CUS2000M

EVALUATION DATA

INDEX

2. Characteristics PAGE

Terminology used

	Definition	
Vin	.....	Input voltage
Vout	.....	Output voltage
Iin	.....	Input current
Iout	.....	Output current
Ta	.....	Ambient temperature
f	.....	Frequency
PG	.....	Power good signal
Vstb	.....	Output voltage of standby
Istb	.....	Output current of standby

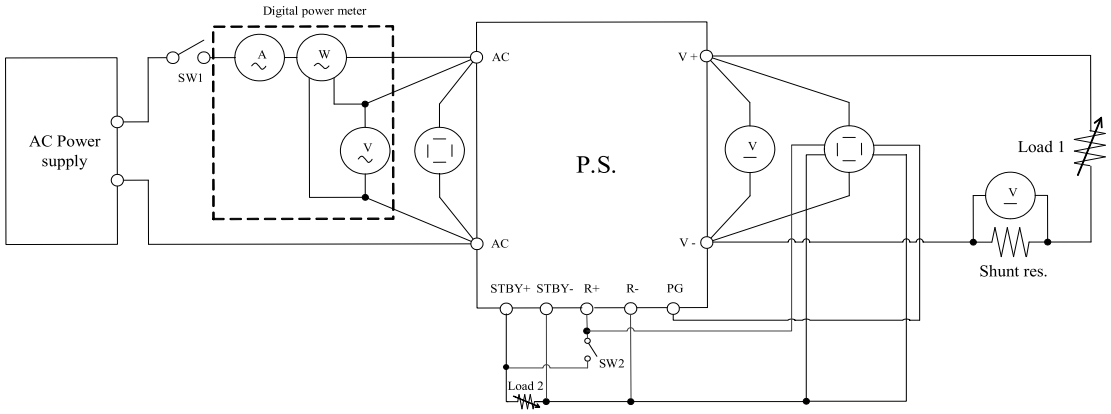
※ Test results are reference data based on our measurement condition.

1. Evaluation Method

1-1. Circuit used for determination

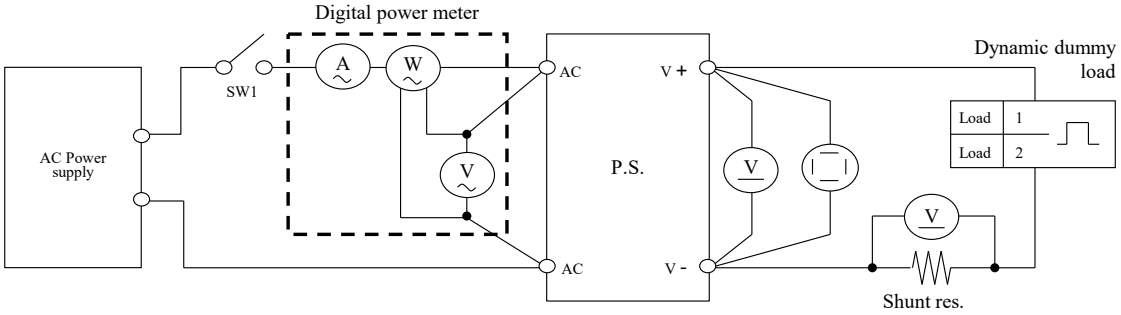
Circuit 1 used for determination

- Steady state data
- Warm up voltage drift characteristics
- Hold up time characteristics
- Output rise characteristics
- Output fall characteristics
- Over current protection (OCP) characteristics
- Over voltage protection (OVP) characteristics
- Response to brown out characteristics
- Various signal

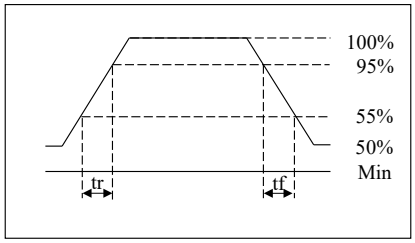


Circuit 2 used for determination

- Dynamic load response characteristics

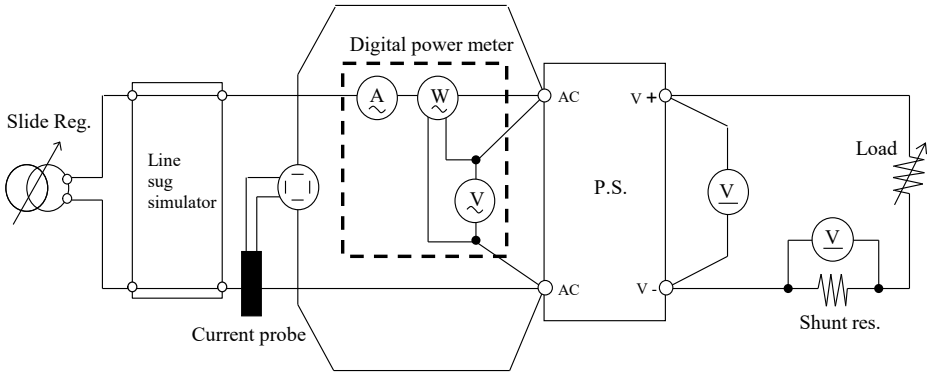


Output current waveform
Iout 50% <==> 100%



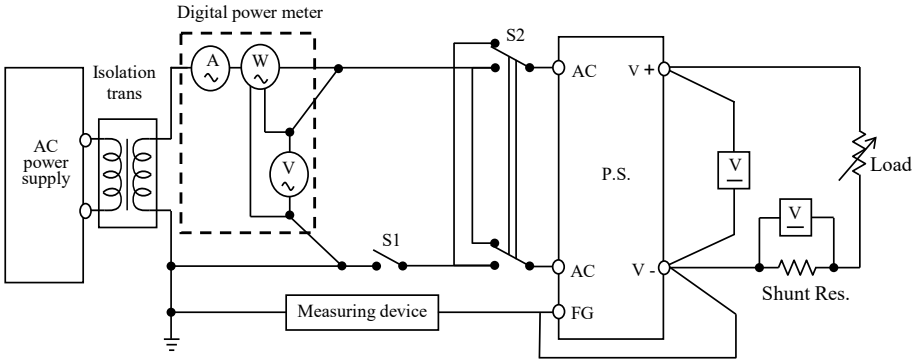
Circuit 3 used for determination

・Inrush current waveform



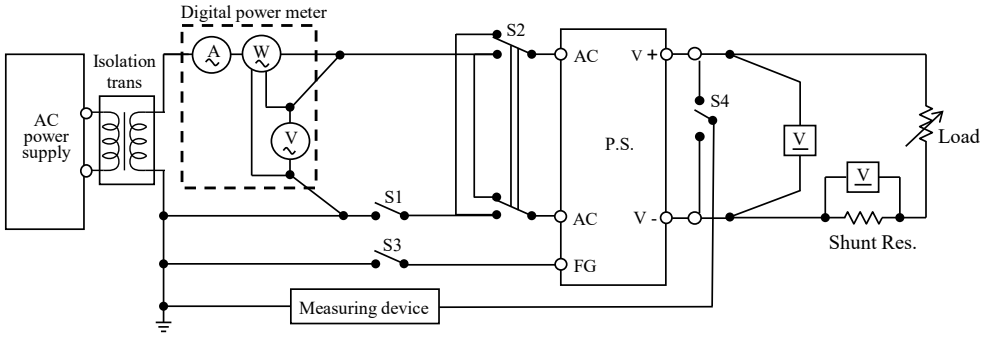
Circuit 4 used for determination

・Earth leakage current characteristics



Measure in all possible combination of position of S2 with :
S1 closed (normal condition), and S1 open (single fault condition)

・Patient leakage current



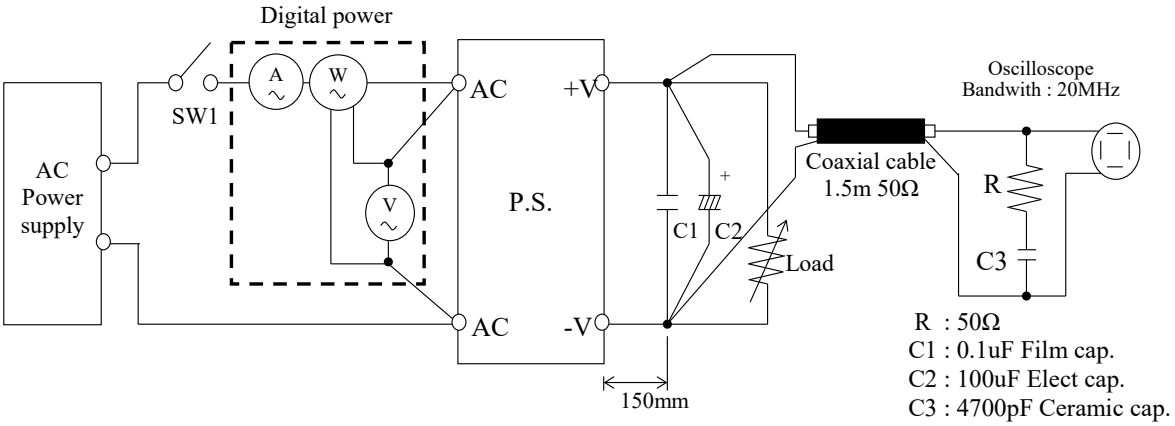
CLASS I equipment:

S1, S3 closed, measure under all possible position of S2 & S4.

Single fault condition: S1 open with S3 close or S1 close with S3 open.

Circuit 5 used for determination

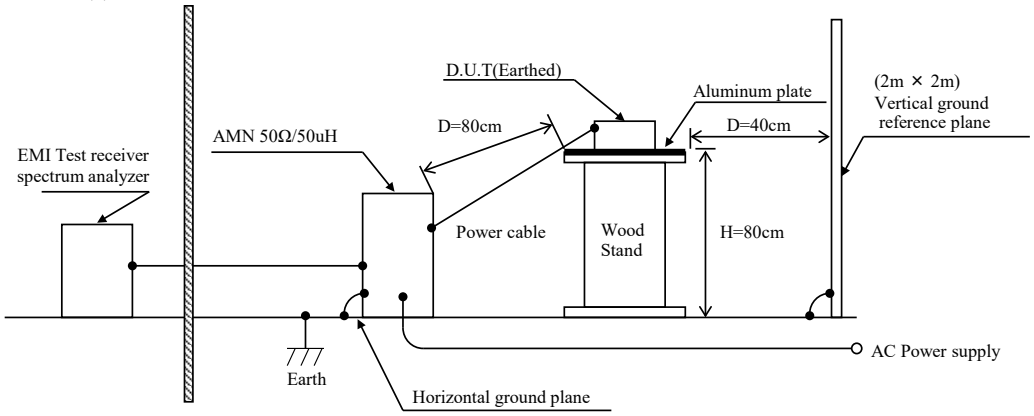
・Output ripple and noise waveform



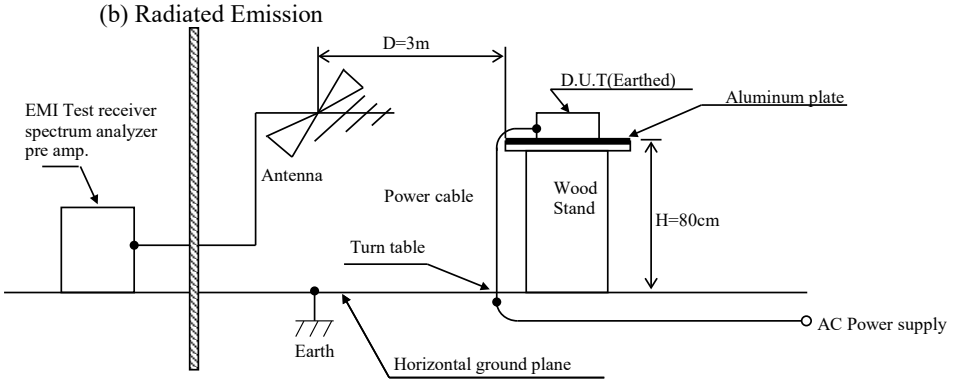
Configuration used for determination

・Electro-Magnetic 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.	DLM3054
2	DIGITAL MULTIMETER	KEYSIGHT	34970A
3	DIGITAL POWER METER	YOKOGAWA ELECT.	WT310
4	CURRENT PROBE	YOKOGAWA ELECT.	701931
5	POWER SUPPLY	YOKOGAWA ELECT.	700938
6	DYNAMIC DUMMY LOAD	CHROMA	63030/63203A/63640
7	AC SOURCE	KIKUSUI	PCR4000LE/PCR6000WE2
8	EARTH LEAKAGE CURRENT METER	SIMPSON	228
9	PATIENT LEAKAGE CURRENT METER	SIQ	SIQ16042
10	CONTROLLED TEMP. CHAMBER	TABAI-ESPEC	SH-662
11	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESR3
12	LISN	ROHDE & SCHWARZ	ENV216
13	BROADBAND ANTENNA	SCHWARZBECK	VULB9163
14	LINE SUG SIMULATOR	TAKAMISAWA	PSA-210
15	SOUND CALIBRATOR	BRUEL AND KJAER	TYPE 4231
16	AUDIO ANALYZER	BRUEL AND KJAER	TYPE 3560-C

1-3. Load conditions

Vin	Iout	12V	24V	36V	48V
85VAC	50%	62.5A	33.35A	22.25A	16.7A
90 - 170VAC	50%	62.5A	33.35A	22.25A	16.7A
170 - 265VAC	50%	66.7A	41.7A	27.75A	20.85A
85VAC	90%	112.5A	60A	40A	30A
90 - 170VAC	100%	125A	66.7A	44.5A	33.4A
170 - 265VAC	100%	133.4A	83.4A	55.5A	41.7A
85 - 265VAC	50%Peak	83.4A	41.7A	27.75A	20.85A
85 - 265VAC	Peak	166.7A	83.4A	55.5A	41.7A

*Vstb=5V, Istb=2A(100%)

2. Characteristics

2-1. Steady state data

(1) Regulation - line and load, Temperature drift / Start up voltage and Drop out voltage

12V

1. Regulation - line and load

Condition Ta : 25 °C
Istb : 0 %

Iout \ Vin	85VAC	100VAC	115VAC	132VAC	Line regulation	
0%	12.059V	12.062V	12.063V	12.063V	4mV	0.033%
50%	12.035V	12.036V	12.036V	12.036V	1mV	0.008%
100%	-	12.014V	12.015V	12.016V	2mV	0.017%
Load regulation	24mV	48mV	48mV	47mV		
	0.200%	0.400%	0.400%	0.392%		

Iout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	12.064V	12.064V	12.064V	12.064V	0mV	0.000%
50%	12.036V	12.036V	12.037V	12.037V	1mV	0.008%
100%	12.013V	12.013V	12.014V	12.014V	1mV	0.008%
Load regulation	51mV	51mV	50mV	50mV		
	0.425%	0.425%	0.417%	0.417%		

2. Temperature drift

Condition Vin : 115 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	11.977V	11.977V	11.974V	3mV	0.025%

Condition Vin : 230 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	11.977V	11.976V	11.971V	6mV	0.050%

3. Start up voltage and Drop out voltage

Condition Ta : 25 °C
Iout : Peak
Istb : 0 %

Start up voltage (Vin)	77.7VAC
Drop out voltage (Vin)	74.6VAC

24V

1. Regulation - line and load

Condition Ta : 25 °C
Istb : 0 %

Iout \ Vin	85VAC	100VAC	115VAC	132VAC	Line regulation	
0%	24.078V	24.077V	24.076V	24.084V	8mV	0.033%
50%	24.045V	24.047V	24.048V	24.049V	4mV	0.017%
100%	-	24.019V	24.020V	24.021V	2mV	0.008%
Load regulation	33mV	58mV	56mV	63mV		
	0.137%	0.242%	0.233%	0.262%		

Iout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	24.081V	24.081V	24.086V	24.080V	6mV	0.025%
50%	24.043V	24.044V	24.044V	24.044V	1mV	0.004%
100%	24.007V	24.007V	24.007V	24.008V	1mV	0.004%
Load regulation	74mV	74mV	79mV	72mV		
	0.308%	0.308%	0.329%	0.300%		

2. Temperature drift

Condition Vin : 115 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	24.013V	24.034V	24.004V	30mV	0.125%

Condition Vin : 230 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	24.011V	24.025V	23.999V	26mV	0.108%

3. Start up voltage and Drop out voltage

Condition Ta : 25 °C
Iout : Peak
Istb : 0 %

Start up voltage (Vin)	78.6VAC
Drop out voltage (Vin)	75.5VAC

(1) Regulation - line and load, Temperature drift / Start up voltage and Drop out voltage

36V 1. Regulation - line and load

Condition Ta : 25 °C
Istb : 0 %

Iout \ Vin	85VAC	100VAC	115VAC	132VAC	Line regulation	
0%	36.068V	36.076V	36.077V	36.077V	9mV	0.025%
50%	36.039V	36.040V	36.042V	36.043V	4mV	0.011%
100%	-	36.026V	36.027V	36.028V	2mV	0.006%
Load regulation	29mV	50mV	50mV	49mV		
	0.081%	0.139%	0.139%	0.136%		

Iout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	36.073V	36.078V	36.073V	36.077V	5mV	0.014%
50%	36.040V	36.040V	36.041V	36.041V	1mV	0.003%
100%	36.021V	36.021V	36.022V	36.022V	1mV	0.003%
Load regulation	52mV	57mV	51mV	55mV		
	0.144%	0.158%	0.142%	0.153%		

2. Temperature drift

Condition Vin : 115 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	36.028V	36.068V	36.058V	40mV	0.111%

Condition Vin : 230 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	36.029V	36.061V	36.053V	32mV	0.089%

3. Start up voltage and Drop out voltage

Condition Ta : 25 °C
Iout : Peak
Istb : 0 %

Start up voltage (Vin)	78.4VAC
Drop out voltage (Vin)	75.4VAC

48V 1. Regulation - line and load

Condition Ta : 25 °C
Istb : 0 %

Iout \ Vin	85VAC	100VAC	115VAC	132VAC	Line regulation	
0%	48.099V	48.101V	48.118V	48.119V	20mV	0.042%
50%	48.083V	48.089V	48.092V	48.095V	12mV	0.025%
100%	-	48.082V	48.085V	48.088V	6mV	0.013%
Load regulation	16mV	19mV	33mV	31mV		
	0.033%	0.040%	0.069%	0.065%		

Iout \ Vin	170VAC	200VAC	230VAC	265VAC	Line regulation	
0%	48.127V	48.118V	48.114V	48.136V	22mV	0.046%
50%	48.095V	48.098V	48.101V	48.101V	6mV	0.013%
100%	48.085V	48.089V	48.091V	48.092V	3mV	0.006%
Load regulation	42mV	29mV	23mV	44mV		
	0.088%	0.060%	0.048%	0.092%		

2. Temperature drift

Condition Vin : 115 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	48.062V	48.072V	48.058V	14mV	0.029%

Condition Vin : 230 VAC
Iout : 100 %
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	48.059V	48.064V	48.052V	12mV	0.025%

3. Start up voltage and Drop out voltage

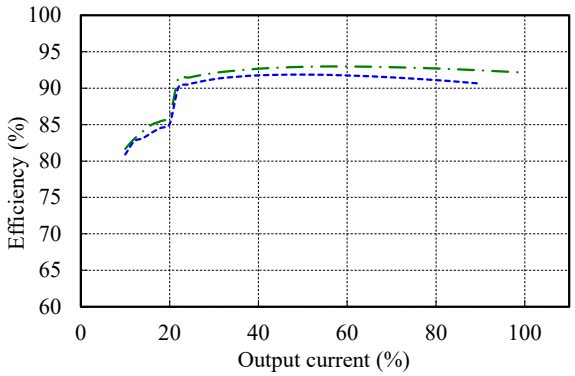
Condition Ta : 25 °C
Iout : Peak
Istb : 0 %

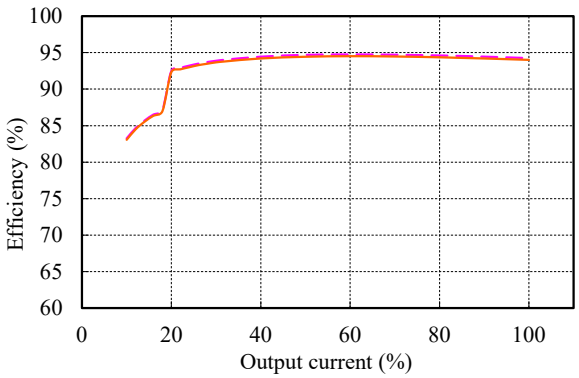
Start up voltage (Vin)	78.0VAC
Drop out voltage (Vin)	74.8VAC

(2) Efficiency vs. Output current

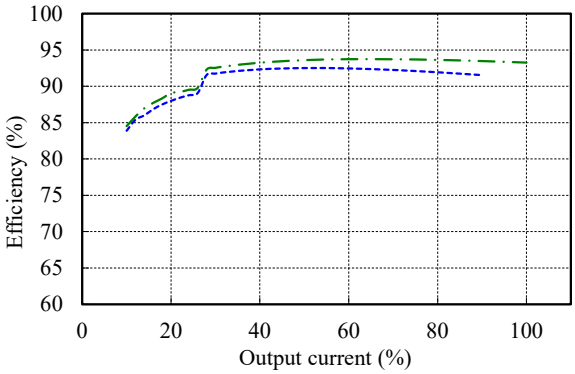
Conditions
Vin : 85 VAC
115 VAC
230 VAC
265 VAC
Ta : 25 °C
Istb : 0 %

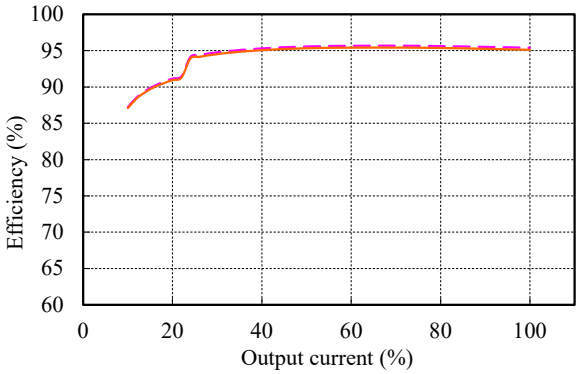
12V



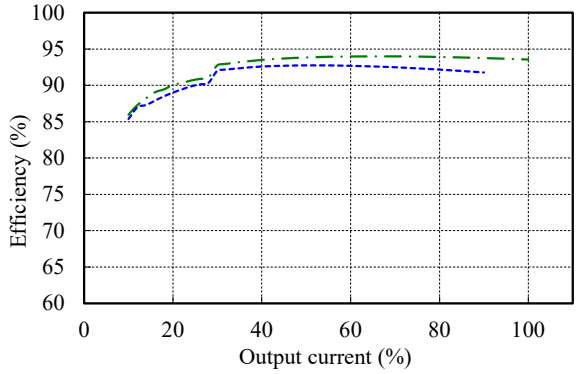


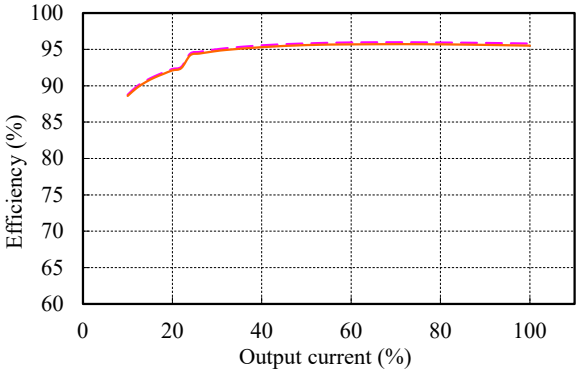
24V



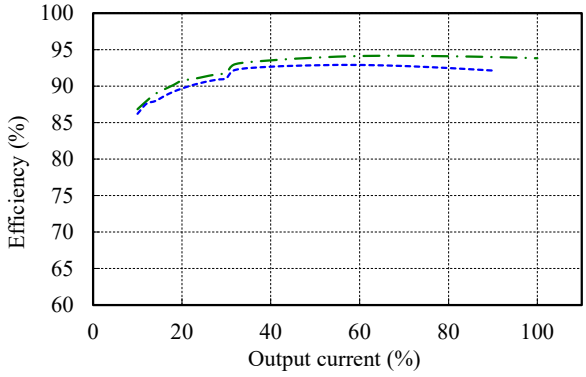


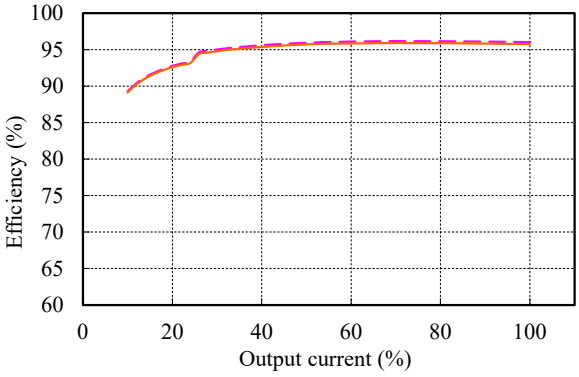
36V





48V

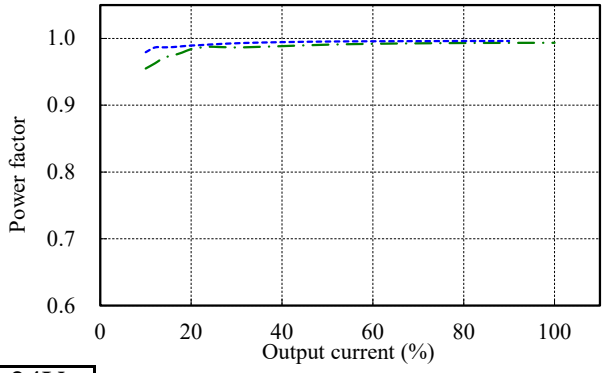


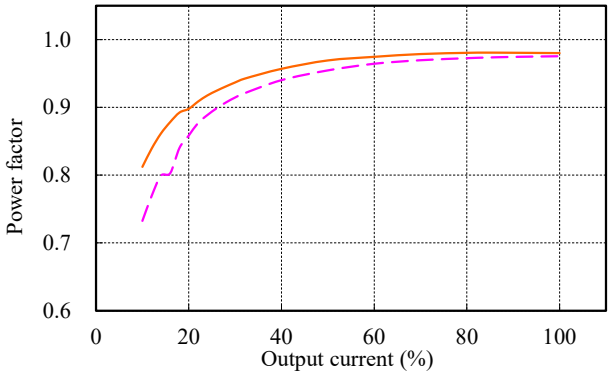


(3) Power factor vs. Output current

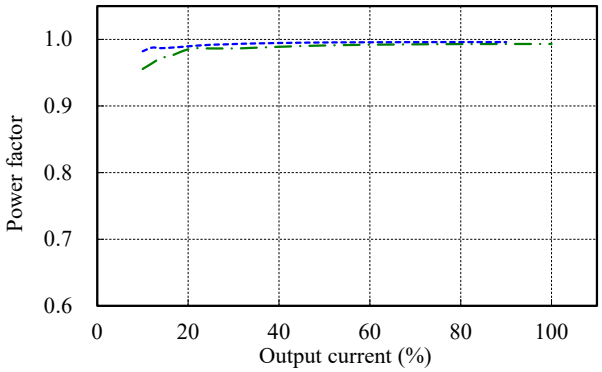
Conditions Vin : 85 VAC
115 VAC
230 VAC
265 VAC
Ta : 25 °C
Istb : 0 %

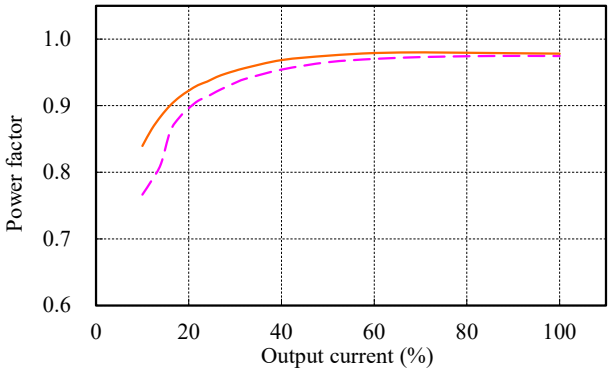
12V



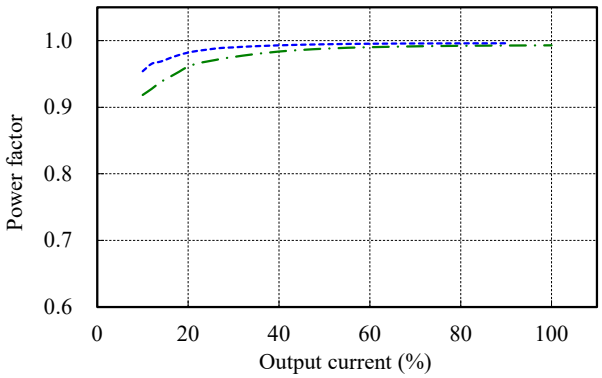


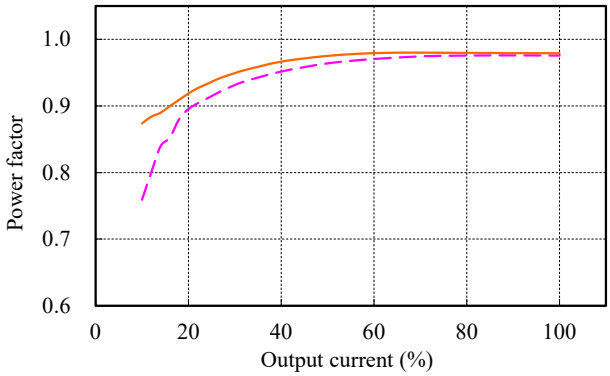
24V



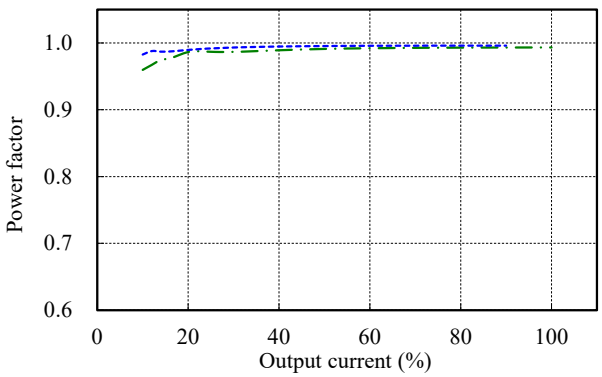


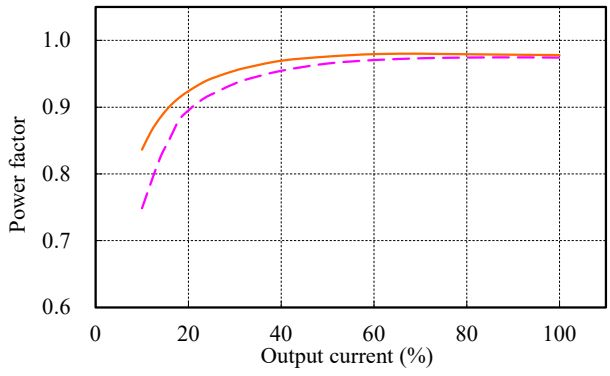
36V





48V



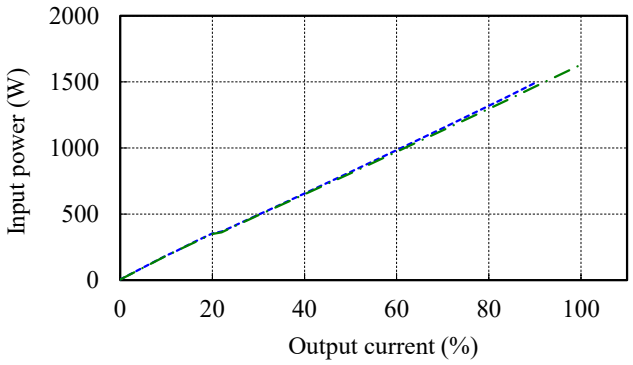


(4) Input power vs. Output current

Conditions Vin : 85 VAC
115 VAC
Ta : 25 °C
Istb : 0 %

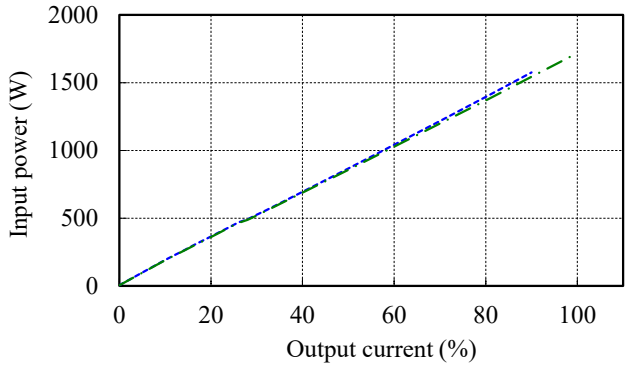
12V

Vin	Input power	
	Iout : 0%	Remote OFF
85VAC	5.5W	0.32W
115VAC	4.4W	0.38W



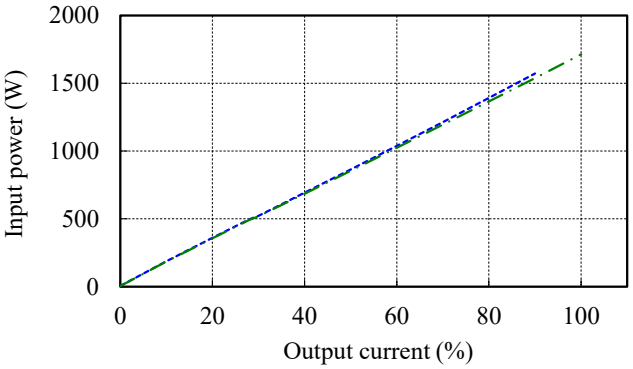
24V

Vin	Input power	
	Iout : 0%	Remote OFF
85VAC	5.4W	0.32W
115VAC	4.6W	0.38W



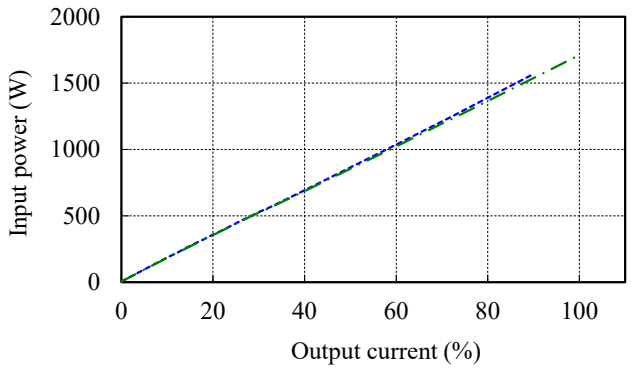
36V

Vin	Input power	
	Iout : 0%	Remote OFF
85VAC	5.5W	0.33W
115VAC	4.9W	0.38W



48V

Vin	Input power	
	Iout : 0%	Remote OFF
85VAC	5.8W	0.32W
115VAC	4.9W	0.38W

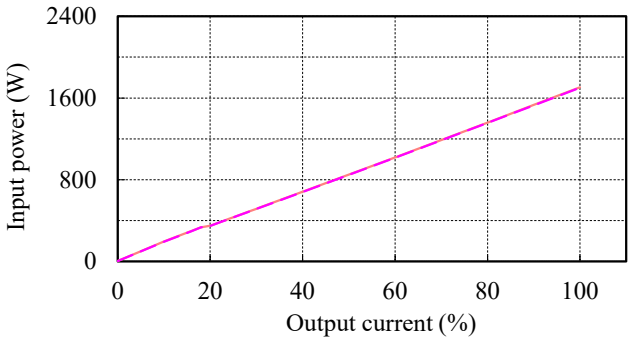


(4) Input power vs. Output current

Conditions Vin : 230 VAC
265 VAC
Ta : 25 °C
Istb : 0 %

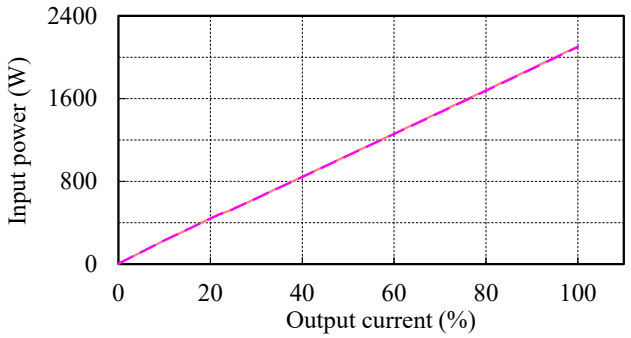
12V

Vin	Input power	
	Iout : 0%	Remote OFF
230VAC	3.9W	0.75W
265VAC	3.9W	0.91W



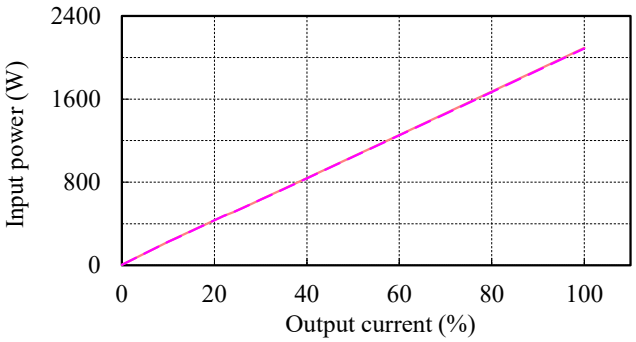
24V

Vin	Input power	
	Iout : 0%	Remote OFF
230VAC	3.9W	0.74W
265VAC	4.4W	0.91W



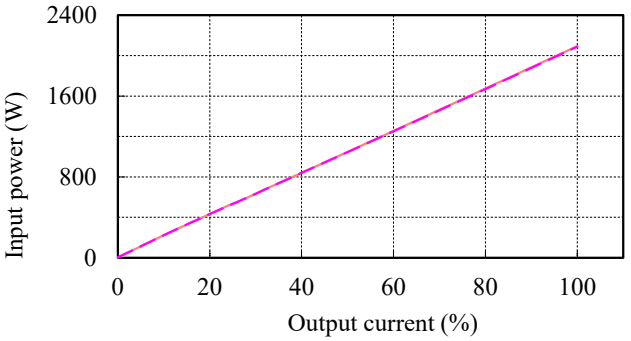
36V

Vin	Input power	
	Iout : 0%	Remote OFF
230VAC	4.6W	0.75W
265VAC	4.4W	0.91W



48V

Vin	Input power	
	Iout : 0%	Remote OFF
230VAC	4.4W	0.75W
265VAC	4.7W	0.91W

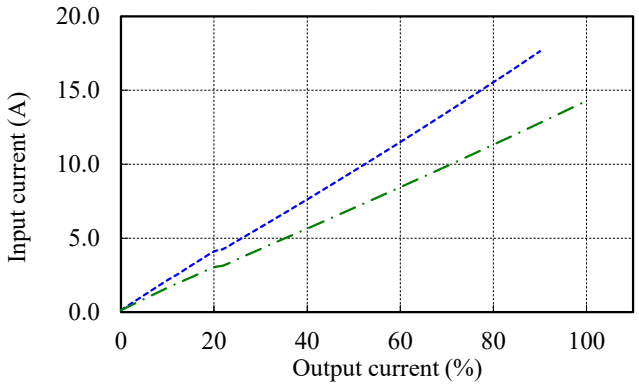


(5) Input current vs. Output current

Conditions Vin : 85 VAC
115 VAC
Ta : 25 °C
Istb : 0 %

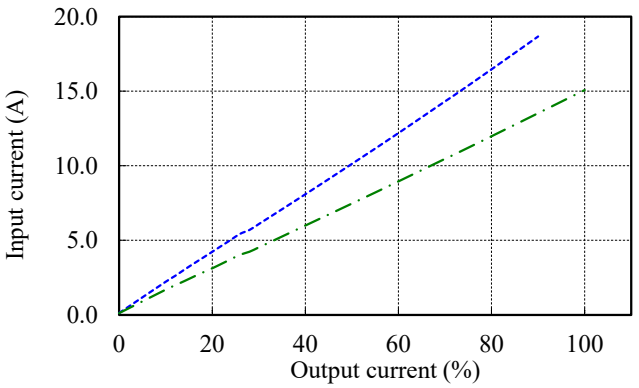
12V

Vin	Input current	
	Iout : 0%	Remote OFF
85VAC	0.13A	0.06A
115VAC	0.13A	0.08A



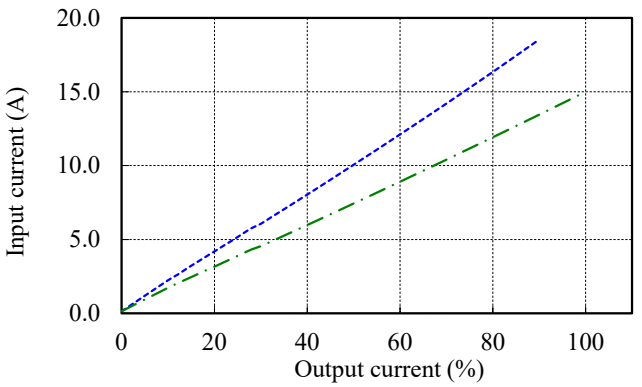
24V

Vin	Input current	
	Iout : 0%	Remote OFF
85VAC	0.13A	0.06A
115VAC	0.12A	0.08A



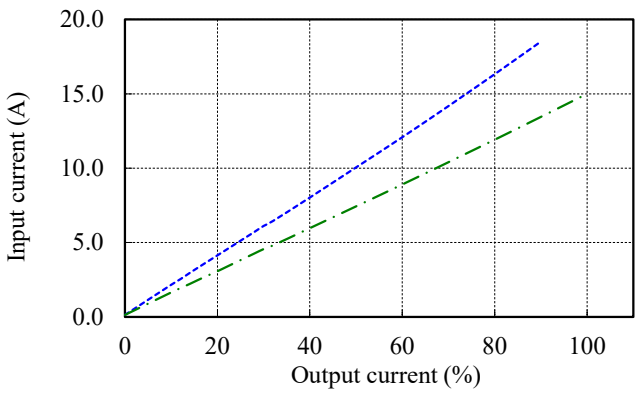
36V

Vin	Input current	
	Iout : 0%	Remote OFF
85VAC	0.13A	0.06A
115VAC	0.14A	0.08A



48V

Vin	Input current	
	Iout : 0%	Remote OFF
85VAC	0.14A	0.06A
115VAC	0.14A	0.08A

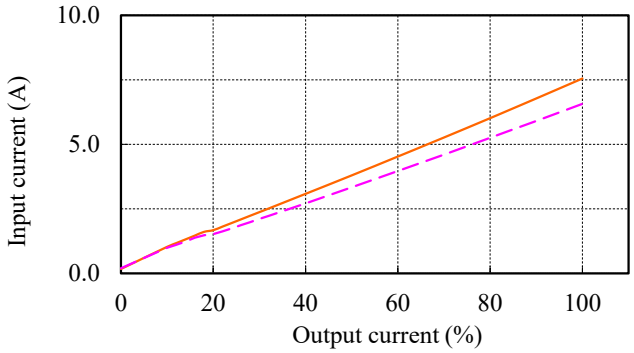


(5) Input current vs. Output current

Conditions Vin : 230 VAC
265 VAC
Ta : 25 °C
Istb : 0 %

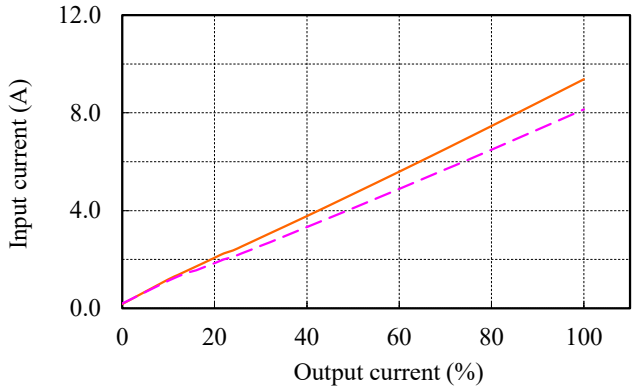
12V

Vin	Input current	
	Iout : 0%	Remote OFF
230VAC	0.17A	0.16A
265VAC	0.20A	0.18A



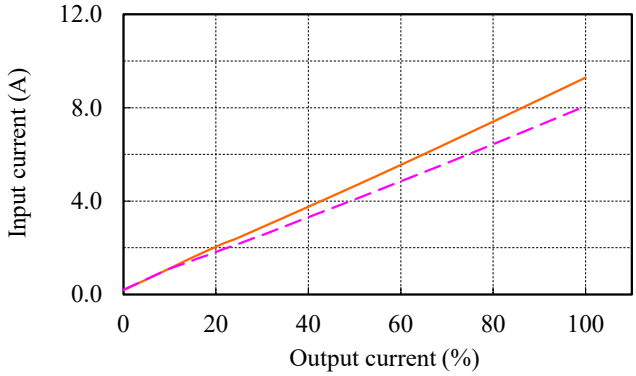
24V

Vin	Input current	
	Iout : 0%	Remote OFF
230VAC	0.17A	0.16A
265VAC	0.20A	0.18A



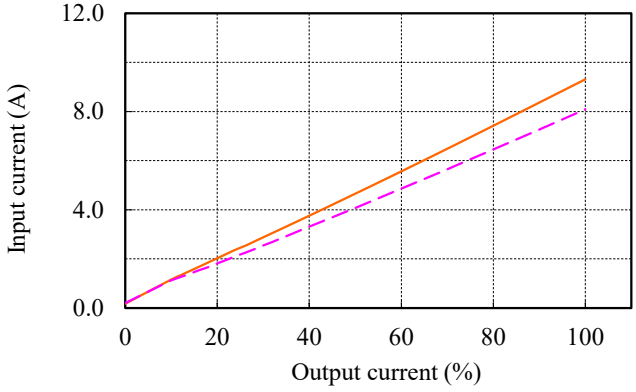
36V

Vin	Input current	
	Iout : 0%	Remote OFF
230VAC	0.18A	0.16A
265VAC	0.20A	0.18A



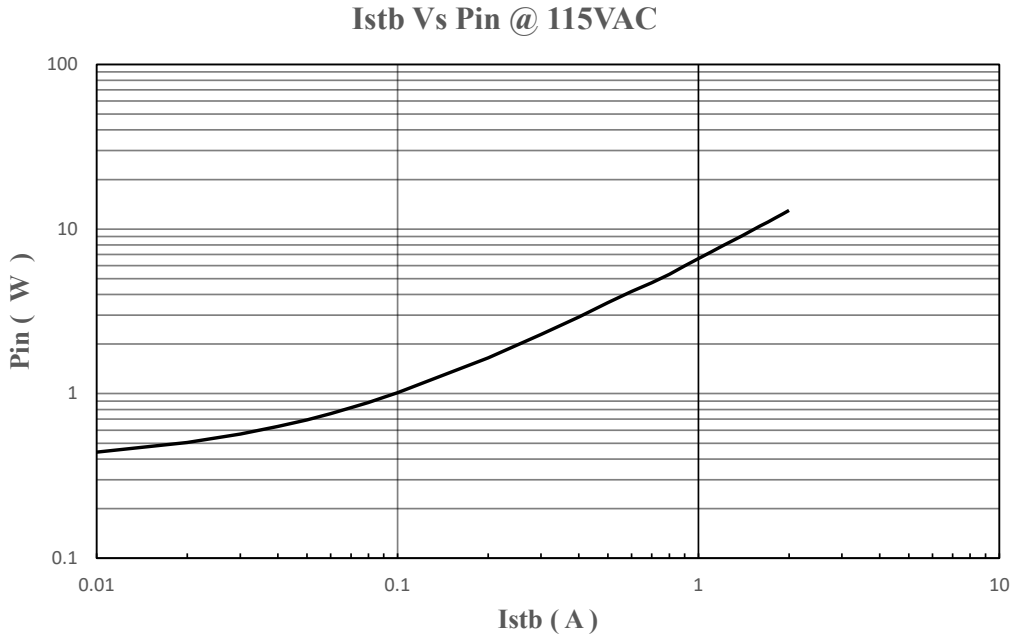
48V

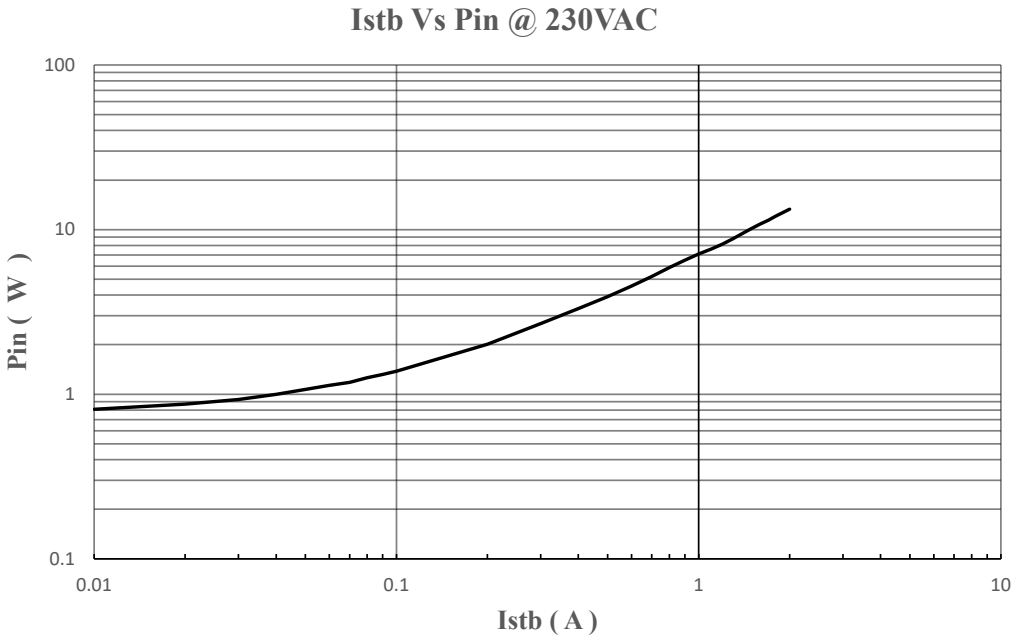
Vin	Input current	
	Iout : 0%	Remote OFF
230VAC	0.18A	0.17A
265VAC	0.20A	0.19A



(6) Input power vs. Output current @ Remote OFF

Condition Remote OFF



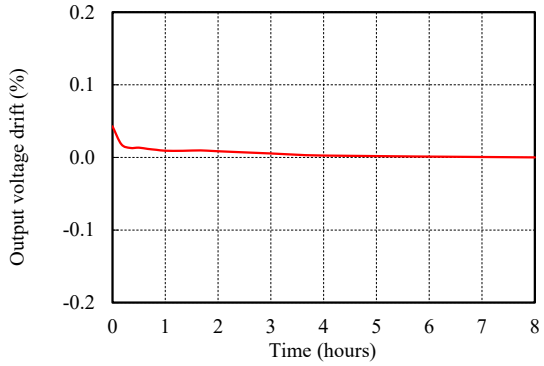


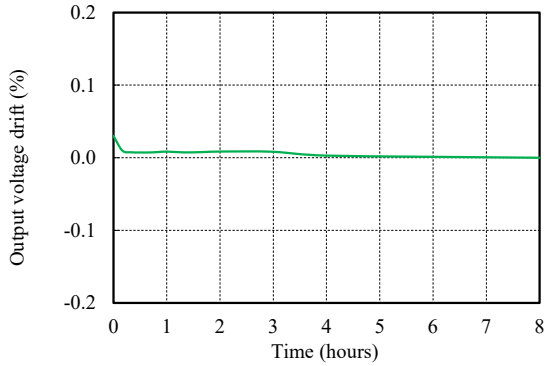
2-2. Warm up voltage drift characteristics

Conditions Vin : 115 VAC
Iout : 100 %
Ta : 25 °C
Istb : 100%

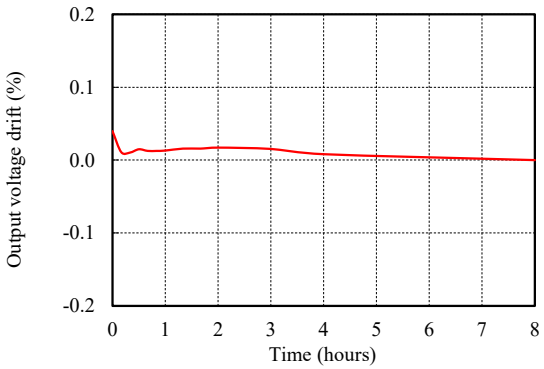
Conditions Vin : 230 VAC
Iout : 100 %
Ta : 25 °C
Istb : 100%

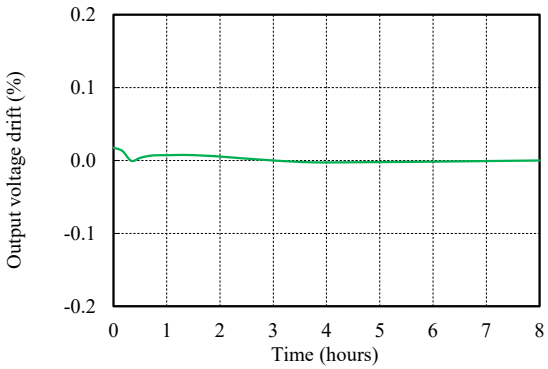
12V



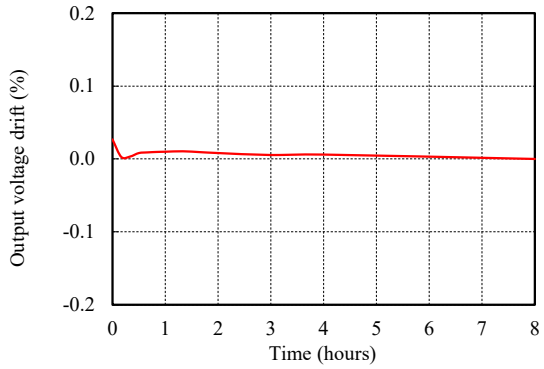


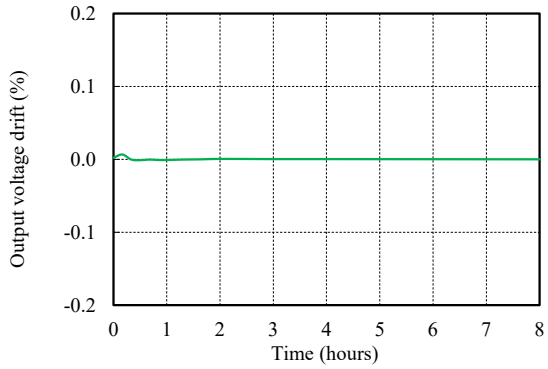
24V



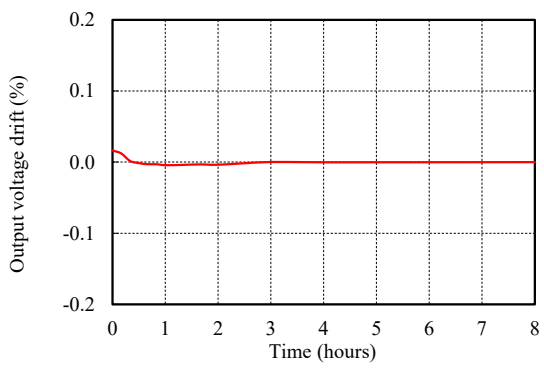


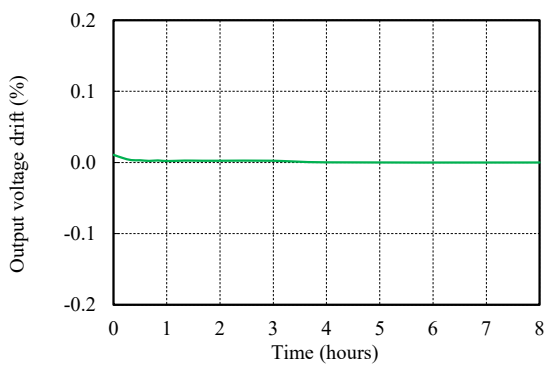
36V





48V

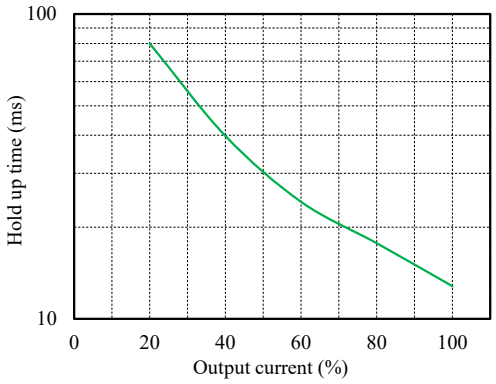


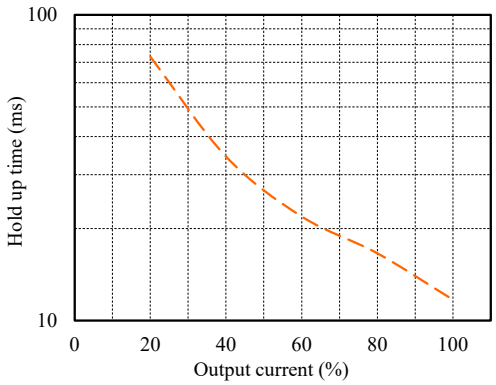


2-3. Hold up time characteristics

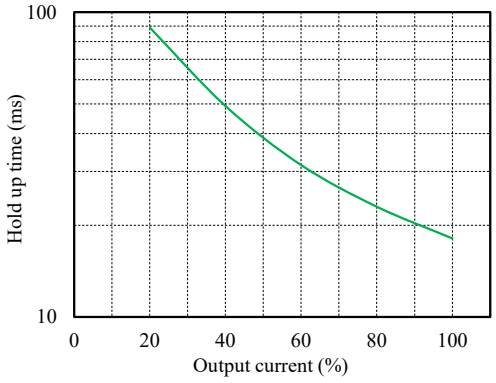
Conditions Vin : 115 VAC
230 VAC
Ta : 25 °C
Istb : 100%

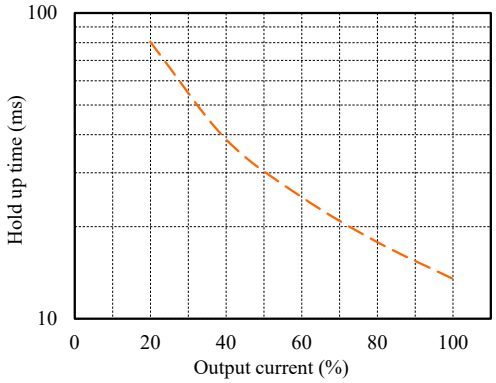
12V



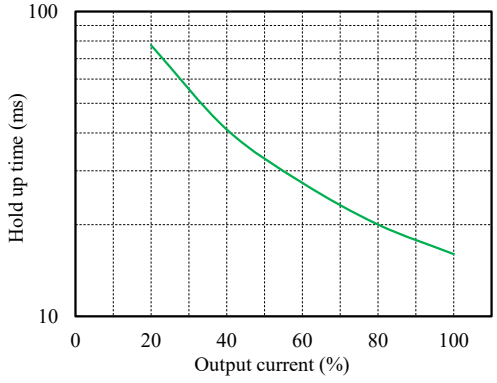


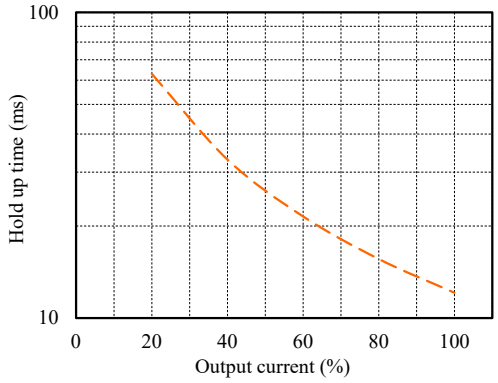
24V



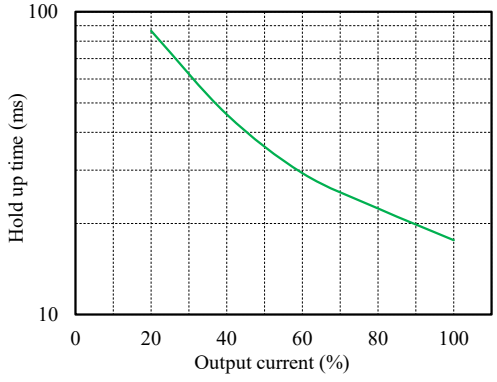


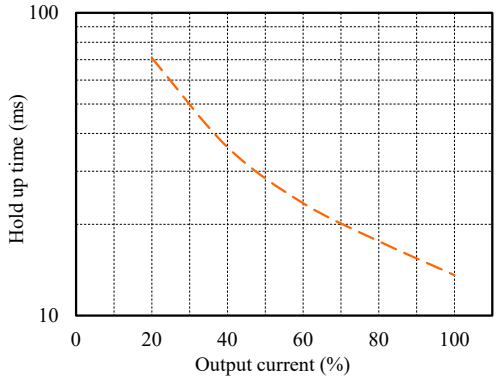
36V





48V



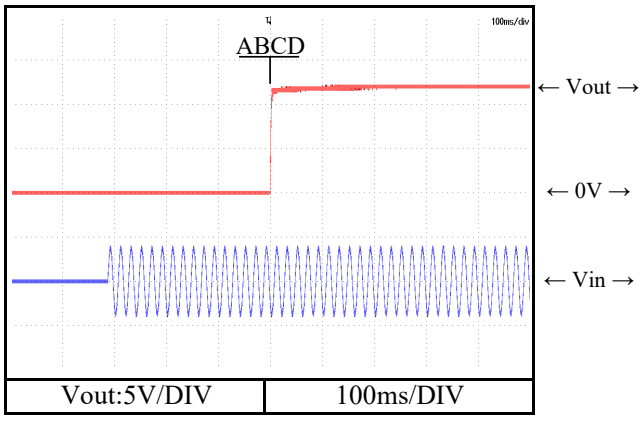


2-4. Output rise characteristics

Conditions Vin : 85 VAC (A)
115 VAC (B)
230 VAC (C)
265 VAC (D)
Istb : 100 %
Ta : 25 °C

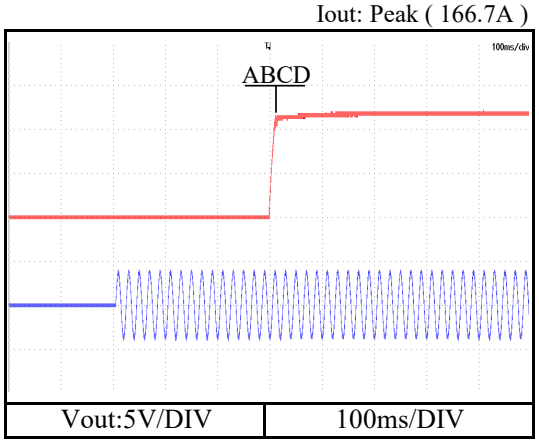
12V

Iout: 0%



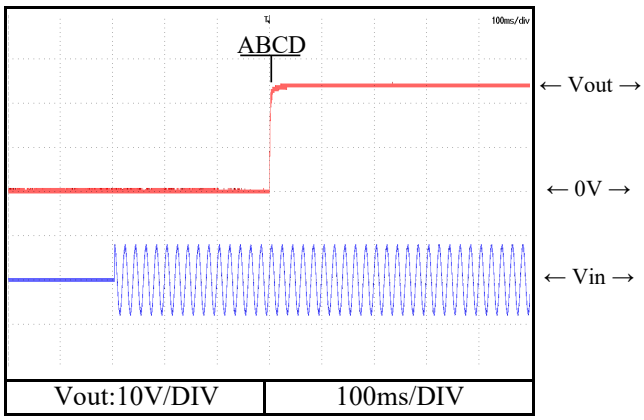
← Vout →
← 0V →
← Vin →

Iout: Peak (166.7A)



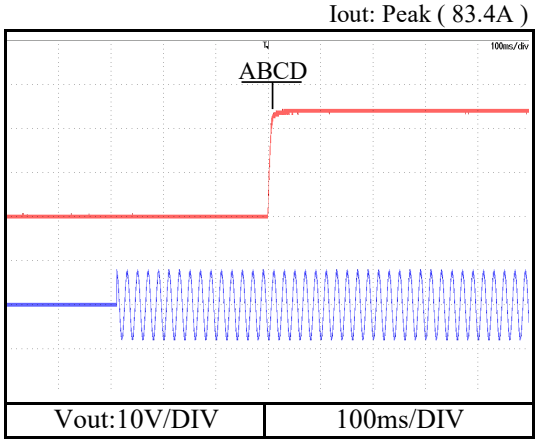
24V

Iout: 0%



← Vout →
← 0V →
← Vin →

Iout: Peak (83.4A)

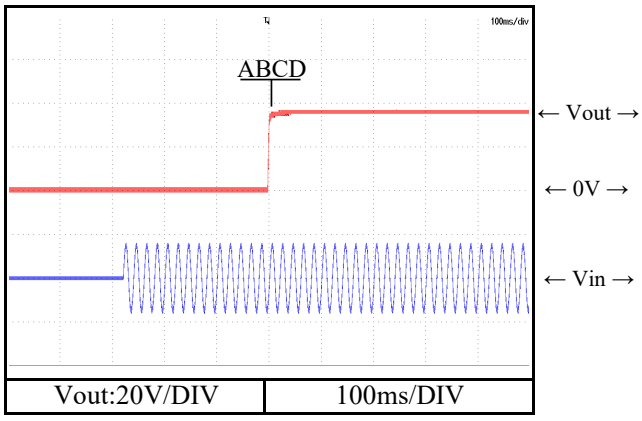


2-4. Output rise characteristics

Conditions Vin : 85 VAC (A)
115 VAC (B)
230 VAC (C)
265 VAC (D)
Istb : 100 %
Ta : 25 °C

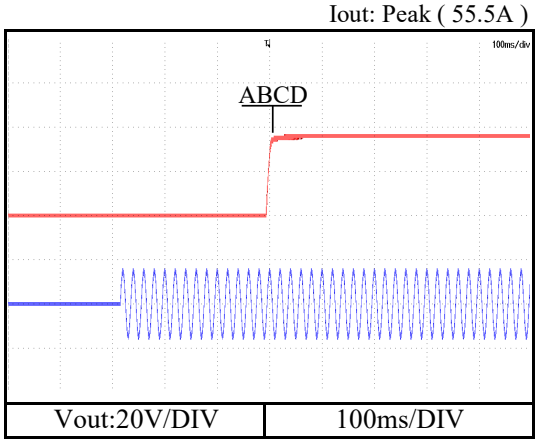
36V

Iout: 0%



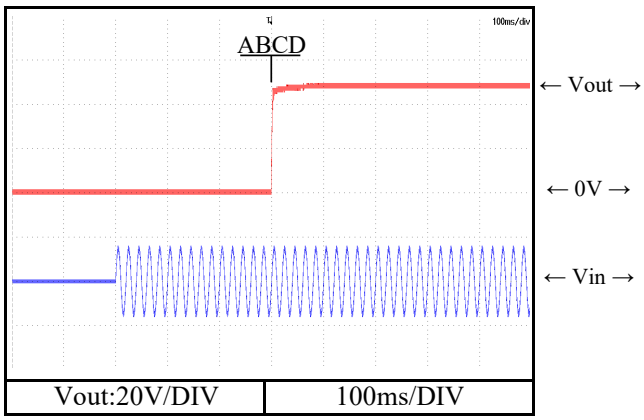
← Vout →
← 0V →
← Vin →

Iout: Peak (55.5A)



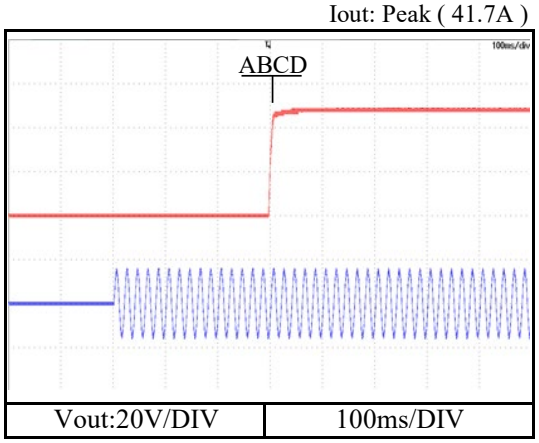
48V

Iout: 0%



← Vout →
← 0V →
← Vin →

Iout: Peak (41.7A)

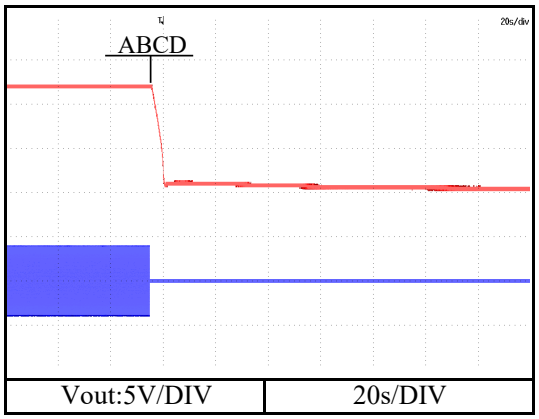


2-5. Output fall characteristics

Conditions Vin : 85 VAC (A)
115 VAC (B)
230 VAC (C)
265 VAC (D)
Istb : 100 %
Ta : 25 °C

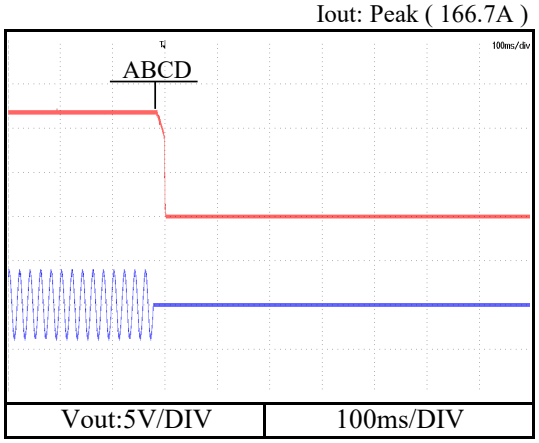
12V

Iout: 0%



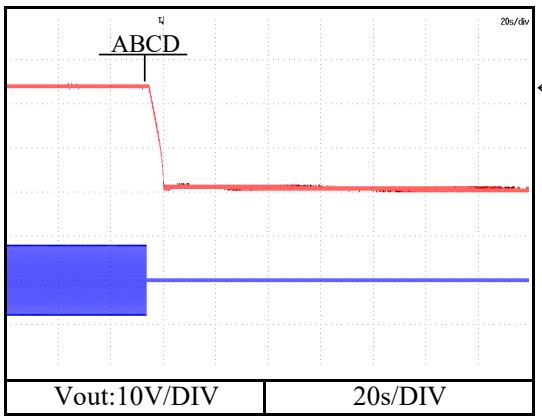
← Vout →
← 0V →
← Vin →

Iout: Peak (166.7A)



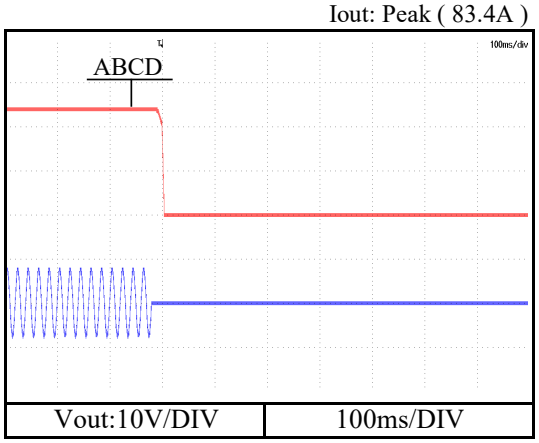
24V

Iout: 0%



← Vout →
← 0V →
← Vin →

Iout: Peak (83.4A)

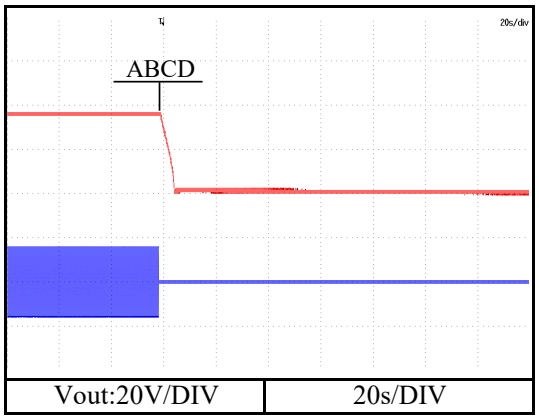


2-5. Output fall characteristics

Conditions Vin : 85 VAC (A)
115 VAC (B)
230 VAC (C)
265 VAC (D)
Istb : 100 %
Ta : 25 °C

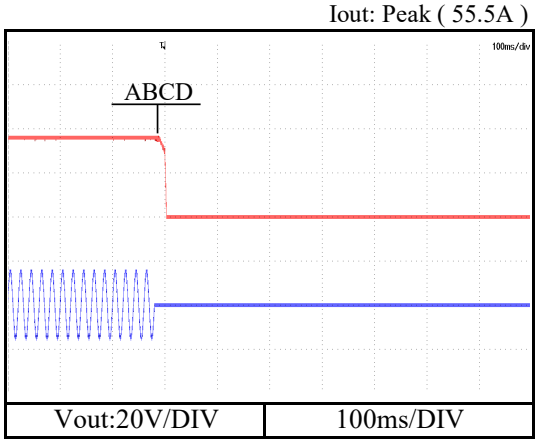
36V

Iout: 0%



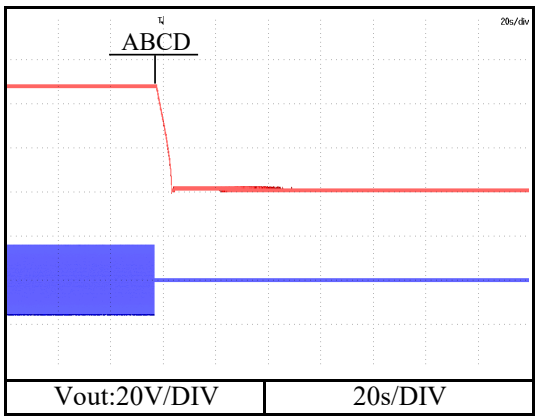
← Vout →
← 0V →
← Vin →

Iout: Peak (55.5A)



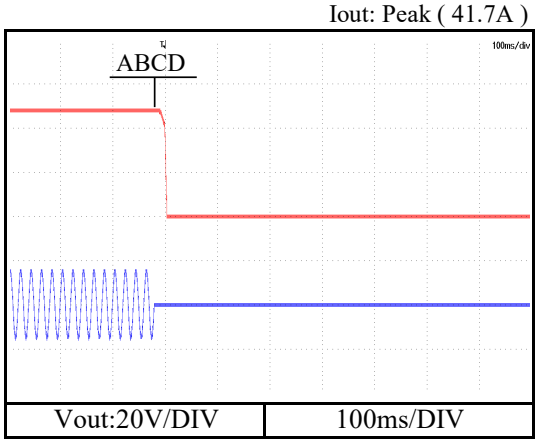
48V

Iout: 0%



← Vout →
← 0V →
← Vin →

Iout: Peak (41.7A)

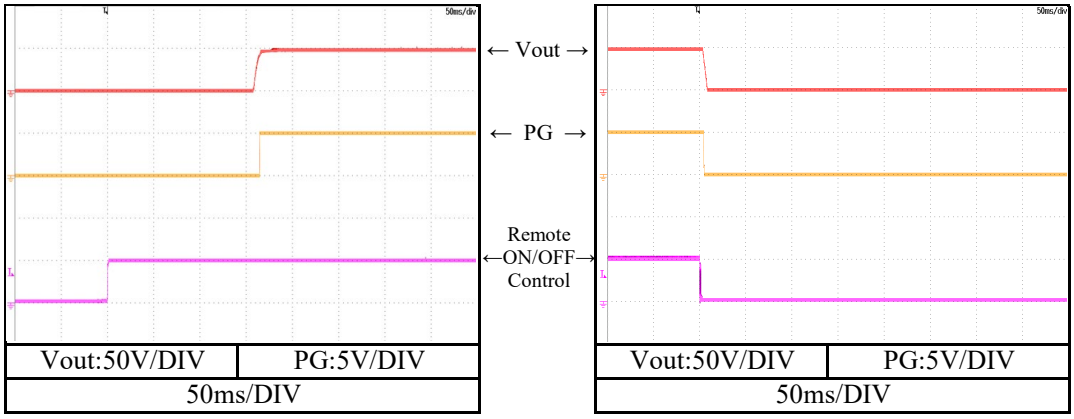


2-6. Various signal

Conditions Vin : 115 VAC
Iout : Peak
Istb : 100 %
Ta : 25 °C

Output rise, fall characteristics with Remote ON/OFF Control

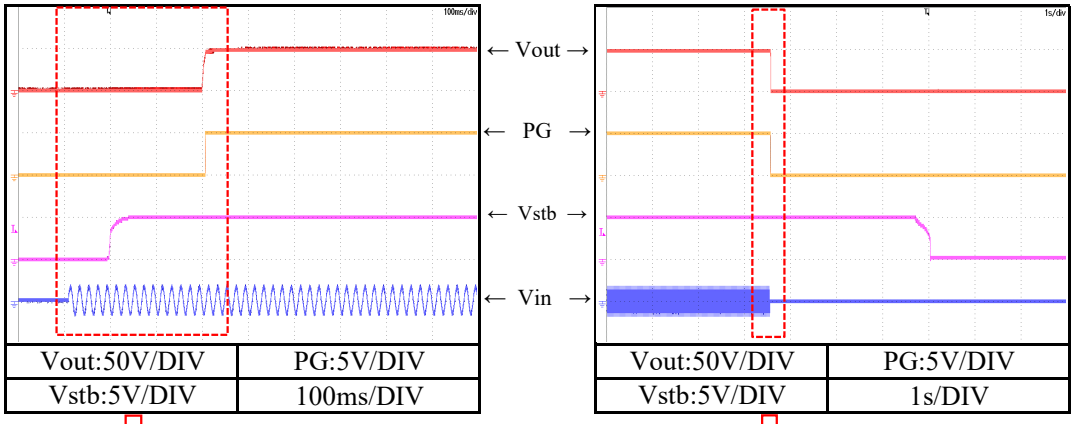
48V



Vout:50V/DIV	PG:5V/DIV
50ms/DIV	

Vout:50V/DIV	PG:5V/DIV
50ms/DIV	

Output rise, fall characteristics with Input voltage ON/OFF

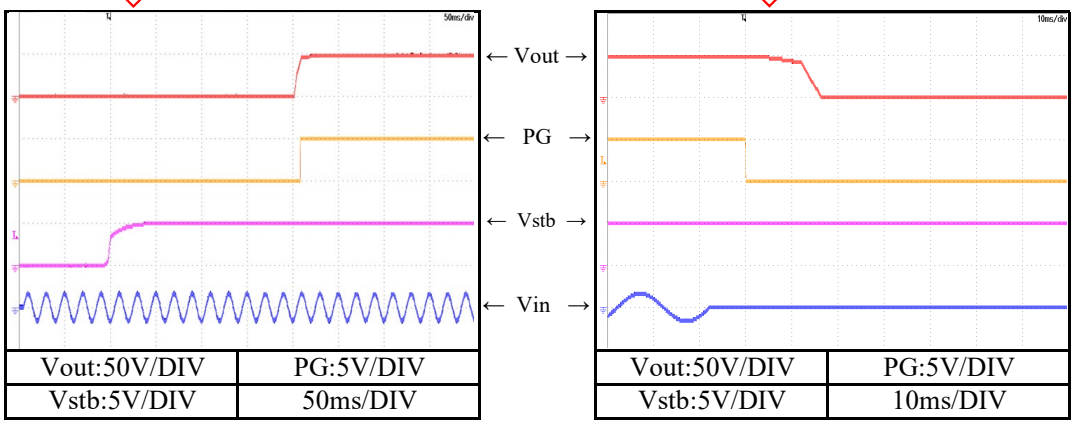


Vout:50V/DIV	PG:5V/DIV
Vstb:5V/DIV	100ms/DIV

Vout:50V/DIV	PG:5V/DIV
Vstb:5V/DIV	1s/DIV

Zoom

Zoom



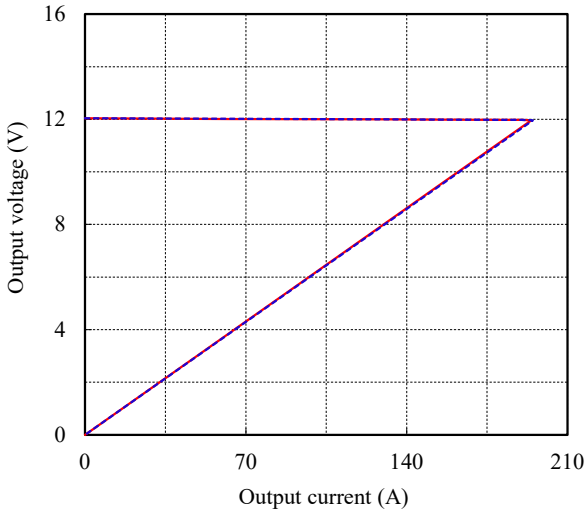
Vout:50V/DIV	PG:5V/DIV
Vstb:5V/DIV	50ms/DIV

Vout:50V/DIV	PG:5V/DIV
Vstb:5V/DIV	10ms/DIV

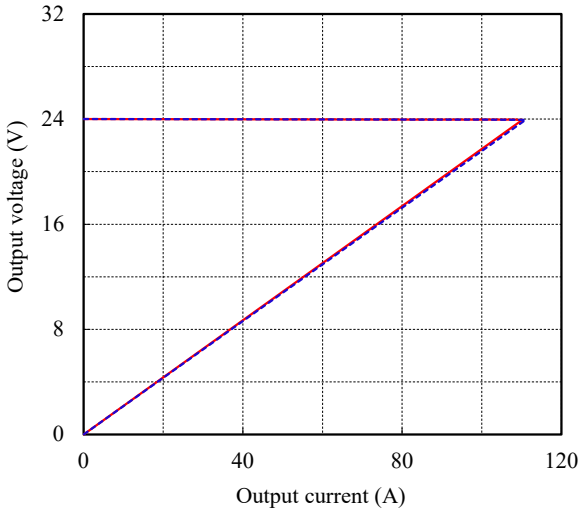
2-7. Over current protection (OCP) characteristics

Conditions Vin : 115 VAC
230 VAC
Istb : 100 %
Ta : 25 °C

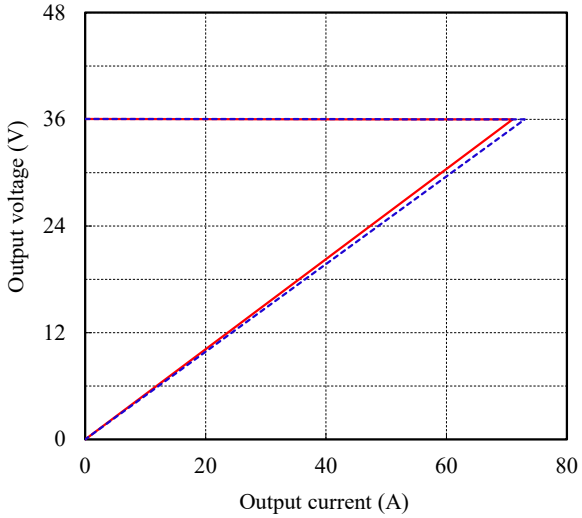
12V



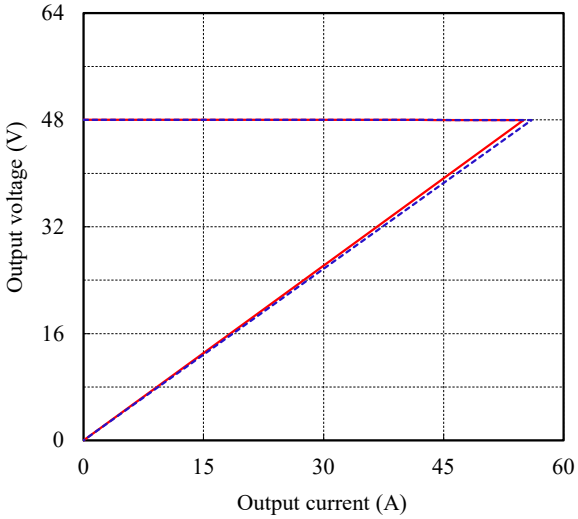
24V



36V



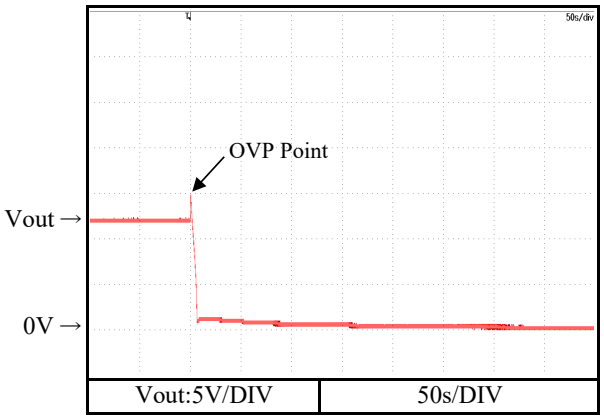
48V



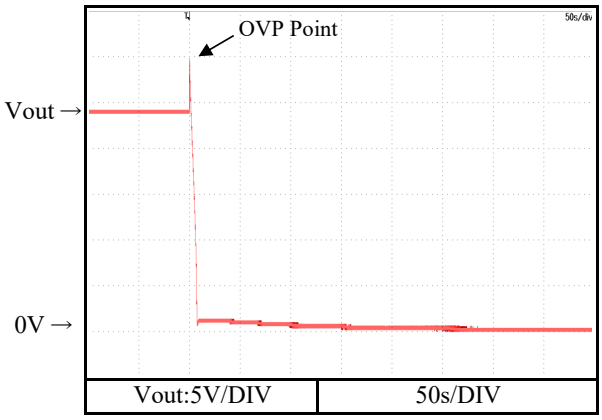
2-8. Over voltage protection (OVP) characteristics

Conditions Vin : 115 VAC
Iout : 0 %
Istb : 0 %
Ta : 25 °C

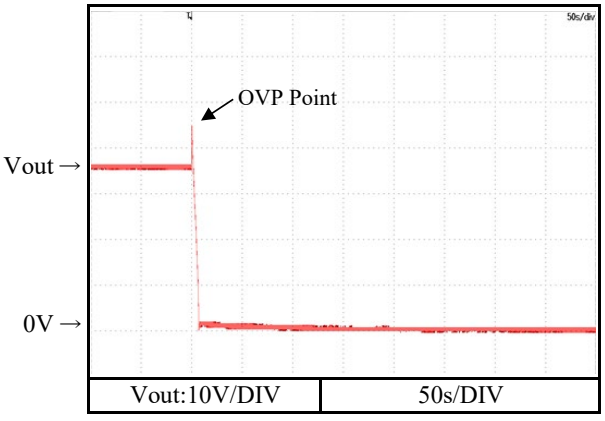
12V



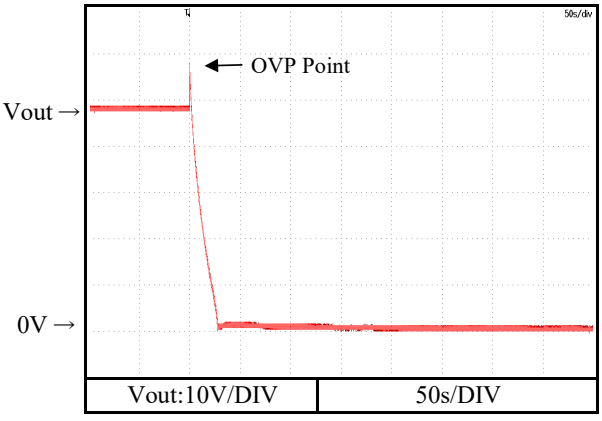
24V



36V



48V

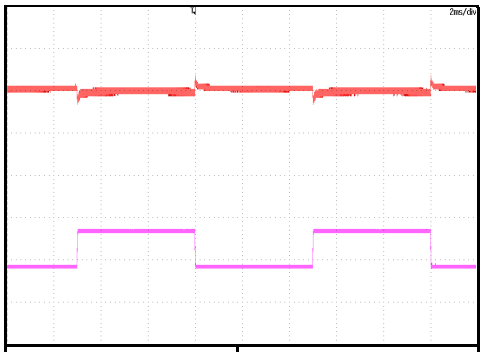


2-9. Dynamic load response characteristics

Conditions Vin : 115 VAC
Iout : 50 % ⇔ 100 % (Peak)
(tr = tf = 50us)
Istb : 100 %
Ta : 25 °C

12V

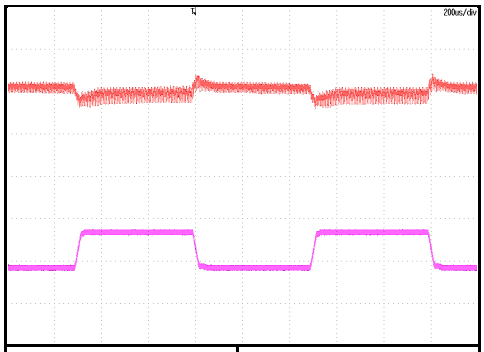
f = 100Hz



Vout:500mV/DIV	Iout:100A/DIV
2ms/DIV	
+1.50%	-1.33%

←Vout→
←Iout→
←Iout:0%→

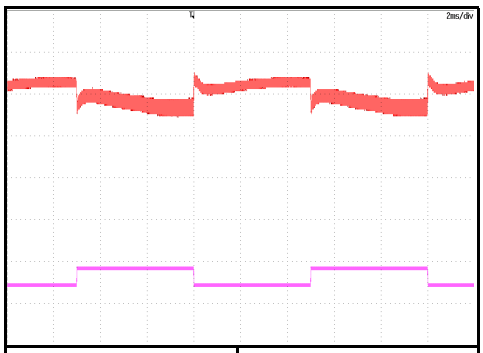
f = 1kHz



Vout:500mV/DIV	Iout:100A/DIV
200µs/DIV	
+1.75%	-1.75%

24V

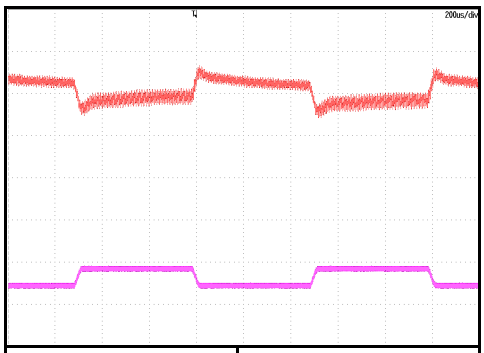
f = 100Hz



Vout:100mV/DIV	Iout:20A/DIV
2ms/DIV	
+0.43%	-0.47%

←Vout→
←Iout→
←Iout:0%→

f = 1kHz



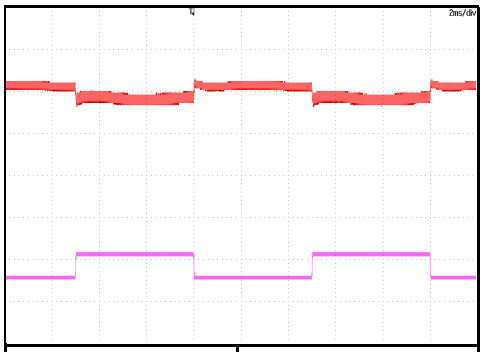
Vout:100mV/DIV	Iout:20A/DIV
200µs/DIV	
+0.55%	-0.48%

2-9. Dynamic load response characteristics

Conditions Vin : 115 VAC
Iout : 50 % ⇔ 100 % (Peak)
(tr = tf = 50us)
Istb : 100 %
Ta : 25 °C

36V

f = 100Hz



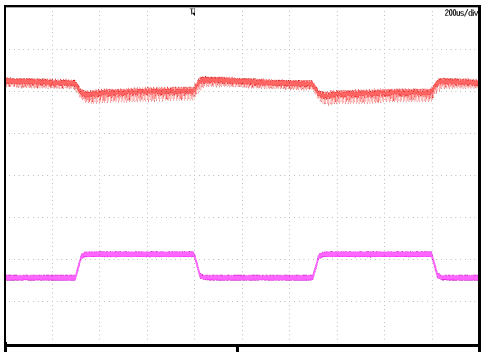
Vout:500mV/DIV	Iout:50A/DIV
2ms/DIV	
+0.39%	-0.50%

←Vout→

←Iout→

←Iout:0%→

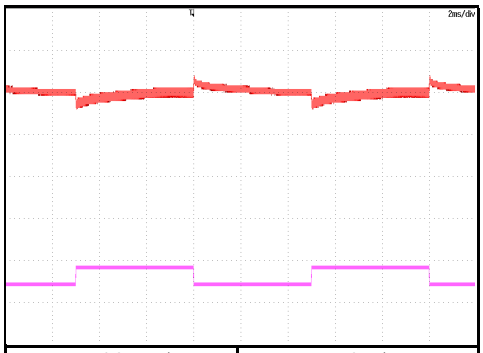
f = 1kHz



Vout:500mV/DIV	Iout:50A/DIV
200us/DIV	
+0.50%	-0.47%

48V

f = 100Hz



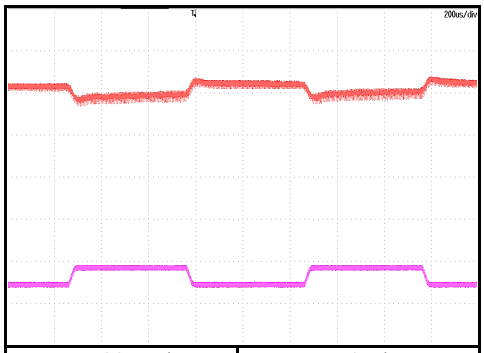
Vout:500mV/DIV	Iout:50A/DIV
2ms/DIV	
+0.42%	-0.42%

←Vout→

←Iout→

←Iout:0%→

f = 1kHz



Vout:500mV/DIV	Iout:50A/DIV
200us/DIV	
+0.42%	-0.33%

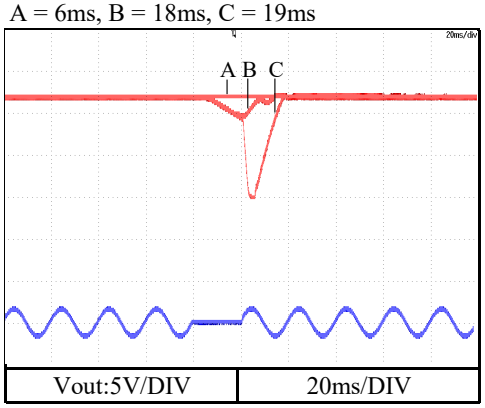
2-10. Response to brown out characteristics

Conditions Iout : Peak
Istb : 100 %
Ta : 25 °C

Interruption time
A : Output voltage does not drop.
B : Output voltage drop down to 20~40% of the nominal output voltage.
C : Output voltage drops until 0V.

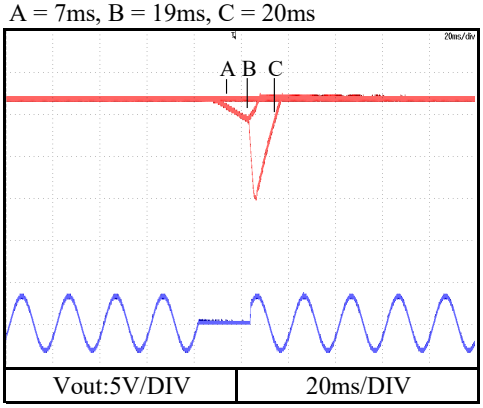
12V

Vin : 115VAC
A = 6ms, B = 18ms, C = 19ms



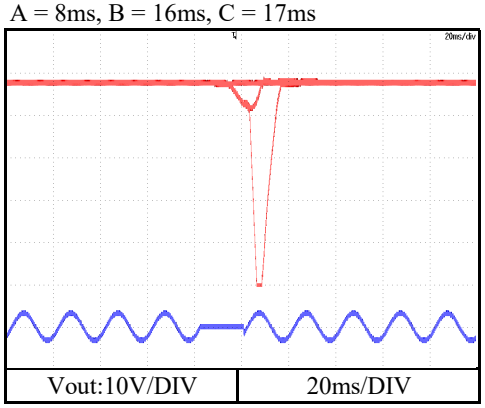
←Vout→
←0V→
←Vin→

Vin : 230VAC
A = 7ms, B = 19ms, C = 20ms



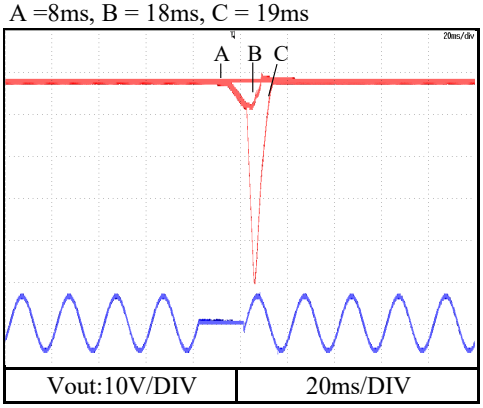
24V

Vin : 115VAC
A = 8ms, B = 16ms, C = 17ms



←Vout→
←0V→
←Vin→

Vin : 230VAC
A =8ms, B = 18ms, C = 19ms



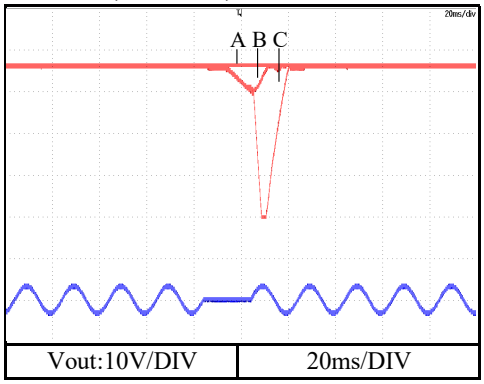
2-10. Response to brown out characteristics

Conditions Iout : Peak
Istb : 100 %
Ta : 25 °C

Interruption time
A : Output voltage does not drop.
B : Output voltage drop down to 20~40% of the nominal output voltage.
C : Output voltage drops until 0V.

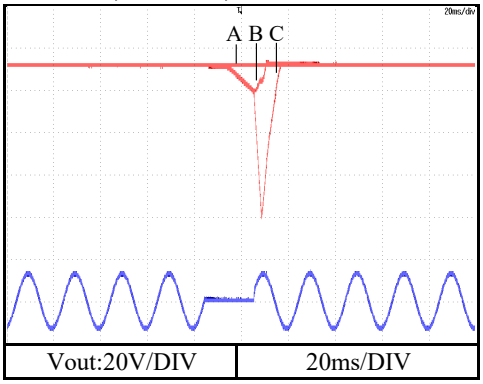
36V

Vin : 115VAC
A = 7.5ms, B = 18ms, C = 20ms



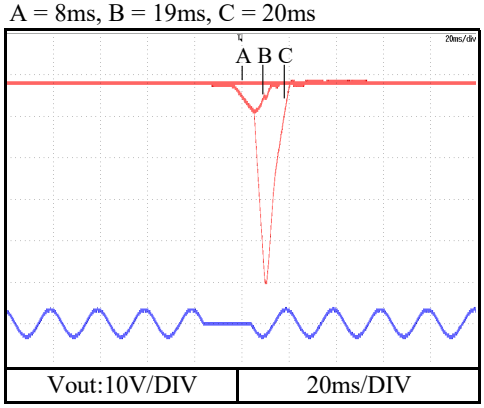
←Vout→
←0V→
←Vin→

Vin : 230VAC
A = 8.5ms, B = 20ms, C = 21ms



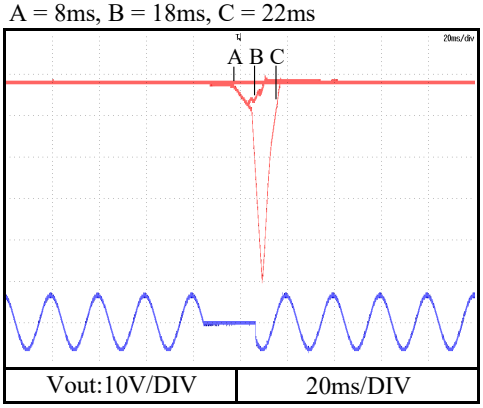
48V

Vin : 115VAC
A = 8ms, B = 19ms, C = 20ms



←Vout→
←0V→
←Vin→

Vin : 230VAC
A = 8ms, B = 18ms, C = 22ms

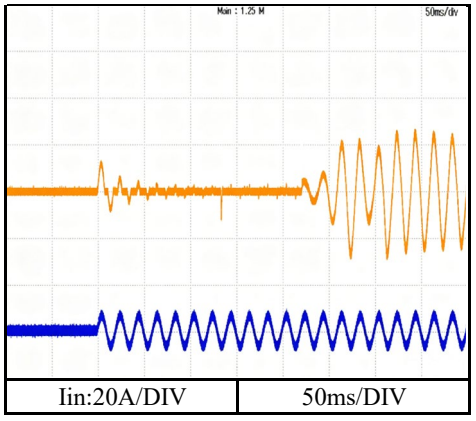


2-11. Inrush current waveform

Conditions Vin : 115 VAC
Iout : Peak (41.7A)
Istb : 100 %
Ta : 25 ℃

48V

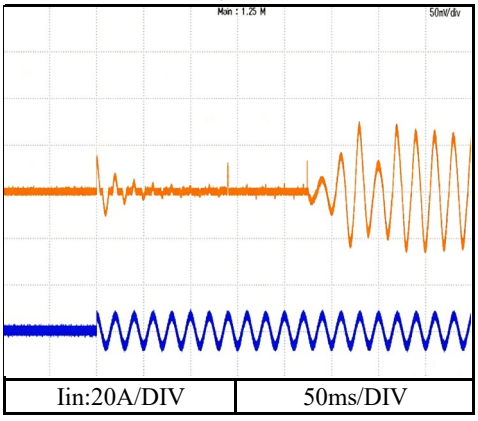
Switch on phase angle of input AC voltage
ϕ = 0°



← Iin →

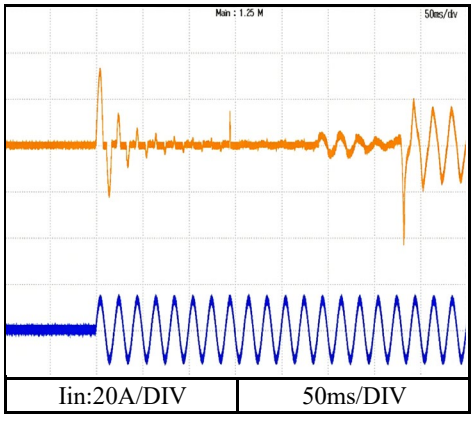
← Vin →

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



Conditions Vin : 230 VAC
Iout : Peak (41.7A)
Istb : 100 %
Ta : 25 ℃

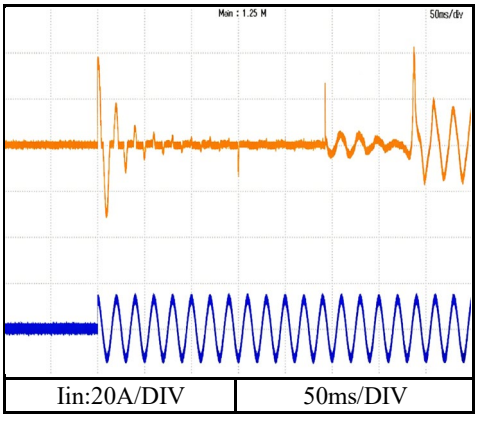
Switch on phase angle of input AC voltage
ϕ = 0°



← Iin →

← Vin →

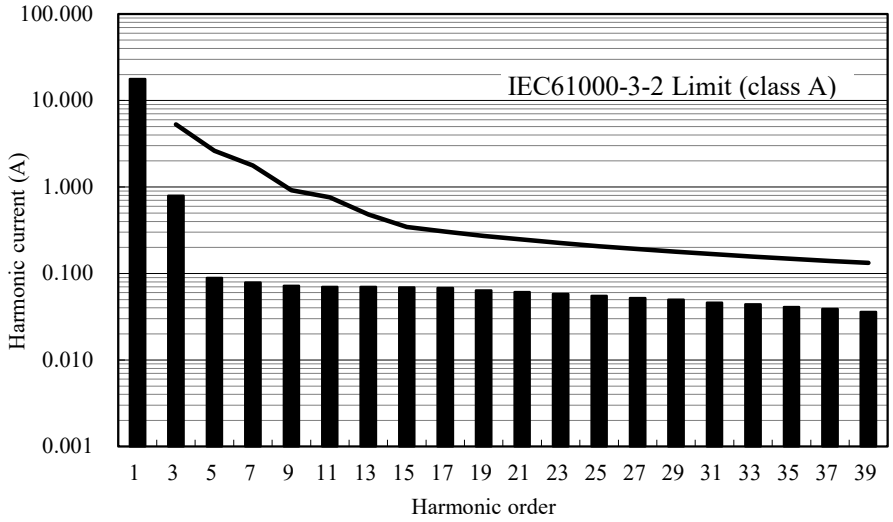
Switch on phase angle of input AC voltage
ϕ = 90°



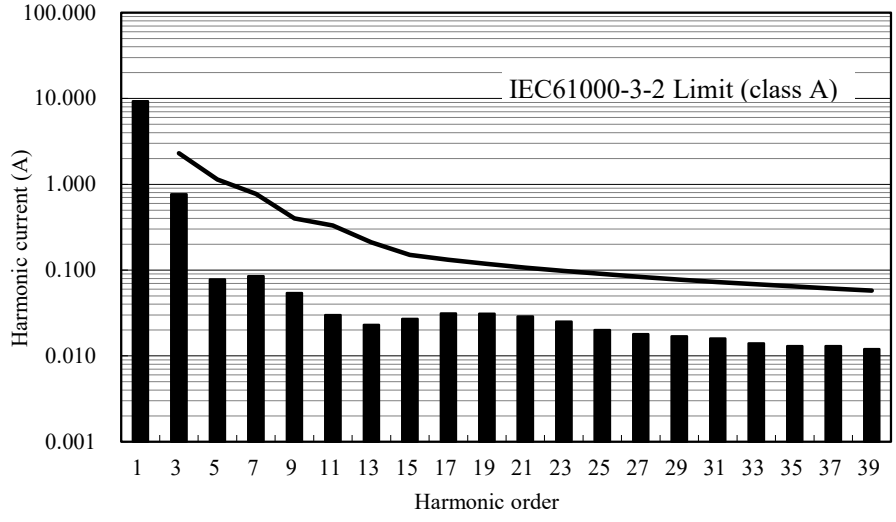
2-12. Input current harmonics

Conditions
Vin : 100 VAC
Iout : 33.4 A (100%)
Istb : 100 %
Ta : 25 °C

48V



Conditions
Vin : 230 VAC
Iout : 41.7 A (100%)
Istb : 100 %
Ta : 25 ℃

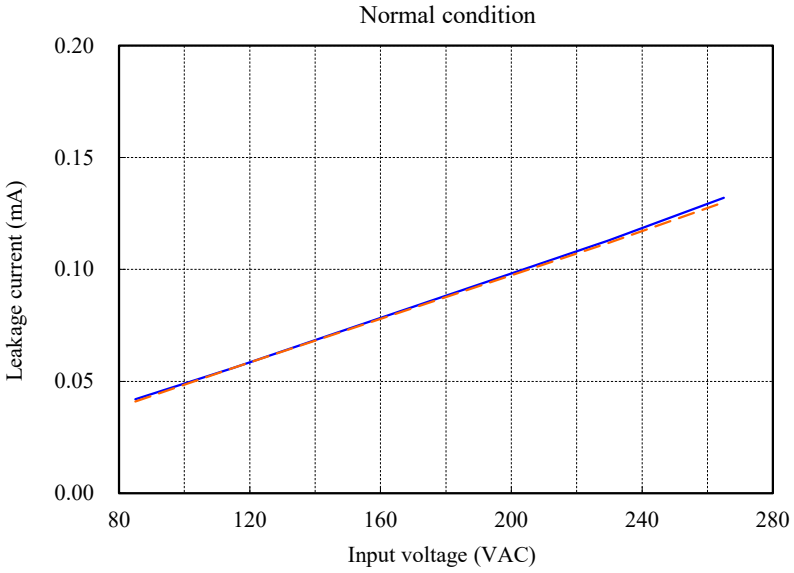


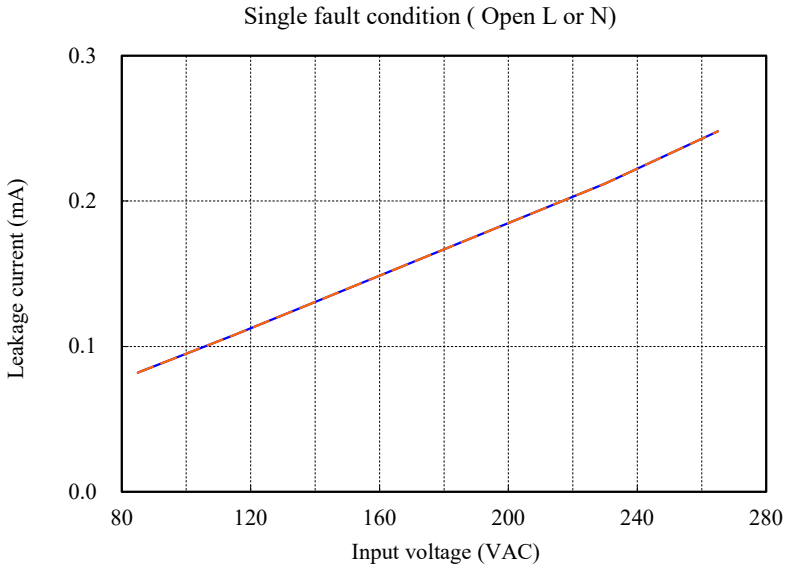
2-13. Leakage current characteristics

Earth leakage current of CLASS I equipment

Conditions Iout : 0 % ——
100 % - - - - -
Ta : 25 °C
Istb : 100 %
f : 60 Hz

48V



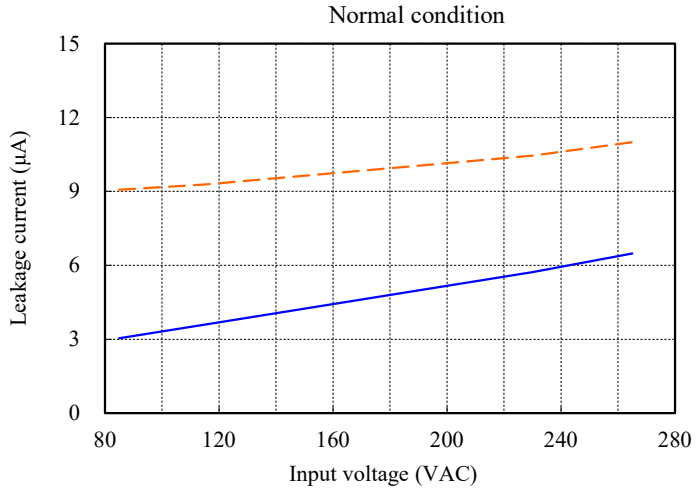


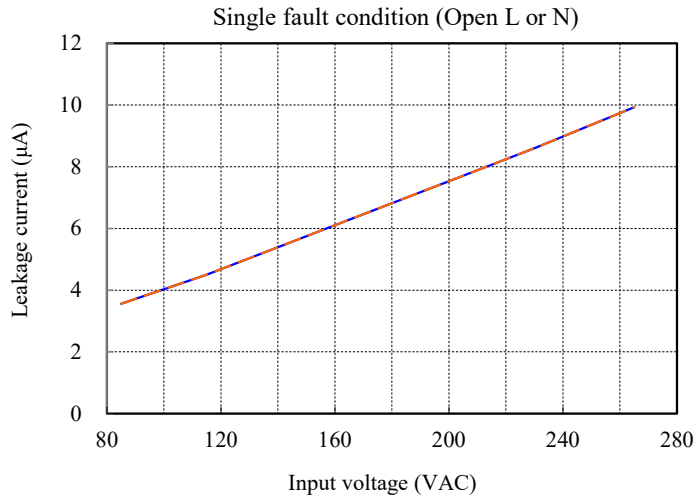
2-13. Leakage current characteristics

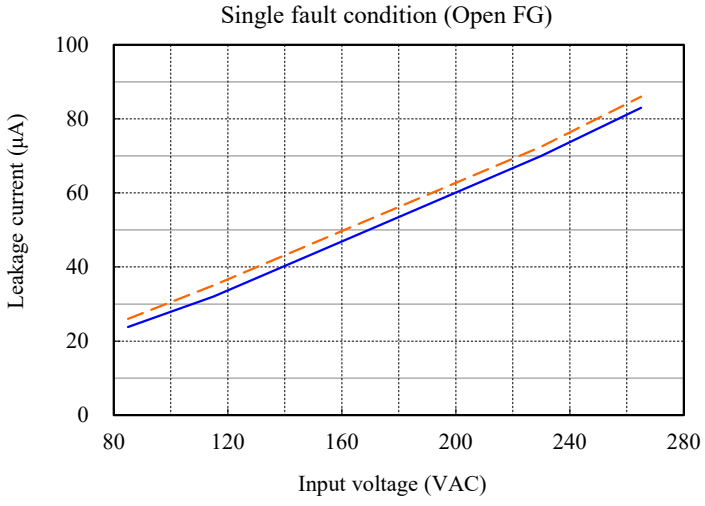
Patient leakage current of CLASS I equipment

Conditions Iout : 0 % —— 100 % - - - -
Ta : 25 °C
Istb : 100 %
f : 60 Hz

48V





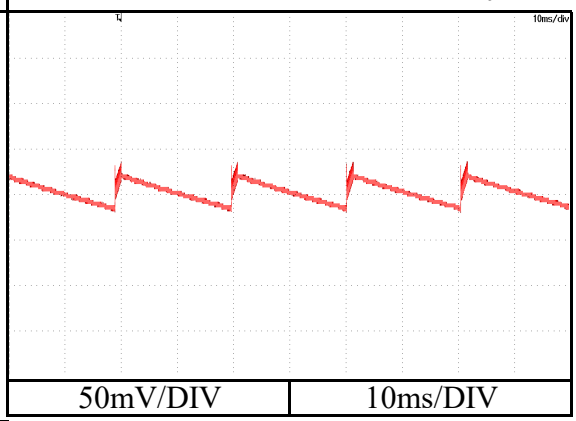


2-14. Output ripple and noise waveform

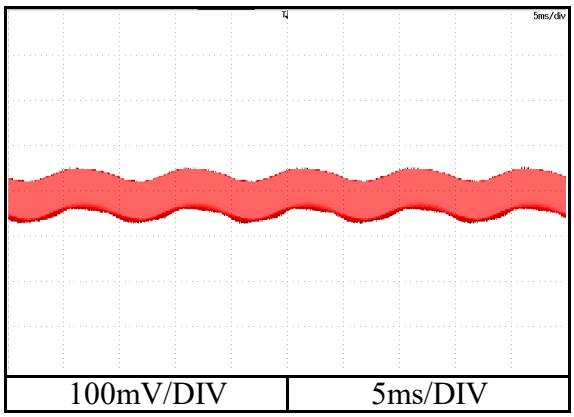
Conditions Vin : 115 VAC
Istb : 100 %
Ta : 25 °C

12V

Iout : 0 %

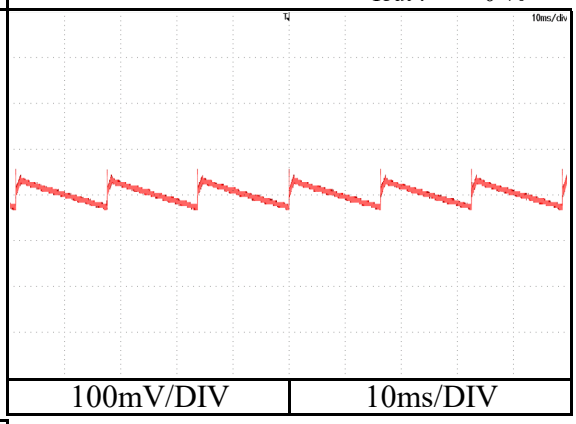


Iout : 100 %

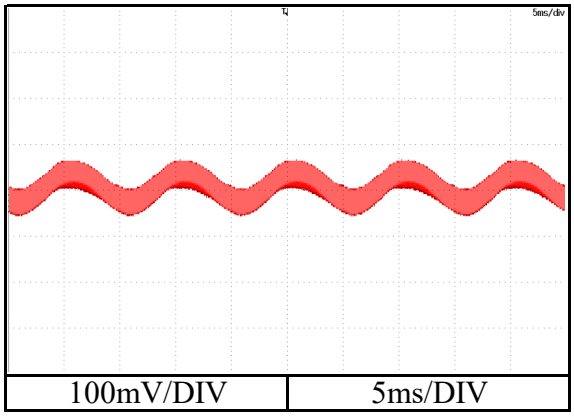


24V

Iout : 0 %

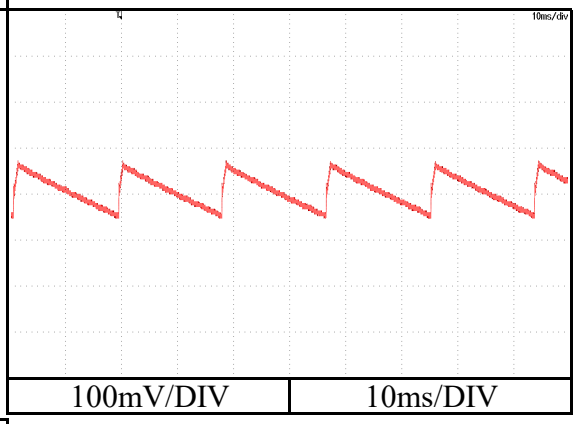


Iout : 100 %

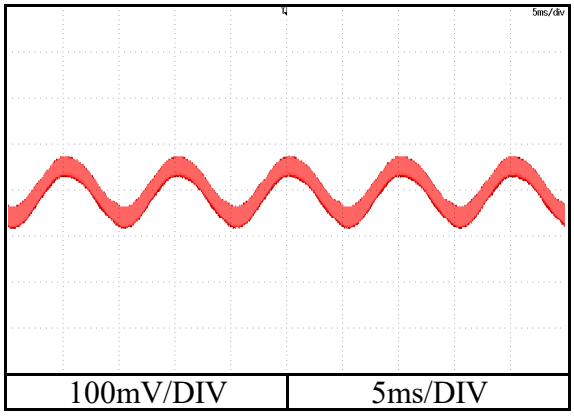


36V

Iout : 0 %

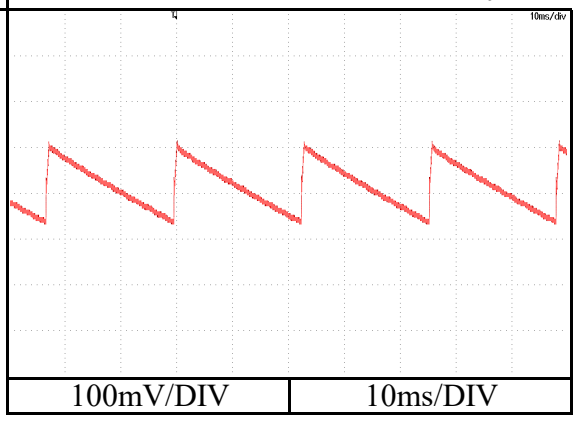


Iout : 100 %

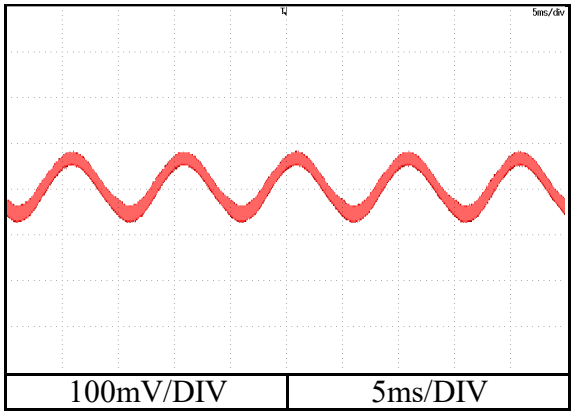


48V

Iout : 0 %



Iout : 100 %

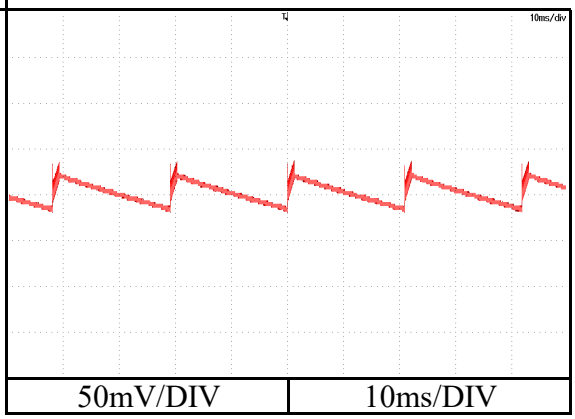


2-14. Output ripple and noise waveform

Conditions Vin : 230 VAC
Istb : 100 %
Ta : 25 °C

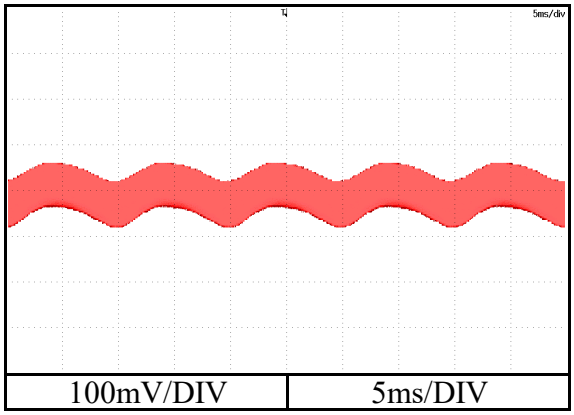
12V

Iout : 0 %



50mV/DIV | 10ms/DIV

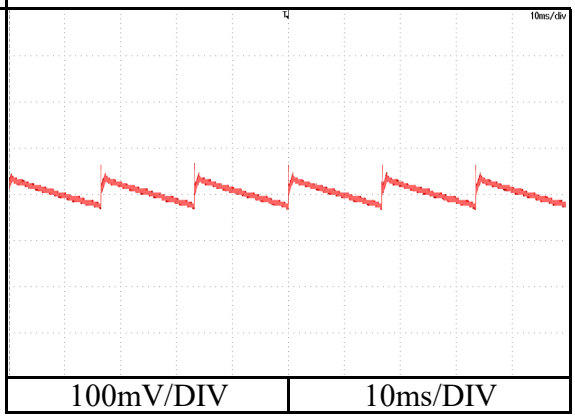
Iout : 100 %



100mV/DIV | 5ms/DIV

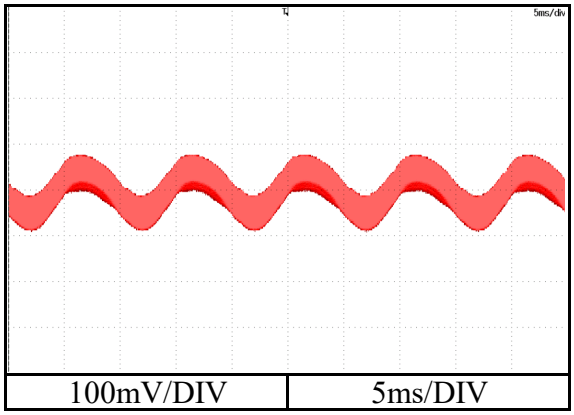
24V

Iout : 0 %



100mV/DIV | 10ms/DIV

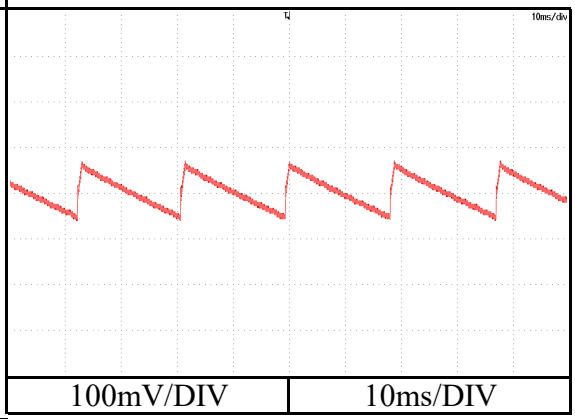
Iout : 100 %



100mV/DIV | 5ms/DIV

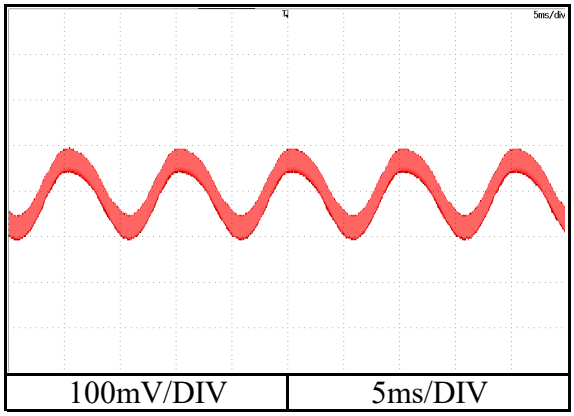
36V

Iout : 0 %



100mV/DIV | 10ms/DIV

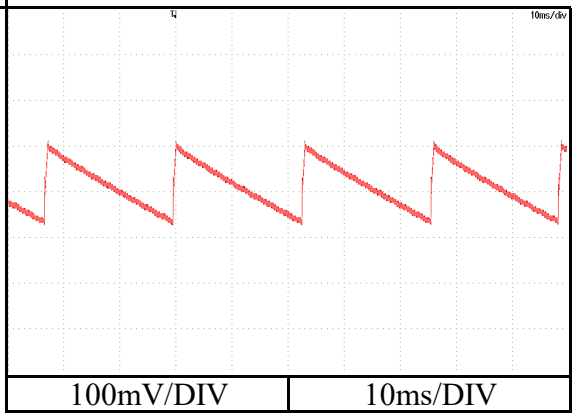
Iout : 100 %



100mV/DIV | 5ms/DIV

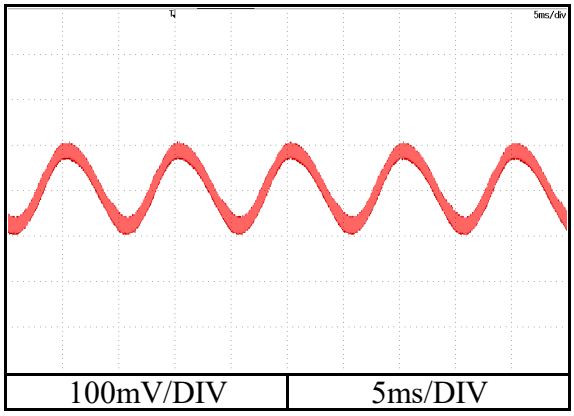
48V

Iout : 0 %



100mV/DIV | 10ms/DIV

Iout : 100 %



100mV/DIV | 5ms/DIV

2-15. Electro-Magnetic Interference characteristics

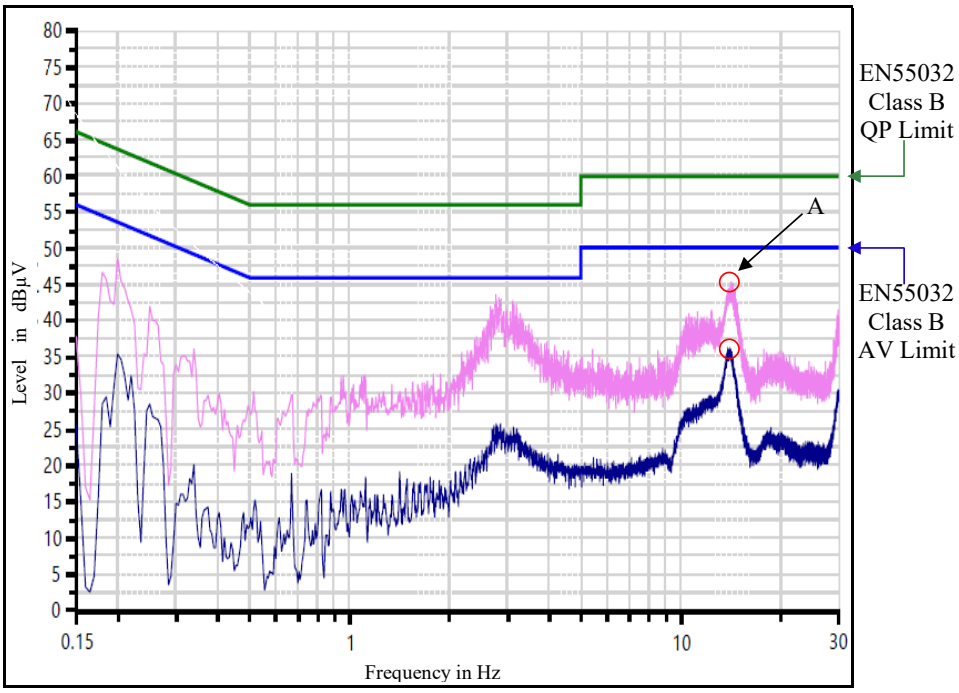
Conditions Vin : 115 VAC
Iout : 125 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

12V

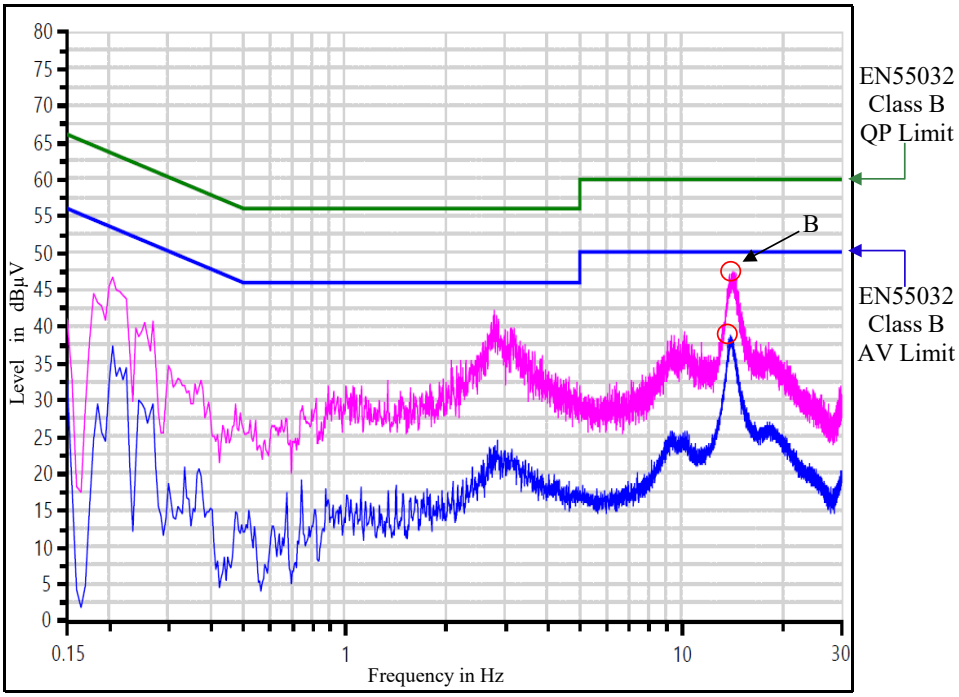
Phase : L

Ref. Data	Point A (14.0MHz) Limit (dB)	Measure (dB)
QP	60.0	45.1
AV	50.0	36.3



Phase : N

Ref. Data	Point B (14.2MHz) Limit (dB)	Measure (dB)
QP	60.0	47.4
AV	50.0	38.8



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

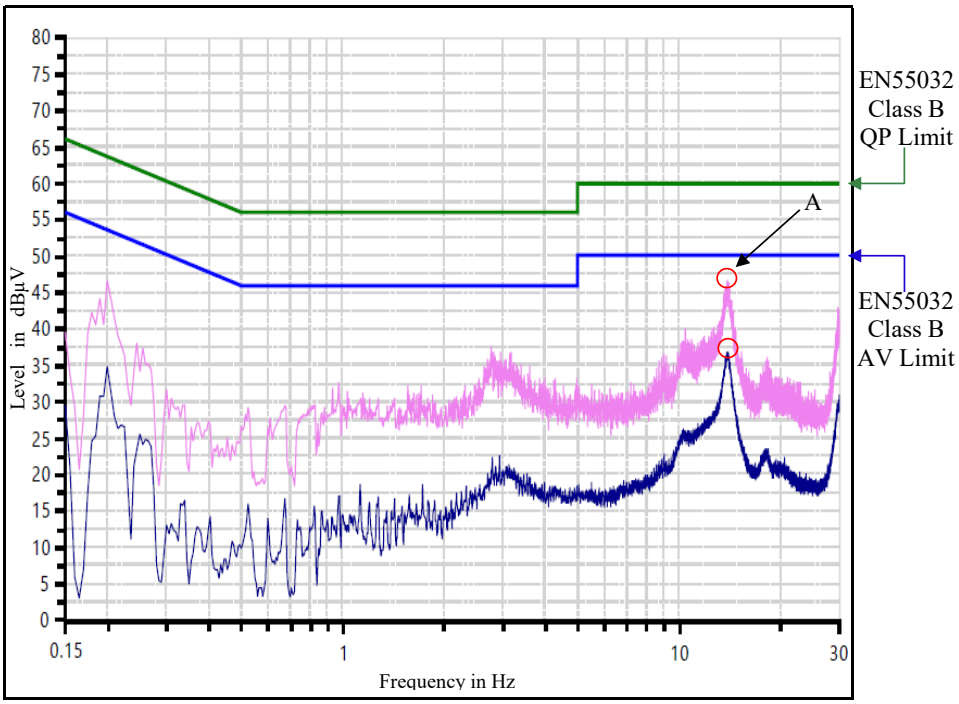
Conditions Vin : 230 VAC
Iout : 133.4 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

12V

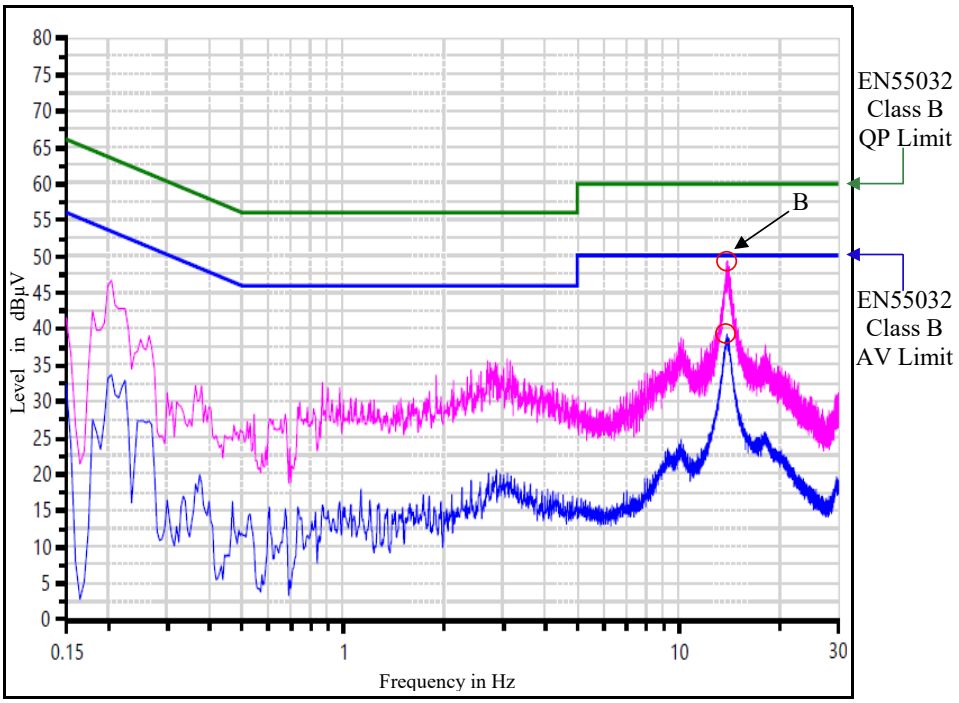
Phase : L

Ref. Data	Point A (13.9MHz) Limit (dB)	Measure (dB)
QP	60.0	46.7
AV	50.0	36.9



Phase : N

Ref. Data	Point B (14.1MHz) Limit (dB)	Measure (dB)
QP	60.0	49.4
AV	50.0	39.2



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

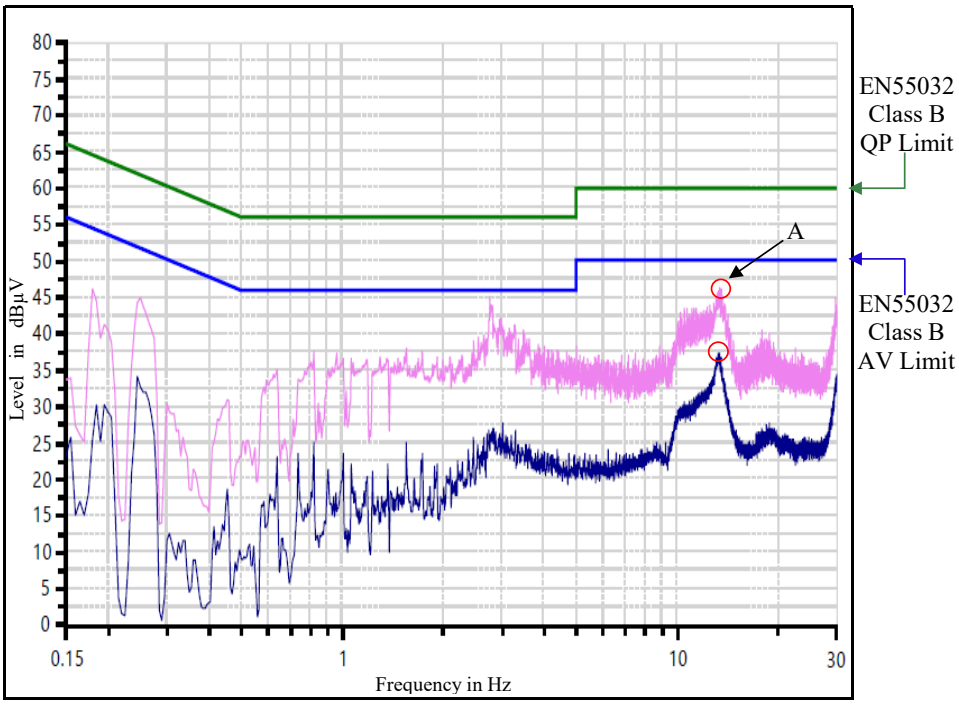
Conditions Vin : 115 VAC
Iout : 66.7 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

24V

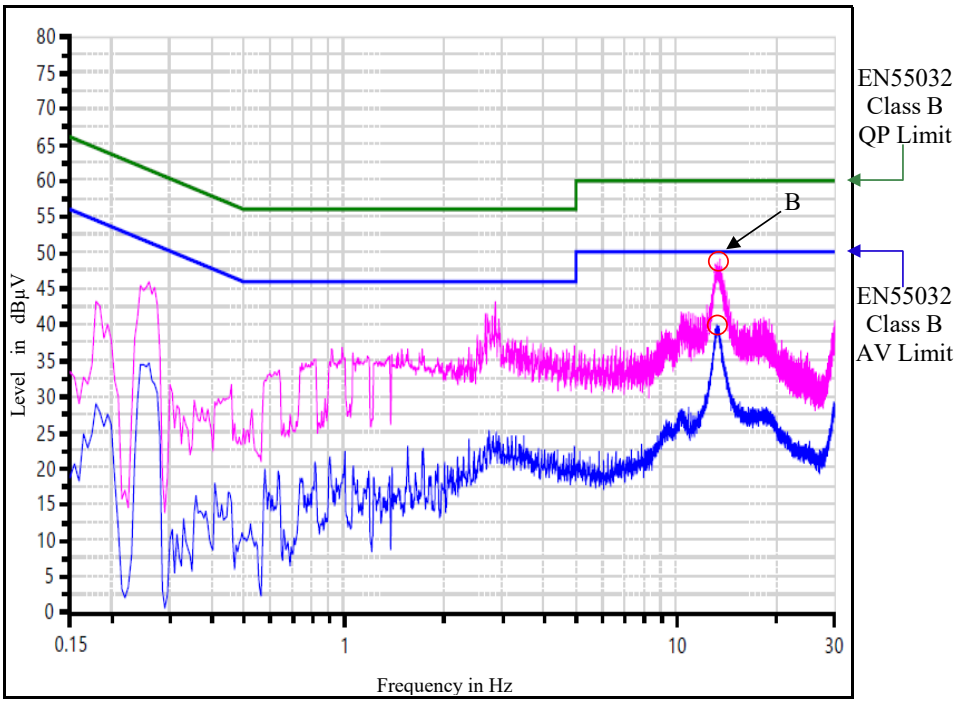
Phase : L

Ref. Data	Point A (13.3MHz) Limit (dB)	Measure (dB)
QP	60.0	46.3
AV	50.0	37.4



Phase : N

Ref. Data	Point B (13.6MHz) Limit (dB)	Measure (dB)
QP	60.0	49.0
AV	50.0	40.1



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

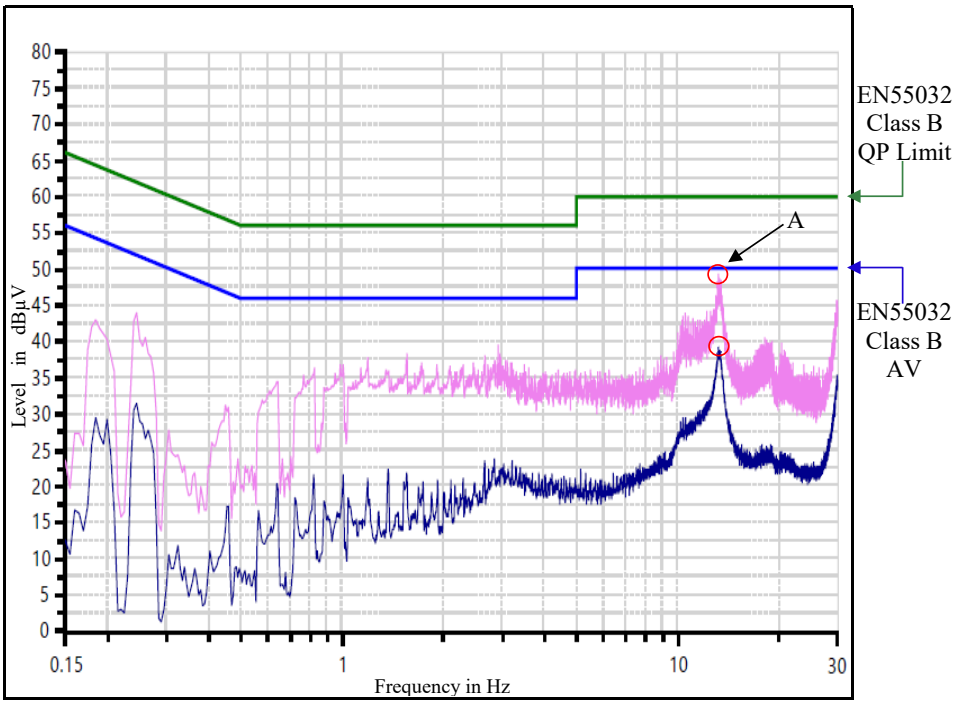
Conditions Vin : 230 VAC
Iout : 83.4 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

24V

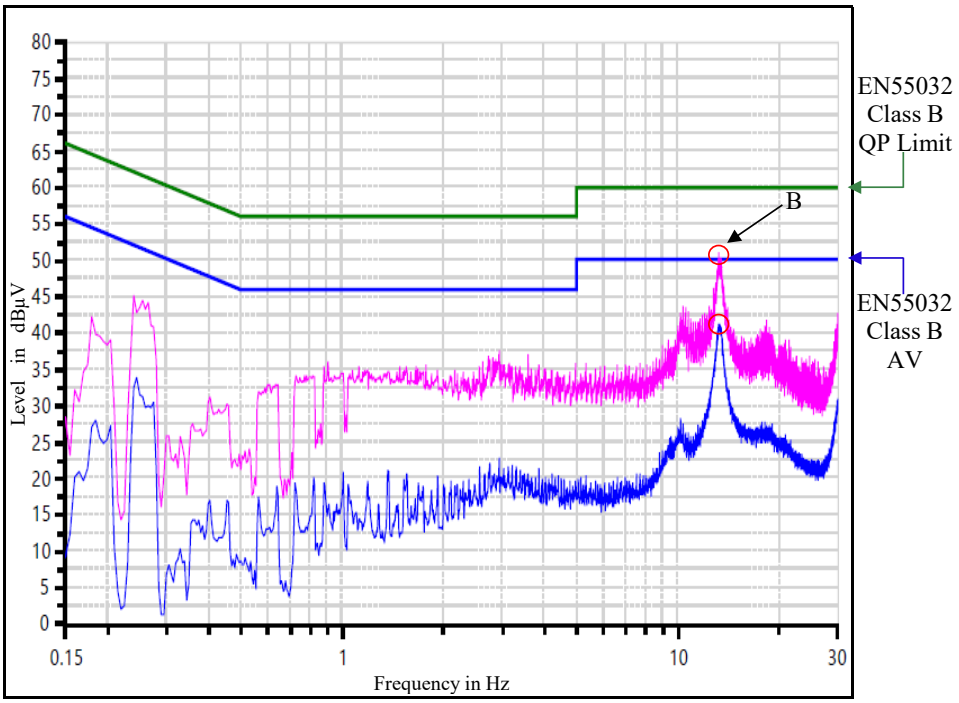
Phase : L

Ref. Data	Point A (13.2MHz) Limit (dB)	Measure (dB)
QP	60.0	49.2
AV	50.0	39.4



Phase : N

Ref. Data	Point B (13.3MHz) Limit (dB)	Measure (dB)
QP	60.0	50.9
AV	50.0	41.3



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

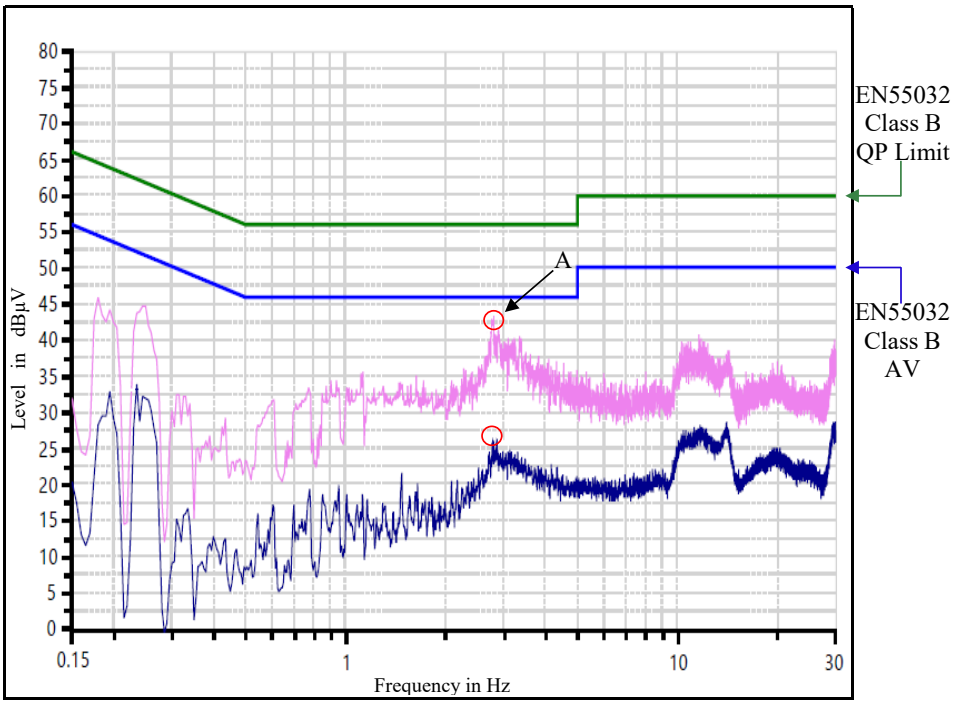
Conditions Vin : 115 VAC
Iout : 44.5 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

36V

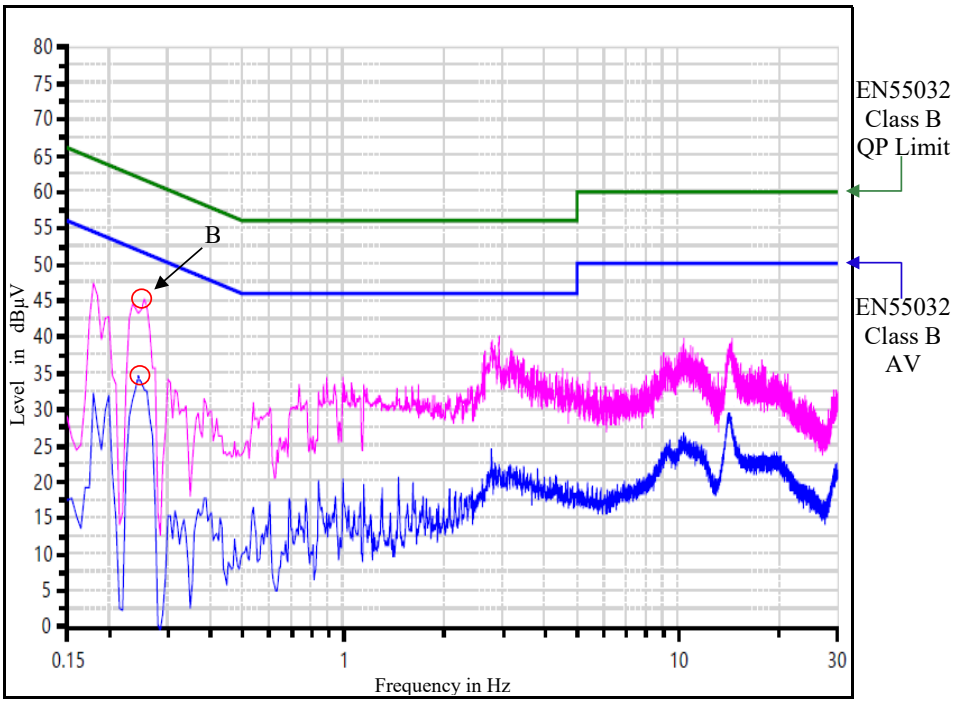
Phase : L

Ref. Data	Point A (2.8MHz) Limit (dB)	Measure (dB)
QP	56.0	43.4
AV	46.0	26.3



Phase : N

Ref. Data	Point B (0.3MHz) Limit (dB)	Measure (dB)
QP	61.9	45.3
AV	51.9	34.7



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

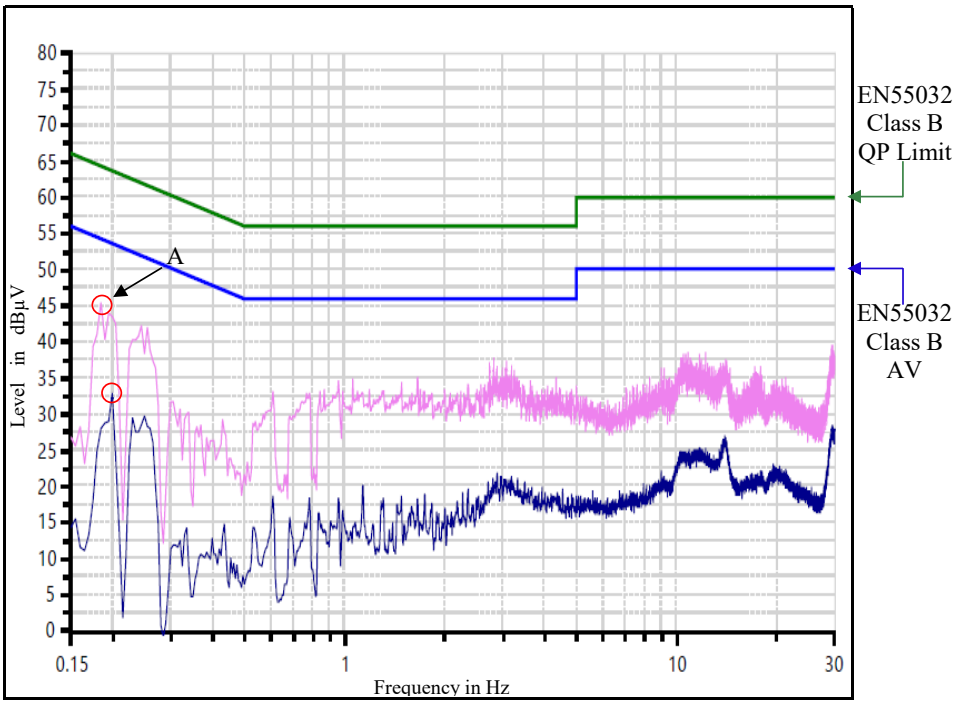
Conditions Vin : 230 VAC
Iout : 55.5 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

36V

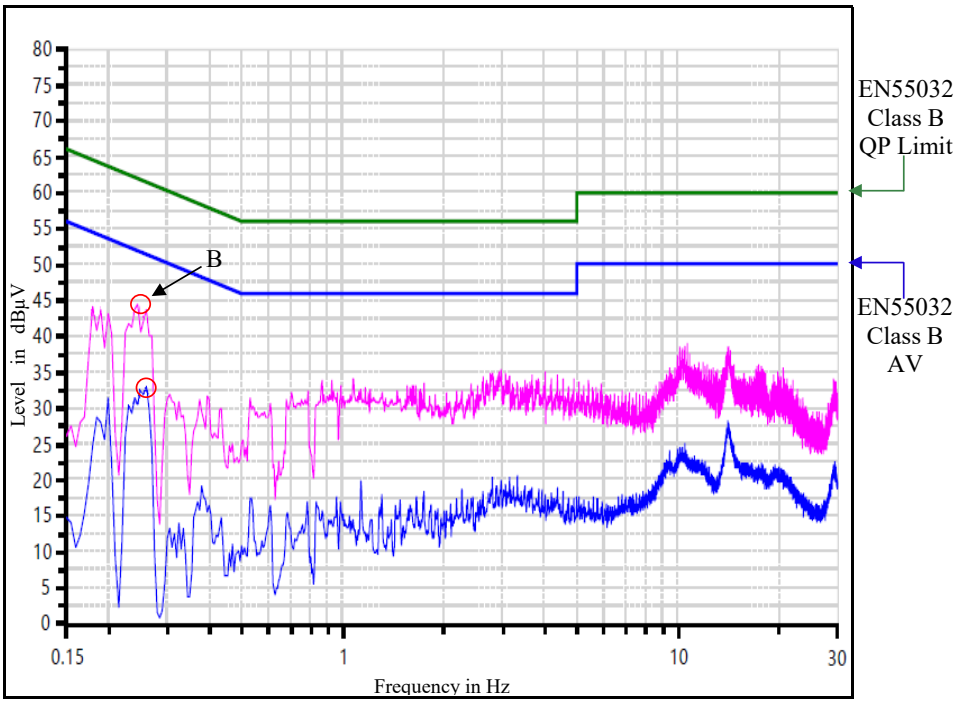
Phase : L

Ref. Data	Point A (0.2MHz) Limit (dB)	Measure (dB)
QP	63.0	45.2
AV	53.6	32.8



Phase : N

Ref. Data	Point B (0.3MHz) Limit (dB)	Measure (dB)
QP	61.9	44.5
AV	51.4	33.2



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

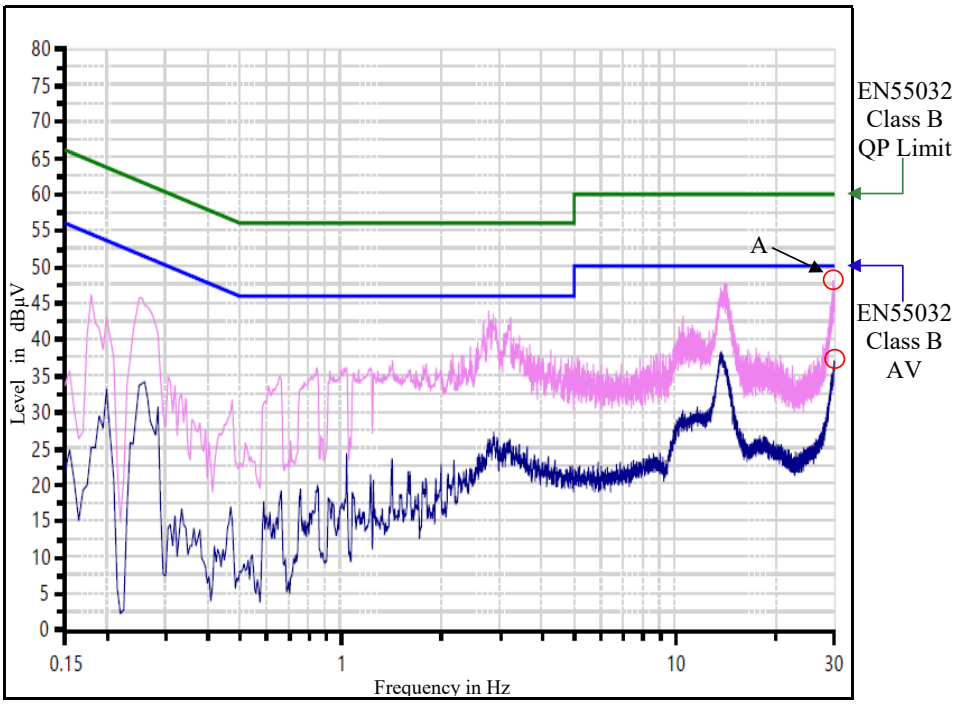
Conditions Vin : 115 VAC
Iout : 33.4 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

48V

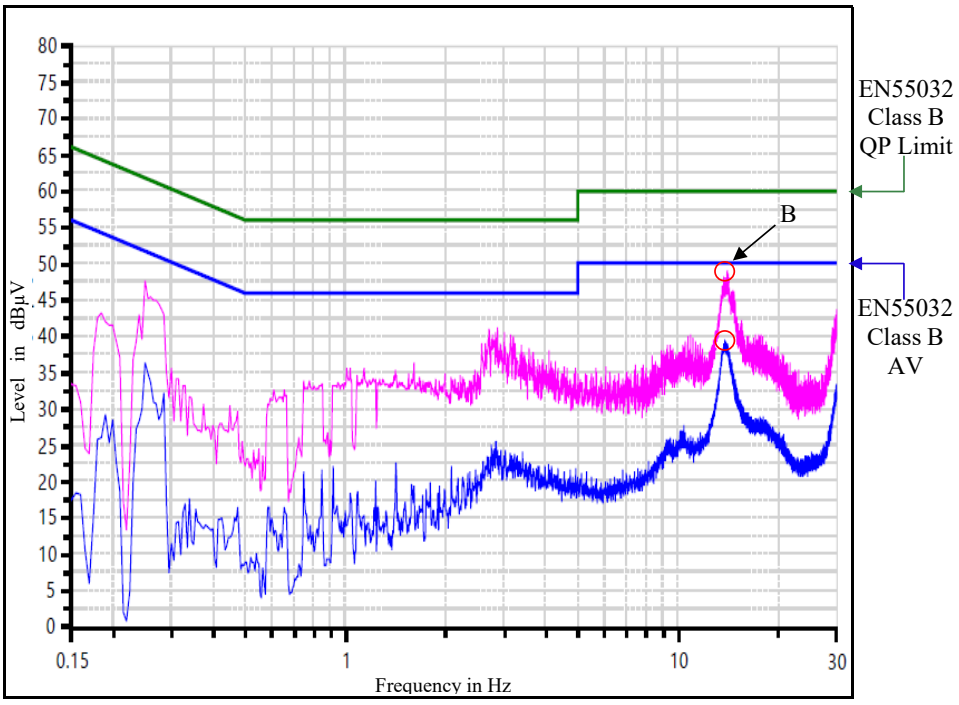
Phase : L

Ref. Data	Point A (29.9MHz) Limit (dB)	Measure (dB)
QP	60.0	48.1
AV	50.0	38.4



Phase : N

Ref. Data	Point B (14.0MHz) Limit (dB)	Measure (dB)
QP	60.0	49.2
AV	50.0	39.4



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

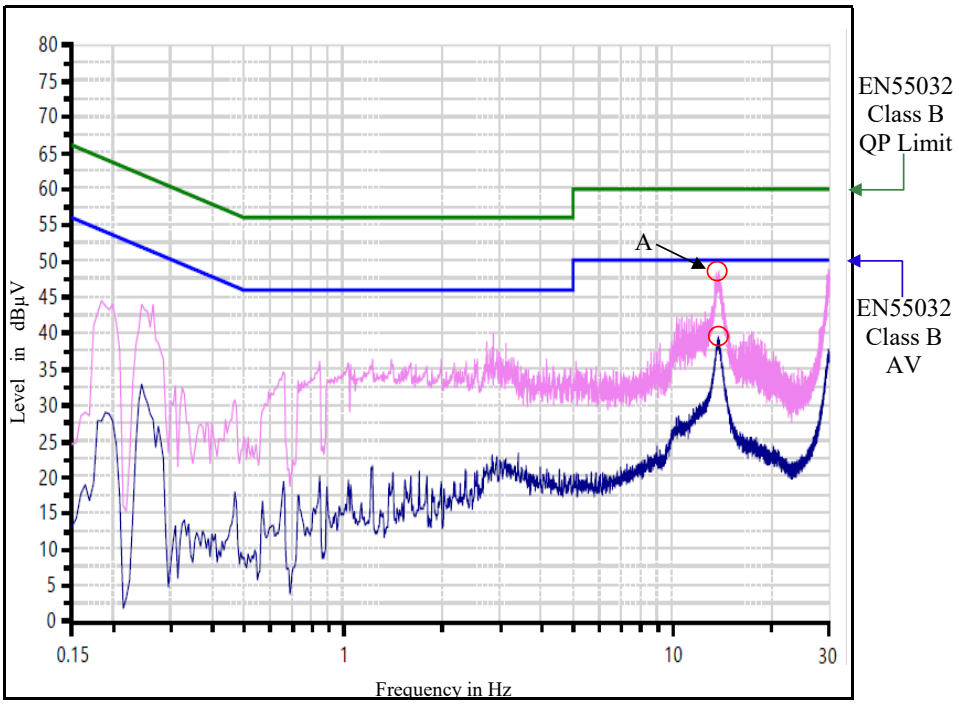
Conditions Vin : 230 VAC
Iout : 41.7 A (100%)
Istb : 100 %
Ta : 25 ℃

Conducted Emission

48V

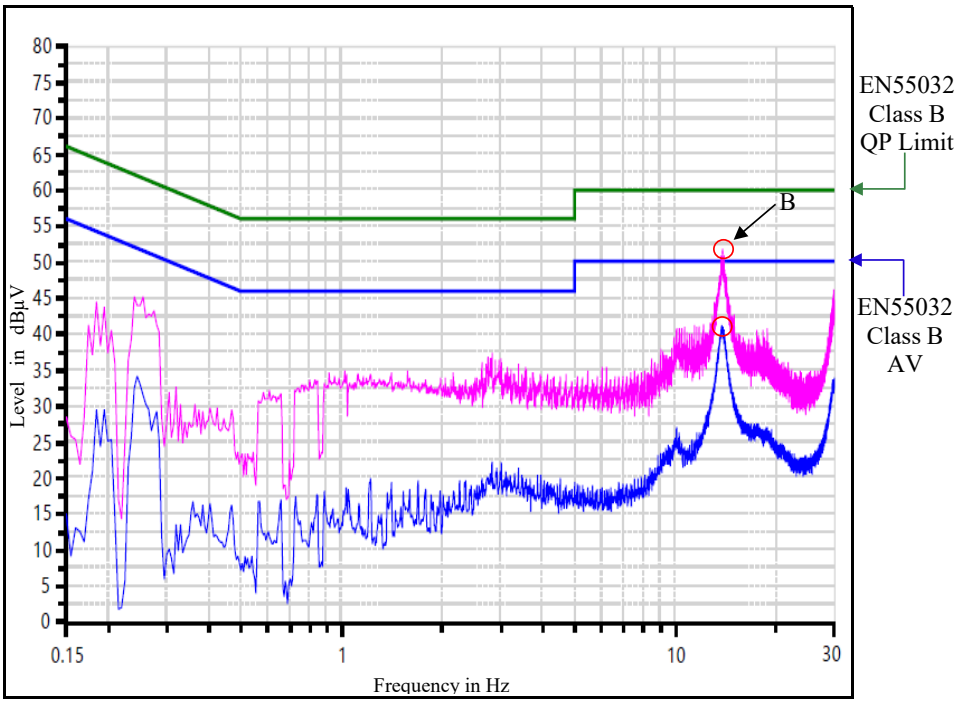
Phase : L

Ref. Data	Point A (13.9MHz) Limit (dB)	Measure (dB)
QP	60.0	48.8
AV	50.0	39.5



Phase : N

Ref. Data	Point B (13.9MHz) Limit (dB)	Measure (dB)
QP	60.0	51.8
AV	50.0	41.3



Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

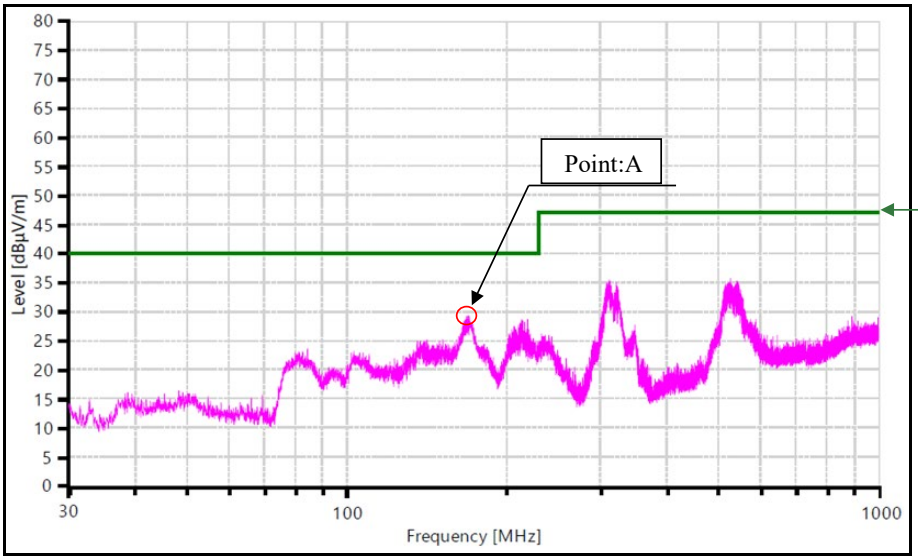
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 115 VAC
Iout : 125 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

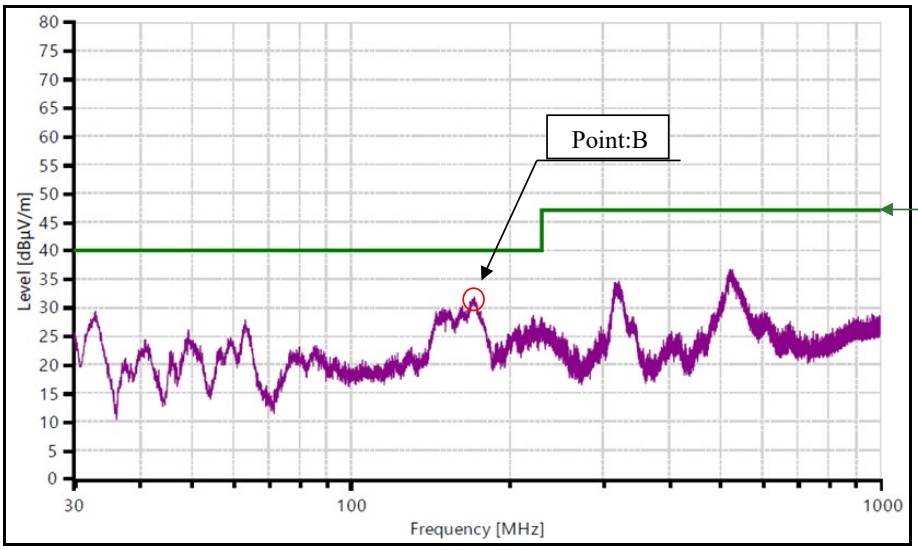
12V

HORIZONTAL



Ref. Data	Point A (169.3MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	29.4

VERTICAL



Ref. Data	Point B (171.4MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	31.9

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

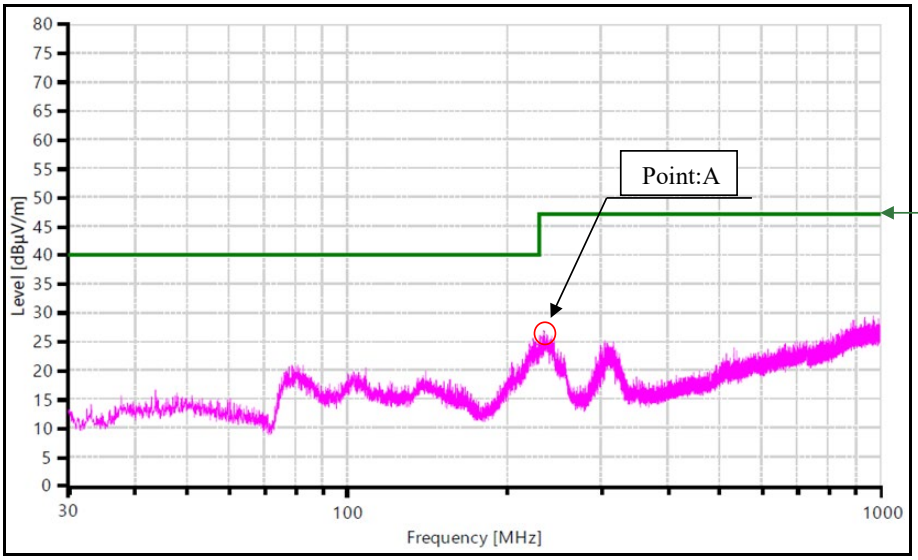
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 230 VAC
Iout : 133.4 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

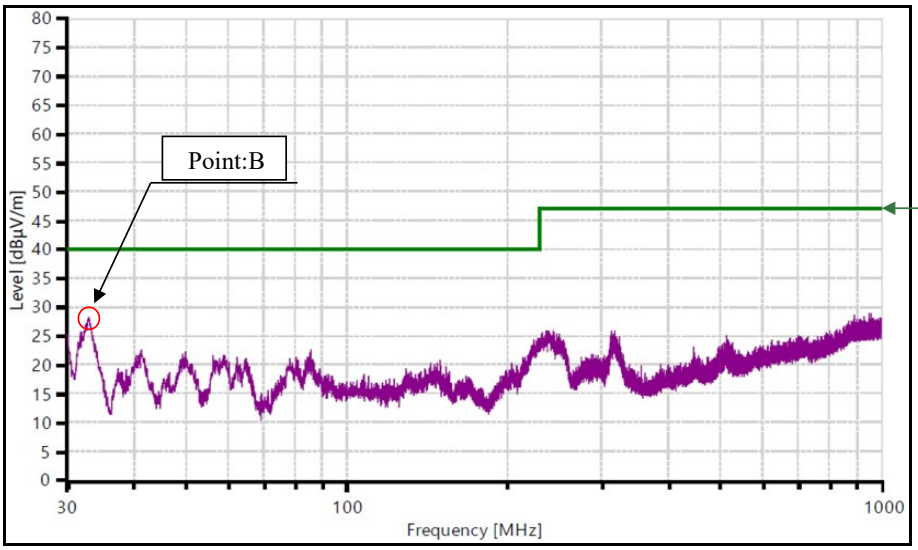
12V

HORIZONTAL



Ref. Data	Point A (229.9MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	25.6

VERTICAL



Ref. Data	Point B (32.9MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	28.2

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

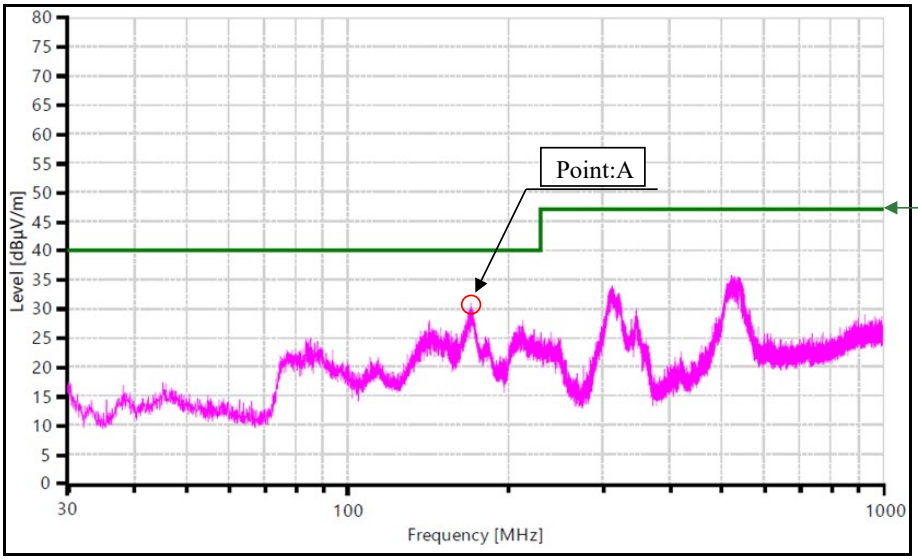
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 115 VAC
Iout : 66.7 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

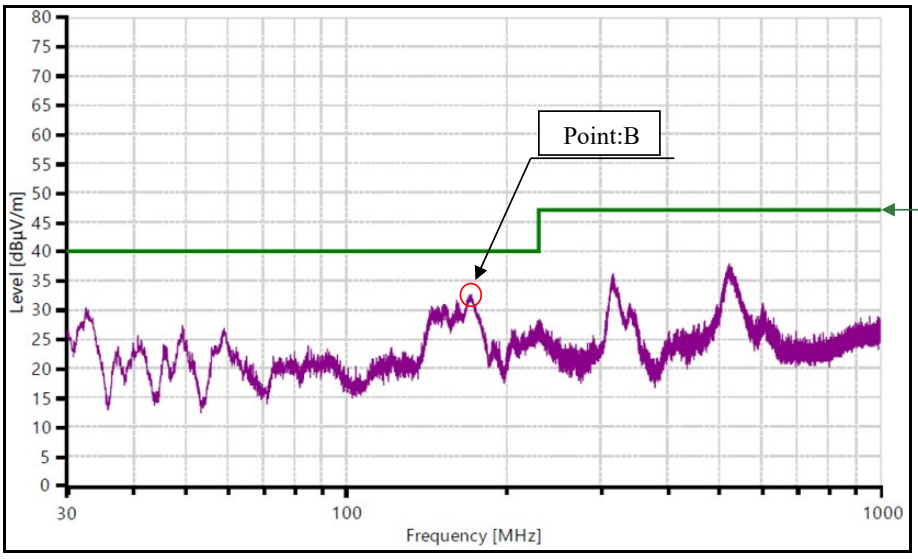
24V

HORIZONTAL



Ref. Data	Point A (170.1MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	30.9

VERTICAL



Ref. Data	Point B (170.2MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	32.8

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

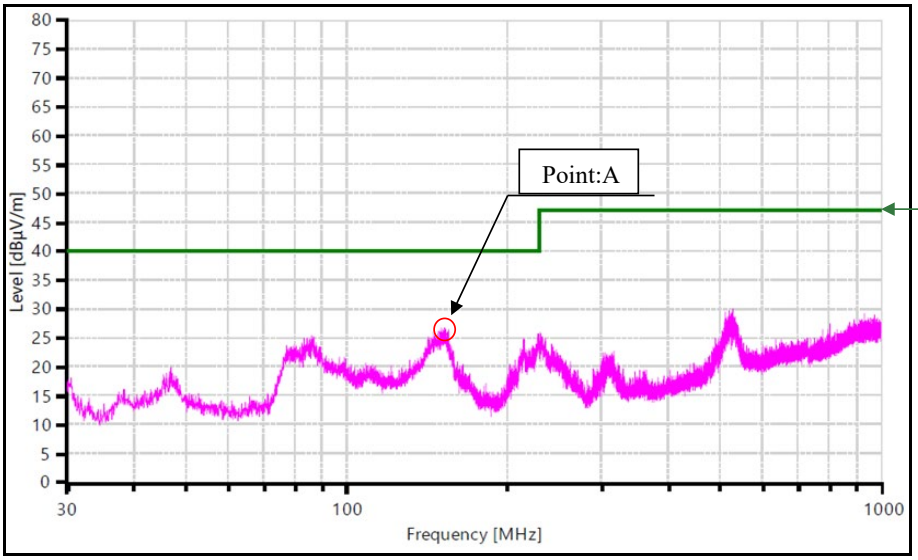
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 230 VAC
Iout : 83.4 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

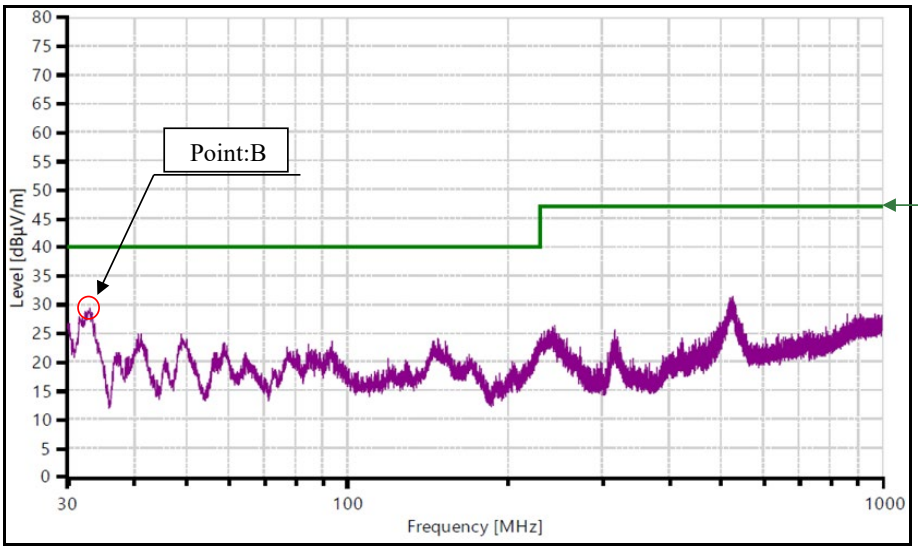
24V

HORIZONTAL



Ref. Data	Point A (152.8MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	26.7

VERTICAL



Ref. Data	Point B (33.1MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	29.5

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

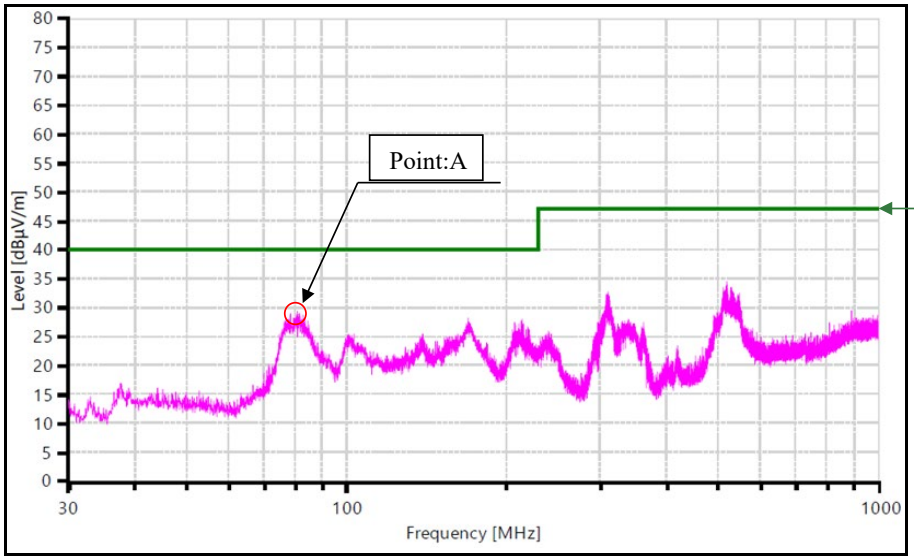
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 115 VAC
Iout : 44.5 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

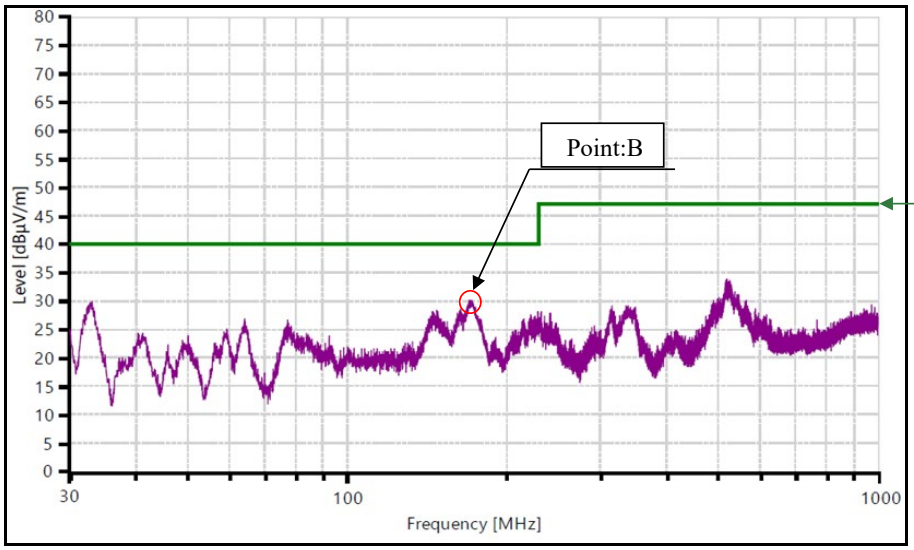
36V

HORIZONTAL



Ref. Data	Point A (78.6MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	29.0

VERTICAL



Ref. Data	Point B (169.6MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	30.2

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

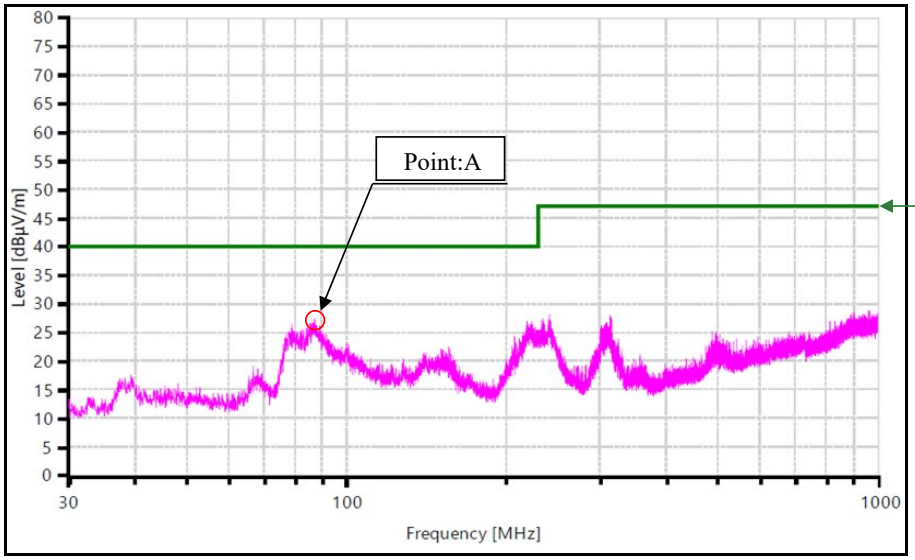
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 230 VAC
Iout : 55.5 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

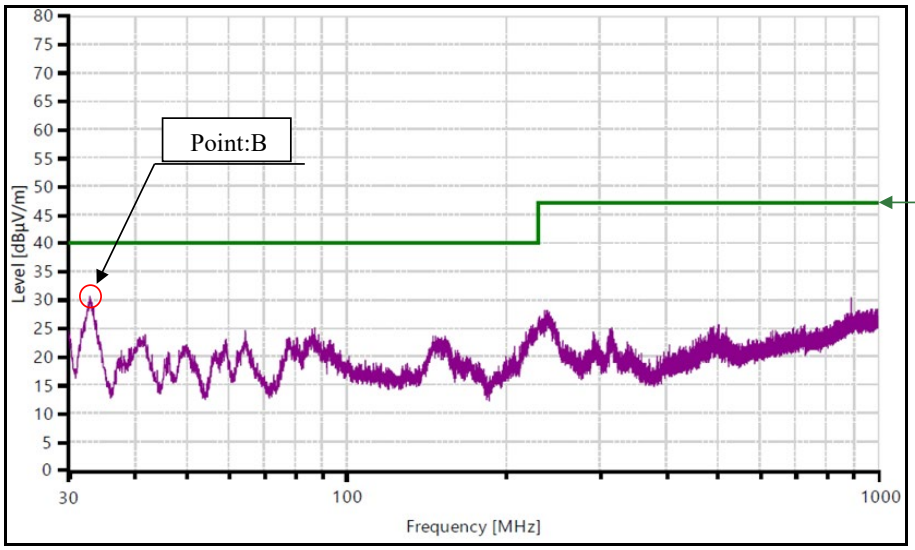
36V

HORIZONTAL



Ref. Data	Point A (87.1MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	27.4

VERTICAL



Ref. Data	Point B (32.9MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	30.6

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

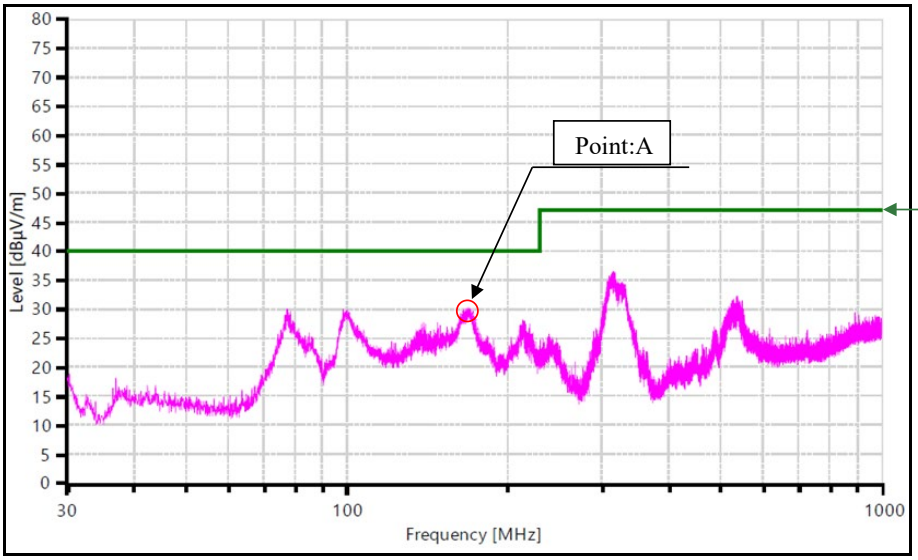
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 115 VAC
Iout : 33.4 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

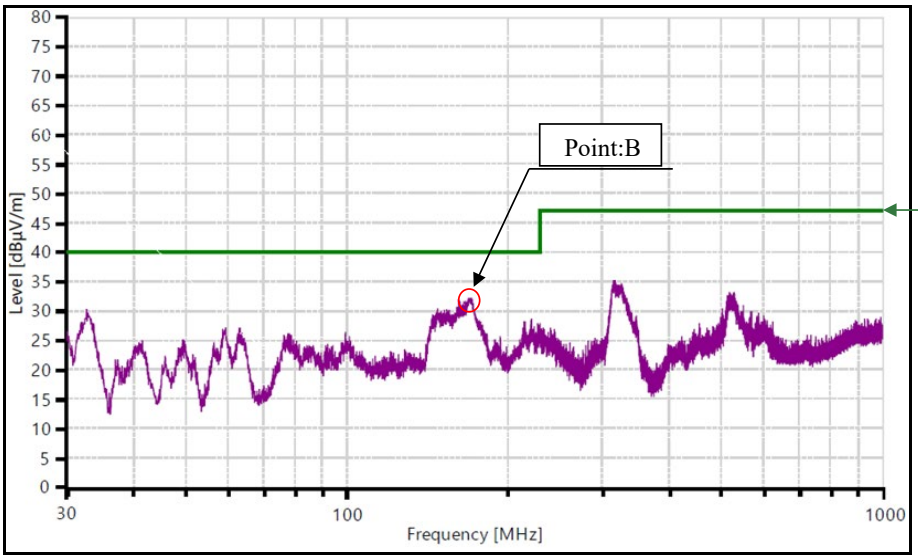
48V

HORIZONTAL



Ref. Data	Point A (169.3MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	30.2

VERTICAL



Ref. Data	Point B (169.6MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	32.2

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

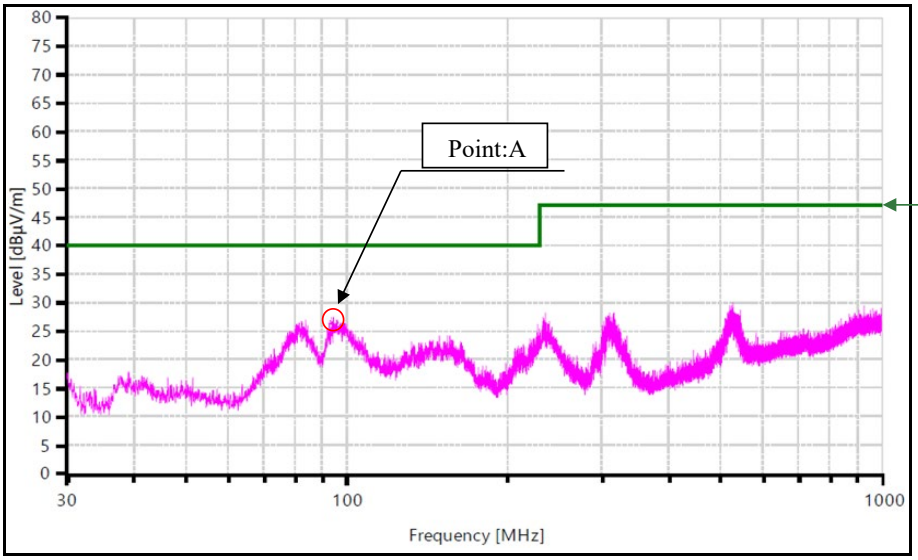
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 230 VAC
Iout : 41.7 A (100%)
Istb : 100 %
Ta : 25 ℃

Radiated Emission

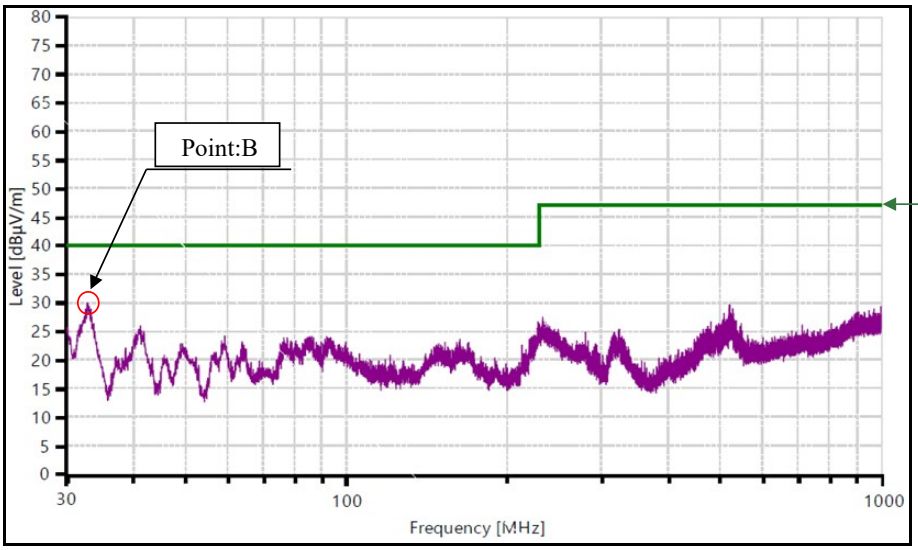
48V

HORIZONTAL



Ref. Data	Point A (94.5MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	27.4

VERTICAL



Ref. Data	Point B (32.8MHz) Limit (dBuV)	Measure (dBuV)
QP	40.0	30.0

Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

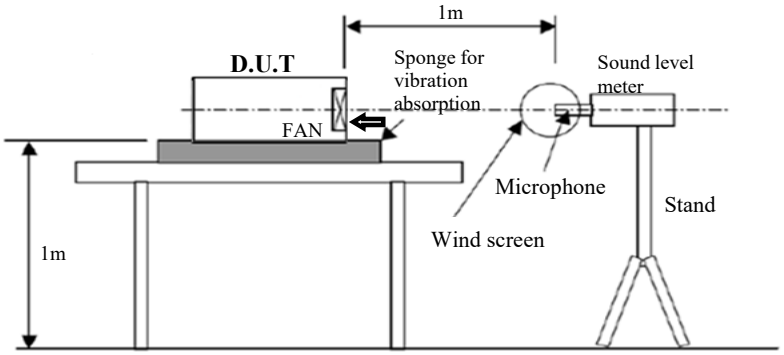
2-16.Audible Noise of FAN

Test condition: Background noise: 14 [dB(A)]
Test duration: 60 [s]
Vin: 100VAC @ 60Hz
230VAC @ 50Hz
Iout: 100% (83.4A)
Istb: 100% (2A)
Ta: 25℃

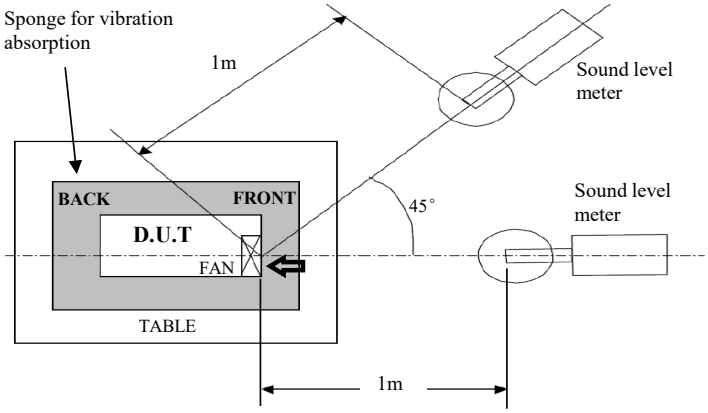
Test equipment :

Sound Calibrator: Type 4231 (B&K) Audio Analyzer: Type 3560-C (B&K)

Test Method :



Basic setting of sound measurements



Position of a sound meter intake surface (air inlet)

Audible Noise Curve of FAN: