

Introduction to DL3000 Programmable Electronic Load



RIGOL TECHNOLOGIES, INC.

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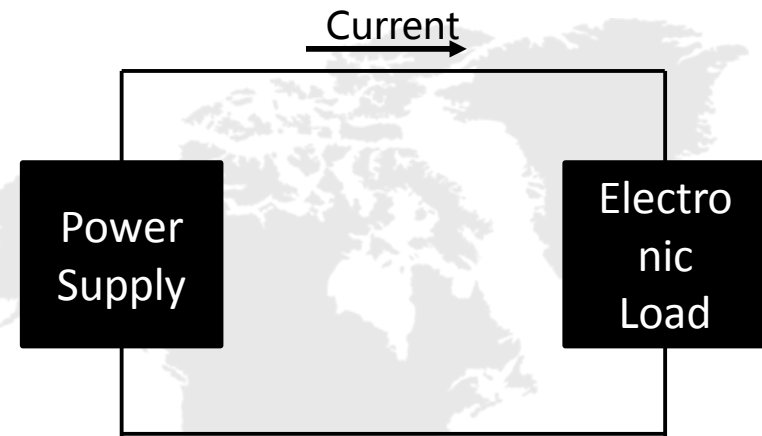
05 DL3000 Market Segment Analysis



What is Electronic Load?

It absorbs the energy from Power Supply and transfers to another type of energy and to be a storage or dissipated equipment.

In electronic application area, designers usually want to implement equipment testing for ON/OFF Power Supply, linear Power Supply, UPS, Transformer, Rectifier, Battery and Charger etc. The traditional testing was implemented by Resistor, Variable Resistor, and even resistor box as testing load, but these sometimes could not fit our versatile requirements. For example, the constant current load, random adjusting type load, constant power load, or dynamic load etc. Thus, the programmable E-Load was developed to satisfy the testing requirement today.



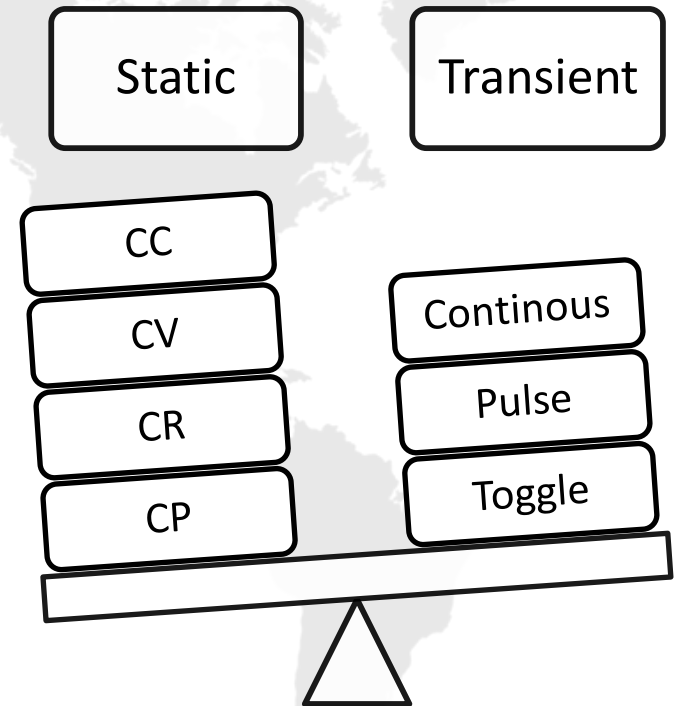
Fundamental Concept of E-Load

What kind of functions in E-Load?

General Speaking, the E-load included two kinds of working mode : Static Mode and Transient Mode;

For Static Mode, it can be separated by four working mode: Constant Current(CC), Constant Voltage(CV), Constant Resistor(CR) and Constant Power modes(CP).

For Transient Mode, according to the method of transient loading, it can be separated by : Continuous, Pulse, Toggled and more complicated "List" function.



Fundamental Concept of E-Load

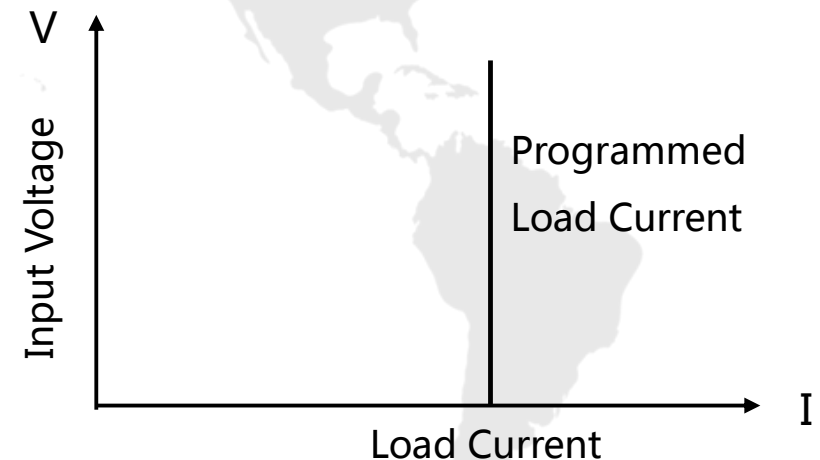
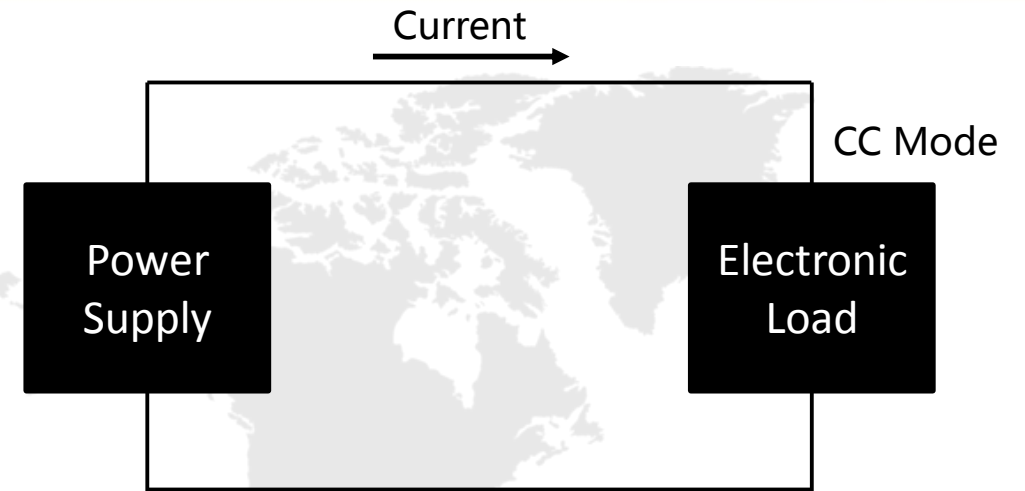
What is Constant Current (CC) Mode?

In the mode of Constant Current, no matter what the input voltage is, the E-load will absorb the energy based on fixed setting current.

Application:

The Constant Current mode is applied to test the load regulation of power supply. The load regulation is the capability which power supply provide a stable voltage under variable loading, the load regulation is the percentage of voltage output deviation of power supply, it can be applied by below formula: :

$$\text{Load Regulation} = \frac{V_o(\text{Max}) - V_o(\text{Min})}{V_o(\text{Normal})} \times 100\%$$



※The E-Load is under CC Mode, but the Power Supply is under CV Mode

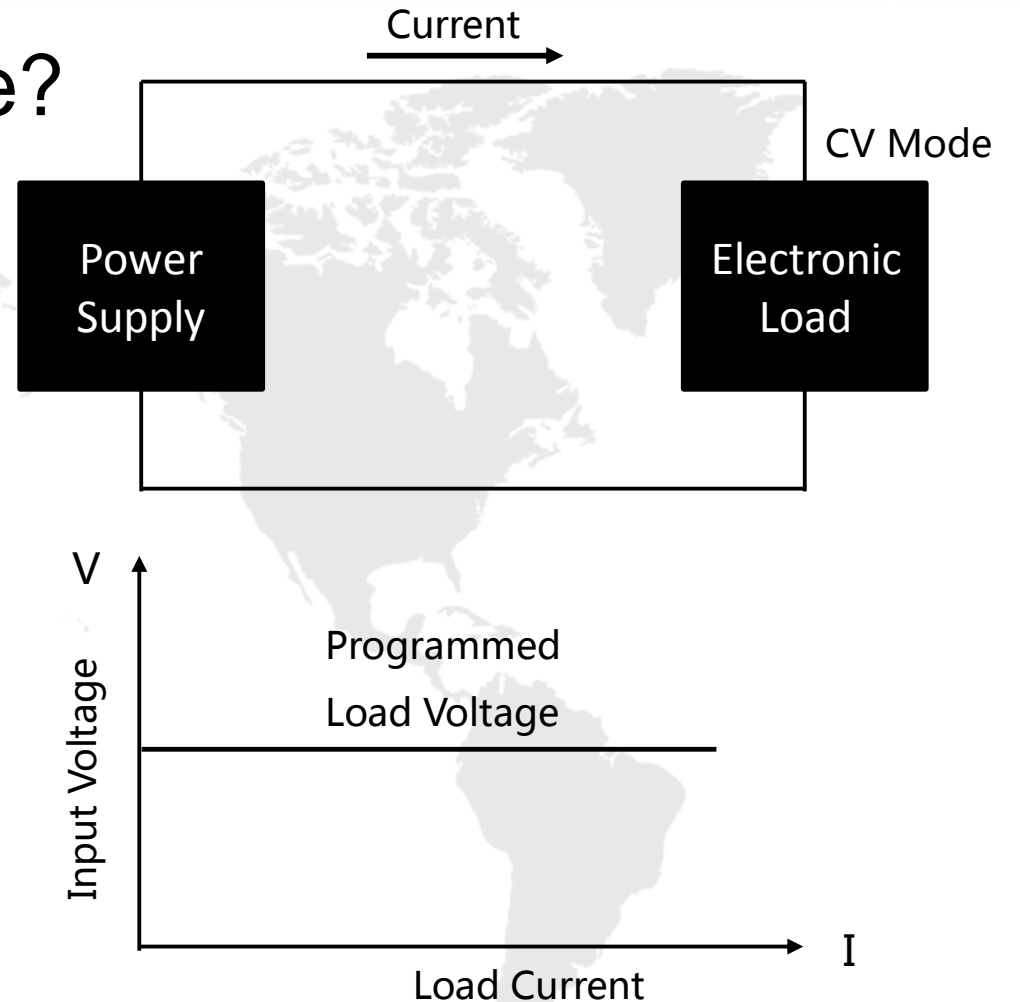
Fundamental Concept of E-Load

What is Constant Voltage (CV) Mode?

In Constant Voltage Mode, no matter what the input current is, the E-Load absorbs the power following by setting voltage value.

Application:

Constant Voltage mode is applied to test current source. It's usually suitable for current limitation feature and current load regulation testing of power supply. The load of constant voltage mode can also simulate the two end voltage difference of battery, so it is suitable for battery charger testing as well.



※The E-Load is under CV mode, but the Power Supply is under CC Mode.

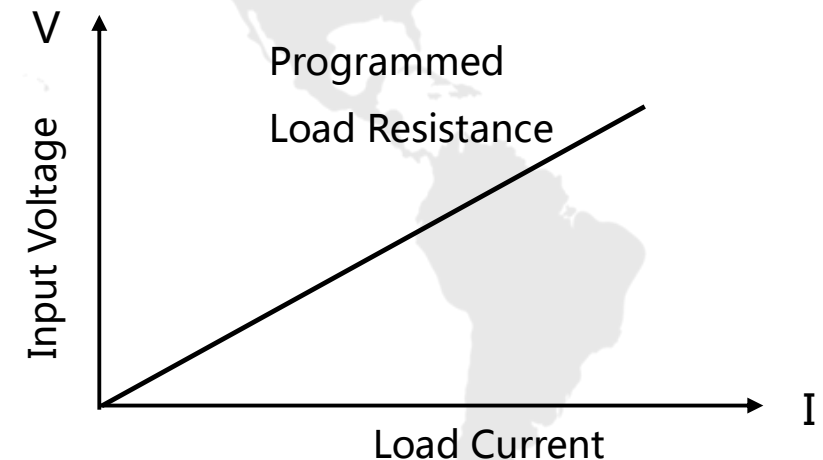
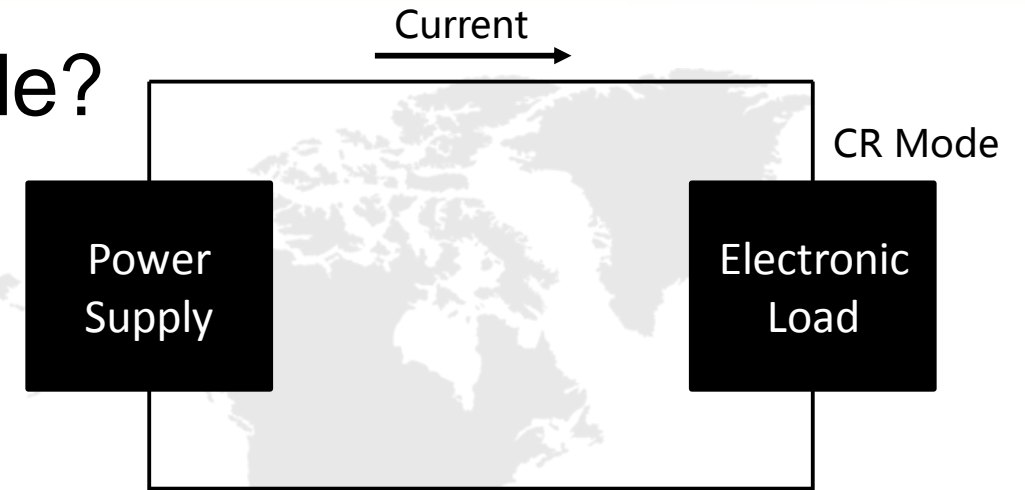
Fundamental Concept of E-Load

What is Constant Resistor (CR) Mode?

In Constant Voltage Mode, the E-Load will absorb the current which has linear fraction relation with input Voltage and keep the constant resistor value.

Application:

Constant Resistor mode is applied to test Voltage or Current sources and it is usually tested for start up and current limitation features of Power Supply, or simulate to set the arbitrary resistor values under specific setting range. .



※ The E-Load is under CR Mode, but the Power Supply can be under CC or CV Mode.

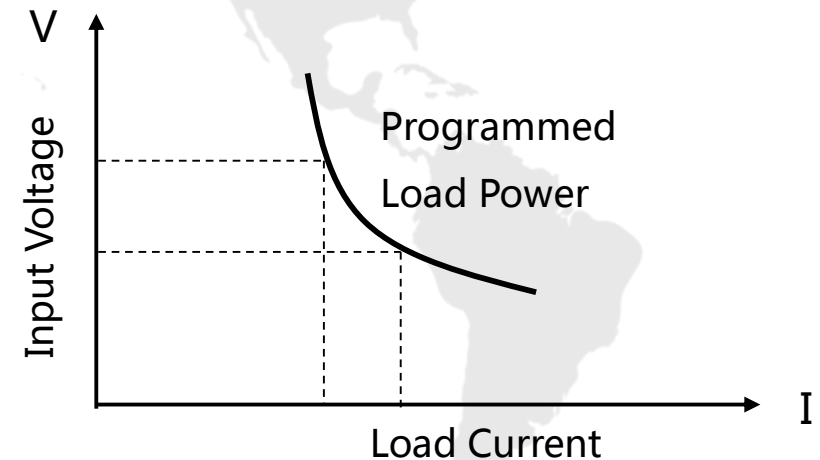
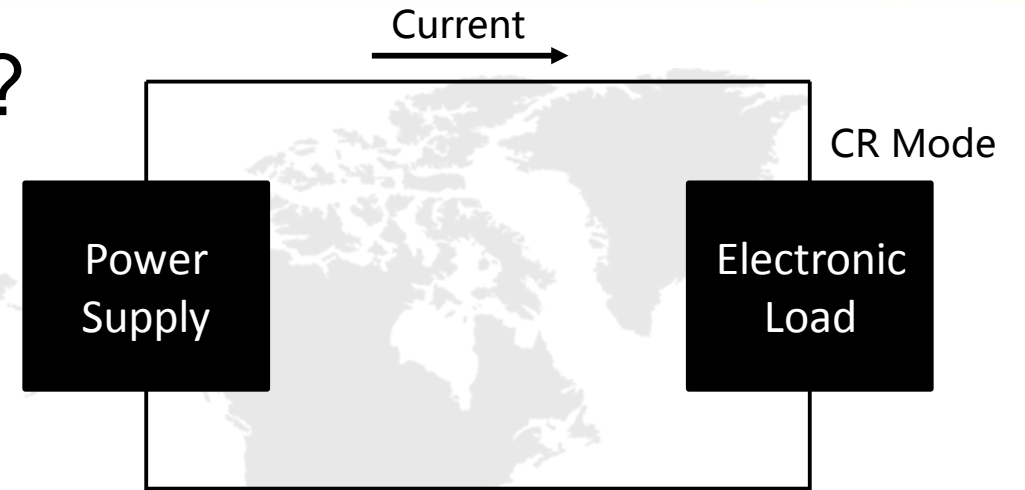
Fundamental Concept of E-Load

What is Constant Power (CP) Mode?

In Constant Power Mode, the E-Load absorbs the multiplied value of Voltage and Current as setting power, that is constant power.

Application:

The Constant Power Mode is mainly applied for Battery capacitor and life testing.



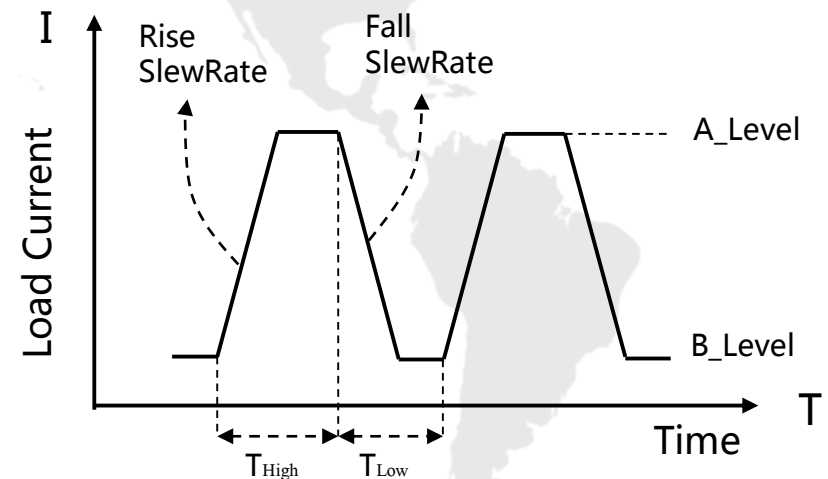
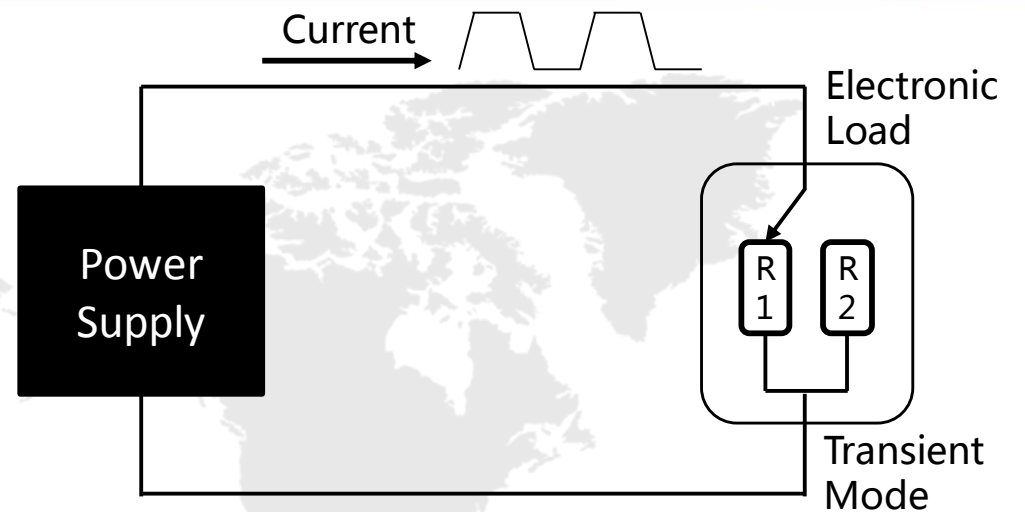
Fundamental Concept of E-Load

What is Transient Mode?

The transient mode is the alternative and periodic switching between two kinds of loadings.

Application:

The method can be applied for the testing of whole circuit loop response of power supply or other transformer. In real application, the load is almost variable. For example, the working current of PC Hard disk is variable under dynamic loading model, and it can be calculated as the response of dynamic loading.



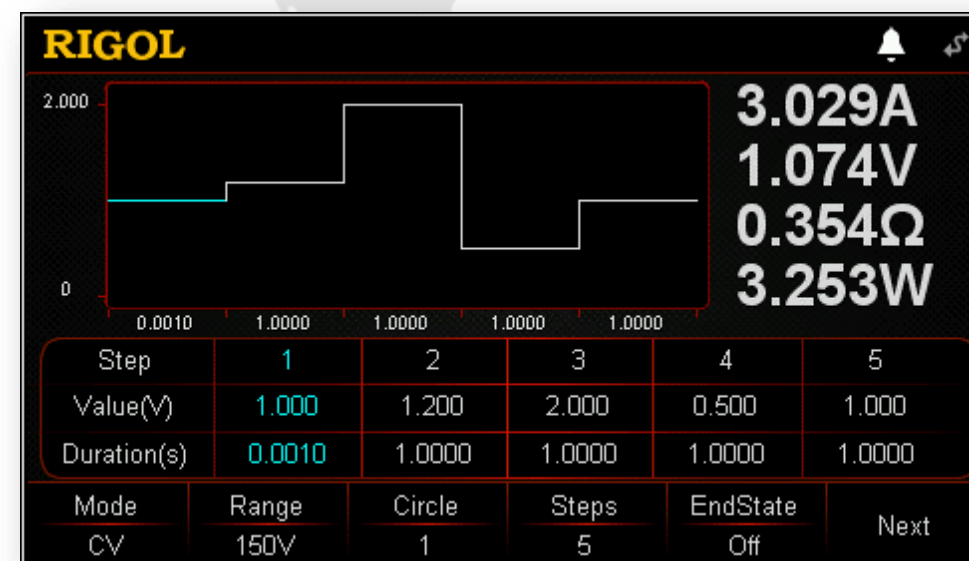
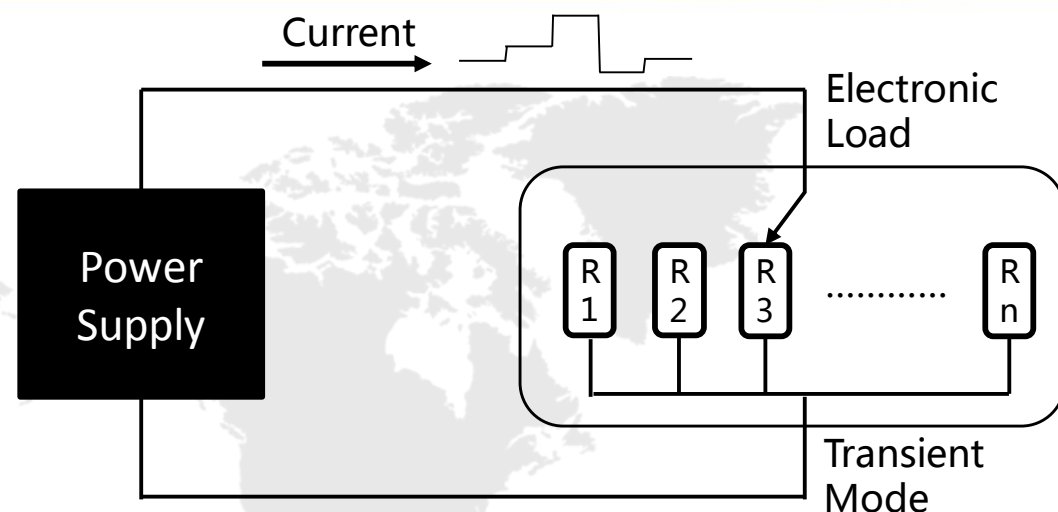
Fundamental Concept of E-Load

What is List function?

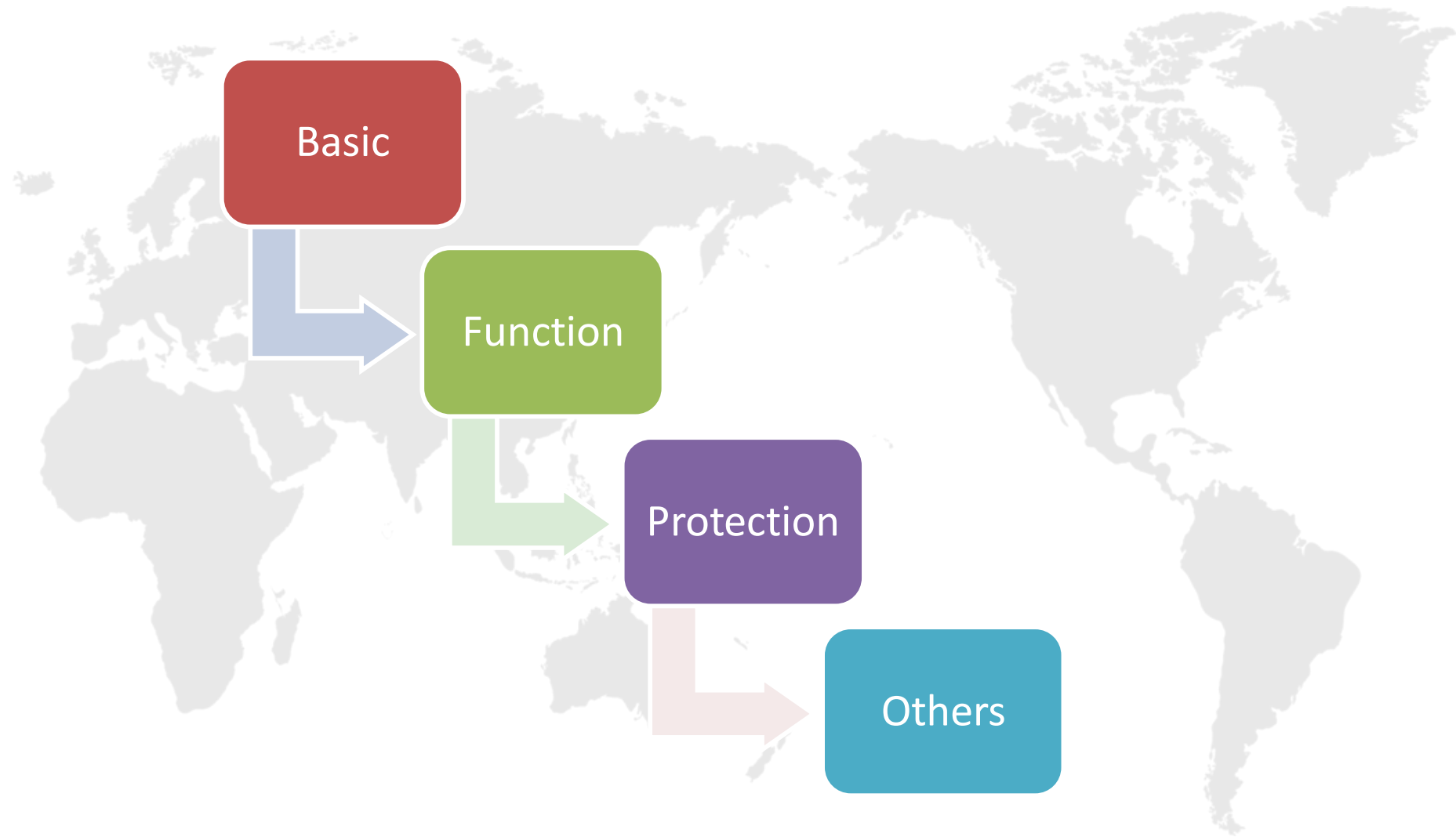
List function provides customer a kind of user define and compile tools, the parameter under each step can be set independent under this function.

Application:

This method can simulate a complicated load variable process, and it is more flexible.



How to select an E-Load ?



How to select an E-Load ?



1. Voltage, Current and Power Selections

To select an E-Load based on the output features of equipment: Voltage, Current and Power. These are the basic parameters of E-Load and it can be decided if it's suitable for customers' requirement.

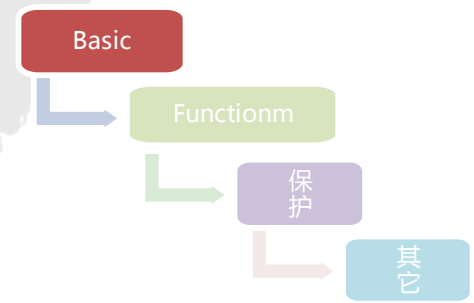
2. The Selections of Accuracy and Resolution

The Accuracy and Resolution are important parameters of E-Load.

The Accuracy can be represented as below:

$\pm(0.1\%+0.1\%FS) \quad \pm(0.1\% \text{ of Value} + 0.1\% \text{ Full Measurement Range})$

The Resolution can represent the tiny variation amount of external variation, it is usually referred to mV or mA.

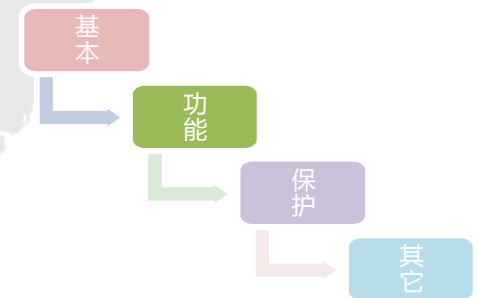


How to select an E-Load ?



1. The selection of Static functions

The E-Load has four kinds of static functions: CC, CV, CR and CP Mode. How to select without differentiation of basic function? It has one circuit under low end E-Load and that is constant current. The other function is calculated based on Ohm's Law. It can save the cost, but has poor accuracy and is unstable. The functions of excellent E-Load are realized by independent circuits and it has excellent performance and the stability is very well. (DL3000 is designed by independent circuits to achieve the performance.)



How to select an E-Load ?

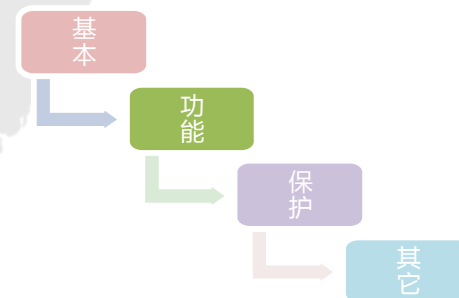
2. The selection of Transient Mode

The transient function can simulate the real variation of load, it has two key parameters: The Slew Rate and dynamic frequency of current.

Slew Rate: When the load has dynamic variations, the variation is under 10%~90%. It is performed by A/us; the E-Load among the market is usually indicated as 3A/us, the better one can be up to 5A/us;

Dynamic Frequency: The E-Load has the variable number in periodic unit time interval, it reflects the response capability of E-Load. The E-Load among the market is usually indicated as 20KHz. (DL3000 can be up to 30KHz)

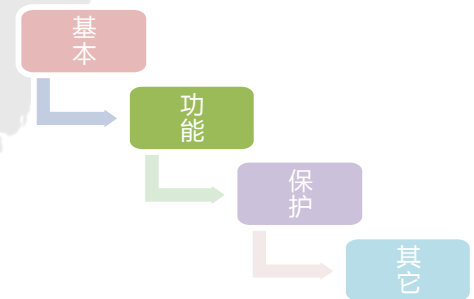
The two parameters reflected the true performance of the E-Load.



How to select an E-Load ?

3. How to select List function?

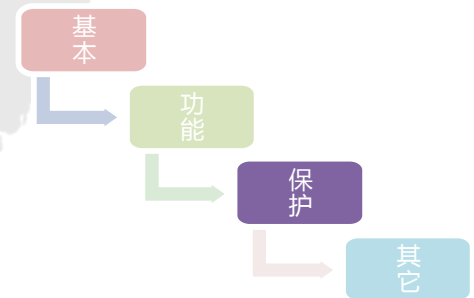
The List function can set all the parameters as a serial timing process, it can complete the whole test procedure of one product and simplified the complicated setting process, reduces the working load. it also simplified the daily operations combined with serial storage and adjust function, the serial setting procedure depends on different brands, the most E-Load among the market can be set to 100 steps. (The DL3000 can be set up to 512 steps.)



How to select an E-Load ?

How to select Protection Function

The MOSFET of E-Load adsorbs large current and the external input conditions can not be controlled, so it has potential burning risk inside the instrument, If there is no perfect protection mechanism, the E-Load is easily damaged. The E-Load usually provides some protection functions : Over Voltage protection, Over Current protection, Over Power protection, Over temperature protection, Reverse connection protection and the Fan damaged protection. The protection function of the best E-Load will be realized by hardware, the protective speed is very fast. If it is realized by software, the protection may be delayed and it may be dangerous under system shut down.



How to select an E-Load ?

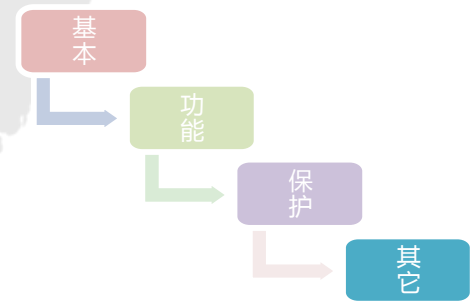


How to select other functions?

It may need other functions based on customers' requirements.

Synchronized Port: Some E-Loads provide Digital IO Ports and can realize the synchronization of multiple E-Load.

Communication Port: System integration use perfect communication port, the most popular port includes RS232, LAN, GPIB, some vendors just provide some of the ports, fewer vendors provide all kinds of communication ports. (The DL3000 provides all kinds of communication ports.)



DL3000 Introduction

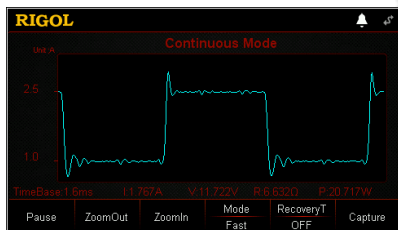


- ◆ DL3021/DL3021A: Single Output, 150V/40A, 200W
- ◆ DL3031/DL3031A: Single Output, 150V/60A, 350W
- ◆ Up to 30kHz Dynamic Frequency
- ◆ Adjustable Current Rising Speed 0.001A/us~5A/us
- ◆ The minimum reading resolution : 0.1mV, 0.1mA
- ◆ 4.3 inch TFT LCD , Parameters and Status can be displayed simultaneously.
- ◆ OV/OC/OP/OT/Reverse Connection Protection.
- ◆ 4 Static Mode: CV/CC/CR/CP
- ◆ 3 Transient Mode: Continuous, Pulse, Toggling
- ◆ List functions can support up to 512 steps
- ◆ Battery Test Function, OC Protection Test Function, OP Protection Function, Factory Test Function and Short Circuit Test Function.
- ◆ Shut down maintain and memory functions
- ◆ Build-in RS232、 USB、 LAN Ports
- ◆ USB-GPIB Interface Module (Option)

DL3000 Introduction



Waveform Display Button

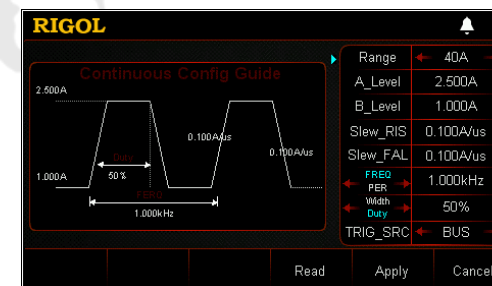
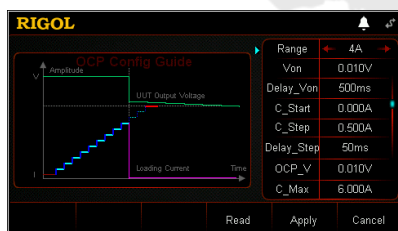


System Button :
Local, Utility, Option, Store, Help



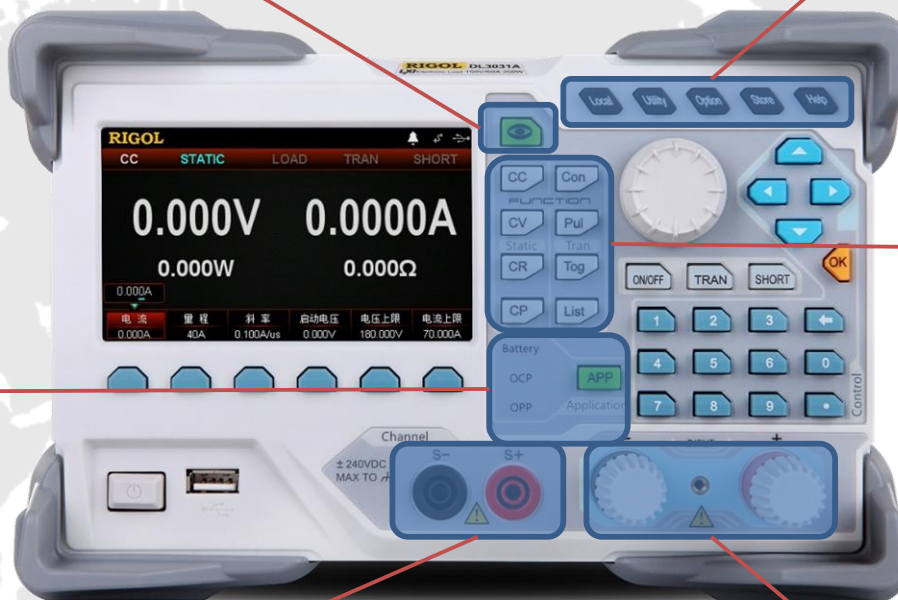
Main Function Buttons :
CC, CV, CR, CP
Con, Pul, Tog, List

Application Function Buttons :
Battery, OCP, OPP



Sense Terminal

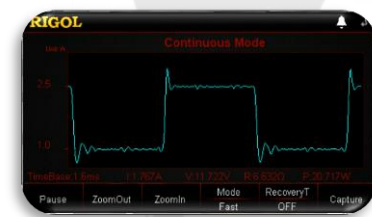
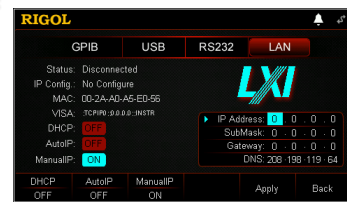
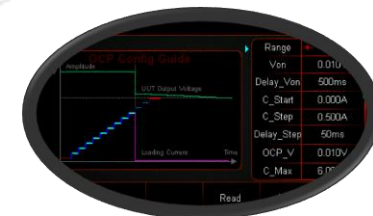
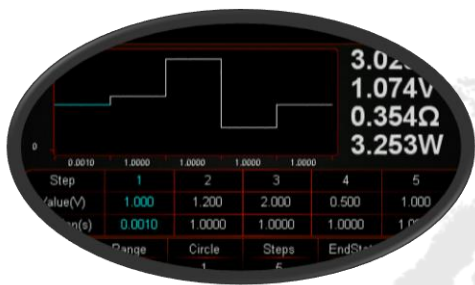
Input Terminal



DL3000 Introduction

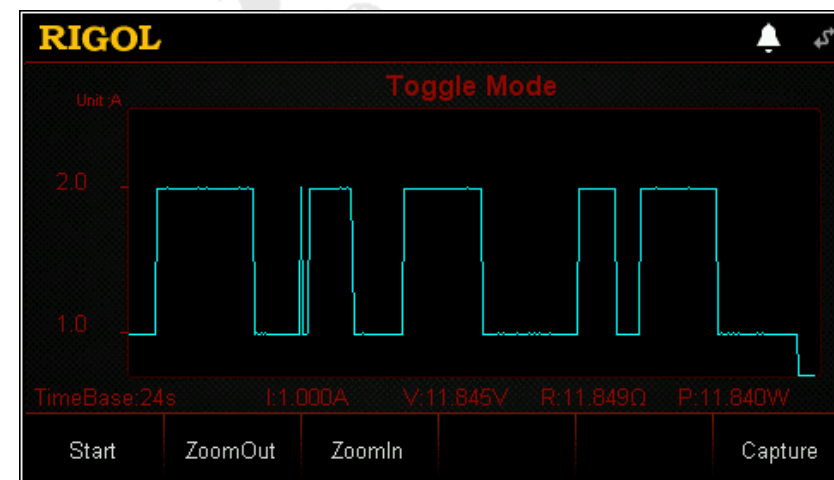
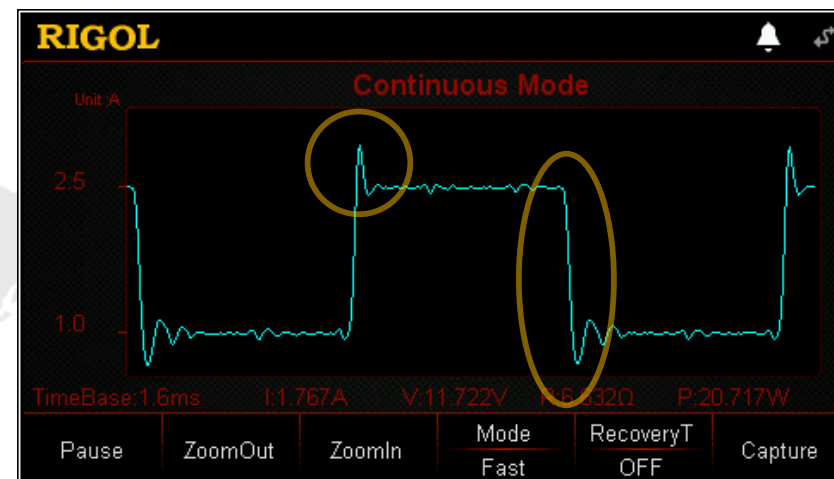


4.3" TFT LCD Provide more information



Waveform Display Quick Button

- Innovative Waveform Display Quick Button, it is adjustable under any modes.
- The Sampling Period can be up to $4\mu\text{s}$, more detailed waveforms can be addressable.
- The Max Timing Windows is 800s , longer waveform trend can be observed.
- Time base is adjustable.

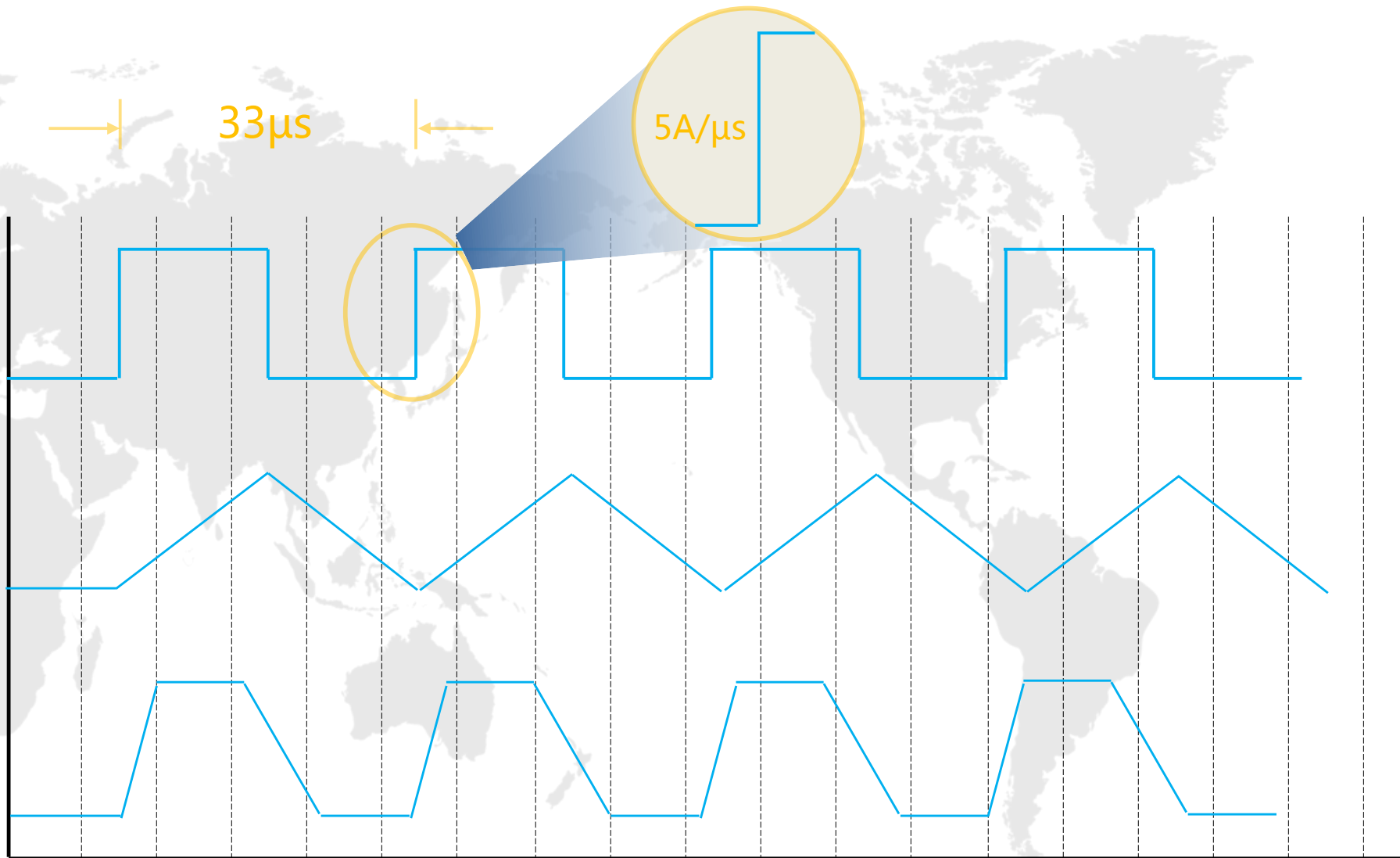


DL3000 Introduction

- High Speed 30kHz
- SlewRate up to 5A/us

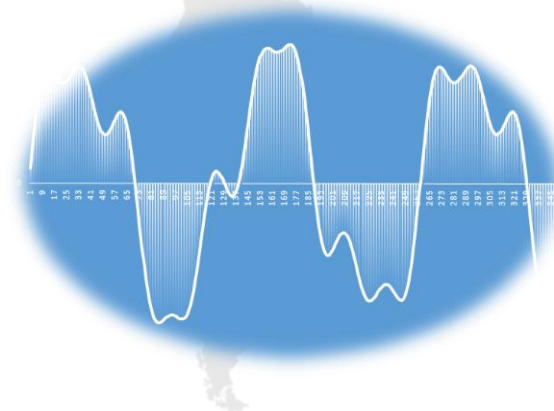
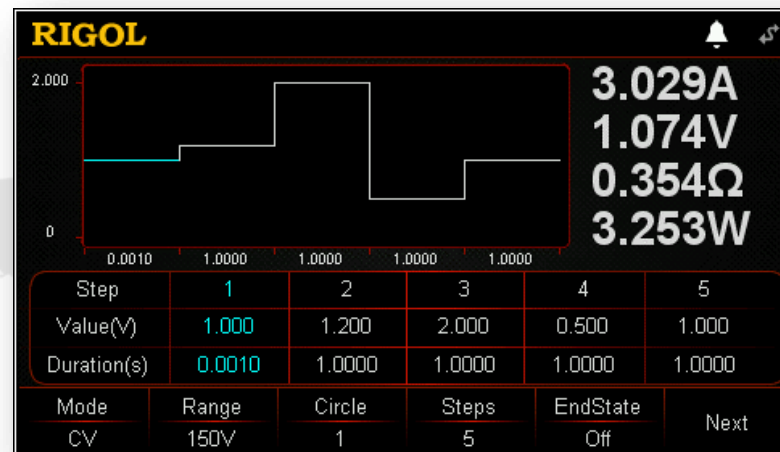


- Up to 30KHz Dynamic Frequency
- Up to 5A/us Current Rising Speed.
- Well Specifications provide stronger dynamic test capability.



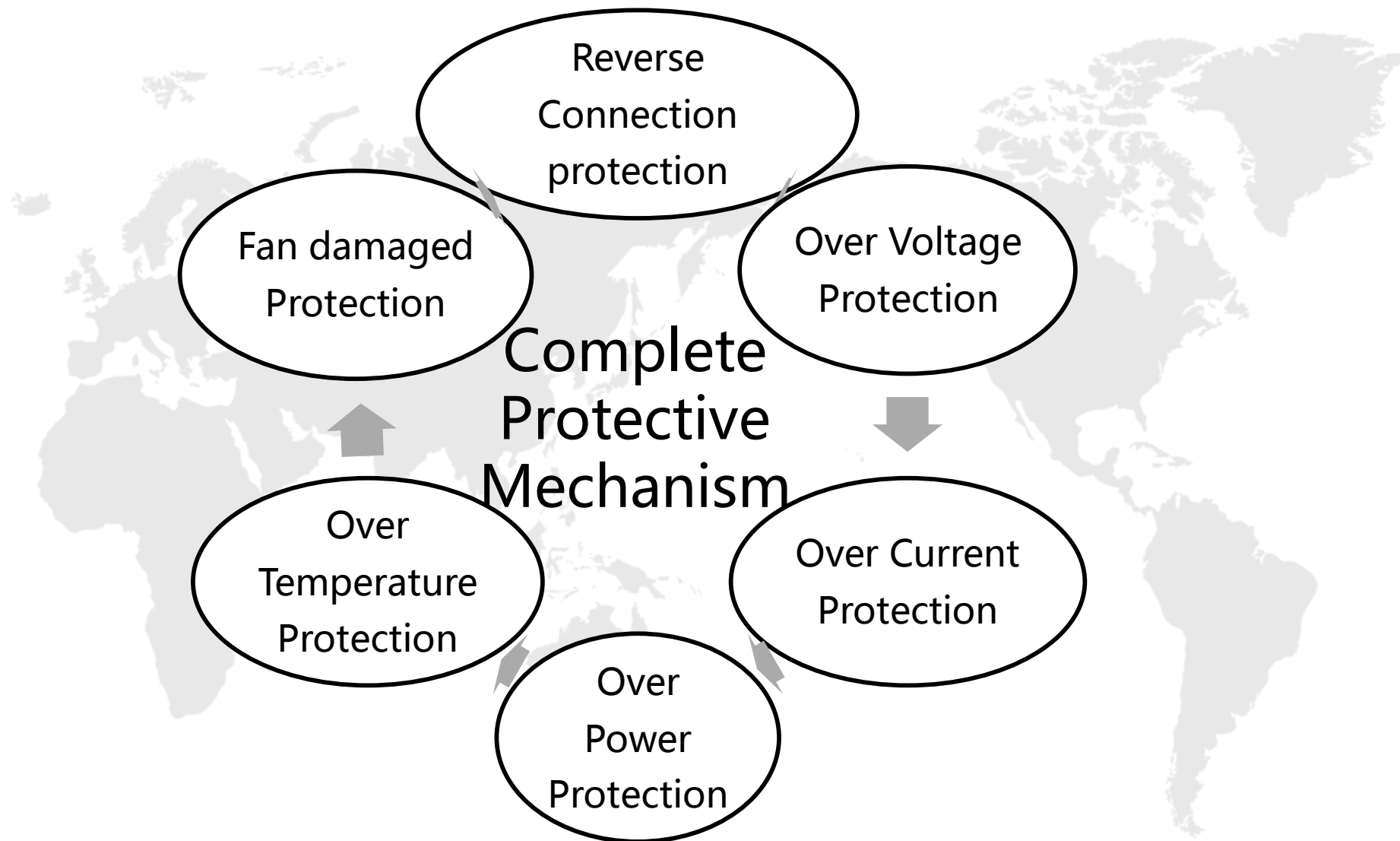
DL3000 Introduction

- High Speed 30kHz
- SlewRate up to 5A/us
- The List function can generate more complicated serial testing and satisfy the requirements and booming up the test efficiency.
- The List function can support up to 512 steps status compiling.
- 100 list documents can be saved locally, and there is no limitation under external USB memory stick.
- The minimum time resolution of each step is 0.1ms.



DL3000 Introduction

- High Speed 30kHz
- SlewRate up to 5A/us



DL3000 Introduction

- High Speed 30kHz SlewRate up to 5A/us
- Powerful Ultra Load PC Software , not only can realize the fundamental operation functions, but also offers the waveform record function etc.
- Integrate the DL3000 Virtual front panel on Ultra Load, so it can simulate the instrument environment on PC.

Ultra Load Main Interface

Virtual front panel interface










DL3000 E-Load Competition Analysis



Introduction		RIGOL		Itech				GW
		DL3031A	DL3031	IT8512+	IT8512C+	IT8812	IT8812C	PEL-3031E
Input Rating	Voltage	✓ 150V	150V	120V	120V	120V	120V	150V
	Current	✓ 60A	60A	30A	60A	30A	60A	60A
	Power	✓ 350W	350W	300W	300W	250W	250W	300W
Dynamic	T1&T2	✓ 30kHz	15kHz	10kHz	25kHz	25kHz	25kHz	10kHz
	SlewRate	✓ 5A/us	2.5A/us	1.5A/us	3A/us	2.5A/us	2.5A/us	2.5A/us
CV Mode	Accuracy	0.05%+0.02%FS		0.05%+0.02%FS		0.05%+0.025%FS	0.025%+0.05%FS	0.1%+0.1%FS
CC Mode	Accuracy	0.05%+0.05%FS		0.05%+0.05%FS		0.05%+0.05%FS	0.05%+0.02%FS	0.1%+0.1%FS+Vin/500kohm
V Meas.	Accuracy	✓ 0.02%+0.02%FS		0.025%+0.025%FS		0.025%+0.025%FS		0.1%+0.1%FS
I Meas.	Accuracy	✓ 0.05%+0.05%FS		0.05%+0.05%FS		0.05%+0.05%FS	0.05%+0.1%FS	0.1%+0.1%FS
Interface		✓ USB/LAN/RS232/GPIB(Opt)		RS232/USB/GPIB (Need to purchase Isolator)				USB/GPIB(Opt)
Display		✓ 4.3 inches TFT LCD		VFD				3.5 inches TFT LCD

DL3000 Market Segment Analysis



							
ITEM	Fuel Cell & Battery	Industrial Power	Telecom Power	Monitor Power	Power Adapter	Desktop Power	Battery Charger
Power	500W-2000W	60W-600W	500W-15000W	75W-300W	<90W	150W-500W	<50W
Voltage	12V/24V/36V /48V/60V/64 V/72V	5V-500V (5V/12V/24V/48V)	48V	0.1V-500V	0.1V-50V	0.5V-48V	5V-50V
Current	1A-1000A	1A-60A	10A-1000A	1A -60A	1A- 20A	1A-150A	1A-10A
Solution		DL3031(A)		DL3031(A)	DL3021(A)	DL3031(A)	DL3021(A)

THANK YOU

