

CUS1200M

EVALUATION DATA

INDEX

1. Evaluation Method	PAGE
1-1. Circuit used for determination	
Circuit 1 used for determination	3
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	3
Dynamic load response characteristics	
Circuit 3 used for determination	4
Inrush current waveform	
Circuit 4 used for determination	4
Earth leakage current characteristics	
Patient current characteristics	
Circuit 5 used for determination	5
Output ripple and noise waveform	
Configuration used for determination	5
Electro-Magnetic Interference characteristics	
(a) Conducted Emission	
(b) Radiated Emission	
1-2. List of equipment used	6
1-3. Load conditions	6

2. Characteristics	PAGE
2-1. Steady state data	
(1) Regulation - line and load, Temperature drift / Start up voltage and Drop out voltage ...	7~8
(2) Efficiency and Power factor vs. Output current	9
(3) Input power vs. Output current	10
(4) Input current vs. Output current	11
(5) Input power vs. Output current @ Remote OFF	12
2-2. Warm up voltage drift characteristics	13
2-3. Hold up time characteristics	13
2-4. Output rise characteristics	14
2-5. Output fall characteristics	15
2-6. Various signal	16
2-7. Over current protection (OCP) characteristics	17
2-8. Over voltage protection (OVP) characteristics	18
2-9. Dynamic load response characteristics	19
2-10. Response to brown out characteristics	20
2-11. Inrush current waveform	21
2-12. Input current harmonics	22
2-13. Leakage current characteristics	23~24
2-14. Output ripple and noise waveform	25
2-15. Electro-Magnetic Interference characteristics	26~37
2-16. Audible Noise of FAN	38

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

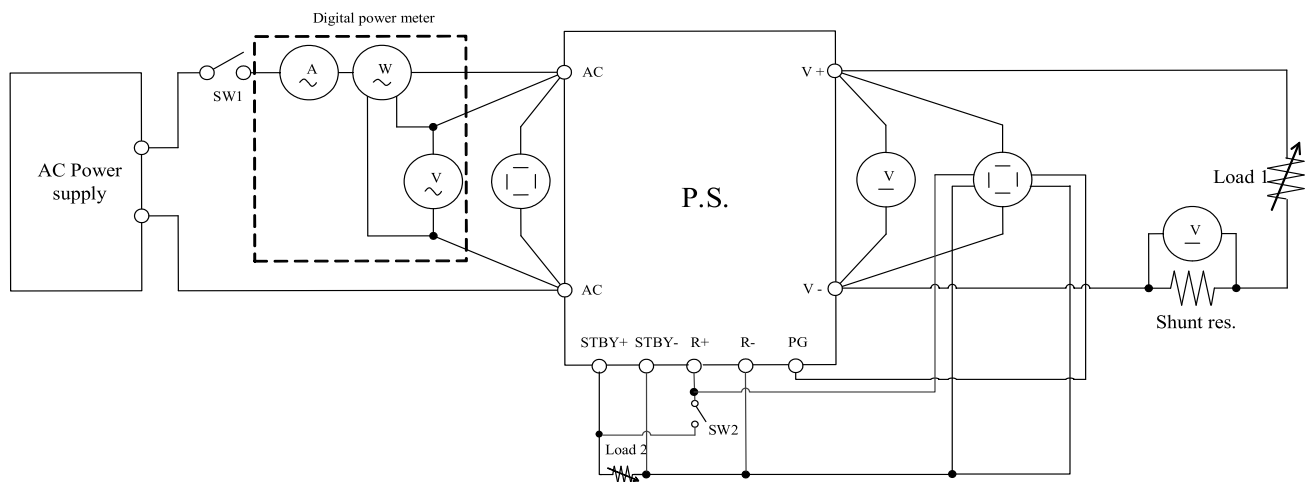
※ Test results are reference data based on our measurement condition.

1. Evaluation Method

1-1. Circuit used for determination

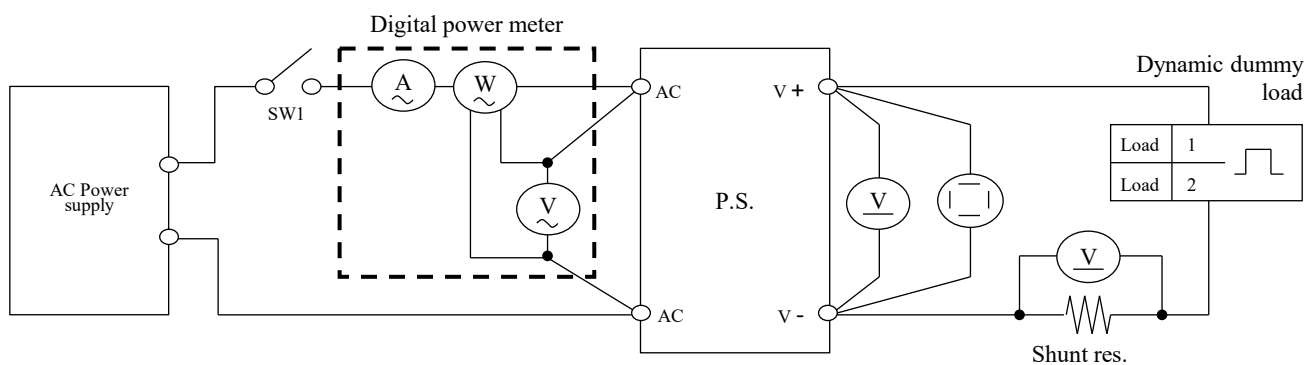
Circuit 1 used for determination

- 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

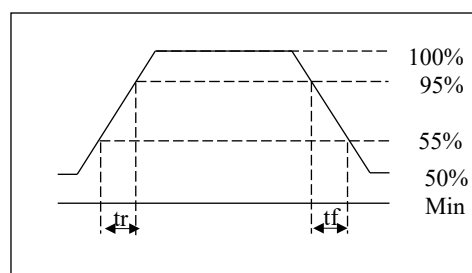


Circuit 2 used for determination

- Dynamic load response characteristics

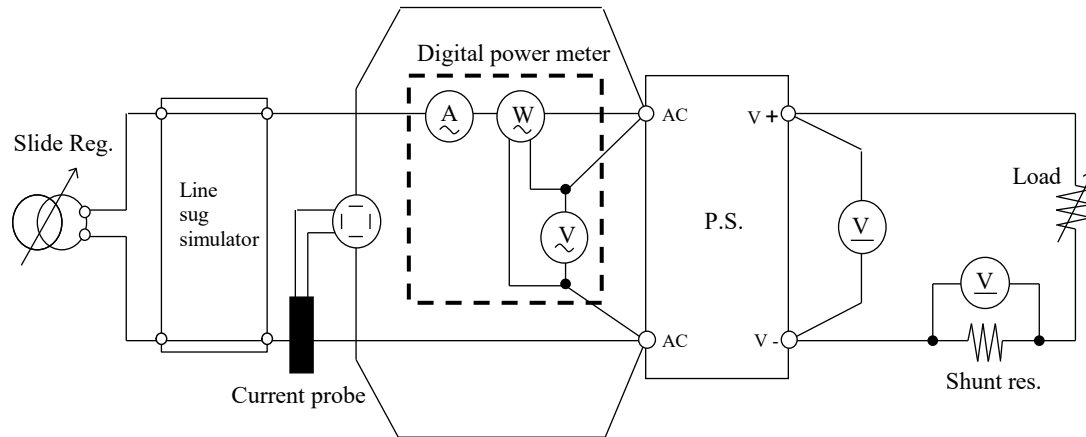


Output current waveform
Iout 50% $\longleftrightarrow$ 100%



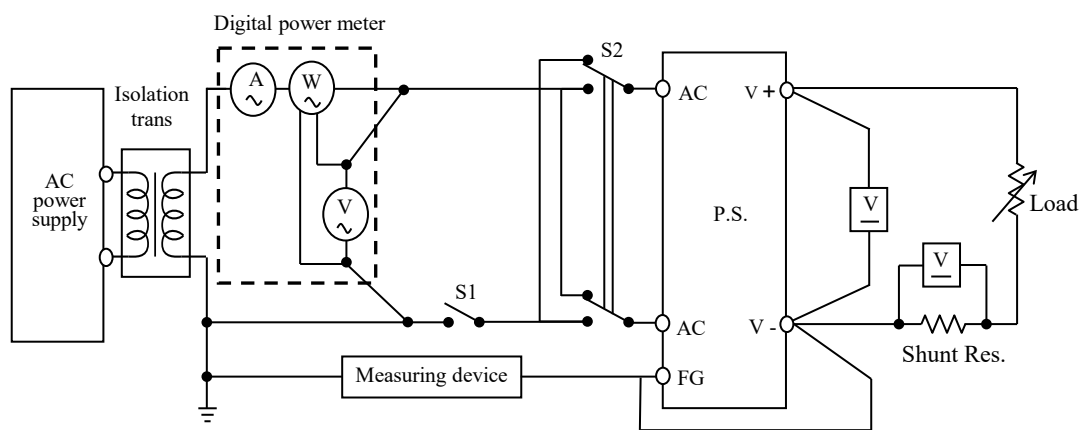
Circuit 3 used for determination

- Inrush current waveform



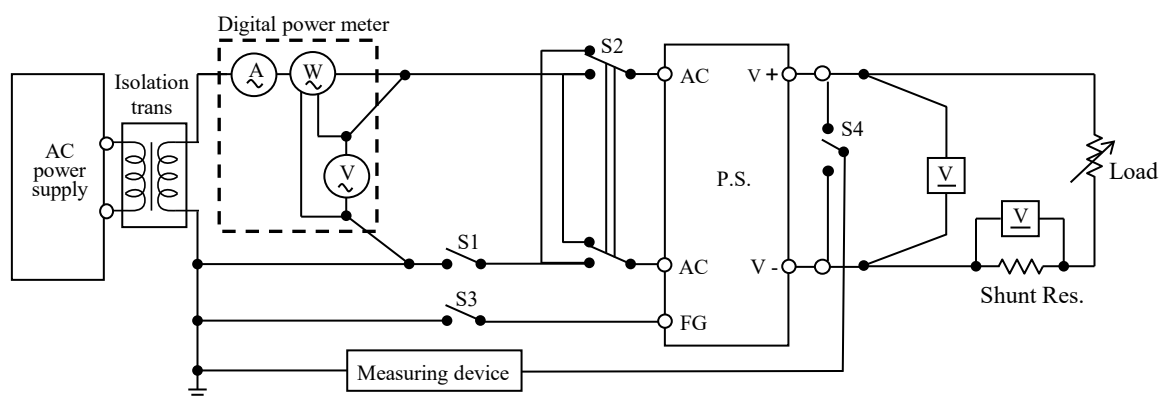
Circuit 4 used for determination

- 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



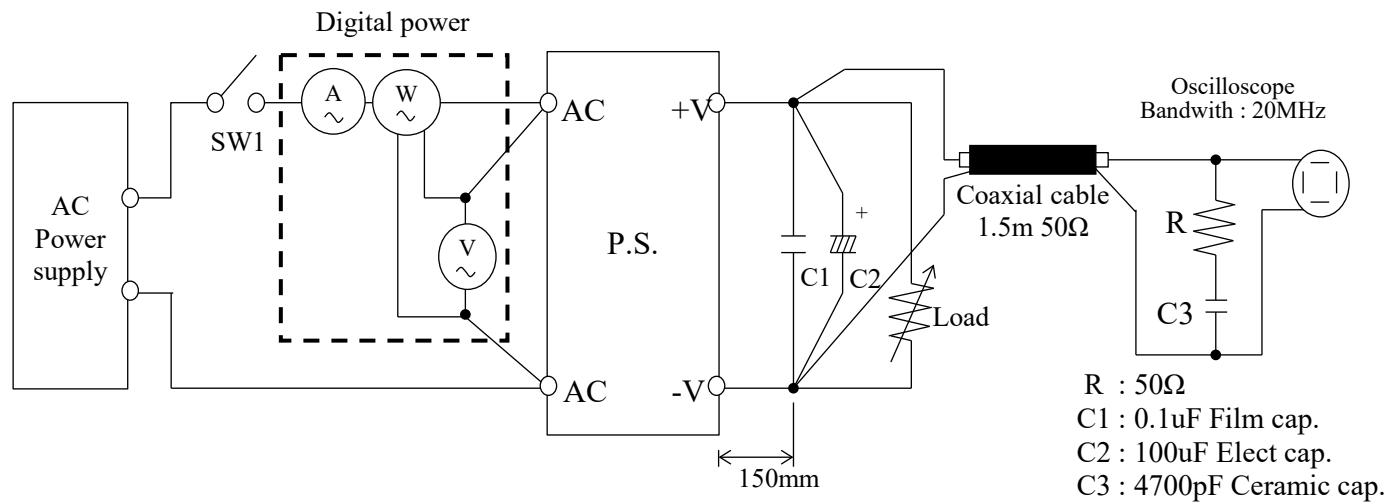
CLASS I equipment:

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

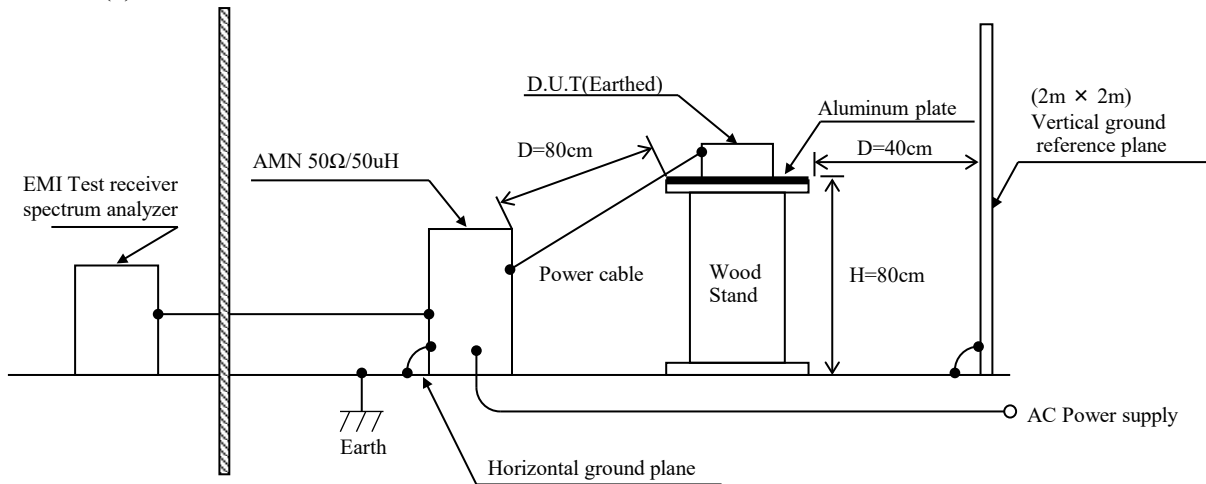
- Output ripple and noise waveform



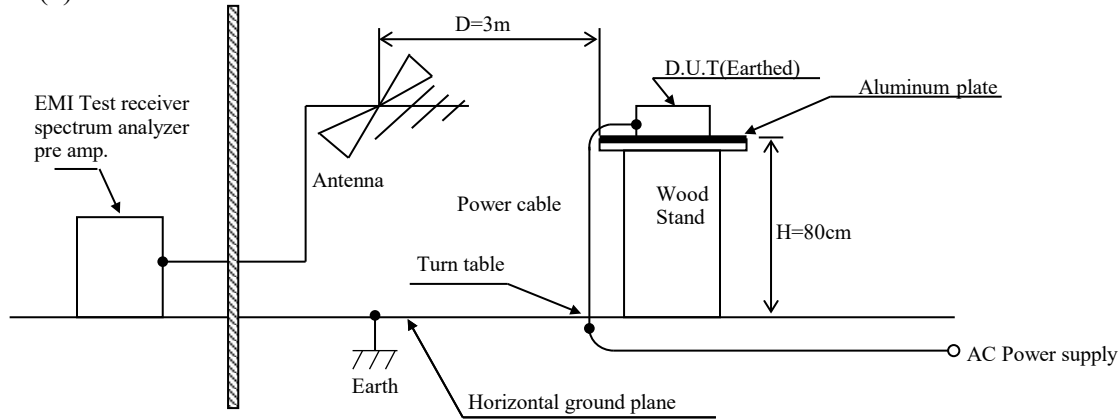
Configuration used for determination

- 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.	DLM2054
2	DIGITAL MULTIMETER	KEYSIGHT	34970A
3	DIGITAL POWER METER	YOKOGAWA ELECT.	WT310
4	CURRENT PROBE	YOKOGAWA ELECT.	701930
5	POWER SUPPLY	YOKOGAWA ELECT.	701934
6	DYNAMIC DUMMY LOAD	CHROMA	63030/63203A/63640
7	AC SOURCE	KIKUSUI	PCR4000LE
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

V _{in}	I _{out}	24V	36V	48V
85VAC	90%	45A	29.97A	22.5A
90 - 265VAC	100%	50A	33.3A	25A

*V_{stb}=5V, I_{stb}=2A(100%)

2. Characteristics

2-1. Steady state data

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

24V

1. Regulation - line and load

Condition Ta : 25 °C
Iout : 100 % (50A)
Istb : 0 %

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	Line regulation	
0%	24.006V	24.003V	23.998V	23.994V	12mV	0.050%
50%	23.946V	23.941V	23.941V	23.940V	6mV	0.025%
100%	-	23.910V	23.913V	23.913V	3mV	0.013%
Load	60mV	93mV	85mV	81mV		
regulation	0.250%	0.388%	0.354%	0.337%		

2. Temperature drift

Condition Vin : 115 VAC
Iout : 100 % (50A)
Istb : 0 %

Ta	-20°C	+25°C	+35°C	Temperature stability	
Vout	23.800V	23.910V	23.919V	119mV	0.496%

3. Start up voltage and Drop out voltage

Condition Ta : 25 °C
Iout : 100 % (50A)
Istb : 0 %

Start up voltage (Vin)	79.2VAC
Drop out voltage (Vin)	76.8VAC

36V

1. Regulation - line and load

Condition Ta : 25 °C
Iout : 100 % (33.3A)
Istb : 0 %

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	Line regulation	
0%	36.066V	36.069V	36.072V	36.075V	9mV	0.025%
50%	36.048V	36.047V	36.047V	36.046V	2mV	0.006%
100%	-	36.014V	36.020V	36.022V	8mV	0.022%
Load	18mV	55mV	52mV	53mV		
regulation	0.050%	0.153%	0.144%	0.147%		

2. Temperature drift

Condition Vin : 115 VAC
Iout : 100 % (33.3A)
Istb : 0 %

Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	35.863V	36.014V	36.057V	194mV	0.539%

3. Start up voltage and Drop out voltage

Condition Ta : 25 °C
Iout : 100 % (33.3A)
Istb : 0 %

Start up voltage (Vin)	79.2VAC
Drop out voltage (Vin)	76.8VAC

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

48V

1. Regulation - line and load

Condition Ta : 25 °C
Iout : 100 % (25A)
Istb : 0 %

Iout \ Vin	85VAC	115VAC	230VAC	265VAC	Line regulation	
0%	48.041V	48.027V	48.025V	48.024V	17mV	0.035%
50%	48.019V	48.019V	48.019V	48.019V	0mV	0.000%
100%	-	47.994V	48.003V	48.005V	11mV	0.023%
Load	22mV	33mV	22mV	19mV		
regulation	0.046%	0.069%	0.046%	0.040%		

2. Temperature drift

Condition Vin : 115 VAC
Iout : 100 % (25A)
Istb : 0 %

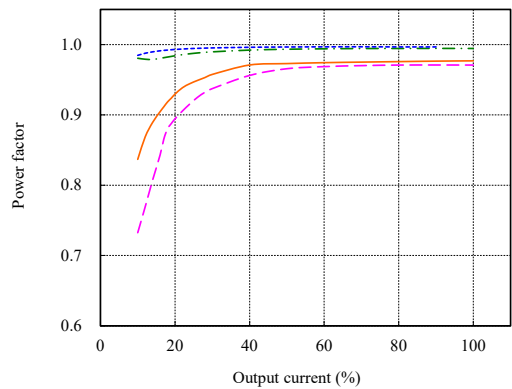
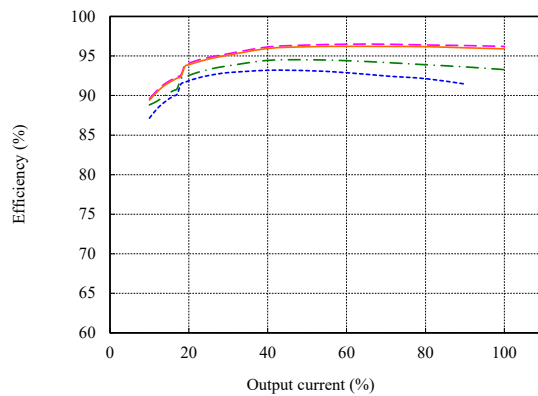
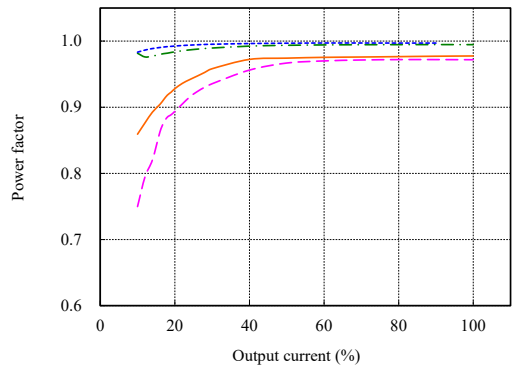
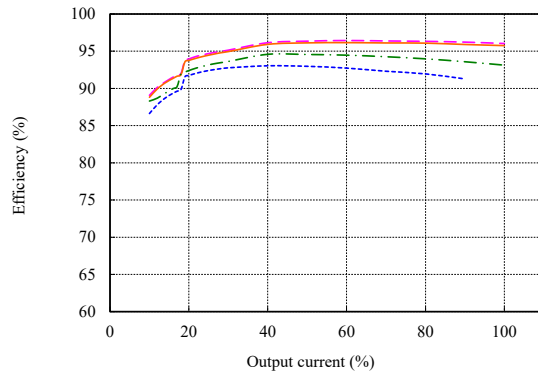
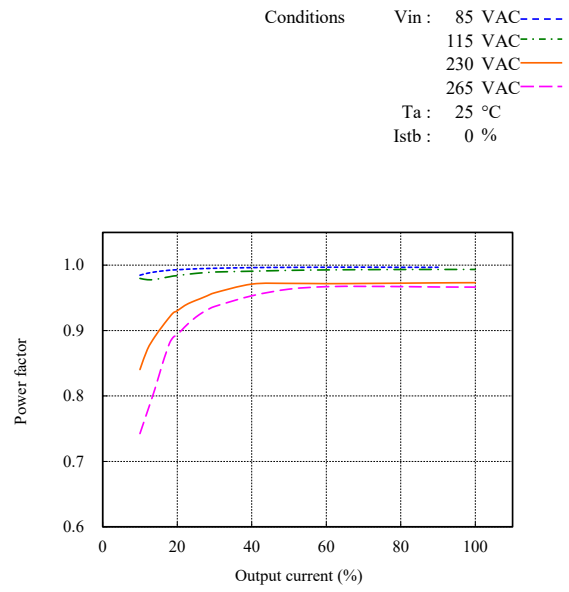
Ta	-20°C	+25°C	+40°C	Temperature stability	
Vout	47.832V	47.994V	48.042V	210mV	0.438%

3. Start up voltage and Drop out voltage

Condition Ta : 25 °C
Iout : 100 % (25A)
Istb : 0 %

Start up voltage (Vin)	79.2VAC
Drop out voltage (Vin)	76.8VAC

24V

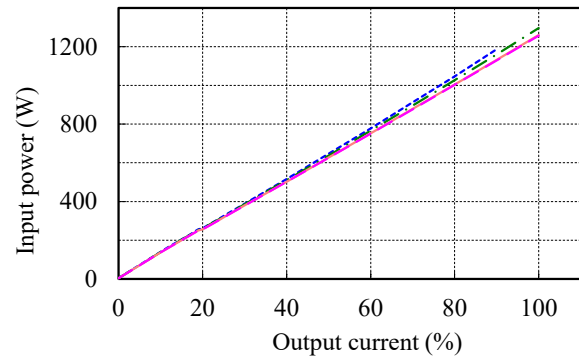


(3) Input power vs. Output current

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

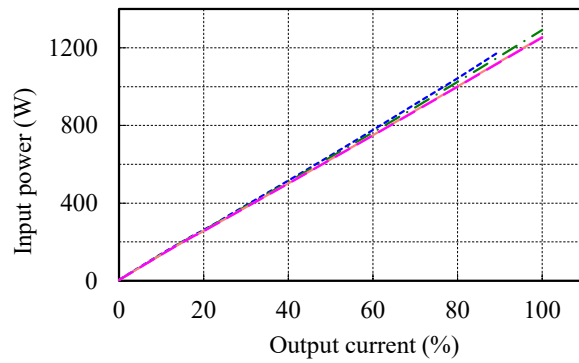
24V

Vin	Input power	
	Iout : 0%	Remote OFF
85VAC	4.5W	0.30W
115VAC	3.8W	0.34W
230VAC	3.8W	0.60W
265VAC	3.3W	0.71W



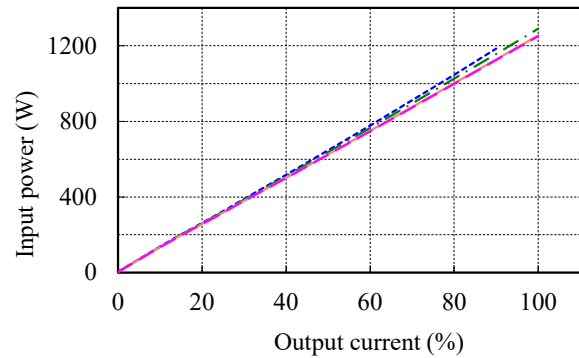
36V

Vin	Input power	
	Iout : 0%	Remote OFF
85VAC	4.9W	0.30W
115VAC	4.2W	0.34W
230VAC	3.7W	0.60W
265VAC	3.8W	0.71W



48V

Vin	Input power	
	Iout : 0%	Remote OFF
85VAC	4.7W	0.30W
115VAC	4.0W	0.34W
230VAC	3.6W	0.60W
265VAC	3.3W	0.71W



(4) Input current vs. Output current

24V

Vin	Input current	
	Iout : 0%	Remote OFF
85VAC	0.10A	0.03A
115VAC	0.09A	0.04A
230VAC	0.12A	0.08A
265VAC	0.13A	0.09A

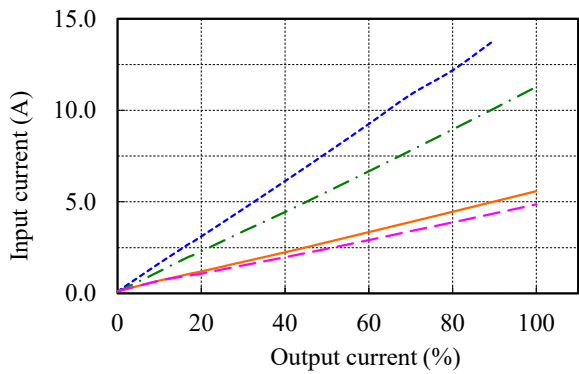
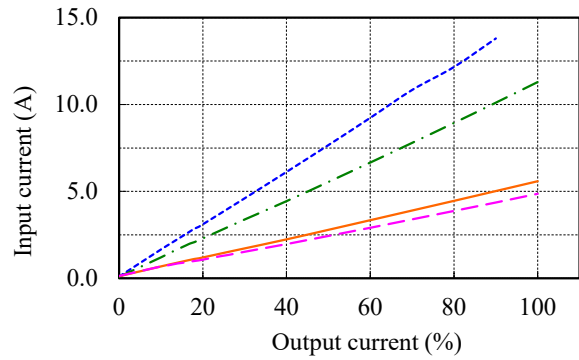
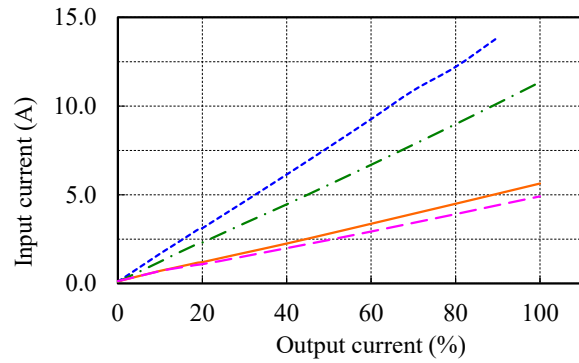
36V

Vin	Input current	
	Iout : 0%	Remote OFF
85VAC	0.10A	0.03A
115VAC	0.09A	0.04A
230VAC	0.12A	0.08A
265VAC	0.14A	0.09A

48V

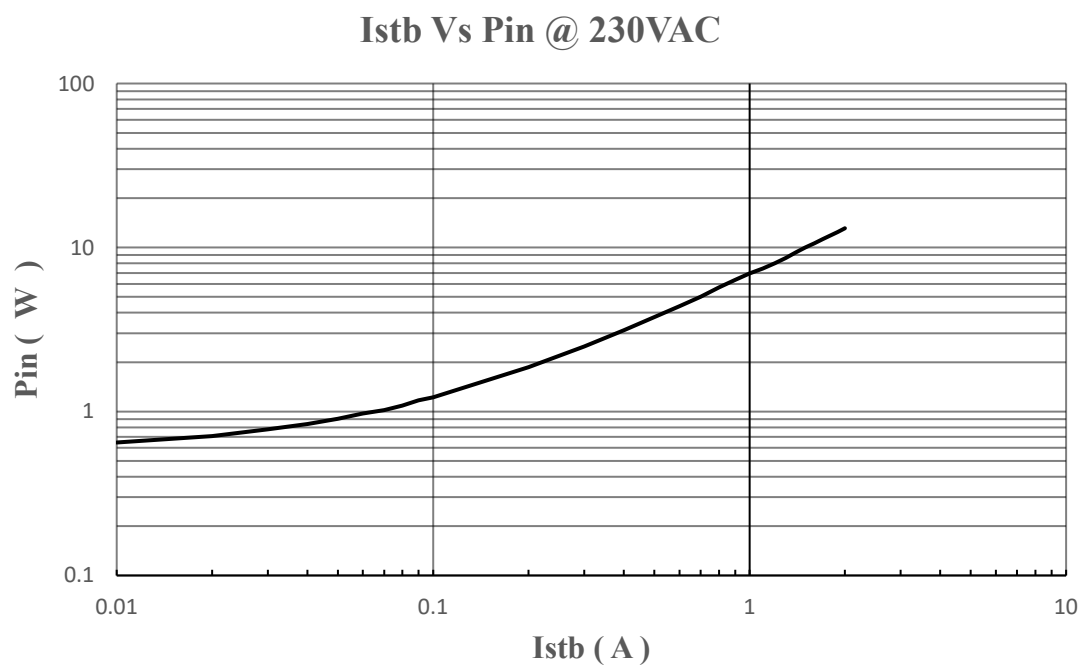
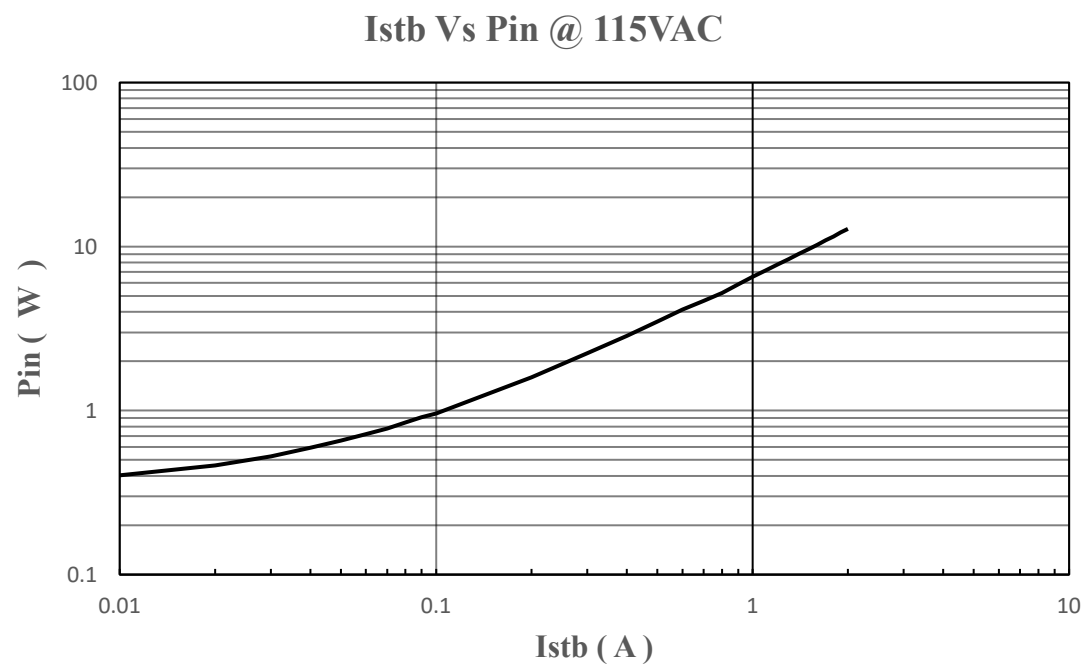
Vin	Input current	
	Iout : 0%	Remote OFF
85VAC	0.10A	0.03A
115VAC	0.09A	0.04A
230VAC	0.12A	0.08A
265VAC	0.12A	0.09A

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



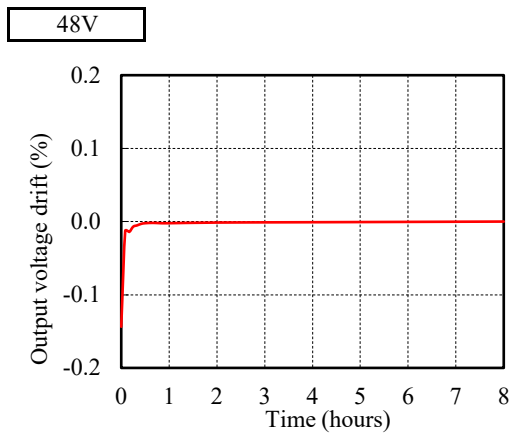
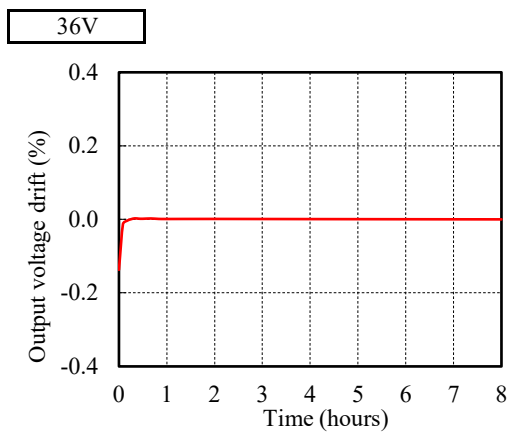
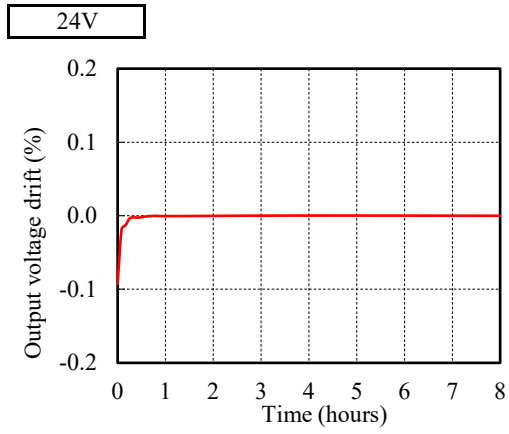
(5) Input power vs. Output current @ Remote OFF

Condition Remote OFF



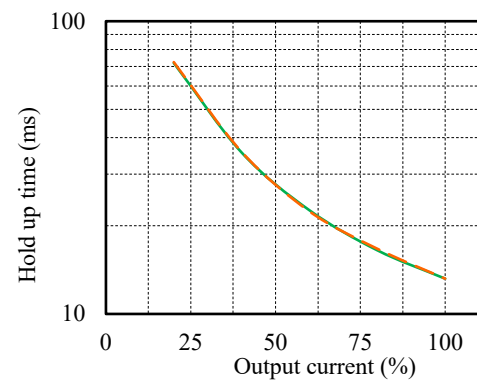
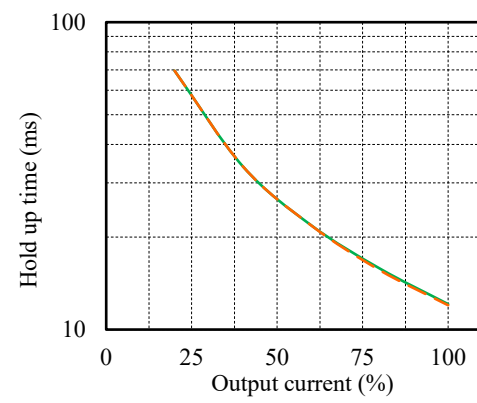
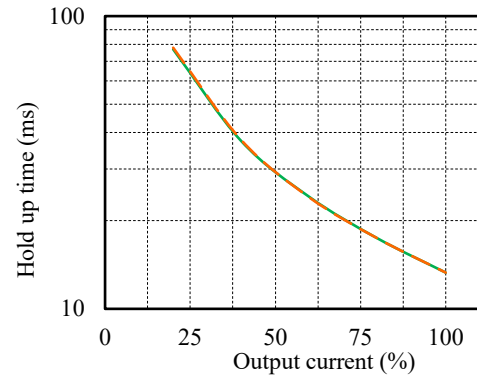
2-2. Warm up voltage drift characteristics

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



2-3. Hold up time characteristics

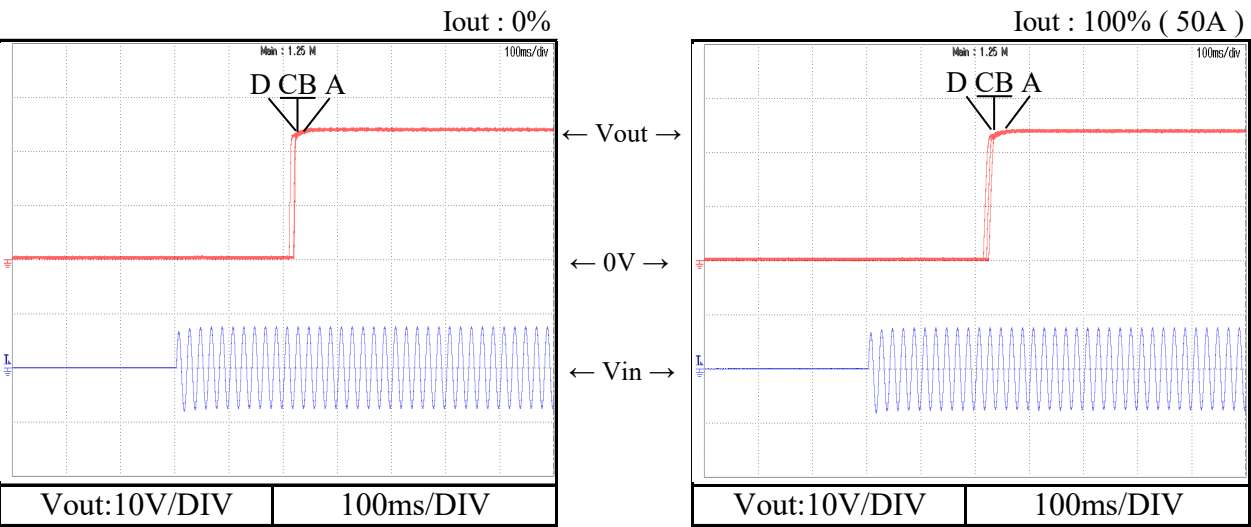
Conditions Vin : 115 VAC
230 VAC
Ta : 25 °C
Istb : 100%



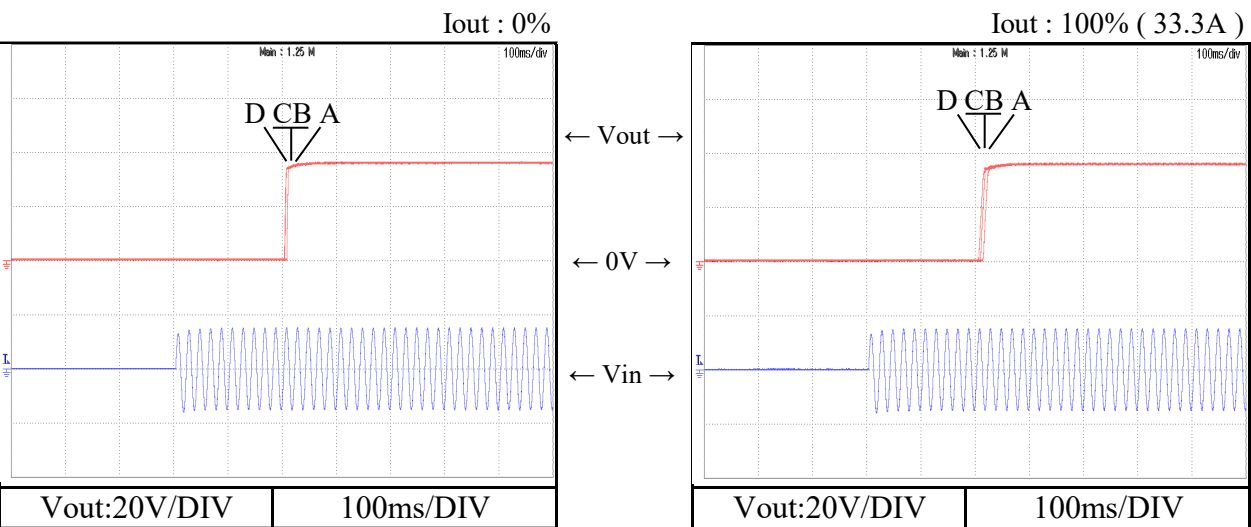
2-4. Output rise characteristics

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

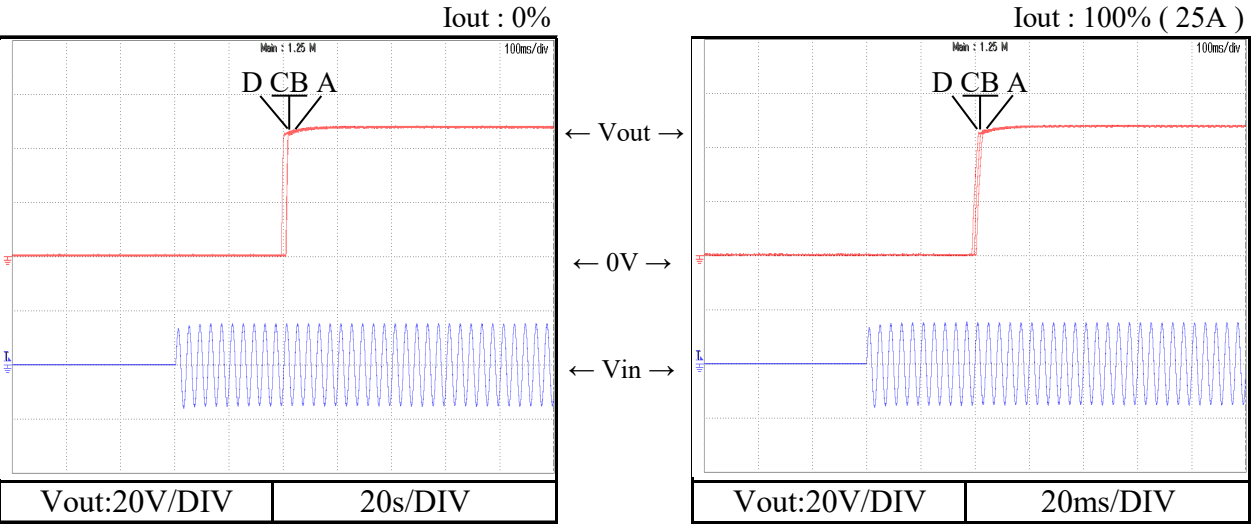
24V



36V



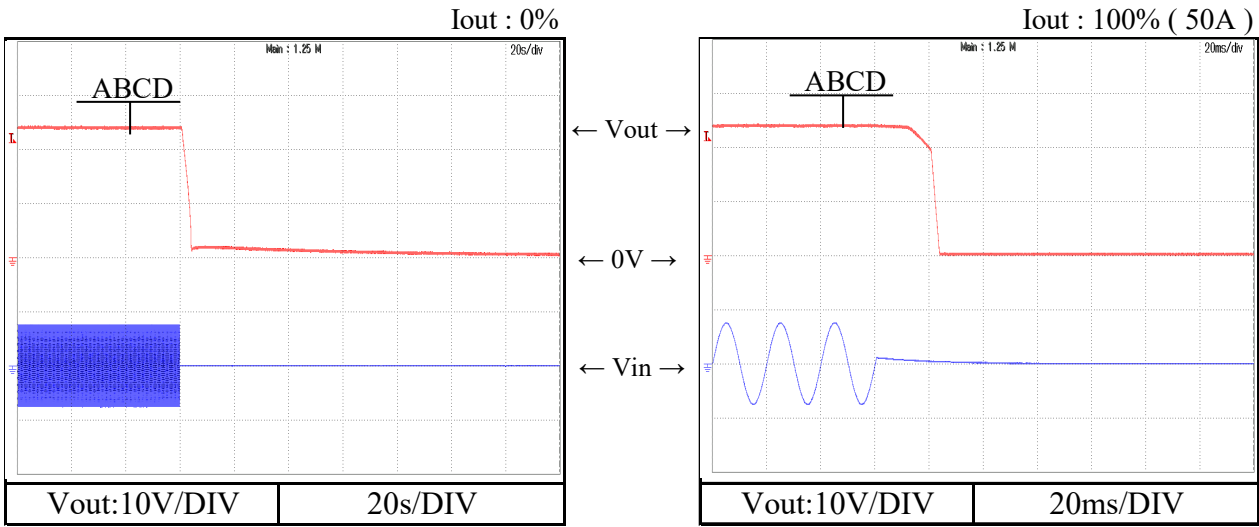
48V



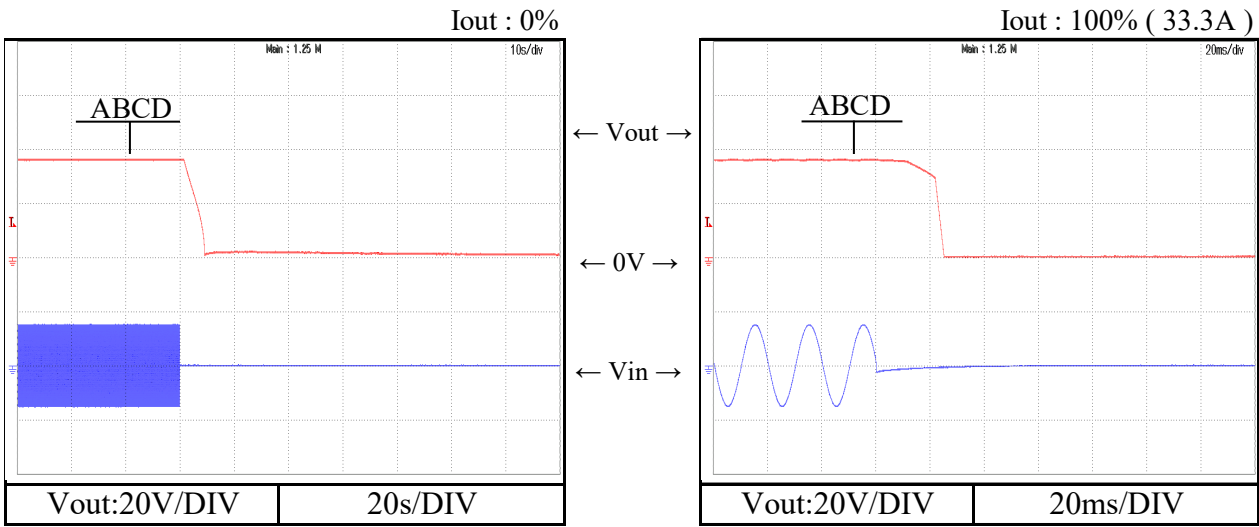
2-5. Output fall characteristics

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

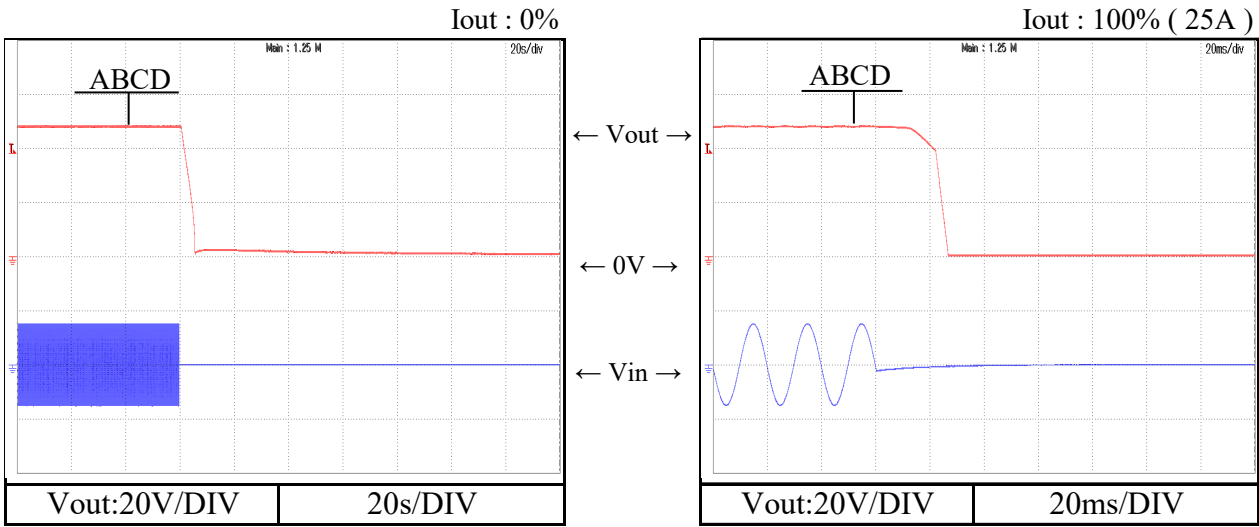
24V



36V



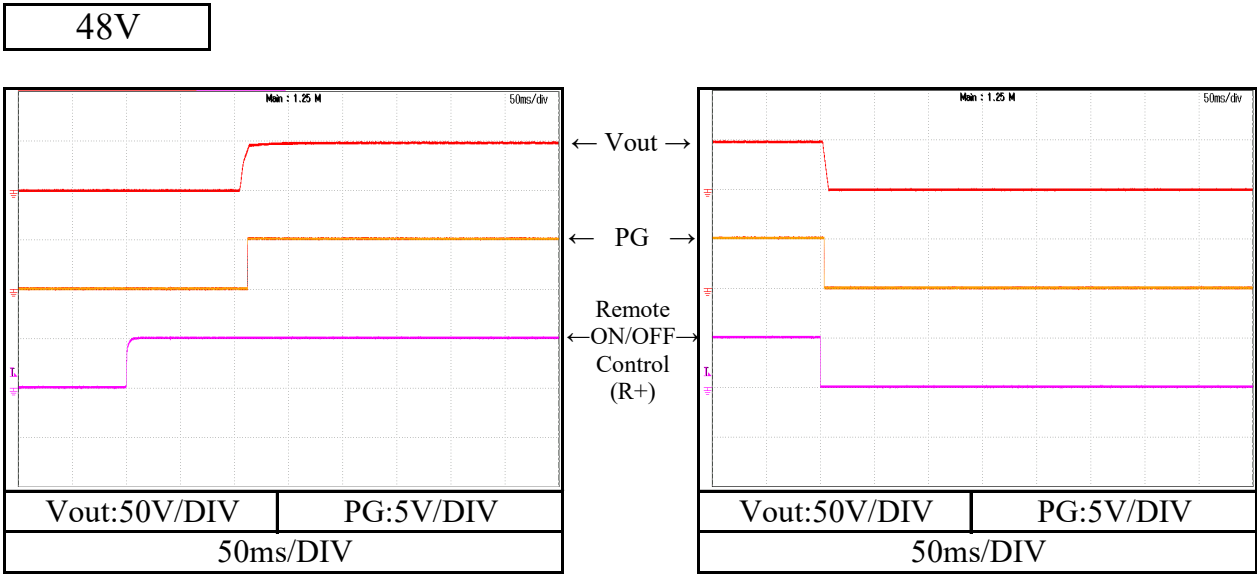
48V



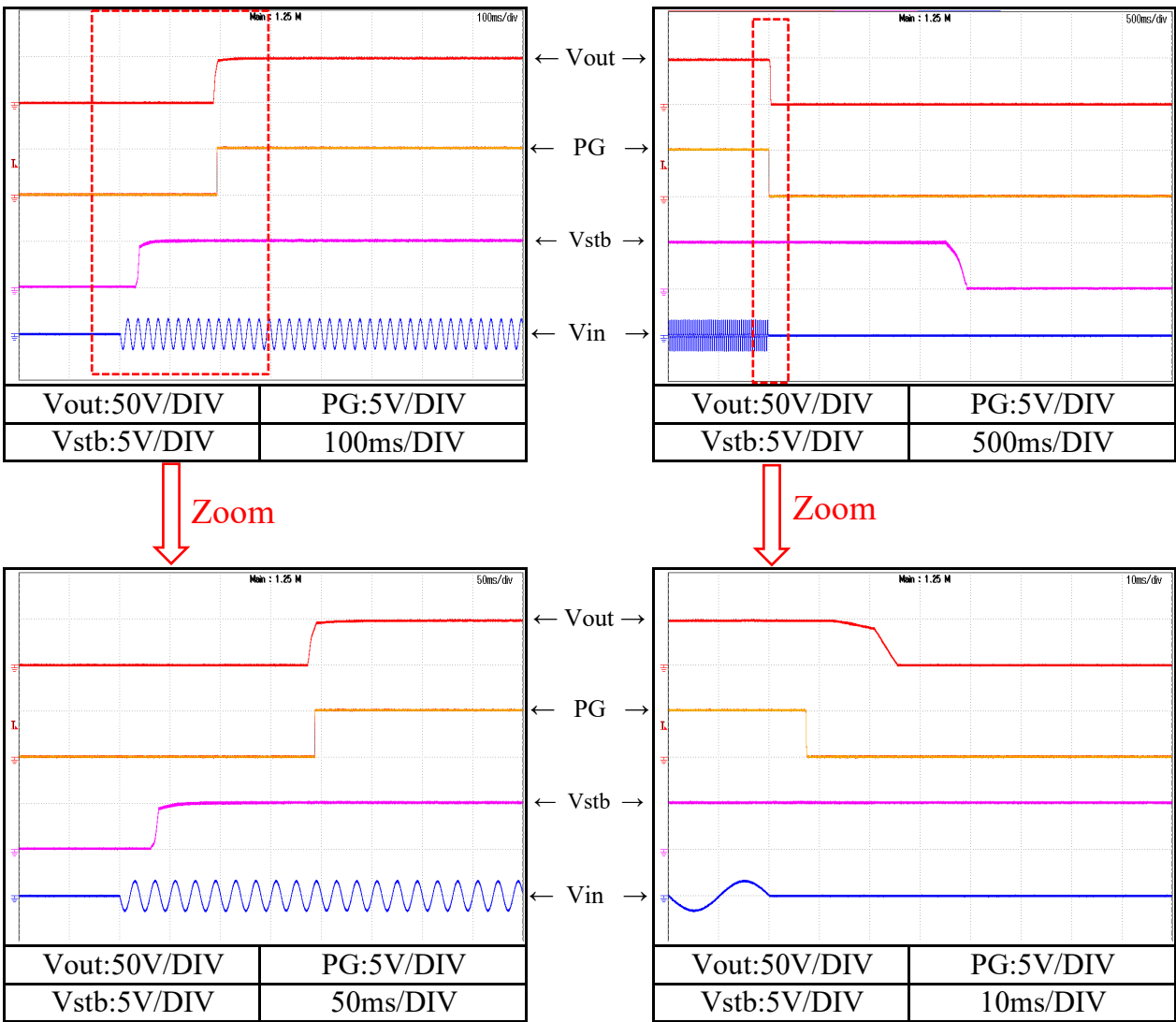
2-6. Various signal

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

Output rise, fall characteristics with Remote ON/OFF Control



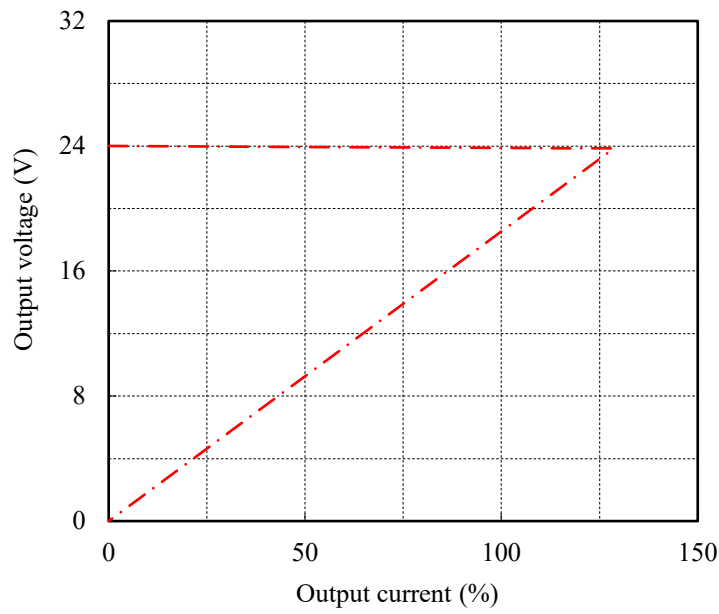
Output rise, fall characteristics with Input voltage ON/OFF



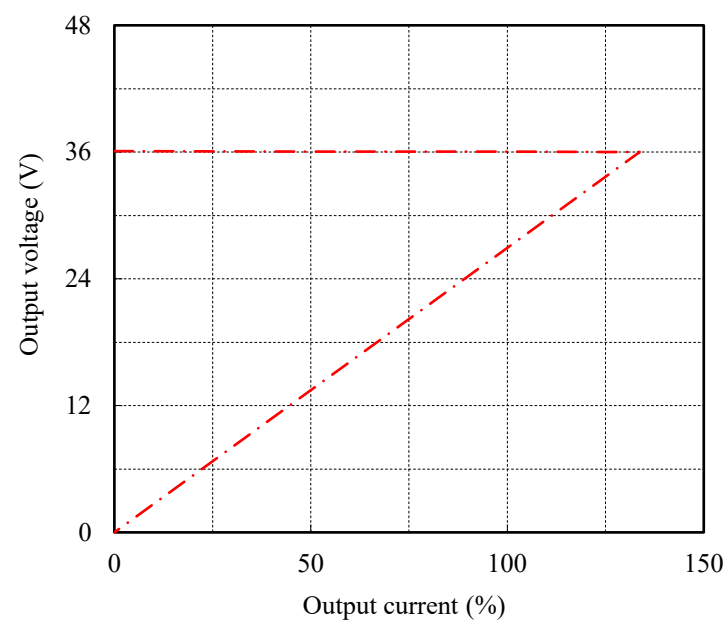
2-7. Over current protection (OCP) characteristics

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

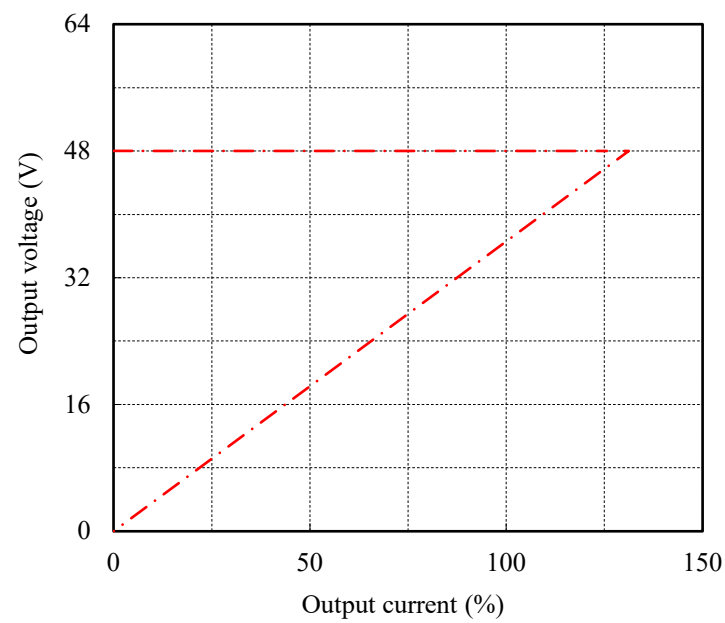
24V



36V



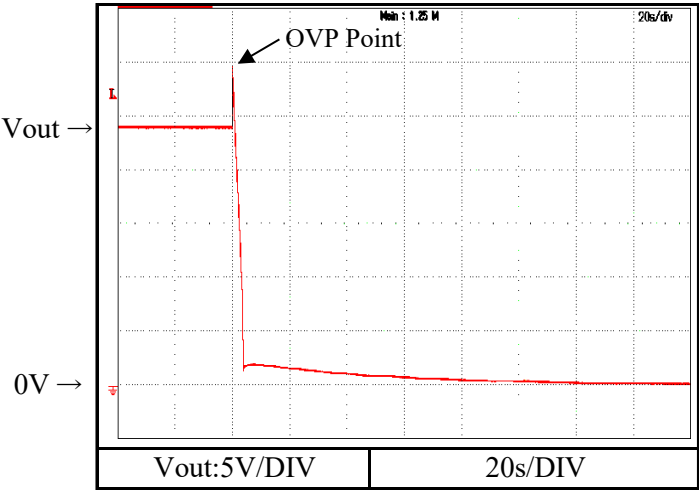
48V



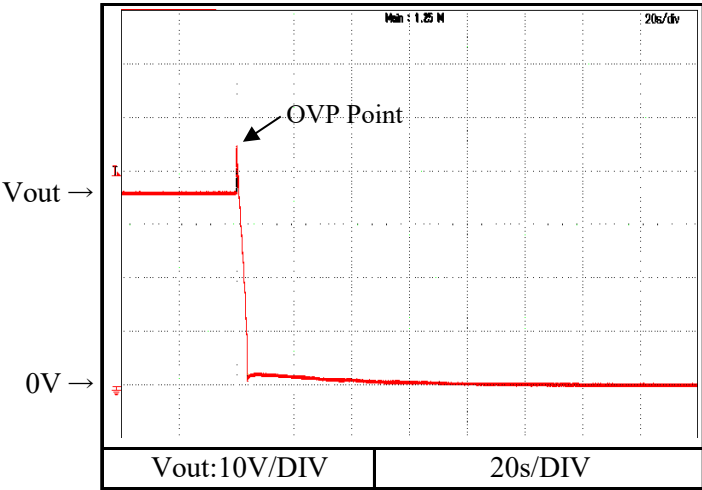
2-8. Over voltage protection (OVP) characteristics

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

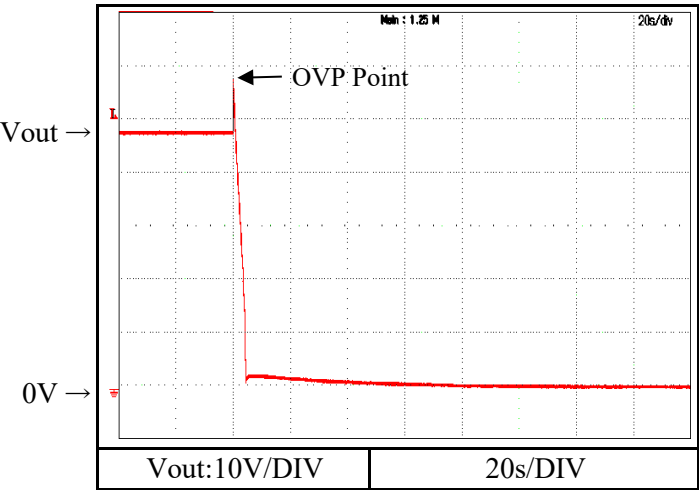
24V



36V



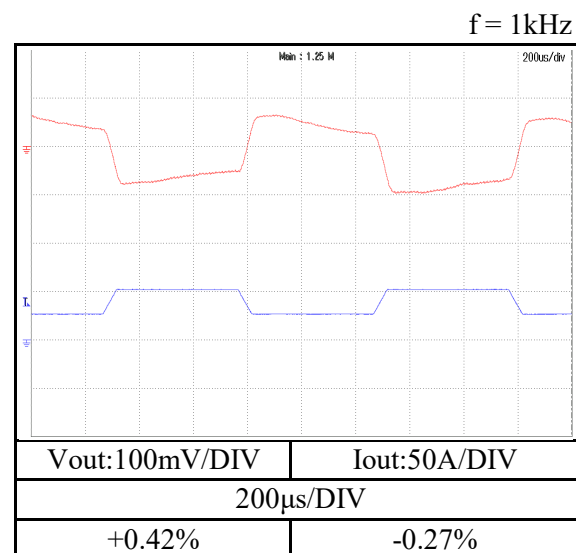
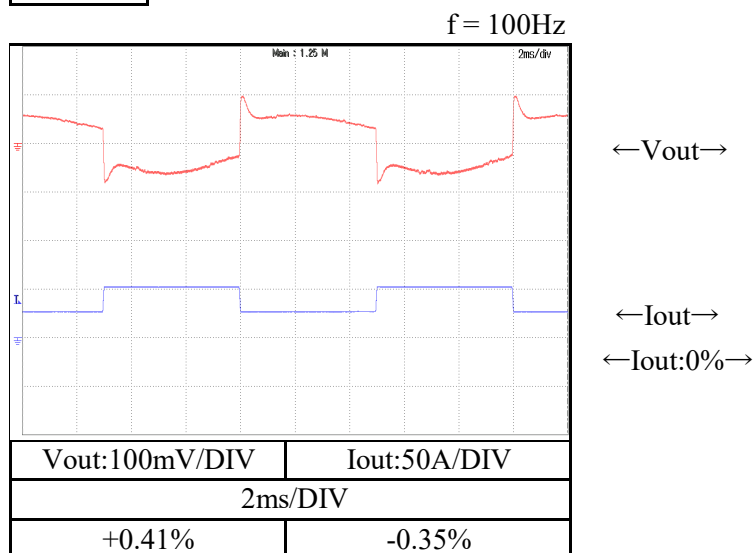
48V



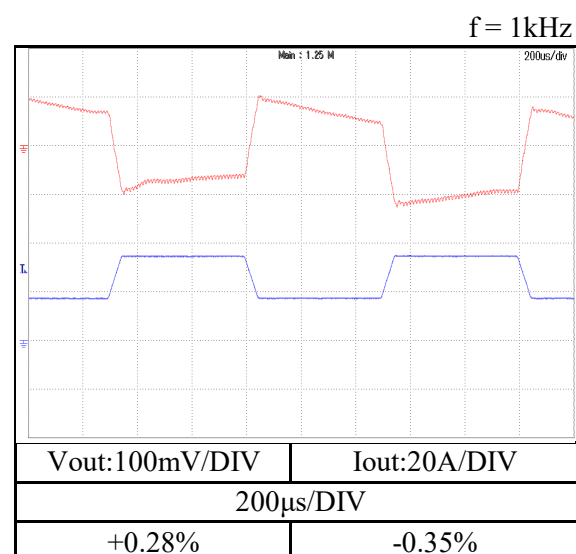
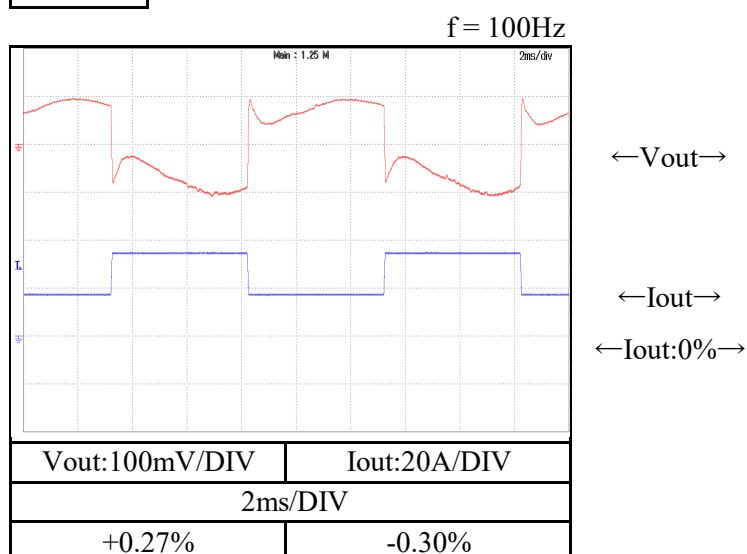
2-9. Dynamic load response characteristics

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

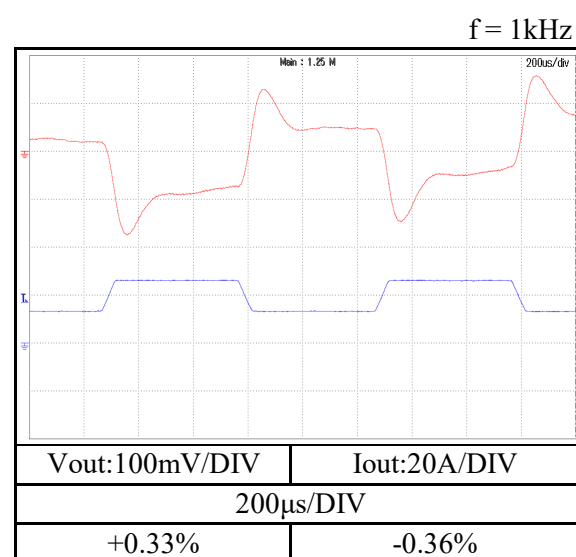
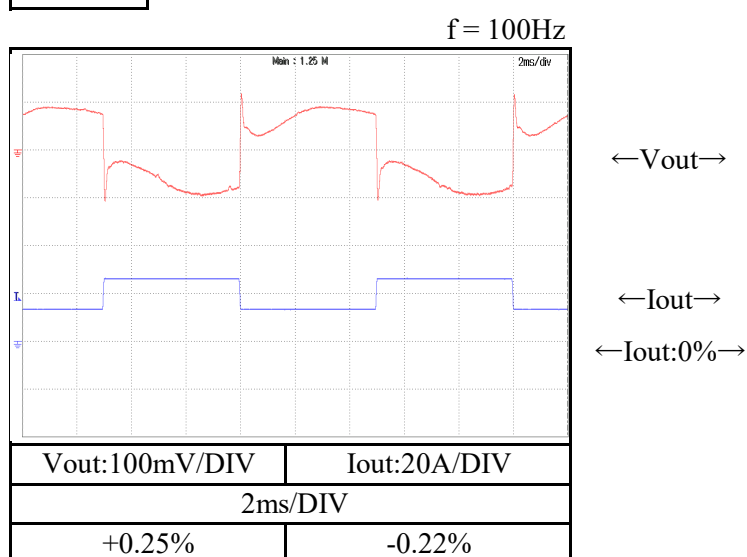
24V



36V

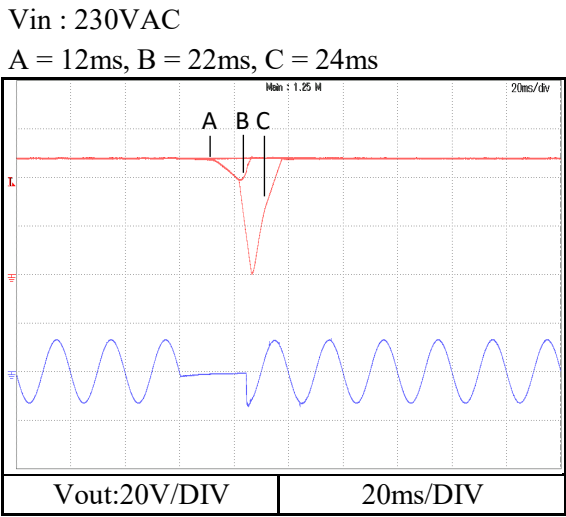
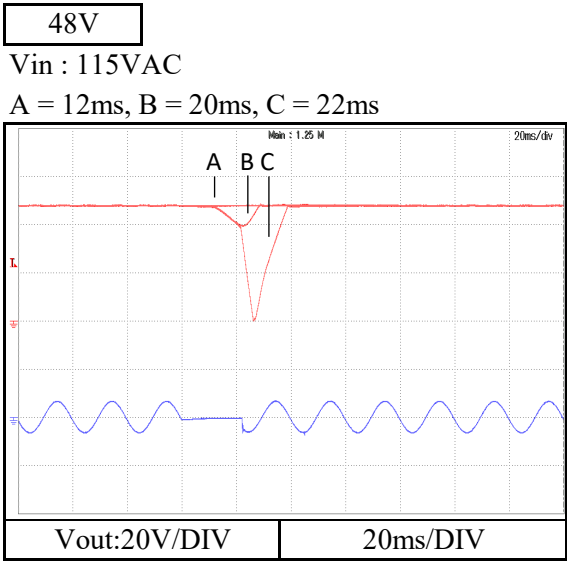
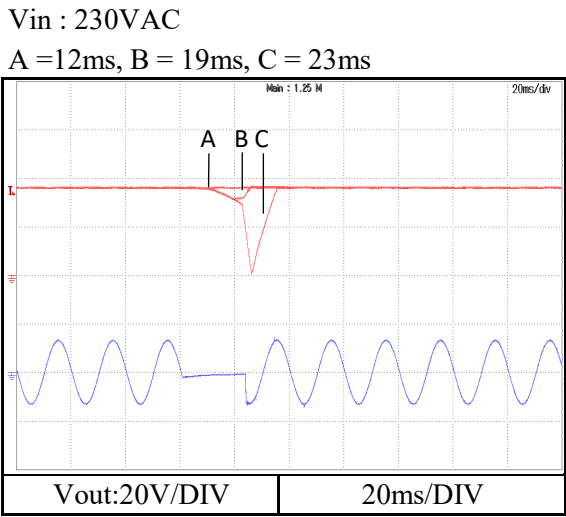
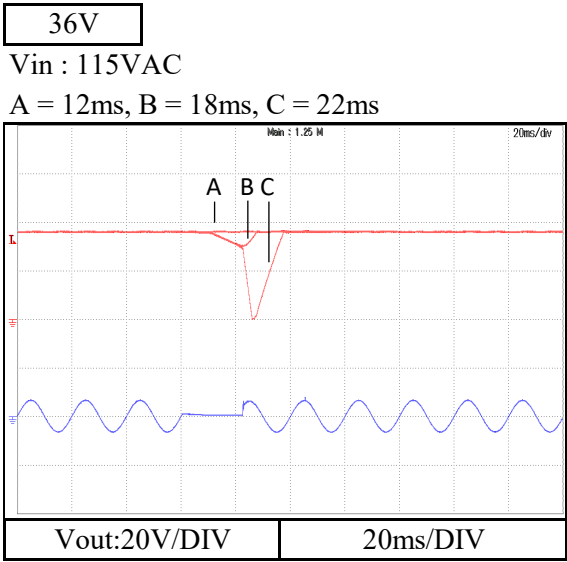
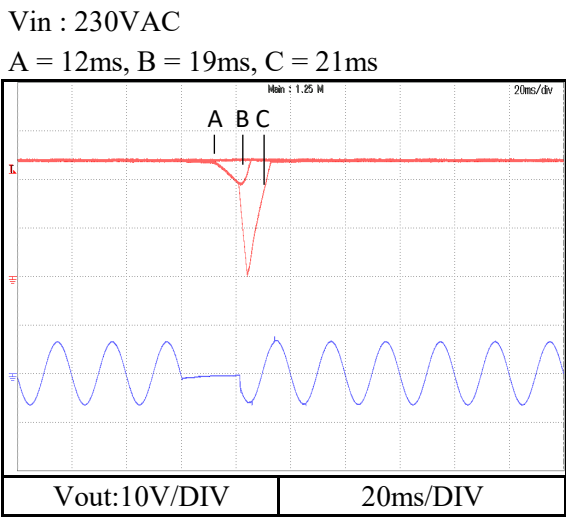
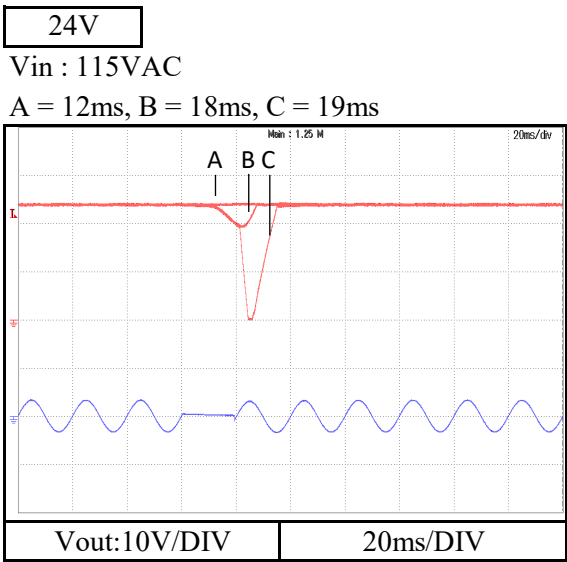


48V



2-10. Response to brown out characteristics

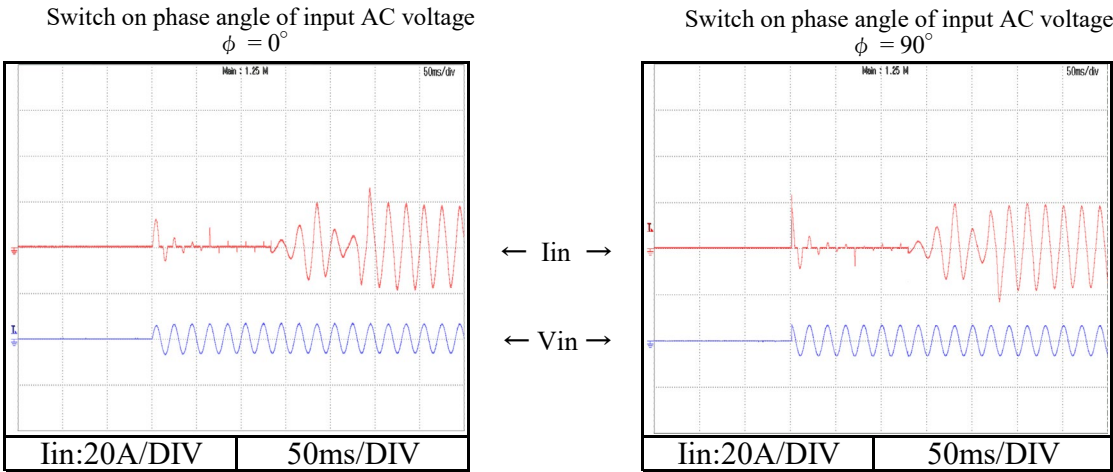
Interruption time	Conditions	Iout : 100 %
A : Output voltage does not drop.		Istb : 100 %
B : Output voltage drop down to 20~40% of the nominal output voltage.		Ta : 25 °C
C : Output voltage drops until 0V.		



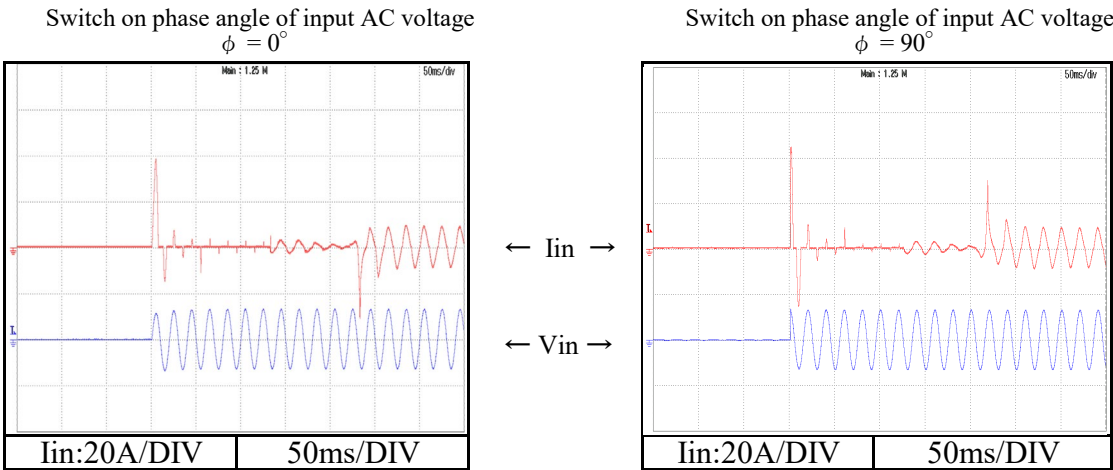
2-11. Inrush current waveform

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

48V



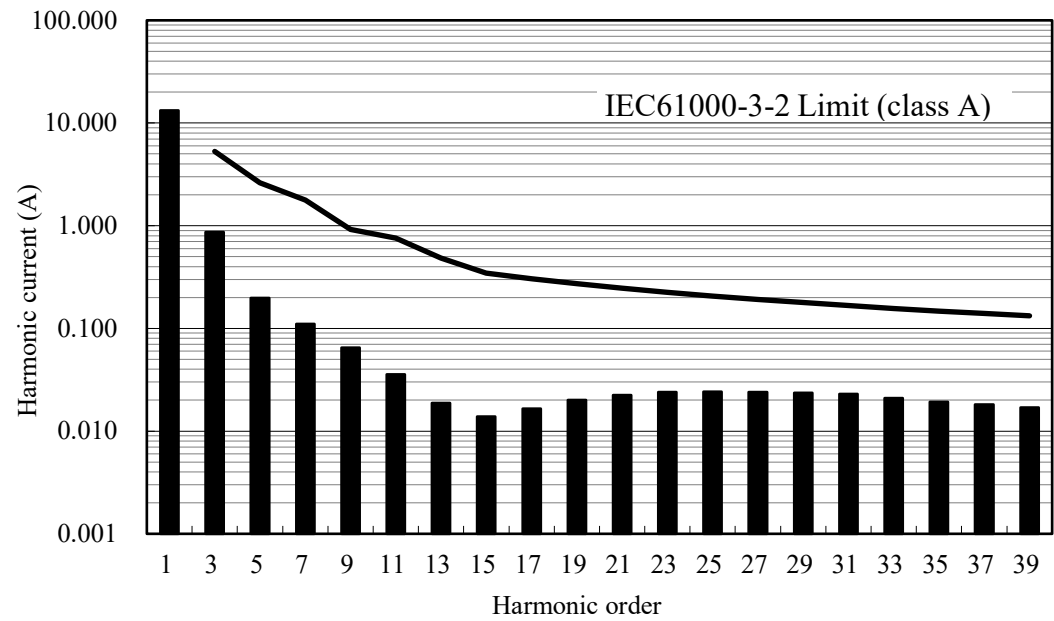
Conditions Vin : 230 VAC
Iout : 100 % (25A)
Istb : 100 %
Ta : 25 °C



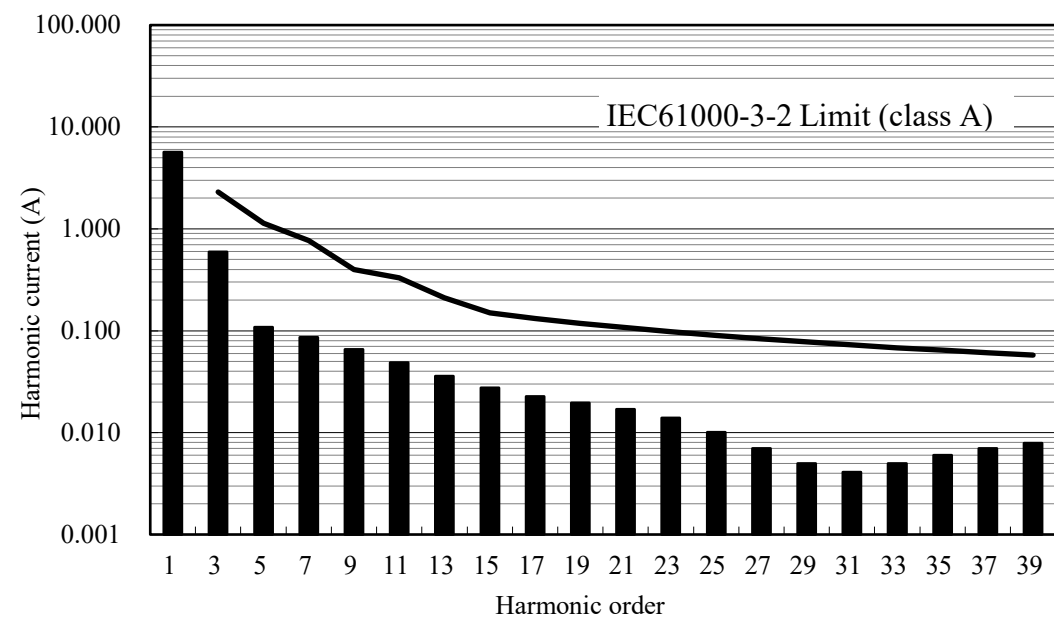
2-12. Input current harmonics

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

48V



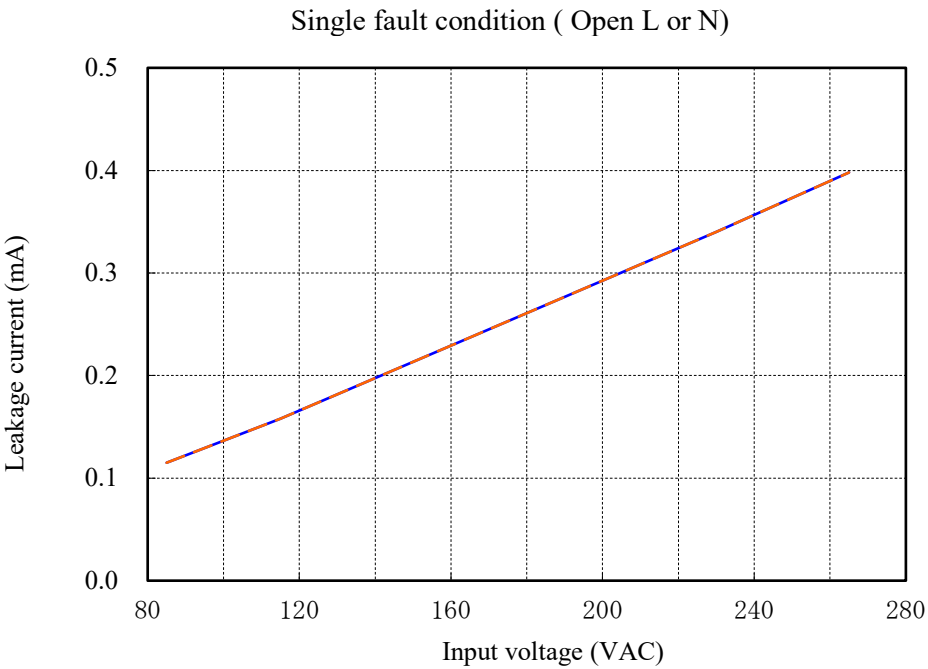
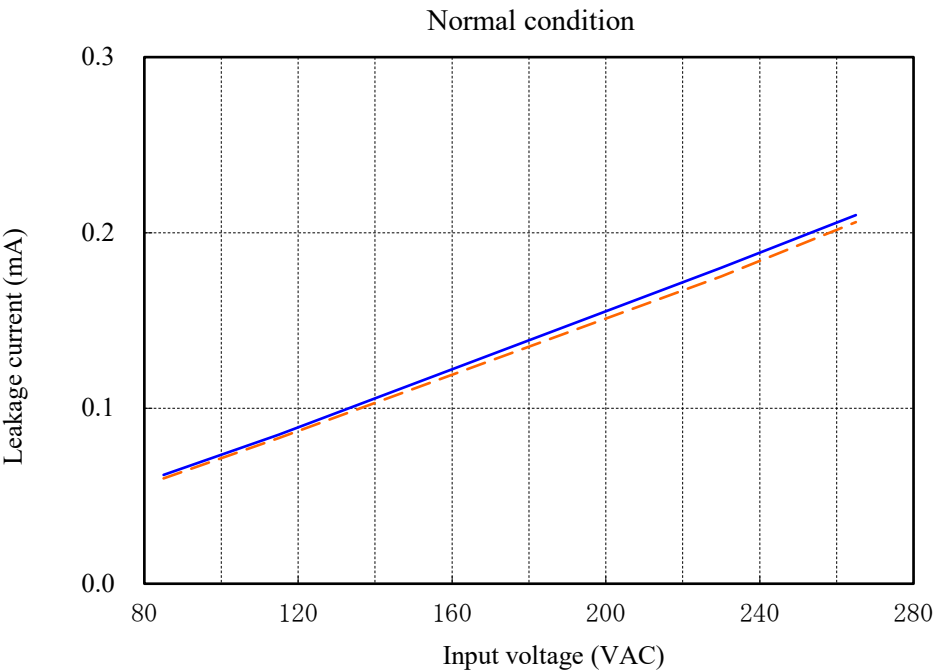
Conditions Vin : 230 VAC
Iout : 50 A (100%)
Istb : 100 %
Ta : 25 °C



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

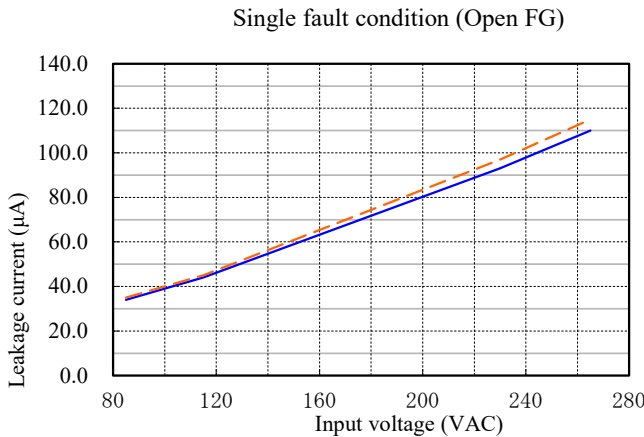
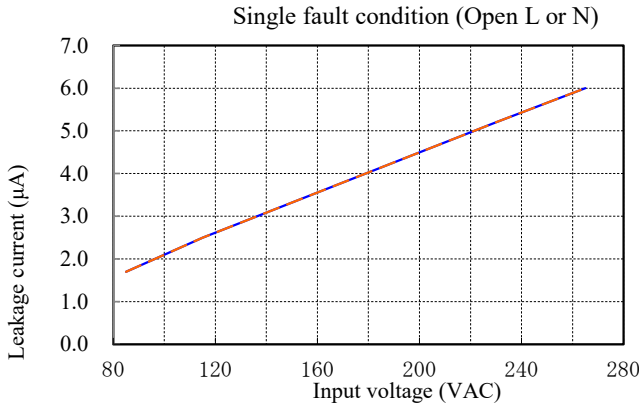
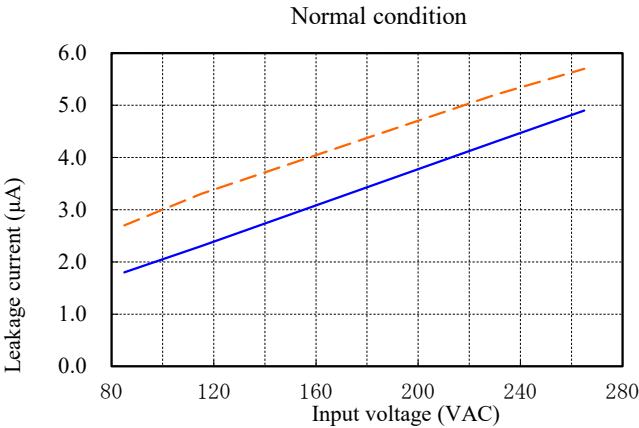


2-13. Leakage current characteristics

Patient leakage current of CLASS I equipment

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

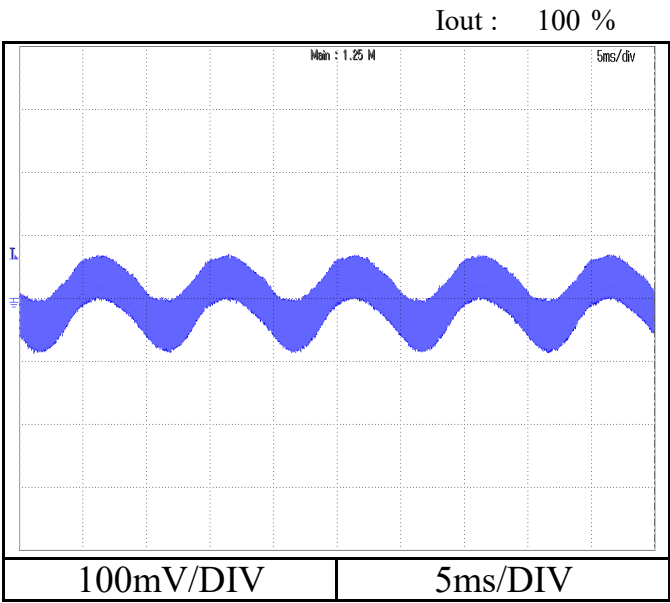
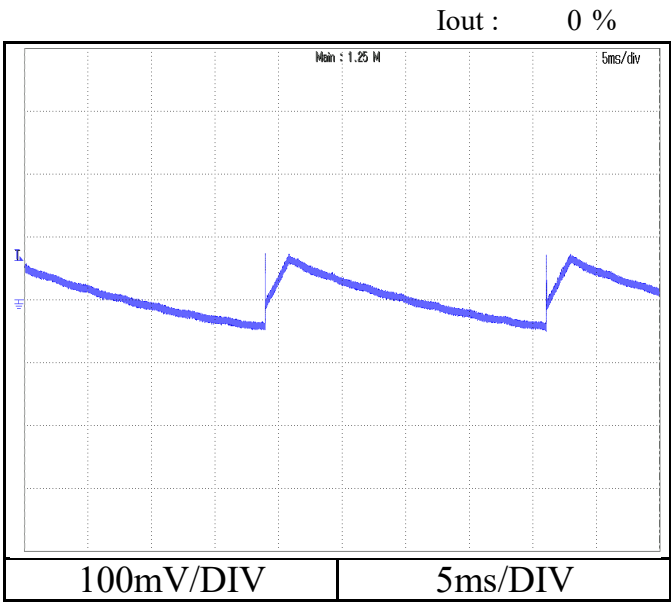
48V



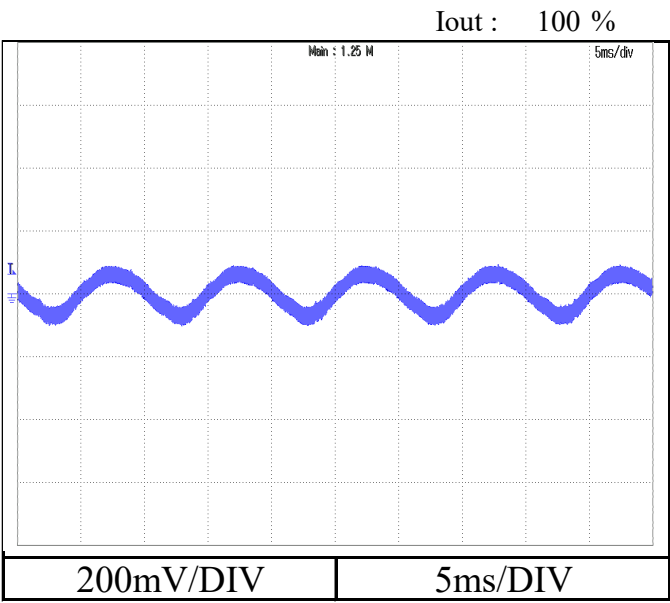
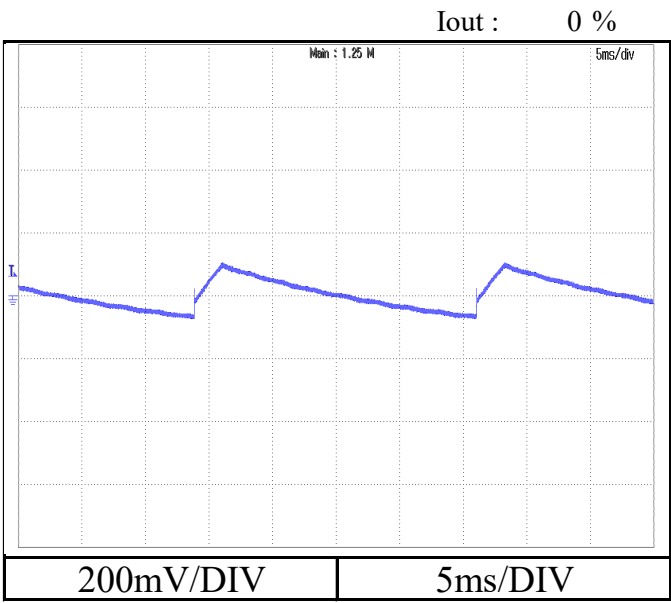
2-14. Output ripple and noise waveform

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

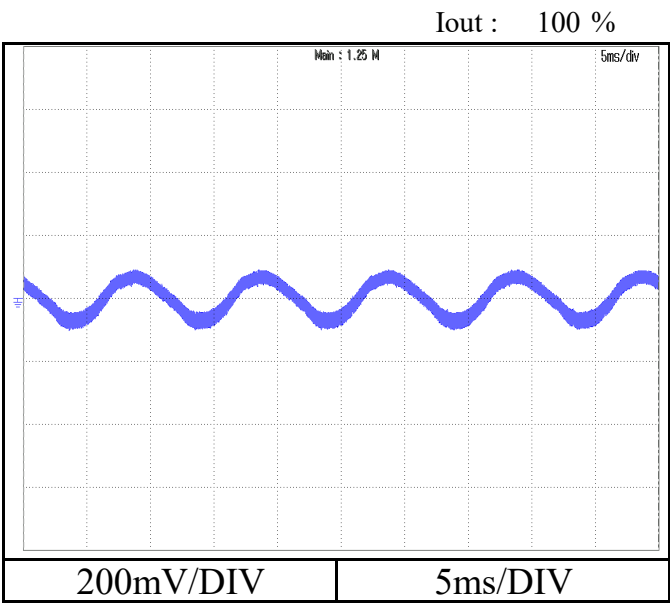
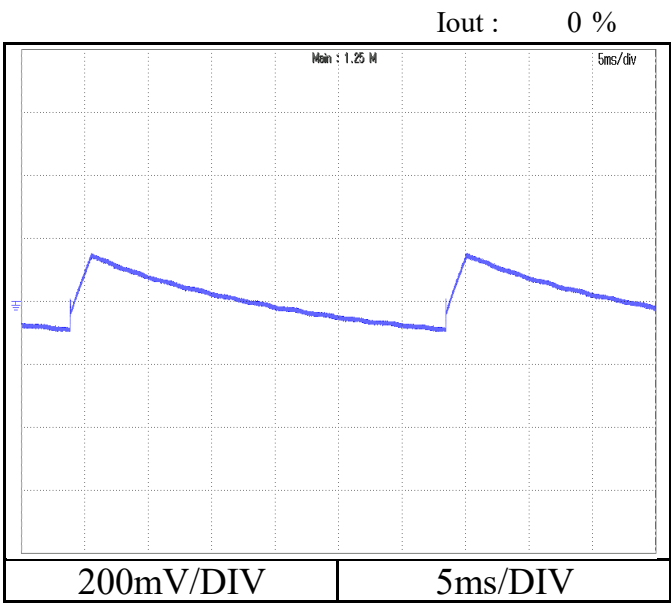
24V



36V



48V



2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 115 VAC
Iout : 50 A (100%)
Istb : 100 %
Ta : 25 °C

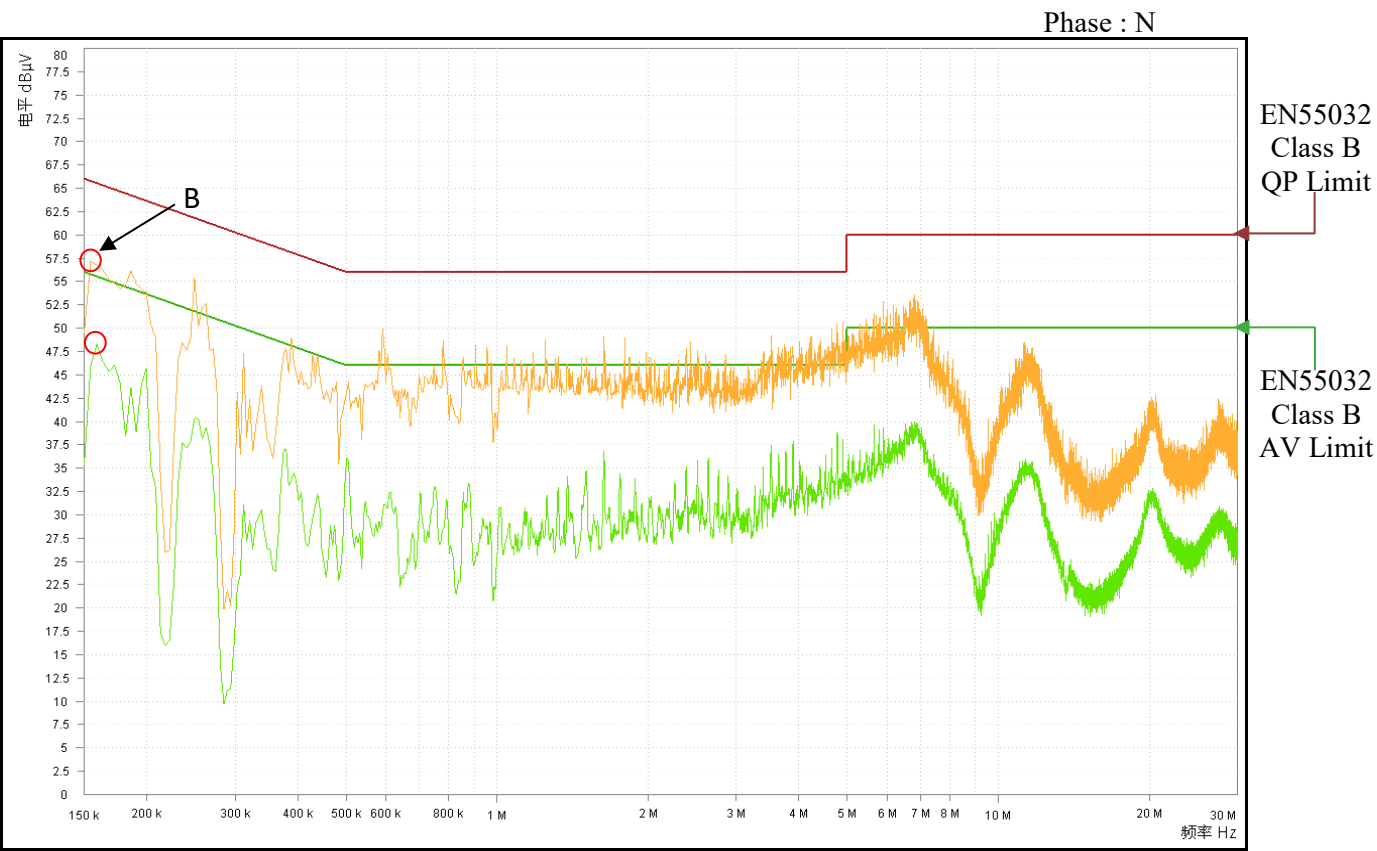
Conducted Emission

24V

Ref. Data	Point A (0.159MHz)	
	Limit (dB)	Measure (dB)
QP	66.5	57.0
AV	55.5	48.1



Ref. Data	Point B (0.159MHz)	
	Limit (dB)	Measure (dB)
QP	66.5	57.1
AV	55.5	48.1



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

2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 230 VAC
Iout : 50 A (100%)
Istb : 100 %
Ta : 25 °C

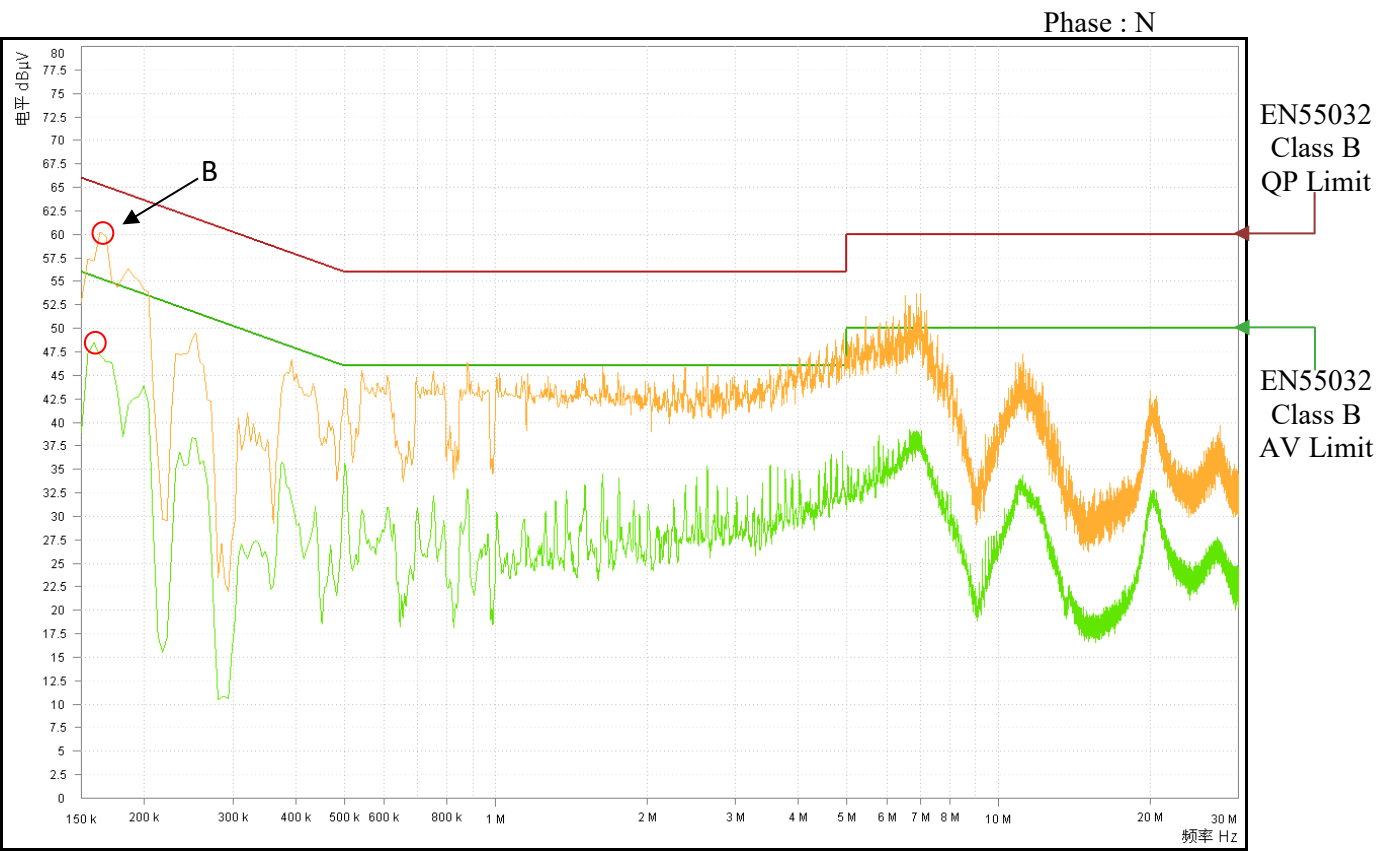
Conducted Emission

24V

Ref. Data	Point A (0.162MHz)	
	Limit (dB)	Measure (dB)
QP	65.3	58.8
AV	55.5	48.4



Ref. Data	Point B (0.162MHz)	
	Limit (dB)	Measure (dB)
QP	65.3	58.7
AV	55.5	48.4



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

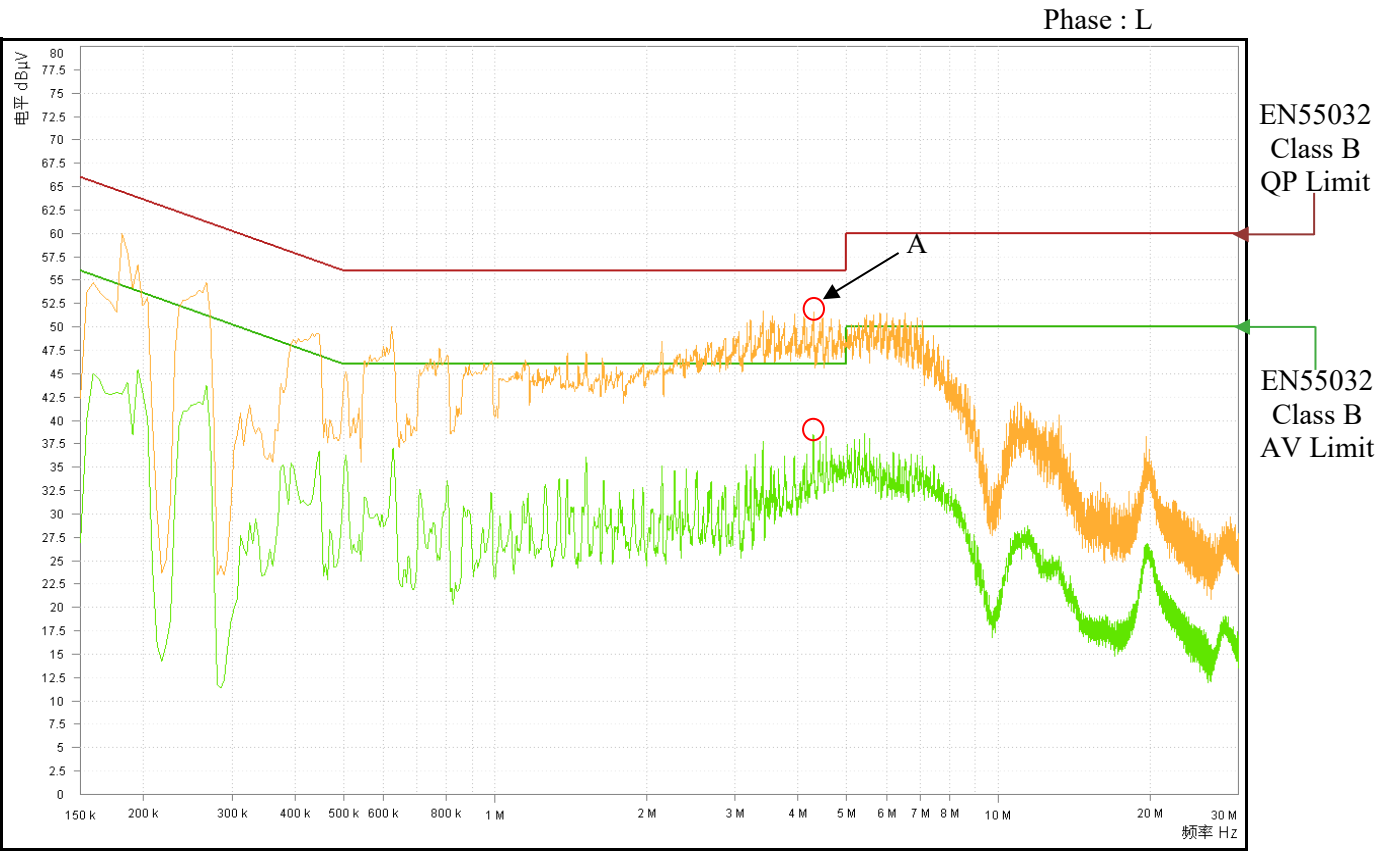
2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 115 VAC
Iout : 33.3 A (100%)
Istb : 100 %
Ta : 25 °C

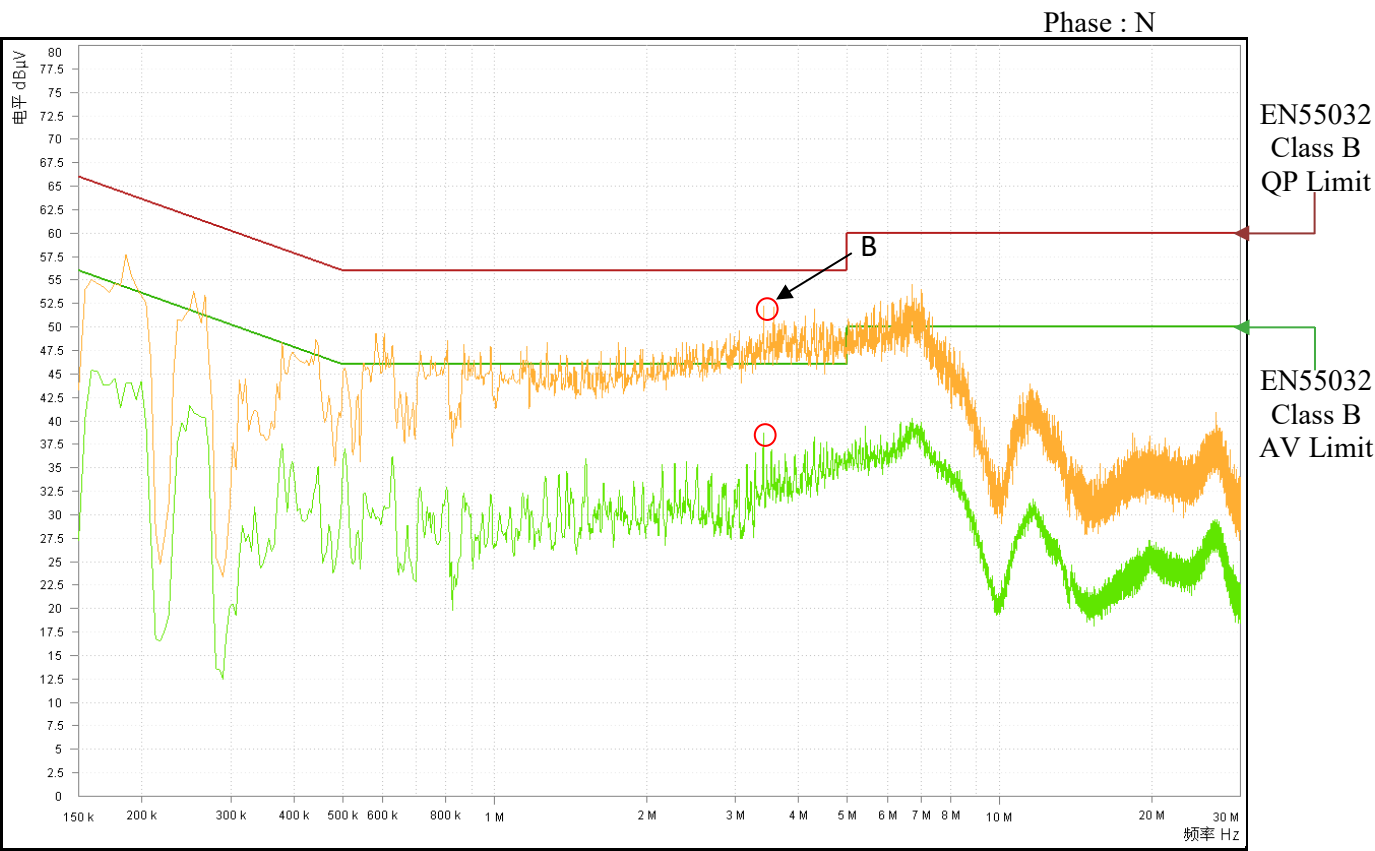
Conducted Emission

36V

Ref. Data	Point A (4.3MHz)	
	Limit (dB)	Measure (dB)
QP	56.0	49.0
AV	46.0	37.5



Ref. Data	Point B (3.4MHz)	
	Limit (dB)	Measure (dB)
QP	56.0	48.1
AV	46.0	38.3



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

2-15. Electro-Magnetic Interference characteristics

Conditions Vin : 230 VAC
Iout : 33.3 A (100%)
Istb : 100 %
Ta : 25 °C

Conducted Emission

36V

Ref. Data	Point A (0.190MHz)	
	Limit (dB)	Measure (dB)
QP	64.0	57.0
AV	54.0	43.8



Ref. Data	Point B (0.182MHz)	
	Limit (dB)	Measure (dB)
QP	64.4	55.3
AV	53.6	44.3



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

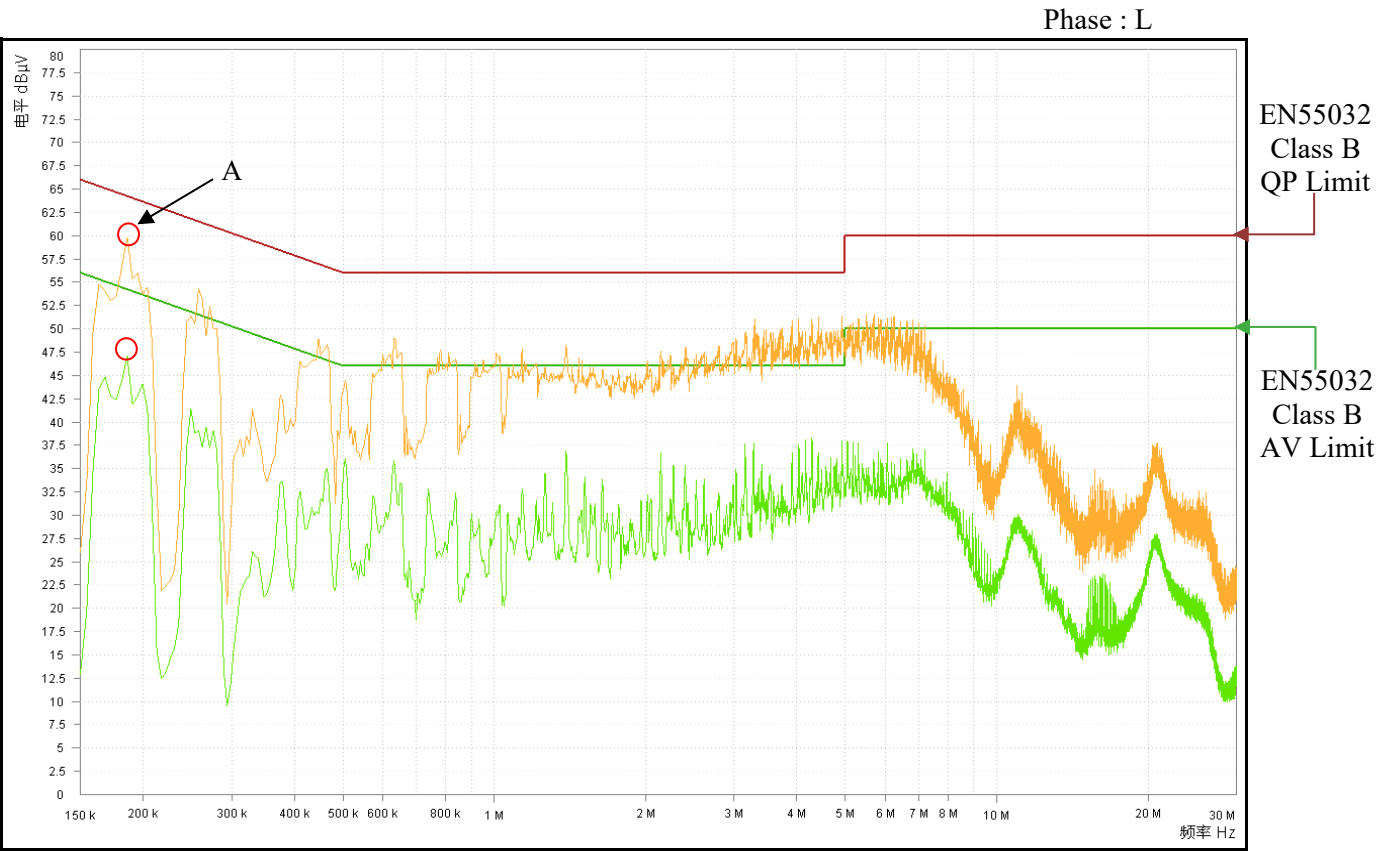
2-15. Electro-Magnetic Interference characteristics

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

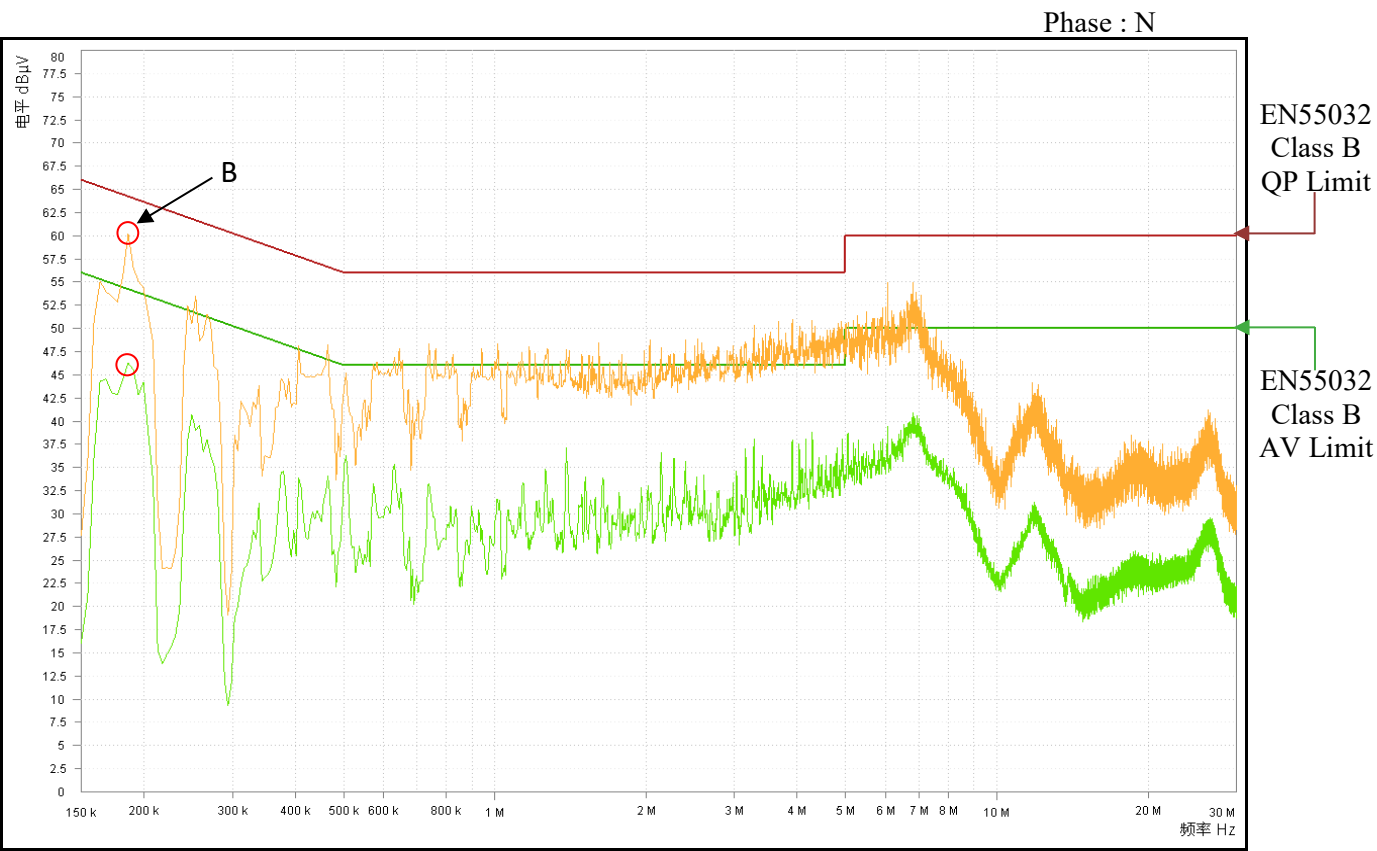
Conducted Emission

48V

Ref. Data	Point A (0.186MHz)	
	Limit (dB)	Measure (dB)
QP	64.2	56.0
AV	54.2	46.1



Ref. Data	Point B (0.186MHz)	
	Limit (dB)	Measure (dB)
QP	64.2	56.2
AV	54.2	46.4



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

2-15. Electro-Magnetic Interference characteristics

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

Conducted Emission

48V

Ref. Data	Point A (0.186MHz)	
	Limit (dB)	Measure (dB)
QP	64.2	56.3
AV	54.2	46.2



Ref. Data	Point B (0.186MHz)	
	Limit (dB)	Measure (dB)
QP	64.2	56.3
AV	54.2	46.8



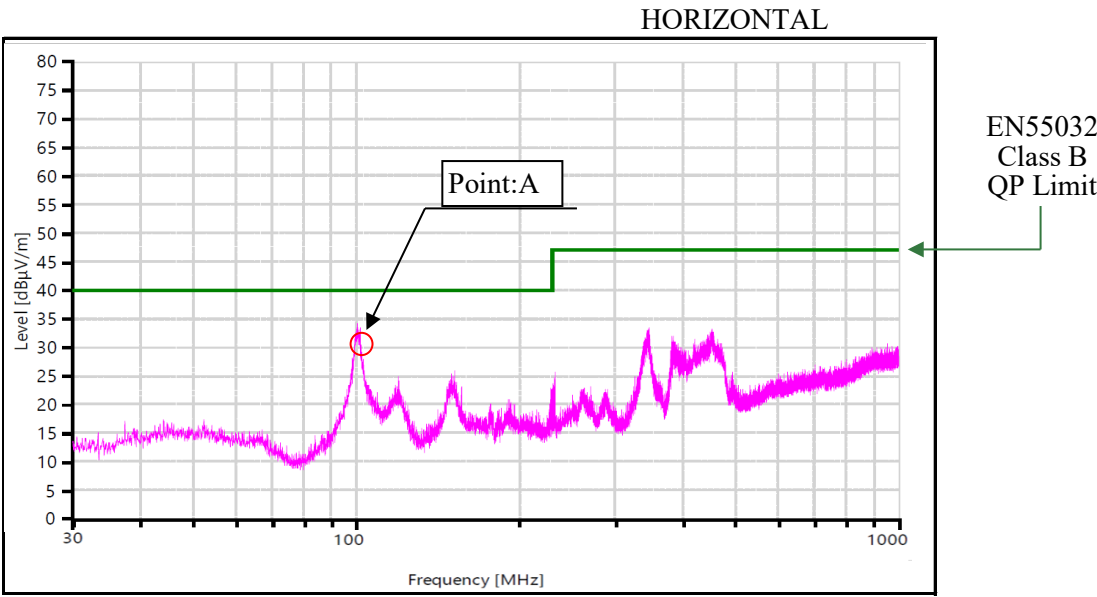
Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

2-15. Electro-Magnetic Interference characteristics

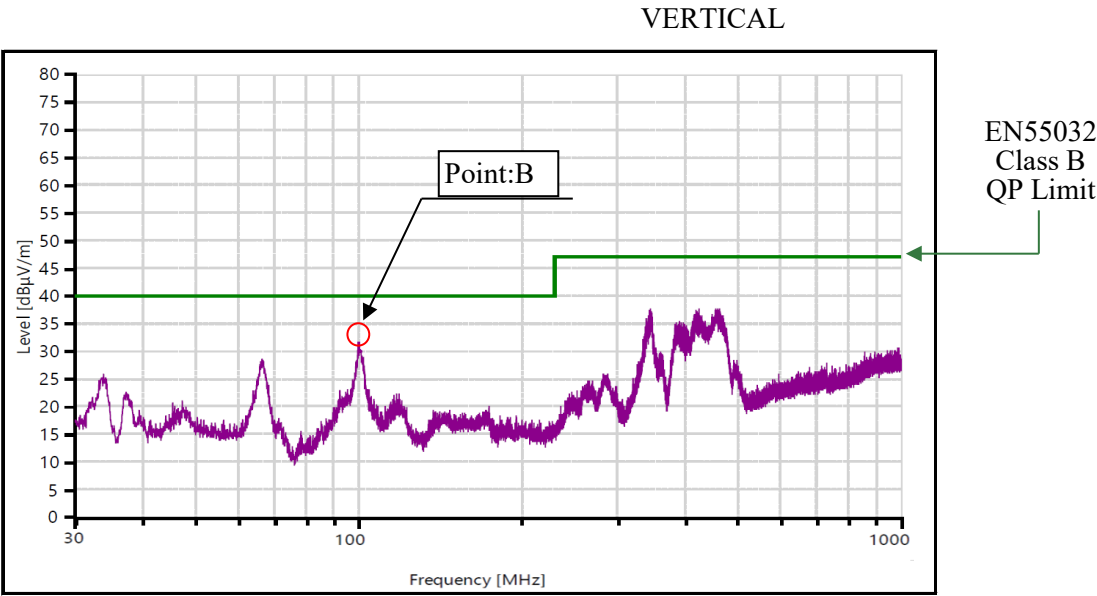
Conditions Vin : 115 VAC
Iout : 50 A (100%)
Istb : 100 %
Ta : 25 °C

Radiated Emission

24V



Point A (100MHz)		
Ref.	Data	Measure
QP	Limit (dBμV)	40.0
		34.0



Point B (100MHz)		
Ref.	Data	Measure
QP	Limit (dBμV)	40.0
		32.0

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

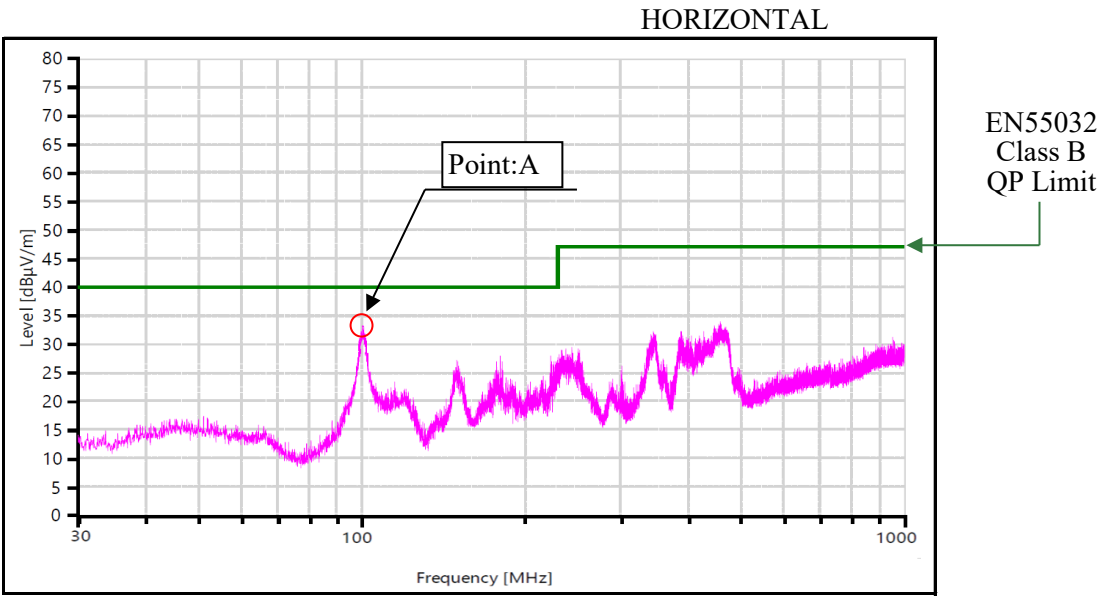
Indication is peak values.

2-15. Electro-Magnetic Interference characteristics

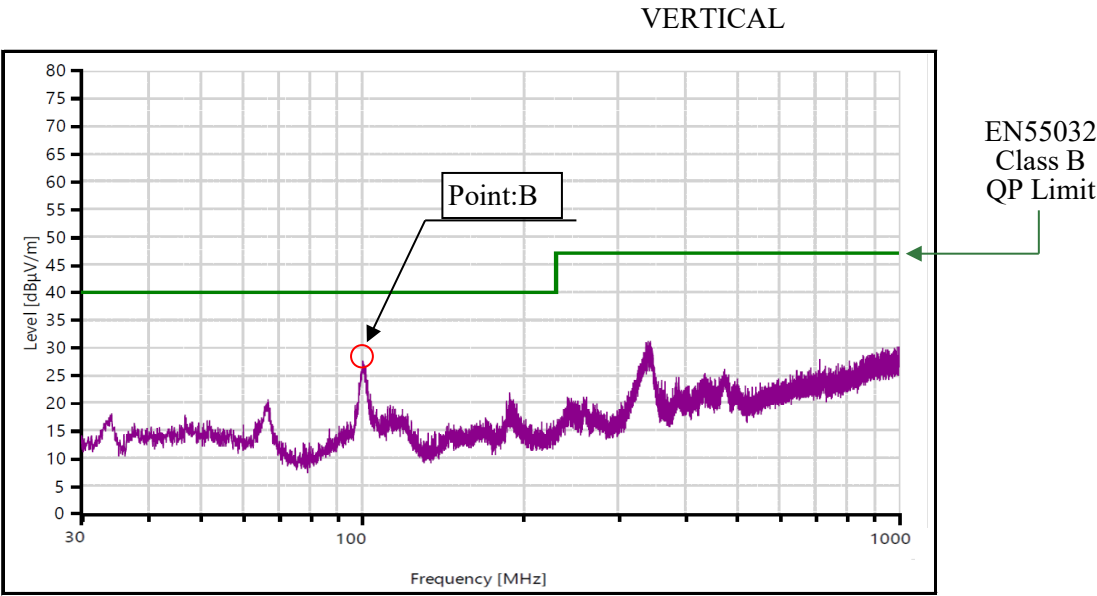
Conditions Vin : 230 VAC
Iout : 50 A (100%)
Istb : 100 %
Ta : 25 °C

Radiated Emission

24V



Point A (100MHz)		
Ref.	Data	Measure
QP	Limit (dBuV)	40.0
		33.0



Point B (100MHz)		
Ref.	Data	Measure
QP	Limit (dBuV)	40.0
		27.0

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

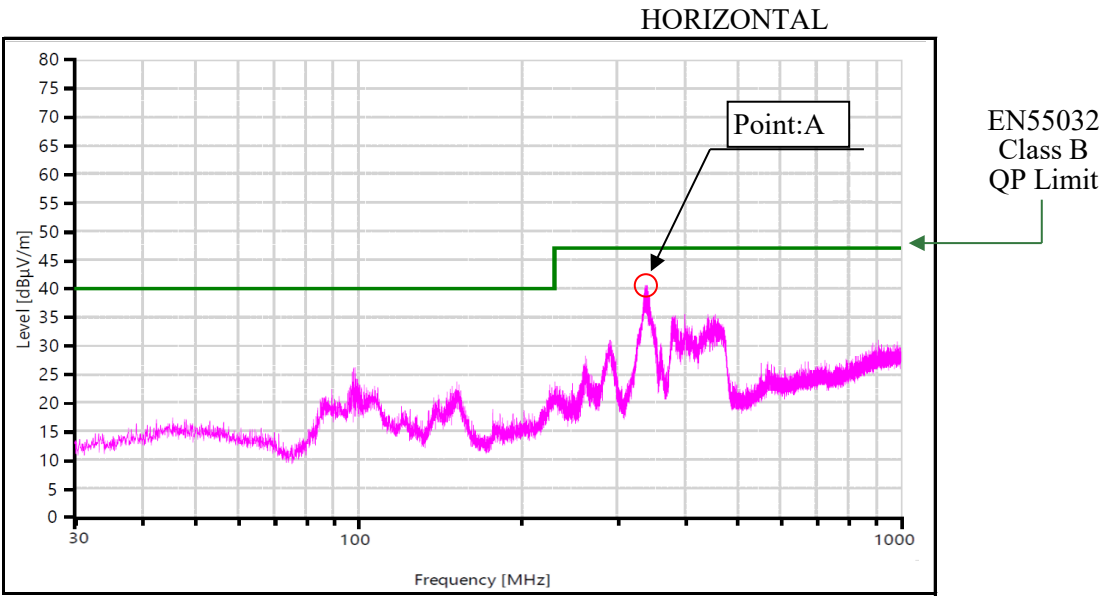
Indication is peak values.

2-15. Electro-Magnetic Interference characteristics

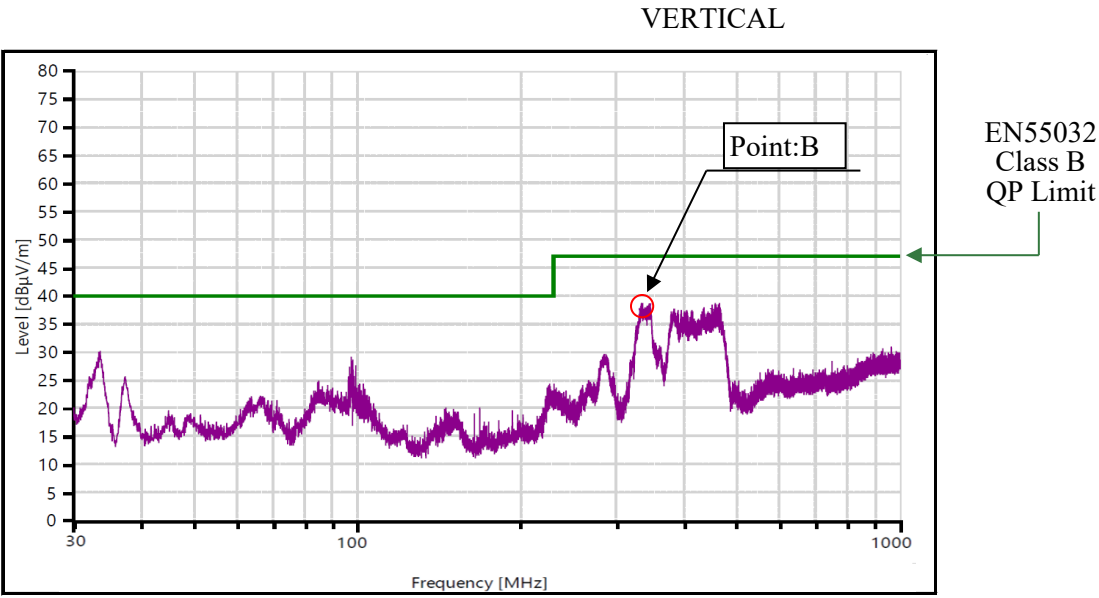
Conditions Vin : 115 VAC
Iout : 33.3 A (100%)
Istb : 100 %
Ta : 25 °C

Radiated Emission

36V



Point A (333MHz)		
Ref.	Data	Limit (dBμV)
QP		47.0



Point B (333MHz)		
Ref.	Data	Limit (dBμV)
QP		47.0

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

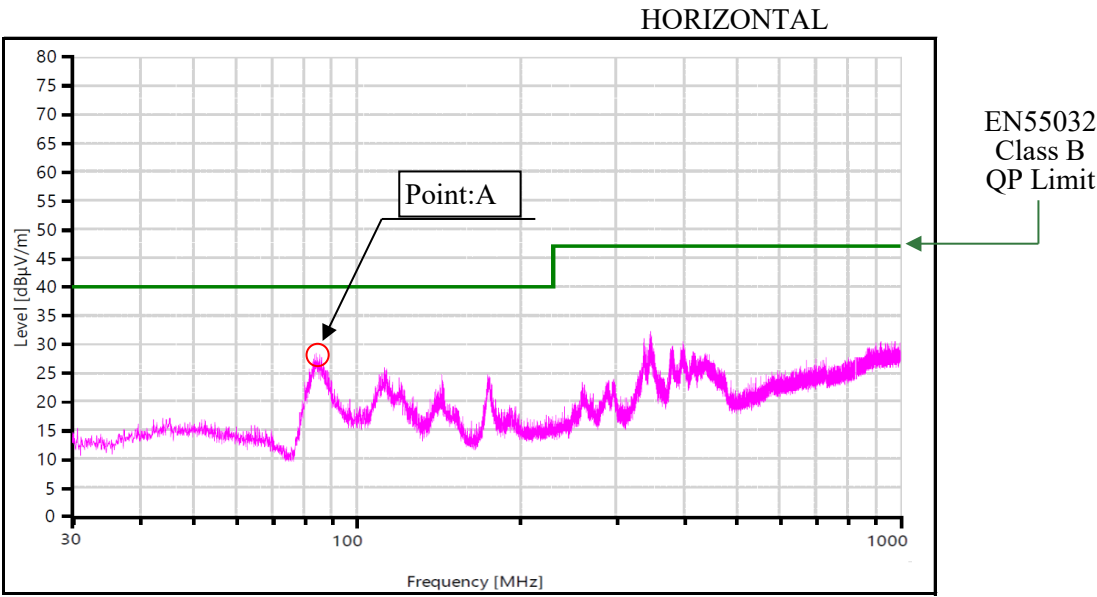
Indication is peak values.

2-15. Electro-Magnetic Interference characteristics

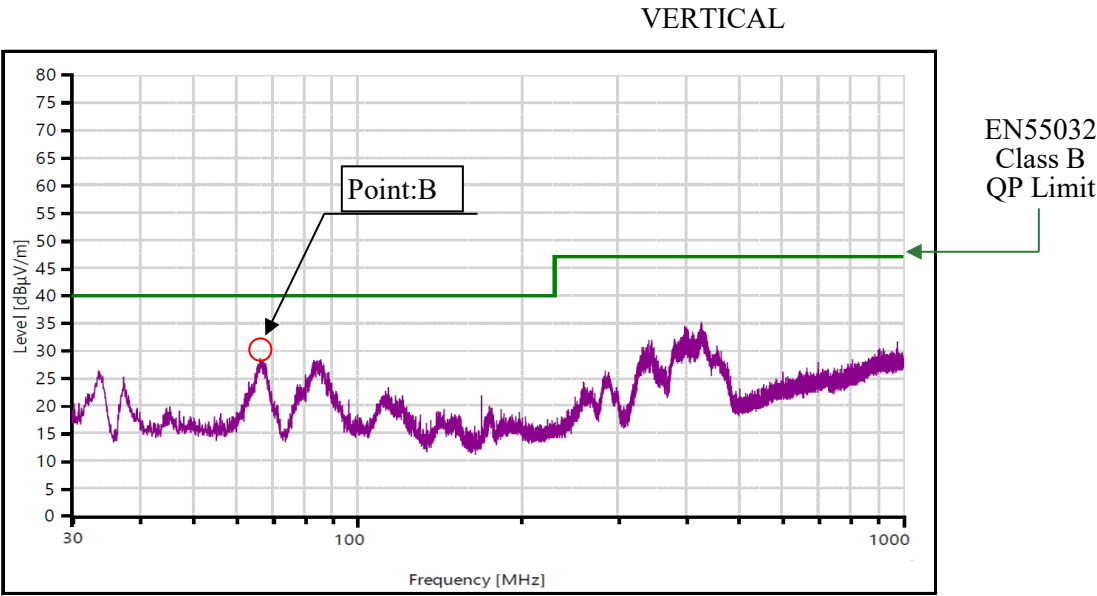
Conditions Vin : 230 VAC
Iout : 33.3 A (100%)
Istb : 100 %
Ta : 25 °C

Radiated Emission

36V



Point A (86MHz)		
Ref.	Data	Measure
QP	Limit (dBuV)	40.0
		28.0



Point B (67MHz)		
Ref.	Data	Measure
QP	Limit (dBuV)	40.0
		28.0

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

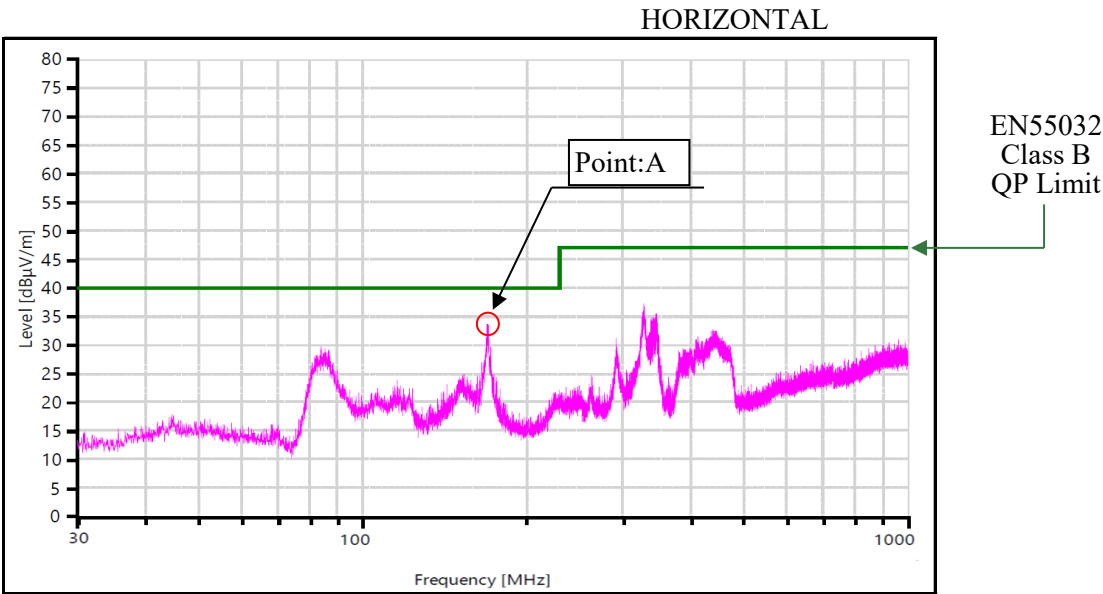
Indication is peak values.

2-15. Electro-Magnetic Interference characteristics

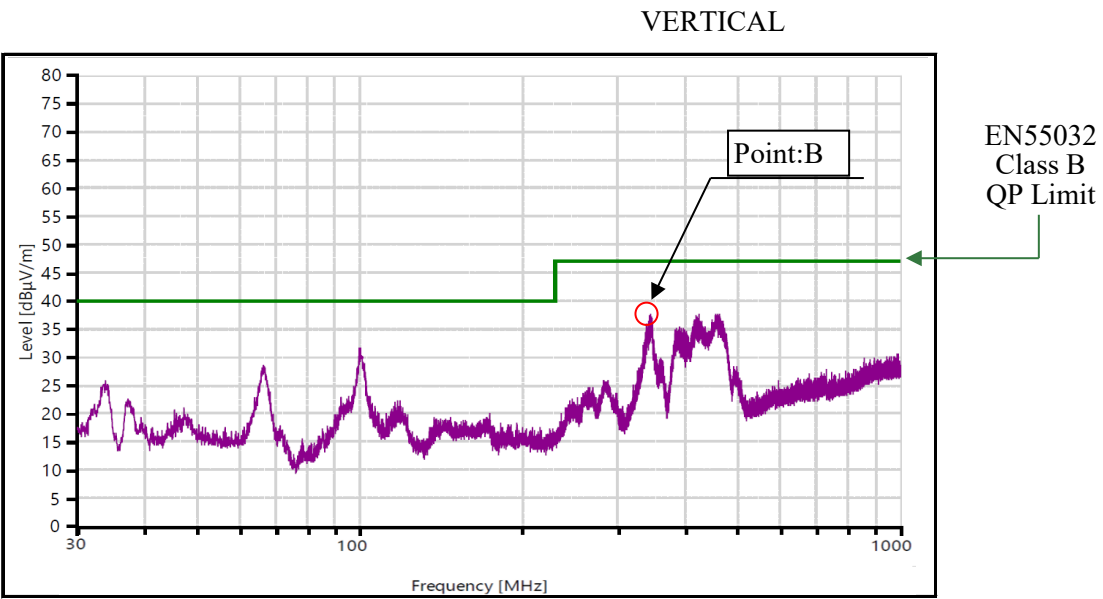
Conditions Vin : 115 VAC
Iout : 25 A (100%)
Istb : 100 %
Ta : 25 °C

Radiated Emission

48V



Point A (169MHz)		
Ref.	Data	Measure
QP	Limit (dBμV)	40.0
		34.0



Point B (339MHz)		
Ref.	Data	Measure
QP	Limit (dBμV)	47.0
		37.4

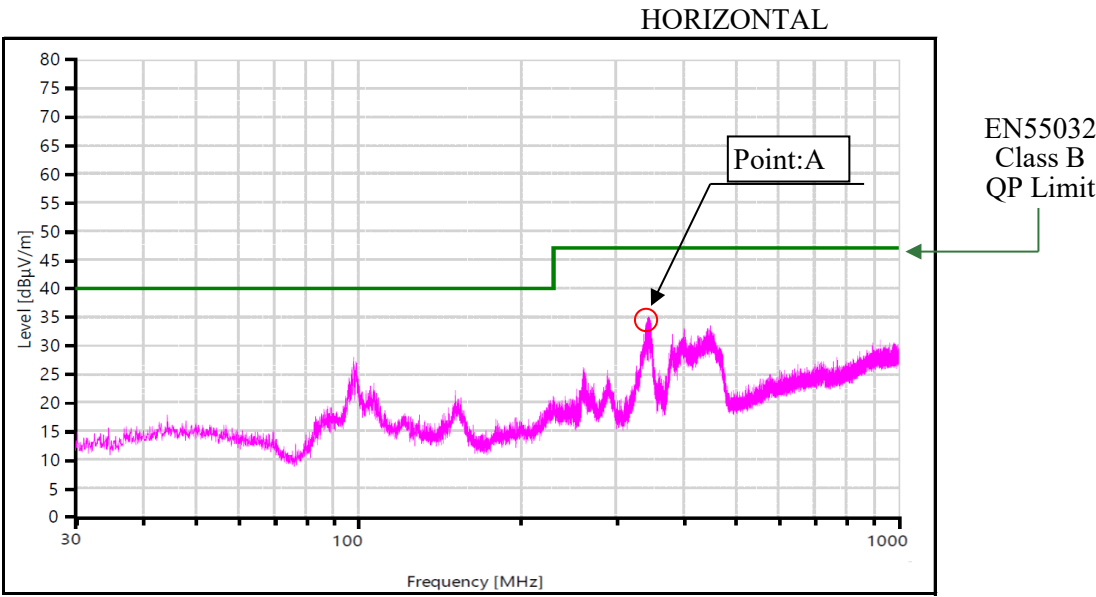
Limit of EN55011-B,FCC-Class B are same as its EN55032-B.

Indication is peak values.

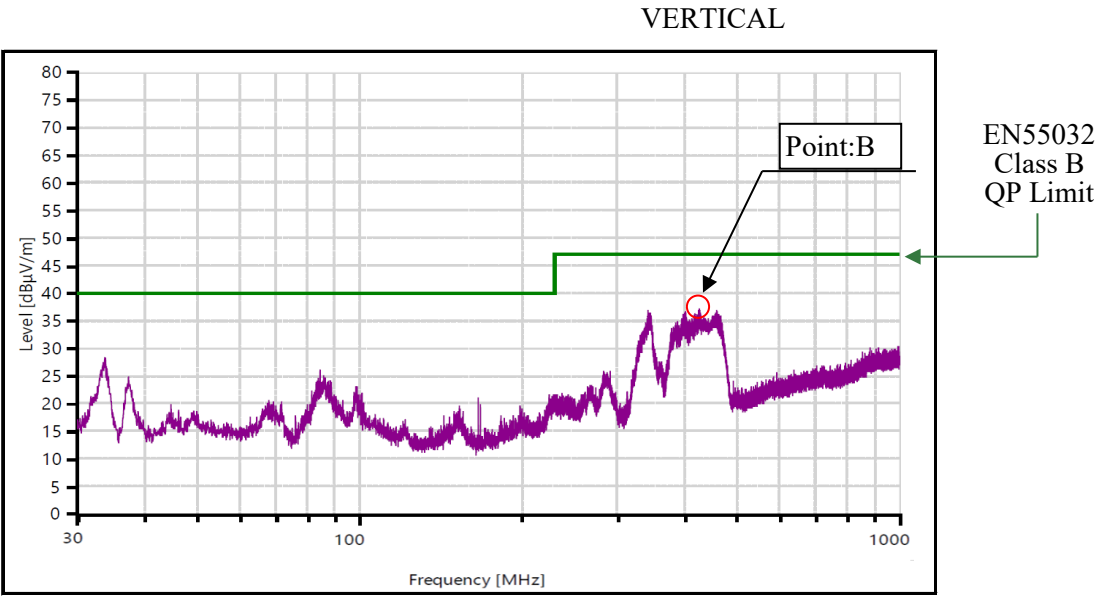
2-15. Electro-Magnetic Interference characteristics

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

Radiated Emission
48V



Point A (346MHz)		
Ref.	Data	Limit (dBμV)
QP		47.0



Point B (425MHz)		
Ref.	Data	Limit (dBμV)
QP		47.0

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

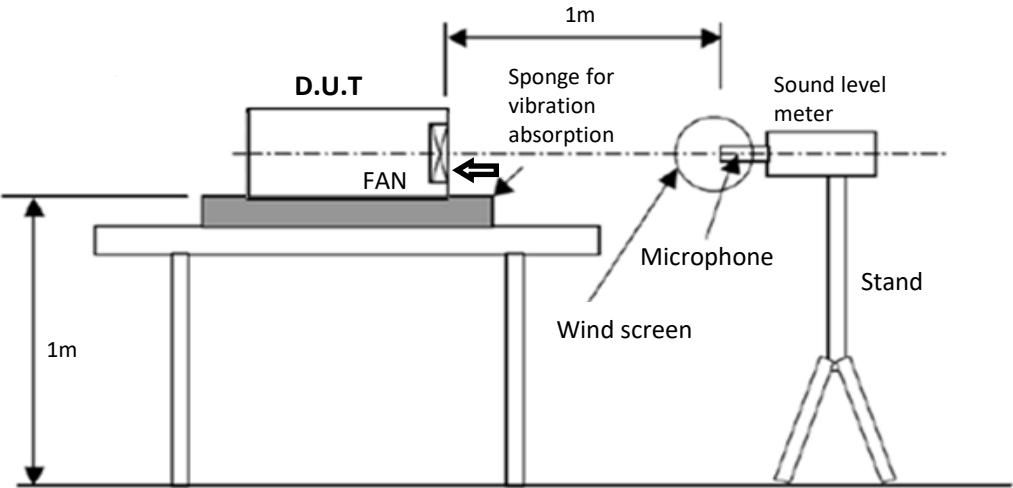
Indication is peak values.

2-16.Audible Noise of FAN

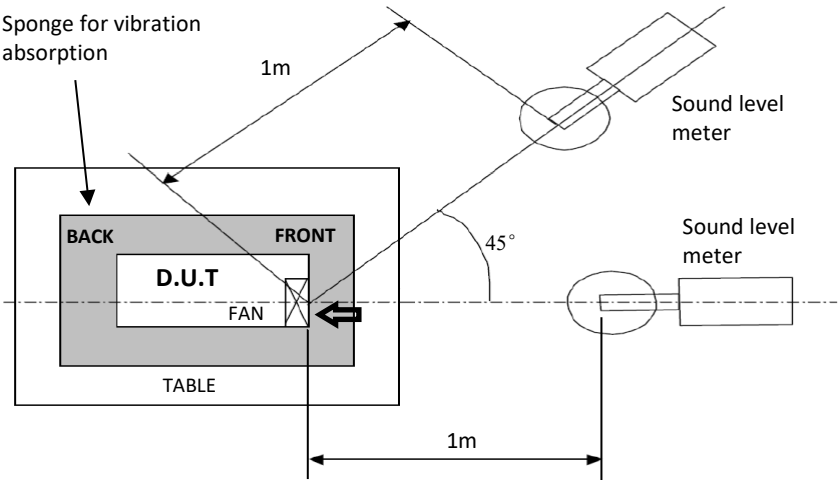
Test condition: Background noise: 12 [dB(A)]
Test duration: 60 [s]
Vin: 100VAC @ 60Hz ———
230VAC @ 50Hz - - - - -
Iout: 100% (50A)
Istb: 100% (2A)
Ta: 25°C

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:

