

USER'S Guide

Programmable DC Electronic Load

Model M9711 M9712 M9712B M9712C M9712B30

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Chapter 1 Overview

The new M97XX series programmable DC electronic load is a new generation product designed from Maynuo Electronic Co.,Ltd. Incorporating high-performance chips, the M97XX series delivers high speed and high accuracy with a resolution of 0.1 mV and 0.01 mA (basic accuracy is 0.03% and basic current rise speed is 2.5 A/ μ s). M97XX series have wide application from production lines for cell phone chargers, cell phone batteries, electronic vehicle batteries, switching power supplies, linear power supplies, and LED drivers, to research institute, automotive electronic, aeronautic and astronautic, maritime, solar cell and fuel cell etc. test and measurement applications.

FEATURES

- Six high speed operation modes: CC,CR,CV,CW,CC+CV,CR+CV
- Over current, over voltage, over power, over heating and polarity reversal protection
- High-luminance vacuum fluorescent display (VFD) screen with two line, four channel display
- Intelligent fan system will automatically activate based on changing ambient temperatures
- Soft-start time setting, activating the power supply in accordance with the set voltage value
- Battery test and short-circuit test functions
- Capable of rising edge and falling edge dynamic testing
- Supporting external trigger on either input or output
- External current waveform monitor terminal output terminal
- Supports remote voltage compensation and multi-data storage
- Power-on-self-test, software calibration and standard rack mountable
- Edits arbitrary waveforms in list function.
- Available with RS232/RS485/USB serial interfaces.

Chapter 2 Technical Specifications

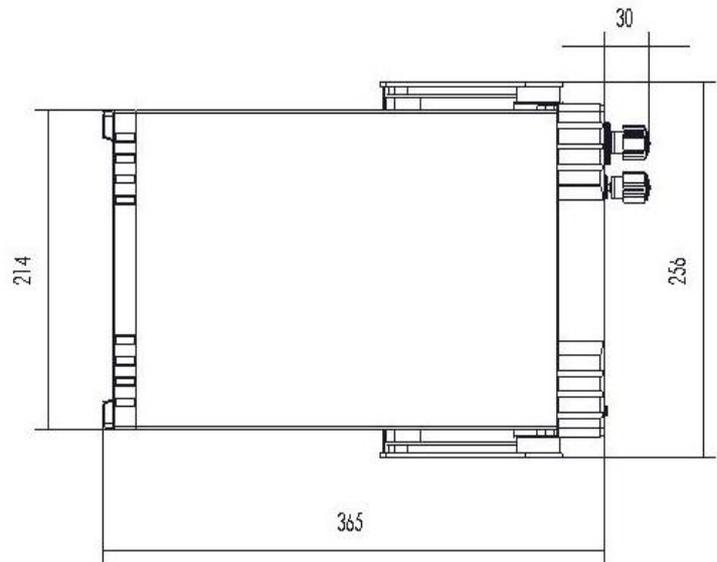
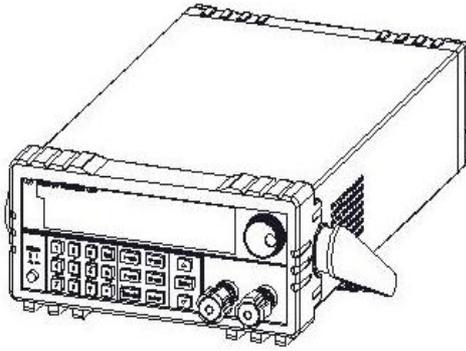
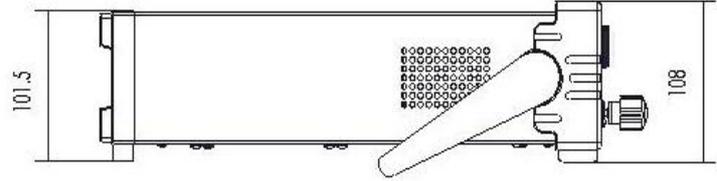
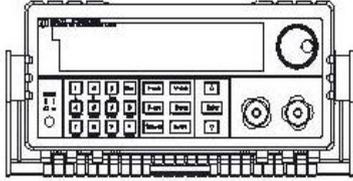
2.1 Main Technical Specifications

This User Manual covers only the M97XX programmable DC electronic loads. Please refer to the following table that details the specific parameters of the 150W-300W M97XX DC electronic loads.

Model		M9711		M9712		M9712B		M9712C	
Input Rating	Power	150W		300W		300W		300W	
	Current	0-30A		0-30A		0-15A		0-60A	
	Voltage	0-150V		0-150V		0-500V		0-150V	
CC Mode	Range	0-3A	0-30A	0-3A	0-30A	0-3A	0-15A	0-6A	0-60A
	Resolution	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA	0.1mA	1mA
	Accuracy	0.03%+0.05%FS	0.03%+0.05%FS	0.03%+0.05%FS	0.03%+0.05%FS	0.03%+0.05%FS	0.03%+0.05%FS	0.03%+0.05%FS	0.03%+0.05%FS
CV Mode	Range	0.1-19.999V	0.1-150V	0.1-19.999V	0.1-150V	0.1-19.999V	0.1-500V	0.1-19.999V	0.1-150V
	Resolution	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV
	Accuracy	0.03%+0.02%FS	0.03%+0.02%FS	0.03%+0.02%FS	0.03%+0.02%FS	0.03%+0.02%FS	0.03%+0.02%FS	0.03%+0.02%FS	0.03%+0.02%FS
CR Mode (Voltage and current input value $\geq 10\%$ full measurement)	Range	0.03 Ω -10K	0.03 Ω -5K	0.03 Ω -10K	0.03 Ω -5K	0.3 Ω -10K	0.3 Ω -5K	0.03 Ω -10K	0.03 Ω -5K
	Resolution	16bit	16bit	16bit	16bit	16bit	16bit	16bit	16bit
	Accuracy	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS
CW Mode (Voltage and current input value $\geq 10\%$ full measurement)	Range	0-150W	0-150W	0-300W	0-300W	0-300W	0-300W	0-300W	0-300W
	Resolution	1mW	10mW	1mW	10mW	1mW	10mW	1mW	10mW
	Accuracy	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS
V Measurement	Voltage	0-19.999V	0-150V	0-19.999V	0-150V	0-19.999V	0-500V	0-19.999V	0-150V
	Resolution	1mV	10mV	1mV	10mV	1mV	10mV	1mV	10mV
	Accuracy	0.015%+0.03%FS	0.015%+0.03%FS	0.015%+0.02%FS	0.015%+0.03%FS	0.015%+0.03%FS	0.015%+0.05%FS	0.015%+0.03%FS	0.015%+0.03%FS
I Measurement	Current	0-3A	0-30A	0-3A	0-30A	0-3A	0-15A	0-6A	0-60A
	Resolution	0.01mA	0.1mA	0.01mA	0.1mA	0.01mA	0.1mA	0.1mA	1mA
	Accuracy	0.03%+0.05%FS	0.03%+0.08%FS	0.03%+0.05%FS	0.03%+0.08%FS	0.03%+0.05%FS	0.03%+0.08%FS	0.03%+0.05%FS	0.03%+0.08%FS
W Measurement (Voltage and current input value $\geq 10\%$ full measurement)	Watt	100W	150W	100W	300W	100W	300W	100W	300W
	Resolution	1mW	10mW	1mW	10mW	1mW	10mW	1mW	10mW
	Accuracy	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS	0.1%+0.1%FS
Battery Measurement	Battery Input: 0.5-120V; Max. Measurement: Capacity=999H; Resolution=0.1mA; Time Range=1S-16HS								
Dynamic Measurement	Transition List: 0-25kHz; 2.5A/uS; T1&T2:60uS-999S; Accuracy: $\pm 15\%$ offset+10% FS								
CC soft-startup Time	1 mS; 2 mS; 5mS; 10mS; 20 mS; 50 mS; 100 mS; 200 mS Accuracy: $\pm 15\%$ offset+10% FS								
Short Circuit	Current(CC)	$\approx 3.3A$	$\approx 33A$	$\approx 3.3A$	$\approx 33A$	$\approx 3.3A$	$\approx 18A$	$\approx 6.6A$	66A
	Voltage(CV)	0V		0V		0V		0V	
	Resistance(CR)	$\approx 55m\Omega$		$\approx 35m\Omega$		$\approx 300m\Omega$		$\approx 25m\Omega$	
Temperature	Operating	0~40°C		0~40°C		0~40°C		0~40°C	
	Nonoperating	-10°C~70°C		-10°C~70°C		-10°C~70°C		-10°C~70°C	
Dimension	W*H*D(mm)	108*214*365							
Weight	Kg	3.5							

Model	M9712B30		
Input Rating	Power	300W	
	Current	0-30A	
	Voltage	0-500V	
CC Mode	Range	0-3A	0-30A
	Resolution	0.1mA	1mA
	Accuracy	0.05%+0.05%FS	0.05%+0.08%FS
CV Mode	Range	0.1-19.999V	0.1-500V
	Resolution	1mV	10mV
	Accuracy	0.03%+0.02%FS	0.03%+0.05%FS
CR Mode (Voltage and current input value $\geq 10\%$ full measument)	Range	0.3 Ω -10K	0.3 Ω -5K
	Resolution	16 bit	16 bit
	Accuracy	0.1%+0.1%FS	0.1%+0.1%FS
CW Mode (Voltage and current input value $\geq 10\%$ full measument)	Range	0-300W	0-300W
	Resolution	1mW	10mW
	Accuracy	0.1%+0.1%FS	0.1%+0.1%FS
V Measurement	Voltage	0-19.999V	0-500V
	Resolution	1mV	10mV
	Accuracy	0.015%+0.03%FS	0.015%+0.05FS
I Measurement	Current	0-3A	0-30A
	Resolution	0.01mA	0.1mA
	Accuracy	0.05%+0.08%FS	0.08%+0.08%FS
W Measurement (Voltage and current input value $\geq 10\%$ full measument)	Watt	100W	300W
	Resolution	1mW	10mW
	Accuracy	0.1%+0.1%FS	0.1%+0.1%FS
Battery Measurement Battery Input: 0.5-120V; Max. Measurement: Capacity=999/H; Resolution=0.1mA; Time Range=1S-16HS			
Dynamic Measurement Transition List: 0-25kHz; 2.5A/uS; T1&T2:60uS-999S; Accuracy: $\pm 15\%$ offset+10% FS			
CC soft-startup Time 1 mS; 2 mS; 5mS; 10mS; 20 mS; 50 mS; 100 mS; 200 mS Accuracy: $\pm 15\%$ offset+10% FS			
Short Circuit	Current(CC)	$\approx 3.3A$	$\approx 33A$
	Voltage(CV)	0V	
	Resistance(CR)	$\approx 280m\Omega$	
Temperature	Operating	0~40°C	
	Nonoperating	-10°C ~70°C	
Dimension	W*H*D(mm)	108*214*365	
Weight	Kg	3.5	

2.2 DC Electronic Load Dimensional Line Drawings



Chapter 3 Quick Reference

3.1 Power-onself-test

Verify that you have received the following items with your XT 98XX DC Programmable Electronic Load.. If anything is missing, contact your nearest XiTRON authorized Sales Representative's Office.

- One power cord for your location/country
- The M97xx User's Manual
- One CD (if you have purchased the optional communication accessories)
- One communication cable (if you have purchased the optional communication accessories)

First, make sure the DC electronic load has been correctly connected and powered on. Please refer to the following table for the detailed operational steps.

Procedure	Display	Explanation
1. Power-up the DC electronic load	SYSTEM SELF TEST Vxxx	The electronic load powers up and the VFD panel displays the firmware revision level #.
2. Wait for 1s after turning the DC electronic load on	EPROM ERROR	EEPROM damage or lost data at last power off session.
	ERROR CAL.DATA	EEPROM lost calibration data.
3. Wait another 2S after ERROR has occurred	xxxxxxxV xxxxxxxA xxxxxxxW xxxxxxxX	Displays the actual input voltage and current values and the actual power and reactant setting values.

3.2 In the Event of a Problem

If the DC electronic load fails to power up, the following troubleshooting steps will help to determine the problem.

- 1) Make sure the power cord is connected properly and the Power switch has been pushed in to ON..
- 2) Check the power voltage setting on the back panel.

There are two voltages that power the DC load: either 110V or 220V. Please make sure the right voltage setting has been selected manually for your area.

- 3) Check the DC load's fuse..

If fuse is open, please replace it with another fuse that meets the following specifications.

Model	Fuse specification (110VAC)	Fuse specification (220VAC)
M9711	T0.5A 250V	T0.3A 250V
M9712	T0.5A 250V	T0.3A 250V
M9712B	T0.5A 250V	T0.3A 250V
M9712C	T0.5A 250V	T0.3A 250V
M9712B30	T0.5A 250V	T0.3A 250V

4). Replace the Fuse

Open the plastic cover on the rear panel of the DC electronic load with a flat screwdriver. (See table 3.1) and find the open fuse. Then replace the open fuse with a new one.

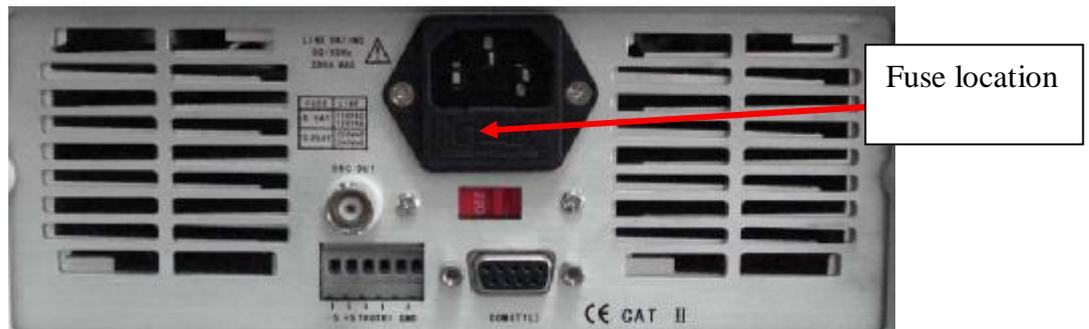


Diagram 3.1 Fuse Location

3.3 Front Panel Operation and Back Panel Operation

Please refer to Diagram 3.2 for the front panel of M97XX DC electronic load.



Diagram 3.2 Front panel

- ① The upper half is the black Vacuum Fluorescent Display (VFD) display screen.
- ② Robtary knob, Turn to adjust the setting values.
- ③ Numeric keys 0-9, ESC key, secondary key functions
- ④ Keypad: set up the current,voltage,power,resistance modes(I-set, V-set, P-set, R-set, Shift and On-Off);Scroll through menus and options
- ⑤ Input terminals
- ⑥ Power switch to turn on/off the instrument
- ⑦ Up-Down keys, Enter key



Diagram 3.3 the back panel of the M97XX Series DC electronic load

- ① BNC Out connector for 0-full range current, that corresponds to 0-10V output.An Oscilloscope can be connected here to view dynamic waveforms.
- ② Remote Measurement terminals and trigger for input/output interface
- ③ DB Sub 9 pin multifunctional communications interface for RS232, RS485 and USB serial buses (with optional M133 D sub 9 to USB conversion cable). **Do not connect an M131 cable with standard RS-232 voltages on the cables connectors. Doing so may damage the instrument and is not covered by WARRANTY.**

3.4 Keypad Directions

1 ~ 9	0-9 numeric keys
Esc	Esc key (enables exit from any working condition/mode)
I-Set	Switch to CC mode

	Setting up a constant current
V-Set	Switch to CV mode Setting up a constant voltage
P-Set	Switch to CW mode Setting up a constant power
R-Set	Switch to CR mode Setting up a constant resistance
Shift	Multi-purpose Used in conjunction with other keys to perform diverse functions and applications(for example: shift+0/Menu key will launch the menu function)
On/Off	Turn DC electronic Load on/off
▲	Scroll up menu choices
▼	Scroll down menu choices
Enter	Confirmation of settings key

3.5 Menu Operation

Press the **Shift+0/Menu** keys in sequence to access the menu functions and the VFD screen displays the menu choices: CONFIG, SYSTEM SET, LIST,AUTO TEST, SHORTCUT AND EXIT. . Select the menu items by pressing the ▲ and ▼ cursor keys and then press the **Enter** key to open the menu item you chose. Or press the **Esc** key to return to the out of the menu function.

MENU		
CONFIG		
	INPUT RECALL	Resets the output to the same state as the last time used when the load is turned off; or to the OFF state when the DC electronic load is powered back on
	ON	Retains the same settings when the DC electronic load is turned off
	OFF	Sets the output to the OFF state when the DC electronic load is powered on. The load will work on CC mode
	KEY PAD SOUND SET-UP	Sets the keypad sounds
	ON	Will activate a beep when any key is pressed.
	OFF	Deactivates the beep when any key is pressed
	CONNECT MODE	Connect mode
	MAXTIDLEXING?	Multi

	SEPARATE	Single
	BAUD RATE SET	Setting the modem Baud rate
	2400 baud	
	9600 baud	
	14400 baud	
	28800 baud	
	57600 baud	
	115200 baud	
	COMM.PARITY	Setting Communications Parity mode
	NONE	No Parity
	EVEN	Even Parity
	ODD	Odd Parity
	ADDRESS SET	Setting an Address
	1~200	The address is the input number (1-200).
	KEY LOCK SET	Setting the password to unlock the keypad (when 0 or null is set, there is no password set)
	EXIT	
SYSTEM SET		
	MAX CURRENT SET	Setting the maximum Current. If the maximum current set is higher than 3A, the load is in high range. Otherwise, it is in low range.
	MAX VOLTAGE SET	Setting the maximum Voltage. If the maximum voltage set is higher than 20V, the load is in high range. Otherwise, it is in low range.
	MAX POWER SET	Setting the Maximum Power.
	TERMINAL SET	Selecting the input terminal
	FRONT	Select the input terminal on the front panel
	BACK	Select the input terminal on the back panel
	EXIT	
LIST		
	LOAD LIST	Choose list files, 1~8
	EDIT LIST	Edit list files
	MINIMUM TIME	Edit minimum time(0.02~1310.7mS)
	LIST MODE	List output mode
	CONTINUOUS	Continuous mode
	END HOLD	Retains the last output voltage level after the entire sequence is successfully completed
	END RESET	Retains the load OFF state after the entire sequence is successfully

		completed
	STEP LENGTH	Step length(1~200)
	STEP n	1~whole step length
	CURRENT	Set current
	TIME	Duration
	EXIT	
AUTO TEST		
	LOAD AUTO TEST	Select automatic test files 1~8
	EDIT AUTO TEST	Edit automatic test files
	STEP LENGTH	Set the entire step length
	STEP n	
	WORK MODE	
	LOAD OFF MODE	Load OFF mode
	CC MODE	Constant Current mode
	CV MODE	Constant Voltage mode
	CP MODE	Constant Power mode
	CR MODE	Constant Resistance mode
	SHORT MODE	Short circuit mode
	TEST MODE	Qualification testing mode
	TEST CURRENT	Test Current
	TEST VOLTAGE	Test Voltage
	TEST POWER	Test Power
	TEST RESI	Test Resistance
	DELAY TIME	Test delay time between(0.2~25.5S)
	INPUT xxxx	Input the parameters desired, for example: CC mode, 1A
	MINIMUM xxxx	Input the minimum lower limit
	MAXIMUM xxxx	Input the maximum upper limit
	SET-UP AUTO TEST	
	TRIGGER	Trigger output selection
	PASS	Trigger once when passing the test
	FAIL	Trigger once when failing the test
	TEST END	Trigger output is initiated when test ends
	DISABLE	Disable trigger output
	OUTPUT	Output electrical characteristics selection
	PULSE	Pulse output
	LEVEL	Voltage level output
	EXIT	
EXIT		

Chapter 4 Panel Operation

4.1 Basic Operation Mode

There are four operation modes for the DC electronic load:

1. Constant Current (CC)
2. Constant Voltage (CV)
3. Constant Resistance (CR)
4. Constant Power (CW)

4.1.1 Constant Current Operation Mode (CC)

In this mode, the DC electronic load will synchronize with a current in accordance with the programmed value regardless of the input voltage. Please refer to Diagram 4.1. If the maximum current value of the power supply under test is lower than the constant current value set, the electronic load might fail to automatically adjust to these levels. Accordingly, the constant current and voltage of the measured power supply should be adjusted lower..

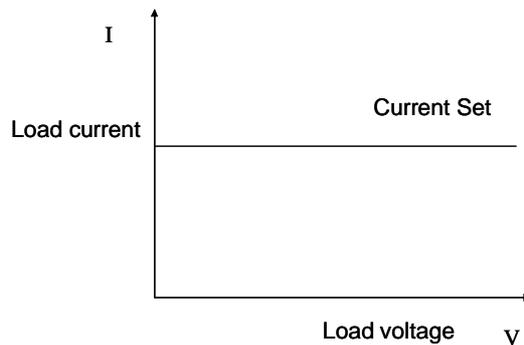


Diagram 4.1 Constant Current Mode

4.1.1.1 Setup a Standard Constant Current Mode

Press the **I-SET key** and the VFD display will show **STANDARD CURR=xxxxxxxA**, the present constant current value. Press the numeric keys and decimal point key to enter the constant current value desired, followed by pressing the **Enter key** to confirm the setting. - The DC Electronic Load load will now be in the standard constant current mode.

If the input state is in **OFF** state, then the word **OFF** will appear in upper right corner of the VFD display. Press the **On/Off key** to change the load's input state to an **ON** state. Now **CC** or **Unreg** will appear in the upper right corner of the VFD display. Displaying **CC** means the load has been successfully set with the expected constant current value; if **Unreg** is displayed, the load couldn't adjust itself to the constant current value that was entered. Please check to determine whether or not the power supply under test has the proper connections and has been turned on; also check to make sure that the desired constant current value is within the range of the power supply under test.

If you want to fine tune the constant current value, rotate the encoder knob to adjust the value. Rotating clockwise will increase the value and rotating it counter-clockwise will decrease the value. Note: if the constant current value you want to set is beyond the maximum constant current value capability of the DC load, the current value will stop increasing even if you continue to rotate the encoder knob clockwise. At this point, the lower right corner of the VFD panel will display the constant current value you set. Within this number sequence, if the cursor underlines one particular digit, that digit requires adjustment. If users want to make adjustments to finetune the accuracy, depress the rotary encoder knob. Every time the rotary encoder is pressed the cursor will move forward to the previous digit.

4.1.1.2 Loading and Unloading Constant Current Mode

Loading and unloading CC mode can protect the power supply under test from damage. When the voltage of the power supply under test starts to increase, the load will automatically adjust itself to the open-circuit state. The load then carries the power supply being tested and adjusts itself to the current value of the UUT set when the voltage of the UUT increased to the **ONSET** loading voltage level. When the voltage of the power supply under test begins to decrease to the **OFFSET** unloading value, the load will again automatically adjust itself to the open-circuit state. If the **ONSET** loading voltage value is higher than the **OFFSET** unloading voltage, the load can avoid frequent carrying and unloading at the critical point of unloading voltage; so the power supply under test will be well protected.

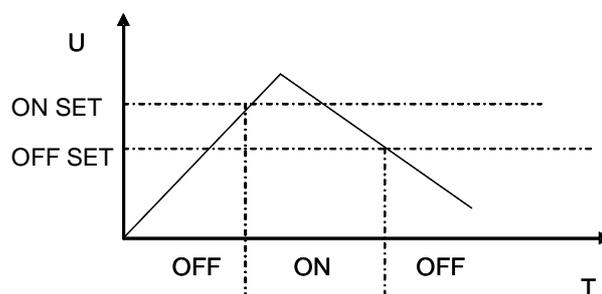


Diagram 4.2 Loading and Unloading Mode

When in standard constant current mode, pressing the **Shift+1(V_Level)** keys in sequence puts the DC Electronic Load into the loading and unloading CC mode. When the VFD display shows **ONSET VOLT=xxxxxxxV** indicating the current loading voltage, use the numeric keys and decimal point key to enter the loading voltage value desired, then press the **Enter** key to confirm the setting. Now the VFD panel will display **OFFSET VOLT=xxxxxxxV** indicating the current unloading voltage level. Press the numeric keys and decimal point key to enter the unloading voltage value desired, followed by pressing the **Enter** key to confirm the setting. Accordingly, the DC Electronic Load will enter into the loading and unloading constant current mode between the two preset limits automatically.

If the input state is **OFF**, then the upper right corner of the VFD panel will show the word **OFF**. Press the **- On/Off** key to change the input state back to **ON**. Then the upper right corner of the VFD display

will show the word **CC_UN** or **Unreg. CC_UN** means the load was successfully set into the expected constant current value; **Unreg** means the load could not adjust itself to the desired constant current value. Please check that the power supply under test has been correctly connected and power switched on; make sure that the voltage set is normal and the selected constant current value is within the range of the UUT.

While in loading and unloading CC mode, press the **Shift+1(V_Level)** keys in sequence and the DC Electronic Load will revert back into the standard constant current mode.

4.1.1.3 Soft Start Constant Current Mode

The Soft Start CC mode enables the DC Electronic Load to function as an inductive load, simulating an inductance value which is in direct proportion with the rise time of the soft start. In this mode, the power supply under test can avoid being damaged by a current strike .

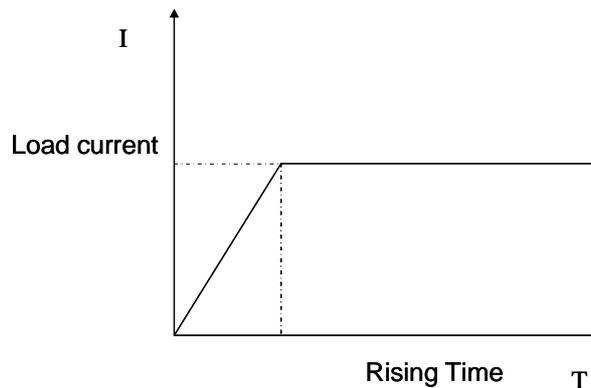


Diagram 4.3 Soft Start Current Mode

When in standard CC mode, pressing the **Shift+2(S_Start)** keys in sequence places the load in the soft start CC mode. When the VFD display shows **Rising TM=xxxxxxxxvmS** indicating the current rise time, use the numeric keys and decimal point key to enter the current rise time desired. Follow by pressing the **Enter** key to confirm the setting and the load will enter into the soft start CC mode.

If the input state is **OFF**, then the upper right corner of the VFD display will show the word **OFF**. Press the **On/Off** key to change the input state to **ON**. Then the upper right corner of the VFD display will show the word **CC_S** or **Unreg**. Showing **CC_S** means the load has been successfully set with the desired CC value; **Unreg** on the display means the load couldn't adjust itself to the desired CC value. Check to assure that the power supply under test has been correctly connected and powered on; make certain that the - CC value selected is within the range of the UUT. When the Shift+2(S_Start) keys are pressed in sequence, the loading and unloading CC mode, of the DC Electronic Load will revert back into the standard CC mode.

Note: The rise time is automatically regulated and set to a value of 20µS times a round number.

4.1.1.4 Constant Current Mode Shifting into Constant Voltage Mode

When the CC mode shifts into CV mode, damage to the power supply under test from current strike is avoided.

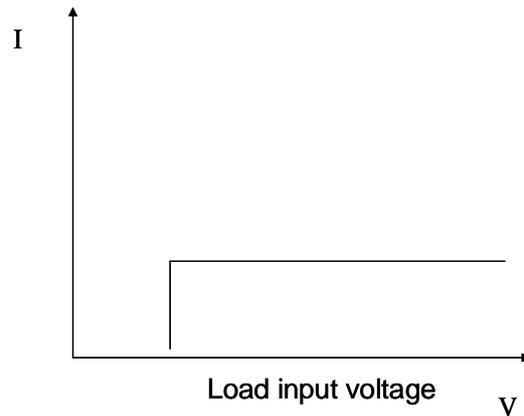


Diagram 4.4 Constant Current Shift Mode back into Constant Voltage Mode

When in standard constant current mode, press the **Shift+4(CC+CV)** keys to enter into the constant current shift to constant voltage mode. When the VFD display shows **CC TO CV VOLT=xxxxxxxV** indicating the current constant voltage value, press the numeric keys and decimal point key to enter the constant voltage value desired followed by pressing the **Enter** key to confirm. Now the load will enter into the constant current shift mode into constant voltage mode.

If the input state is in **OFF**, then the upper right corner of the VFD display will show the word **OFF**. Press the **On/Off** key to change the input state into **ON**. The upper right corner of the VFD display will show the combination of **CC+CV** or **Unreg**. When **CC+CV** is displayed, the DC Electronic load has been successfully set into the desired CC value; by displaying **Unreg** means the load could not adjust itself to the selected CC value. Check that the unit under test has been connected correctly and powered on. Also, assure that voltage level is normal.

When in the loading and unloading constant current mode, pressing the **Shift+4(CC+CV)** keys will make the load revert back into the standard constant current mode.

4.1.2 Constant Resistance Operation Mode (CR)

In this mode, the DC Electronic Load will synchronize to a current linearly proportional to the input voltage scaled to the resistance programmed. Please refer to the Diagram 4.5.

Note: when the voltage of the unit under test is set too high and the resistance set is too low, either the unit under test will consume the excess current and be shock damaged, or the DC Electronic Load will fail to automatically adjust to the constant resistance and the load will suffer the shock damage from the excess current.

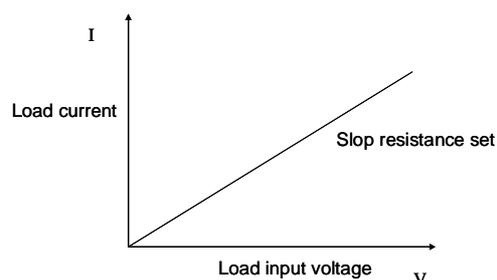


Diagram 4.5 Constant Resistance Mode

4.1.2.1 Setting up a Standard Constant Resistance Mode

By pressing the **R-SET** key the VFD display will show **STANDARD RESI=xxxxxxxΩ** indicating the present constant resistance. In order to place the DC Electronic Load into the standard constant resistance mode, press the numeric keys and decimal point key to select the desired values. Finally, after the values are selected press the **Enter** key to confirm the setting.

When the input state is in **OFF**, the upper right corner of the VFD display will show the word **OFF**. Press the **On/Off** key to change the input state to **ON**. Now the upper right corner of the VFD display will show either **CR** or **Unreg.** -**CR** means the load has been successfully set into the expected constant resistance value; **Unreg** means the load was unable adjust itself to the desired constant resistance value. Verify that the unit under test is connected correctly and turned on; be sure the resistance value selected is within the output current of the power supply under test so that it can source the expected amount of resistance to drive the DC Load..

If you need to adjust the constant resistance value, rotate the encoder knob to change the value. Rotating clockwise increases the value while rotating counter-clockwise decreases the value. Now the lower right corner of the VFD display shows the constant resistance value set, but if under the value a cursor is blinking it means the number set, is in need of further adjustment. -When users want to adjust or fine tune the accuracy, simply push in on the rotary encoder knob.. Each click the encoder is rotated moves the cursor left or right on the VFD screen.

4.1.2.2 Loading and Unloading Constant Resistance Mode

Figure 4.1.1.2 illustrates the CR loading and unloading mode theory of operation.

When in standard constant resistance mode, press the **Shift+1(V_Level)** keys to enter the CR loading and unloading mode. When the VFD display shows **ONSET VOLT=xxxxxxxV**, it indicates the current load voltage state. Pressing the numeric keys and decimal point key will enter the load's desired voltage setting. Pressing the **Enter** key will confirm the setting. Next the VFD will display **OFFSET VOLT=xxxxxxxV** indicating the need to set an offset voltage. Pressing the numeric keys and decimal point key will set that desired offset voltage.. Now press the **Enter** key to confirm the setting. Now the DC Electronic Load will be in the CR load /unload mode.

If the input state shows **OFF**, then the upper right corner of the VFD panel will display **OFF**. Press the **On/Off** key to change the input state to **ON**.. Now the upper right corner of the VFD display will show either **CR_UN** or **Unreg.** **CR_UN** means the load has been successfully set into the desired constant resistance value; **Unreg** means the load could not accept the constant resistance value set. Check to see the power supply under test is correctly connected and turned on; make sure the voltage is normal and the output current of the unit under test is within the range that the can drive DC Electronic Load.

From the loading and unloading CC mode, press the **Shift+1(V_Level)** keys and the DC Electronic Load will return to the standard constant resistance mode.

4.1.2.3 Shifting from Constant Resistance to Constant Voltage Mode

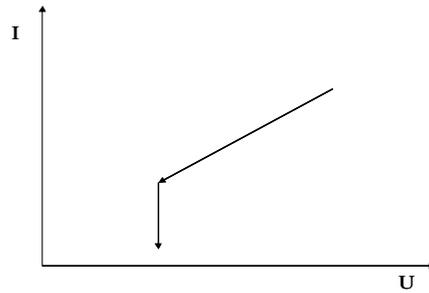


Diagram 4.6 Shifting from Constant Resistance to Constant Voltage Mode

By shifting from constant resistance into constant voltage mode, the power supply under test can avoid damage from a current strike..

From the standard constant current mode, press the **Shift+5(CR+CV)** keys to enter the constant current shifting to constant voltage mode. When the VFD display shows **CR TO CV VOLT=xxxxxxxV** it indicates the current constant voltage value that is set. Press the numeric keys and decimal point key to enter the constant voltage value desired, and press the **Enter** key to confirm the setting. In this mode, the load will shift from the constant resistance to the constant voltage set.

If the input state is **OFF**, then the upper right corner of the VFD display will show **OFF**. Press the **On/Off** key to change the input state to **ON**. Then the upper right corner of the VFD display will show either **CR+CV** or **Unreg**. **CR+CV** means the load has been successfully set with the selected constant resistance value; **Unreg** means the DC Load could not accept the input constant resistance value. Please check that the power supply under test has been correctly connected and turned on; make sure voltage is normal.

Pressing the Shift+5(CR+CV) keys in sequence while in the loading and unloading constant resistance mode, will place the DC Load back into the standard constant resistance mode.

4.1.3 Constant Voltage Operation Mode (CV)

In this mode, the DC Electronic Load will attempt to generate sufficient current and synchronize to the source voltage of the unit under test with the programmed value. Please refer to the Diagram at 4.7. Note: When the voltage of the power supply under test is less than the voltage value set, or the input current is beyond the maximum current that the DC load can withstand, the load will be unable to synchronize to the voltage value set.

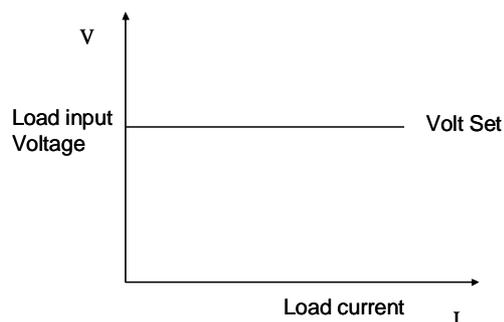


Diagram4.7 Constant Voltage Mode

4.1.3.1 Setting Up Standard Constant Voltage Mode

Pressing the **V-SET** key - will display **STANDARD VOLT=xxxxxxxV** indicating the current constant voltage value set-up field. Here, enter the constant voltage value desired, followed by pressing **Enter**. Now the DC load will be in standard constant voltage mode.

If the input state is **OFF**, then the upper right right corner of the VFD display will show **OFF**. Press the **On/Off** key to change the input state to **ON**. Now the upper right right corner of the VFD display will show either **CV** or **Unreg. CV**. **CV** means the DC load has been successfully set with the desired constant voltage value; **Unreg** means the load couldn't accept the selected constant voltage value. Check that the - LED driver has been correctly connected and is powered on; make sure that the voltage of the LED driver is normal and that its output current is not beyond the maximum current that the DC electronic load can accept.

In order to adjust the constant voltage value, rotate the encoder knob at the upper right on the front panel display to adjust the value settings. Rotating clockwise increases the value while rotating counter-clockwise decreases the value. Note: if the constant voltage value you want to set is beyond the maximum constant voltage capability of the DC load, the current value will stop at its top end and not increase despite continued rotation of the encoder knob. Once a proper value is selected, the lower right corner of the VFD display shows the constant voltage value that has been set. Should a blinking cursor show up under one of the digits, it will require additional tweaking.. If users wish to adjust the accuracy, pushing in the encoder knob will effectuate the change. Each time the encoder knob is pressed, the cursor will move to the next digit position, left or right.

4.1.3.2 Loading and Unloading Constant Voltage Mode

For the theory of operation on the loading and unloading of constant voltage mode, please refer to the Diagram -4.1.1.2

From the standard constant voltage mode, press the **Shift+1(V_Level)** keys to enter into the constant loading and unloading CV mode. When the VFD display shows **ONSET VOLT=xxxxxxxV** indicating the current loading voltage, press the numeric keys and decimal point key to enter the loading voltage value desired, and then press the **Enter** key to confirm. The VFD now displays, **OFFSET VOLT=xxxxxxxV** indicating the current offset voltage. Press the numeric keys and decimal point key to enter the offset voltage value desired, followed by pressing the **Enter** key to confirm. Now the DC electronic load will enter the loading and unloading constant voltage mode.

If the input state is **OFF**, then the upper right corner of the VFD display will show **OFF**. Press the key **On/Off** to change the input state to **ON**. Then the upper right corner of the VFD display will show either **CV_UN** or **Unreg. CV_UN**. **CV_UN** means the load has been successfully set with the desired constant voltage value; **Unreg** means the load couldn't accept the desired constant voltage value. Check the power supply under test has been correctly connected and turned on; also make sure the voltage set is normal and that

the maximum output current of the unit under test does not exceed the range of maximum current that the DC load can absorb.

From the loading and unloading constant voltage mode, press the **Shift+1(V_Level)** keys, and the load will go back to the standard constant voltage mode.

4.1.3.3 SoftStart Constant Voltage Mode

Softstart constant voltage mode enables the DC Electronic Load to function as a capacitive load, simulating electric capacity which is in direct proportion to the rise time of the softstart. In this mode, the LED driver under test will avoid damage from a current strike.

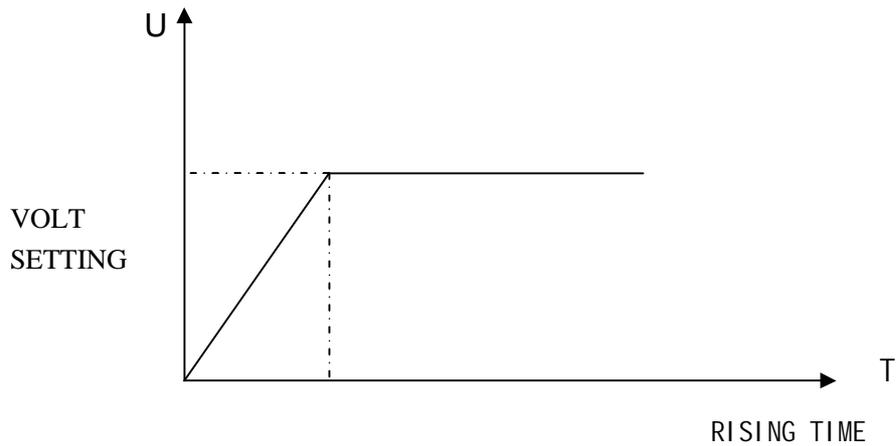


Diagram 4.8 SoftStart Constant Voltage Mode

When the **Shift+2(S_Start)** keys are pressed in standard constant voltage mode, the DC Load will enter the soft start constant voltage mode. The VFD display will show **RISING TM=xxxxxxxxvmS** indicating the current rise time set. Press the numeric keys and decimal point key to enter the rise time desired, and then press the **Enter** key to confirm the setting. Now the DC Load will be in the softstart constant voltage mode.

If the input state is **OFF**, then the upper right corner of the VFD display will say **OFF**. Press the **On/Off** key to change the input state to **ON**. Now the upper right corner of the VFD display will show either **CV_S** or **Unreg. CV_S** means the load has been successfully set with the desired constant voltage value; **Unreg** means the DC load couldn't accept the selected constant voltage value. Check to see that the LED driver under test has been correctly connected and turned on; also assure that the maximum output current of the LED driver is within the range of the maximum current that the DC load can handle.

From the loading and unloading constant voltage mode, press the **Shift+2(S_Start)** keys and the DC Load will revert back to the standard constant voltage mode.

Note: The rise time that is set will be automatically regulated as value set rounded up to a whole number multiplied by 20µS.

4.1.4 Constant Power Operation Mode (CW)

In this mode, the DC Electronic Loads will consume a set constant power. Please refer to the Diagram 4.9. As the load's input voltage value increases, the load input current will decrease

in linear increments. Accordingly, the equation of load power(=V * I)will remain constant in the power setting.

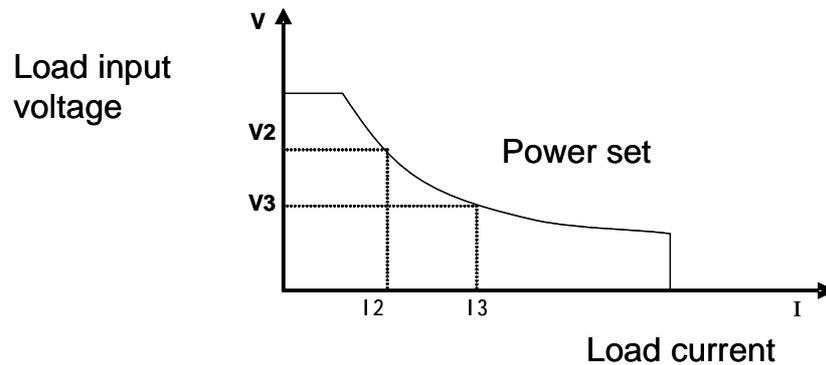


Diagram 4.9 Constant Power Mode

4.1.4.1 Setting up a Standard Constant Power Mode

Press the **P-SET** key, and the VFD panel displays **STANDARD POWER=xxxxxxxW** indicating the selection screen for constant power. Press the numeric keys and decimal point key to enter the constant power value desired then press the **Enter** key. The DC load will now be in standard constant power mode.

If the input state is **OFF**, the upper right right corner of the VFD panel will display the word **OFF**. Press the **On/Off** key to change the input state to **ON**. Now the upper right corner of the VFD display will show either **CW** or **Unreg**. **CW** means the DC load has been successfully set with the desired constant power value; **Unreg** means the DC load couldn't accept the selected constant power value. Check that the LED driver under test has been correctly connected and powered on; make sure the voltage of the LED driver is normal and that its maximum output current is within the specified range of the DC Load or at an undercurrent threshold.

In order to fine tune the constant power value, rotate the **encoder** knob to adjust the value desired. Rotating clockwise increases the value while rotating counter-clockwise decreases the value desired. Now the lower right corner of the VFD display shows the constant power value set. Should a blinking cursor appear under any digit, more tweaking is needed. To make additional changes/refinements, use the rotary encoder knob. It also functions as an enter key for changes to DC Load settings. With each key press of the rotary encoder the cursor will move forward to the next digit position.

4.1.4.2 Loading and Unloading Constant Power Mode

For the theory of operation to load and unload constant power mode, please refer to Diagram 4.1.1.2

From standard constant power mode, press the **Shift+1(V_Level)** key to enter the constant power loading and unloading mode. When the VFD panel displays **ONSET VOLT=xxxxxxxV**, it indicates the DC Load's current voltage. To enter a different voltage load, use numeric selector keys and decimal point key to change the load voltage value desired. Then press the **Enter** key to confirm the setting. The VFD panel will next show **OFFSET VOLT=xxxxxxxV** indicating the DC Load's present unload voltage. Press

the numeric selector keys and decimal point key to enter the unload voltage value desired, followed by pressing the **Enter** key to confirm. Now the load will be in the loading and unloading constant power mode.

If the input state is **OFF**, then the upper right corner of the VFD display will show **OFF**. Press the **On/Off** key to change the input state to **ON**. Now the upper right corner of the VFD panel will display either **CW_UN** or **Unreg. CW_UN**. **CW_UN** means the DC Load has been successfully set with the desired constant power value; **Unreg** means the DC Load did not accept the desired constant power value. Please check that the LED driver under test has been correctly connected and powered on; make sure that its voltage is normal and that its output current is within the range of current that the DC Load's selected power can withstand.

From the load and unload constant power mode, press the **Shift+1(V_Level)** keys, and the DC Load will revert back to the standard constant power mode.

4.2 Dynamic Testing Operation

Dynamic testing operation enables the DC electronic load to periodically switch between two pre-set load levels. This function can be used to test the transient characteristics of the LED driver being tested.

Dynamic testing operation can be turned on and off by pressing the **Shift** + **Tran** keys on the front panel. Before turning dynamic testing operation on, all of the parameters associated with dynamic testing operation should be set by pressing the **Shift** + **S-Tran** keys, including: Value A, A pulse time, Rise time from value A to value B, Value B, B pulse time, Fall time from value B to value A and dynamic testing operation mode. There are three modes of dynamic testing operation: continuous, pulsed and triggered modes.

4.2.1 Continuous Mode (CONTINUOUS)

In this mode, when the dynamic test operation is turned on, the DC electronic load will periodically switch between values A and B.

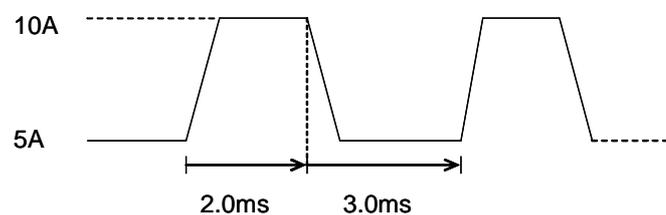


Diagram 4.10 Continuous Operation Mode

4.2.2 Pulsed Mode (PULSED)

In this mode, when the dynamic test operation is turned on, the DC electronic load will switch to value B when receiving one triggered pulse signal, then capture the pulse time (**TWD**) of value B, after which the DC Electronic Load will return to Value A.

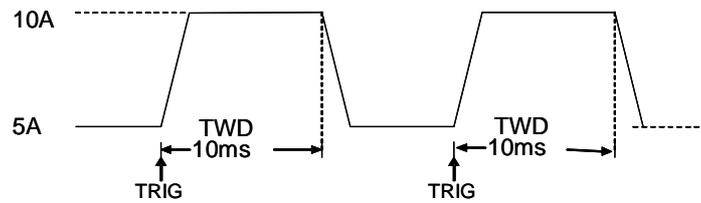


Diagram 4.11 Pulse Operation Mode

4.2.3 Trigger Mode(TRIGGER)

In this mode, when the dynamic test operation is turned on, the DC electronic load will switch the state between value A and value B after receiving a trigger signal.

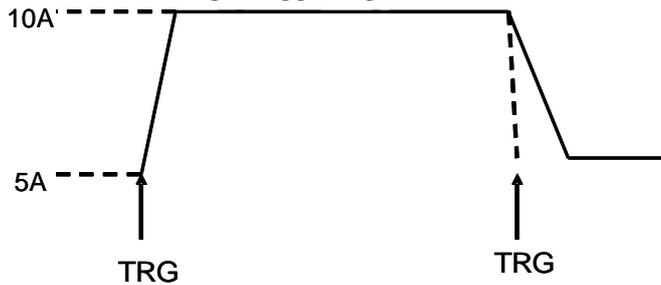


Diagram 4.12 Trigger Operation Mode

4.2.4 Setting up Dynamic test operational Parameters

Press the **Shift+6(S_Tran)** keys, and the DC Electronic Load's VFD display shows **LEVEL A CURR=xxxxxxxxA** indicating value A's current setting. Use the numeric keys and decimal point key to select the current value desired, followed by pressing the key **Enter** to confirm the setting.

When the load VFD display shows **WIDTH A TM=xxxxxxxxmS**, it indicates the current duration time of current set for value A.. Using the numeric keys and decimal point key, enter the duration time desired, then press the **Enter** key to confirm.

When the DC Load's display shows **RISING TM=xxxxxxxxmS**, it indicates the current rise time set from value A to value B. Use the numeric and decimal point keys to enter the rise time desired, and press the **Enter** key to confirm.

Next the DC Load's display shows **LEVEL B CURR=xxxxxxxxA** that indicates the current value B setting. Use both the numeric and decimal point keys to enter the current value desired, and press the **Enter** key to confirm.

When **WIDTH B TM=xxxxxxxxmS** appears on the display panel it indicates the current duration interval for value B that's set. To enter a different value for current, press the numeric and decimal point keys to enter the duration period desired, followed by pressing the **Enter** key to confirm.

Next the DC Load's VFD panel displays **FALLING TM=xxxxxxxxmS** which indicates the current falling off time presently set between value B to value A. To change that value, use both the numeric and decimal point keys to enter the falling off time desired, and press the **Enter** key to confirm.

After all of these parameters have been set, the DC Electronic Load's panel will display the set-up of **TRANMODE CONTINUOUS/ TRANMODE PULSE / TRNMODE TRIGGER** indicating the unit is currently

ready for each of the 3 dynamic test operation modes. Select the dynamic operation mode desired by pressing the up ▲ or down ▼ keys followed by pressing the **Enter** key to confirm.

4.2.5 Waveform Control

4.2.5.1 Square Wave

When set in the Continuous mode, with the rise time and fall time are both set to zero, the output wave is a square wave. The output frequency will be the inverse of the pulse duration sum of both current A and current B. Since the minimum accuracy of all the time interval is set at 20µS, the DC Electronic Load can read the square wave with a maximum frequency of 25KHz at 50% duty cycle.

4.2.5.2 Triangular Wave

When set in the Continuous mode, with the interval time of current A and current B are both set to zero, the output wave is a triangular wave. The output frequency will be the inverse of the sum of the rise and fall times. Since the minimum accuracy of all the time interval is set at 20µS, the DC Electronic Load can read the triangular wave with a maximum frequency of 25KHz. Since the rising edge and falling edge of the triangular wave are all stepped within a 20µS interval, the ideal angle of the triangular wave will be in inverse proportion to its output frequency. In extreme situations, the triangular wave might function as a square wave; there are 0-100 different accuracy steps scaled according to the different rising and falling times set.

4.2.5.3 Trapezoidal Wave

When set in the Continuous mode of the dynamic test operation, and all four timing parameters that need to be individually set are all greater than zero, the output wave is a trapezoidal wave. It has the same frequency characteristics as the triangular wave.

4.2.6 Trigger Control

In dynamic test operation mode trigger control is initiated when either pulse or trigger mode is set. The three trigger modes are:

- a、 Keypad trigger
Press the **Shift+Trigger** keys to trigger the DC Electronic load.
- b、 TTL trigger
Send a high pulse with a constant time greater than 5msec to initiate the trigger-through terminals on rear panel of the DC electronic load.
- c、 PC soft control trigger sends a command to the DC electronic load

4.2.7 List Function (Mode Sequence Steps)

The DC electronic load has a mode sequence list function. A maximum of 8 sequence steps can be edited and 200 steps within each set of data can be changed. Users can alter the duration of each step, setting the minimum time of each step. Please note the minimum time setting must be a round number no less than 0.02mS and ranging from 0.02mS to 1310.7mS. The duration of each step is linked to the minimum time setting. If the minimum time is set at 0.02mS, then the duration of each step ranges from

0.02mS to 1310.7mS; if the minimum time is set at 2mS, then the duration of each step ranges from 2mS to 131070mS.

4.2.7.1. List Operation

1) Press the **Shift+0** keys to enter the menu operation, and then use the **▲** and **▼** keys to get to **MENU LIST**, followed by keying **Enter** to confirm. Then press the **▲** and **▼** keys to reach **EDIT LIST**, followed by pressing **Enter** to confirm. Then press the **▲** and **▼** keys to select the sequential code that needs to be set, followed by pressing **Enter** to confirm.

2) When the display shows **MINIMUM TM= xxxxxx mS**, it indicates the minimum required time setting. Since this value affects the fine tuning and operable length of all the waveforms, please select the suitable parameters carefully. Then press **Enter** to confirm. The electronic load will offer the following three output modes: **LIST CONTINOUS**, **LIST END HOLD**, and **LIST END RESET**. Press the **▲** and **▼** keys to select the output mode desired, and press **Enter**.

LIST CONTINOUS means continuous output mode.

LIST END HOLD means the electronic load will retain the last value set in the last step when all the steps in one set of data have been successfully executed.

LIST END RESET means the electronic load will reset itself to load off mode when all the steps set in one set of data have been successfully completed.

3) After pressing **Enter** to confirm, the VFD panel displays **STEP LENG= xxx**, indicating the required step length that needs to be set. Press the numeric keys to input the step length desired, followed by pressing **Enter** to confirm. Please note that the step length should be a round number between 1~200.

4) When the VFD display shows **STEP 1 CURR=xxxxxA**, it indicates the required current that needs to be set in the first step. Use the numeric keys to input the current desired in the first step, and press **Enter** to confirm. When the display shows **STEP 1 TM=xxxxx mS**, it indicates the current duration of the first step. Press the numeric keys to input the current duration desired in the first step, followed by pressing **Enter** to confirm.

5) After all the setting steps have been entered, the VFD panel will display **EDIT LIST**, which means exiting back to the beginning at list function. If all the setting steps have not been edited, the display will show **STEP n CURR=xxxxxA**. This means that the value of the N step needs to be changed. Make the required changes following the operating instructions in the previous step 4).

6) Since list function shares the same storage space as the automatic testing function; make sure that the sequential code selected in the list function is the same as that in automatic testing function. If the sequential code defined for the automatic testing function prior to now is also the same entered for list function, this sequential code of the automatic testing function will be deleted and cannot be restored.

4.2.7.2 Executing List Function

Press the **Shift+0** keys to enter menu configuration, and then press the **▲** and **▼** keys to arrive at **MENU LIS**, and press **Enter**. Now press the **▲** and **▼** keys to get to **LOAD LIST**, and press the **Enter**. Then press the **▲** and **▼** keys to set the sequential code of the list function you want to execute, and press **Enter**.

Since the list function shares the same storage space as the automatic testing function, the sequential code set for the automatic testing function will be automatically shielded from the sequential codes chosen for the list function.

4.2.8 Automatic Testing Function

The DC electronic load provides an automatic testing function in which 8 data parameters can be set, maximum, and 50 steps that can be changed within each set of data. Each step can be selected from among the following six working modes: load off mode, constant current mode, constant voltage mode,

constant power mode, constant resistance mode, short circuit mode. Four comparison choices are available: current comparison, voltage comparison, power comparison and resistance comparison. Moreover, the delay time of each step can also be varied. The delay time of each step ranges from 0.1~25.5S, depending on the quickness and accuracy required. When each automatic test is over, the DC electronic load will indicate a pass or a fail result.. The electronic load will sound an alarm when a UUT fails a test. The trigger function of the electronic load can be set at the front-panel for TRIGGER IN for the hardware voltage level in from the back-panel terminal connector, and TRIGGER OUT for voltage level out from the terminal connector on the back panel. The trigger mode can be set up as either voltage level trigger or pulse trigger, and has 4 selection options of pass trigger, fail trigger, test complete trigger and disable- trigger.

4.2.8.1 Automatic Test Operation

1) Press **Shift+0** keys to enter menu configuration, and then use the **▲** and **▼** keys to reach **MENU AUTO TEST**, and press **Enter** to confirm. Using press the **▲** and **▼** keys, go to **EDIT AUTO TEST**, and press **Enter**.. Now use the **▲** and **▼** keys to select the sequence steps desired and then press **Enter**.

2) When **STEP LENG= XX**, appears, set the desired step length. Use the numeric keys to input the step length, and press **Enter**. Note: step lengths should be a round number between 1~50.

3) At **STEP 1 xxxxx MODE**, use the **▲** and **▼** keys to select from the following six working modes, then press **Enter**.

Working Mode	Prompt Messages	Explanation
Load Off Mode	LOAD OFF MODE"	Compares the voltages when in load off mode
CC Mode	"CC MODE"	Choose one of four comparison types: current, voltage, power or resistance
CV Mode	"CV MODE"	Choose one of four comparison types: current, voltage, power or resistance
CP Mode	"CP MODE"	Choose one of four comparison types: current, voltage, power or resistance
CR Mode	"CR MODE"	Choose one of four comparison types: current, voltage, power or resistance
Short Circuit Mode	"SHORT MODE"	Compares the current when in short circuit mode

4) At **STEP 1 TEST xxxx**, there are four test types to select from: current, voltage, power and resistance. Use the **▲** and **▼** keys to select one from the four test types, and **Enter**. If in the previous step, if either load off mode or short circuit mode, was selected, then the electronic load will skip step over this step 4).

5) At **DELAY TM=xx.xS**, indicating the delay time input for each step, the valid range is between 0.1~25.5S. . The lower the value set, the shorter the duration of the test. Caution: in certain cases, if the value set is too low, the test result might be compromised because the test was ended before the power supply under test reaches its static state., To assure valid test results, select the delay time within optimal duration for best results. The recommended delay time is 0.5S. Note: The upper range of 25.5S is pre-set

as a test suspended mode. Setting the delay time of any certain step at 25.5S, the load will stop and not proceed to the next step until a trigger signal is provided to continue the test. The trigger signal can be made either by the hardware on the back-panel, or by using the **Shift+Trigger** or the **On/Off** keys on the VFD display panel.

6)When **INPUT xxxx=xxxxxx**, is displayed, it indicates the corresponding current, voltage, , power and resistance values in the working mode that have been set. Use the numeric keys to enter these values, and press **Enter** to confirm. Again, if in the prior step 3), load off mode or short circuit mode had been selected, the DC electronic load will skip over this step 6).

7) When **MINIMUM xxxx=xxxxxx**, appears, it indicates the lower limit value of a valid test comparison. Use the numeric keys to input the value, and press **Enter** to confirm. When the VFD display shows **MAXIMUM xxxx=xxxxxx**, the upper limit value of a valid test comparison is shown. Use the numeric keys to input the value, and press **Enter** to confirm.

When **EDIT AUTO TEST** is displayed on the screen, all the steps set requiring input values have been completed., the The DC electronic load will exit back to the automatic testing function. But if all the stepshave not been properly selected and values entered **STEP n xxxxx MODE** will be displayed indicating that some data of the N step needs to be keyed in.

4.2.8.2 Setting up Automatic Test Trigger Output Mode

Press **Shift+0** keys to enter the menu configuration mode, and using the **▲** and **▼** keys to get to **MENU AUTO TEST**, and press **Enter**. Scroll the **▲** and **▼** keys to get to **SETUP AUTO TEST**, and press **Enter**. The DC electronic load will be in automatic test trigger output mode.

There are 4 types of trigger output modes shown in the table below. Using the **▲** and **▼** keys, select the mode desired and press **Enter**.

Prompt Messenges	Explanation
“TRIGGER WHEN PASS”	Test passed result
“TRIGGER WHEN FAIL”	Test failed result
“TRIGGER WHEN TEST END”	Test completed
“TRIGGER DISABLE”	Trigger disabled

Meanwhile, the Load will display the following trigger output electrical feature

Display	Description
“OUTPUT LEVEL”	Upon trigger, the output, voltage level will change from low to high, until a key is pressed or a trigger input signal arrives, and the voltage level then drops to low status.
“OUTPUT PLUSE”	Upon trigger the output voltage level changes from low to high status, and after 5 seconds automatically drops to a lower level

4.2.8.3 Executing Automatic Test Function

Using both the **Shift+0** keys go to menu configuration, and then press the **▲** and **▼** keys to get to **MENU AUTO TEST**, and press **Enter**. Scroll with the **▲** and **▼** keys and get to **LOAD AUTO TEST**, and press **Enter**.. Use the **▲** and **▼** keys to select the sequential code for the automatic test function you want to execute, then press the **Enter** The top right corner of the VFD two line display shows **AUT n**, meaning the **n** automatic test in the list will be initiated. The bottom right of the VFD shows OFF D.

If all settings have been entered correctly, press the **On/Off** key to initiate the automatic test. The automatic test can also be initiated by lowering the voltage level of **TRIG IN** port with a duration of more than 5mS. When in testmode, the lower right corner of the VFD display will show **WAIT** or **STAY**,

meaning the DC electronic load is waiting for test initiation or remaining in the suspended mode respectively. Please retrigger it so testing continues onward.

After each test is completed, the lower right corner of the VFD display will show either **PASS** or **FAIL**. If failure occurs, the buzzer will sound. At this point, initiate the next trigger or press any key to free the load from the pass or fail indication

Once the automated test is finished, press the **▲** and **▼** keys to initiate a manually operated test mode. With each key press of the **▲** or the **▼** keys one time, the DC electronic load will resume the test of the previous step or the next step in the sequence. Users can observe the actual state of every step. When the ON/OFF key is pressed or a trigger is initiated, the DC electronic load will automatically exit from the manually operated test mode and return to the automatic test mode again.

4.3 Input Control

4.3.1 Short Circuit Operation (SHORT)

The DC Electronic Load can simulate a short circuit at the input end by turning the load on with full-scale current. The short circuit function can be toggled on/off at the front panel by pressing the **Shift+9(Short)** keys. Short circuit operation does not influence the current value set. When the short circuit operation is in **OFF** state, the Load will return to its original setting state.

The actual current value that the load consumes in short circuit operation depends on the active working mode and current range of the load. In CC, CW and CR modes, the maximum short-circuit current value is 1.2 times the current range. In CV mode, short-circuit operation is identical to setting constant voltage to 0V.

4.3.2 Input On/Off Operation

When the load input state is **ON**, pressing the **On/Off** key will change the input state to **OFF**. Now top right corner of the VFD display shows **OFF**. When the load input state is **OFF**, pressing the **On/Off** key will change the input state to **ON** state. Now the upper right corner of the two line display shows **SHORT** indicating the current working state.

4.4 Electronic Load Operation Range

The DC Electronic load operates in the following range of Rated Current, Rated voltage and Rated Power. Please refer to the Diagram 4-13 and Diagram 4-14.

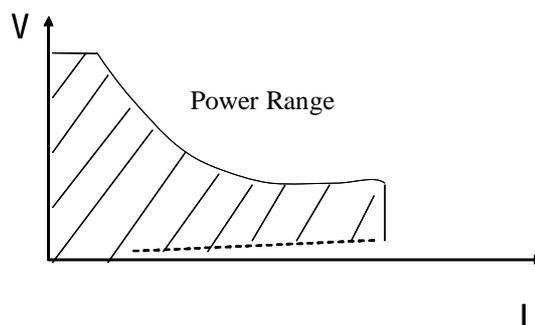


Diagram 4-13 Electronic Load Power Range

DC Electronic Load Mode Changes

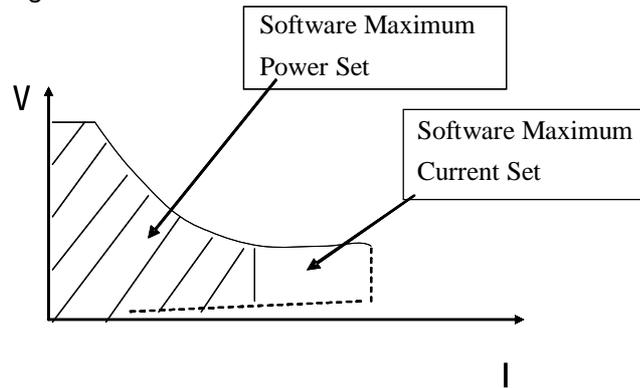


Diagram 4-14 Software Maximum Setting Value

4.5 Protection Functions

The DC Electronic Load features the following protection functions.

4.5.1 Over Voltage Protection (OV)

If input voltage exceeds the maximum voltage range of the load, it will automatically shut down the input. A buzzer will sound and the VFD panel displays the **Over Volt** message

The DC Electronic load's maximum voltage value can be set by pressing both **Shift+0(Menu)** keys. When the VFD display shows **MENU SYSTEM SET**, press the **Enter** key to confirm. Now the VFD display shows **SYSTEM IMAX=xxxxxxxxA**. Use the **Up** and **Down** keys to reach **SYSTEM UMAX=xxxxxxxx V** setting input. Here the current maximum voltage limit value is displayed as 150V. Entering a different voltage value can be done using both the numeric and decimal point keys. Pressing the **ESC** key exits the **Menu** mode.

Note: The maximum acceptable input voltage of the M9712 DC electronic load is 150V. When any value beyond 150V is input, the load will default back to 150V.

Besides, the maximum voltage value input is closely related to voltage resolution. If the maximum voltage value set is below 20V, the load's voltage resolution will be 0.1mV; if the maximum voltage value set is above 20V, then the load's voltage resolution will be only 1mV.

4.5.2 Over Current Protection (OC)

If input current exceeds the maximum current range of the load, it will automatically shut down the input. A beep will sound and the VFD panel displays the **OVER CUR** message

The load's maximum current value can be set by pressing both the **Shift+0(Menu)** keys. When the VFD display shows **MENU SYSTEM SET**, press the **Enter** key to confirm. Now the VFD display shows **SYSTEM IMAX=xxxxxxxxA** setting input. Here the current maximum current value is displayed as 30A. Entering a different current value can be done using both the numeric and decimal point keys. Pressing the **ESC** key exits the **Menu** mode.**Note:** The maximum acceptable input current of the M9712 DC

electronic load is 30A. When any value beyond 30A is input, the load will default back to 30A. Besides, the maximum current value input is closely related to current resolution. If the maximum current value set is below 3A, the load's current resolution will be 0.01mA; if the maximum current value set is above 3A, then the load's current resolution will be only 0.1mA.

4.5.3 Over Power Protection (OW)

If input wattage exceeds the maximum wattage range of the load, it will automatically shut down the input. A buzzer will sound and the VFD panel displays the **OVER POW** message

Press any key to get the load back to normal operation. Note: if the current input state is **OFF**, press the **ON/OFF** key to make the load resume normal operation. If the over power problem is not solved, the load will continue to display the **OVER POW** message.

The load's maximum wattage value can be set by pressing both the **Shift+0(Menu)** keys. When the VFD display shows **MENU SYSTEM SET**, press the **Enter** key to confirm. Now the VFD display shows **SYSTEM PMAX=xxxxxxxW** setting input. Here the current maximum wattage value is displayed as 300W. Entering a different current value can be done using both the numeric and decimal point keys. Pressing the **ESC** key exits the **Menu** mode.

Note: The maximum acceptable input wattage of the M9712 DC electronic load is 300W. When any value beyond 300W is input, the load will default back to 300W.

4.5.4 Input Polarity Reversed

If the DC electronic load has its input polarity reversed, a buzzer will sound and the VFD display will show **REVERSE** as a message

4.5.5 Over Heat Protection(OH)

When the temperature of internal power components exceeds 80°C, over heat protection will be automatically initiated. The load will shut down input, a buzzer will sound and the VFD display will show the **OVERHEAT** message.

4.6 Remote Measurement Function

When in CV, CR and CP mode, if the DC electronic load consumes high current, the power supply under test will have a voltage drop in the cables/wires connecting it to the load's BP terminals. In order to assure measurement accuracy, there are remote measurement terminals installed on the rear-panel of the DC electronic load. Users can measure the voltage at the output terminals of the power supply under test by using these rear panel terminal connections.

The remote measurement function can be set up by pressing both the **Shift+0(Menu)** keys. Go to **MENU SYSTEM SET**, and press **Enter**. The display will come up at **SYSTEM IMAX=xxxxxxxA**. Use the **Up** and **Down** keys and scroll to **SYSTEM TERMINAL SEL** and press **Enter**. There are only two options for the remote measurement function, **TERMINAL SELECT FRONT** or **TERMINAL SELECT BACK**. Use the **Up** and **Down** keys to make a selection. **TERMINAL SELECT FRONT** means the Binding Post (BP)

input terminals on the front panel of the DC electronic load. Selecting the BP will disable the remote measurement function on the rear panel. **TERMINAL SELECT BACK** means the input terminals on the rear panel of the load. Selecting these back panel terminals will disable the remote measurement function of the BPs on the load's front panel. After making the remote measurement selection, press the key **Esc** to exit **Menu** mode.

Note: Either of the input terminals on the front panel or back panel can be initiated at any time. However, it is impossible to initiate both sets of input terminals simultaneously. If the voltage of the load is near to zero point and does not change in conjunction with the signal, please check that the wire mode matches the parameters of the remote measurement function.

Please refer to the picture 4.4 for the trigger terminals and measurement terminals.

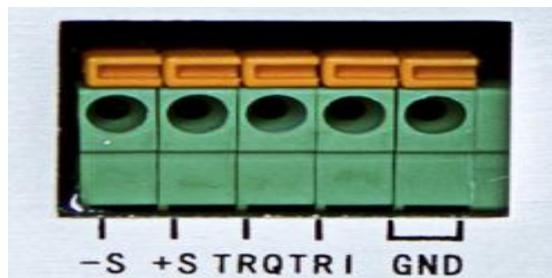


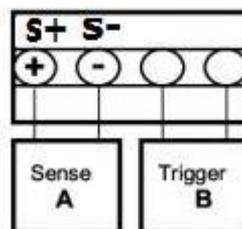
Photo 4.4 Remote Measurement Terminals

-S and +S are remote measurement terminals;

TRQ and TRI are trigger terminals, the last two terminals are ground terminals.

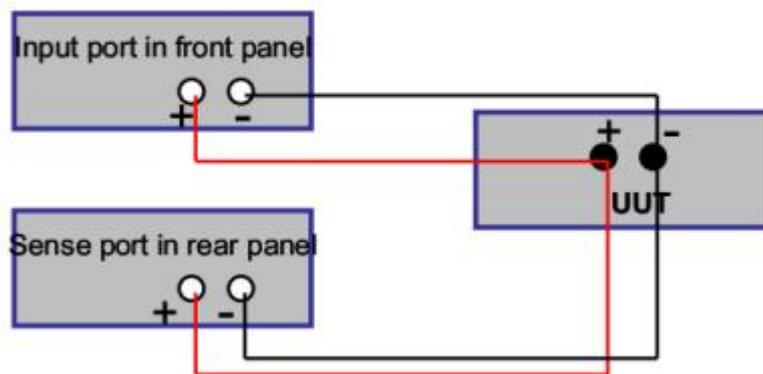
The output of power supply will be turned off when testing out the change in voltage level from high to low from TRQ port which is under the latched mode of the remote control function. As a multifunction extended port, TRI port is designed for future expanded.

The following diagram shows the remote sense terminals on the back panel of the instrument.



The following shows wiring diagram for the remote sensing:

Wiring diagram for remote sense



4.7 Battery Testing

Experimentation has proven that the DC Electronic Load is the best way to confirm the operability of most batteries.. With the correct load test set-up, the battery expectant life curve can be confirmed. The electronic loads can currently be used to test about any type of the battery.

For batteries that are embedded in other equipment or placed in uninterrupted power service systems, it is vital to use a DC electronic load for testing battery life status. Because batteries are among the lowest reliability components in such systems, it should be tested periodically using a DC electronic load for viability and utility.

Battery Life Stability Test

In Constant Current mode the Serial electronic load can test battery life stability Set up the load to control voltage level. When the voltage of the battery is too low, the serial electronic load will identify the battery being on the threshold value set or at the margin of an insecure state and will stop testing automatically. When the load is in test mode, you can see the battery's voltage, battery discharge current, electronic, load power and battery capability that remains. If the load is connected through PC software, then you can see the battery discharge curve.. This test can measure the reliability and remaining life of the battery. So it is important to perform the test before the battery is re-charged, or swapped out for a newer battery.

Operation:

- 1) In standard constant current mode, adjust the load's current value to the same discharge current value of battery needed.
- 2) Press both **Shift+8(Battery)** keys. When VFD display shows **END TEST VOLT= xxxxxxxxV**, input the shut-off voltage and press **Enter** to start the battery life stability test. When the battery's voltage drops to the turn-off voltage set, the load will automatically shut off.
- 3) Press the **On/Off** keys to start or pause the battery capability test.
- 4) Press both the **Shift+8(Battery)** keys to exit the battery life stability test mode.

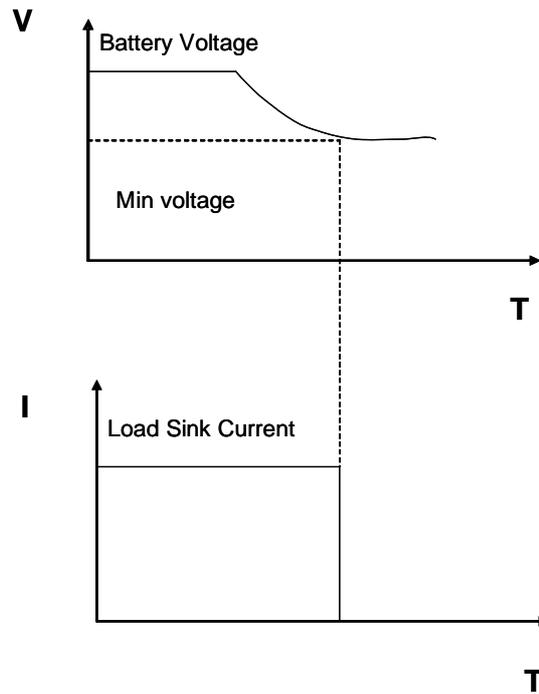


Diagram 4-16 Battery capacity calculation

4.8 Communication protocol

4.8.1 Introduction

M97 series programmable electronic loads work on the Modbus protocol. The data frame contains 4 parts as follows:

Slave Address	Function Code	Data	Error Checking(CRC)
---------------	---------------	------	---------------------

To assure high reliability communications, the frame pitch set must be greater than 3.5 times the transient time of a single bit byte. In other words, when the comm. rate is 9600 baud, the frame pitch time must be set greater than $11 \times 3.5 / 9600 = 0.004s$.

M97 series programmable DC electronic loads are equipped with two way asynchronous communication, with 1 bit fixed as the start bit, 8 data bits, and 1 stop bit. It supports Non parity check, Odd Parity check and Even parity check. The communications rate is selectable at 2400, 9600, 14400, 28800, 57600, 115200 baud.

1) Setting up additional addresses and communication parameters

The additional address is a single byte with 16 hexadecimal system data; the M97 series DC electronic loads will only respond to the request data frame that has the same additional address.

2) Setup of the additional address

Press both **Shift+0** keys in sequence, placing you in Main Menu mode., The DC electronic Load display will be at **MENU CONFIG**. Press the key **Enter** to confirm. Using the **CONFIG Menu**, -up and down **▲ ▼**

keys, scroll to **CONFIG ADDRESS SET**, then press Enter to confirm., Now the load will display **ADDRESS ADDR= xxx**. Enter the new address using numeric keys, and press the **Enter** key again to confirm.

Note: Only whole numbers from 1 - 200 range will be accepted as valid additional addresses.

3)Selectingthe check mode

Press the **Shift+0** keys in sequence, placing you in Main Menu mode. The XT 98XX DC Electronic Load will now display **MENU CONFIG**. Press the **Enter** key to confirm.At **CONFIG menu**, use the up and down **▲** and **▼** keys, adnd scroll to **CONFIG COMM.PARITY**, and press **Enter**. The load will now display **COMM.PAR xxxxx**There are three choices, ODD, EVEN and NONE to select from. Enter the numeric value for the parity mode using the keypad and press **ENTER**. Now the load has its parity mode set.

4.8.2 Setup Baudrate

Press the **Shift+0** keys in sequence, placing it in Main Menu mode. The XT 98XX DC Electronic Load will now display **MENU CONFIG**. Press the **Enter** key to confirm. At **CONFIG menu**, use the up and down **▲** and **▼** keys, and scroll to **CONFIG BAUDRATE SET**, then press Enter to confirm. The load will now display **BUADRATE xxxxx**. The DC Load offers you six choices of baud rate to set. Use the use up and down **▲** and **▼** keys to set the desired communications rate from 2400,9600,14400,28800,57600 and115200 baud.

4.8.3 Data

The M97 series loads operate in the Modbus protocol. Accordingly, in some data frames, the date length is fixed, but in other data frames, the length is not fixed. According to this protocol, all the hexadecimal data and the floating point number are fixed in the High Byte and the unfixed data length fields are in the Low Byte. In addition,the output value of a force single coil must be either 0x0000 or 0xFF00. 0x0000 means OFF, and 0xFF00 means ON. All other values are invalid and will not affect the coil.

4.8.4 Function Code

Function codes are single byte hex numbers; there are 4 functional modes as below:

Function Code	Description
0x01	Read Coil Status, read the data by each bit
0x05	Force Single Coil, write the data by each bit
0x03	Read Holding Registers, read the data by each word
0x10	Preset Multiple Registers, write the data by each word

4.8.5 Error checking (CRC)

The M97 series loads use the Cyclic Redundancy Check (CRC). The CRC field examines the contents of the entire message. The CRC fileld is two bytes, containing a 16-bit binary value.When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

The discipline is as follows:

- a) Set one hex CRC register, and give it the initial value as 0xFFFF.
- b) Make bit xor the first byte of the frame date and the lower 8 bit of the CRC register. Save the bit xor result into the CRC register.
- c) Right move the CRC register for 1 byte, and make certain the lowest bit is set as1. If the lowest bit is 1, then make the bit xor for the CRC register and the fixed data as 0xA001.
- d) Repeat c) 8 times.
- e) Repeat steps b,c andd, for the next byte of frame data until the last byte.
- f) The last number of the CRC register is the last parity check result. Place it at the end of the frame data, keeping the lower 8 bits in the latter and higher 8 bits in former.

4.8.6 Complete Command Frame Analysis

1. Read Coil Status (0x01)

Read Coil Status Example Query

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x01
Starting Address	2	0~0xFFFF
O. of Points	2	1~16
CRC Error Check	2	

Read Coil Status Example for a Logical Response

Filed Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x01
Byte Count	1	1~2
Data(Coil Status)	n	
CRC Error Check	2	

Read Coil Status Example in anlllogical Response

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x81
Abnormal Code	1	01~04
CRC Error Check	2	

Example:

The following example reads the load input state (ISTATE) of the Coil of the slave device as address 0x01.

From table 4.8.7.1 below, we know that the ISTATE address is 0x0510.

Query: 0x01 0x01 0x05 0x10 0x00 0x01 0xFC 0xC3

The Corresponding Nomal Response: 0x01 0x01 0x01 0x48 0x51 0xBE, within which, 0x48 is the read-back data and its lowest bit is 0 that means the input state ISTATE is OFF.

2. Force Single Coil (0x05)

Force Single Coil Example Query

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x05
Coil Address	2	0~0xFFFF
Force Data (Coil Status)	2	0x0000 or xFF00
CRC Error Check	2	

Force Single Coil Example for a Logical Response

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x01

Coil Address	2	0~0xFFFF
Force Data (Coil Status)	2	0x0000 or 0xFF00
CRC Error Check	2	

Force Single Coil Example in an Illogical Response

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x85
Abnormal Code	1	01~04
CRC Error Check	2	

A value of 0xFF00 will force the coil to turn ON, and 0x0000 forces the coil to be turn OFF. All other values are invalid and will not affect the coil status.

Example:

The following example places the load in remote control at slave device address of 0x01. From table 4.8.7.1 below, we know that the PC1 remote address is 0x0510.

Query: 0x01 0x05 0x05 0x00 0xFF 0x00 0x8C 0xF6

The Corresponding Response: 0x01 0x05 0x05 0x00 0xFF 0x00 0x8C 0xF6

3. Read Holding Registers (0x03)

Read Holding Registers Example Query

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x03
Starting Address	2	0~0xFFFF
No. of Points	2	n=1~32
CRC Error Check	2	

Read Holding Registers Example for a Logical Response

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x03
Byte Count	1	2*n
Data	2*n	
CRC Error Check	2	

Read Holding Registers Example in an Illogical Response

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x83
Abnormal Code	1	01~04
CRC Error Check	2	

Example:

The following example reads the present voltage value at the slave device as address 0x01.

From table 4.8.7.1 below, we know that the register address of the present voltage value is 0x0B00,

Query: 0x01 0x03 0x0B 0x00 0x00 0x02 0xC6 0x2F

The Corresponding Logical Response: 0x01 0x03 0x04 0x41 0x20 0x00 0x2A 0x6E 0x1A, within which, 0x41 0x20 0x00 0x2A is the read-back voltage value and the corresponding floating point value is 10V.

4. Preset Multiple Registers (0x10)

Preset Multiple Registers Example Query

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x10
Starting Address	2	0~0xFFFF
No. of Registers	2	n=1~32
Byte count	1	2*n
Preset Data	2*n	
CRC Error Check	2	

Preset Multiple Registers Example for a Logical Response

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x10
Starting Address	2	0~0xFFFF
No. of Registers	2	N
CRC Error Check	2	

Preset Multiple Registers Example in an Illogical Response

Field Name	Byte length	Example Value
Slave Address	1	1~200
Function Code	1	0x90
Abnormal Code	1	01~04
CRC Error Check	2	

Example:

The following example sets the load's constant current IFIX as 2.3A at the slave device address of 0x01. From table 4.8.7.1 below, we know that the IFIX register address is 0x0A01 and the floating point takes up a two-word length.

Query: 0x01 0x10 0x0A 0x01 0x00 0x02 0x04 0x40 0x13 0x33 0x33 0xFC 0x23

The Corresponding Logical Response: 0x01 0x10 0x0A 0x01 0x00 0x02 0x13 0xD0

4.8.7 Coil With The Register Address Allocation

Table 1: Coil-bit definition:

Name	Address	Bit	Property	Description
PC1	0x0500	1	W/R	When the remote control status bit is set to 1, the front key panel is disabled
PC2	0x0501	1	W/R	When the local prohibition bit is set to 1, the "Shift +7" keys on the front panel are disabled
TRIG	0x0502	1	W/R	Trigger tagged: triggered once by software command

REMOTE	0x0503	1	W/R	1: remote input voltage
ISTATE	0x0510	1	R	Input status: 1= input ON, 0= input OFF
TRACK	0x0511	1	R	Tracking status: 1=voltage tracking; 0=current tracking
MEMORY	0x0512	1	R	1:input state memory
VOICEEN	0x0513	1	R	1: audible key sound ON/OFF
CONNECT	0x0514	1	R	1: multi 0= single
ATEST	0x0515	1	R	1: Automatic test mode
ATESTUN	0x0516	1	R	1: Automatic test pattern waiting to be triggered
ATESTPASS	0x0517	1	R	1: automatic test passed ,0: automatic test failed
IOVER	0x0520	1	R	1:over-current tag
UOVER	0x0521	1	R	1: over-voltage tag
POVER	0x0522	1	R	1: over- Power tag
HEAT	0x0523	1	R	1: over-heated tag
REVERSE	0x0524	1	R	1: reverse tag
UNREG	0x0525	1	R	1: registered parameter fail tag
ERREP	0x0526	1	R	1: EPPROM error tag
ERRCAL	0x0527	1	R	1: calibration data error tag

Table 2: Register XRAM area definition

Name	Address	Bit	Property	Description
CMD	0x0A00	1	W/R	Command Register : lower 8 bits logical,high 8 bits illogical
IFIX	0x0A01	2	W/R	Constant current register: double-type
UFIX	0x0A03	2	W/R	Constant voltage register, double-type
PFIX	0x0A05	2	W/R	Constant power register,double-type
RFIX	0x0A07	2	W/R	Constant resistance register: double-type
TMCCS	0x0A09	2	W/R	Current soft-start rise time register , double type
TMCVS	0x0A0B	2	W/R	Voltage soft-start rise time register , double type
UCCONSET	0x0A0D	2	W/R	Constant current load voltage register :double-type
UCCOFFSET	0x0A0F	2	W/R	constant current unload voltage register , double-type
UCVONSET	0x0A11	2	W/R	Constant voltage load voltage register :double-type
UCVOFFSET	0x0A13	2	W/R	Constant voltage unloaded voltage register, double-type
UCPONSET	0x0A15	2	W/R	Constant power load voltage register, double-type
UCPOFFSET	0x0A17	2	W/R	Constant power unload voltage register , double-type
UCRONSET	0x0A19	2	W/R	Constant resistance load voltage register , double-type
UCROFFSET	0x0A1B	2	W/R	Constant resistance unload voltage register,

				double type
UCCCV	0x0A1D	2	W/R	constant current shift constant voltage register,double type
UCRCV	0x0A1F	2	W/R	Constant resistance shift constant voltage register, double type
IA	0x0A21	2	W/R	dynamic mode A phase current register, double-type
IB	0x0A23	2	W/R	dynamic mode B phase current register, double-type
TMAWD	0x0A25	2	W/R	dynamic mode A pulse-width register, double-type
TMBWD	0x0A27	2	W/R	dynamic mode B pulse-width register ,double-type
TMTRANRIS	0x0A29	2	W/R	Dynamic mode rising time register,r double-type
TMTRANFAL	0x0A2B	2	W/R	Dynamic model falling time register double-type
MODETRAN	0x0A2D	1	W/R	Dynamic mode register,u16-type
UBATTEND	0x0A2E	2	W/R	Battery Test termination voltage register ,double type
BATT	0x0A30	2	W/R	Battery capacity register, double –type
SERLIST	0x0A32	1	W/R	LIST serial number register, u16 type
SERATEST	0x0A33	1	W/R	Automatic Test serial number register , u16 type
IMAX	0x0A34	2	W/R	Current maximum register, double type
UMAX	0x0A36	2	W/R	Voltage maximum register, double type
PMAX	0x0A38	2	W/R	Power maximum register ,double type
ILCAL	0x0A3A	2	W/R	Calibration current low-end target value double type
IHCAL	0x0A3C	2	W/R	Current high-end calibration target value , double type
ULCAL	0x0A3E	2	W/R	Voltage low-end calibration target value , double type
UHCAL	0x0A40	2	W/R	Voltage high-end calibration target value , double type
TAGSCAL	0x0A42	1	W/R	Calibration state tag, u16 type
U	0x0B00	2	R	Voltage Register ,double type
I	0x0B02	2	R	Current Register ,double type
SETMODE	0x0B04	1	R	Operation Mode register,u16e type
INPUTMODE	0x0B05	1	R	Input Status Register, u16 type
MODEL	0x0B06	1	R	Model Register ,u16 type
EDITION	0x0B07	1	R	software version number register,u16 type

4.8.8 Definition Of The Command Register CMD

Definition	CMD Value	Description
CC	1	

CV	2	
CW	3	
CR	4	
CC Soft Start	20	
Dynamic Mode	25	
Short Circuit Mode	26	
List Mode	27	
CC Loading And Unloading Mode	30	
CV Loading And Unloading Mode	31	
CW Loading And Unloading Mode	32	
CR Loading And Unloading Mode	33	
CC Mode Switch To CV Mode	34	
CR Mode Switch To CV Mode	36	
Battery Test Mode	38	
CV Soft Start	39	
Changin System Parameters	41	
Input ON	42	
Input OFF	43	

4.8.9 Common Operational Function Descriptions

Table 1. Remote Control Operation:

Operation	Register	Value	Description
Force Single Coil	PC1	1	mandatory

Table 2. Cancelling remote control operation:

Operation	Register	Value	Description
Force Single Coil	PC1	0	mandatory

Table 3. Local control override operation:

Operation	Register	Value	Description
Force Single Coil	PC2	1	mandatory

Table 4. Local control allows the operator to:

Operation	Register	Value	Description
Force Single Coil	PC2	0	mandatory

Table 5. Input ON operation:

Operation	Register	Value	Description
Preset Multi-Registers	CMD	42	mandatory

Table 6. Input OFF operation:

Operation	Register	Value	Description
Preset Multi-Registers	CMD	43	mandatory

Table 7. Short-circuit operation:

Operation	Register	Value	Description
Preset Multi-Registers	CMD	26	mandatory

Table 8. CC mode operation:

Operation	Register	Value	Description
Preset Multi-Registers	IFIX	Double	Optional
Preset Multi-Registers	CMD	1	mandatory

Table 9. CV mode operation:

Operation	Register	Value	Description
Preset Multi-Registers	UFIX	Double	Optional
Preset Multi-Registers	CMD	2	mandatory

Table 10. CW mode operation:

Operation	Register	Value	Description
Preset Multi-Registers	PFIX	Double	Optional
Preset Multi-Registers	CMD	3	mandatory

Table 11. CR mode operation:

Operation	Register	Value	Description
Preset Multi-Registers	RFIX	Double	Optional
Preset Multi-Registers	CMD	4	mandatory

Table 12. CC mode soft-start:

Operation	Register	Value	Description
Preset Multi-Registers	IFIX	Double	Optional
Preset Multi-Registers	TMCCS	Double	Optional
Preset Multi-Registers	CMD	20	mandatory

Table 13. CV mode soft-start:

Operation	Register	Value	Description
Preset Multi-Registers	UFIX	Double	Optional
Preset Multi-Registers	TMCVS	Double	Optional
Preset Multi-Registers	CMD	39	mandatory

Table 14. CC loading and unloading mode:

Operation	Register	Value	Description
Preset Multi-Registers	IFIX	Double	Optional
Preset Multi-Registers	UCCONSET	Double	Optional
Preset Multi-Registers	UCCOFFSET	Double	Optional
Preset Multi-Registers	CMD	30	mandatory

Table 15. CV loading and unloading mode:

Operation	Register	Value	Description
Preset Multi-Registers	UFIX	Double	Optional
Preset Multi-Registers	UCVONSET	Double	Optional
Preset Multi-Registers	UCVOFFSET	Double	Optional
Preset Multi-Registers	CMD	31	mandatory

Table 16. CW loading and unloading mode:

Operation	Register	Value	Description
Preset Multi-Registers	PFIX	Double	Optional
Preset Multi-Registers	UCPONSET	Double	Optional
Preset Multi-Registers	UCPOFFSET	Double	Optional
Preset Multi-Registers	CMD	32	mandatory

Table 17. CR loading and unloading mode:

Operation	Register	Value	Description
Preset Multi-Registers	RFIX	Double	Optional

Preset Multi-Registers	UCRONSET	Double	Optional
Preset Multi-Registers	UCROFFSET	Double	Optional
Preset Multi-Registers	CMD	33	mandatory

Table 18. CC mode switch to CV mode:

Operation	Register	Value	Description
Preset Multi-Registers	IFIX	Double	Optional
Preset Multi-Registers	UCCCV	Double	Optional
Preset Multi-Registers	CMD	34	mandatory

Table 19. CR mode switch to CR mode:

Operation	Register	Value	Description
Preset Multi-Registers	RFIX	Double	Optional
Preset Multi-Registers	UCRCV	Double	Optional
Preset Multi-Registers	CMD	35	Must select

Table 20. Battery test mode:

Operation	Register	Value	Description
Preset Multi-Registers	IFIX	Double	Optional
Preset Multi-Registers	UBATTEND	Double	Optional
Preset Multi-Registers	CMD	38	mandatory

Table 21. Dynamic Test Mode:

Operation	Register	Value	Description
Preset Multi-Registers	IA	Double	Optional
Preset Multi-Registers	IB	Double	Optional
Preset Multi-Registers	TMAWD	Double	Optional
Preset Multi-Registers	TMBWD	Double	Optional

Preset Multi-Registers	TMTRANRIS	Double	Optional
Preset Multi-Registers	TMTRANFAL	Double	Optional
Preset Multi-Registers	MODETRAN	0~2	Optional
Preset Multi-Registers	CMD	25	mandatory

Table 22. System parameter setting mode:

Operation	Register	Value	Description
Preset Multi-Registers	IMAX	Double	Optional
Preset Multi-Registers	UMAX	Double	Optional
Preset Multi-Registers	PMAX	Double	Optional
Force Single Coil	REMOTE	0xFF00/0x0000	Optional
Preset Multi-Registers	CMD	41	mandatory

4.9 Remote operation

4.9.1 M-131 or M-133 Communication Cable

The DB9 interface connector on the rear panel of the DC electronic load provides a TTL voltage level; The communication cable (M-131 or M-133) can be used to connect the DB9 interface connector of the electronic load and an RS-232 interface connector of a PC to enable remote operation/ communication. Please refer to the following photos of the M-131 or M-133 interface cables.



Photo 4. 9.1 M-131(DB9 pin to RS-232)



Photo 4. 9.2 M-133 (DB 9 pin to USB)

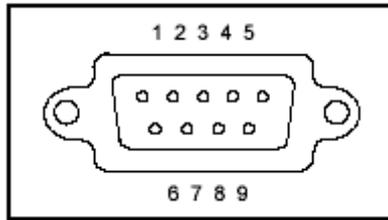
Note: An industry standard RS-232 interface cable between the M97XX and a regular PC will not facilitate communication between the devices. The dongle on the M-133 provides the necessary switching to enable proper communication.

1. RS232 Setting

Before using the remote operation mode, please insure that the baudrate and communication port address of the DC electronic load are the same as that in the PC's software or the communication will fail. You can change the baud rate and communication port address from the front panel of the load or and match it to the PC in the computer set-up for new devices

- (1) Baud rate: 9600(4800, 9600, 19200, 38400, which are selectable from the menu on the front-panel.)
- (2) Data bit: 8
- (3) Stop bit: 1
- (4) Parity: (none, even, odd)

2. DB9 Serial Interface



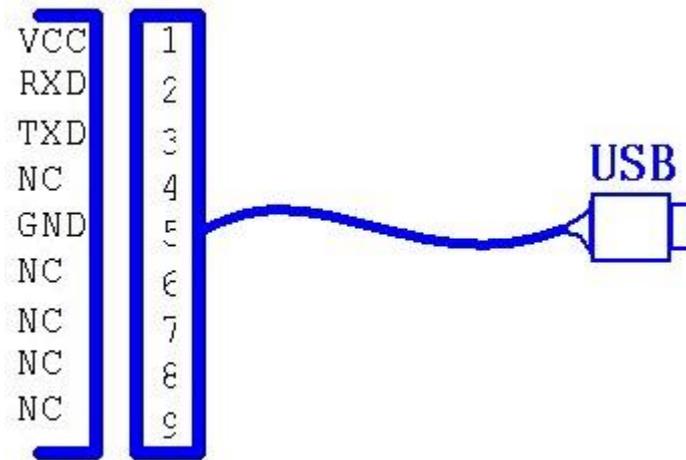
DB9 Serial Interface

- 1 +5V
- 2 TXD
- 3 RXD
- 4 NC
- 5 GND
- 6 NC
- 7 NC
- 8 NC
- 9 NC

The output of DB9 interface on the rear-panel of the power supplier is TTL voltage level, so the pin outs of the voltage level shift cable (M-131 or M-133) must be set-up to match the PC before connecting the DB9 interface with the serial interface on PC.

M-131	Voltage Level Shift Cable	PC
VCC	1	1 VCC
RXD	2	2 RXD
TXD	3	3 TXD
NC	4	4 DTR
GND	5	5 GND
NC	6	6 NC
NC	7	7 RTS
NC	8	8 NC
NC	9	9 NC

M-133 Voltage Level Shift Cable PC



Note: An industry standard RS-232 interface cable between the M97XX and a regular PC will not facilitate communication between the devices. The dongle on the M-133 provides the necessary switching to enable proper communication.

Quick Reminders

Safety

Please do not install any spare parts or repair the instrument without contacting the factory for authorization. In order to assure the works normally according to its specification, have it repaired in the service provider designated by the manufacturer.

Please review the following safety precautions before operating the equipment.

Safety Symbols

Please keep in mind the following items which could inflict serious bodily injuries.



Ground the unit properly using the wire recommended in the user manual.



High voltage danger (Only authorized service personnel should remove the cover and have internal access to the instrument)



This symbol on an instrument indicates that the user should consult the operating Instructions in the User Manual. Wear gloves when you start the operation and always beware of electric shock hazard!. Don't use the equipment without regard for personal safety.

Certification and Warranty

M97 Series Electrical Loads are warranted to meet its published technical specifications upon shipment from the factory.

Warranty

This product is warranted against defects in material and workmanship for a period of one year from date of shipment.

Maintenance Service

This product must be returned to a factory authorized service provider for repair. Customer shall prepay shipping charges (and shall pay all duties and taxes) for products returned to the overseas supplier for warranty repair.

Limitations of Warranty

The manufacturer's warranty shall not apply to

1. Defects resulting from improper or inadequate maintenance by the Customer,
2. Customer-supplied software or interfacing,
3. Unauthorized modification or misuse,
4. Operation beyond the environmental specifications of the product(s), or improper site preparation and maintenance.
5. Defects resulting from client-installed circuits.

Disclaimer

Manufacturer reserves the right to make specification(s) changes to product(s) and its accompanying documentation, at any time, and without previous notification to its customers.