MINMAX AC/DC 、DC/DC 模块电源产品应用

一、DC/DC 电源模块测试方法

Test Method - DC / DC Converter

Circuit Test Drawing

Basic usefully circuit

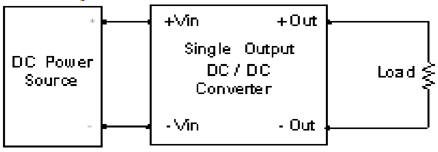

Figure 1

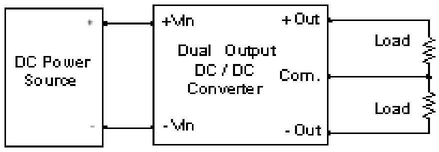

Figure 2

General Test Set-Up

Figure 3 shows a general equipment set-up for testing DC/DC converters. Except where otherwise required, the following conditions should be applied:

- Nominal DC input voltage
- +25°C ambient temperature
- Full rated output load

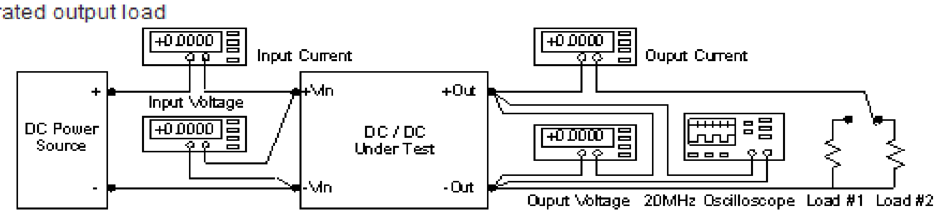

Figure 3

Measurements

All connections to the converters should be made with great care, especially to the output pins. Standard four-terminal or Kelvin, measurement practices should always be observed in making DC/DC converters measurements. Figure 4 shows a voltage measurement being made from the output terminals of a DC/DC converter by means of separate contacts that do not carry load current. If contacts carrying load current are used for measurement, an erroneous reading of many millivolts can be resulted.

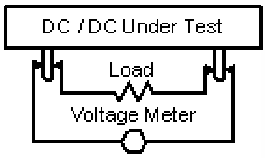

Figure 4

Output Voltage Accuracy

Make and record the following measurements:

1.Output voltage at nominal input voltage (V_{ON}).	Output Voltage Accuracy = $\frac{V_{ON} - V_O}{V_O}$ X 100%
2.Output voltage specified in the data sheet (V_O).	
3.Output voltage accuracy is derived by the formula.	

For example, an output voltage measurement of 12.01V_{DC} yields $\frac{12.01V_{DC} - 12V_{DC}}{12V_{DC}} \times 100\% = 0.083\%$

Line Regulation

- Regulated

Make and record the following measurements:

1.Output voltage at nominal input voltage (V_{ON}).	Line Regulation = $\frac{V_{ON} - V_D}{V_{ON}} \times 100\%$
2.Output voltage at maximum input voltage (V_{OH}).	
3.Output voltage at minimum input voltage (V_{OL}).	
4.Maximum Measurement of output voltage (V_D).	
5.Line regulation is derived by the formula.	

For example, V_{OH} equals 12.02V_{DC}, while V_{OL} equals 12.005V_{DC} using 12.02 V_{DC} yields:

$$\frac{12.01V_{DC} - 12.02V_{DC}}{12.01V_{DC}} \times 100\% = -0.083\%$$

- Unregulated

Make and record the following measurements:

1.Output voltage at nominal input voltage (V_{ON}).	Line Regulation = $\dfrac{\dfrac{V_{ON} - V_D}{V_{ON}}}{\Delta V_{IN\%}} \times 100\,\%$
2.Output voltage at maximum input voltage (V_{OH}).	
3.Output voltage at minimum input voltage (V_{OL}).	
4.Maximum Measurement of output voltage (V_D).	
5.Line regulation is derived by the formula.	

Where $\triangle V_{IN}$ % is the change in input line as a percentage

For example, V_{OH} equals 12.02V_{DC} while V_{OL} equals 12.005V_{DC} using 12.02V_{DC} and input voltage 9V_{DC}~12V_{DC}

$$\frac{\dfrac{12.01V_{DC} - 10.01V_{DC}}{12.01V_{DC}}}{\dfrac{(12V_{DC} - 9V_{DC})}{12V_{DC}}\,\%} \times 100\% = -0.66\%$$

Load Regulation

Make and record the following measurements:

1.Output voltage at full load (V_{OF}).	Load Regulation = $\dfrac{V_{OM} - V_{OF}}{V_{OF}}$ X 100%
2.Output voltage at minimum load specified in the data sheet (V_{OM}).	
3.Load regulation is derived by the formula.	

For example, V_{OM} equals 12.05V_{DC} and V_{OF} equals 12.01V_{DC}

We derive:

$$\frac{12.05\,V_{DC} - 12.01V_{DC}}{12.01V_{DC}} \times 100\,\% = 0.333\%$$

Output Voltage Balance(Dual Output)

1.Plus Output voltage measured of nominal input voltage($+V_O$).	Load Regulation = $\dfrac{\left\|+V_O\right\| - \left\|-V_O\right\|}{\dfrac{\left\|+V_O\right\| + \left\|-V_O\right\|}{2}} \times 100\,\%$
2.Negative Output voltage measured of nominal input voltage($-V_O$).	

For example, if we measure the following

$+V_O$=+12.01V_{DC}

$-V_O$=-11.999V_{DC}

we derive:

$$\left(\frac{\left|+12.01V_{DC}\right| - \left|-11.99V_{DC}\right|}{\dfrac{\left|+12.01V_{DC}\right| + \left|-11.99V_{DC}\right|}{2}}\right) \times 100\,\% = 0.166\,\%$$

Efficiency

Make and record the following measurements:

1.Output voltage at nominal input voltage (V_{ON}).	Efficiency = $\dfrac{V_{ON} \times I_O}{V_{IN} \times I_{IN}} \times 100\,\%$
2.Input Current at nominal input voltage (I_{IN}).	
3.Efficiency is derived by the formula.	
4.V_{IN} is nominal input voltage	
5.I_O is output current	

For example, if we measure the following

V_{ON}=12.01V_{DC} ; I_O=755mA ; V_{IN}=12V_{DC} ; I_{IN}=900mA

we derive:

$$\frac{12.01V_{DC} \times 755\,mA}{12V_{DC} \times 900\,mA} \times 100\,\% = 84\,\%$$

Output Ripple & Noise

This is an AC measurement at the output of a power converter at rated load and +25°C ambient temperature. The Measurement is made in either millivolts RMS or millimvolts peak-to-peak. Figure 5 shows the typical voltage waveform.

In the case of DC/DC converters, the output ripple voltage is a series of small pulses with high frequency content and for this reason, it is almost always specified as peak-to-peak rather than RMS value. A 50 millivolts peak-to-peak output ripple from a DC/DC converter can have a very low RMS value – perhaps just 5V – but this type of specification would be of questionable value to the designer who must specify the power supply for his system.

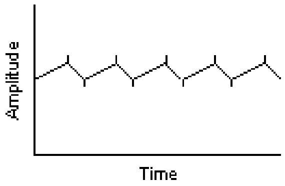

Figure 5

Because of the high frequency content of this ripple, special measurement techniques must be employed so that correct measurements are obtained. First, a 20MHz bandwidth oscilloscope is normally used for the measurement so that all significant harmonics of the ripple spikes are included.
The actual ripple voltage measurement must be carefully made in order not to induce error voltages in the test equipment. Therefore, the conventional ground clip on an oscilloscope probe (see Figure 6) should never be used in this type of measurement. This clip, when placed in a field of radiated high frequency energy, acts as an antenna or inductive pickup loop, creating an extraneous voltage that is not part of the output noise of the converter.

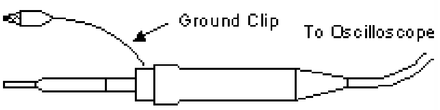

Figure 6

This noise pickup is eliminated as shown in Figure 7 by using a scope probe with an external ground band or ring and pressing this band directly against the output common terminal of the power converter while the tip contacts the voltage output terminal. This makes the shortest possible connection across the output terminals.

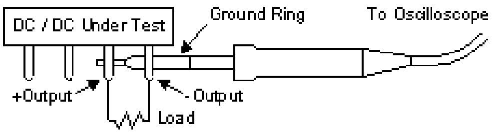

Figure 7

Another method of measuring the output voltage ripple & noise that is specified for many switching power supplies is shown in Figure 8. A 30cm twisted pair of no. 20 AWG copper wire is connected to a 10uF capacitor of proper polarity and voltage rating. The oscilloscope probe ground led should connect right to the ground ring of the probe and be as short as possible. The oscilloscope bandwidth should be at 20MHz and connected to AC ground.

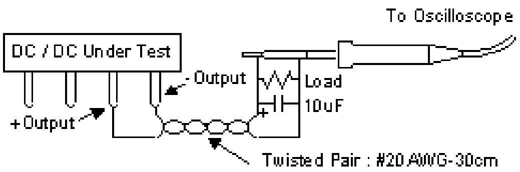

Figure 8

Transient Recovery Time

The time required for return to value of stabilization when a load in a step change cause output voltage of skew.

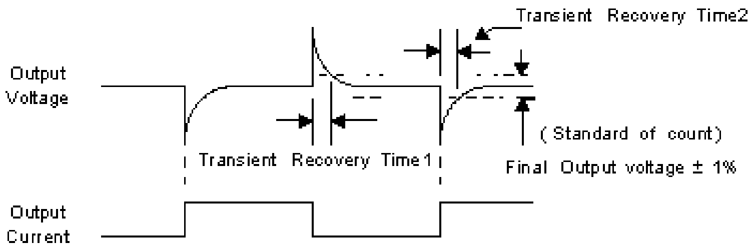

Figure 9

Transient Response Deviation

When a load was change in a very short time, the percentage of transient response amount is in output voltage.

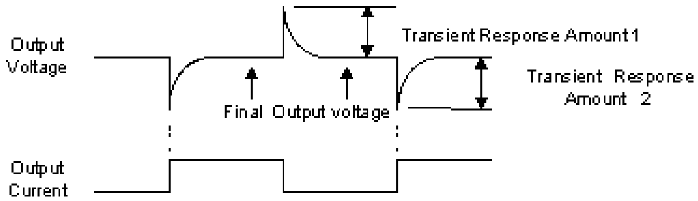

Figure 10
Transient variable rate must count "1" "2" respectively.

Peak-to-Peak Output Noise Measurement Test

Use a Cout ceramic capacitor. Please refer to capacitor value of every series)
Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz.
Position the load between 50 mm and 75 mm from the DC/DC Converter.

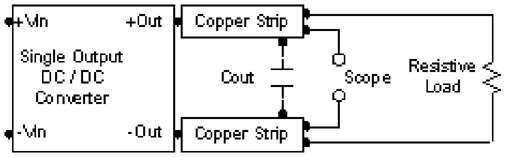

Figure 11

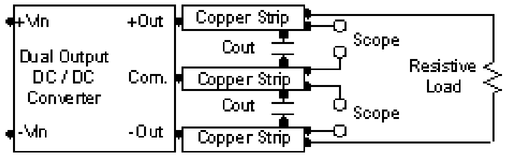

Figure 12

Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ωat 100 KHz) capacitor, please refer to capacitor value of every series.

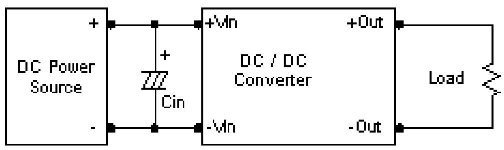

Figure 13

Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use reference of every serie's capacitors at the output.

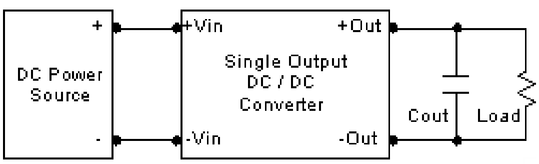

Figure 14

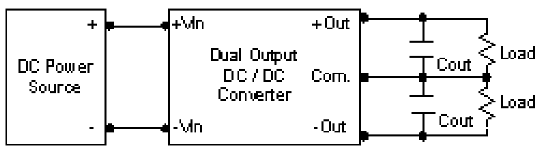

Figure 15

二、AC/DC 电源模块测试方法

Test Method - AC / DC Power Module

Measurements

The pin of AC line (L), ac neutral (N) should be retained from the AC power outlet to the power supply input terminal without accidental interchange. The following condition applied in Figure 1.

- The input voltage is nominal AC input voltage.
- The load is set to the rated output load (Full Load).
- The ambient temperature is 25 °C.

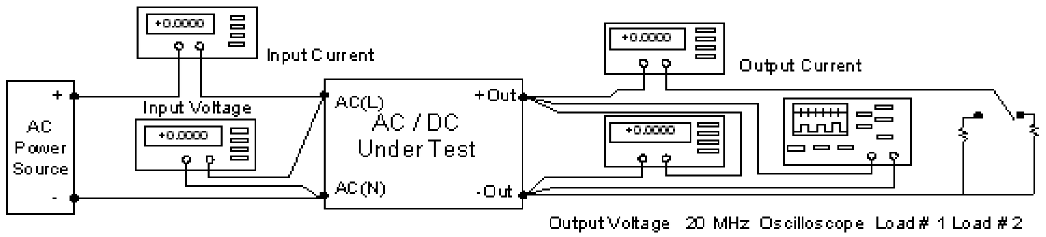

Figure 1

Output Voltage Accuracy

Make and record the following measurements:

1.Output voltage at nominal input voltage (V_{ON}).	Output Voltage Accuracy = $\frac{V_{ON} - V_O}{V_O} \times 100\%$
2.Output voltage specified in the data sheet (V_O).	
3.Output voltage accuracy is derived by the formula.	

For example: V_{ON}=5.02, V_O=5

$$\text{Output Voltage Accuracy} = \frac{V_{ON} - V_O}{V_O} \times 100\% = \frac{5.02 - 5}{5} \times 100\% = 0.4\%$$

Line Regulation

Make and record the following measurements:

1.Output voltage at maximum input voltage (V_{OH}).	Line Regulation = $\frac{V_{OH} - V_{OL}}{V_{OL}} \times 100\%$
2.Output voltage at minimum input voltage (V_{OL}).	
3.Line regulation is derived by the formula.	

For example: V_{OH}=5.048, V_{OL}=5.038

$$\text{Line Regulation} = \frac{V_{OH} - V_{OL}}{V_{OL}} \times 100\% = \frac{5.048 - 5.038}{5.038} \times 100\% = 0.198\%$$

Load Regulation

Make and record the following measurements:

1.Output voltage at full load (V_{OF}).	Load Regulation = $\frac{V_{OM} - V_{OF}}{V_{OF}} \times 100\%$
2.Output voltage at minimum load specified in the data sheet (V_{OM}).	
3.Load regulation is derived by the formula.	

For example: V_{OF}=5.023, V_{OM}=5.053

$$\text{Load Regulation} = \frac{V_{OM} - V_{OF}}{V_{OF}} \times 100\% = \frac{5.053 - 5.023}{5.023} \times 100\% = 0.597\%$$

Cross Regulation

1.Dual Positives / Triple Output : Measured output Io = 20% to 100% of rated load. Other outputs are set at 50% of rated load.	Cross Regulation = $\frac{V_{OM} - V_{OF}}{V_{OF}} \times 100\%$
2.Output voltage at full load (V_{OF}).	
3.Output voltage at 20% load specified in the data sheet (V_{OM}).	
4.Load regulation is derived by the formula.	

For example: V_{OM}=5.033, V_{OF}=5.021

$$\text{Cross Regulation} = \frac{V_{OM} - V_{OF}}{V_{OF}} \times 100\% = \frac{5.033 - 5.021}{5.021} \times 100\% = 0.239\%$$

Efficiency

Make and record the following measurements:

1.Output voltage at nominal input voltage (V_{ON}). Nominal input voltage (V_{IN}).	Formula 1: $\text{Efficiency} = \frac{V_{ON} \times I_{ON}}{V_{IN} \times I_{IN} \times PF} \times 100\%$
2.Input Current at nominal input voltage (I_{IN}). Output current (I_{ON}).	
3.Power Factor (PF).	Formula 2: $\text{Efficiency} = \frac{\text{Power(output)}}{\text{Power(input)}} \times 100\%$
4.Efficiency is derived by the formula.	

For example: V_{ON}=5.005, I_{ON}=2, V_{IN}=115, I_{IN}=0.2022, PF=0.569

$$\text{Power(output)} = V_{ON} \times I_{ON} = 5.005 \times 2 = 10.01W$$

Power(input)=13.3W

$$\text{Formula 1: Efficiency} = \frac{V_{ON} \times I_{ON}}{V_{IN} \times I_{IN} \times PF} \times 100\% = \frac{5.005 \times 2}{115 \times 0.2022 \times 0.569} \times 100\% = 75.65\%$$

$$\text{Formula 2: Efficiency} = \frac{\text{Power(output)}}{\text{Power(input)}} \times 100\% = \frac{10.01W}{13.3W} \times 100\% = 75.26\%$$

Output Ripple & Noise

This is an AC measurement at the output of a power module at rated load and +25°C ambient temperature. The measurement is made in either millivolts RMS or millivolts peak-to-peak. Figure 2 shows the typical voltage waveform.In the case of AC/DC Power Modules, the output ripple voltage is a series of small pulses with high frequency content, and for this reason It is almost always specified as peak-to-peak rather than RMS value.

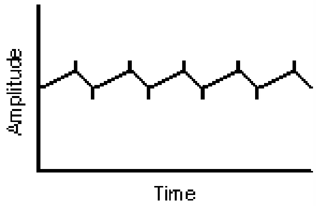

Figure 2

Because of the high frequency content of this ripple, special measurement techniques must be employed so that correct measurements are obtained. First, a 20MHz bandwidth oscilloscope is normally used for the measurement so that all significant harmonics of the ripple spikes are included.

The actual ripple voltage measurement must be carefully made in order not to induce error voltages in the test equipment. Therefore, the conventional ground clip on an oscilloscope probe (See Figure 3) should never be used in this type of measurement. This clip, when placed in a field of radiated high frequency energy, acts as an antenna or inductive pickup loop, creating an extraneous voltage that is not part of the output noise of the converter.

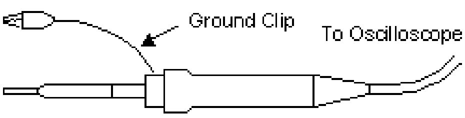

Figure 3

This noise pickup is eliminated as shown in Figure 4 by using a scope probe with an external ground band or ring and pressing this band directly against the output common terminal of the power converter while the tip contacts the voltage output terminal. This makes the shortest possible connection across the output terminal.

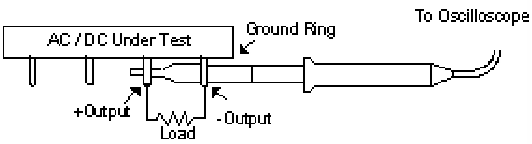

Figure 4

Another method of measuring the output voltage ripple & noise that is specified for many switching power supplies is shown in Figure 5. A 30cm twisted pair of no. 20 AWG copper wire is connected to a 10uF capacitor of proper polarity and voltage rating. The oscilloscope probe ground led should connect right to the ground ring of the probe and be as short as possible. The oscilloscope bandwidth should be at 20MHz and connected to AC ground.

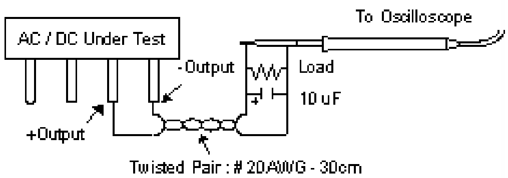

Figure 5

NOTE

1.Specifications typical at Ta=+25°C, resistive load, 115VAC, 60Hz input voltage, rated output current unless otherwise noted.

2.Ripple & Noise measurement bandwidth is 0-20MHz.

3.These power modules require a minimum output loading to maintain specified regulation.

4.Operation under no-load conditions will not damage these devices; however they may not meet all listed specifications.

5.All AC/DC modules should be externally fused at the front end for protection.

6.Other input and output voltage may be available, please contact factory.

7.Specifications subject to change without notice.