EVA2400

EVALUATION DATA

DWG No. IA754-53-01		
APPD	CHK	DWG
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22/Jun/12	22.Jun.'12	22.Jun.'12

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Terminology used

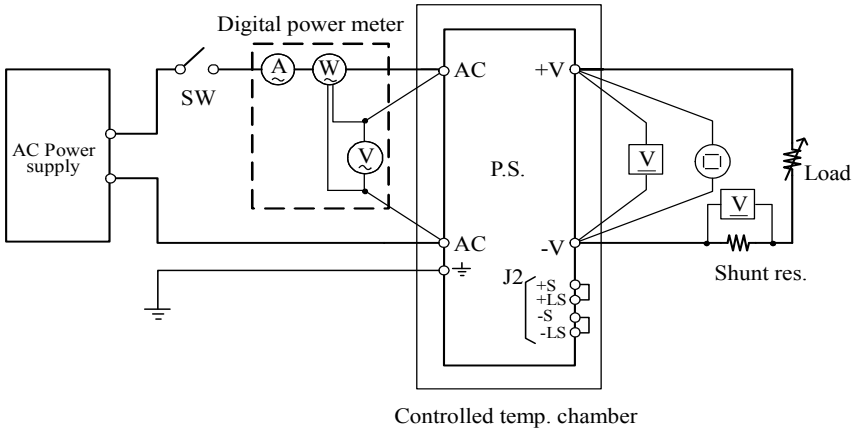
		Definition
Vin	.....	Input voltage
Vout	.....	Output voltage
Iin	.....	Input current
Iout	.....	Output current
Ta	.....	Ambient temperature
f	.....	Frequency

1. Evaluation method

1.1 Circuit used for determination

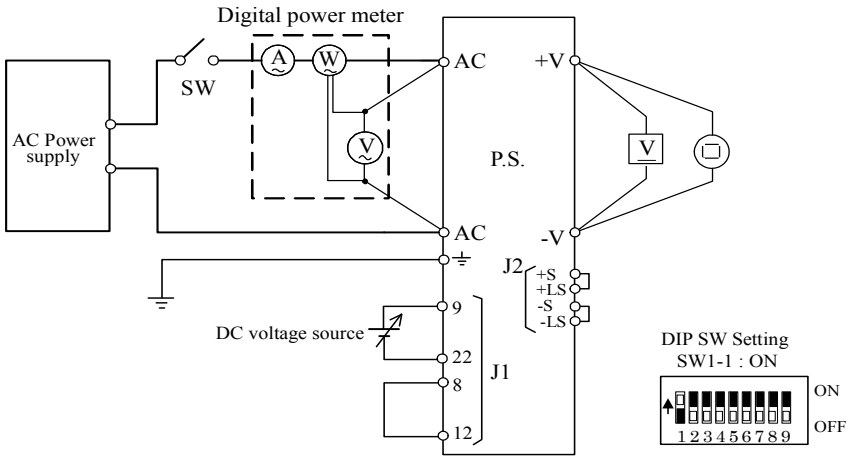
Circuit 1 used for determination

Steady state data



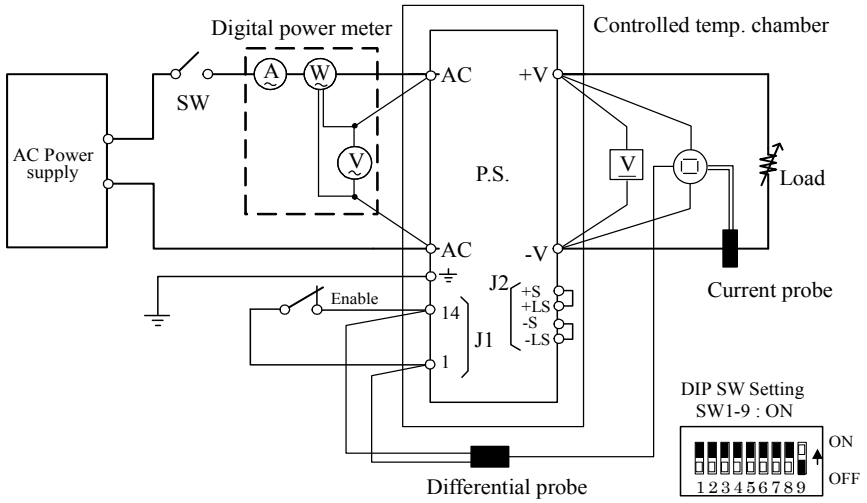
Circuit 2 used for determination

Over voltage protection (OVP) characteristics



Circuit 3 used for determination

Output rise & fall characteristics with ON/OFF CONTROL by Enable

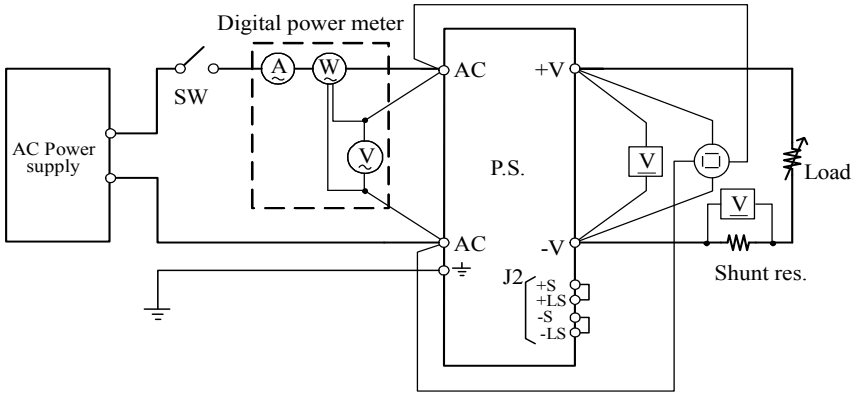


Circuit 4 used for determination

Hold up time characteristics

Dynamic line response characteristics (C.V mode)

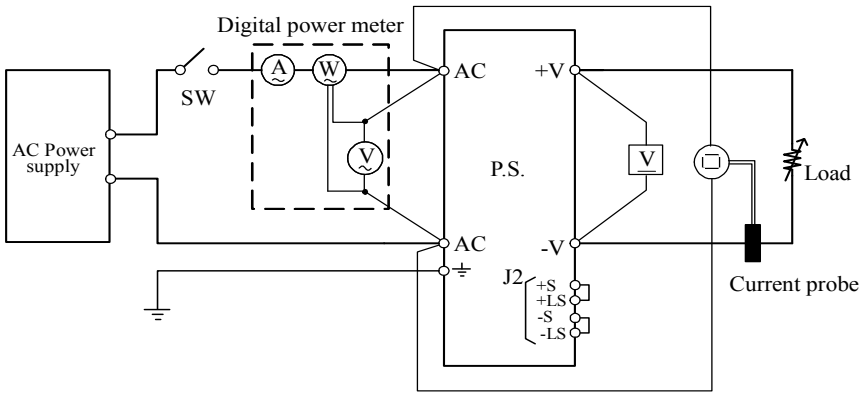
Response to brown out characteristics (C.V mode)



Circuit 5 used for determination

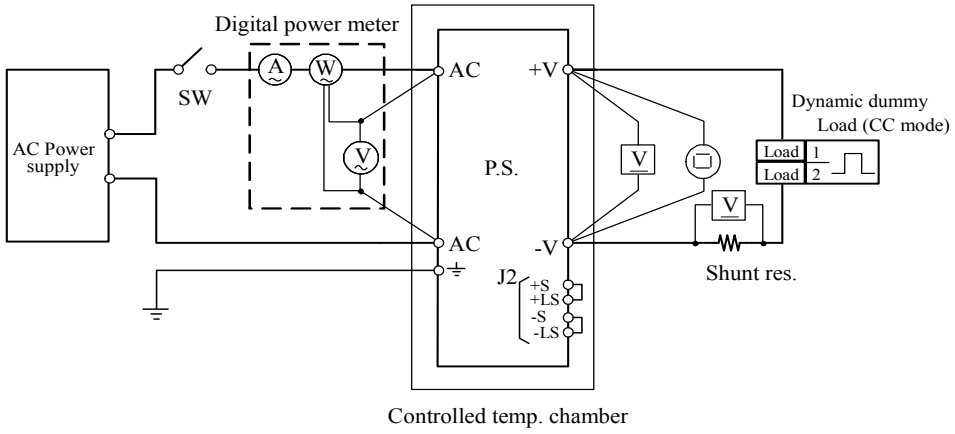
Dynamic line response characteristics (C.C mode)

Response to brown out characteristics (C.C mode)



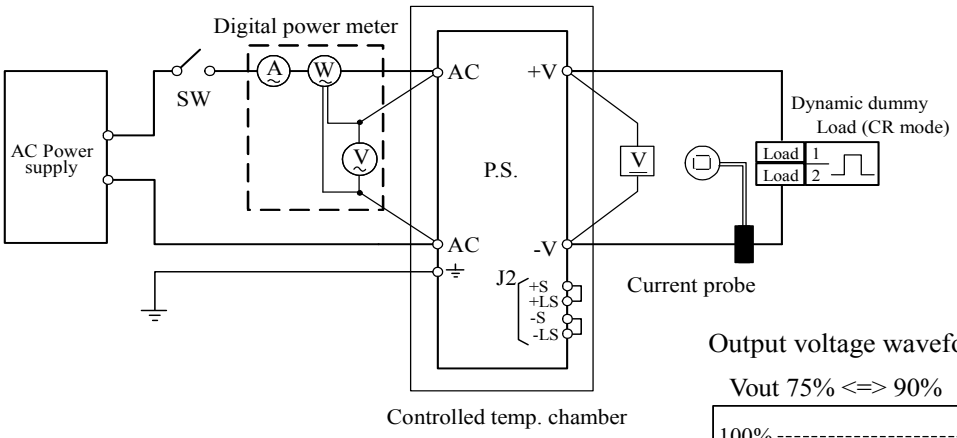
Circuit 6 used for determination

Dynamic load response characteristics (C.V mode)



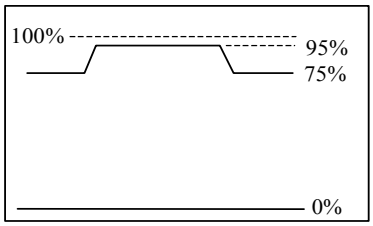
Circuit 7 used for determination

Dynamic load response characteristics (C.C mode)



Output voltage waveform

Vout 75% <=> 90%



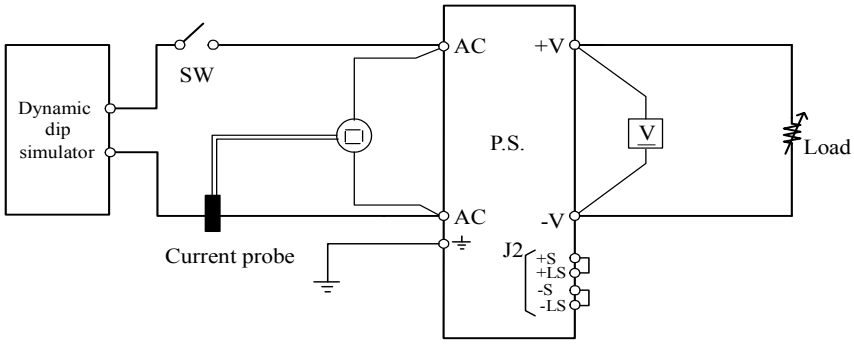
* f<10Hz, Excluding E-cap discharge

Circuit 8 used for determination

Inrush current characteristics during line brown outs

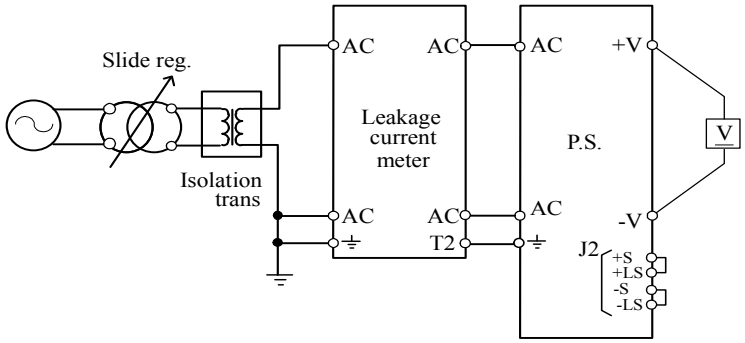
Inrush current waveform

Input current waveform



Circuit 9 used for determination

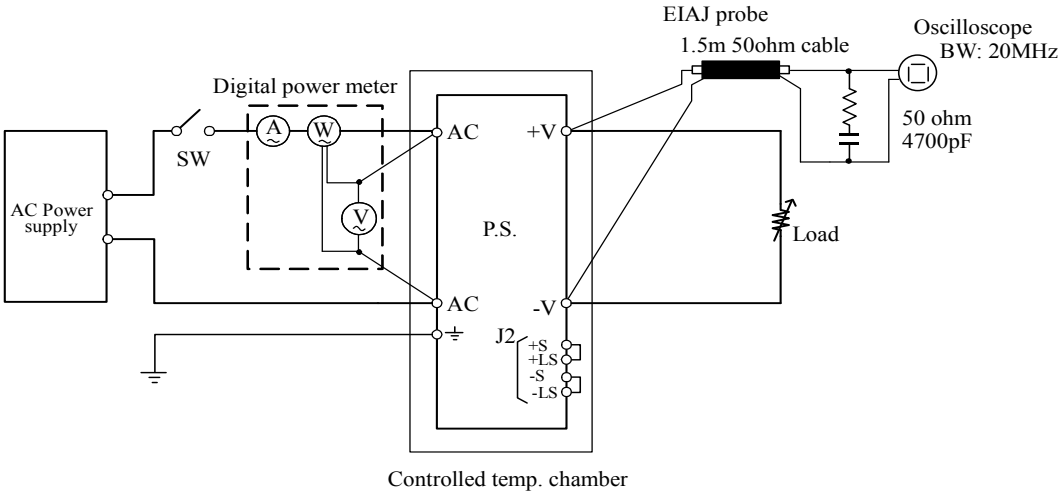
Leakage current characteristics



Circuit 10 used for determination

Output ripple and noise waveform (150V, 300V models)

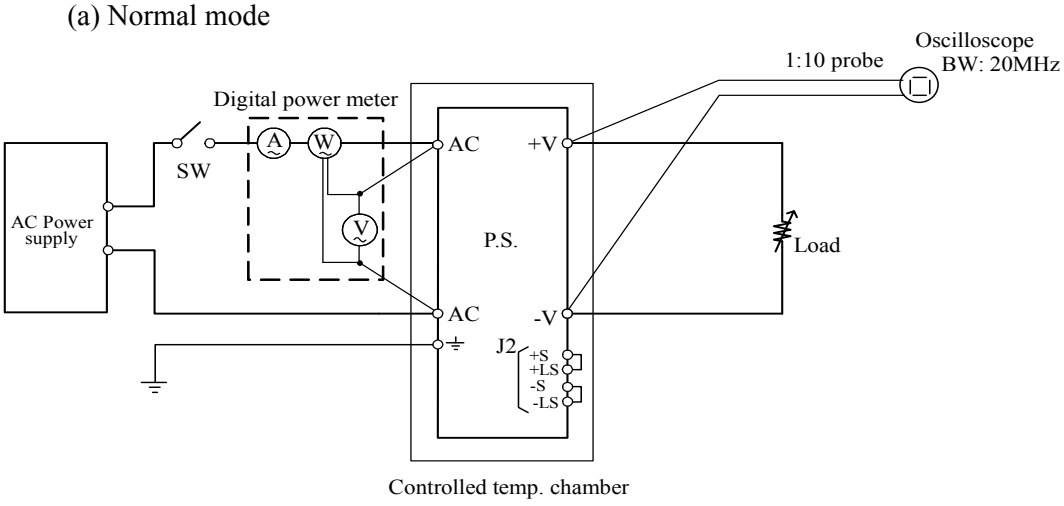
(a) Normal mode (JEITA Standard RC-9131A)



Circuit 11 used for determination

Output ripple and noise waveform (600V model)

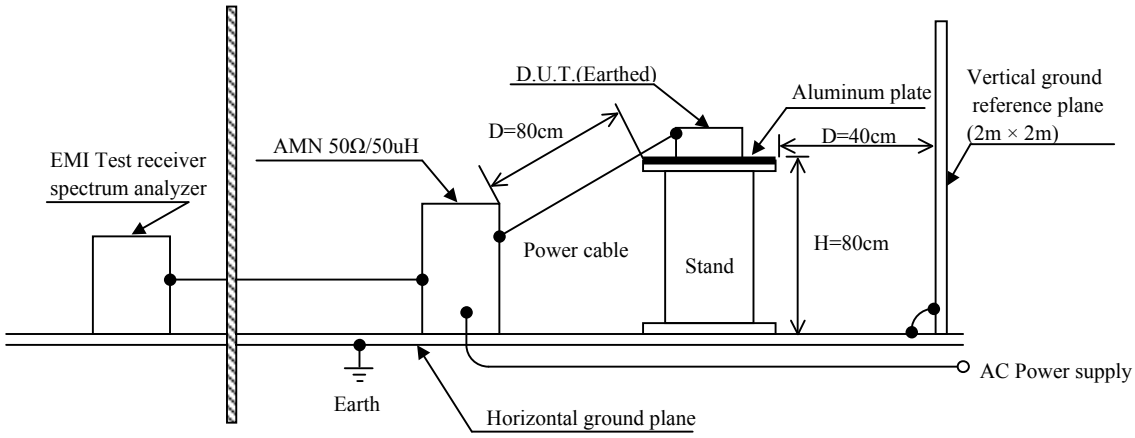
(a) Normal mode



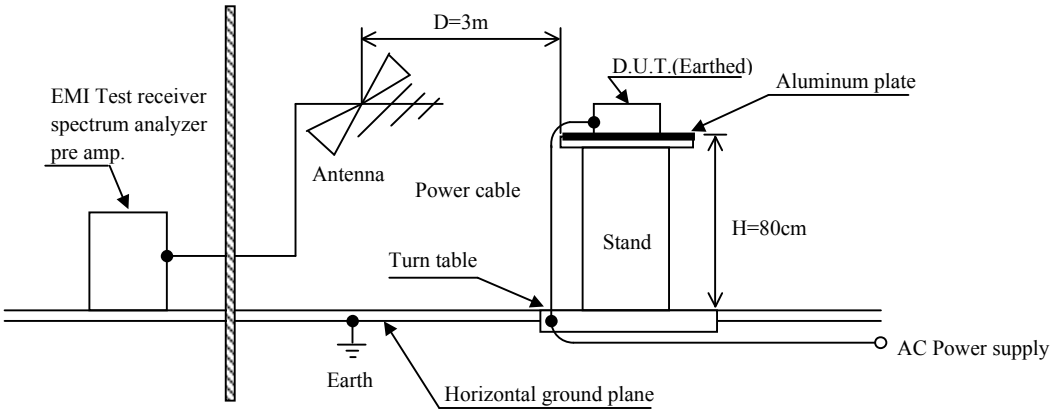
Configuration used for determination

Electromagnetic interference characteristics

(a) Conducted emission



(b) Radiated emission



1.2 List of equipment used

	EQUIPMENT USED	MANUFACTURER	MODEL NO.
1	DIGITAL STORAGE OSCILLOSCOPE	YOKOGAWA ELECT.	DL1740EL
2	DIGITAL STORAGE OSCILLOSCOPE	YOKOGAWA ELECT.	DL9040L
3	Current probe	YOKOGAWA ELECT.	701930
4	Differential probe	YOKOGAWA ELECT.	700924
5	DIGITAL POWER METER	HIOKI	3334
6	DIGITAL MULTIMETER	AGILENT	34970A
7	DIGITAL MULTIMETER	AGILENT	34401A
8	LOAD	KIKUSUI	PLZ1004WH, PLZ2004WHB
9	CVCF	KIKUSUI	PCR6000LA
10	CVCF	NF	ES10000S
11	DYNAMIC DIP SIMULATOR	TAKAMISAWA	PSA-210
12	LEAKAGE CURRENT METER	HIOKI	3156
13	SLIDE REGULATOR	MATSUNAGA	SD-2650
14	CONTROLLED TEMP. CHAMBER	ESPEC	PL-4KP
15	EMI TEST RECEIVER / SPECTRUM ANALYZER	ROHDE & SCHWARZ	ESCI
16	PRE AMP.	SONOMA	310N
17	AMN	SCHWARZBECK	NNLK8121
18	ANTENNA	SCHWARZBECK	CBL6111D

2. Characteristics

2.1 Steady state data

(1) Regulation - Line and Load, Temperature drift

C.V mode

EVA150-16

1. Regulation - Line and Load

Conditions Ta : 25 ℃
Vo : 100 %

Iout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	150.006V	150.005V	150.007V	150.006V	2mV	0.001%
20%	150.006V	150.006V	150.007V	150.006V	1mV	0.001%
40%	150.006V	150.005V	150.007V	150.007V	2mV	0.001%
60%	150.007V	150.006V	150.008V	150.007V	2mV	0.001%
80%	150.007V	150.007V	150.007V	150.007V	0mV	0.000%
100%	150.006V	150.006V	150.007V	150.007V	1mV	0.001%
Load regulation	1mV	2mV	1mV	1mV		
	0.001%	0.001%	0.001%	0.001%		

2. Temperature drift

Conditions Vin : 200 VAC
Iout : 100 %

Ta	-10℃	+25℃	+45℃	Temperature stability	
Vout	149.995V	150.006V	150.003V	11mV	0.007%

EVA300-8

1. Regulation - Line and Load

Conditions Ta : 25 ℃
Vo : 100 %

Iout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	300.016V	300.018V	300.019V	300.016V	3mV	0.001%
20%	300.017V	300.018V	300.019V	300.017V	2mV	0.001%
40%	300.018V	300.019V	300.019V	300.017V	2mV	0.001%
60%	300.018V	300.020V	300.020V	300.018V	2mV	0.001%
80%	300.019V	300.019V	300.020V	300.018V	2mV	0.001%
100%	300.019V	300.020V	300.020V	300.020V	1mV	0.000%
Load regulation	3mV	2mV	1mV	4mV		
	0.001%	0.001%	0.000%	0.001%		

2. Temperature drift

Conditions Vin : 200 VAC
Iout : 100 %

Ta	-10℃	+25℃	+45℃	Temperature stability	
Vout	299.989V	300.020V	300.048V	59mV	0.020%

EVA600-4

1. Regulation - Line and Load

Conditions Ta : 25 ℃
Vo : 100 %

Iout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	600.040V	600.039V	600.040V	600.042V	3mV	0.001%
20%	600.040V	600.038V	600.040V	600.040V	2mV	0.000%
40%	600.038V	600.039V	600.043V	600.041V	5mV	0.001%
60%	600.038V	600.039V	600.041V	600.039V	3mV	0.001%
80%	600.038V	600.041V	600.044V	600.040V	6mV	0.001%
100%	600.039V	600.040V	600.045V	600.039V	6mV	0.001%
Load regulation	2mV	3mV	5mV	3mV		
	0.000%	0.001%	0.001%	0.001%		

2. Temperature drift

Conditions Vin : 200 VAC
Iout : 100 %

Ta	-10℃	+25℃	+45℃	Temperature stability	
Vout	599.975V	600.040V	600.075V	100mV	0.017%

2. Characteristics

2.1 Steady state data

(1) Regulation - Line and Load, Temperature drift

C.C mode

EVA150-16

1. Regulation - Line and Load

Conditions Ta : 25 ℃
Io : 100 %

Vout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	15.981A	15.981A	15.982A	15.982A	1 mA	0.006%
20%	15.981A	15.981A	15.980A	15.981A	1 mA	0.006%
40%	15.981A	15.980A	15.980A	15.981A	1 mA	0.006%
60%	15.982A	15.981A	15.980A	15.981A	2 mA	0.012%
80%	15.981A	15.981A	15.981A	15.981A	0 mA	0.000%
100%	15.981A	15.980A	15.981A	15.980A	1 mA	0.006%
Load	1 mA	1 mA	2 mA	2 mA		
regulation	0.006%	0.006%	0.012%	0.012%		

2. Temperature drift

Conditions Vin : 200 VAC
Vout : 100 %

Ta	-10℃	+25℃	+45℃	Temperature stability	
Iout	16.009A	15.980A	15.963A	46mA	0.288%

EVA300-8

1. Regulation - Line and Load

Conditions Ta : 25 ℃
Io : 100 %

Vout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	7.994A	7.994A	7.994A	7.994A	0 mA	0.000%
20%	7.993A	7.994A	7.993A	7.992A	2 mA	0.025%
40%	7.992A	7.992A	7.992A	7.993A	1 mA	0.013%
60%	7.992A	7.993A	7.993A	7.992A	1 mA	0.013%
80%	7.994A	7.992A	7.992A	7.992A	2 mA	0.025%
100%	7.993A	7.993A	7.991A	7.992A	2 mA	0.025%
Load	2 mA	2 mA	3 mA	2 mA		
regulation	0.025%	0.025%	0.038%	0.025%		

2. Temperature drift

Conditions Vin : 200 VAC
Vout : 100 %

Ta	-10℃	+25℃	+45℃	Temperature stability	
Iout	8.001A	7.993A	7.988A	13mA	0.162%

EVA600-4

1. Regulation - Line and Load

Conditions Ta : 25 ℃
Io : 100 %

Vout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	3.996A	3.997A	3.996A	3.997A	1 mA	0.025%
20%	3.996A	3.996A	3.996A	3.996A	0 mA	0.000%
40%	3.995A	3.996A	3.997A	3.995A	2 mA	0.050%
60%	3.996A	3.996A	3.997A	3.995A	2 mA	0.050%
80%	3.996A	3.995A	3.993A	3.995A	3 mA	0.075%
100%	3.990A	3.990A	3.990A	3.990A	0 mA	0.000%
Load	6 mA	7 mA	7 mA	7 mA		
regulation	0.150%	0.175%	0.175%	0.175%		

2. Temperature drift

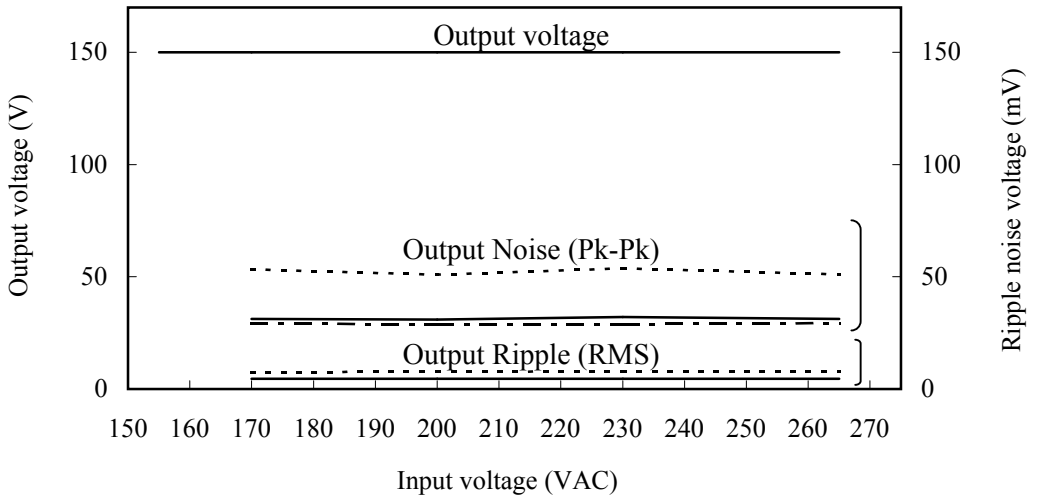
Conditions Vin : 200 VAC
Vout : 100 %

Ta	-10℃	+25℃	+45℃	Temperature stability	
Iout	4.000A	3.990A	3.990A	10mA	0.250%

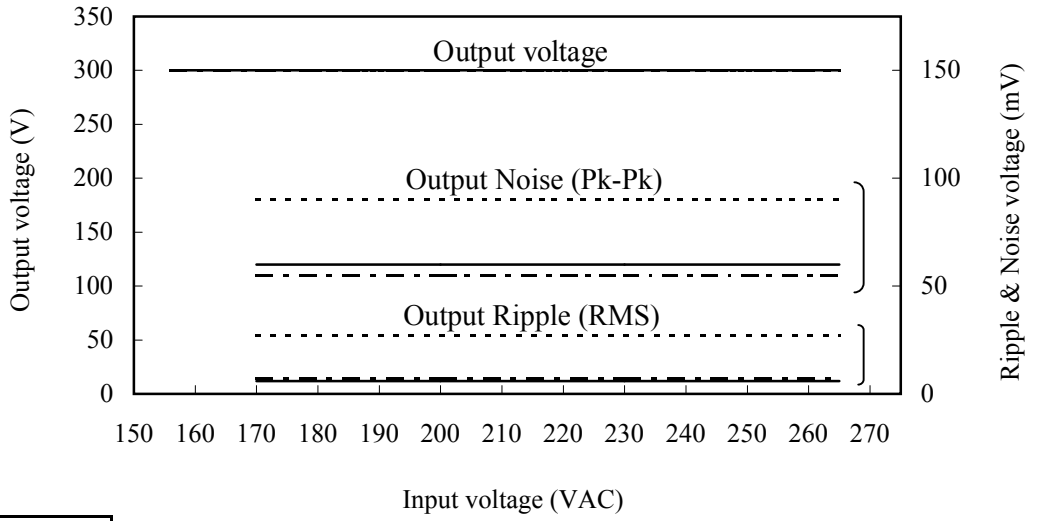
(2) Output voltage and Ripple noise voltage vs. Input voltage

Conditions Vout : 100 %
Iout : 100 %
C.V mode Ta : -10 ℃ ------
25 ℃ -·-·-·-
45 ℃ ——

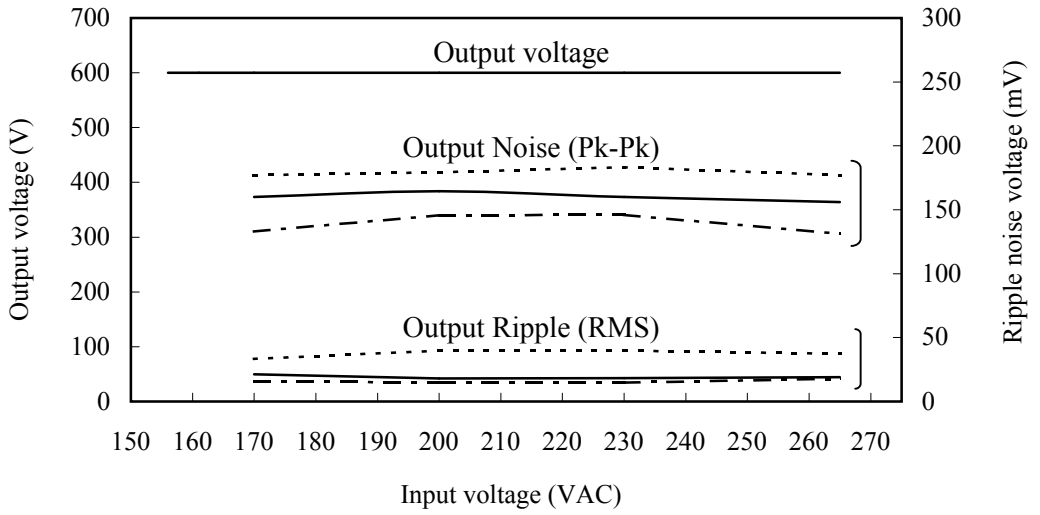
EVA150-16



EVA300-8



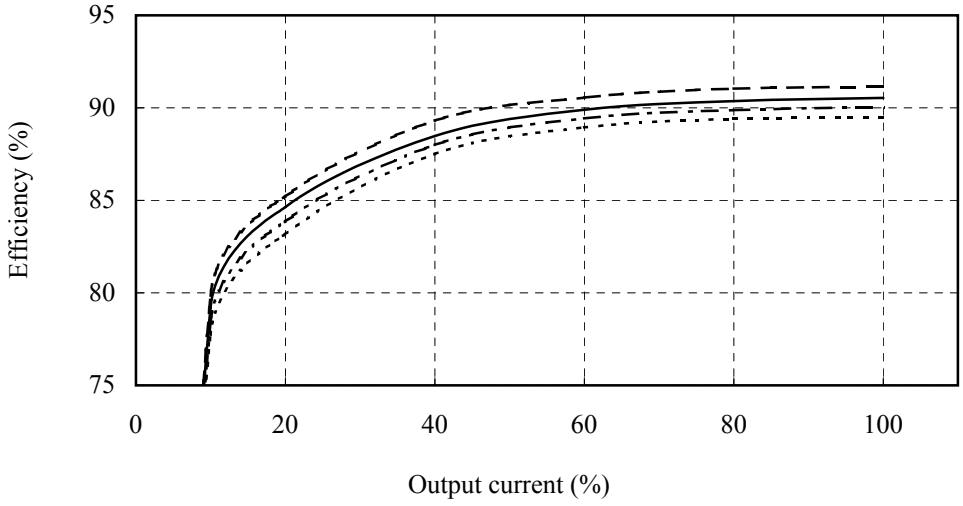
EVA600-4



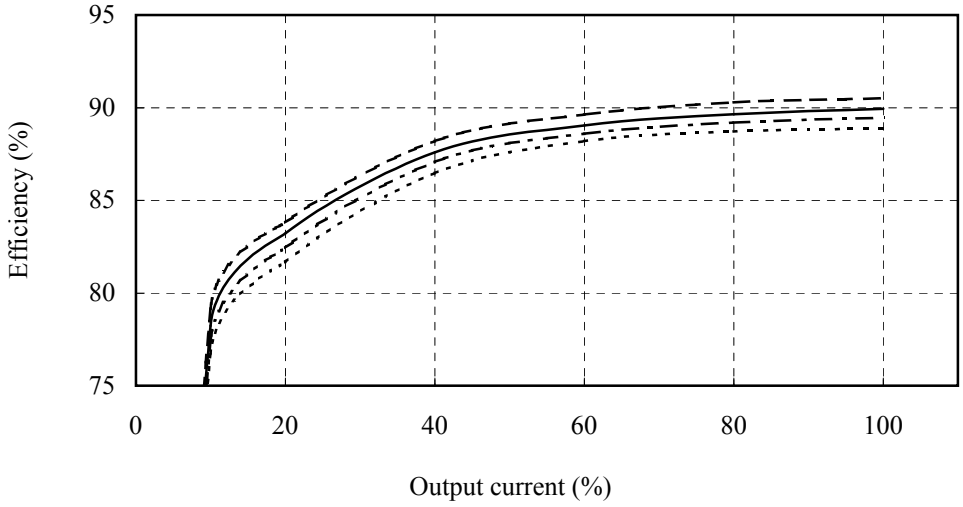
(3) Efficiency vs. Output current

Conditions Vin : 170 VAC ------
: 200 VAC —·—·—
: 230 VAC ——
: 265 VAC – – – –
Vo : 100 %
Ta : 25 ℃

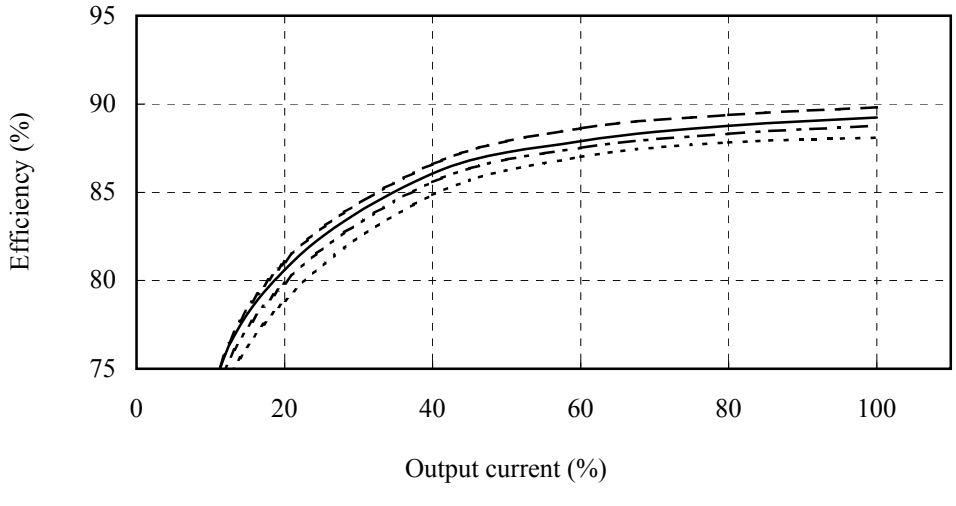
EVA150-16



EVA300-8



EVA600-4

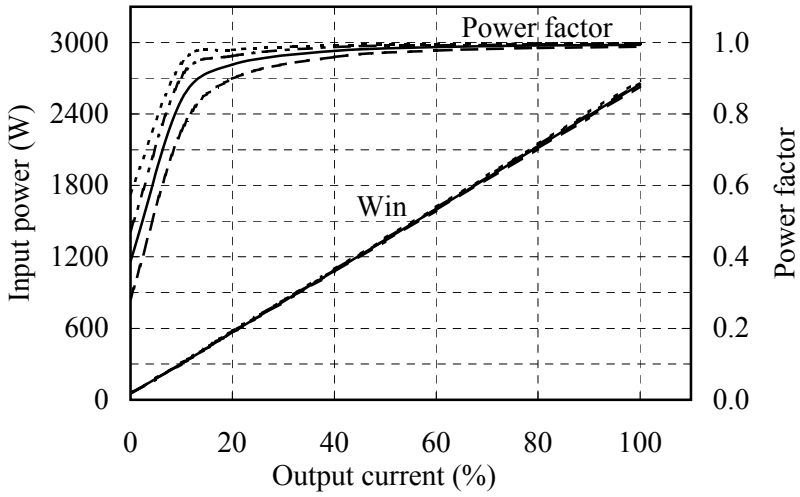


(4) Input power and Power factor vs. Output current

Conditions Vin : 170 VAC -----
: 200 VAC –·–·
: 230 VAC ——
: 265 VAC – – –
Vo : 100 %
Ta : 25 ℃
Auxiliary output : 5V,0A 15V,0A

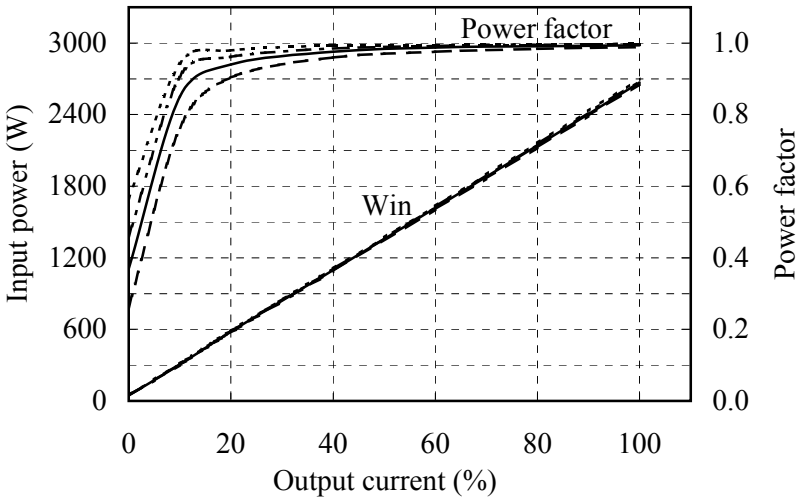
EVA150-16

Vin	Input power	
	Cont OFF	Vo: 100% Iout : 0%
170VAC	20W	53W
200VAC	20W	51W
230VAC	20W	50W
265VAC	20W	50W



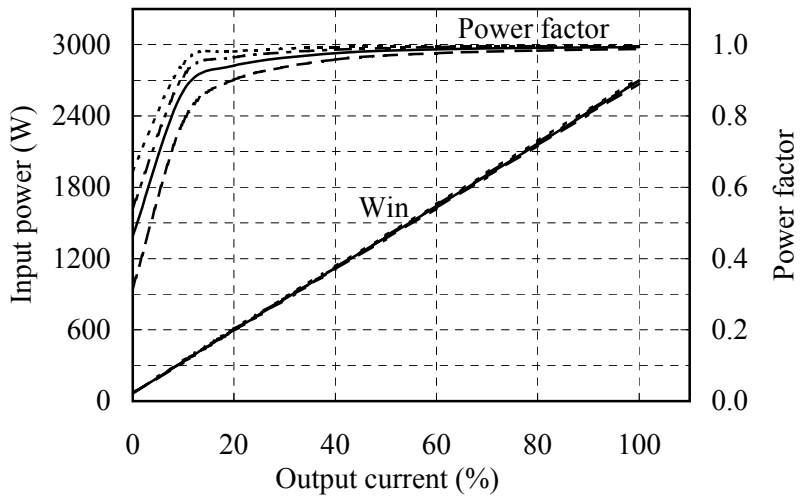
EVA300-8

Vin	Input power	
	Cont OFF	Vo: 100% Iout : 0%
170VAC	20W	48W
200VAC	20W	46W
230VAC	20W	45W
265VAC	20W	45W



EVA600-4

Vin	Input power	
	Cont OFF	Vo: 100% Iout : 0%
170VAC	20W	67W
200VAC	20W	65W
230VAC	20W	64W
265VAC	20W	63W

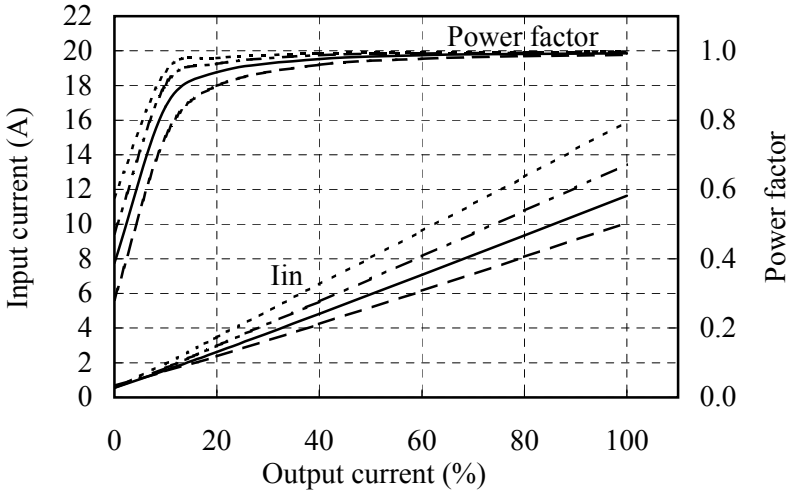


(5) Input current and Power factor vs. Output current

Conditions Vin : 170 VAC -----
: 200 VAC –·–·
: 230 VAC ——
: 265 VAC – – –
Vo : 100 %
Ta : 25 ℃
Auxiliary output : 5V,0A 15V,0A

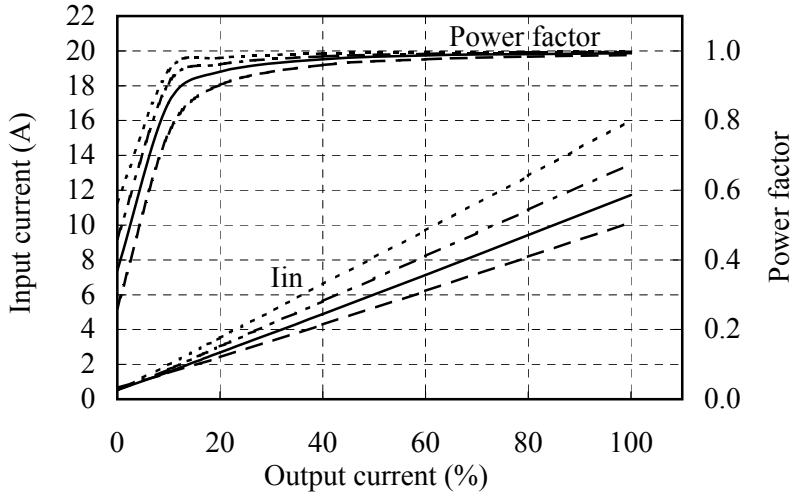
EVA150-16

Vin	Input current	
	Cont OFF	Vo: 100% Iout : 0%
170VAC	0.36A	0.54A
200VAC	0.38A	0.54A
230VAC	0.43A	0.56A
265VAC	0.52A	0.67A



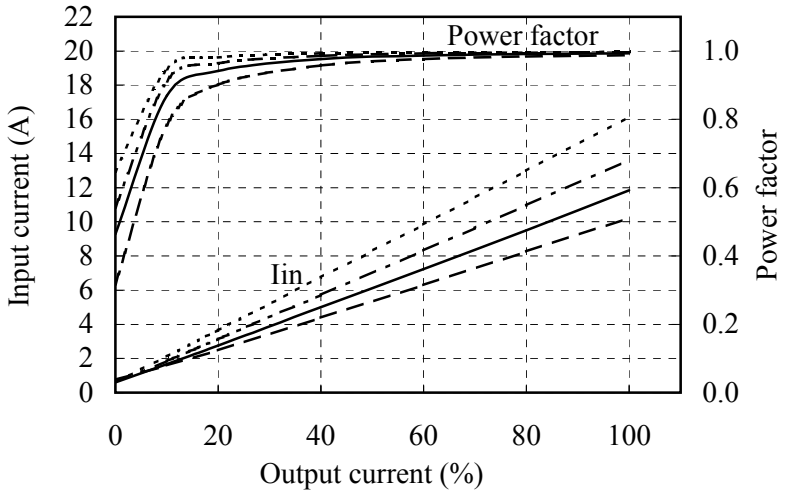
EVA300-8

Vin	Input current	
	Cont OFF	Vo: 100% Iout : 0%
170VAC	0.36A	0.50A
200VAC	0.38A	0.50A
230VAC	0.43A	0.53A
265VAC	0.52A	0.65A



EVA600-4

Vin	Input current	
	Cont OFF	Vo: 100% Iout : 0%
170VAC	0.36A	0.61A
200VAC	0.38A	0.60A
230VAC	0.43A	0.60A
265VAC	0.52A	0.75A

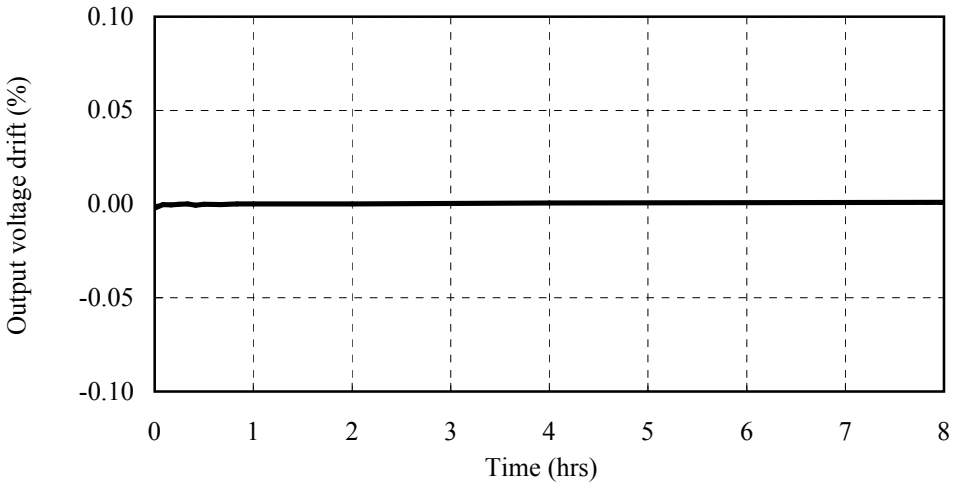


2.2 Warm up drift characteristics

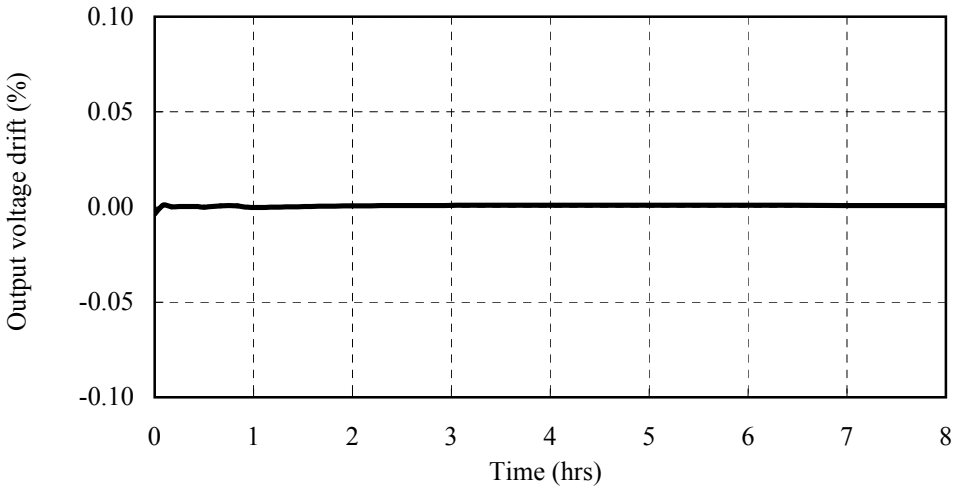
Conditions Vin : 200 VAC
Vout : 100 %
Iout : 100 %
Ta : 25 ℃

C.V mode

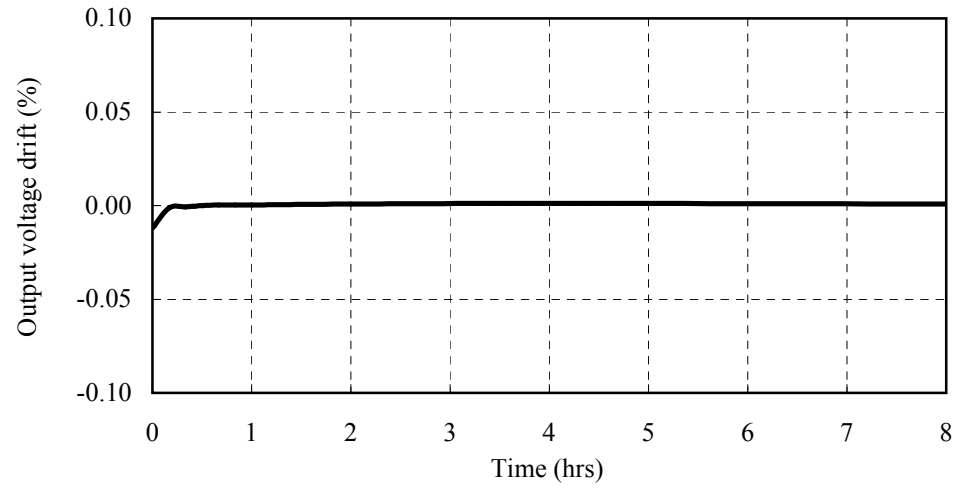
EVA150-16



EVA300-8



EVA600-4

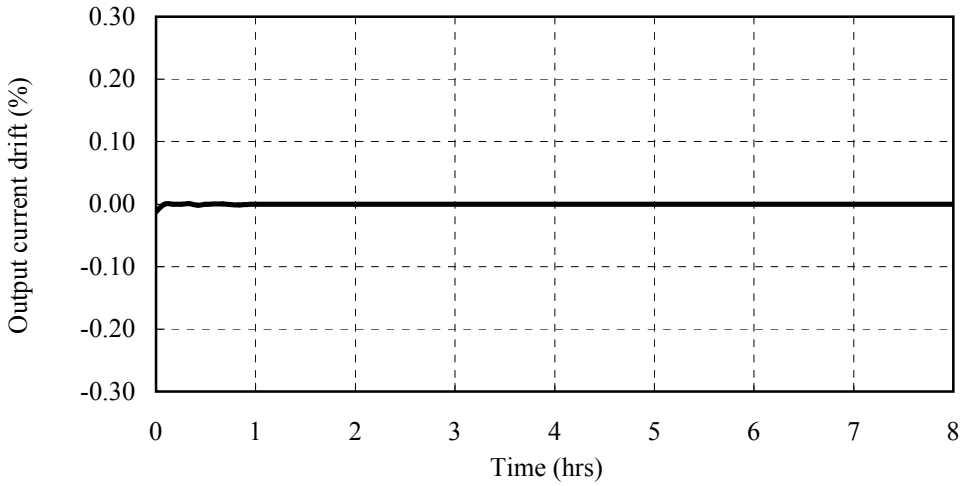


2.2 Warm up drift characteristics

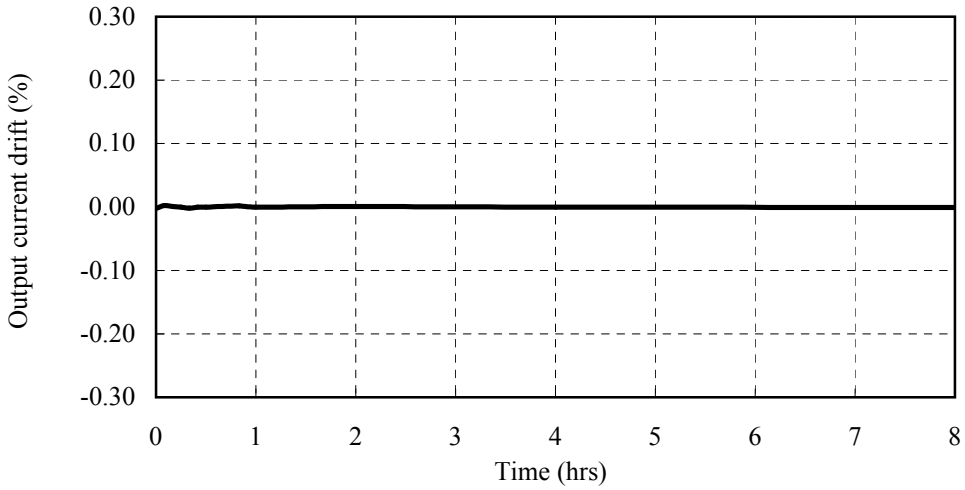
C.C mode

Conditions
Vin : 200 VAC
Vout : 100 %
Iout : 100 %
Ta : 25 ℃

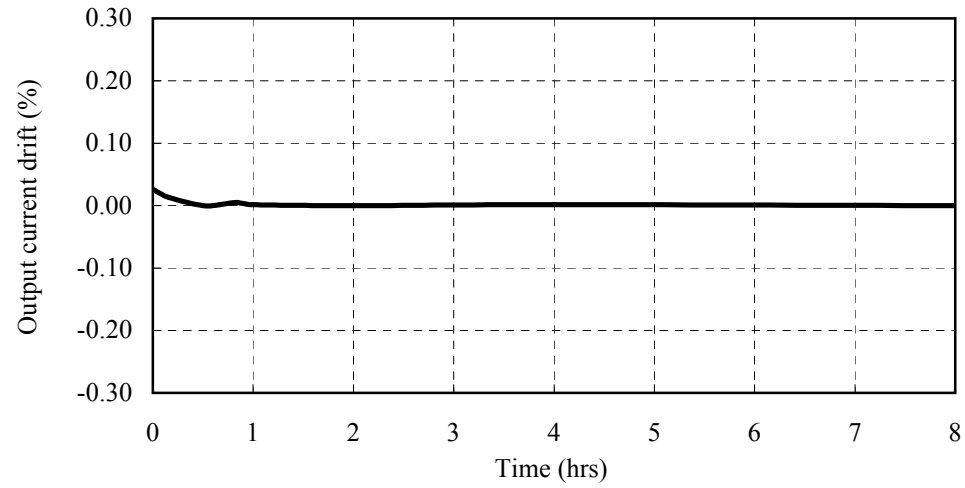
EVA150-16



EVA300-8



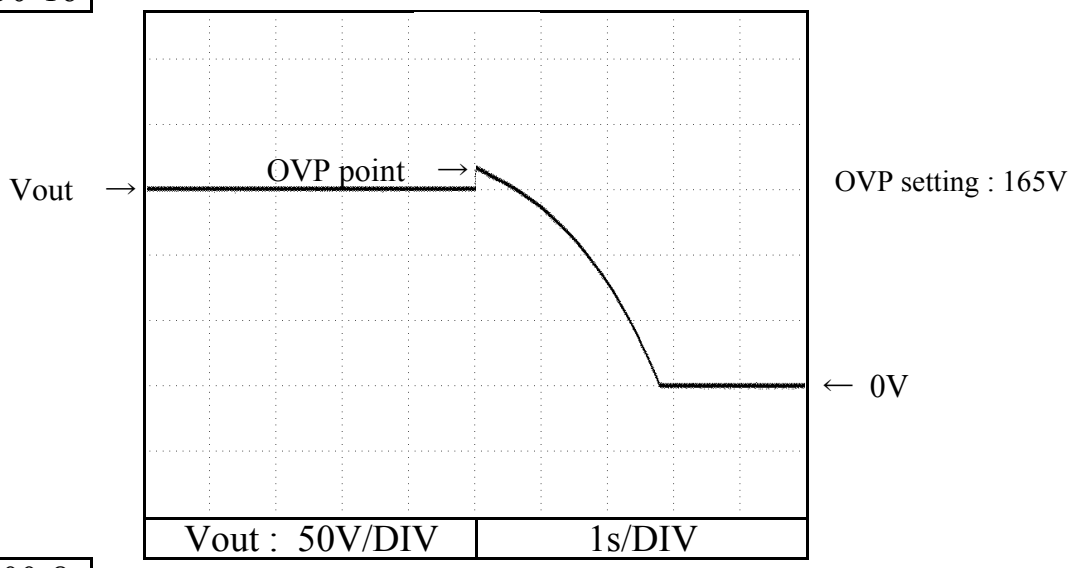
EVA600-4



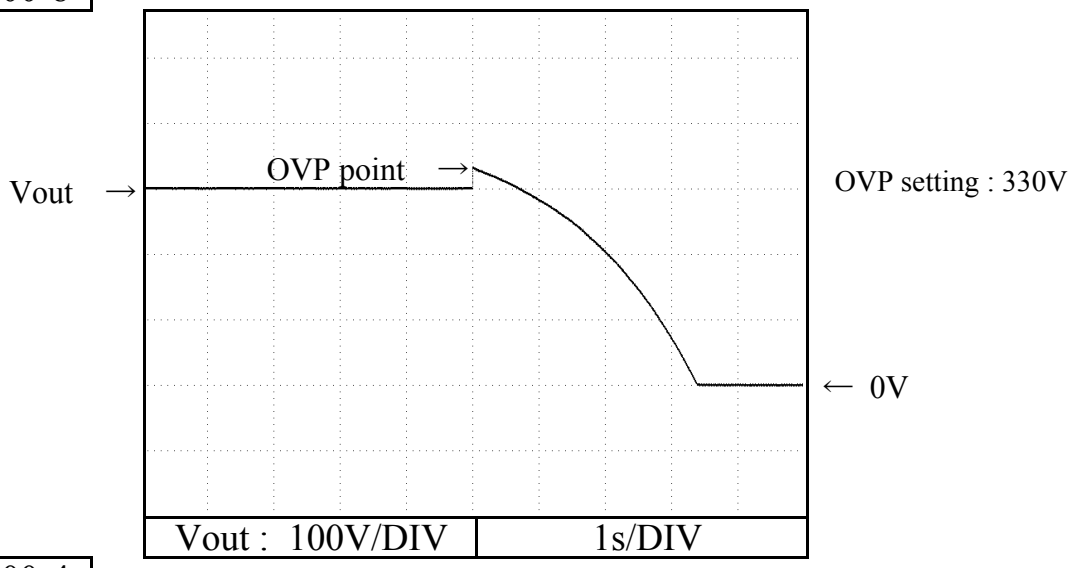
2.3 Over voltage protection (OVP) characteristics

Conditions
Vin : 200 VAC
Vout : 100 %
Iout : 0 %
Ta : 25 ℃

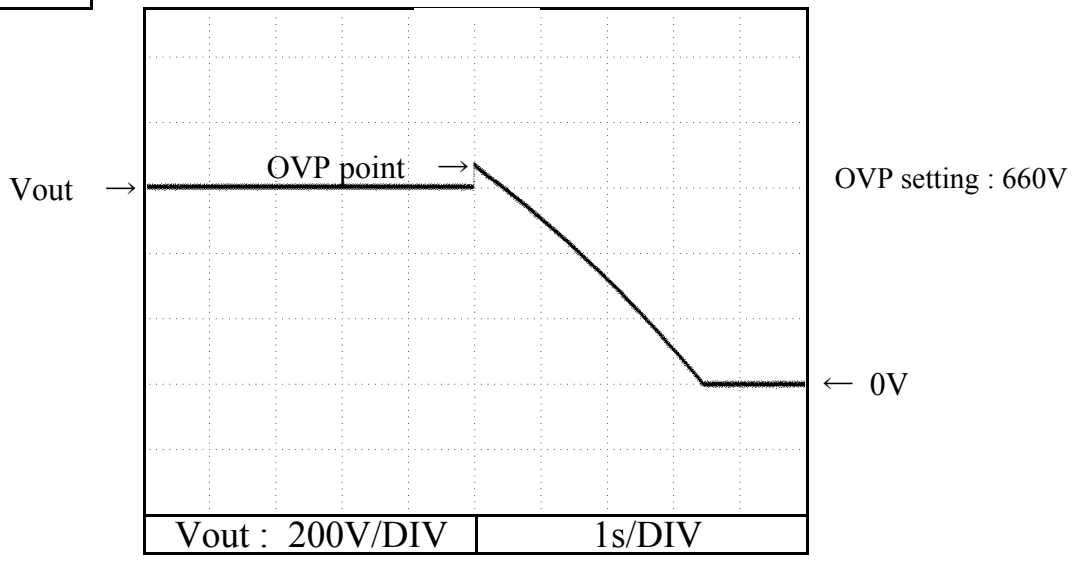
EVA150-16



EVA300-8



EVA600-4

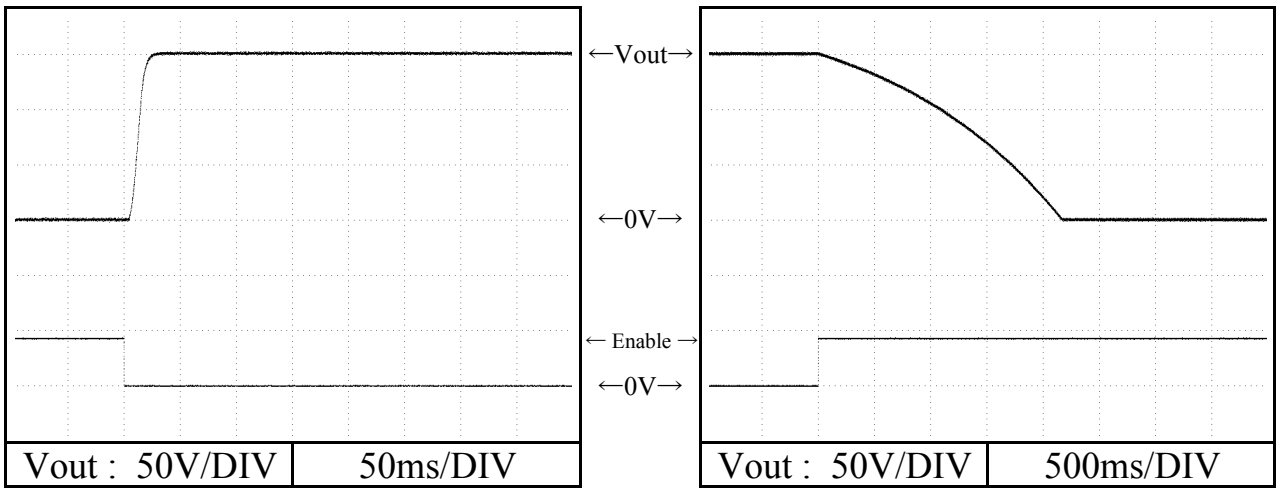


2.4 Output rise & fall characteristics with ON/OFF CONTROL by Enable

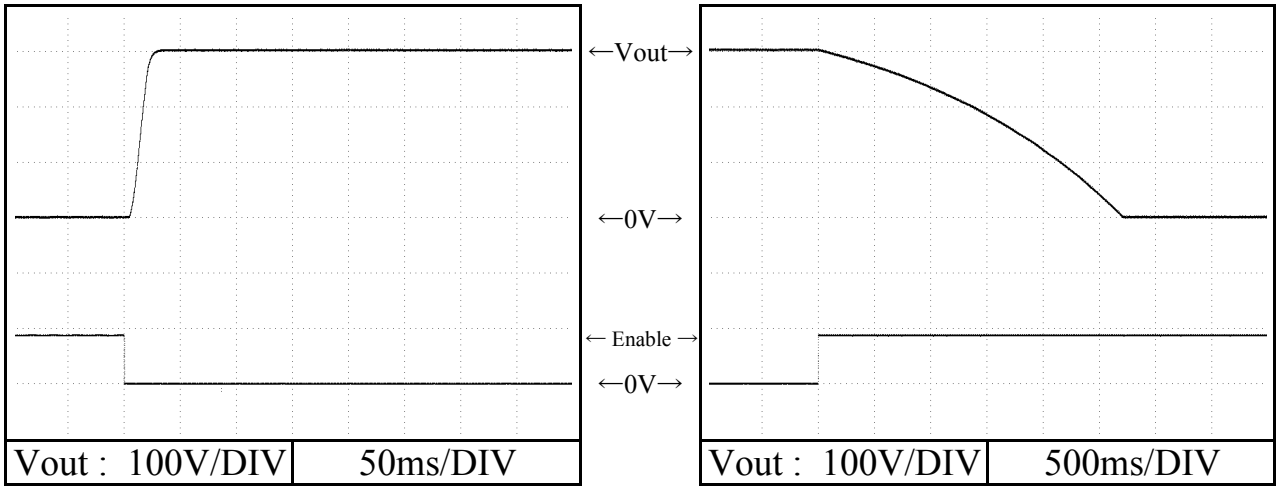
C.V mode

Conditions Vin : 200VAC
Vout : 100%
Iout : 0%
Ta : 25℃

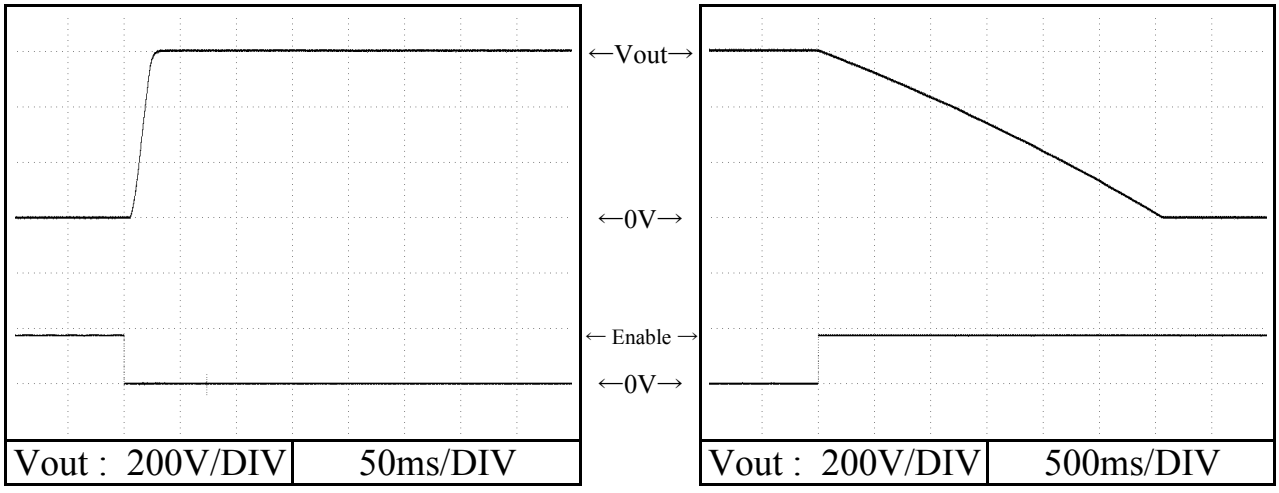
EVA150-16



EVA300-8



EVA600-4

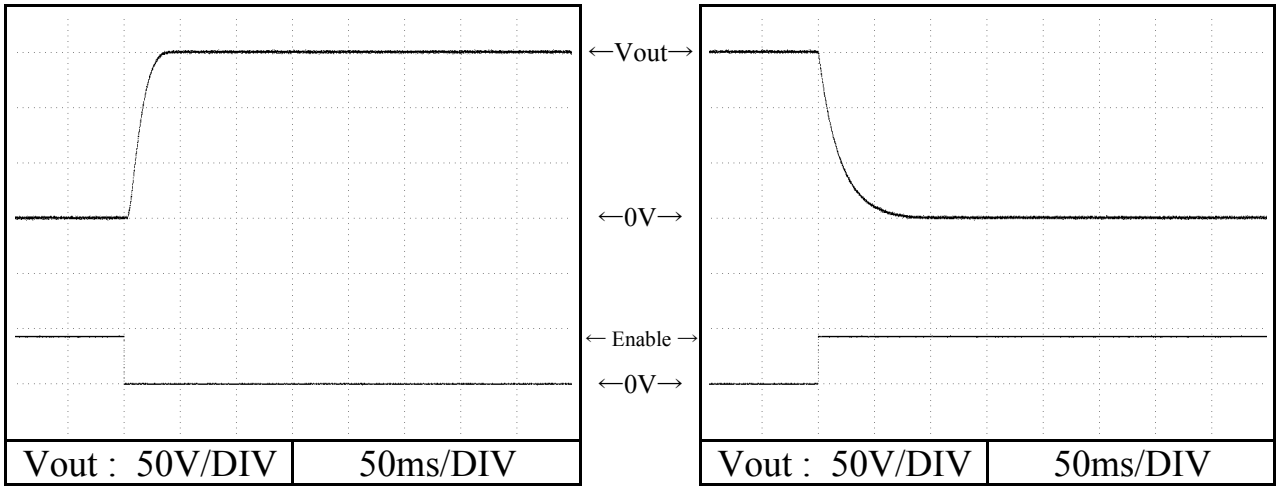


2.4 Output rise & fall characteristics with ON/OFF CONTROL by Enable

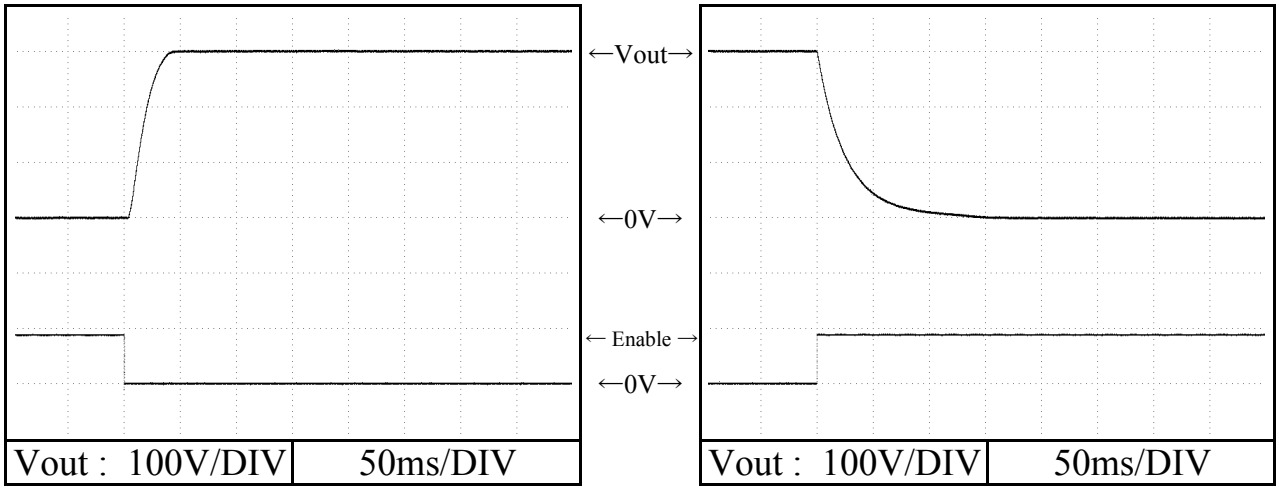
C.V mode

Conditions Vin : 200VAC
Vout : 100%
Iout : 100%
Load : CR
Ta : 25℃

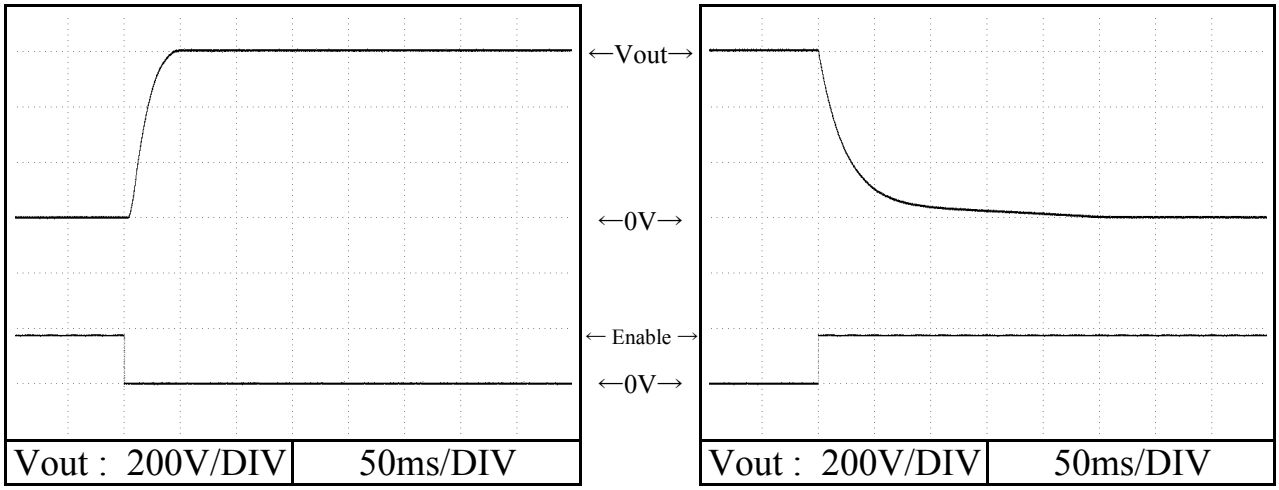
EVA150-16



EVA300-8



EVA600-4

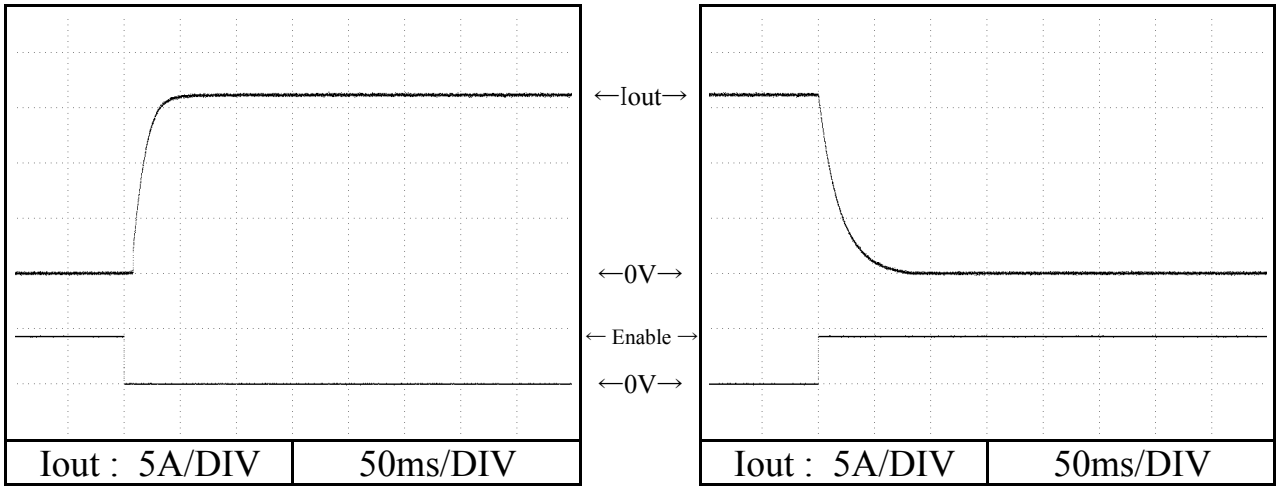


2.4 Output rise & fall characteristics with ON/OFF CONTROL by Enable

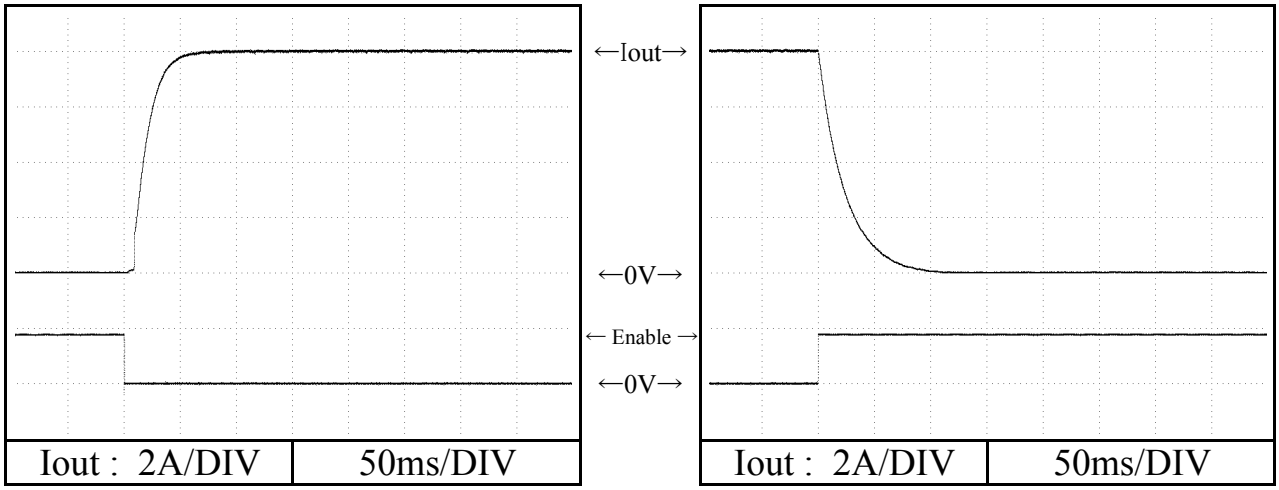
C.C mode

Conditions Vin : 200VAC
Vout : 100%
Iout : 100%
Load : CR
Ta : 25℃

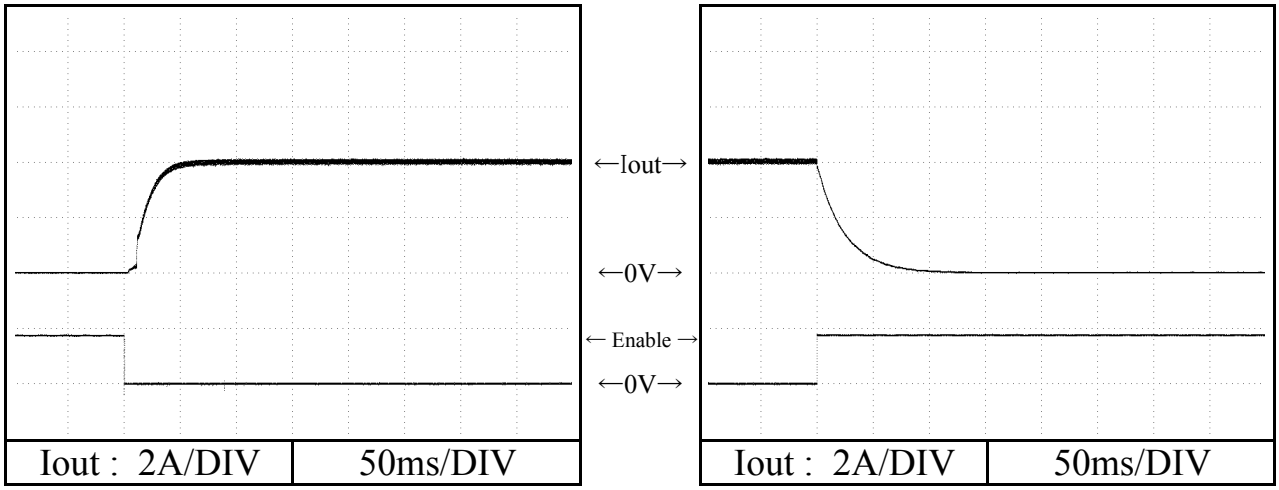
EVA150-16



EVA300-8



EVA600-4

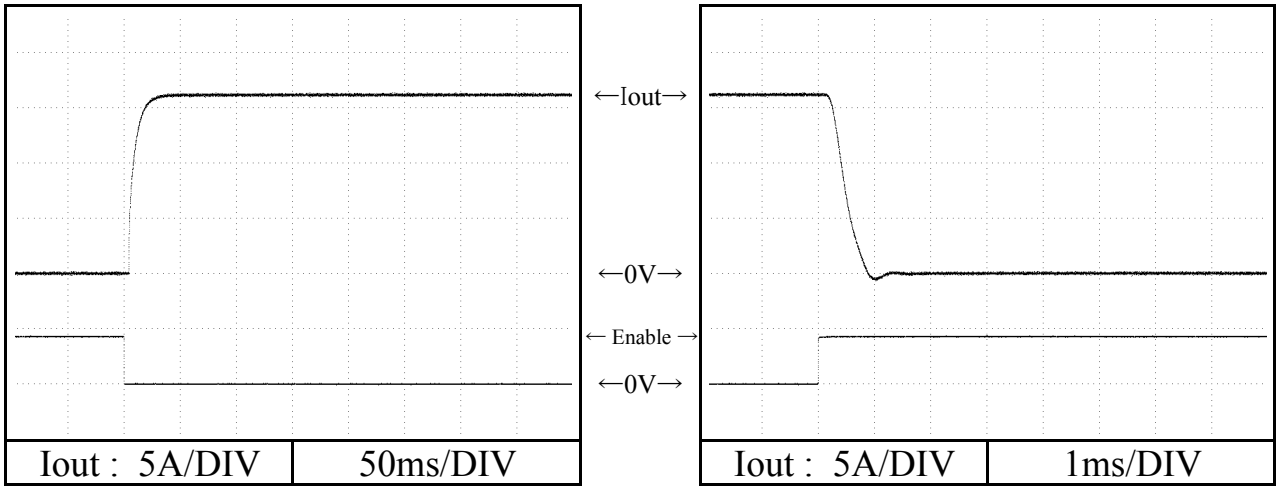


2.4 Output rise & fall characteristics with ON/OFF CONTROL by Enable

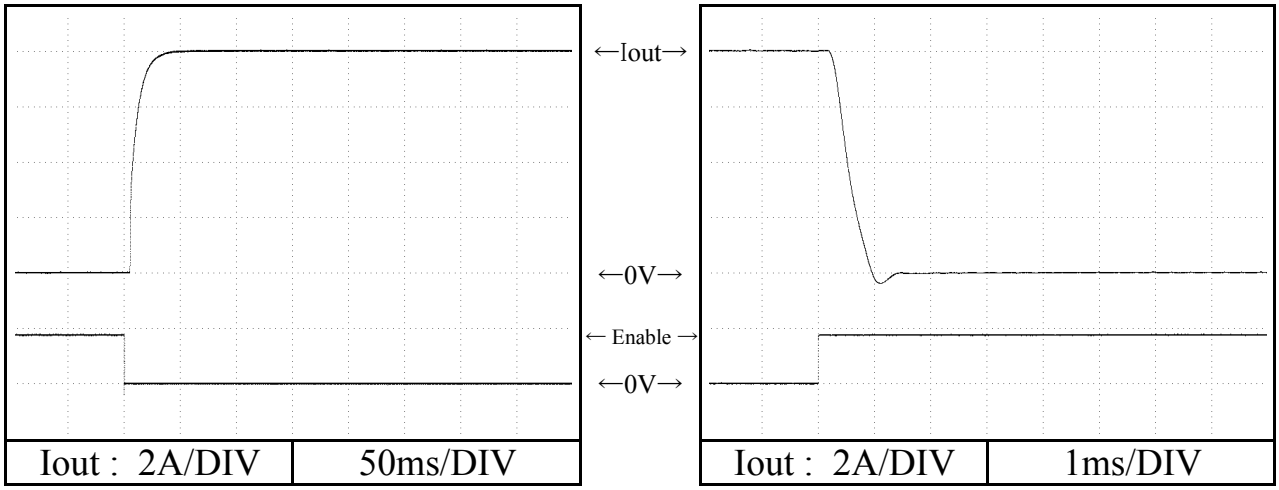
C.C mode

Conditions Vin : 200VAC
Vout : 100%
Iout : 100%
Load : Short
Ta : 25℃

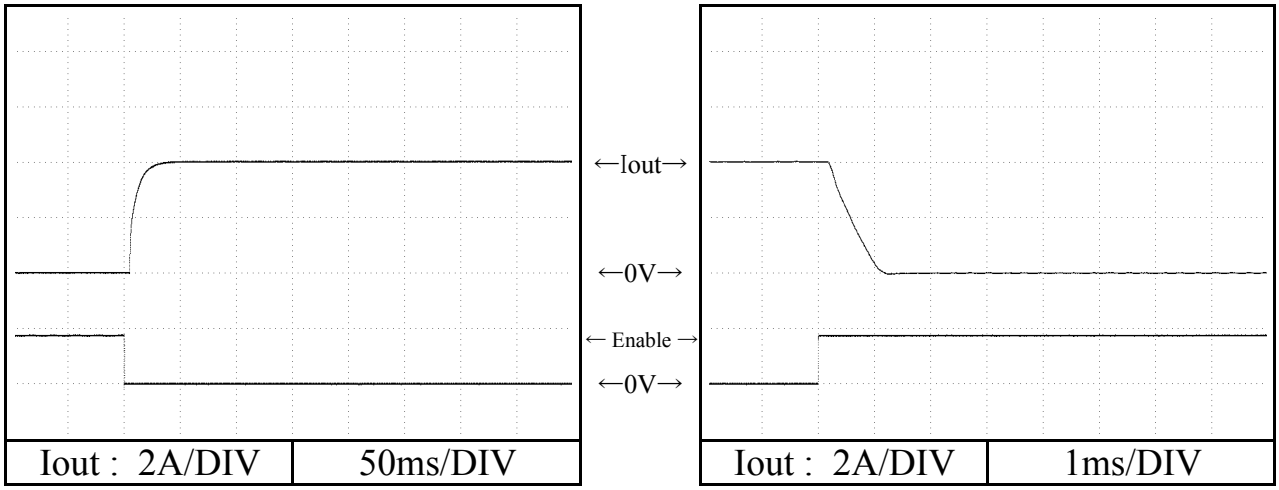
EVA150-16



EVA300-8



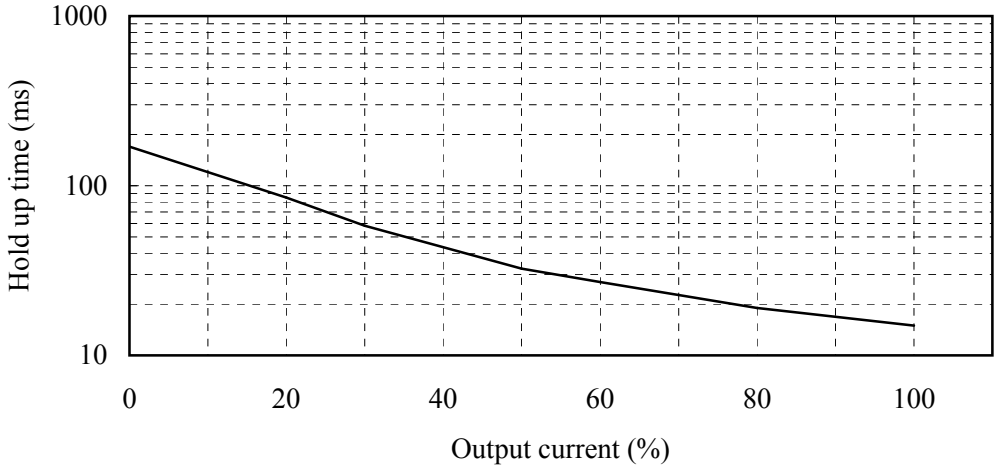
EVA600-4



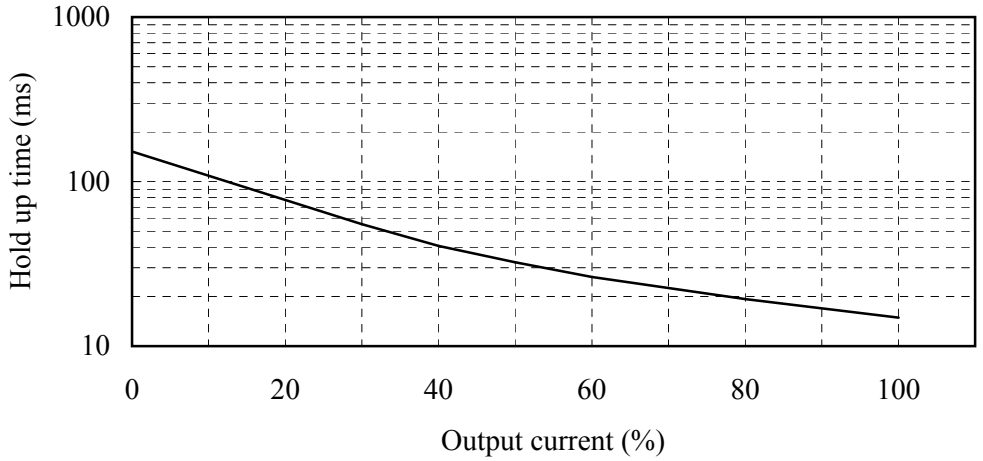
2.5 Hold up time characteristics

Conditions Vin : 200 VAC
Vout : 100 %
Ta : 25 ℃

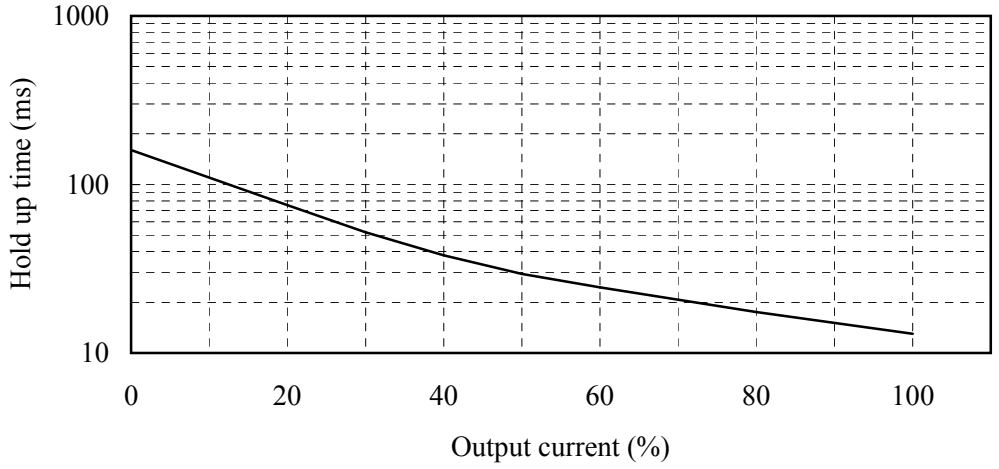
EVA150-16



EVA300-8



EVA600-4

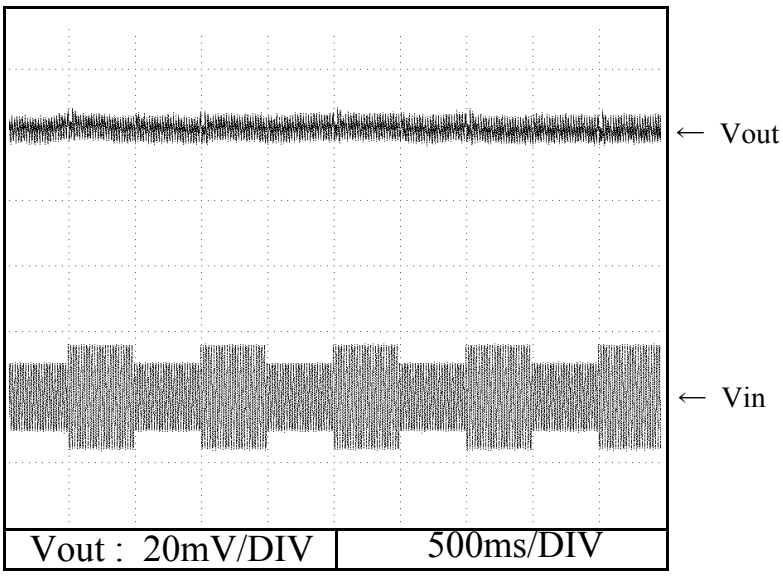


2.6 Dynamic line response characteristics

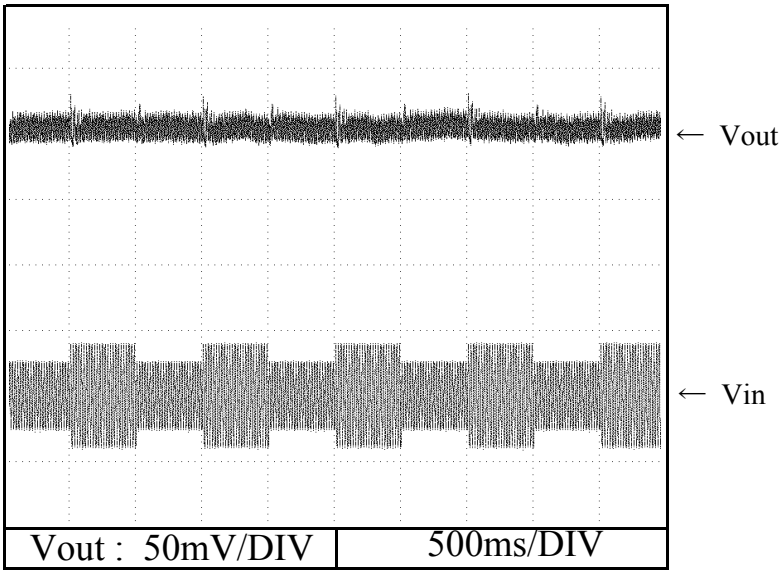
C.V mode

Conditions
Vin : 170 VAC←→265VAC
Vout : 100 %
Iout : 100 %
Ta : 25 ℃

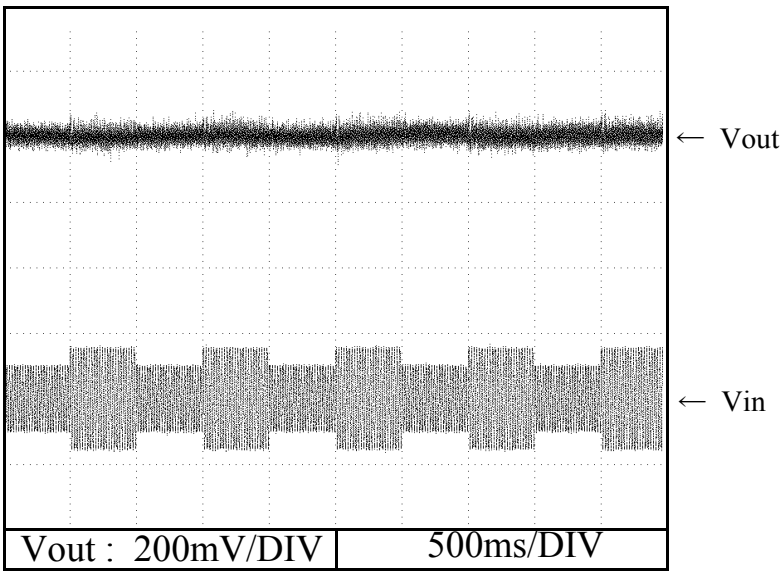
EVA150-16



EVA300-8



EVA600-4

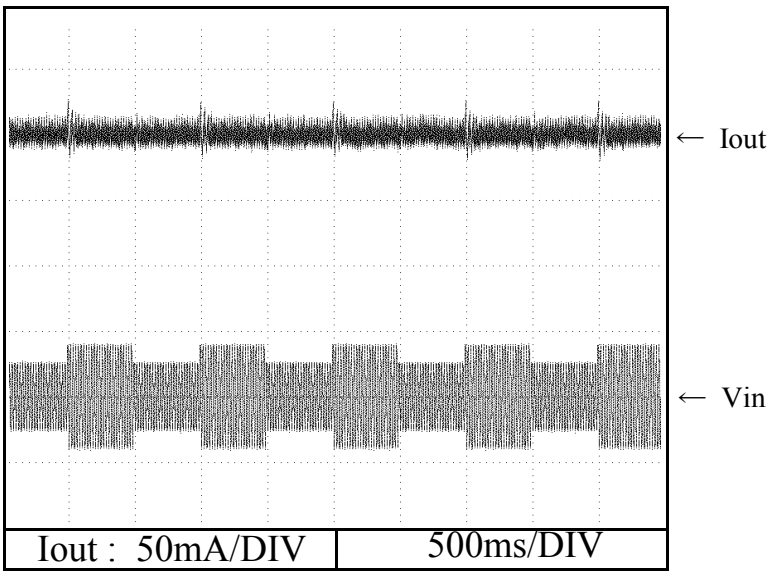


2.6 Dynamic line response characteristics

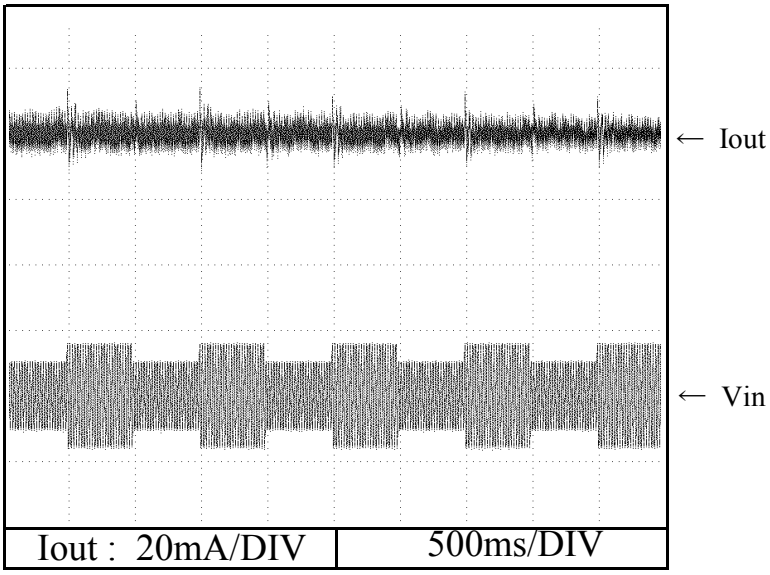
C.C mode

Conditions Vin : 170 VAC←→265VAC
Iout : 100 %
Ta : 25 ℃

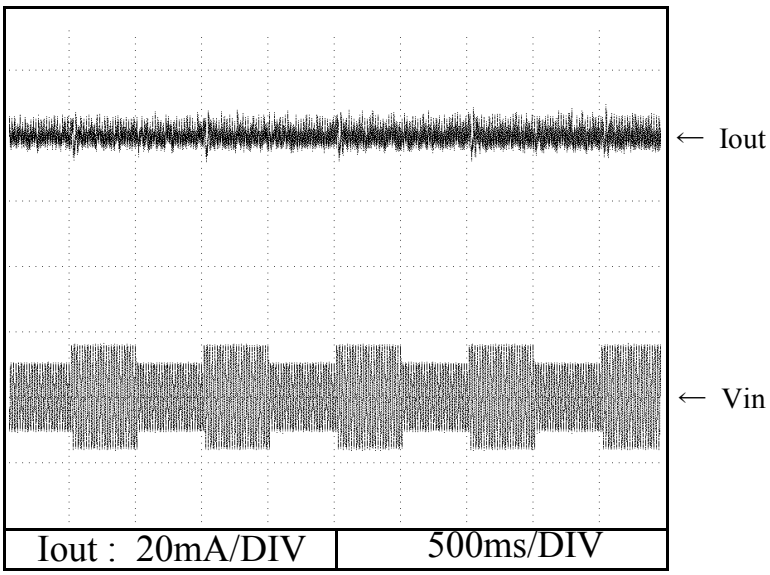
EVA150-16



EVA300-8



EVA600-4



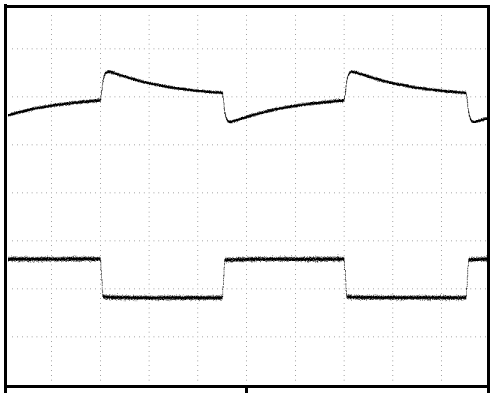
2.7 Dynamic load response characteristics

C.V mode

Conditions Vin : 200VAC
Vout : 100%
Iout : 50 % ⟷ 100 %
(tr = tf = 100us)
Ta : 25 ℃

EVA150-16

f = 100Hz



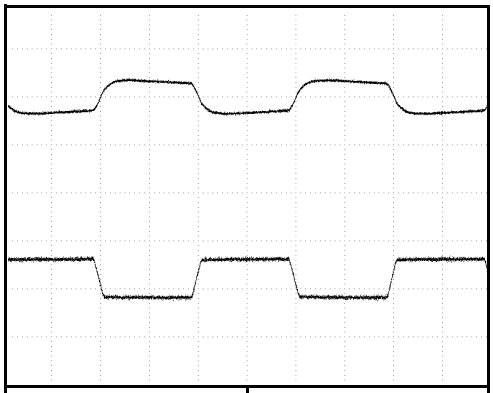
Vout : 0.5V/DIV	2ms/DIV
+0.19%	-0.19%

← Vout →

← Iout →

← 0A →

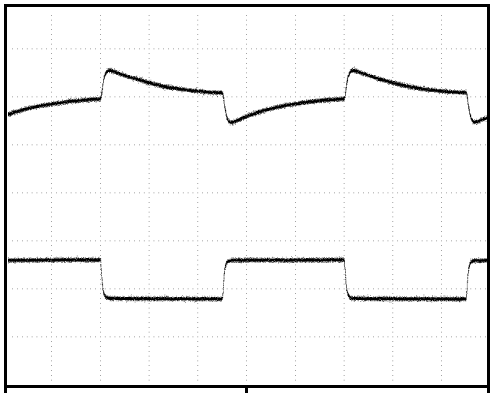
f = 500Hz



Vout : 0.5V/DIV	500µs/DIV
+0.13%	-0.13%

EVA300-8

f = 100Hz



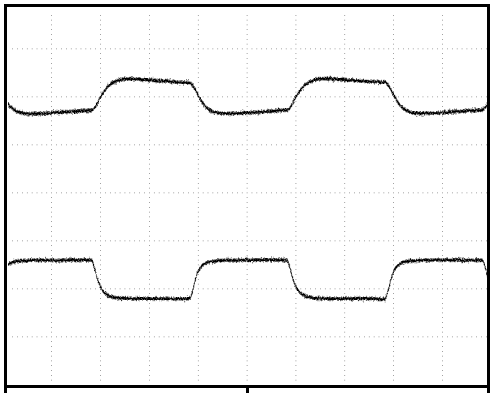
Vout : 1V/DIV	2ms/DIV
+0.21%	-0.20%

← Vout →

← Iout →

← 0A →

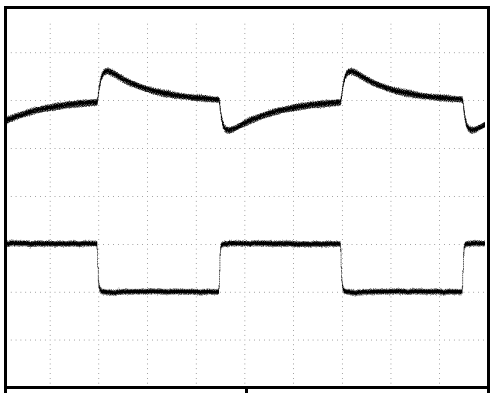
f = 500Hz



Vout : 1V/DIV	500µs/DIV
+0.15%	-0.14%

EVA600-4

f = 100Hz



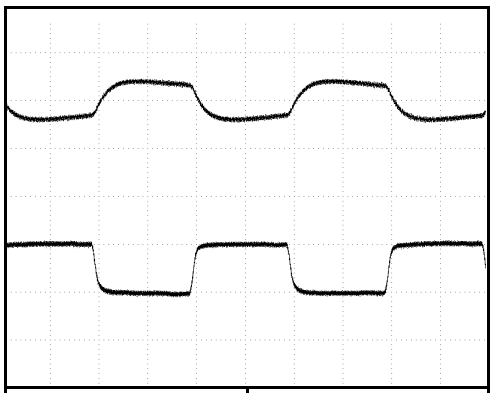
Vout : 2V/DIV	2ms/DIV
+0.24%	-0.24%

← Vout →

← Iout →

← 0A →

f = 500Hz



Vout : 2V/DIV	500µs/DIV
+0.16%	-0.16%

2.7 Dynamic load response characteristics

C.C mode

Conditions Vin : 200VAC
Vout : 75 % ⟷ 90 %
f : 10Hz
Ta : 25 ℃

EVA150-16

Iout : 100 %

Iout : 2A/DIV	2ms/DIV
+20.9%	-18.1%

← Iout →

Iout : 50 %

Iout : 2A/DIV	2ms/DIV
+13.0%	-11.0%

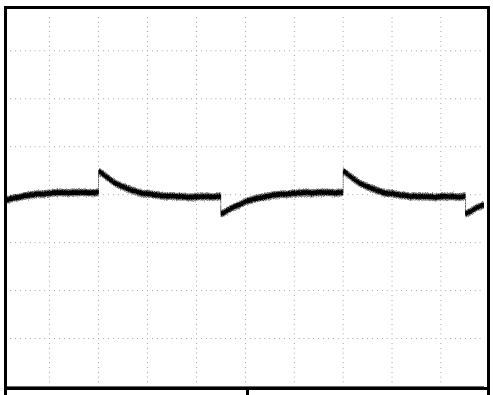
EVA300-8

Iout : 100 %

Iout : 2A/DIV	20ms/DIV
+23.8%	-20.1%

← Iout →

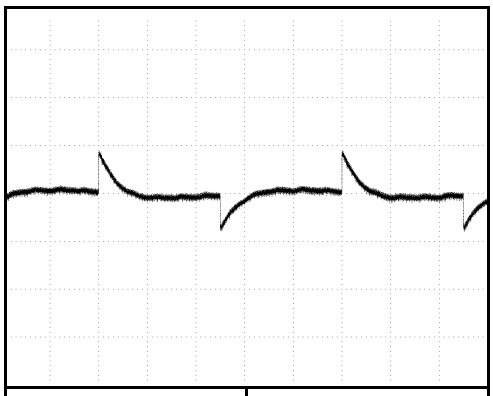
Iout : 50 %



Iout : 2A/DIV	20ms/DIV
+14.3%	-11.9%

EVA600-4

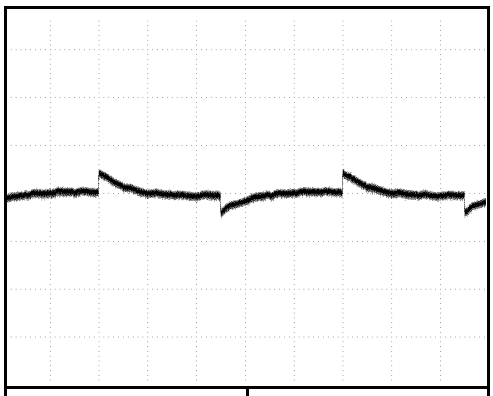
Iout : 100 %



Iout : 1A/DIV	20ms/DIV
+22.3%	-20.1%

← Iout →

Iout : 50 %



Iout : 1A/DIV	20ms/DIV
+12.7%	-12.7%

2.8 Response to brown out characteristics

C.V mode

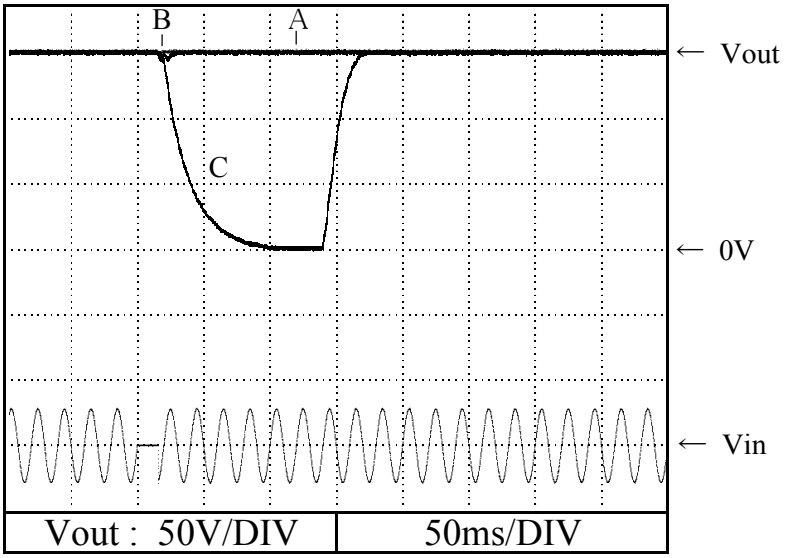
Conditions Vin : 200 VAC
Vout : 100 %
Iout : 100 %
Ta : 25 ℃

EVA150-16

A = 16ms

B = 17ms

C = 18ms

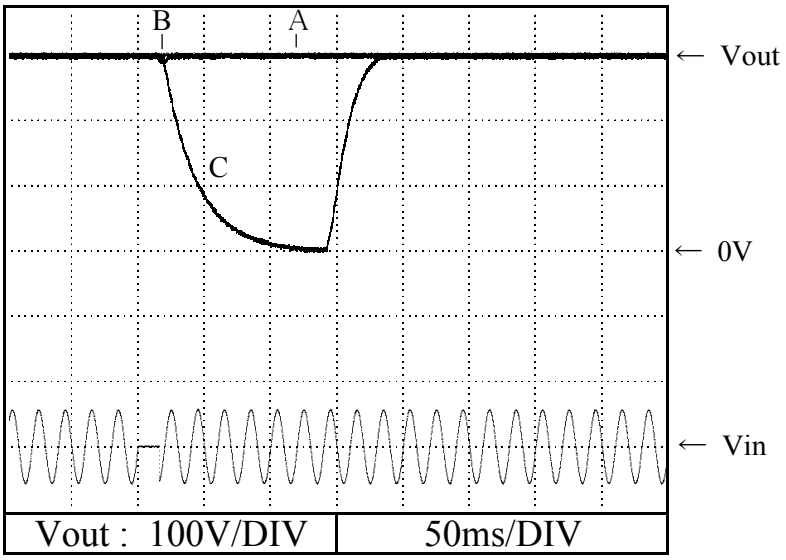


EVA300-8

A = 16ms

B = 17ms

C = 18ms

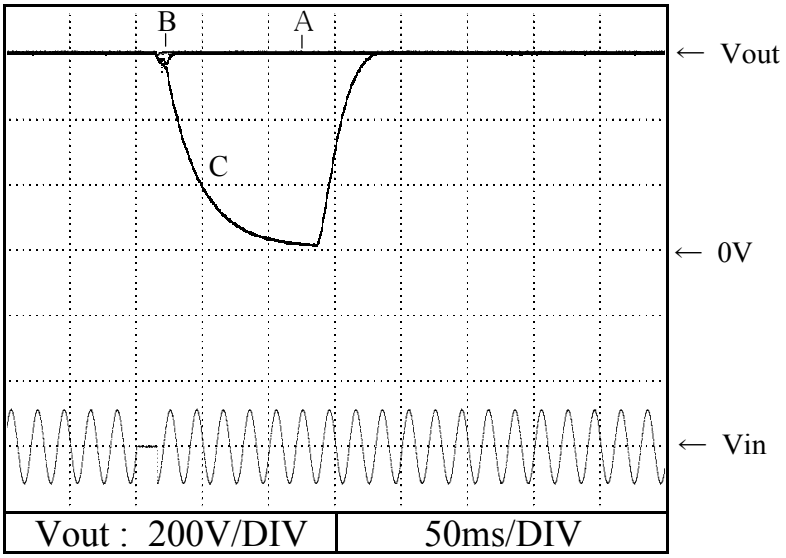


EVA600-4

A = 14ms

B = 15ms

C = 16ms



2.8 Response to brown out characteristics

C.C mode

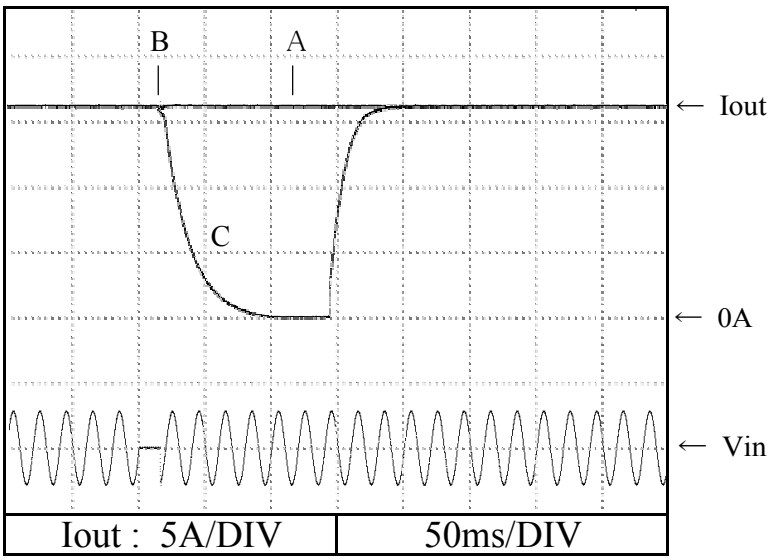
Conditions Vin : 200 VAC
Vout : 100 %
Iout : 100 %
Ta : 25 ℃

EVA150-16

A = 16ms

B = 17ms

C = 18ms

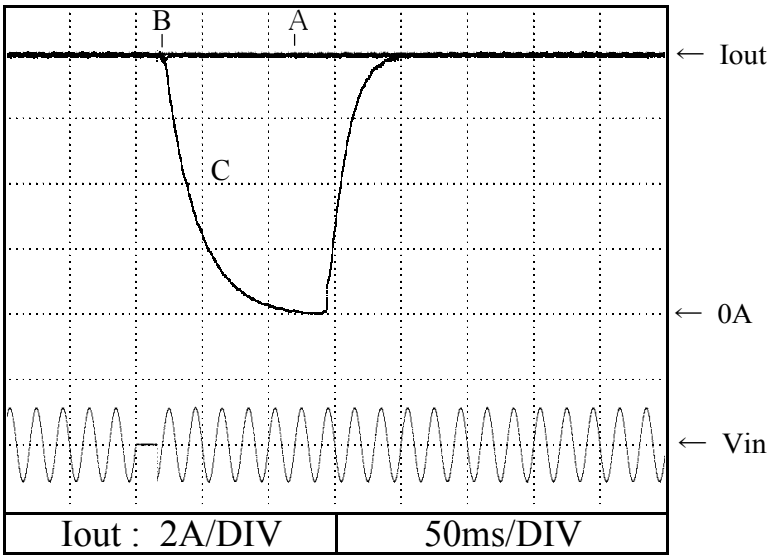


EVA300-8

A = 16ms

B = 17ms

C = 18ms

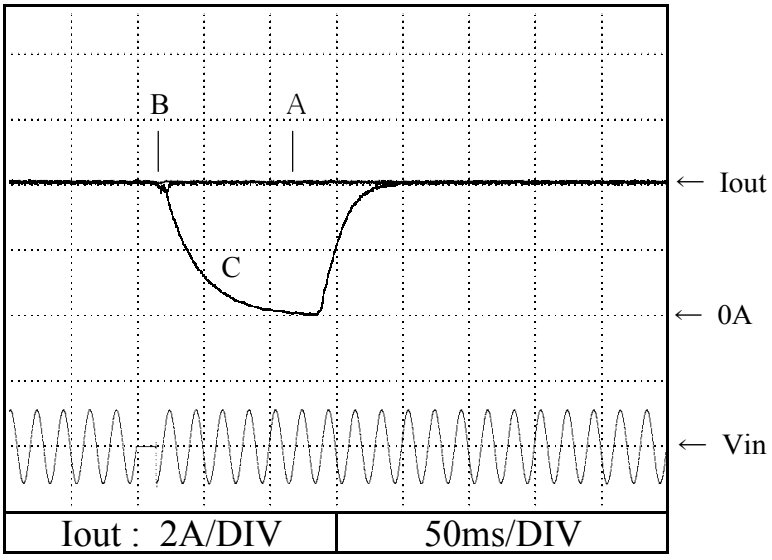


EVA600-4

A = 14ms

B = 15ms

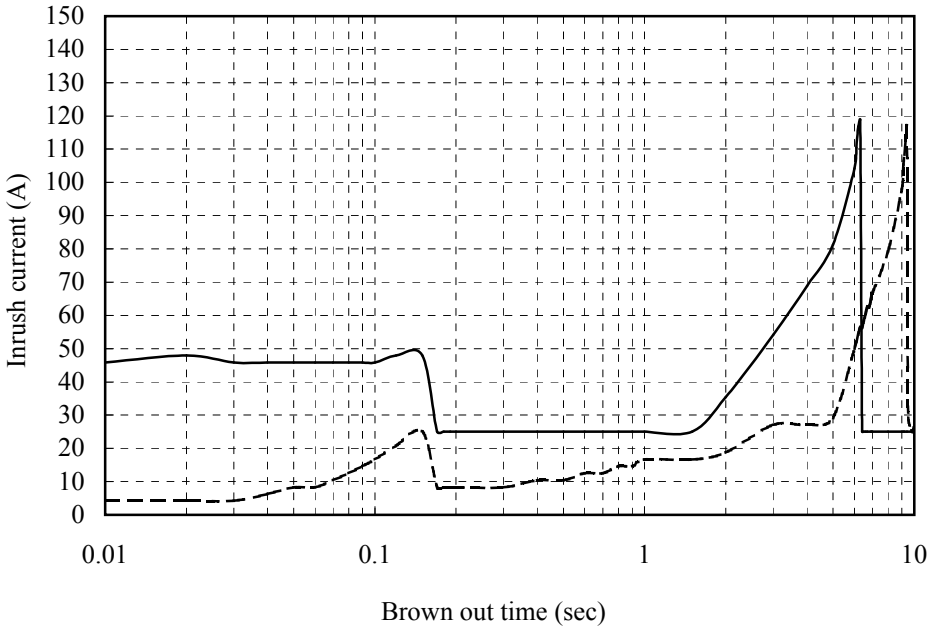
C = 16ms



2.9 Inrush current characteristics during line brown outs

Conditions Vout : 100 %
Iout : 0 % ----
100 % ——
Ta : 25 ℃

Vin: 200VAC



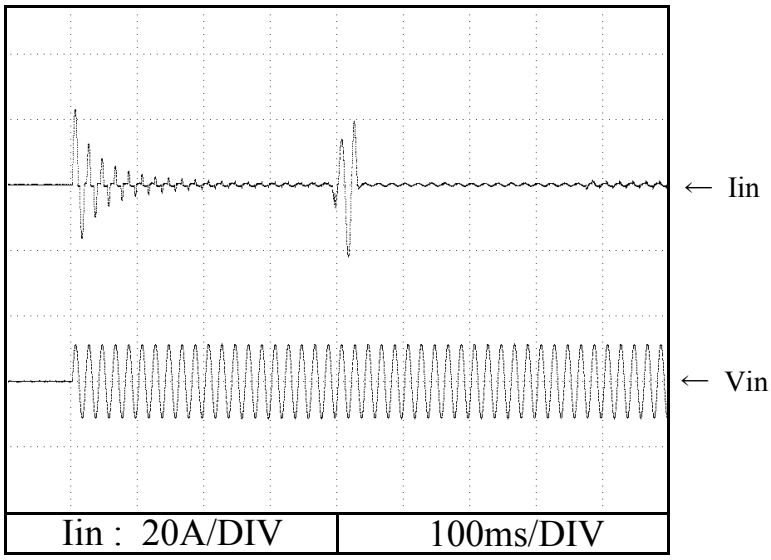
* Above data includes secondary inrush current.

2.10 Inrush current waveform

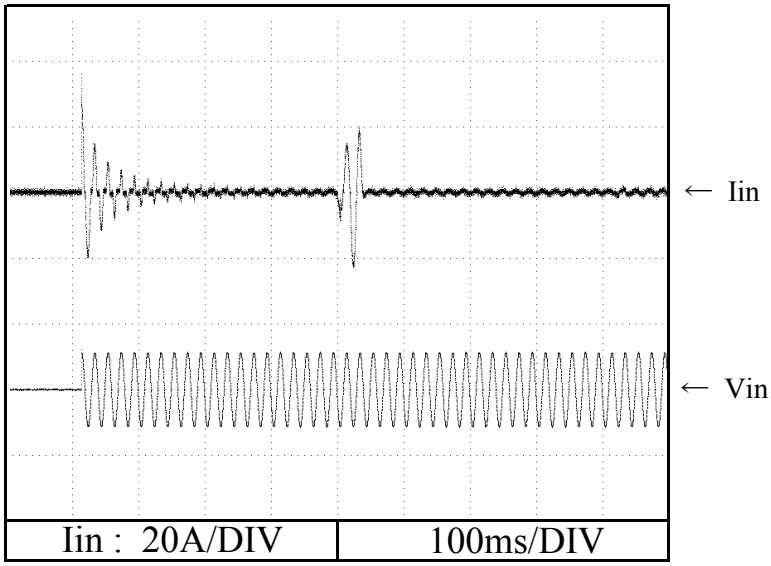
Conditions Vout : 100 %
Iout : 100 %
Ta : 25 ℃

Vin: 200VAC

Switch on phase angle of input AC voltage ϕ =0°



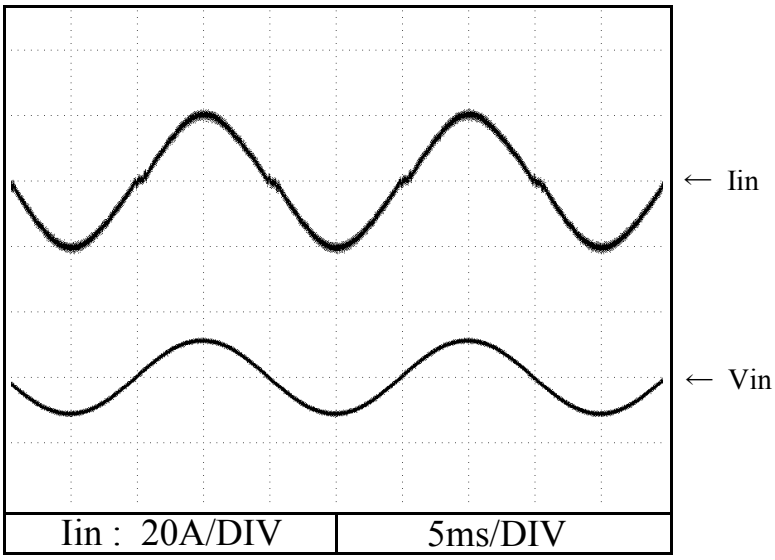
Switch on phase angle of input AC voltage ϕ =90°



2.11 Input current waveform

Conditions Vout : 100 %
Iout : 100 %
Ta : 25 ℃

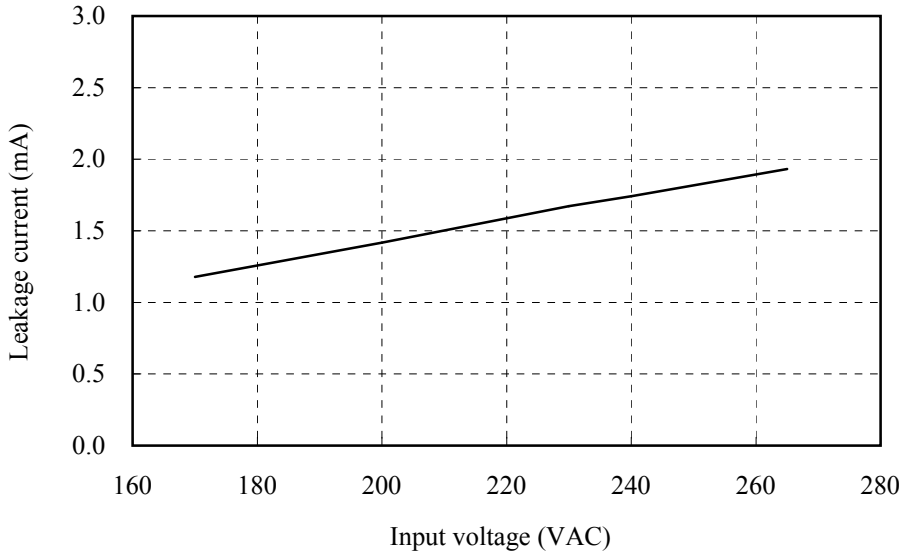
Vin: 200VAC



2.12 Leakage current characteristics

Conditions Ta : 25 ℃
f : 60 Hz

Vin: 170 ~ 265VAC



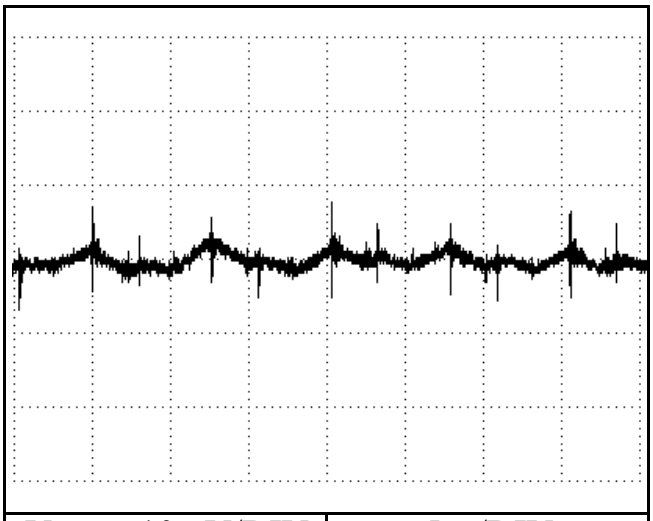
2.13 Output ripple and noise waveform

C.V mode

Conditions Vin : 200 VAC
Vout : 100 %
Iout : 100 %
Ta : 25 ℃

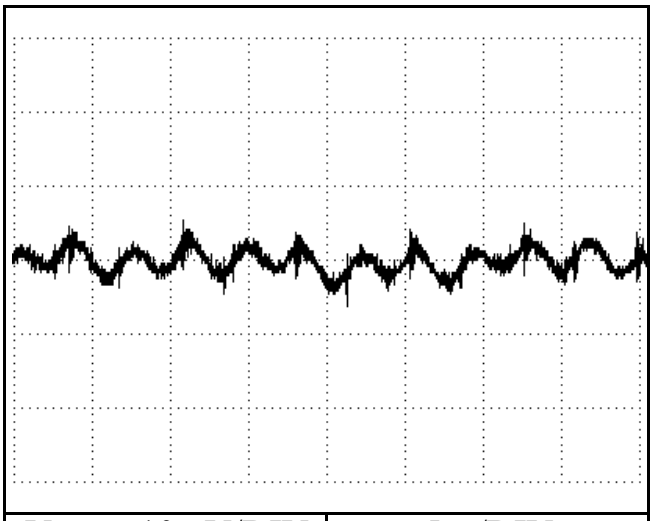
Normal Mode

EVA150-16



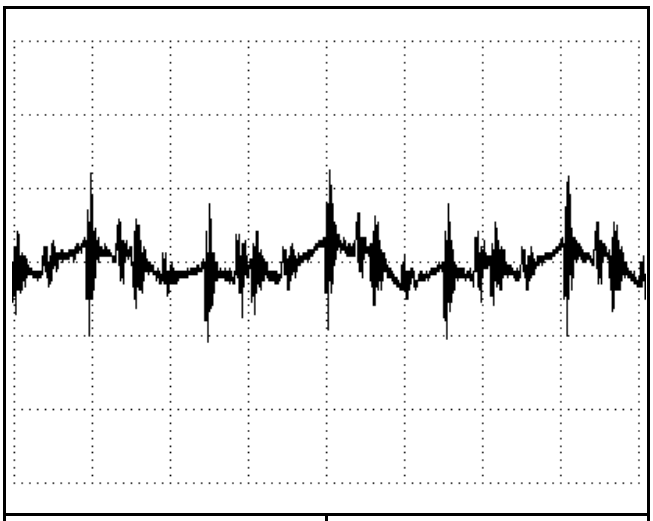
Vout : 10mV/DIV | 5μs/DIV

EVA300-8



Vout : 10mV/DIV | 5μs/DIV

EVA600-4



Vout : 50mV/DIV | 5μs/DIV

2.14 Electromagnetic interference characteristics

Conditions Vin : 200VAC
Vout : 100%
Iout : 100%
Ta : 25℃

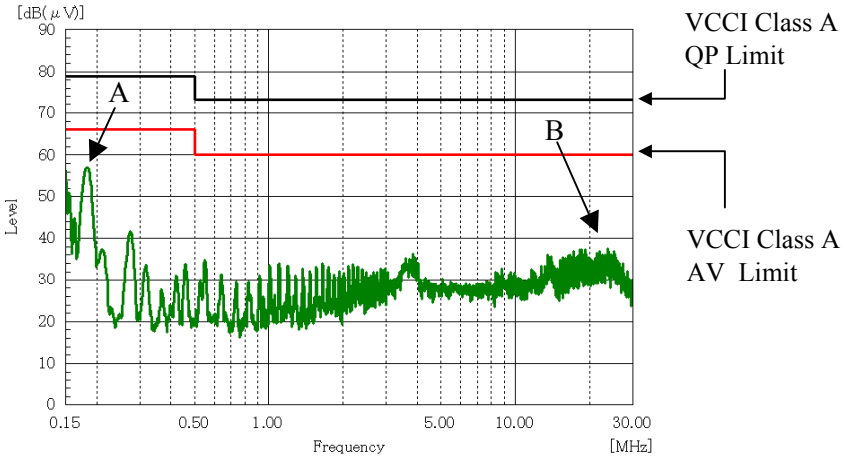
Conducted emission

EVA150-16

Ref. Data	Point A (182kHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	79.0	55.9	23.1
AV	66.0	49.0	17.0

Ref. Data	Point B (23.6MHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	73.0	32.7	40.3
AV	60.0	29.4	30.6

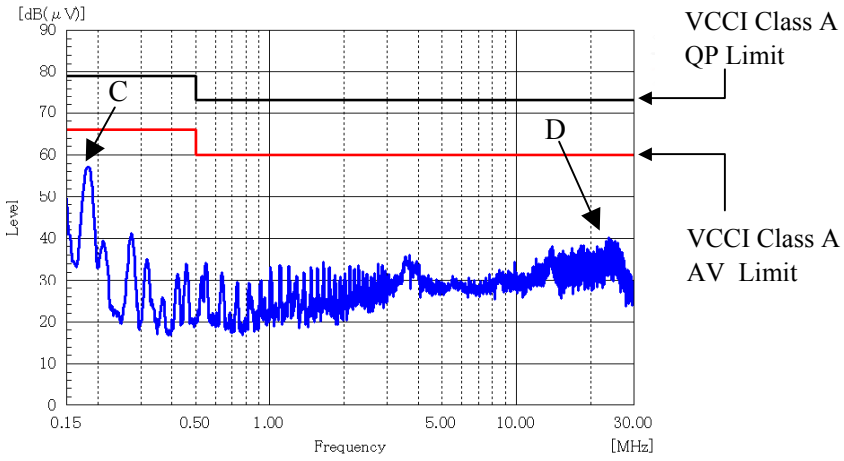
Phase : N



Ref. Data	Point C (182kHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	79.0	55.8	23.2
AV	66.0	48.8	17.2

Ref. Data	Point D (23.8MHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	73.0	36.5	36.5
AV	60.0	33.5	26.5

Phase : L



Limit of EN55011-A,EN55022-A,FCC-A are same as its VCCI class A.

2.14 Electromagnetic interference characteristics

Conditions Vin : 200VAC
Vout : 100%
Iout : 100%
Ta : 25℃

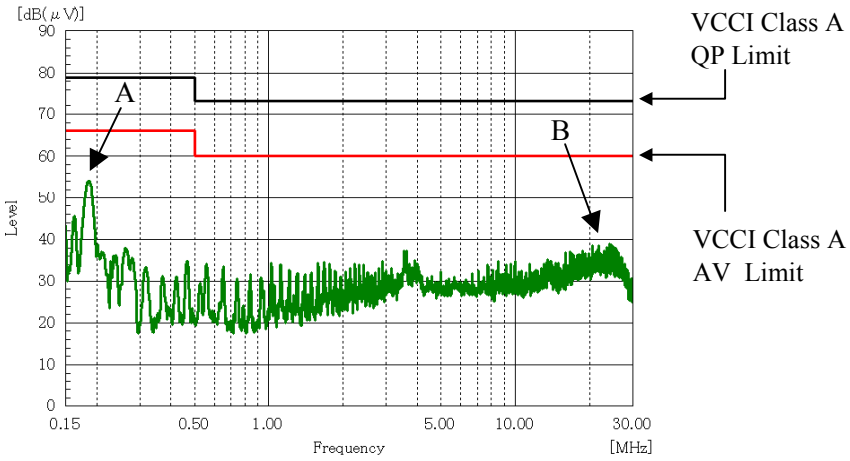
Conducted emission

EVA300-8

Ref. Data	Point A (183kHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	79.0	52.0	27.0
AV	66.0	45.5	20.5

Ref. Data	Point B (24.3MHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	73.0	34.2	38.8
AV	60.0	29.3	30.7

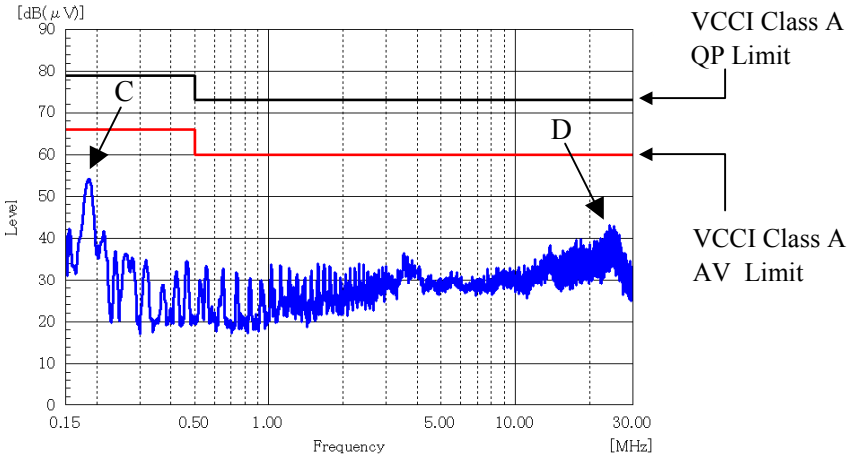
Phase : N



Ref. Data	Point C (183kHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	79.0	51.6	27.4
AV	66.0	45.3	20.7

Ref. Data	Point D (24.2MHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	73.0	39.6	33.4
AV	60.0	35.6	24.4

Phase : L



Limit of EN55011-A,EN55022-A,FCC-A are same as its VCCI class A.

2.14 Electromagnetic interference characteristics

Conditions Vin : 200VAC
Vout : 100%
Iout : 100%
Ta : 25℃

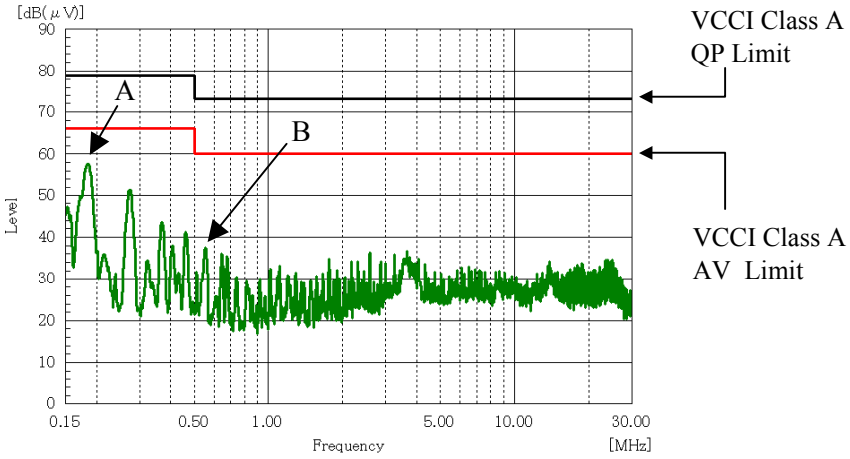
Conducted emission

EVA600-4

Ref. Data	Point A (184kHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	79.0	56.5	22.5
AV	66.0	50.4	15.6

Ref. Data	Point B (555kHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	73.0	36.0	37.0
AV	60.0	33.8	26.2

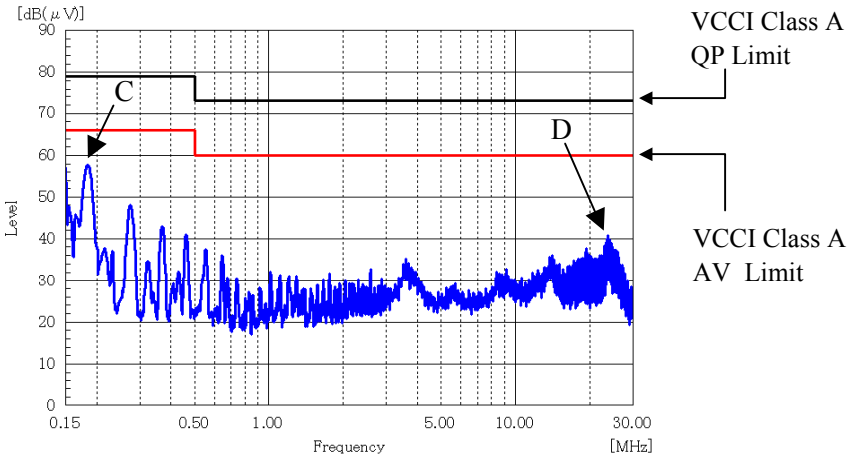
Phase : N



Ref. Data	Point C (184kHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	79.0	56.2	22.8
AV	66.0	49.9	16.1

Ref. Data	Point D (23.9MHz) Limit (dBuV)	Measure (dBuV)	Margin (dB)
QP	73.0	37.3	35.7
AV	60.0	34.4	25.6

Phase : L



Limit of EN55011-A,EN55022-A,FCC-A are same as its VCCI class A.

2.14 Electromagnetic interference characteristics

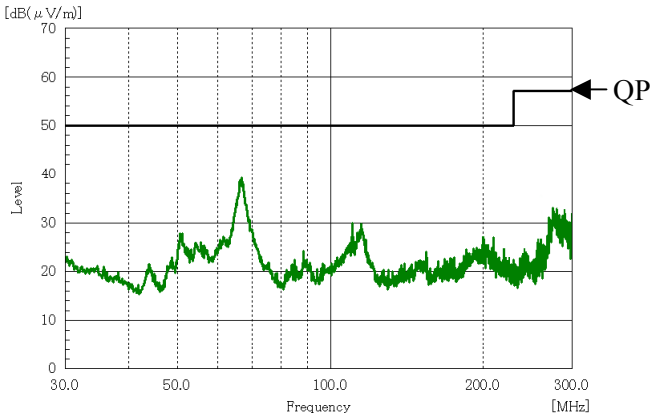
Conditions Vin : 200VAC
Vout : 100%
Iout : 100%
Ta : 25℃

Radiated emission

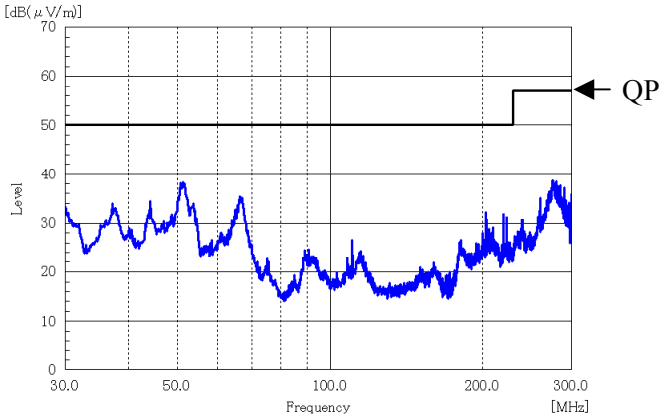
Limit of EN55011-A,EN55022-A are same as its VCCI class A.
Indication is peak values.

EVA150-16

Horizontal

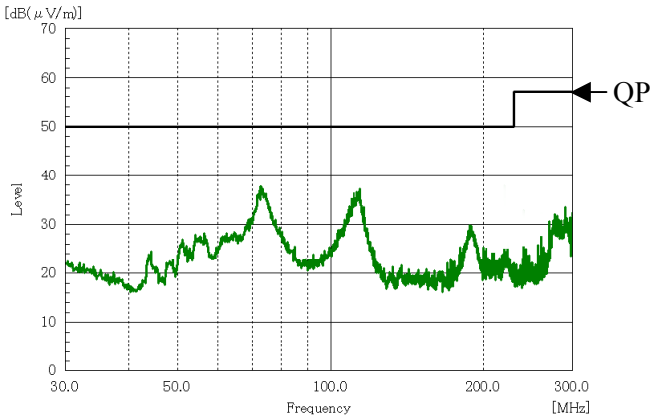


Vertical

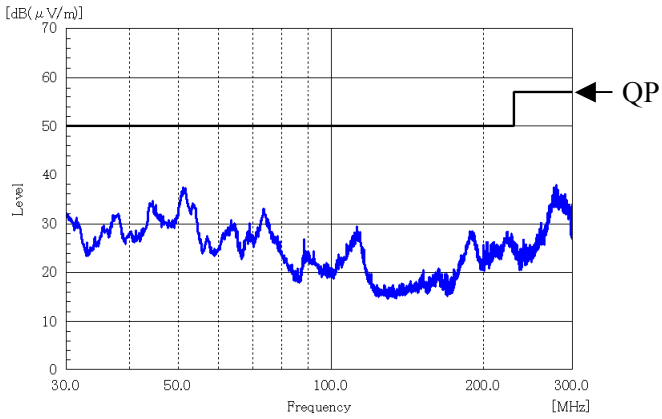


EVA300-8

Horizontal

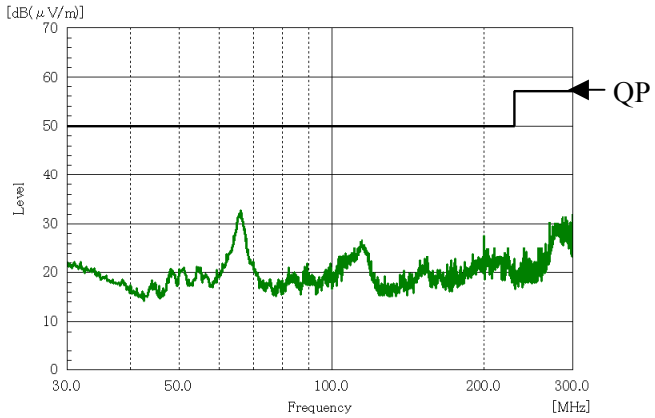
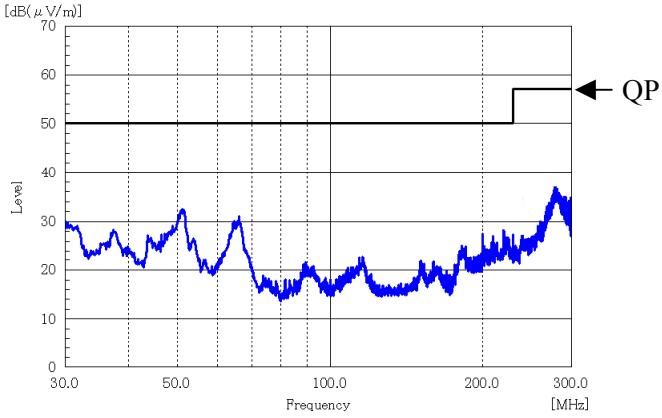


Vertical



EVA600-4

Horizontal



Vertical