SUNPOL mPOL product Model: SP-1406

6A mPOL synchronous step-down regulator with integrated inductor and MOSFET

Features

- Ultra-small package with embedded inductor and low on-resistance integrated MOSFET
- Maximum 6A continuous output current
- 3V to 18V input voltage range
- 0.6V to 7V adjustable output voltage
- Built-in soft start
- 1% feedback voltage accuracy
- Use pulse skip mode to achieve high efficiency under light load conditions
- ≤5μA shutdown current
- -40°C to +125°C operating temperature range
- Fault protection functions include over-voltage protection (OVP), under-voltage protection (UVP), under-voltage lockout (UVLO) and thermal shutdown
- Slim size: 6mm × 4mm × 3mm

Description

SP-1406 is a simple, easy-to-use, fully integrated, high-frequency, compact miniature point-of-load (mPOL) synchronous buck regulator that can achieve 6A continuous output current.

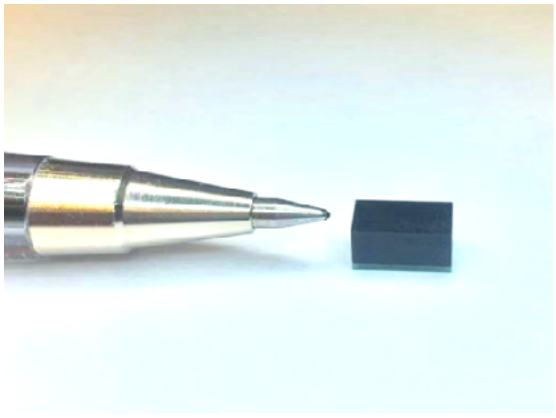
This device has a built-in pulse width modulation (PWM) controller, and integrates MOSFETs and embedded inductors and capacitors. This compact module is suitable for automated assembly using standard surface mount equipment.

mPOL utilizes an optional pulse skipping mode and the low on-resistance ($R_{DS(on)}$)of the internal MOSFET to achieve high efficiency under light load conditions.

The built-in protection functions include soft-start protection, over-voltage protection (OVP), under-voltage protection (UVP), under-voltage lockout (UVLO), cycle-by-cycle over-current protection and thermal shutdown.

Application

- Telecommunications and network equipment
- FPGA, DSP and ASIC consumables
- Distributed POL applications, such as computer motherboards
- Consumer electronics products
- Conventional DC/DC voltage converter



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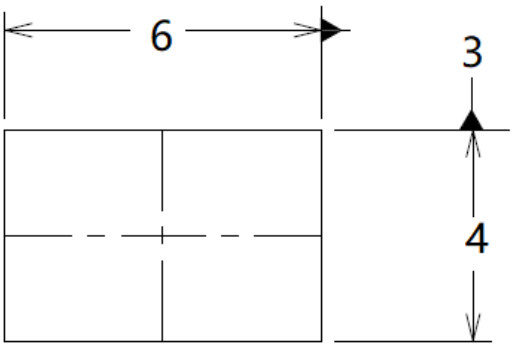
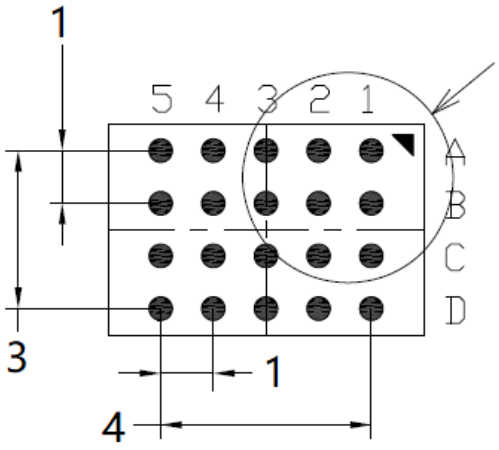


顶视图



底视图

Pin assignment：

Feature	Pin	Function
VIN	A2、A3、A4、A5	Input power
Vout	D1、D2、D3、D4、D5、	Output power
VCC	C1	(note1)
FB	C2	Voltage adjustment (note2)
EN	C3	Enable
PGnd	A1、B1、B2、B3、B4、B5、C4、C5	Power ground

note

1：5.0V internal VCC LDO output. This pin provides voltage for the internal circuitry and gate driver. Bypass this pin with a 1μF capacitor. If VVIN is below 5 V, VCC will follow the VIN voltage。

2：Output voltage feedback input, internal 20K grounding resistance, internal voltage comparator reference is 0.6V.

3：The power is turned off after a low level or grounding. If the EN pin is open, the internal pull-up resistor will make the power supply work by default.

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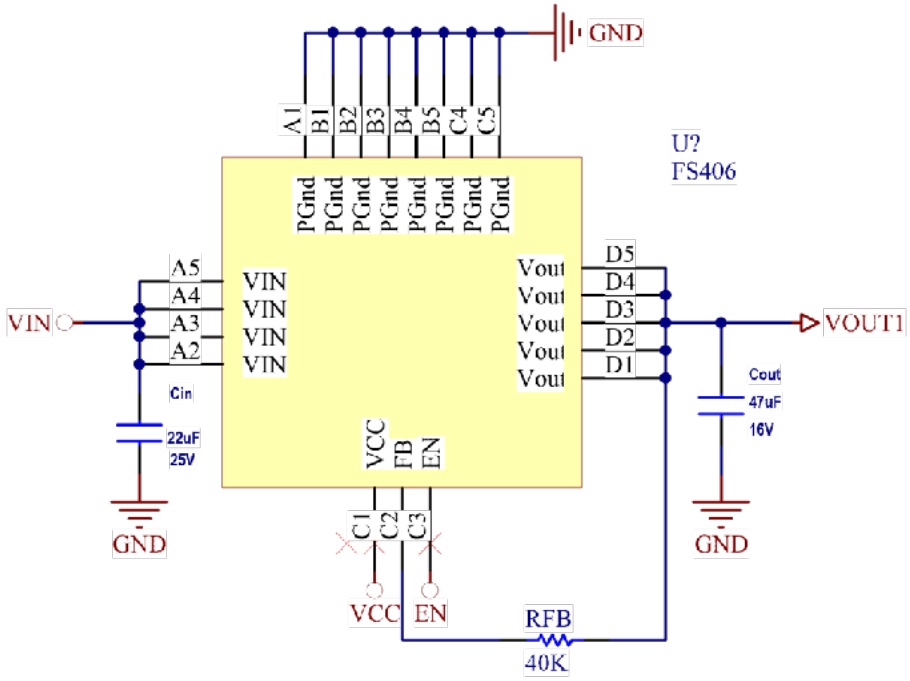
6A mPOL synchronous step-down regulator with integrated inductor and MOSFET

reference circuit：



Relationship of output voltage and RFB resistor value:

Vout=0.6*(1+RFB/20K)

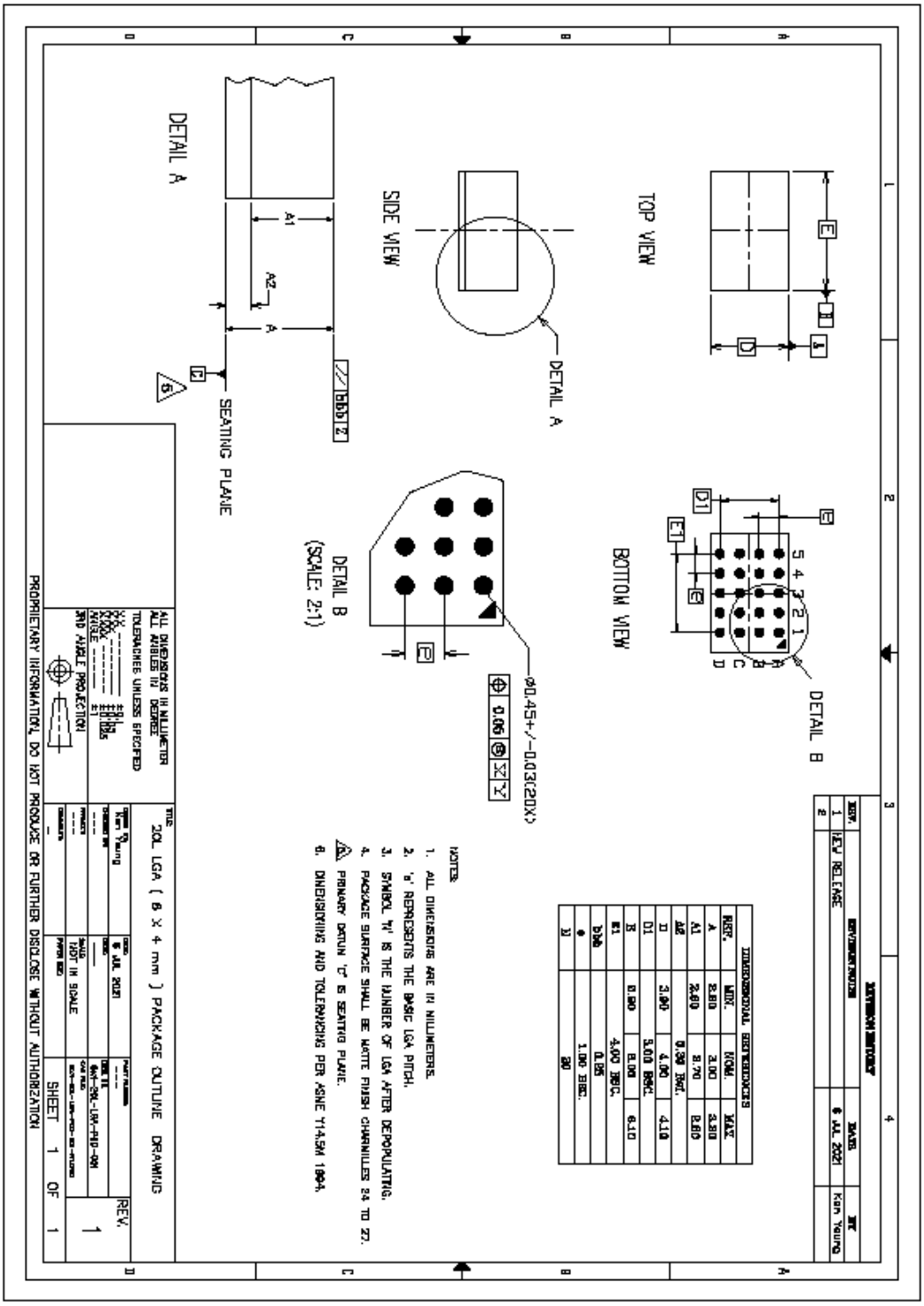
note 4:The Cin input capacitor must use a high frequency ceramic capacitor, and it is recommended not to be lower than 22uF; the Cout output capacitor must use a high frequency ceramic capacitor, and it is recommended not to be lower than 47uF ；

SUNPOL mPOL product Model: SP-1406

PRELIMINARY

6A mPOL synchronous step-down regulator with integrated inductor and MOSFET

package and structure:



SUNPOL mPOL product Model: SP-1406

6A mPOL synchronous step-down regulator with integrated inductor and MOSFET

SP-1406 testing report

1. Testing equipment

equipement	model
DC electronic load	KIKUSUI PLZ334W
Regulated DC Power Supply	KIKUSUI PWX1500ml
Precision Power Analyser	YOKOGAWA WT332
Oscilloscope	Tektronix MSO44

2. Efficiency

Description: Output voltage is fixed at 1.8V, testing the efficiency of different input voltage.

Test	Output voltage	Input voltage	testing personel
1	1.8V	5V	Wu Kun; CYX
3		8V	
5		12V	
7		16V	

Test results:

Input voltage: 5V

No.	Io	Vo	Vi	Ii	Po	Pi	Ploss	Effi
1	0	1.83	4.996	0	0	0	0	0
2	0.471	1.814	5.009	0.187	0.855	0.934	0.079	0.915
3	0.971	1.805	5.012	0.379	1.753	1.902	0.148	0.922
4	1.471	1.796	5.024	0.573	2.641	2.878	0.237	0.918
5	1.97	1.787	5.027	0.773	3.52	3.886	0.366	0.906
6	2.471	1.778	5.038	0.978	4.392	4.929	0.537	0.891
7	2.97	1.769	5.039	1.191	5.254	6.001	0.747	0.876
8	3.471	1.76	5.039	1.411	6.109	7.11	1.001	0.859
9	3.971	1.752	5.049	1.636	6.956	8.261	1.305	0.842
10	4.471	1.744	5.047	1.873	7.796	9.454	1.658	0.825
11	4.97	1.736	5.056	2.117	8.627	10.701	2.074	0.806
12	5.471	1.728	5.064	2.367	9.451	11.987	2.536	0.788
13	5.97	1.719	5.059	2.639	10.265	13.35	3.084	0.769

Input voltage: 8V

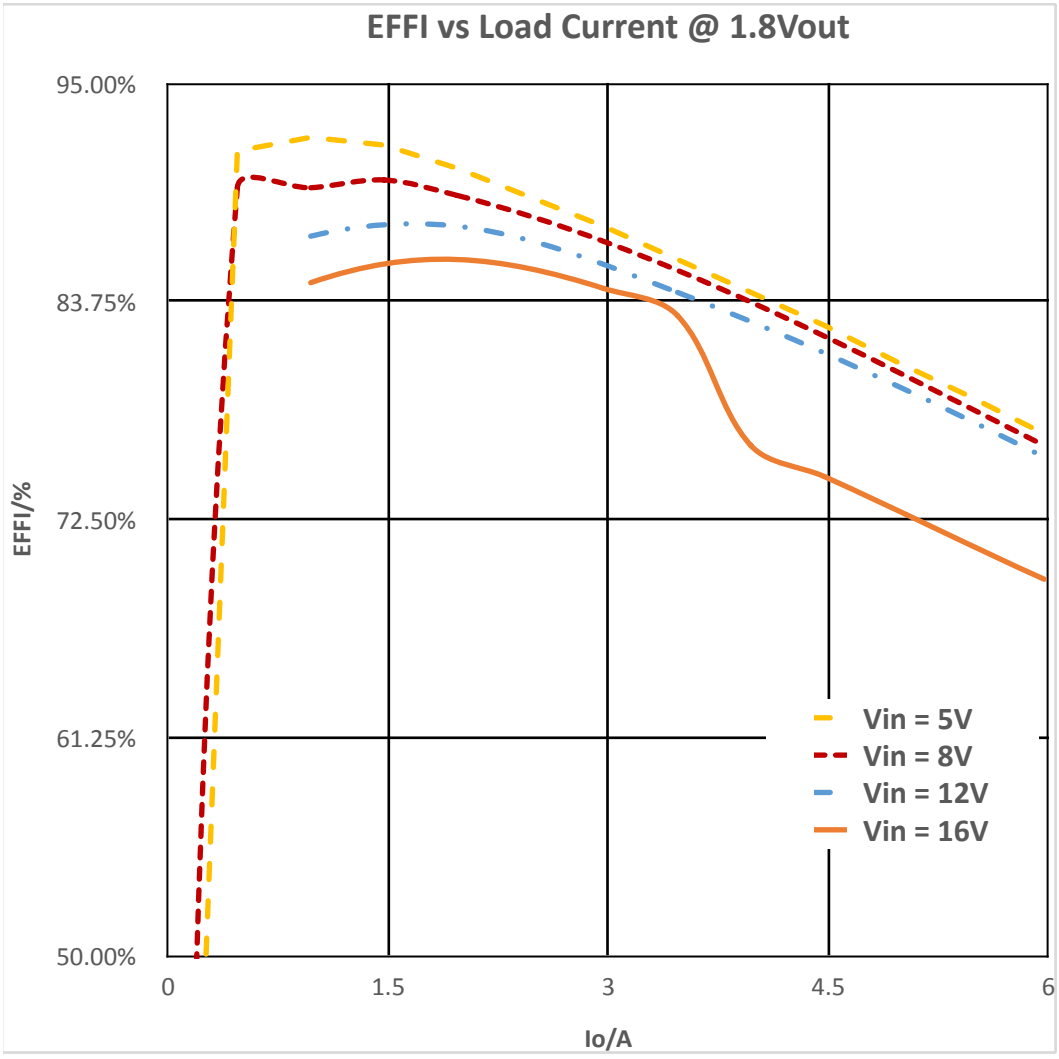
No.	Io	Vo	Vi	Ii	Po	Pi	Ploss	Effi
1	0	1.831	7.992	0	0	0	0	0
2	0.471	1.814	8	0.119	0.855	0.954	0.099	0.896
3	0.971	1.803	8.01	0.244	1.751	1.955	0.203	0.896
4	1.471	1.792	8.018	0.365	2.636	2.928	0.293	0.9
5	1.97	1.782	8.027	0.49	3.51	3.936	0.425	0.892
6	2.471	1.771	8.035	0.618	4.375	4.967	0.592	0.881
7	2.97	1.76	8.044	0.75	5.228	6.035	0.807	0.866
8	3.471	1.75	8.051	0.886	6.073	7.133	1.06	0.851
9	3.971	1.739	8.058	1.027	6.905	8.277	1.373	0.834
10	4.471	1.729	8.066	1.172	7.729	9.452	1.723	0.818
11	4.971	1.718	8.073	1.323	8.538	10.678	2.14	0.8
12	5.471	1.706	8.08	1.477	9.336	11.936	2.6	0.782
13	5.97	1.696	8.084	1.641	10.123	13.265	3.142	0.763

Input voltage: 12V

No.	Io	Vo	Vi	Ii	Po	Pi	Ploss	Effi
1	0	1.833	11.985	0	0	0	0	0
2	0.471	1.813	11.997	0	0.854	0	0.854	inf
3	0.971	1.802	12.001	0.167	1.75	2.009	0.259	0.871
4	1.471	1.79	12.003	0.249	2.633	2.992	0.359	0.88
5	1.97	1.779	12.014	0.332	3.504	3.993	0.489	0.878
6	2.471	1.767	12.018	0.418	4.366	5.024	0.658	0.869
7	2.97	1.755	12.029	0.506	5.213	6.09	0.877	0.856
8	3.471	1.743	12.041	0.597	6.051	7.185	1.134	0.842
9	3.97	1.732	12.043	0.69	6.875	8.314	1.438	0.827
10	4.471	1.72	12.044	0.787	7.689	9.483	1.794	0.811
11	4.97	1.707	12.054	0.887	8.486	10.691	2.205	0.794
12	5.471	1.695	12.054	0.991	9.27	11.948	2.678	0.776
13	5.97	1.682	12.064	1.099	10.04	13.26	3.22	0.757

Input voltage: 16V

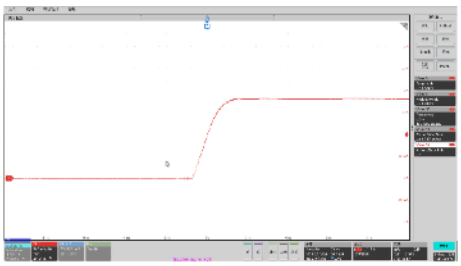
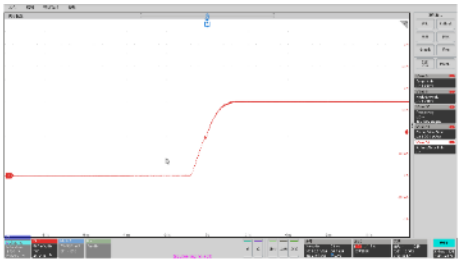
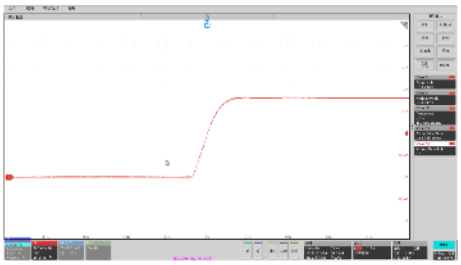
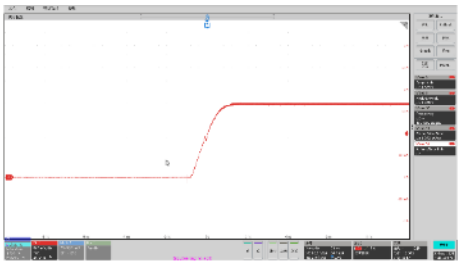
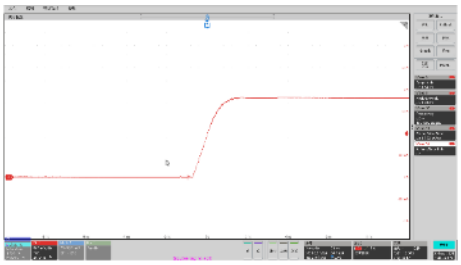
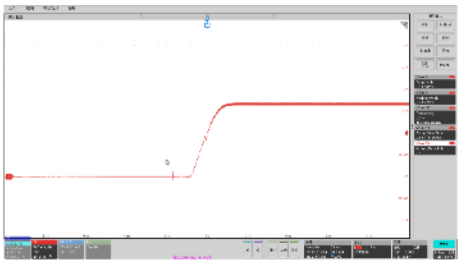
No.	Io	Vo	Vi	Ii	Po	Pi	Ploss	Effi
1	0	1.834	15.981	0	0	0	0	0
2	0.472	1.813	15.985	0	0.855	0	0.855	inf
3	0.971	1.802	15.989	0.129	1.75	2.066	0.315	0.847
4	1.471	1.789	15.994	0.191	2.632	3.061	0.429	0.86
5	1.97	1.777	15.997	0.254	3.501	4.066	0.564	0.861
6	2.471	1.765	16.001	0.319	4.361	5.104	0.744	0.854
7	2.97	1.753	16.004	0.386	5.206	6.171	0.965	0.844
8	3.471	1.741	16.009	0.455	6.042	7.283	1.241	0.83
9	3.971	1.735	16.008	0.564	6.89	9.028	2.138	0.763
10	4.471	1.724	16.01	0.644	7.708	10.314	2.606	0.747
11	4.971	1.712	16.012	0.729	8.508	11.665	3.156	0.729
12	5.471	1.696	16.013	0.815	9.28	13.047	3.767	0.711
13	5.97	1.683	16.015	0.905	10.049	14.487	4.439	0.694



3. Power on output waveform ripple

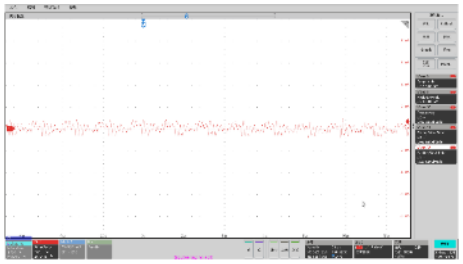
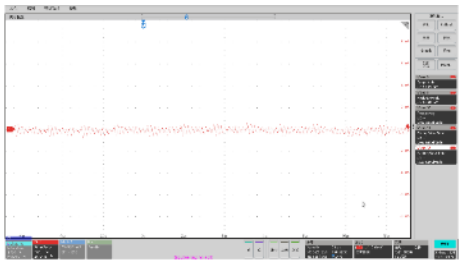
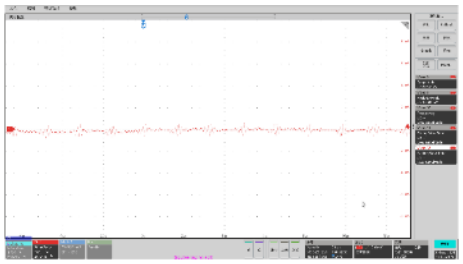
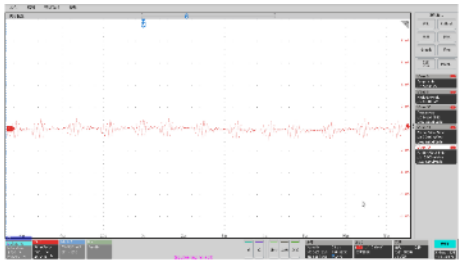
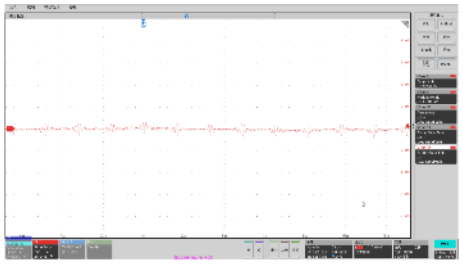
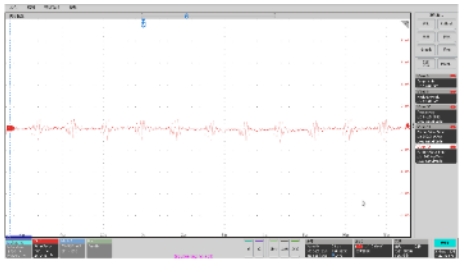
Description: Fix the output voltage at 1.8V, test the waveform when power on for different input voltage and loading

bandwidth: 20MHz。

Test	Input voltage	Output current	Output voltage	Waveform	Testing personel
1	5V	0A	1.8V		Wu Kun; CYX
2		6A			
3	8V	0A			
4		6A			
5	12V	0A			
6		6A			

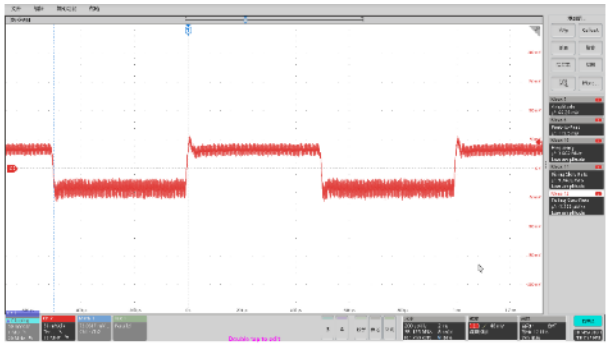
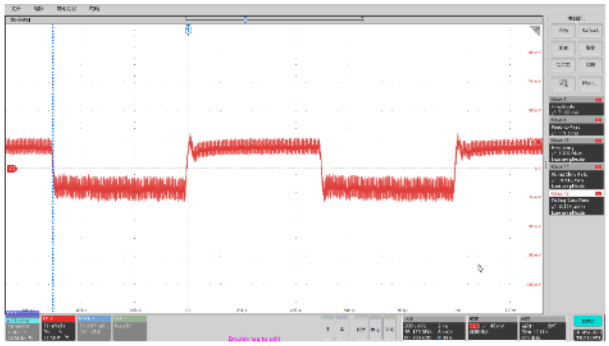
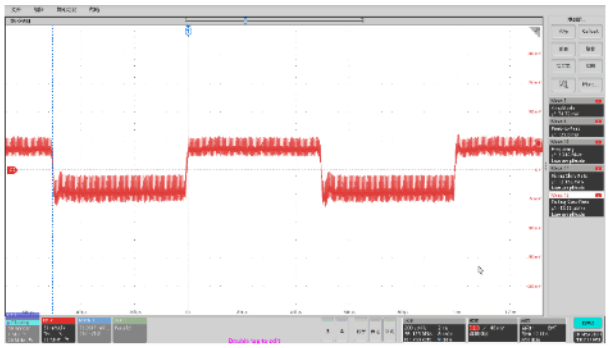
4. Output wave form ripple

Description: Fix the output voltage at 1.8V, test the waveform when power on for different input voltage and loading
bandwidth: 20MHz。

Test	input voltage	Output current	Output voltage	Waveform	PK-PK	testing personel
1	5V	3A	1.8V		16.80mV	Wu Kun; CYX
2		6A			13.60mV	
3	12V	3A			13.60mV	
4		6A			20.00mV	
5	16V	3A			15.20mV	
6		6A			21.60mV	

5. Output dynamic

Description: 1.8V output waveform when input voltage are 9V,12V and 15V、1.8V
Testing condition: 1A/us;1kHz;2.0A - 5A

test	Input voltae	waveform	testing personel
1	8V		Wu Kun; CYX
2	12V		Wu Kun; CYX
3	16V		Wu Kun; CYX

Before the test, please be proficient and follow the relevant test equipment manuals and operation methods, and be clear about the readings and meanings of the relevant instruments.

Appendix: Test Equipment Connection Diagram and Description

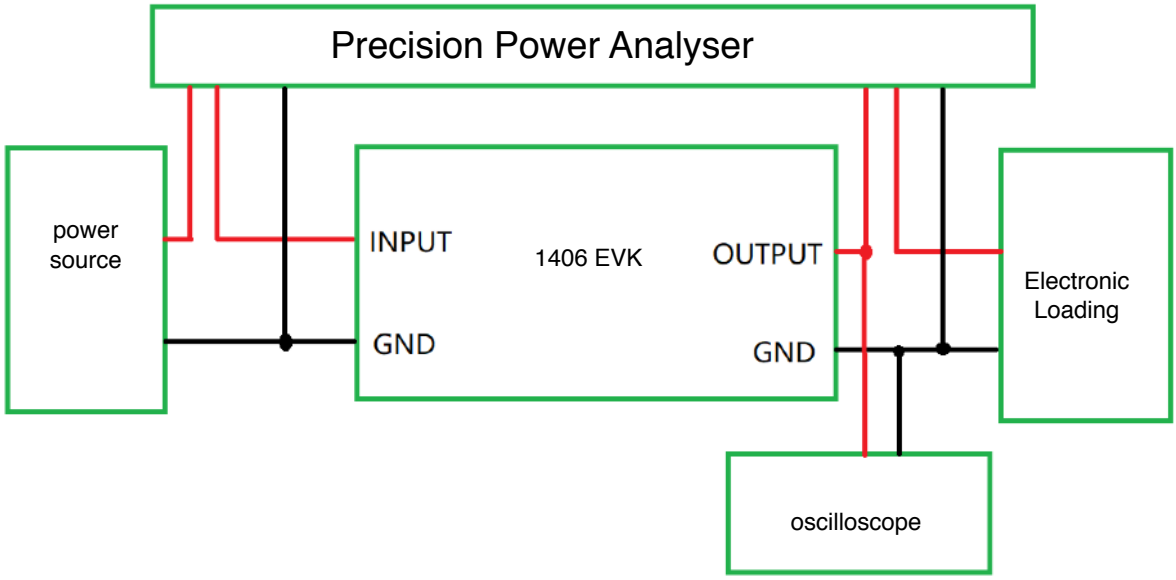


Figure 1: Schematic diagram of test equipment connection

Description:

- Because of the voltage drop of long leads and the introduction of EMC interference test results radiated from the external space, it is recommended that the probe of the multimeter and the test probe of the oscilloscope should be directly connected between Vin/Vout and GND directly at the root of the 1406 module test PCB connection.

- Because the tested ripple model is unusually sensitive and weak, reaching below 10mV, the EMC environmental noise has a great influence on the test results, and the background noise emitted or received by the test equipment can easily drown out the formal ripple. False ripple, so requires very little background noise for EMC instruments and environments.

Test ripple steps and precautions:

1. Check whether there are instruments/lamps with very loud switching noise in the test environment laboratory. They radiate or pollute the cables of the entire laboratory through the AC line, causing a lot of background noise on the test line.
2. It is recommended not to use the switching power supply experimental power input source for the input power supply during the test, because the output ripple of the switching power supply itself is greater than 10mV, and a linear experimental power supply with a small output ripple should be selected as much as possible.
3. The input line and the output line should be as short as possible and separated as much as possible to prevent the interference models from interfering with each other and affecting the test results.
4. Avoid using the oscilloscope to test the probe ground cable, because the lead will introduce EMC interference radiated from the outside space, so that the background noise exceeds 10mV and affects the test results.

Remove the oscilloscope cable clip and use the method of direct connection to the output port to eliminate the interference caused by the space radiation of other equipment in the laboratory as much as possible, as shown in the example below (non-1406 test board demonstration):

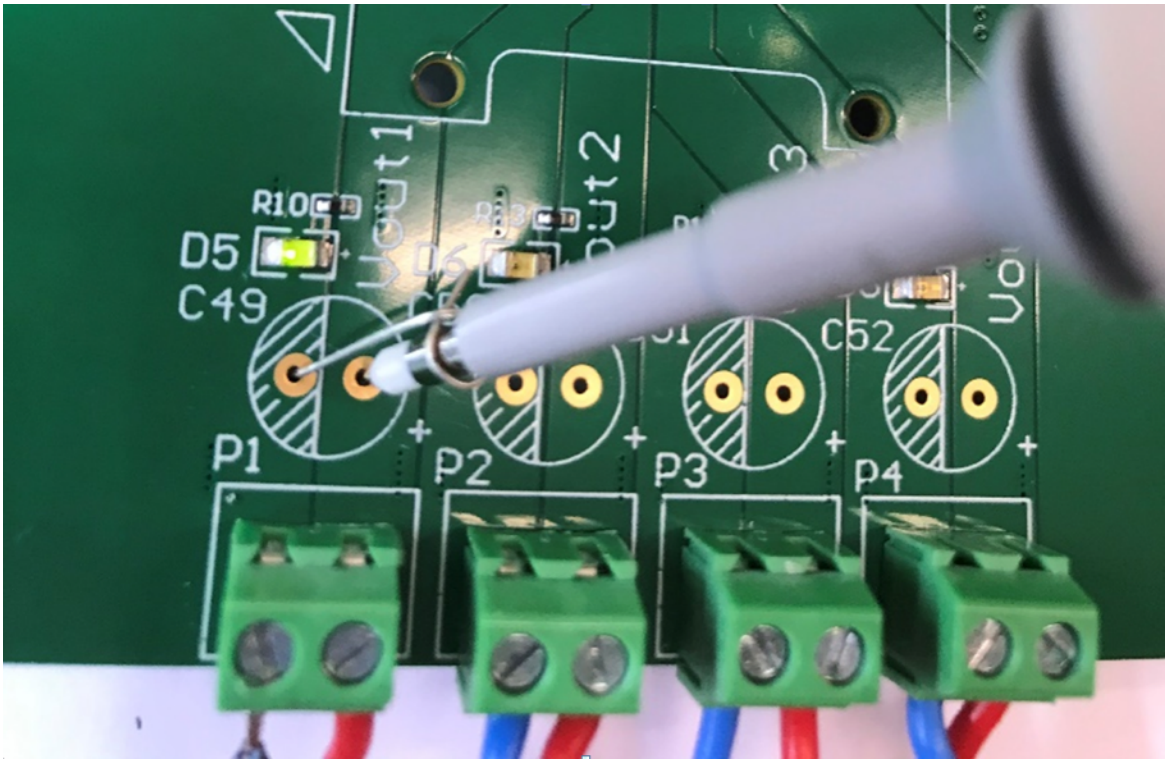
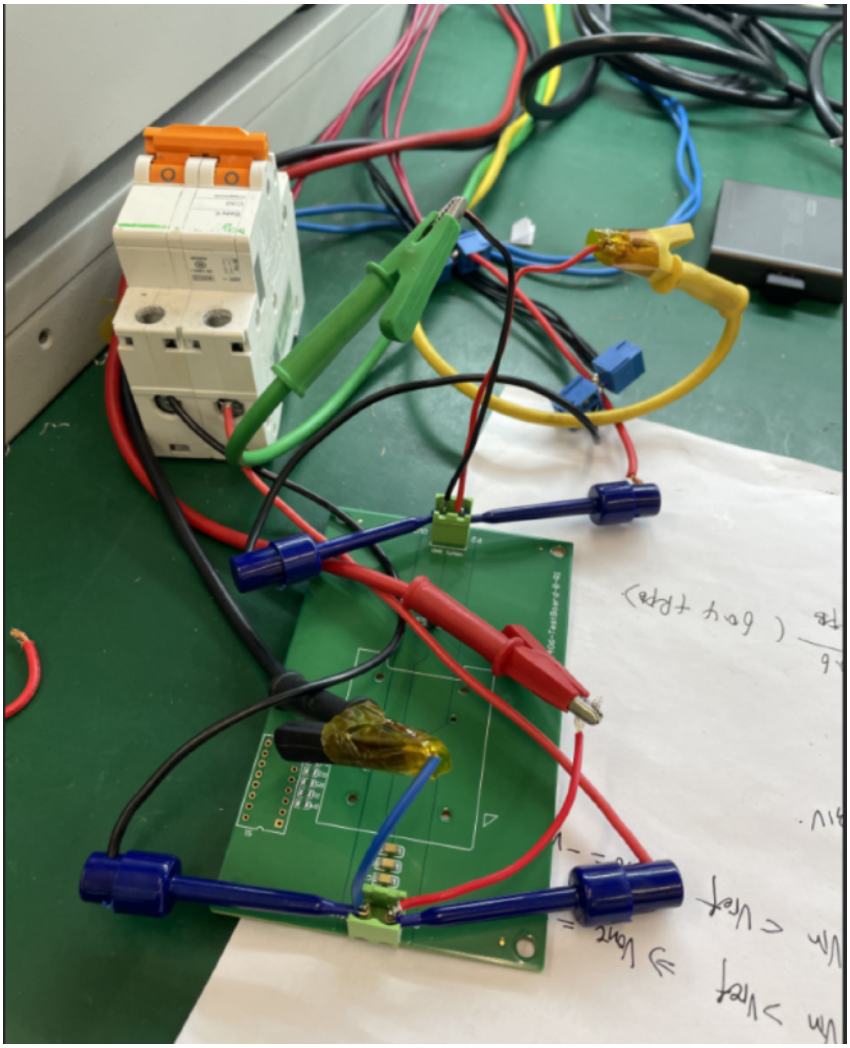


Figure 2: Example of oscilloscope pen test when testing ripple

Test board test connection site photo

This test did not use the wire bonding method, but used the plug-in connection. The specific method is as follows。



（In order to test the performance and efficiency of all aspects more accurately, try to avoid the performance test difference caused by the uncertain contact resistance of the connector as much as possible. It is recommended to use welding to connect the input and output ports of the test board.）