Demo-board User Guide of 10W DC-DC power supply ±5V output, input 18-75VDC (SCM1101ADEB-3)

Modification Date	Version No.	Reasons for revision	Model	Main Application Field
2019.05.10	A/0	First version	SCM1101AMA	Industrial control, communication, electric power, instruments etc.

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1. Overview

This application solution features 18-75VDC input, ±5VDC/10W output, isolated DC-DC power supply based on chip of SCM1101AMA(MORNSUN), SCM9603BTA(MORNSUN) and TTURA4805-10T transformer(MORNSUN). It can be applied to industrial control, communication, instrumentation, electricity and other fields. The circuit solution takes flyback circuit topology, control IC with SCM1101AMA (MORNSUN), with simple external circuits and cost-effective advantages. In terms of performance, the chip has an intelligent frequency reduce control mode, which means the operating frequency decreases as the load decreases, allowing the converter to maintain high efficiency over the entire load range. When approaching no-load, the chip also enters the intermittent mode, which greatly reducing the standby power consumption. In addition, the SCM1101AMA (MORNSUN) also integrates a series of protection functions, which greatly improves the reliability of the system.

2. Input & Output Specifications

Input Specifications					
Item	**Operating Conditions**	**Min**	**Typ**	**Max**	**Unit**
Input Voltage		18	48	75	VDC
Input Current (full load/no-load)	48VDC input	--	251/3	--	mA
Start-up Voltage		--	--	18	VDC
Under-voltage Protection		12	15.5	--	
Ctrl	Module on	Ctrl pin open or pulled high (3.5-12VDC)			
	Module off	Ctrl pin pulled low to GND (0-1.2VDC)			
	Input current when off	--	6	10	mA

Output Specifications						
Item	**Operating Conditions**		**Min**	**Typ**	**Max**	**Unit**
Output Voltage	Input voltage range		--	±5	--	VDC
Output Current	Input voltage range	Positive output	0	--	1000	mA
		Negative output	-1000	--	0	
Output Power	Input voltage range		--	--	10	W
Max. Capacitive Load	Input voltage range		--	--	1000	uF
Voltage Accuracy	0%-100%load		--	±1	±3	%
Linear Regulation	Input voltage variation from low to high at full load	Positive output	--	±0.2	±0.5	
		Negative output	--	±0.5	±1	
Load Regulation	5%-100% load	Positive output	--	±0.5	±1	
		Negative output	--	±0.5	±1.5	
Cross Regulation	Dual output		--	--	±5	
Ripple & Noise	20MHz bandwidth, 5%-100% load		--	40	80	mVp-p
Efficiency	48VDC input, 100% load		--	83	--	%
Short-circuit Protection	Input voltage range		Continuous, self-recovery			
Transient Recovery Time	25% load step change, 48VDC input,		--	300	500	μs
Transient Response Deviation			--	±3	±5	%
Switching Frequency	PWM Mode		--	350	--	KHz

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3. Schematic Circuit Diagram

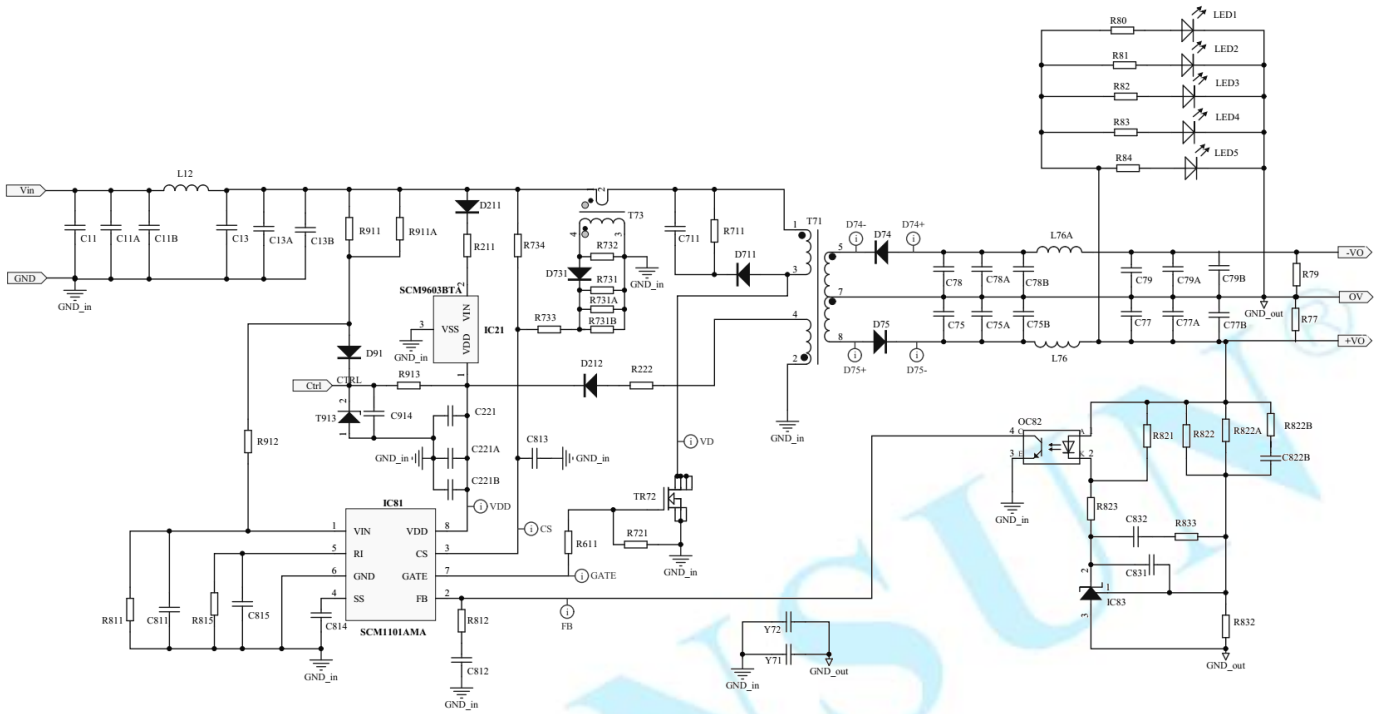

Figure 1. Schematic Circuit Diagram

DEMO Description		
Test location	**Description**	**Wiring instructions**
VIN	Input voltage positive	
GND	Input voltage reference ground	
CTRL	Remote control switch function foot	
+Vo	Output voltage positive	
0V	Output voltage reference ground	
FB	SCM1101AMA FB pin waveform test point	Oscilloscope probe ground clamp GND
CS	SCM1101AMA CS waveform test point	Oscilloscope probe ground clamp GND
GD	SCM1101AMA GATE pin waveform test point	Oscilloscope probe ground clamp GND
VDD	SCM1101AMA VDD pin waveform test point	Oscilloscope probe ground clamp GND
VD	D-wave waveform test point of the original MOS tube	Oscilloscope probe ground clamp GND
D74+	Anode waveform test point of the secondary Diode D74	Oscilloscope probe ground clamp 0V
D74-	Cathode waveform test point of the secondary Diode D74	Oscilloscope probe ground clamp 0V
D75+	Anode waveform test point of the secondary Diode D75	Oscilloscope probe ground clamp 0V
D75-	Cathode waveform test point of the secondary Diode D75	Oscilloscope probe ground clamp 0V
LED1、LED2、LED3、LED4、LED5	Indicates the output voltage value (for example, LED5 is lit to indicate that the output voltage is 24V)	

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4. Bill of material

Device Description	Specification	Quantity	Position No.
Inductance	CD54 0.47uH 12mΩ 9.0A	2	L76/L76A
Inductance	CD53 6.8uH 88mΩ 1.45A	1	L12
Capacitor	106K 25V 1210 X7R	8	C75/C75A/C77A/C77B/C78/C78A/C79/C79A
Capacitor	102K 2000V 1206 X7R	1	Y71
Capacitor	105K 100V 1210 X7R	4	C11/C11A/C13/C13A
IC	**SCM9603BTA SOT-23（MORNSUN）**	**1**	**IC21**
Switching diode	100V 0.2A SOD-323	4	D731/D91/D211/D212
Capacitor	101J 250V 0805 NP0	2	C811/C813
ESD	14V/0402	1	T913
IC	AZ431AN-ATRE1 SOT-23	1	IC83
IC	**SCM1101AMA MSOP-8（MORNSUN）**	**1**	**IC81**
Optocoupler	3H7A SSOP4	1	OC82
Resistor	3KΩ 1/8W ±1% 0805	1	R812
Resistor	1KΩ 1/8W ±1% 0805	2	R732/R822B
Resistor	2.87KΩ 1/8W ±1% 0805	1	R832
Resistor	22KΩ 1/8W ±1% 0805	1	R815
Resistor	5.1Ω 1/8W ±1% 0805	1	R611
Resistor	470Ω 1/8W ±1% 0805	1	R731A
Resistor	33Ω 1/8W ±1% 0805	1	R731
Resistor	1KΩ 1/4W ±1% 1206	1	R211
Resistor	200KΩ 1/8W ±1% 0805	2	R912/R734
Resistor	300Ω 1/8W ±1% 0805	2	R733/R823
Resistor	2.7MΩ 1/8W ±1% 0805	1	R911
Resistor	10Ω 1/8W ±1% 0805	1	R222
Resistor	10KΩ 1/8W ±1% 0805	2	R721/R913
N-MOS	200V 18A 80mΩ DFN5*6	1	TR72
CT	MCP5.0 CT (70:1)	1	T73
Transformer	**TTURA4805-10T（MORNSUN）**	**1**	**T71**
Resistor	150KΩ 1/8W ±1% 0805	1	R822A
Resistor	2.94KΩ 1/8W ±1% 0805	1	R822
Capacitor	104K 50V 0805 X7R	2	C822B/C812
Capacitor	123K 50V 0805 X7R	1	C814
Schottky diode	40V 5A SMA	2	D74/D75
Capacitor	475K 50V 1206 X7R	1	C221
Resistor	2.2MΩ 1/8W ±1% 0805	1	R911A
Resistor	5.1KΩ 1/8W ±1% 0805	1	R79
Capacitor	473K 50V 0805 X7R	1	C831
Resistor	5.1KΩ 1/8W ±1% 0805	1	R81
Green LED	17-21 GHC-XS1T2M 3T	1	LED2

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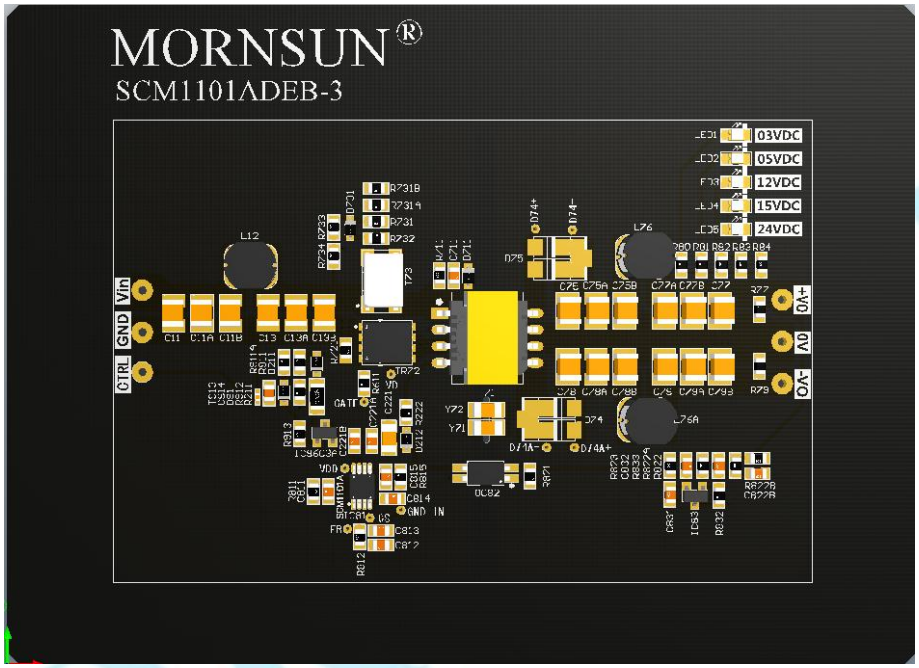
Device Description	Specification	Quantity	Position No.
Note: The operating temperature and withstand isolation voltage depend on the selection of the customer's component and relate to the PCB layout. Recommended surface operating temperature range for MORNSUN IC and transformer TTURA4805-10T: -40 ℃~125 ℃, the withstand isolation voltage of transformer TTURA4805-10T: 1650VDC, leakage current: less than 1mA.			

5. PCB



6. Test Data

Test Item		Test Result
1. Input Specifications		
Input Current (48VDC/Full Load)		246mA
No Load Power Consumption (48VDC/no load)		143mW
2. Output Specifications		
Output Voltage (48VDC/Full Load)	Positive output	5VDC
	Negative output	4.95VDC
Load Regulation	Positive output	0%
	Negative output	0.2%
Linear Regulation	Positive output	0%
	Negative output	-0.4%
Voltage Accuracy max	Positive output	0%
	Negative output	-1.4%
Cross Regulation		72mV
Ripple & Noise (48VDC/Full Load)		-3.03%
Efficiency (48VDC/Full Load)		84.2%
3. Protection Specification		
Under-voltage Protection (Full Load)		15.81VDC

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Test Item	Test Result
Short-circuit Protection	Output continuous, self-recovery
Note: The minimum load: 5% Iomax, Iomax: Rated load.	

6.1. Input Specifications

6.1.1. Input Current

Operating Conditions: Normal temperature, input voltage range, full load output, test Input Current;

Test Standard: 48VDC input, Input Current typical value: 251mA.

Table 1. Input Current With Full Load

Input Voltage	18VDC	48VDC	75VDC
Input Current (mA)	663	246	167

6.1.2. No Load Power Consumption

Operating Conditions: Normal temperature, input voltage range, no load output, test Input Power;

Test Standard: 48VDC input，Input Power typical value: 144mW.

Table 2. Input Power With No Load

Input Voltage	18VDC	48VDC	75VDC
Input Power (mW)	61	143	221

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6.2. Output Specifications

6.2.1. Linear Regulation, Load Regulation, Voltage Accuracy

Operating Conditions: Normal temperature, input voltage range, output load range;

Test Standard: Linear Regulation≤ ±0.5%, Load Regulation≤ ±1%.

Table 3. Output Voltage Test Data

Input Voltage	Output Voltage (VDC)					
	Minimum Load		Half Load		Full Load	
	Positive output	Negative output	Positive output	Negative output	Positive output	Negative output
18VDC	5	4.95	5	4.95	5	4.93
48VDC	5	4.96	5	4.95	5	4.95
75VDC	5	4.97	5	4.96	5	4.95

Table 4. Linear Regulation, Load Regulation, Voltage Accuracy

Test Item		Load Regulation (%)			Linear Regulation (%)			Voltage Accuracy (%) max		
Input Voltage		48VDC			18VDC	48VDC	75VDC	18/48/75VDC		
Output Current (mA)		Minimum Load	Half Load	Full Load	Full Load			Minimum Load	Half Load	Full Load
Test Result	Positive output	0			0			0		
	Negative output	0.2			-0.4			-1.4		

6.2.2. Cross Regulation

Operating Conditions: Normal temperature, input voltage range, output load: 25%Iomax, 50%Iomax, 100%Iomax;

Test Standard：Cross Regulation≤ ±5%.

Table 5 Cross Regulation

Test Item		18VDC	48VDC	75VDC
Io1=50%Iomax Io2=50%Iomax	Positive output (VDC)	5.00	5.00	5.00
	Negative output (VDC)	4.95	4.95	4.95
Io1=25%Iomax Io2=100%Iomax	Positive output (VDC)	5.00	5.00	5.00
	Negative output (VDC)	4.78	4.80	4.80
Io1=100%Iomax Io2=25%Iomax	Positive output (VDC)	5.00	5.00	5.00
	Negative output (VDC)	5.09	5.08	5.09
Cross Regulation (%)	Negative output	-3.43	-3.03	-3.03

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6.2.3. Ripple & Noise

Operating Conditions: Normal temperature, input voltage range, output load range, “parallel cable” method;

Test Standard：20MHz bandwidth, input voltage range, output load range, Ripple & Noise≤ 80mV.

Table 6. Ripple & Noise Test Data

Input Voltage	Ripple & Noise (mV)		Wave Table
	Minimum Load	Full Load	
18VDC	32	56	Figure 2/Figure 3
48VDC	52	72	Figure 4/Figure 5
75VDC	38	67	Figure 6/Figure 7

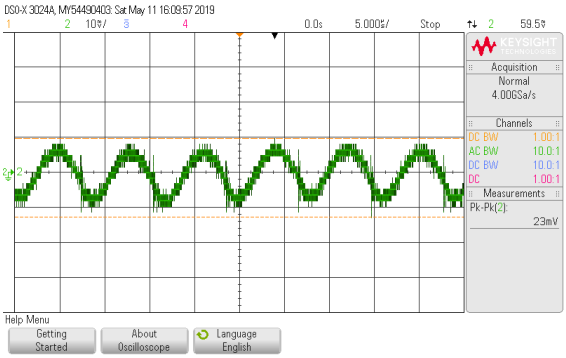

Figure 2. Ripple & Noise Wave Table (18VDC Minimum Load)

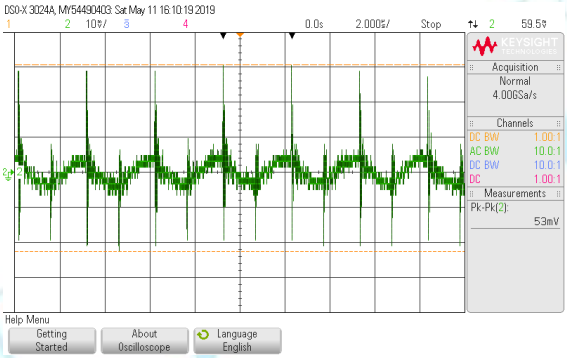

Figure 3. Ripple & Noise Wave Table (18VDC Full Load)

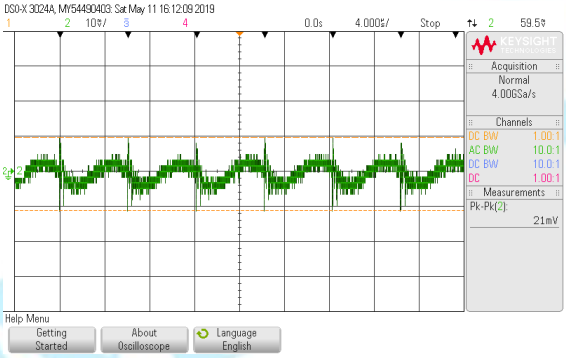

Figure 4. Ripple & Noise Wave Table (48VDC Minimum Load)

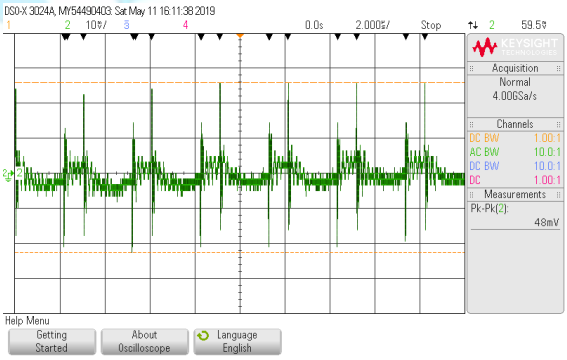

Figure 5. Ripple & Noise Wave Table (48VDC Full Load)

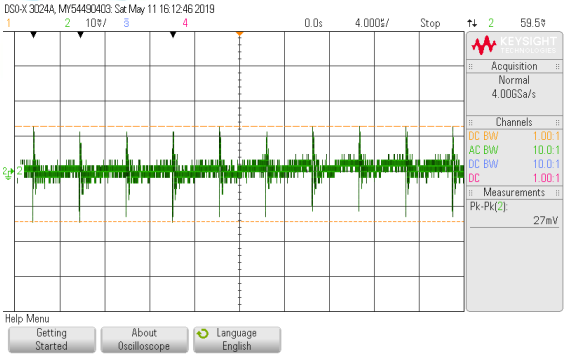

Figure 6. Ripple & Noise Wave Table (75VDC Minimum Load)

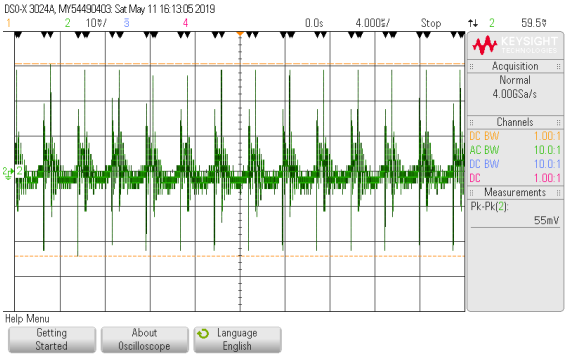

Figure 7. Ripple & Noise Wave Table (75VDC Full Load)

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6.2.4. Transient Response Performance Test

Operating Conditions: Normal temperature, input voltage range, 25%load step change;

Test Standard：48VDC input, 25%load step change, Transient Response Deviation ≤ ±5%, Transient Recovery Time ≤ 500us.

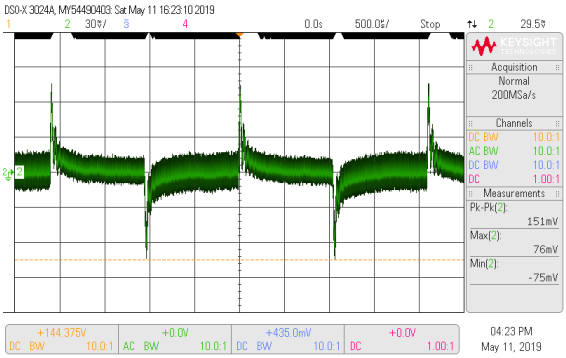

Figure 8. 25%-50%-25%load step change (48VDC)

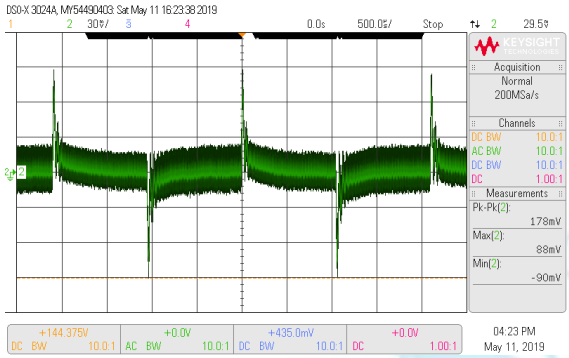

Figure 9. 50%-75%-50%load step change (48VDC)

6.2.5. Efficiency

Operating Conditions: Normal temperature, input voltage range, output load range;

Test Standard: 48VDC input, full load output, efficiency typical value: 83%.

Table 7. Efficiency Test Data

Input Voltage	Efficiency (%)				
	5% Iomax	25% Iomax	50% Iomax	75% Iomax	100% Iomax
18VDC	74.8	83.2	84.0	84.2	83.4
48VDC	69.9	79.9	82.8	83.4	84.2
75VDC	58.7	74.9	82.2	83.6	82.2

6.3. Time series Test

6.3.1. Start-up And Turn-off Test

Operating Conditions: Normal temperature, 48VDC input, full load output;

Test Standard: /.

Table 8 Start-up And Turn-off Test

Test Item		Start-up Wave Table	Turn-off Wave Table
Input Voltage	48VDC	Figure 10	Figure 11
Output Current	Full Load		

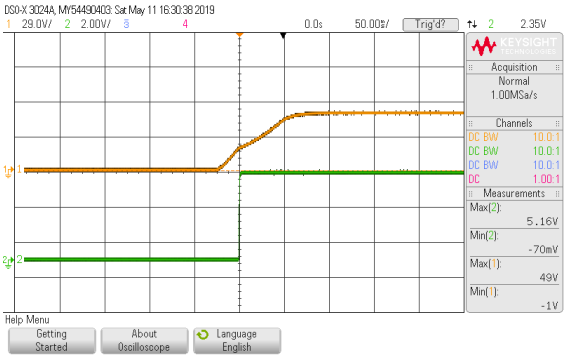

Figure 10. Start-up Wave Table, Yellow: VIN, Green: Vo

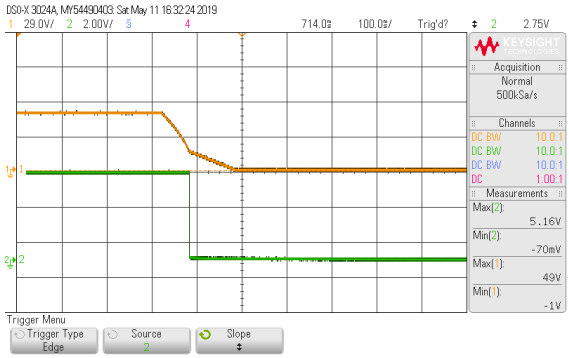

Figure 11. Turn-off Wave Table, Yellow: VIN, Green: Vo

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6.3.2. Ctrl Test

Operating Conditions: Normal temperature, input voltage range, full load and minimum load output;

Test Standard: Module on when Ctrl pin open or pulled high (3.5-12VDC); Module off when Ctrl pin pulled low to GND (0-1.2VDC).

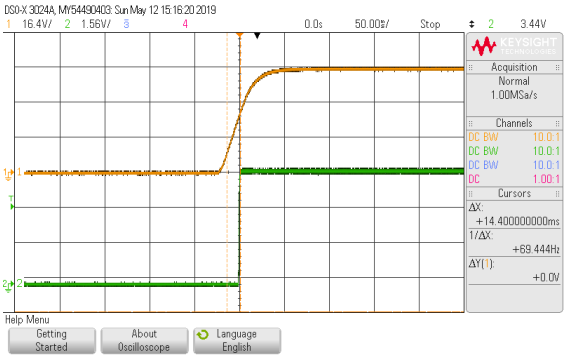

Figure 12. Ctrl Start-up Wave Table,

Yellow:VIN(48VDC);CTRL (5VDC);Green: Vo(5VDC)

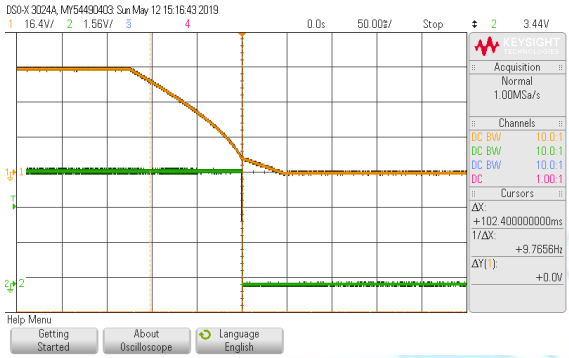

Figure 12.Ctrl Turn-off Wave Table,

Yellow:VIN(48VDC);CTRL (5VDC);Green: Vo(5VDC)

6.4. Protection specification

6.4.1. Under-voltage Protection (UVP)

Operating Conditions: Normal temperature, full load and minimum load output;

Test Standard: Start-up Voltage≤ 9VDC, Turn-off Voltage≥ 5.5VDC.

Table 9. UVP Test Data

Output Current	Start-up Voltage	Turn-off Voltage
Full Load	15.85VDC	15.81VDC
Minimum load	14.21VDC	14.35VDC

6.4.2. Short-circuit Protection (SCP)

Operating Conditions: Normal temperature, 48VDC input, full load output;

Test Standard: Output continuous, self-recovery.

Table 10. Short-circuit Protection Test

Input Voltage	48VDC
Short-circuit Protection Recovery Wave Table	Figure 14

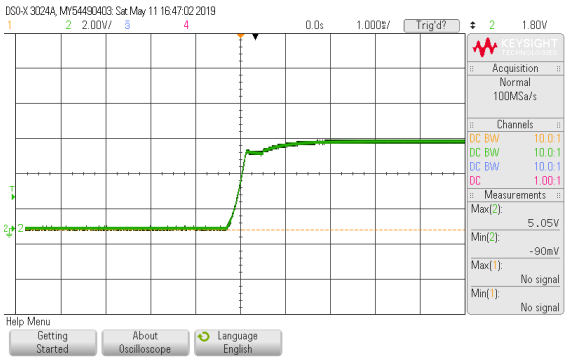

Figure 14. Short-circuit Protection Recovery Wave Table (48VDC)

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7. Appendix

No.

If you have any suggestions or questions about this article, or consult other applications, please contact us fae800@mornsun.cn, we will give you a detailed answer!

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