

# LD option

Connect the input and output sides of the AC source to the grid so that the input/output voltage is within the operating voltage range of the power supply. Change the parameters value, read and record the output current measurement value and oscilloscope waveform on the power analyzer and power supply.

The AC load function consists of CC&CP rectification mode, CC&CP lead/lag mode, and CR mode. Set parameters such as CC/CP mode, CF value and phase angle on the panel(the phase angle setting range is 90°~-90°; the CF parameter setting range is 1.414~3), record the oscilloscope waveform.



Schematic diagram of test system connection



## 1 CC Mode

Set the power supply to work in CC mode, the rated current value of the harmonic current generated is 25A, and the 2 ~ 40 harmonics are emitted in sequence. One type of harmonic is emitted each time, and the actual harmonic current emitted is read with the power analyzer and recorded in the table In 1, observe the oscilloscope waveform.

#### Steps:

1. Set the CC output mode (Figure 1-②) → set the current rating to 25A/50Hz (Figure 1-①) → select Harmonic Settings → check Coupling and Harm Select (Figure 1-③) → click  $\boxed{A\_THD 0.0}$ . After setting the harmonic order components, click Settings (Figure 2).

2. Turn on the power  $\rightarrow$  click APPLY  $\rightarrow$  click POWER ON (start)  $\rightarrow$  click OUTPUT ON (start)  $\rightarrow$  click OUTPUT SWITCH (start).



Bi ESA File Hardware Limits So	equence Measuremen	ts Wave Fault			- 🗆 X
		Sequence			Connected
IA1[A]         IA2[A]           0.00         0.00	IA3[A] UA1[ 0.00 0.0	V] UA2[V] L 0.0	JA3[V] P[kW] 0.0 0.00	Q[kvar] 0.00	Fault
1 L1	L2	L3	Conditional	NO.1	Output 2
Irms[A] 25.00 ↓ Angle[deg] 0.0 ↓ f[Hz] 50.00 ↓	Irms[A] 25.00 Angle[deg] 0.0 Dwell T[ms] 100.0 ♠	Irms[A]         25.00           Angle[deg]         0.0           Ramp T[ms]         100.0	Unselect 0.0	Keyboard Select 🖓	
L1	L2	L3	Conditional	NO.2	
Irms[A] 220.00 + Angle[deg] 0.0 +	Irms[A] 220.00 + Angle[deg] 0.0 +	Irms[A] 220.00 Angle[deg] 0.0	Unselect V 0.0	Keyboard	
f[Hz] 50.00 🔹	Dwell T[ms] 100.0	Ramp T[ms] 100.0	On/Off	Select	Apply
L1	L2	L3	Conditional	NO.3	
Irms[A] 220.00 ÷ Angle[deg] 0.0 ÷	Irms[A] 220.00 + Angle[deg] 0.0 +	Irms[A] 220.00 4	Unselect V 0.0	Keyboard	Power On
f[Hz] 50.00 🜩	Dwell T[ms] 100.0	Ramp T[ms] 100.0	On/Off	Select v	Output On
Harmonic Settings CF	Settings 3				
<b>BTHD</b> 30.0 +		ter Harm	Idc Offset_L1[A] Idc Offset_L2[A]	0.00 ×	Output Switch
CTHD 30.0 + H	larm Select	Select	Idc Offset_L3[A]	0.00	

Figure 1

<b>Bri</b> Harmonic Settings			×
2 Angle[°] 2 Harmonic[%] 0.0 ♀ ■ 30.0 ♀ ■	12Angle[°]         12Harmonic[%]           0.0         ↓	22Angle[°] 22Harmonic[%] 0.0	32Angle[°]         32Harmonic[%]           0.0         ↓
3 Angle[°] 3 Harmonic[%] 0.0 ♀ 0.0 ♀	13Angle[°]         13Harmonic[%]           0.0         ↓         0.0         ↓	23Angle[°]         23Harmonic[%]           0.0         ▼         0.0         ▼	33Angle[°] 33Harmonic[%] 0.0 ★ 0.0 ★
4 Angle[°]         4 Harmonic[%]           0.0         ♀	14Angle[°]         14Harmonic[%]           0.0         €	24Angle[°]         24Harmonic[%]           0.0         ↓	34Angle[°]         34Harmonic[%]           0.0         ♥
5 Angle[°]         5 Harmonic[%]           0.0         •	15Angle[°]         15Harmonic[%]           0.0         •	25Angle[°]         25Harmonic[%]           0.0         ★         0.0         ★	35Angle[°]         35Harmonic[%]           0.0         ▼
6 Angle[°] 6 Harmonic[%] 0.0 € 0.0 €	16Angle[°]         16Harmonic[%]           0.0         €	26Angle[°]         26Harmonic[%]           0.0         ▼         0.0         ▼	36Angle[°]         36Harmonic[%]           0.0         ↓
7 Angle[°] 7 Harmonic[%] 0.0 ♀ 0.0 ♀	17Angle[°]         17Harmonic[%]           0.0         ↓	27Angle[°] 27Harmonic[%] 0.0 ★ 0.0 ★	37Angle[°] 37Harmonic[%] 0.0
8 Angle[°] 8 Harmonic[%] 0.0 ♀ 0.0 ♀	18Angle[°]         18Harmonic[%]           0.0         ↓         0.0         ↓	28Angle[°]         28Harmonic[%]           0.0         ▼         0.0         ▼	38Angle[°]         38Harmonic[%]           0.0         ▼         0.0         ▼
9 Angle[°] 9 Harmonic[%] 0.0 ♀ 0.0 ♀	19Angle[°]         19Harmonic[%]           0.0         ♀         0.0         ♀	29Angle[°]         29Harmonic[%]           0.0         ↓         0.0         ↓	39Angle[°]         39Harmonic[%]           0.0         ♥         0.0         ♥
10Angle[°]         10Harmonic[%]           0.0         ♀         0.0         ♀	20Angle[°] 20Harmonic[%] 0.0 ♀ 0.0 ♀	30Angle[°]         30Harmonic[%]           0.0         ▼         0.0         ▼	40Angle[°] 40Harmonic[%] 0.0 ♥ 0.0 ♥
11Angle[°]         11Harmonic[%]           0.0         ↓         0.0         ↓	21Angle[°]         21Harmonic[%]           0.0         ▼	31Angle[°]         31Harmonic[%]           0.0         ▼	Settings Cancel Clear



Table 1	
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25A No	Harmonic	Set harmonic component	Harmonic Current (Phase A/B/C)			I <sub>тно</sub> (Phase A/B/C)			
1	2 <sup>nd</sup>	30%	7.52	7.49	7.50	30.12% 30.04%		30.03%	
2	3 <sup>rd</sup>	30%	7.45	7.43	7.43	29.81%	29.79%	29.77%	
3	5 <sup>th</sup>	30%	7.45	7.44	7.47	29.84%	29.85%	29.92%	
4	7 <sup>th</sup>	30%	7.49	7.48	7.49	30.01%	30.00%	29.99%	
5	11 <sup>th</sup>	30%	7.56	7.55	7.57	30.29%	30.28%	30.32%	
6	13 <sup>th</sup>	30%	7.57	7.57	7.56	30.35%	30.32%	30.26%	
7	17 <sup>th</sup>	20%	5.01	5.00	5.02	20.05%	20.03%	20.10%	
8	19 <sup>th</sup>	20%	5.01	5.00	5.00	20.10%	20.04%	20.01%	
9	23 <sup>th</sup>	20%	5.04	5.03	5.04	20.17%	20.19%	20.17%	
10	25 <sup>th</sup>	20%	5.06	5.04	5.04	20.26%	20.23%	20.20%	
11	29 <sup>th</sup>	10%	2.53	2.53	2.53	10.13%	10.14%	10.14%	
12	31 <sup>th</sup>	10%	2.54	2.53	2.53	10.19%	10.17%	10.15%	
13	35 <sup>th</sup>	10%	2.54	2.55	2.55	10.19%	10.19% 10.22%		
14	37 <sup>th</sup>	10%	2.56	2.55	2.55	10.28%	10.26%	10.24%	
15	40 <sup>th</sup>	10%	2.57	2.55	2.55	10.30%	10.21%	10.21%	



DEF	AULT AC OL	JTPUT	DC OUTPUT Sums				Display
			(All Channels)	(All Ch	annels)		Harmonics
			f <sub>h</sub> 150.164 Hz	f <sub>1</sub> 50.05	46 Hz		Transform
							Phase - Ch 🗄
							All
		/I <sub>fund</sub> 1		/I <sub>fund</sub> 2		I/I <sub>fund</sub> 3	
0	0.040	%	0.135	%	0.009	%	Harmonics
1	100.000	%	100.000	%	100.000	%	Odd & Even
2	0.049	%	0.060	%	0.088	%	Values
3	29.810	%	29.788	%	29.774	%	I J
4	0.117	%	0.018	%	0.105	%	Amplitudes
5	0.235	%	0.319	%	0.270	%	Relative
6	0.062	%	0.027	%	0.023	%	$\square$
7	0.135	%	0.163	%	0.185	%	
_	0.001	07	0.000	0/	0.040	07	
	reeze Grp. 1	Filt			Grp. 2 Filt		
	<b>1</b> 23 1 250.01	0 V	2 250.0 V	250.0 V	4 4 3.0 V		

3rd harmonic-set content 30%



DEE			DC OUTPUT Sums				Display
DEIT	NO CIT IND C			(11)			
			(All Channels)	(All C	Channels)		Harmonics
			f <sub>h</sub> 350.151 Hz	f <sub>1</sub> 50.0	215 Hz		Transform
							Phase - Ch
		I/I <sub>fund</sub> 1		I/I <sub>fund</sub> 2		/I <sub>fund</sub> 3	All
4	0.006	%	0.054	~ %	U.U3Z	%	Harmonics
5	0.311	%	0.293	%	0.234	%	Odd & Even
6	0.104	%	0.079	%	0.076	%	Values
7	30.010	%	30.002	%	29.995	%	
8	0.122	%	0.059	%	0.089	%	
9	0.073	%	0.050	%	0.057	%	Amplitudes
10	0.051	%	0.038	%	0.026	%	Relative
11	0.072	%	0.027	%	0.042	%	
12	0.055	%	0.025	%	0.032	%	
	reeze Grp.	1 Filt	01023		Grp. 2 Filt		
$\sim =$	49.99	Hz .0 V	250.0 V	250.0 V	 , 3.0 V		
1 42	× 1₂3 <b>↓</b> 40.	0 A	40.0 A	40.0 A	4 7.5 A		

7th harmonic-set content 30%



DEF	AULT AC OU	TPUT	DC OUTPUT	Sums						Display
			(A	II Channels)		(All Channels)				Harmonics
			f <sub>h</sub> 84	9.244 Hz	f <sub>1</sub> 4	9.9555 H	Iz			Transform
										Phase - Ch 🗄
										AII
	/ا ۱	I <sub>fund</sub> 1			/I <sub>fund</sub> 2			I/I <sub>fund</sub> 3		Harmonics
10	0.079	/0		0.178	/0		0.140	/0		
14	0.148	%		0.127	%		0.175	%		Odd & Even
15	0.214	%		0.199	%		0.286	%		Values 🗉
16	0.468	%		0.519	%		0.528	%		
17	20.059	%		20.039	%		20.102	%		Amerilandez
18	0.497	%		0.601	%		0.513	%		Amplitudes
19	0.367	%		0.206	%		0.236	%		Relative
20	0.158	%		0.183	%		0.149	%		
21	0.184	%		0.277	%		0.066	%		
Grp. 1 Filt										
	$1^{250.}$	0 V	2	0.0 V 3	250.0 V	4	.0 V			

17th harmonic-set content 20%

				=
				BRIDGE
Tek	停止	<b>ö</b>		声滤波器关闭
	M. M.			
		10.0ms		252.418 Hz
	2004 Bu 🥏	<u></u> 均万根 2 2004 Bal の均方根 2	25.6 A <b>11</b> 山峯一山峯 88. 25.6 A <b>11</b> 山峯一山峯 88.	0A <u>14/31/00</u>
- 955			0.0 H CALINE ME 1.	
DEH	AULT ACOUIPUT D			Display Harmonics
		(All Channels) (All	All Channels)	Transform
		h 1.15045 KHZ 1 50	.0213 112	Transionin
				Phase - Ch
				Phase - Ch 🗐 All
	// <sub>fund</sub> 1	1/1 <sub>fund</sub> 2	ا// <sub>fund</sub> 3	Phase - Ch 🗎 All Harmonics
- 19	/  <sub>fund</sub> 1 ────────────────────────────────────	//I <sub>fund</sub> 2 ∪.∪82 % 0.162 %	//I <sub>fund</sub> 3 0.279 % 0.191 %	Phase - Ch III All Harmonics Odd & Even
19 20 21	ا/ا <sub>fund</sub> 1 0.262 % 0.167 % %	//I <sub>fund</sub> 2 0.082 % 0.162 % 0.274 %	//I <sub>fund</sub> 3 0.279 % 0.191 % 0.1 <u>9</u> 5 %	Phase - Ch All Harmonics Odd & Even
ту 20 21 22	I/I <sub>fund</sub> 1 0.262 % 0.167 % 0.300 % 0.513 %	الالسط 2 0.082 % 0.162 % 0.274 % 0.427 %	i/l <sub>fund</sub> 3 0.279 % 0.191 % 0.195 % 0.493 %	Phase - Ch III All Harmonics Odd & Even Values
19 20 21 22 23	I/I <sub>fund</sub> 1 0.262 % 0.167 % 0.300 % 0.513 % 20.178 %	l/l <sub>fund</sub> 2 0.082 % 0.162 % 0.274 % 0.427 % 20.192 %	//I <sub>fund</sub> 3 0.279 % 0.191 % 0.195 % 0.493 % 20.172 %	Phase - Ch All Harmonics Odd & Even Values
19 20 21 22 23 24	I/I <sub>fund</sub> 1 0.262 % 0.167 % 0.300 % 0.513 % 20.178 % 0.511 %	I/Ifund 2         0.082 %         0.162 %         0.274 %         0.427 %         20.192 %         0.422 %	I/Ifund 3         0.279 %         0.191 %         0.195 %         0.493 %         20.172 %         0.442 %	Phase - Ch All Harmonics Odd & Even Values I Amplitudes
19 20 21 22 23 24 25	I/Ifund 1         0.262 %         0.167 %         0.300 %         0.513 %         20.178 %         0.511 %         0.142 %	IVIfund 2         0.082 %         0.162 %         0.274 %         0.427 %         20.192 %         0.422 %         0.289 %	I//Ifund 3         0.279       %         0.191       %         0.195       %         0.493       %         20.172       %         0.442       %         0.304       %	Phase - Ch All Harmonics Odd & Even Values
19 20 21 22 23 24 25 26	I/Itund 1         0.262       %         0.167       %         0.300       %         0.513       %         20.178       %         0.511       %         0.142       %         0.171       %	I/Ifund 2         0.082 %         0.162 %         0.274 %         0.427 %         20.192 %         0.422 %         0.289 %         0.196 %	I//Itund 3         0.279       %         0.191       %         0.195       %         0.493       %         20.172       %         0.304       %         0.156       %	Phase - Ch All Harmonics Odd & Even Values I Amplitudes Relative
19 20 21 22 23 24 25 26 27	I/Itund 1         0.262 %         0.167 %         0.300 %         0.513 %         20.178 %         0.511 %         0.142 %         0.171 %         0.225 %	Image: 1000 minipage       Image: 1000 minipage         0.0082 %       0.0082 %         0.162 %       0.274 %         0.427 %       0.427 %         20.192 %       0.422 %         0.289 %       0.196 %         0.192 %       0.092 %	I/Ifund 3         0.279       %         0.191       %         0.195       %         0.493       %         20.172       %         0.442       %         0.304       %         0.156       %         0.282       %	Phase - Ch All Harmonics Odd & Even Values I Amplitudes Relative
19 20 21 22 23 24 25 26 27	I/ltund 1         0.262       %         0.167       %         0.300       %         0.513       %         20.178       %         0.511       %         0.142       %         0.171       %         0.225       %         Grp. 1Filt       50.00         Hz       %	Image: 1000 state       1000 state       1000 state         0.162       %       1000 state       1000 state         0.274       %       1000 state       1000 state       1000 state         0.427       %       1000 state       10000 state       1000 state       10000 state	I// Fund 3         0.279       %         0.191       %         0.195       %         0.493       %         20.172       %         0.304       %         0.304       %         0.156       %         0.282       %	Phase - Ch All Harmonics Odd & Even Values I Amplitudes Relative

23th harmonic-set content 20%



31th harmonic-set content 10%



40th harmonic-set content 10%



Multi-harmonic superposition (3rd harmonic-set content 20% + 11th harmonic-set content 20% + 17th harmonic-set content 10% + 23th harmonic-set content 10% + 35th harmonic-set content 5% + 40th harmonic-set content 5%)



## 2 CP Mode

Set the power supply to work in CP mode, the rated total capacity of generating harmonic current is 30KW, set the crest factor CF value to 1.414 ~ 3, read and record the oscilloscope waveform.

### Steps:

1. Set the CP output mode (Figure 3-(2))  $\rightarrow$  set the output rated power value to 30KW (Figure 3-(1))  $\rightarrow$  select CF Settings  $\rightarrow$  check Select (Figure 3-(3))  $\rightarrow$  and click

L1\_CF 0.000

to set the crest factor.

2. Turn on the power  $\rightarrow$  click APPLY  $\rightarrow$  click POWER ON (start)  $\rightarrow$  click OUTPUT ON (start)  $\rightarrow$  click OUTPUT SWITCH (start).



Bri File	ESA Hardwar	e Limits	Sequence M	easurement	s Wave	Fault						X
					Sequenc	e					Conne	cted
	A1[A] ).00	IA2[A] 0.00	IA3[A] 0.00	UA1[\ 0.0	/] UA: 0.0	2[V]	UA3[V] <mark>0.0</mark>	P[kW]	Q[kvar]		F	ault <b>E</b>
	1 L1		L	2	-	L3	Cor	nditional	NO.1	1	2	tput <b>man</b>
1	P[kW] Angle[deg] f[Hz]	10.00 0.0 50.00	P[kW]     Angle[deg]     Dwell T[ms]	10.00 ÷ 0.0 ÷ 100.0 ÷	P[kW] Angle[deg Ramp T[me	10.00 a) 0.0 s] 100.0	Unse     0.0	lect v On/Off v	Keyboard Select 🗸			O SEQ ATI AC
	L1 P[kW] Angle[deg]	220.00 0.0	P[kW]	2 220.00 🔹 0.0	P[kW]	L3 220.00	Cor Unse	nditional lect 🗸	NO.2 Keyboard		000 © CP	
	f[Hz]	50.00	Dwell T[ms]	100.0	Ramp T[m	s] 100.0	•	On/Off ⊡	Select 🗌			Apply
	L1	N.	L	2	-	L3	Cor	nditional	NO.3		-	
	P[kW] Angle[deg]	220.00 0.0	P[kW] Angle[deg]	220.00 ÷	P[kW] Angle[deg	220.00 g] 0.0	Unse     0.0	lect 🗸	Keyboard		Po	wer On
	f[Hz]	50.00	Dwell T[ms]	100.0 🔹	Ramp T[m	s] 100.0	•	On/Off ⊡	Select	~	Ou	tput On
	L1_CF L2_CF L3_CF	0.000 0.000 0.000 0.000	Select				Ide ( Ide ( Ide (	Offset_L1[A] Offset_L2[A] Offset_L3[A]	0.00 (m) 0.00 (m) 0.00 (m)		Outŗ	out Switch

Figure 3



CF=1.414









CF=3