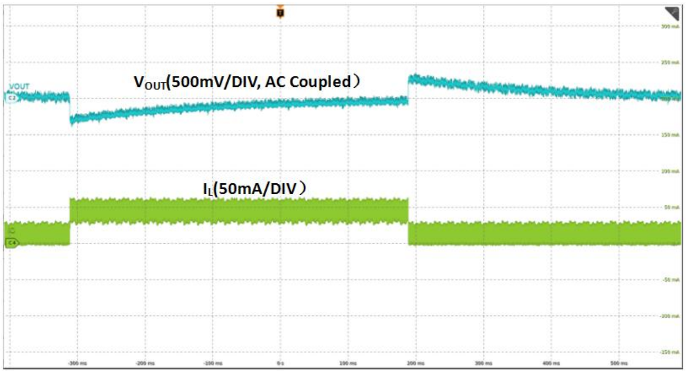
(V_{IN}=24V, V_{OUT}=24V, I_O=50mA)



Time(5µs/DIV)

Figure 19. Switching Node and Output Voltage Waveform

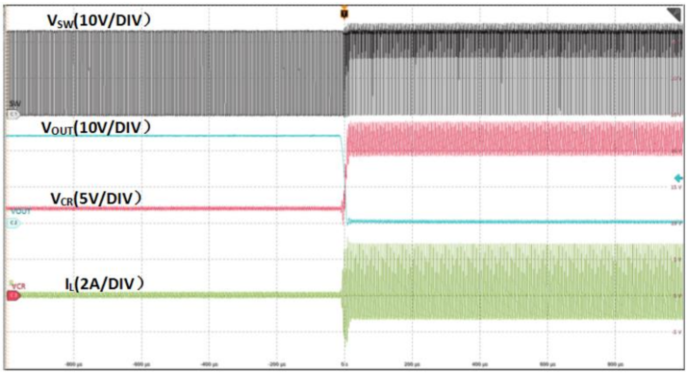
(V_{IN}=24V, V_{OUT}=24V, I_O=50mA)



Time(100ms/DIV)

Figure 20. Load Transient Between 20mA and 50mA

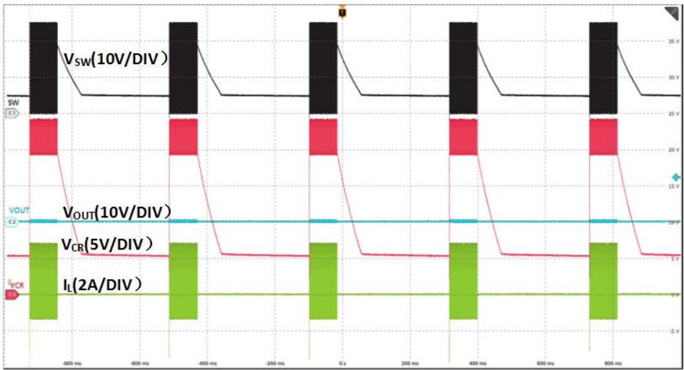
(V_{IN}=24V, V_{OUT}=24V, Slew rate=3A/us)



Time(200µs/DIV)

Figure 21. Short Circuit Test Waveform

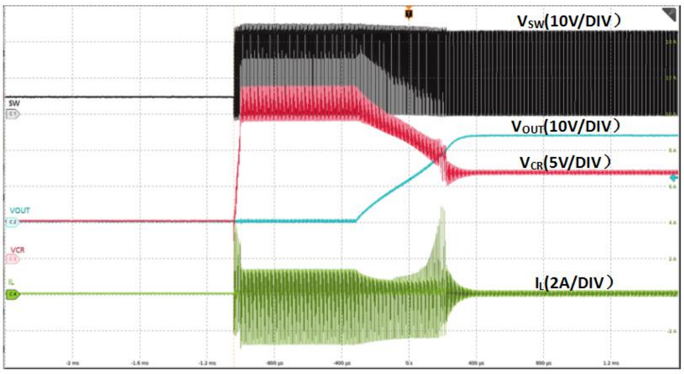
(V_{IN}=24V, V_{OUT}=24V)



Time(200ms/DIV)

Figure 22. Hiccup Waveform

(V_{IN}=24V, V_{OUT}=24V)

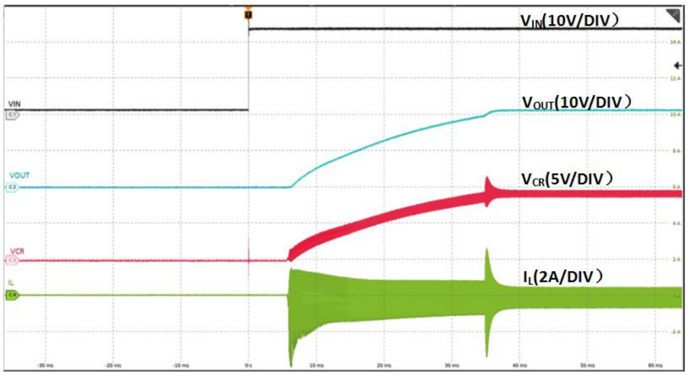
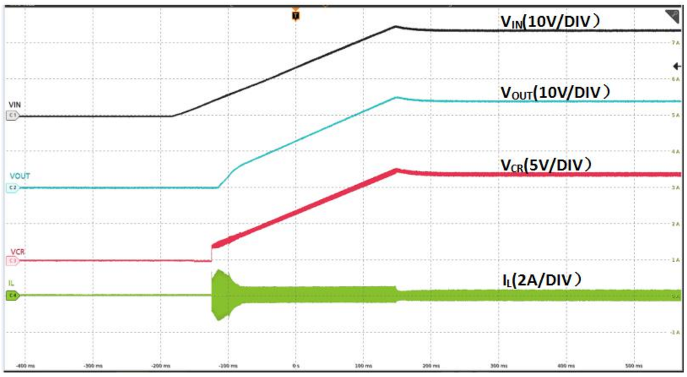


Time(1ms/DIV)

Figure 23. Short Circuit Recovery Waveform

(V_{IN}=24V, V_{OUT}=24V)

4: With large capacitance load start：T_A=+25℃，V_{IN} = 24V，V_{OUT} = 24V。

 Time(10ms/DIV) **Figure 24. V_{IN} Start-up Waveform I_O=100mA (Single road closed-loop AHBF application with 330 uF capacitive load)**	 Time(50ms/DIV) **Figure 25. V_{IN} Start-up Waveform I_O=50mA (Single road open-loop AHB application with 330 uF capacitive load)**

SCM1111A is a synchronous step-down DCDC converter ,with a wide input range from 6.5v to 36v,open-loop mode can support maximum 2.4W applications and closed-loop mode can support maximum 3W applications. The SCM1111A can be supplied in 12V, 15V, 24V input system。

The SCM1111A has an integrated 5V regulator to provide the power for bootstrap capacitor. When the bootstrap voltage drops below the specified threshold, the high-side MOSFET is turned off using an UVLO circuit which allows the low-side MOSFET to conduct and refresh the charge on the BOOT capacitor. Internal soft start is featured to minimize input inrush currents. The switching frequency in closed-loop mode is programmable from 200kHz to 1.2MHz by an external resistor.But in open-loop mode the switching frequency is fixed at 200kHz.

The chip also integrates various protection functions, including power supply under-voltage protection, peak current protection, short-circuit protection and over-temperature protection.

The SCM1111A is a buck converter chip, which is based on peak current mode. The chip contains a "half-bridge" main-power MOSFET and its drive and control modules, it supports AHBF primary side closed-loop feedback application and simultaneously supports open-loop symmetrical HB application. By optimizing the transformer design, the multiplexed outputs can be extended, the design of driving power supply is greatly simplified and the hardware cost in the design is reduced.

Working principle of AHBF primary side closed-loop feedback

The schematic diagram of the circuit is shown in typical application circuit 1. In order to facilitate the working principle, the single-channel output is taken as an example to illustrate, namely. $I_{o2}=0$

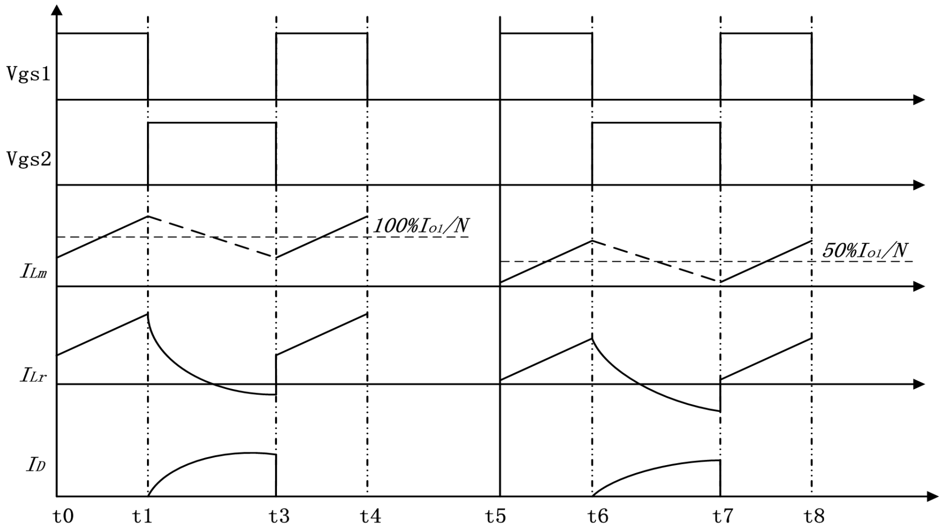
According to the ampere-second balance principle of the resonant capacitor's steady-state within one period, the average current of the excitation inductance is as follows:

$$I_{Lm}=\frac{I_{O1}}{N_1}+\frac{I_{O2}}{N_2}=\frac{I_{O1}}{N_1}$$

The ripple coefficient of excitation current is defined as λ_m , which satisfies:

$$\lambda_m=\frac{\Delta I_{Lm}}{I_{Lm}}$$

The AHBF topology be controlled by fixed-frequency PWM, primary high-side MOS can realize ZVS in the case of λ_m >2 (the primary side inductance is small). However, at this time, a large resonant current flows through the resonator cavity when the circuit is lightly loaded, resulting in lower load efficiency and higher no-load power consumption, which is the biggest bottleneck to apply this circuit in practical.
Considering the actual drive power application, the input voltage is low and the output power is small, so the ZVS of the high-side MOS is not very important. In this case, the resonant cavity current can be reduced by reducing λ_m (λ_m <<2) to achieve the lower no-load power consumption. The specific method is to increase Lm design value. At the same time, in order to ensure the accuracy of the primary side sampling and the stability loop, the lower ESR and uF level capacitors should be selected. This finally determines that the actual working state of the drive power is the AHBF CCM mode(λ_m <<2). The working key nodes waveform of the actual circuit are shown in the following figure:



The above figure shows the key nodes working waveform of the circuit with half-load and full-load. When the input voltage remains unchanged and the load changes, the duty ratio D almost remains unchanged. The average value of the excitation inductance current decreases as the load decreases.The chip control design is different from the common synchronous BUCK chip, it must support the FCCM mode, and there will be a certain negative current in the low-side MOSFET.

Working principle of Open-loop symmetrical HB

The open-loop scheme can be applied to the symmetrical HB scheme. The circuit principle is shown in typical application circuit 3. For open-loop application, the "half bridge" main power MOS inside the chip is symmetrically turned on, and the duty cycle is 50%. The secondary side adopts voltage doubling rectification, that is, the output voltage is twice the secondary side winding voltage. The working principle of open-loop application is similar to the symmetrical half bridge principle, The output voltage is related to the transformer turn ratio and input voltage. The typical application circuit 3, which only takes the single output application as an example, that is $I_{o2} = 0$, it can be seen that:

$$Vo1 = Vin / N - 2 * V_F$$

Similarly, the ZVS of the upper tube is not very important for low-voltage applications. The resonator current can also be reduced by reducing λ_m （ λ_m <<2 ） to decrease no-load power consumption, that is, to increase the design value of Lm. The capacitance shall be uF grade and low ESR.

PWM Mode

The SCM1111A implements peak current mode control. The Vcr voltage is compared through external resistors on the FB pin to an internal voltage reference by an error amplifier which drives the internal COMP node. An internal oscillator initiates the turn on of the high side MOSFET, and the inductor current increases linearly. The SCM1111A senses the peak current, and high side MOSFET is turned off when the peak current reaches the threshold, which allows the low-side MOSFET to conduct, until the current through the inductor falls linearly to the negative current threshold or when next cycle restarts.

Current limit

SCM1111A implements peak current control mode and the high-side MOSFET is controlled to turn off periodically by the internal COMP voltage. In each period, the switch MOSFET current is compared with the COMP voltage, When the switch MOSFET peak current rises to the COMP voltage, the high-side MOSFET is controlled to turn off. In the current-limiting state, the output voltage is pulled down, and COMP voltage is pulled up by the error amplifier to achieve the internal clamping voltage, and finally the switch current will be limited on a cycle by cycle basis.SCM1111A low-side MOSFET also adopts cycle by cycle peak current protection. After sampling the low-side MOSFET current in each cycle, it is compared with the reference voltage . When the low-side MOSFET peak current rises to the comparison voltage, the low-side MOSFET is controlled to turn off to realize the current limiting function.

External Compensation

In order to use a simple loop compensation method and achieve the faster transient response, SCM1111A adopts current mode control and the COMP pin is used to achieve loop compensation. The COMP pin is the output of the error amplifier (EA), through series or parallel resistors and capacitors on the COMP pin, zeros and poles are generated, so as to realize the stability of the loop. The output impedance of the error amplifier (EA) is:

$$R_{EA} = A_{VEA} / G_{EA}$$

Soft Start

In the closed-loop mode ，the soft-start feature allows the SCM1111A to gradually reach the steady state operating point, thus reducing Start-up stresses and surges. The SCM1111A regulates the FB pin to the internal soft voltage or the internal 1V reference, whichever is lower. At the beginning of the soft-start sequence when soft= 0 V, the internal current source gradually increases the voltage on an internal soft-start capacitor , resulting in a gradual rise of the FB and output voltages。Finally, the output reaches the steady-state voltage。

In the open-loop mode, the SCM1111A realizes the soft start of output voltage by gradually increasing the conduction time of upper and lower mos. At the initial stage of start-up, the output voltage is low, the charging slope of inductive current is steep, the discharge slope is slow, and the opening time of upper and lower mos is short at this stage. With the increasing output voltage, the charge discharge slope of the inductor current tends to balance, the conduction time of the upper and lower mos gradually becomes longer, and the final output reaches the steady-state voltage, which can greatly reduce the input surge current.

Inductance current charge slope： $\frac{\Delta I_{CHARGE}}{\Delta T} = \frac{V_{IN} - V_O}{L}$

Inductance current discharge slope： $\frac{\Delta I_{DISCHARGE}}{\Delta T} = -\frac{V_O}{L}$

Short Protection

If the voltage on the FB input falls below about 0.6 V due to a short circuit in the closed-loop mode,perhaps the continuous overcurrent of the chip reaches 80ms in the open-loop mode.The device enters into hiccup mode. In this mode, the device stops switching for about 94 ms/400ms（closed-loop mode/open-loop mode）and then goes through a normal re-start with soft start.If the short-circuit condition remains, the device runs in current limit for about 20 ms/80ms（closed-loop mode/open-loop mode）and then shuts down again. This cycle repeats,（As shown in Figure 7/Figure 22）as long as the short-circuit-condition persists. This mode of operation helps reduce the temperature rise and the loss of the device during a hard short on the output. The output current is greatly reduced during hiccup mode. Once the output short is removed and the hiccup delay is passed, the output voltage recovers normally（As shown in Figure 8/Figure 23）.

Mode Switching

When the RT pin is externally connected to VCC, SCM1111A chip operates in open-loop mode and the frequency is fixed at 200kHz. When the external resistance of RT pin is grounded, SCM1111A operates in closed-loop mode. The switching frequency of closed-loop mode can be set through the RT resistance between RT pin and GND.

Thermal Shutdown

The chip inside has a shutdown function for over-temperature protection, when the chip's own junction temperature exceeds 162°C, the chip will be turned off , it restarts after chip temperature drops to 152°C.

Vin-Uvlo

The SCM1111A incorporates an undervoltage-lockout feature on the input of the VIN pin.When VIN reaches about 5 V （Typ）the device is ready to start up. When VIN falls below about 4.7 V the device shuts down.

Application Information

Typical application 1: Application illustration of AHBF closed-loop primary feedback scheme (circuit schematic diagram is shown in typical application circuit 1)

Vcr voltage setting

Vcr is set by external feedback resistors R1 and R2:

$$V_{FB} = V_{Cr} \times R_1 / (R_1 + R_2) = 1V$$

Vcr voltage setting:

$$V_{Cr} = 1V \times (R_1 + R_2) / R_1$$

The average Vcr voltage is simultaneously satisfied:

$$V_{Cr} = V_{in} \times D$$

According to the AHBF topology characteristics (when duty cycle exceeds the "monotonic", output gain decreases with the increase of D), it is generally required that the full-load duty cycle D in the low-voltage input is preferably less than 50% (the maximum duty cycle Dmax of the inside chip is less than 60%), that is, in general, the Vcr voltage should be less than 1/2Vin_min.

Transformer Design

Two basic principles should be guaranteed in transformer design and optimization: First, reduce primary and secondary side leakage inductance as much as possible; Second, reduce the primary and secondary side windings DCR as much as possible. Only in this way the circuit will have a higher load adjustment rate.

Calculate the positive peak value of excitation inductance current:

$$I_{Lm\_peak+} = (1 + \lambda_m)(\frac{I_{O1}}{N_1} + \frac{I_{O2}}{N_2})$$

The transformer design process should ensure that the positive peak value of the excitation inductance current is satisfied as $I_{Lm\_peak+} < I_{SC+}$, and leave a certain safety margin, otherwise the chip protection will be triggered. At the same time, it must be ensured that $I_{Lm\_peak-} < I_{SC-}$ and a certain safety margin is left. The negative peak value of the magnetizing inductance current I_{Lm_peak-} related to the resonance parameters, and then the specific mathematical algebra is too complicated, but it can be debugged based on experience. That is, after the transformer parameters are selected, increasing the resonant capacitor Cr value can reduce the negative peak value of the excitation inductance current I_{Lm_peak-} . If the negative peak value of the excitation inductance current reached the negative current limit I_{SC-} inside the chip during in actual debugging, it can be solved by increasing the resonant capacitor Cr value.

Output voltage setting

Vo1, Vo2 voltage setting:

$$V_{O1} = V_{Cr} / N_1 - V_F$$

$$V_{O2} = V_{Cr} / N_2 - V_F$$

$$N_1 = N_P / N_{S1} \text{，} N_2 = N_P / N_{S2}$$

The output voltage can be adjusted by changing the transformer turns ratios N1 and N2, and fine tuning the VCr setting value.
It can be seen that the AHBF closed-loop primary-side feedback scheme is a step-down topology in itself, and also is an ideal scheme for the application of the 24V drive power input system. However, for the 12V and 15V input system of the drive power supply, the output voltage is 24V. In this case, the turns ratio N1 and N2 required by the AHBF closed-loop primary side feedback scheme will exceed 4, the transformer leakage inductance will affect the circuit performance. Therefore, reduce the transformer turns ratio will become very important. Through the AHBF closed-loop primary feedback scheme is used to control the floating ground, all input voltages are used to excite the transformer, and the transformer turns ratio can be reduced.
For the driving power 12V and 15V input system, the recommended solution is AHBF Controlled Floating ground (ACF) primary-side feedback.

Typical application 2: AHBF Controlled Floating (ACF) primary side feedback scheme application illustration (the circuit schematic is shown in the typical application circuit 2)

The AHBF Controlled Floating Ground (ACF) primary feedback scheme, it contains the circuit topology has changed by suspending the control ground, that is, it becomes the ACF topology, and the principle is not repeated here.

Voltage stress and scheme selection

Input and Output Specifications	Recommendation	Recommended the ratio of transformer winding	Stress Description		Notes
			Primary MOSFET	Secondary Diode	
24V±10%Input、24V Ouput	AHBF closed-loop primary feedback scheme	Np：Ns1：Ns2= 1:2:2	Vin	Vin/N	When designing the stress, it is necessary to consider that voltage spikes of the secondary diode is not turned off by ZCS. At the same time, an absorption circuit should be added to the circuit.
15V±10%Input、24V Ouput 12V±10%Input、24V Ouput	AHBF ACF primary feedback scheme	Np：Ns1：Ns2= 1:2:2	Vin+NVo	Vin/N+Vo	

Typical application 3: Application description of open-loop symmetrical HB scheme (the circuit schematic diagram is as shown in typical application circuit 3).

The chip's RT pin function is multiplexed, when the RT pin is connected to VCC through a resistor, the chip is an open-loop control state, the output drive circuit to work under 50% duty cycle, and then the Vcr voltage is related to the input voltage and transformer turns ratio. The open-loop scheme can be applied to open-loop symmetrical HB system, and the specific principle and transformer design can be analyzed and designed according to the specific topology, which will not be elaborated here.

Thermal Shutdown

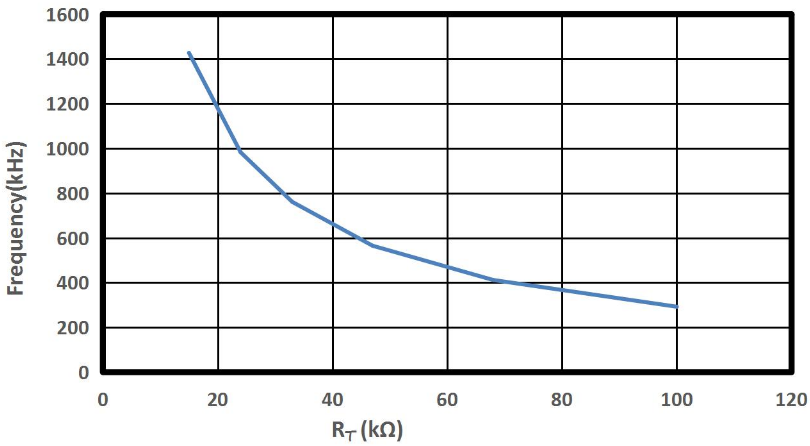
In order to avoid overheating chip off, need a thermal analysis according to different applications. In principle, the need to ensure maximum internal power shall not exceed the maximum junction temperature requirements:

$$P_{L(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

$T_{J(MAX)}$ Maximum allowable junction temperature，T_A Ambient temperature，θ_{JA} Junction to ambient thermal resistance。

Setting the Switching Frequency

The switching frequency of the SCM1111A in closed-loop mode can be programmed by the resistor from RT pin to GND pin.The corresponding relationship between RT resistance and switching frequency is shown in the following curve.



The typical relationship between R_T resistance and switching frequency is shown in the following table.

R_T (kΩ)	f_{SW} (kHz)
100	292.5
68	412
49.9	550 (Typ)
47	565
33	761
24	983
15	1427

Input Capacitor Selection

The input current of buck regulator is discontinuous, so the input capacitor is needed to stabilize the input voltage. A low ESR capacitor , for example, ceramic capacitor, tantalum capacitor or low ESR electrolytic capacitor, is needed to prevent the noises and interferences appearing at the input. One

4.7μF input capacitor with X7R or X5R dielectric is needed at least. Using the larger the capacitance to accomplish the better filtering result is reasonable. The input capacitor must be placed close to the VIN pin in order to achieve the best performance when users design a PCB.

Resonant Capacitor and Output Capacitor Selection

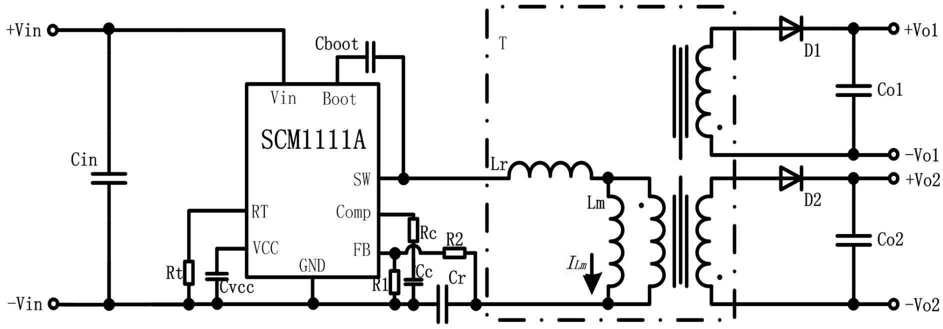
The resonant capacitor and output capacitor will determine the DC output voltage and the loop stability. Low ESR capacitor will meet the better output voltage ripple.

One 2.2μF resonant capacitor and one 10μF output capacitor are needed at least. Using the larger the capacitance to accomplish the better output voltage ripple and transient load response is reasonable.

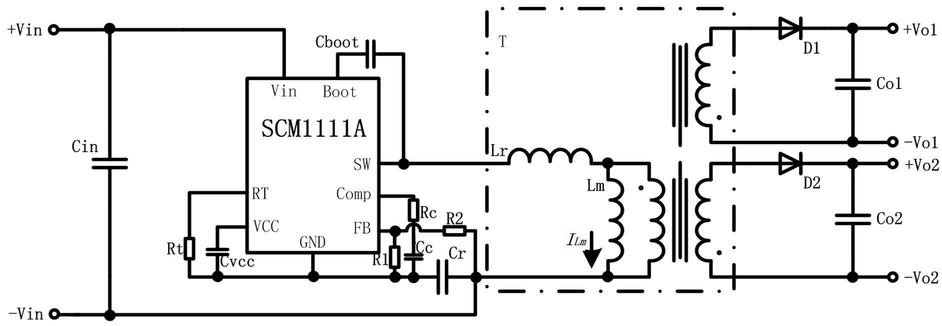
Bootstrap Capacitor Selection

A 0.1μF~1μF capacitor , X7R or X5R dielectric and a voltage rating is greater than 10V , is recommended, and a large value is preferable at high duty cycle.

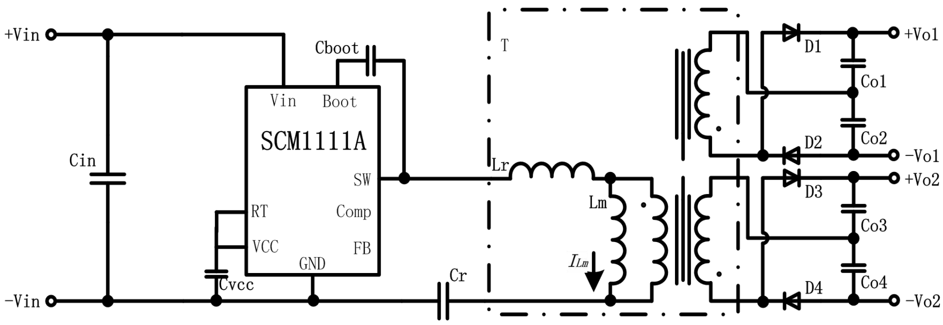
Application Circuit



Typical Application Circuit 1　AHBF closed-loop primary feedback solution



Typical Application Circuit 2　AHBF closed-loop primary floating-ground （ACF） feedback control solution

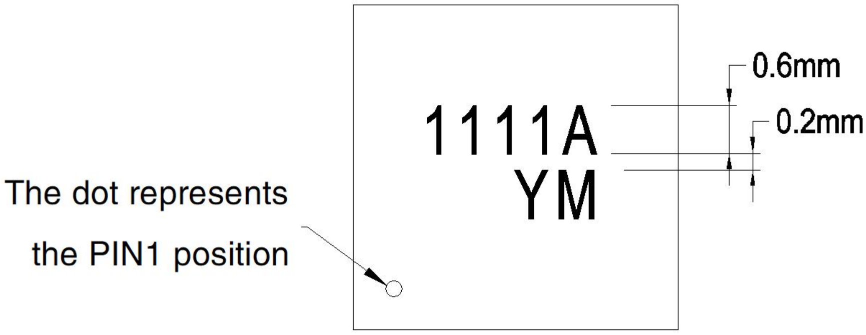


Typical Application Circuit 3　Open-loop symmetrical HB solution

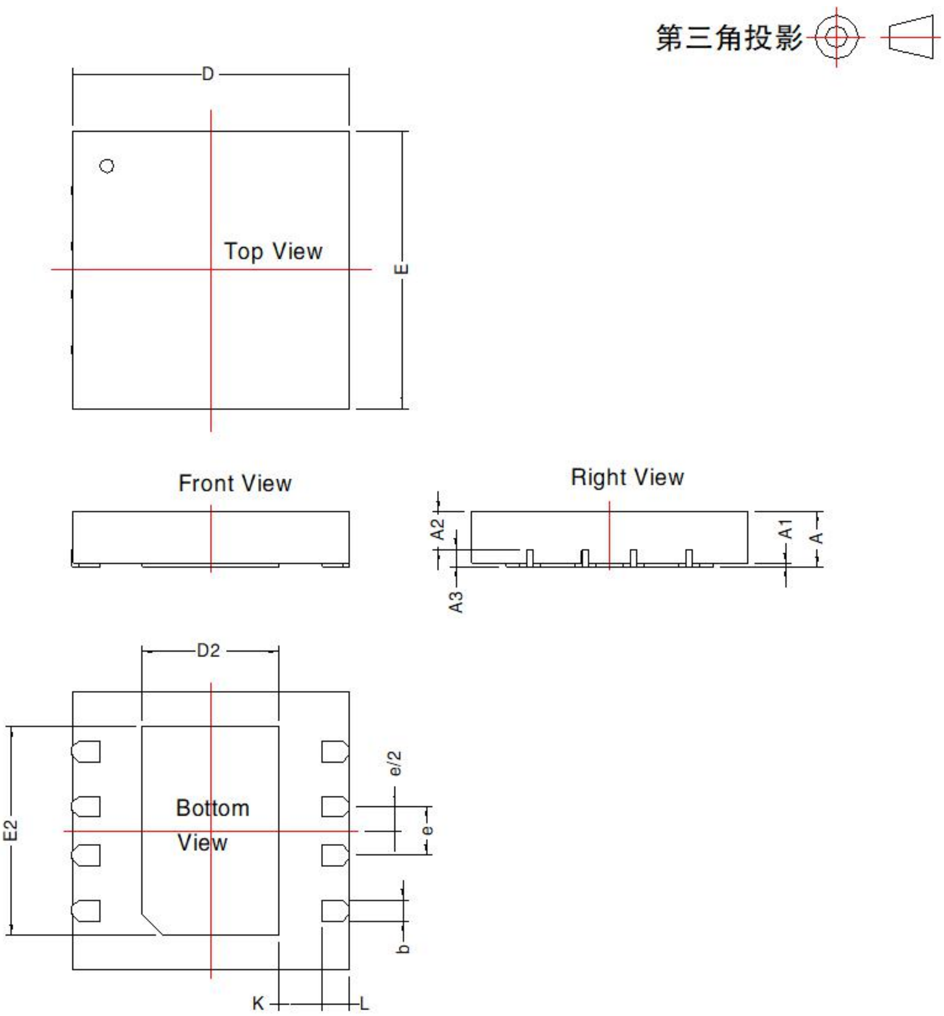
Ordering Information

Part number	Package	Number of pins	Product Marking	Tape & Reel
SCM1111AFA	DFN-8L	8	1111A YM	5k/Reel

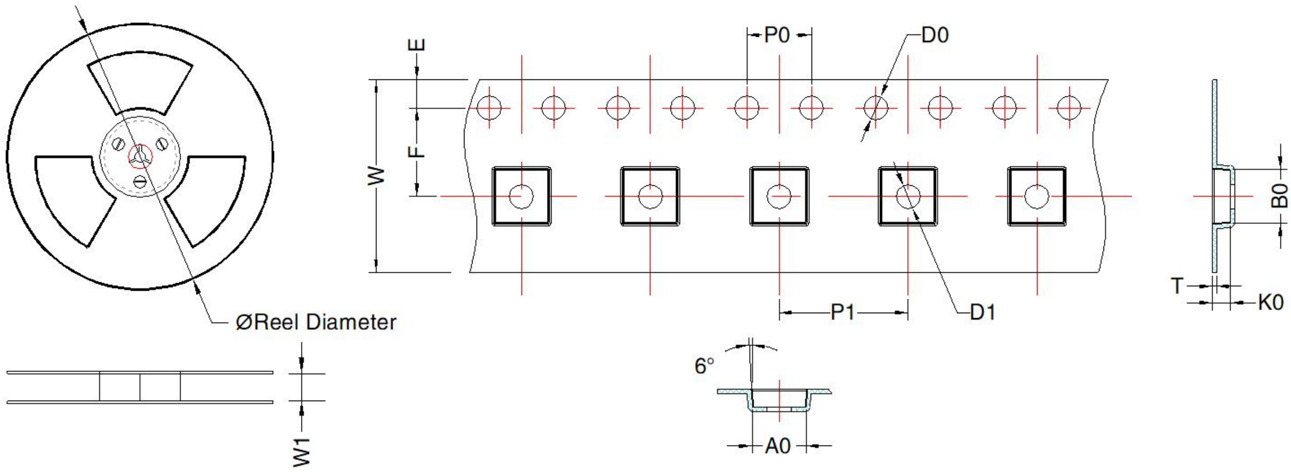
Product marking and data code:
(1) SCM1111, Product designation.
(1) A, Version code information.
(3) F, Packaging definition code; F: DFN-8L package.
(4) A, Operating temperature range; C: 0℃-70℃, I: -40℃-85℃, A: -40℃-125℃, M: -55℃-125℃.
(5) YM, Data code for product traceability.



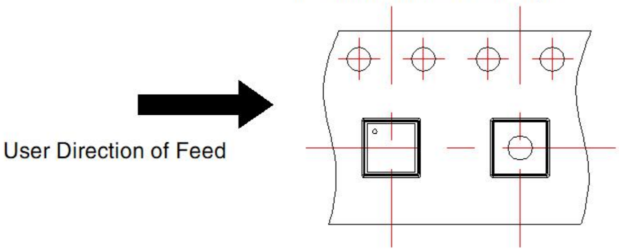
Note:
1、Typeface: Arial;
2、Character size:
Height: 0.6mm, Spacing: 0.1mm, LineSpacing: 0.2mm;



DFN 8L						
Mark	Dimension(mm)			Dimension(inch)		
	Min	Nom	Max	Min	Nom	Max
A	0.7	0.75	0.8	0.028	0.030	0.031
A1	0	0.02	0.05	0	0.001	0.002
A2	—	0.55	—	—	0.022	—
A3	0.203REF			0.008REF		
b	0.25	0.3	0.35	0.010	0.012	0.014
D	4 BSC			0.157 BSC		
E	4 BSC			0.157 BSC		
e	0.8 BSC			0.031 BSC		
D2	1.88	1.98	2.08	0.074	0.078	0.082
E2	2.9	3	3.1	0.114	0.118	0.122
k	0.3	0.4	0.5	0.012	0.016	0.020
L	0.61 REF			0.024 REF		



The orientation of IC in tape



Device	Package Type	MPQ	Reel Diameter (mm)	Reel Width W1(mm)	A0 (mm)	B0 (mm)	K0 (mm)	T (mm)	W (mm)	E (mm)	F (mm)	P1 (mm)	P0 (mm)	D0 (mm)	D1 (mm)
SCM1111AFA	DFN 8L	5000	330.0	12.4	4.3 ± 0.1	4.3 ± 0.1	1.1 ± 0.1	0.25 ± 0.03	$12.0^{+0.3}_{-0.1}$	1.75 ± 0.1	5.5 ± 0.1	8.0 ± 0.1	4.0 ± 0.1	$1.5^{+0.1}_{-0}$	$1.5^{+0.25}_{-0}$

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